BM T65 - MEDICAL INFORMATICS AND EXPERT SYSTEMS

UNIT - I

2 MARKS

1. What is a data model? List the types of data model used. (May 2014)

A data model is a collection of conceptual tools for describing data, data relationships, data semantics and consistency constraints.

Types of Data Models:

- ➢ **Conceptual Data Models:** High-level, static business structures and concepts
- ➢ **Logical Data Models:** Entity types, data attributes and relationships between entities
- ➢ **Physical Data Models:** The internal schema database design

2. How is E-R model useful (May 2014)

Uses:

- ➢ Helps you to define terms related to entity relationship modelling.
- ➢ Provide a preview of how all your tables should connect, what fields are going to be on each table
- ➢ Helps to describe entities, attributes, relationships
- ➢ ER diagrams are translatable into relational tables which allows you to build databases quickly
- ➢ ER diagrams can be used by database designers as a blueprint for implementing data in specific software applications

3. What is E-R diagram? (Nov 2014)

E-R Diagram stands for Entity Relationship Diagram, also known as ERD is a diagram that displays the relationship of entity sets stored in a database. In other words, ER diagrams help to explain the logical structure of databases. ER diagrams are created based on three basic concepts: entities, attributes and relationships.

4. What are the four aspects of medical informatics? (Nov 2014)

> **Knowledge management:** Systematic approach of gathering, analysing and sharing of knowledge in order to increase performance.

> **Clinical information management:** Computerised system that organises, store and provide security to medical information.

> **Communication:** Application of computer technology and networking in health care.

> **Decision support:** Applications to assist health care managers to predict future consequences and derive policies accordingly on the basis of predictions, analysis and recommendations.

5. Define trees. (May 2015)

A tree is a collection of nodes. The collection can be empty; otherwise, a tree non empty (sub) trees consists of a distinguished node r. called the root, and zero or m Tl, T2,...,Tk each of whose roots are connected by a directed edge from r

6. What is query language? (May 2015, Nov 2016)

Query language (QL) refers to any computer programming language that requests and retrieves data from database and information systems by sending queries. It works on user entered structured and formal programming command based queries to find and extract data from host databases.

7. Write a note on records? (Nov 2015)

A **record** is a collection of fields, possibly of different data types, typically in a fixed number and sequence. It is the most basic type of DNS record and are used to point a domain or subdomain to an IP address.**Records** are composed of fields, each of which contains one item of information. A set of **records** constitutes a file.

8. List few query language. (Nov 2015)

A **query language** is a specialized programming **language** for searching and changing the contents of a database

Types of Query Language

1. **Data Definition Language-**It is used to create schema, tables, indexes, constraints etc. in the database

2. **Data Manipulation Language-** It is used for accessing and manipulating data in a database.

3. **Data Control Language-** It is used to retrieve the stored or saved data.

9. Define medical Informatics.(May 2016, May 2017, May 2019)

Medical informatics is the sub-discipline of health informatics that directly impacts the patient – physician relationship. It focuses on the information technology that enables the effective collection of data using technology tools to develop medical knowledge and to facilitate the delivery of patient medical care.

10. List out the security issues used in internet. (May 2016)

1. **Exposure of data**: The privacy and confidentiality of the data of the patients are of utmost concern with legal as well as other implications. The confidential data of patients should not be leaked or exposed by any patient chance to anyone other than those concerned with its use. They could be doctors, patients and expert health care providers who could be allowed access to subject related data after obtaining due consent from the

2. **Tampering with the data:** Data integrity of the patients is not only necessary, but any kind of unwanted changes in the patient's data can lead to harmful results, causing even death of the patient, as doctors usually refer to the previous data (history/symptoms) before taking any particular action in future.

3. **Denial of service by the system:** With system availability, denial of service attacks is increasingly common, especially on the internet services.

11. What are the advantages of relational model? (Nov 2016)

➢ Simple Model- It does not require any complex structuring or querying processes.

➢ Data Accuracy- In the relational database system, there can be multiple tables related to one another with the use of primary key and foreign key concepts.

➢ Easy access to Data- In a Relational Database System, there is no pattern or pathway for accessing the data, as to another type of databases can be accessed only by navigating through a tree or a hierarchical model.

➢ Data Integrity- It is a crucial characteristic of the relational database system in which it ensure that all the Data in the database confines within suitable arrangements and the data necessary for creating the relationships are present.

➢ Normalization- The methodical style is maintained for making sure of a relational database structure is liberated of any variances that can make a difference in the integrity and accuracy of the tables in the database.

12. What is the E-health service?(May 2017, May 2018)

E-health is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies.
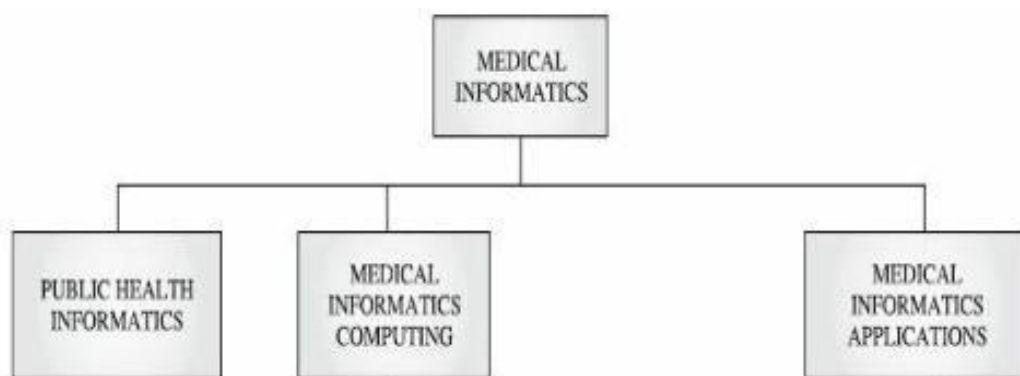
13. What is search space and web spider?(Dec 2017)

A search space is the set or domain through which an algorithm searches. In computer science, the space may be a well-defined and finite data structure whereas a Web Spideror a Web Crawler is a type of bot that's typically operated by search engines like Google and Bing by the purpose of indexing the content of websites all across the Internet, so that those websites can appear in search engine results.

14. What is the use of internet in medicine?(Dec 2017)

Internet, the largest network of connected computers, is becoming the ultimate frontier to access information for health providers. This review focuses on how developments of this communication technology have become a useful educational resource in medicine, and describes modest ideas in computer network use.

15. Draw the structure of medical Informatics?(May 2018)

16. Define medical database. (May 2019)

It is a collection of information related to medical sciences which can be accessed, managed and updated. It access to over 1,400 essential publications in full text covering topics across all areas of medical sciences.

17. What is the role of research and modelling in the medical Informatics system?(Dec 2019)

Role of Research and Modelling:

1. System analysis.
2. Mathematical modelling.
3. Modelling of 3D structure of protein.
4. 3D anatomical and physiological mapping.
5. BMD – Bio Medical Computer Package.
6. SPSS – Statistical Package for Social Science.

18. What are the important modules that our personal registration in system? (Dec 2019)

➢ This includes permission of doctors/professionals to register both their entry as well as exit from the hospital

➢ It also provides various report on staff members of the hospital.

19. Mention the types of threads in terms of security goals.(Sep 2020)

Types of Threads:

Passive intruders: These types of intruders are less harmful as they just eavesdrop, but do not modify data in anyway. However, they snoop over confidential patient data causing much embarrassment to service provider and the patient if the same is detected at any stage.

Active intruders: These type of intruders attempts to break into the system by corrupting the data or making unauthorised changes in it. They are much more harmful than passive intruders as they could alter and distort original information causing increased risks to the lives of patients and compromising health care safety.
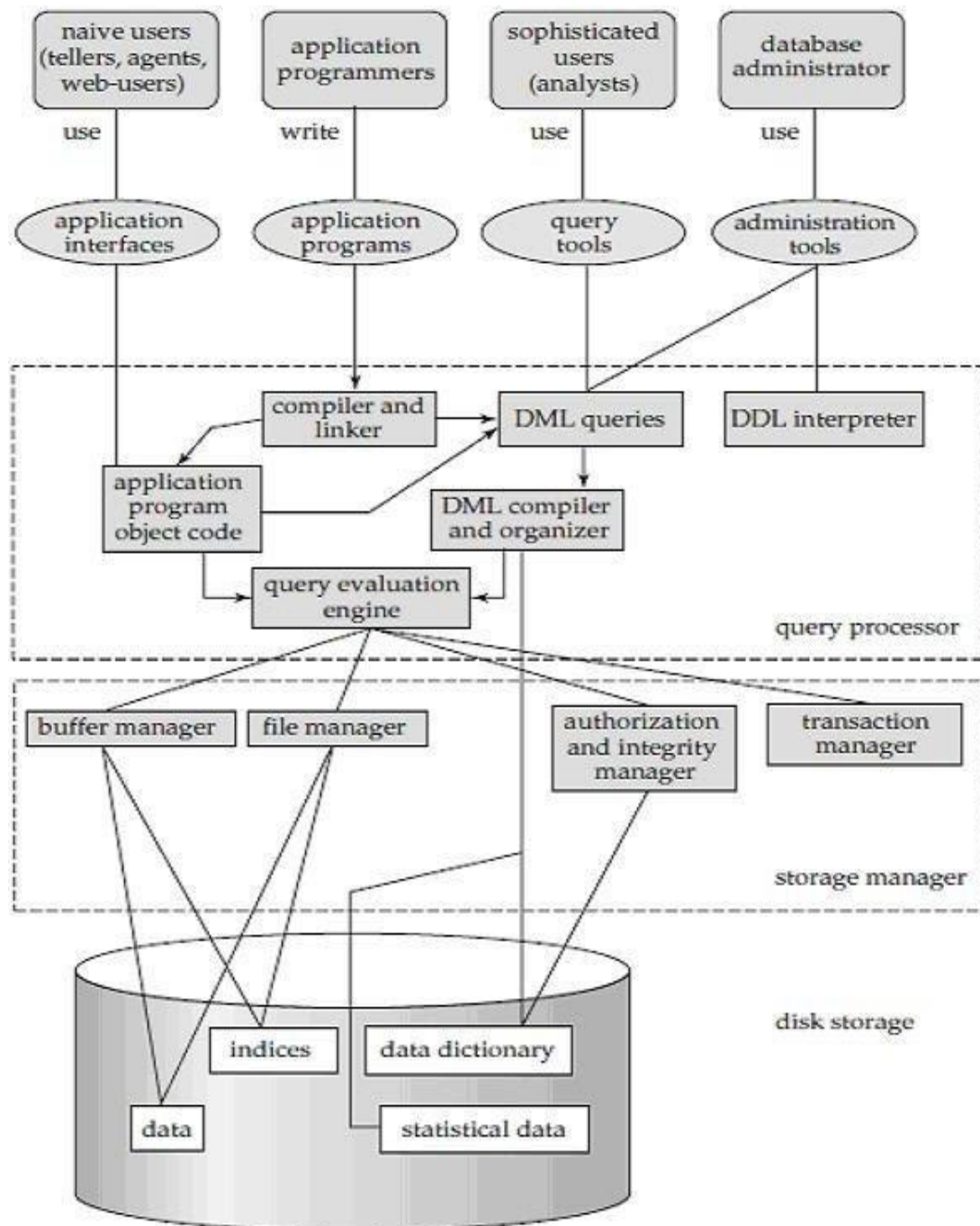
20. State the need of DARE. Sep 2020

Need for DARE:

➢ It evaluates the effects of health and social care interventions and the delivery and organization of health and social care services.

➢ It also indexes reviews of the wider determinants of health, such as housing and transport, where these impact health or have the potential to impact health and wellbeing.

11 MARKS

1. With neat diagram and explain the structure of DBMS.(May 2014)

Structure of DBMS:

A database system is partitioned into modules that deal with each of the responsibilities of the overall system. The functional components of a database system can be broadly divided into the **storage manager** and the **query processor** components. The storage manager is important because databases typically require a large amount of storage space. The query processor is important because it helps the database system simplify and facilitate access to data.

Query Processor

The query processor components include

DDL interpreter interprets DDL statements and records the definitions in the data dictionary.

DML compiler translates DML statements in a query language into an evaluation plan consisting of low-level instructions that the query evaluation engine understands.

Storage Manager

A storage manager is a program module that provides the interface between the low level data stored in the database and the application programs and queries submitted to the system.

Authorization and integrity manager tests for the satisfaction of integrity constraints and checks the authority of users to access data.

Transaction Manager ensures that the database remains in a consistent (correct) state despite system failures, and that concurrent transaction executions proceed without conflicting.

File manager manages the allocation of space on disk storage and the data structures used to represent information stored on disk.

2. **What is mean by selection and projection used in relational algebra? Explain how we made lossless and lossy joins in relational model? (May 2014)**

The **SELECTION** operation is used for selecting a subset of the tuples according to a given selection condition. Sigma Symbol denotes it. It is used as an expression to choose tuples which meet the selection condition. The **PROJECTION** eliminates all attributes of the input relation but those mentioned in the projection list. The projection method defines a relation that contains a vertical subset of Relation.

Lossless Decomposition Model:

1. The decomposition R1, R2, R3… Rn for a relation schema R are said to be lossless if there natural join results the original relation R.
2. Formally, Let R be a relation and R1, R2, R3… Rn be its decomposition when it is lossless if R1, R2, R3… Rn = R
3. There is no loss of information as the relation obtained after natural join of decompositions is equivalent to original relation. Thus is also referred to as non-addictive join decomposition.
4. The common attribute of the sub-relation is a super-key of any one of the relation.

Lossy Join Decomposition

1. The decomposition R for a relation schema is lossy if there natural join results into addition of extraneous tuples with the original relation R.
2. Formally, Let R be a relation and R1, R2, R3… Rn be its decomposition when it is lossy if R1, R2, R3… Rn = R
3. There is a loss of information as extraneous tuples are added into the relation after natural join of decomposition. Thus, it is also referred to as careless decomposition.
4. The common attribute of the sub-relation is not a super-key of any of the sub relation.

3. **What is data structure? What is the data organising principle? Explain (Nov 2014)**
   - ➢ Data Structures are the programmatic way of storing data so that data can be used efficiently. Almost every enterprise application uses various types of data structures in one or the other way. This tutorial will give you a great understanding on Data Structures needed to understand the complexity of enterprise level applications and need of algorithms, and data structures.
   - ➢ There are many ways of organizing the data in the memory as we have already seen one of the data structures

> ➤ Array in C language: Array is a collection of memory elements in which data is stored sequentially, i.e., one after another. In other words, we can say that array stores the elements in a continuous manner. This organization of data is done with the help of an array of data structures.

4. Using an example of SQL, explain the query language. (Nov 2014)

An SQL is a standard Database language which is used to create, maintain and retrieve the relational database. Following are some interesting facts about SQL.

The queries to deal with relational database can be categories as:

Data Definition Language: It is used to define the structure of the database. e.g; CREATE TABLE, ADD COLUMN, DROP COLUMN and so on.

Data Manipulation Language: It is used to manipulate data in the relations. e.g.; INSERT, DELETE, UPDATE and so on.

Data Query Language: It is used to extract the data from the relations. e.g.; SELECT

So first we will consider the Data Query Language. A generic query to retrieve from a relational database is:

1. **SELECT** [**DISTINCT**] Attribute_List**FROM** R1,R2….RM
2. [**WHERE** condition]
3. [**GROUP BY** (Attributes)[**HAVING** condition]]
4. [**ORDER BY**(Attributes)[**DESC**]];

5. Explain in detail about the different types of database and data indexing technique. (May2015)

Types of Database

Centralized Database- It is a type of database that stores data at a centralized database system from different locations through several applications.

Relational Database- It stores data in the form of rows(tuple) and columns(attributes), and together forms a table(relation).

Network Database- It is the database that typically follows the network data model.

Object-oriented Database- It uses the object-based data model approach for storing data in the database system. The data is represented and stored as objects which are similar to the objects used in the object-oriented programming language.

Hierarchical Database- Itstores data in the form of parent-children relationship nodes. Here, it organizes data in a tree-like structure.

Data Indexing

Indexing is a data structure technique to efficiently retrieve records from the database files based on some attributes on which the indexing has been done. Indexing in database systems is similar to what we see in books.

Indexing is defined based on its indexing attributes. Indexing can be of the following types –

Primary Index − Primary index is defined on an ordered data file. The data file is ordered on a **key field**. The key field is generally the primary key of the relation.

Secondary Index − Secondary index may be generated from a field which is a candidate key and has a unique value in every record, or a non-key with duplicate values.

Clustering Index − Clustering index is defined on an ordered data file. The data file is ordered on a non-key field.

6. **Structures of relational database and relational model in May 2015 Nov 2015**

Structure of Relational Database

> ➢ A Relational Database basically consists of a number of tables, each of which is called a relation instance or simply relation.
> ➢ Each table contains a number of rows and a number of columns.
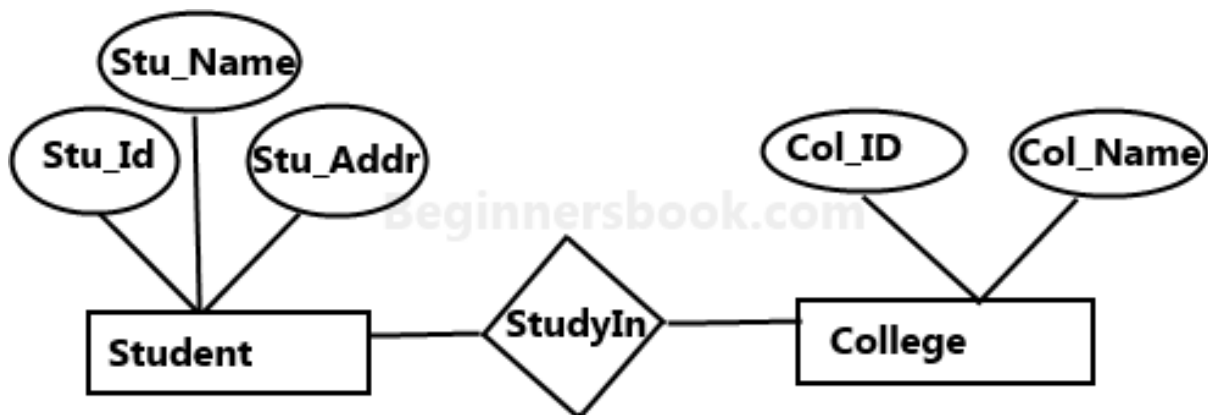> ➢ Each row is called a tuple.
> ➢ Each column is called an attribute

customer_name	customer_street	customer_city
Jones	Main	Harrison
Smith	North	Rye
Curry	North	Rye
Lindsay	Park	Pittsfield

Structure of Relational Data Model:

➢ Implemented through Relational Database Management System (RDBMS)

➢ It manages the complexity of physical implementation

➢ Users see database as a collection of tables in which data are stored.

➢ A table (also known as relations) is a form of data that are related to each other through some shared attributes.

➢ It contains attributes and it is also a set of characteristics of a table.

7. Explain in detail about E-R diagram with example? (Nov 2015)

➢ An **Entity–relationship model (ER model)** describes the structure of a database with the help of a diagram, which is known as **Entity Relationship Diagram (ER Diagram)**.

➢ An ER model is a design or blueprint of a database that can later be implemented as a database.

➢ An E-R diagram shows the relationship among entity sets. An entity set is a group of similar entities and these entities can have attributes.

➢ In terms of DBMS, an entity is a table or attribute of a table in database, so by showing relationship among tables and their attributes, ER diagram shows the complete logical structure of a database.

➢ Lets have a look at a simple ER diagram to understand this concept.

Sample E-R Diagram

8. **Explain in detail the use of Internet in medicine? (May 2016)**

➢ Internet, the largest network of connected computers, is becoming the ultimate frontier to access information for health providers.

➢ This review focuses on how developments of this communication technology have become a useful educational resource in medicine, and describes modest ideas in computer network use.

➢ It can make patient records, test results, and practice guidelines accessible from the examination room.

➢ It can also allow care providers to consult with each other electronically to discuss treatment plans or operative procedures.

➢ At the same time, the Internet supports a shift toward more patient-centered care, enabling consumers to gather health-related information themselves; to communicate with care providers, health plan administrators, and other consumers electronically.

➢ By supporting financial and administrative transactions, public health surveillance, professional education, and biomedical research, the Internet can streamline the administrative overhead associated with health care, improve the health of the nation's population, better train health care providers, and lead to new insights into the nature of disease.

9. With a neat diagram explain the various characteristics of Hospital Information System and the online and offline services offered by it. (May 2016, May 2017)

A hospital information system (HIS) is an element of health informatics that focuses mainly on the administrational needs of hospitals. In many implementations, a HIS is a comprehensive, integrated information system designed to manage all the aspects of a hospital's operation, such as medical, administrative, financial, and legal issues and the corresponding processing of services. Hospital information system is also known as hospital Management Software (HMS) or Hospital Management System.

Characteristics

- Maintain the medical records of the patient
- Maintain the contact details of the patient
- Keep track of the appointment dates
- Save the insurance information for later reference
- Tracking the bill payments.

Online and offline services:

The term online is commonly referred to as connected to the WWW via internet.Offline, it refers to the actions performed when the user is not connected, via telecommunications to another computer or a network like the internet

Blog - A blog is information that is instantly published to a Web site. Blog scripting allows someone to automatically post information to a Web site. The information first goes to a blogger Web site. Then the information is automatically inserted into a template tailored for your Web site.

Bookmark – a way of storing your favorite sites on the Internet. Browsers like Netscape or Internet Explorer let you to categorize your bookmarks into folders.

CGI (**C**ommon **G**ateway **I**nterface script) – a specification for transferring information between a Web server and a CGI program, designed to receive and return data

Chat – real-time, synchronous, text-based communication via computer.

Cookie – Information (in these case URLs created by a Web server and stored on a user's computer. People can set up their browsers to accept or not acceptcookies.

FTP – Using file transfer protocol software to receive from upload) or send to (download) files (text, pictures, spread sheets, etc.) from one computer/server to another.

Home page - Generally the first page retrieved when accessing a Web site. Usually a "home" page acts as the starting point for a user to access information on the site. The "home" page usually has some type of table of contents for the rest of the site information or other materials. When creating Web pages, the "home "page has the filename "index.html," which is the default name. The "index "page automatically opens up as the "home" page.

HTML – A type of text code in Hypertext Mark-up Language which, when embedded in a document, allows that document to be read and distributed across the Internet.

HTTP – The hypertext transfer protocol (http) that enables html documents to be read on the Internet.

Hyperlink – Text, images, graphics that, when clicked with a mouse (or activated by key strokes) will connect the user to a new Web site. The link is usually obvious, such as underlined text or a "button" of some type, but not always.
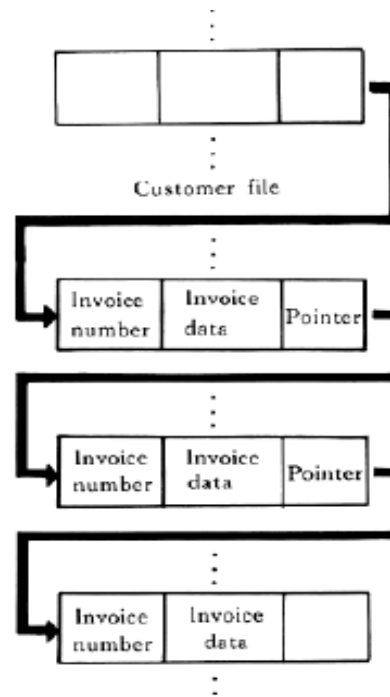
Instant Messaging (IM) – a text-based computer conference over the Internet between two or more people who must be online at the same time.

IP (Internet Protocol)Address–The number or name of the computer from which you send and receive information on the Internet.

10. Explain in detail about the structuring techniques. (Nov 2016)
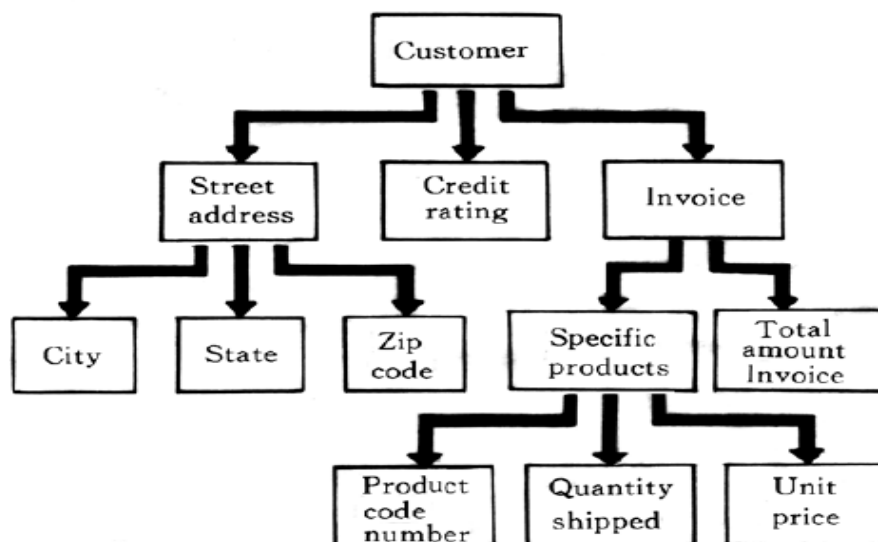
    List Structure

       In this logical approach, records are linked together by the use of pointers by which it is a data item in one record that identifies the storage location of another logically related record.

Fig.12—2 List structure

Hierarchical Structure

By this approach, data units are structured in multiple levels that graphically resemble an "upside down" tree with the root at the top and the branches formed as a superior-subordinate relationship in a hierarchical (tree) structure.

Fig.12—3 Hierarchical (tree) structure

Network Structure

Unlike the tree approach, which does not permit the connection of branches, the network structure permits the connection of the nodes in a multidirectional manner. Thus,each node may have several owners and may, in turn, own any number of other data units.
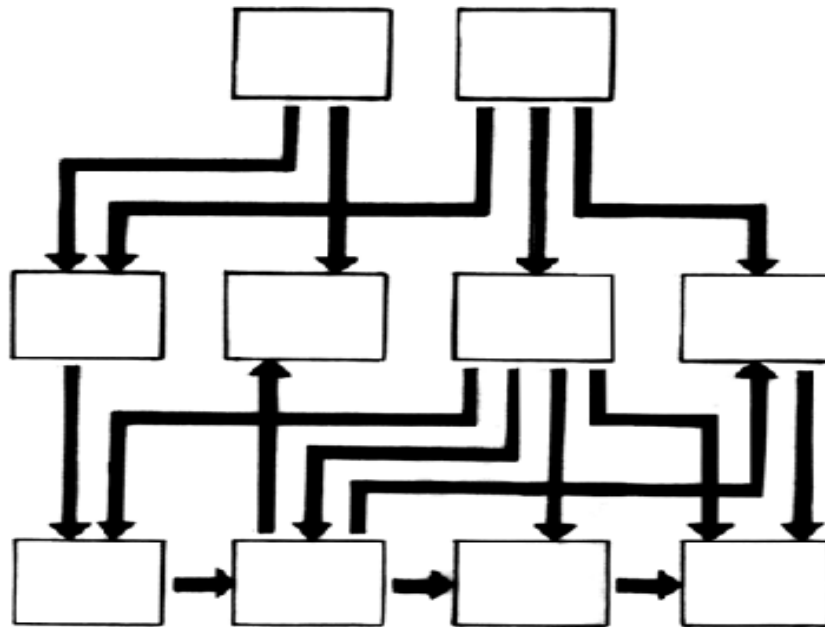

Fig.12-4 Network structure

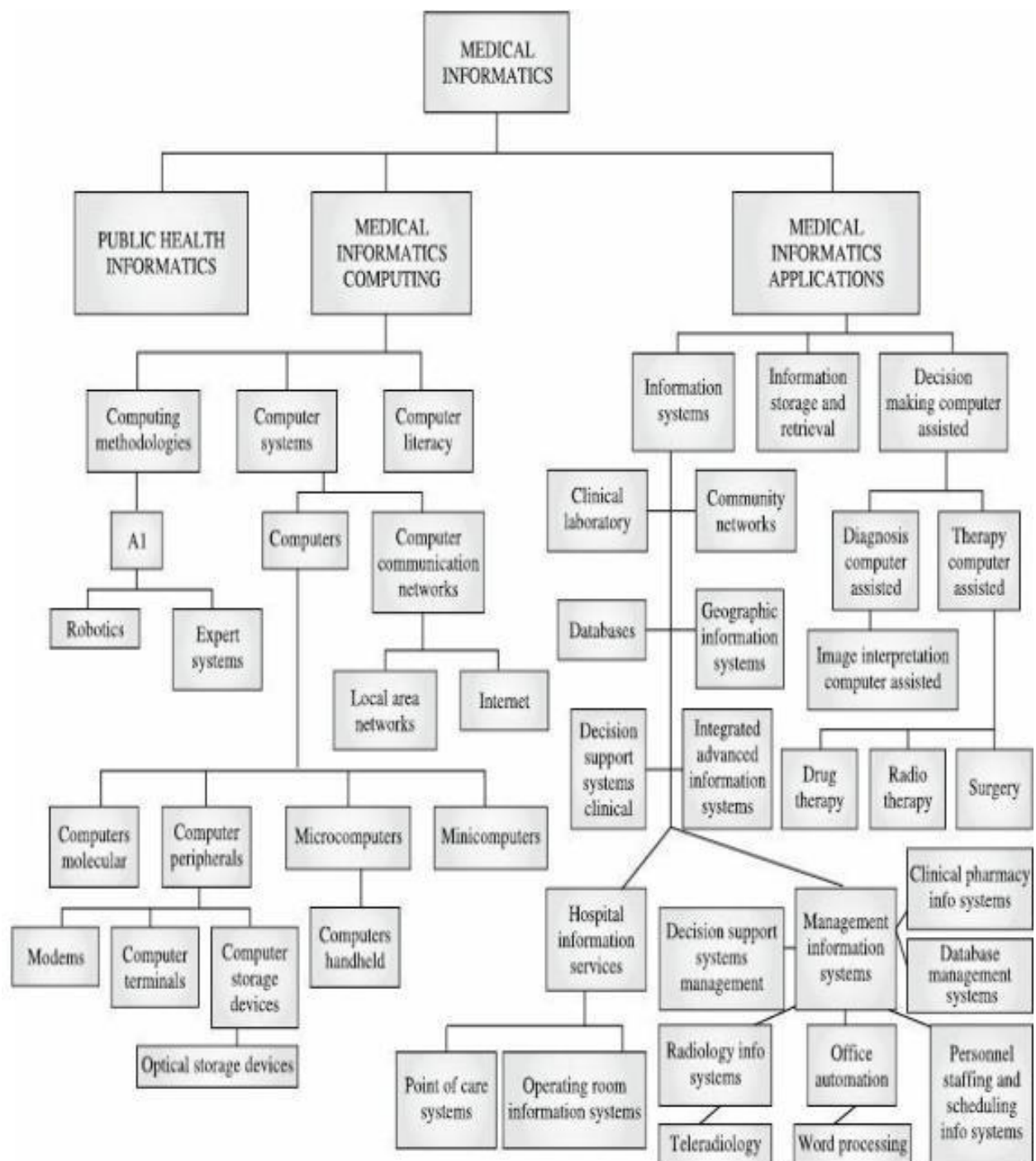**11. Explain about singly and doubly linked data? (Nov 2016)**

Singly & Doubly Linked Data:

➢ In Singly Linked Data, the complexity of insertion and deletion at a known position is O(n).

➢ In case of doubly linked Data, the complexity of insertion and deletion at a known position is O (1).

➢ In singly linked data implementation is such as where the node contains some data and a pointer to the next node in the list.

➢ While doubly linked data has some more complex implementation where the node contains some data and a pointer to the next as well as the previous node in the list.

➢ Itallows traversal elements only in one way also a doubly linked data allows element two way traversal.

➢ Singly Linked Data are generally used for implementation of stacks whereas doubly linked data can be used to implement stacks as well as heaps and binary trees.

12. Explain structures of medical Informatics and its security issues?(Dec 2017)

Structure of Medical Informatics:

Security issues:

As enormous amount of information isstored oncomputers and computernetworks, protecting the information from unauthorised users is a major concern for operating system. Hackers or individuals could crack into useful information database of health care facilities and cause severe harm like distorting original information or introducing virus in the system or snoop over confidential files.

The three basic threats with the security of any kind of data stored in hospitals or research laboratories are:

1. **Exposure of data**:The privacy and confidentiality of the data of the patients are of utmost concern with legal as well as other implications. The confidential data of patients should not be leaked or exposed by any patient chance to anyone other than those concerned with its use.

2. **Tampering with the data:**Data integrity of the patients is not only necessary, but any kind of unwanted changes in the patient's data can lead to harmful results,causing even death of the patient, as doctors usually refer to the previous data (history/symptoms) before taking any particular action in future.

3. **Denial of service by the system:** With system availability, denial ofservice attacks is increasingly common, especially on the internet services.

13. **How bio Informatics plays a vital role in medical field? What are the significant features differentiate bioinformatics from Medical Informatics? (Dec 2017)**

   ➤ **Bioinformatics** researchers specialize in the application of computer technology to manage, manipulate, and interpret large amounts of biological data.

   ➤ An emerging multidisciplinary field which has experienced accelerated growth due to the publication of the Human Genome Project, bioinformatics aims to analyze genetic data to further gene-based research and to discover medical cures.

   ➤ Researchers in bioinformatics use computational biology to create three-dimensional models to test the efficacy of new drugs.

   ➤ Due to its multidisciplinary nature, bioinformatics attracts a wide range of scientific research professionals who hold master's and doctoral degrees in genetics, molecular biology, neuroscience, epidemiology, and agriculture.

➤ Other professionals in this sector have advanced degrees in mathematics, computer science, and programming.

Bioinformatics	Medical Informatics
Gradual build-up, focusing on science-driven methods of analysis for data from emerging gene and protein technologies. Early connections with cybernetics, information, and automata theory gave an information-oriented focus to genomics.	Rapid launch in the 1960s based on computer technology opportunities in health care. Few connections of medicial practice with "preinformatics" disciplines (mathematical modeling, statistics, linguistics, AI, etc.)—though fundamental for public health epidemiology, laboratory medicine, and radiology.
Molecular biology and biochemistry—massive data analysis and management demands for biological scientific discovery.	Medicine—standardization, efficient data processing and specialized analysis and management tools for clinical practice, biomedical research, and education.
Scientific data—controlled noise and uncertainty models and prospective studies allow relatively frequent direct application of data mining methods.	Clinical data—other than for controlled clinical trials, the incompleteness, subjectivity, and uncertainty of retrospective patient data make mining results difficult to replicate and transfer.
Many specialized databases publicly available over the Web. Interoperability good; quality issues addressed by increased duration.	Pioneering networking (Medline, SUMEX-AIM), documentation standards, vocabularies, and coding (e.g., UMLS, SNOMED, HL7). Clinical databases mostly nonpublic.
Recent emphasis on ontologies, network models, etc. No involvement in clinical applications until gene expression and SNP studies—still in early stages.	Emphasis on information systems for patient care, hospital, and medical information (HIS, MIS), education, and telemedicine. Representation of medical knowledge and language, central for information retrieval and decision support.
Signal processing biophysics-oriented. Three-dimensional graphic visualization of molecular structures for scientific	Signal, image processing, and computational modeling bioengineering-oriented. Three-dimensional visualization of radiologic,

research. Image analysis of functional data and network modeling and simulation	histologic, other imaging for clinical and educational use. Related to clinically useful (logic, coding, text, and graphics) knowledge representations and systems architectures.
Widely available tools for scientific data analysis. Prevention and personalized diagnosis and treatment seen as future promises.	Widely available Web sites, multimedia tools for accessing wide range of biomedical information, analysis tools less widely disseminated.

14. Describe in detail about the Computer Based medical Information retrieval process? (May 2018)

Internet has provided the doctor sitting in his home or office with the capability of accessing medical information online at any time.

RETRIVAL SYSTEMS:

MEDLARS:

In 1964, National Library of Medicine (NLM) in US began the MEDICAL LITERATURE ANALYSIS AND RETRIVAL SYSTEM(MEDLARS),to exploreadvanced technique for information retrieval.The MEDLARS contains 40 online computerized databases such asMEDLINE, TOXILINE and CANCERLIT.It covers almost 4600 international journals from 1966 to date covering all medicaland surgical specialities and pre-clinical sciences.

PUBMED:

It is the clinician database for medicine since 1997 free access is available to all. The Entrez-PUBMED is the most popular free way to access the medicine database.

MIB(Medical Information Bank):

It is the comprehensive bank of information system would contain substantive answers to the questions posted by practitioners.It provides answers that are current and correct of a group of experts.Provide data supporting the answers as well as citations to primary publications for more detailed study if desired.

MESH (Medical Subject Handling):

It is the National Library of Medicine controlled by vocabulary thesaurus.It consists of set of terms naming descriptors in a hierarchal structure that permits searching various levels.MESH descriptors are arranged both in alphabetical and hierarchal structures.

15. Explain in detail about the functional capabilities of a computerized HIS.(May 2018, Sep 2020)

Capabilities of computerized HIS:

Personal registration:

This includes permission of doctors/professionals to register both their entry as well as exit from the hospital. It also provides various report on staff members of the hospital.

Inpatient administration:

It includes online Reservation, Pre admission, Transfer, Discharged patients, Enquiryand Bed –control function. It also provides offline statistical report.

Outpatient registration:

This module provides online facilities to make out-patient appointment Pre –register and discharged outpatients. This module should also provide an out-patient log.

Employee information module:

Maintain an online computerized data base in all employees of the hospital.It displays records of employees in a specific type on demand and it prepares various reports required by the hospital.

Operation theatre module:

Online facility schedule, Re-schedule (or) cancel the surgery.It provides the needs of maintaining the current schedule of all operating goods within the hospital.It also be capital of reserving one(or) more operating rooms for physicians (or) forholidays (or) for routine maintenance.

Pharmacy control:

A comprehensive online pharmacy information system designed to accommodate notonly a single unit but also for talk dispensing method. This system also tests for drug to drug interaction.

Medical records index module:

An online computerized firing system which should provide the hospital withpowerful means of storing and rapidly retrieving patient's records.It maintains the patients demographic personal and previous stained information at thehospital which is used for future treatment.

16. Explain briefly aboutE- health.(May 2019)

E-health is an emerging field in the intersection of medical informatics, public health and business, referring to health services and information delivered or enhanced through the Internet and related technologies. In a broader sense, the term characterizes not only a technical development, but also a state-of-mind, a way of thinking, an attitude, and a commitment for networked, global thinking, to improve health care locally, regionally, and worldwide by using information and communication technology.

As such, the "e" in e-health does not only stand for "electronic," but implies a number of other "e's," which together perhaps best characterize what e-health is all about (or whatit **should** be). Last, but not least, all of these have been (or will be) issues addressed inarticles published in the Journal of Medical Internet Research.

The 10 e's (Services) in "e-health":-

1. **Efficiency** - one of the promises of e-health is to increase efficiency in health care, thereby decreasing costs. One possible way of decreasing costs would be by avoiding duplicative or unnecessary diagnostic or therapeutic interventions, through enhanced communication possibilities between health care establishments, and through patient involvement.

2. **Enhancing quality** of care - increasing efficiency involves not only reducing costs, but at the same time improving quality. E-health may enhance the quality of health care for example by allowing comparisons between different providers, involving consumers as additional power for quality assurance, and directing patient streams to the best quality providers.

3. **Evidence based** - e-health interventions should be evidence-based in a sense that their effectiveness and efficiency should not be assumed but proven by rigorous scientific evaluation. Much work still has to be done in this area.

4. **Empowerment** of consumers and patients - by making the knowledge bases of medicine and personal electronic records accessible to consumers over the Internet, e-health opens new avenues for patient-centered medicine, and enables evidence-based patient choice.

5. **Encouragement** of a new relationship between the patient and health professional, towards a true partnership, where decisions are made in a share dmanner.

6. **Education** of physicians through online sources (continuing medical education)and consumers (health education, tailored preventive information for consumers)

7. **Enabling** information exchange and communication in a standardized way between health care establishments.

8. **Extending** the scope of health care beyond its conventional boundaries. This is meant in both a geographical sense as well as in a conceptual sense. e-health enables consumers to easily obtain health services online from global providers. These services can range from simple advice to more complex interventions of a pharmaceuticals.

9. **Ethics** - e-health involves new forms of patient-physician interaction and poses new challenges and threats to ethical issues such as online professional practice, informed consent, privacy and equity issues.

10. **Equity** - to make health care more equitable is one of the promises of e-health, butat the same time there is a considerable threat that e-health may deepen the gapbetween the "haves" and "have-nots".

17. **Write a short about the various modulus in the hospital management information system (May 2019 ,Dec 2019)**

Modules in HIS:

Personal registration:

This includes permission of doctors/professionals to register both their entry as well as exit from the hospital. It also provides various report on staff members of the hospital.

Inpatient administration:

It includes online Reservation, Pre admission, Transfer, Discharged patients, Enquiry and Bed –control function. It also provides offline statistical report.

Outpatient registration:

This module provides online facilities to make out-patient appointment Pre –register and discharged outpatients. This module should also provide an out-patient log.

Employee information module:

Maintain an online computerized data base in all employees of the hospital. It **d**isplays records of employees in a specific type on demand and it prepares various reports required by the hospital.

Operation theatre module:

Online facility schedule, Re-schedule (or) cancel the surgery. It provides the needs of maintaining the current schedule of all operating goods within the hospital. It also be capital of reserving one(or) more operating rooms for physicians (or) for holidays (or) for routine maintenance.

Pharmacy control:

A comprehensive online pharmacy information system designed to accommodate not only a single unit but also for talk dispensing method. This system also tests for drug to drug interaction.

Medical records index module:

An online computerized firing system which should provide the hospital with powerful means of storing and rapidly retrieving patient's records. It maintains the patients demographic personal and previous stained information at the hospital which is used for future treatment.

18. What are the applications of Medical Informatics, bioinformatics and health informatics system? (Dec 2019)

Applications of Medical Informatics:

The various applications of MI are:

1. Information system:
2. Clinical laboratory
3. Database
4. Geographic information system
5. Clinical decision support systems
6. Hospital information system (HIS)

Applications of Bio-Informatics:

1. Molecular medicine
2. Personalized medicine
3. Preventative medicine
4. Gene therapy
5. Drug development
6. Microbial genome applications
7. Waste cleanup
8. Climate change Studies
9. Alternative energy sources
10. Biotechnology
11. Antibiotic resistance

12. Forensic analysis of microbes

13. Bio-weapon creation

14. Evolutionary studies

15. Crop improvement

16. Insect Resistance

17. Improve nutritional quality

18. Development of Drought resistance varieties

19. Veterinary Science

Applications of Health Informatics System:

1. Medical Practice Management System

2. Electronic Health Records (EHR)

3. E-Prescribing Software

4. Remote Patient Monitoring

5. Master Paint Index (MPI)

6. Patient Portal

7. Medical Billing Software.

19. **Explain how personalizes the health service is the key factor of successful implementation. (Sep 2020)**

   ➢ Personalized e-health services hold many promises, e.g. the improvement of health care quality or the reduction of costs.

   ➢ However, such services can't tap their full potential if they will not be used.

   ➢ That's why it is essential to understand what brings potential users to accept them.

   ➢ In the literature many acceptance models exist that predict the usage of innovations, but none of them specifically refers to the adoption of e-health services.

   ➢ Therefore we combined the Unified Theory of Acceptance and Use of Technology (UTAUT) and the e-health literacy concept and enhanced the resulting model with additional factors. MEDLINE® was searched; 75 studies were included for final analysis.

   ➢ Apart from the UTAUT variables and e-health literacy, 10 additional factors were identified: anxiety, trust, attitude toward using, computer self-efficacy, perceived

system quality, search strategy, user's condition, health specific knowledge, Internet dependency and satisfaction with medical care.

➢ Future research will include the devolvement of an instrument for assessing these factors and testing the initial research model in an international context.

BM T65 - MEDICAL INFORMATICS AND EXPERT SYSTEMS

UNIT - II

2 MARKS

1. What are the two major relational database design approaches? (Nov 2014)

The process by which we efficiently organize data to achieve these goals:

- Eliminating redundancy
- Ensuring data is stored in the correct table
- Eliminating need for restructuring database when data is added

2. What are WMRM device? (Nov 2014)

In order to maximize the security of the WMRM (Windows Media Rights Manager) system, a number of interlocking features and algorithms are used. The goal of Windows Media Rights Manager is to make compromising the system and playing content without authorization as difficult as possible. To that end, Windows Media Rights Manager designers have created a complex system that takes many potential security breaches into account.

3. What is the use of data retrieval system? (May 2015)

Data retrieval typically requires writing and executing data retrieval or extraction commands or queries on a database. Based on the query provided, the database looks for and retrieves the data requested. Applications and software generally use various queries to retrieve data in different formats. In addition to simple or smaller data, data retrieval can also include retrieving large amounts of data, usually in the form of reports.

4. Define Normalization. (May 2015, Nov 2015)

The process of organizing data to minimize redundancy is called normalization.

5. What is RDBMS? (Nov 2015)

A relational database is based on the relational model and uses a collection of tables to represent both data and the relationships among those data.

6. What are the functions of computerized patient record? (May 2016)

Functions:

- Intelligent Graphical Interface (IGI).
- Clinical Management System (CNS).
- Clinical Data Frameworks (CDF).
- Open Record for CARE (ORCA).
- OODB/CORBA.
- Symptoms entry using pen-based computers.
- Auto acquisition of patient information.
- Java Speech Implementation.
- Problem Oriented Patient Record (POPR).
- Longitudinal Medical Record.
- Standard General Mark-ups Language (SGML).

7. Define the term clinical information system? (May 2016)

This is a computerised system to store, organise and cross-check all the available medical information. It electronically manages all the records related to a patient as maintained in a doctor's file or nurse diary. It includes patient's past history, prescribed prescriptions, doctor's reports and other related information as one file.

8. What is Ethernet? (May 2017)

Ethernet, pronounced "E-thernet" (with a long "e"), is the standard way to connect computers on a network over a wired connection. It provides a simple interface and for connecting multiple devices, such computers, routers, and switches. With a single router and a few Ethernet cables, you can create a LAN, which allows all connected devices to communicate with each other.

9. List the advantages of CPR? (May 2017)

- EMRs do not allow creations of duplicate patient details in new entries being madeif existing details are available in the system.
- EMRs can be assessed round the clock and by several users,helping duringemergency scenario.
- Computerised records are easier to read and interpret than handwritten notes.
- With EMRs decision making becomes simpler.
- Easy to transfer records electronically between several users/service providers irrespective of time, costs
- EMRs reduce costs due to the data duplication and losses.
- Allows control of leakage, damage, theft and usage of resources (records) by keeping a track on users.

10. When will you perform CPR? (Dec 2017)

CPR or Computer-Based Patient Record is an integrated system that saves patient information. It contains not only a patient's health status but also his/her demographic and financial information. CPR aims to reduce organizational expense, improvement in the quality of care, and implementation of a data stream. A CPR system should ensure data mining and strong connectivity.

11. How tools can use for creating CPR? how are they authentic?(Dec 2017)

It is an important function of combining the management tools for generating alarms, alerts, possible linkages to several knowledge sources for health care decision-making, data analysis for research and patient care.

12. Mention the components of computerized patient records? (May 2018)

Depending on the level or need of care a patient has, records may vary, but all medical records in the EPR will contain some common information.

13. List out the development tools used in CPR? (May 2018)

Tools used in CPR:

- Clinical Departmental Information System (DIS)
- Clinical Information System (CIS)
- Clinical Decision Support system (CDSS)

14. What type of information will be available in CPR? (May 2019)

Depending on the level or need of care a patient has records may vary, but all medical records in the CPR will contain some common information.

15. What is the use of DIRLINE? (Dec 19)

Uses of DIRLINE:

✓ It contains two sub-files on specialty topics: poison control and substance abuse.

✓ Information provided for each organization includes its full name, address, contact person, and telephone number, as well as a summary of its services, activities, publications and interests.

16. What is mean by history taking by computers?(Dec 2019)

Generations of Electronic Computers

Generation	First Generation I	Second Gen. II	Third Gen. III	Fourth Gen. IV
Technology	Vacuum Tubes	Transistors	Integrated Circuits (multiple transistors)	Microchips (millions of transistors)
Size	Filled Whole Buildings	Filled half a room	Smaller	Tiny - Palm Pilot is as powerful as old building sized computer

17. What are the various functional requirement of CPR? (Sep 2020)

- ✓ Authentication
- ✓ Interoperability
- ✓ Privacy
- ✓ Older record incorporation
- ✓ Preservation
- ✓ Customization

18. Mention some of the risk factors of ASP. (Sep 2020)

- Remote access serving for the users of an enterprise
- An off-premises local area network to which mobile users can be connected with a common file server
- Specialized applications that would be expensive to install and maintains within your own company or on your own computer.

11 MARKS

1. Explain 2nf and 3nf with suitable example in detail. (May 2014)

Second Normal Form (2NF)

In 2NF, relational must be in 1NF. In the Second Normal form, all non-key attributes are fully functional dependent on the primary key.

Example:

EMP_ID	EMP_NAME	EMP_AGE
001	AAA	30
002	BBB	30

003	CCC	35
004	DDD	38
005	EEE	38

Third Normal Form (3 NF)

A relation will be in 3NF if it is in 2NF and not contain any transitive partial dependency. It is used to reduce the duplication of data and it is also used to achieve the data integrity. If there is no transitive dependency for non-prime attributes, then the relation must be in 3NF.

A relation is in Third normal form, it holds at least one of the following conditions for every non-trivial functional dependency.

Example:

EMP_ID	EMP_NAME	EMP_ZIP	EMP_STATE	EMP_CITY
111	AAA	201010	UP	Noida
222	BBB	02228	MP	Bhopal
333	CCC	06389	UK	Norwich
444	DDD	60007	US	Chicago
555	EEE	600028	TN	Chennai

EMP_ZIP	EMP_STATE	EMP_CITY
201010	UP	Noida
02228	MP	Bhopal

06389	UK	Norwich
60007	US	Chicago
600028	TN	Chennai

2. Discuss the different type of data storage and retrieval system (May 2014)

It is a systematic process of collecting and identifying its data, so that they can be located and displayed on request. Computers and data processing techniques have made possible to access the high-speed and large amounts of information from government, commercial and academic purposes.

Data Storage:

Data storage refers to a place where paper records are kept to a storage device such as computer hard disk, CD, DVD or similar device which can hold data.

Types:

1. **Hard Drive-** It is always inside the computer that stores all the programs and documents that the computer needs to work.
2. **Floppy Disk-** It is a portable storage medium that saves information to your computer.
3. **CD & DVD-** It is a portable storage that allows you to save information to it.
4. **USB Flash Drive-** It is smaller in device than others that is easy to carry every place to hold more data than a floppy disk.

Retrieval System:

An **Information retrieval system** is an information system that is used to store items of information that need to be processed, searched, retrieved and disseminated to various user populations.

Types:

1. **Database-** It is a system whose base and its key concept is simply a particular way of handling data and its objective to record and maintains information.

2. **Search Mechanism-** It is systematically searched and retrieved when a corresponding search mechanism is provided. It can be categorized as basic or advance search procedure that determines what retrieval techniques will be available to users and how information stored in databases can be retrieved.

3. **Language-** It relies information when being processed, transferred or communicated that can be identified as natural language and controlled vocabulary.

4. **Interface-** It considers whether or not an information retrieval system is user friendly. Quality of interface is checked by interaction mode when determines the ultimate success of a system for information retrieval.

3. **Explain 1NF and 2NF normalisation of relational database design.(Nov 2014)**

First Normal Form (1NF)

A relation is in First Normal Form (1NF) if and only if all underlying domains that contains atomic values only. It eliminates duplicative columns from the same table and it creates separate tables for each group of related data and identify each row with a unique column or set of columns (as Primary key).

Second Normal Form (2NF)

In 2NF, relational must be in 1NF. In the Second Normal form, all non-key attributes are fully functional dependent on the primary key.

It addresses further concept of removing duplicative data that can be identified as follows.

✓ Meets all the requirements of the 1NF.

✓ Remove subsets of data that apply to multiple rows of a table and place them in separate table.

✓ Create relationships between these new tables and their the non-key attributes are mutually independent.

4. Write notes on: a) optical jukebox b) Magneto optical device (Nov 2014)

a. Optical Jukebox

An optical jukebox is a device used for robotic data storage whereby optical discs can be automatically loaded and unloaded without any outside human assistance. These discs are normal data storage discs such as compact discs, DVDs, Ultra Density Optical or Blu-ray discs, and offer terabytes (TB) and petabytes (PB) of secondary storage options. Jukebox devices may have up to 2,000 slots for disks, and usually have a picking device that traverses the slots and drives. The arrangement of the slots and picking devices affects performance, depending on the space between a disk and the picking device. Seek times and transfer rates vary depending upon the optical technology used.

b. Magneto Optical device

A magneto-optical disk is a rewritable disk that makes use of both magnetic disk and optical technologies. It is similar to a magnetic diskette except for its larger size. Magneto-optical disks are seldom manufactured and used due to the advent of flash drives and DVD/CD drives, which are less expensive and have better writing time and reliability. Both 130 mm (5.25 in) and 90 mm (3.5 in) form factors exist. In 1983, just a year after the introduction of the Compact Disc, **Kees Schouhamer Immink** and **Joseph Braat** presented the first experiments with **erasable magneto-optical Compact Discs** during the 73rd AES Convention in Eindhoven. The technology was introduced commercially in 1985. Although optical, they appear as hard disk drives to the operating system and can be formatted with any file system. Magneto-optical drives were common in some countries, such as Japan, but have fallen into disuse.

5. Describe in detail about the database security ?(Nov 2015)

Database security encompasses a range of security controls designed to protect the Database Management System (DBMS). The types of database security measures your business should use

include protecting the underlying infrastructure that houses the database such as the network and servers), securely configuring the DBMS, and the access to the data itself.

Database security is a complex and challenging endeavor that involves all aspects of information security technologies and practices. It's also naturally at odds with database usability. The more accessible and usable the database, the more vulnerable it is to security threats; the more invulnerable the database is to threats, the more difficult it is to access and use.

Computer-based Controls:

The different forms of countermeasure to threats on computer systems range from physical controls to managerial procedures. In spite of the range of computer-based controls that are pre-existing, it is worth noting that, usually, the security of a DBMS is merely as good as that of the operating system, due to the close association among them.

Most of the computer-based database security is listed below:

- Access authorization.
- Access controls.
- Views.
- Backup and recovery of data.
- Data integrity.
- Encryption of data.
- RAID technology.

Access Controls:

The usual way of supplying access controls to a database system is dependent on the granting and revoking of privileges within the database. A privilege allows a user to create or access some database object or to run some specific DBMS utilities. Privileges are granted users to achieve the tasks required for those jobs.

The database provides various types of access controls:

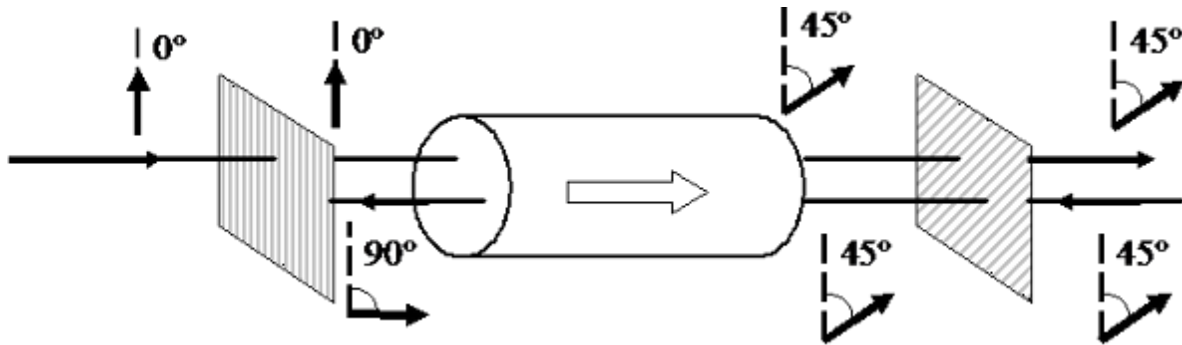- Discretionary Access Control (DAC)
- Mandatory Access Control (MAC)

6. Explain in detail about the miniaturized data storage and retrieval system? (May 2015)

Automatic Storage (or a miniature data storage) and Retrieval System (AS / RS) is one of the leading automation technologies in the warehouse section considering the large number of industries that use it. In terms of educational for young generation, AS/RS learning modules are ineffective and often ignored to be studied because the lack of machine facilities to support the learning process. That is because the price of an AS/RS machines are expensive for educational institutions to afford it. AS/RS machines that sold by the market also require a lot of space to be installed considering how big is the machine. The AS / RS machine in general also has a complex system mechanism and program content so it is often difficult to understand during the learning process. Because of these problems, a mini-sized version of AS/RS will be designed with an Arduino-based program to overcome these problems so that it is more suitable for educational institution.

The AS / RS miniature design starts from the electrical hardware component based on the number of AS/RS input modes that you want to make. Then the design continues with the installation of the mechanism of motion in accordance with CAD drawings previously made. After that, the contents of the machine program are made based on the electrical hardware circuit that has been made. The size and position of the rack is made to adjust to the mechanism of motion and motor movements that are regulated in the program. After miniature AS/RS has been finished, then work instruction will be made along with the evaluation of machine performance.

7. With a neat Diagram explain about magneto-optical device.(Nov 2015)

Diagram:

A magneto-optical disk is a rewritable disk that makes use of both magnetic disk and optical technologies. It is similar to a magnetic diskette except for its larger size. Magneto-optical disks are seldom manufactured and used due to the advent of flash drives and DVD/CD drives, which are less expensive and have better writing time and reliability. Both 130 mm (5.25 in) and 90 mm (3.5 in) form factors exist. In 1983, just a year after the introduction of the Compact Disc, **Kees Schouhamer Immink** and **Joseph Braat** presented the first experiments with **erasable magneto-optical Compact Discs** during the 73rd AES Convention in Eindhoven. The technology was introduced commercially in 1985. Although optical, they appear as hard disk drives to the operating system and can be formatted with any file system. Magneto-optical drives were common in some countries, such as Japan, but have fallen into disuse.

8. Explain the indexing and hashing in relational database design. (Nov 2015)

Indexing

It is a technique that allows to quickly retrieving records from database file. It is generally used to optimize or increase performance of database simply by minimizing number of disk accesses that are required when a query is processed. It offers faster search and retrieval of data to users that helps to reduce table spaces and makes it possible to quickly retrieve or fetch data can be used for sorting. A main purpose is to provide basis for both rapid random lookups and efficient access of ordered records. It is not considered best for large databases and its good for small databases. Types of Indexing: Ordered indexing, primary indexing, secondary indexing, clustered indexing. It uses data reference to hold address of disk blocks and it is important

because it protects files and documents of large size business organizations and optimizes performance of database.

Hashing

It is a technique that allows searching location of desired data on disk without using index structure. It is generally used to index and retrieve items in database as it is faster to search that specific item using shorter hashed key rather than using its original value. It is faster than searching arrays and lists, provides more flexible and reliable method of data retrieval rather than any other data structure, can be used for comparing two files for quality, etc. Its main purpose is to use math problem to organize data into easily searchable buckets. It's main purpose is to use math problem to organize data into easily searchable buckets. Types of Indexing: Static hashing and dynamic hashing. It uses mathematical functions known as hash function to calculate direct location of records on disk. It is important because it ensures data integrity of files and messages takes variable length string or messages and compresses and converts it into fixed length value.

9. Describe in detail the components and functionality of computerized patient record?(May 2016, May 2017)

Components:

Functionality:

1. **Interoperability**

✓ It is the ability of the different information technology systems and software applications to communicate, and to exchange data accurately, effectively and consistently and to use the information that has been exchanged.

✓ Many physicians currently have systems that can be used in conjugation with health information exchange to share patient information which are necessary for timely patient care.

2. **Privacy**

✓ A major concern is adequate confidentiality of individual records being managed electronically.

✓ Multiple access points over an open network like internet increases patient data interception.

3. **Older record incorporation**

✓ To attain wide accessibility, efficiency, patient safety and cost savings promised by EPR.

✓ Older paper medical records ideally should be incorporated into patient's record.

✓ Digital scanning involved is time consuming and some content may be illegible after conversion.

4. Preservation

Under data protection legislation and law, the physical medical records are the property of medical provider facility. The patient has a right of view for original records and obtains copies.

5. Customization

Every medical practice has different requirements systems that need to be custom tailored as per health care service requirement

6. Authentication

Using digital signatures, data can be authenticated for those intended to use it.

10. Explain in detail the role of computerized patient record in Radiology? (May 2016).

Role of CPR in Radiology:

Patient management

A RIS can track a patient's entire workflow within the radiology department; radiology providers can add images and reports to EHRs (Electronic Health Records), where they can be retrieved and viewed by authorized radiology staff.

Scheduling

The RIS allows staff to make appointments for both inpatients and outpatients.

Patient tracking

Using a RIS system, providers can track a patient's entire radiology history from admission to discharge and coordinate the history with past, present and future appointments.

Results Reporting:

A RIS can generate statistical reports for a single patient, group of patients or particular procedures.

Image Tracking

Traditionally, radiology providers use RIS to track individual films and their associated data. But as EHRs have become standard across the healthcare industry and digitized images and PACS have been widely adopted, radiology departments and their RIS-PACS systems have been more drawn into the clinical workflow of the entire medical enterprise.

Billing

RIS systems provide detailed financial record-keeping and process electronic payments and automated claims, though these functions are becoming incorporated into medical organizations' overall EHR systems

11. Explain in detail about normalisation in relational database design? (Nov 2016)

Normalization is a database design technique that reduces data redundancy and eliminates undesirable characteristics like Insertion, Update and Deletion Anomalies. Normalization rules divides larger tables into smaller tables and links them using relationships. The purpose of Normalization in SQL is to eliminate redundant (repetitive) data and ensure data is stored logically.

The inventor of the relational model Edgar Codd proposed the theory of normalization of data with the introduction of the First Normal Form, and he continued to extend theory with Second and Third Normal Form. Later he joined Raymond F. Boyce to develop the theory of Boyce-Codd Normal Form.

Database Normal Forms:

- First Normal Form (1NF)
- Second Normal Form (2NF)
- Third Normal Form (3NF)

- Boyce-Codd Normal Form (BCNF)

First Normal Form (1NF)

A relation is in First Normal Form (1NF) if and only if all underlying domains that contains atomic values only. It eliminates duplicative columns from the same table and it creates separate tables for each group of related data and identify each row with a unique column or set of columns (as Primary key).

Second Normal Form (2NF)

In 2NF, relational must be in 1NF. In the Second Normal form, all non-key attributes are fully functional dependent on the primary key.

Third Normal Form (3 NF)

A relation will be in 3NF if it is in 2NF and not contain any transitive partial dependency. It is used to reduce the duplication of data and it is also used to achieve the data integrity. If there is no transitive dependency for non-prime attributes, then the relation must be in 3NF.

Boyce-Codd Normal Form (BCNF)

A relation will be in Boyce-Codd Normal Form (BCNF or 3.5 NF) if every determinant is a candidate key. It is used for database normalization that is slightly stronger version of the Third Normal form (3NF).

12. Explain an example of the RDBMS design package?(Nov 2016)

RDBMS Design Package:

It stands for "Relational Database Management System" (in short DBMS) is a database program for a software system that uses a standard method of cataloguing, retrieving, and running queries on data. The DBMS manages incoming data, organizes it, and provides ways for the data to be modified or extracted by users or other programs.

Package Specification

It includes

- Name of the package
- Names of the data types of any arguments
- This declaration is local to the database and global to the package

This means that procedures, functions, variables, constants, cursors and exceptions and other objects, declared in a package are accessible from anywhere in the package. Therefore, all the information a package needs, to execute a stored subprogram, is contained in the package specifications itself.

Syntax:

Create [or replace] package package_name
 {is | as}
   Package_specification
End package_name;

Example:

CREATE OR REPLACE PACKAGE OPERATION
IS
  PROCEDURE ADDITION (A IN NUMBER, B IN NUMBER);
FUNCTION SUB (A IN NUMBER, B IN NUMBER) RETURN NUMBER;
END OPERATION;
/

Examples of RDBMS Packages:

Some DBMS examples include MySQL, PostgreSQL, Microsoft Access, SQL Server, FileMaker, Oracle, RDBMS, dBASE, Clipper, and FoxPro.

13. Explain in detail the applications of computerized prescriptions for patients? (May 2017)

Applications of computerized prescriptions for patients:

✓ **Reduced costs**. A recent **study** indicates that e-prescribing increases first fill medication adherence by 10% with the potential to save $140 - $240 billion over the next 10 years.

✓ **Improved patient safety**. Pharmacists no longer have to interpret handwritten prescriptions, reducing potential for errors.

✓ **Increased efficiency**. E-prescriptions are delivered directly in the pharmacy's computer system, reducing the amount of time pharmacy technicians spend interpreting handwriting or entering information manually. Additionally, since physicians have better information available at the time of prescribing, fewer pharmacist-to-physician follow up calls will be needed.

✓ **Expanded reach**. A single connection to the largest network of **long term and post-acute care** facilities, pharmacies, EHRs, health systems, and health information exchanges makes direct connections unnecessary.

14. What is clinical information system? How it is used in the medical field? How they are created and maintained? (Dec 2017)

It is a computerised system to store, organise and cross-check all the available medical information. It electronically manages all the records related to a patient as maintained in a doctor's file or nurse diary. It includes patient's past history, prescribed prescriptions, doctor's reports and other related information as one file.

Benefits in Medical field:

- Improving communication between the many health professionals caring for each patient
- Providing all the information clinicians need to make good decisions
- Making it easier for patients to have x-rays and scans when needed
- Encouraging quality improvement
- Allowing better clinical research.

These data should be, as far as possible, automatically populated based on names of the form used, username on log-on and current location as in the Patient Management System. As a rule, documentation is associated with a task. The data elements describe the task and the results generated by it. The record of events and results generated by it should be written or captured in chronological order. It is necessary for the input devices and the database to have a synchronized system clock and each data entry and capture given a time stamp. There should be concurrency control so that the correct sequence is maintained.

15. Explain the merits and demerits of computerized prescription for patient? (Dec 2017)

Merits:

✓ **Increased patient safety** done through warning systems and alerts at the point of prescription that flag potentially harmful.
✓ **Eliminates legibility errors** and aids in stream lining the overall prescription process by reducing the need for call-backs from pharmacists is to verify prescription information.
✓ **Refills helps request** receives and authorizes refills much easier
✓ **Convenience** provides a great amount of convenience to the physician

Demerits:

✓ Software is necessary and comes at costs that are associated with use. Start-up, maintenance and transaction fees.
✓ Pharmacists must learn how to use the software.
✓ The computer may give a false sense of security that is still possible to make errors
✓ Electronic prescribing cannot be used during power outages and may be difficult in rural areas with poor internet connections.
✓ System failures and incompatibilities between technology designs may prove to be problematic.
✓ Errors associated with e-prescriptions are not always detected by the pharmacists which results in decreased safety as well as patient harm.

16. Give detailed accepts of CPR in Radiology.(Dec 2019)

Users are more likely to accept a technology if several conditions are met: they have a stake in the system; they can use it at minimum cost; the technology produces information leading to improved clinical services; that information is almost immediately available; and the technology increases their status (Young, 1987).

Computing applications that do not significantly change the routines associated with the practice of medicine are also more likely to be accepted by users. An individual's propensity to use a technology has been attributed to specialization, fear of malpractice suits, industry promotion, a specific form of medical practice, and payment methods.

An acceptance of clinical computing systems relate to the way a physician organizes his or her thought processes and interacts with written aids. The written record is not just a repository of information; it often forms part of the doctor's thought process, so that the style of writing, the position on the paper of particular items, abbreviations, the sequence of information, use of margins, may all have an important significance for the individual practitioner—a significance which goes beyond the actual facts recorded, and which is impossible to capture in an orderly typed record or video display unit.

It is the loss of these individual aspects of the medical record which causes most problems. The advantages of structured, typewritten reports commonly do not outweigh the loss of the extra information which is conveyed to the individual practitioner by the above features.

17. Briefly explain about clinical information system?(Dec 2019) (Dec 2018)

It is a computerised system to store, organise and cross-check all the available medical information. It electronically manages all the records related to a patient as maintained in a doctor's file or nurse diary. It includes patient's past history, prescribed prescriptions, doctor's reports and other related information as one file.

Features:

Features of CIS.

Advantages:

1. Easy access to patient data:

2. Structured information

3. Improved drug prescription and patient safety

Disadvantages:

1. Initial cost of acquisition

2. Privacy and security

3. Clinician resistance

4. Integration of legacy systems

18. Describe the importance of CPR in Radiology?(Sep 2020)

A radiology information system is a database system used to organize and store the data of radiology patients. It also houses image files collected throughout the course of diagnosis and treatment. A radiology information system is an electronic health record system specifically created to be used in radiology.

Importance:

✓ A Material management is extremely time consuming and often inaccurate if you have a paper record system by which a computerized system allows your staff to see at a glance what needs to be ordered immediately and where you have surplus supplies.

✓ It improves efficiency that allows your employees to eliminate many redundancies found in the registration process of new patients also it helps your staff to make better use of their time and boosts morale.

✓ A recorded information is far more accurate than it would be without a modern radiology information system for which it takes fewer data entry mistakes occurred by entering data into a next screen.

✓ The managers and owners of a radiology practice to invest in an RIS is the fact that it saves money. Not only do your employees take less time to enter the data, but they also spend less time correcting mistakes because they are much less likely to make them.

✓ The length of your revenue cycle is a big part of the success of your business. Your radiology information system increases revenue partly by reducing the turnaround time for reports. The sooner you process documents to bill providers for your services, the shorter your revenue cycle will be. However, it also greatly reduces missed appointments.

✓ A streamlined RIS applications leads to more accurate diagnoses. This means you can expect an improvement in the statistics you gather on patient positive outcomes for the year.

✓ With computerized records, coordinating the care of patients is much easier. You can work with a rehabilitation facility for post-treatment exercises, or a hospital for a procedure.

✓ By computerizing and streamlining the paperwork, increasing the accuracy of data entry and increasing the rate of correct diagnoses, you have the time to focus on your patients and provide them with higher quality care.

19. Describe in detail about the design procedure to be followed for help system and state the benefits of CIS. (Sep 2020)

Design procedure for CIS:

Step 1: The decision to procure the installation of a CIS/PDMS in an ICU in a hospital either refers to an isolated installation or might include other/all ICUs of the same hospital, or even ICUs in other hospitals residing in the same area or other areas in the country.

Step 2: When it comes to IT solutions, our generation's perceived needs are poorly correlated with the capabilities of even commercially available systems. If right from the beginning the clinical team "undermines" its position by expressing minimal functionality requirements then the game will be gradually lost as the vendor will neither have the motivation to offer more functionality in a certain price range, nor will deploy the resources necessary to offer it.

Step 3: An ICU (or hospital/healthcare authority) based interdisciplinary project governance team having regular (preferably open) meetings with publicly available agenda and minutes with action points and timelines is essential to allow for effective procurement.

Step 4: Securing funding necessary to conclude procurement, installation and ongoing, meaningful support is of crucial importance as this kind of project can easily "die" if procurement lasts for a long period of time.

Step 5: Setting up a PMP is not a trivial task, and in the case of big installations, particularly at the hospital or health authority region level, a full-time professional project manager is required from the beginning and through all steps described here.

Step 6: Setting performance indices and a system to follow them up, troubleshoot accordingly and inform the project/unit management and the IDT meetings, is of paramount importance as it allows for early interventions that can maximise success.

Step 7: It is created for the CIS rendered sustainable if and only if the community that lives in continues to follow a structured and timed sequence of (re)design, procurement, parameterization, testing, and implementation.

Benefits of CIS:

➢ The key benefits of CISs include reducing medical errors, improving clinical decision-making during patient encounters, and providing universal access to a patient's information in real time.

➢ However, to harvest the sweet benefits of CISs, one must address the major challenges and pitfalls during the planning, design, and implementation of such systems.

➢ Additionally, healthcare organizations should adopt CISs to improve quality of care and to be able to stay competitive.

➢ The ultimate goal is to strike a balance between available resources, current HIS architecture, and the desired clinical improvement objectives.

➢ The quest to a perfect CIS is a long journey that is best started today.

BMT65 – MEDICAL INFORMATICS & EXPERT SYSTEMS
UNIT-3

2 MARKS

1) Define expert systems with help of an example. (May 2014)

Expert System

➢ An expert system is a computer program that attempts to mimic human experts by the system's capability to render advice, to teach and execute intelligent tasks.

Example

➢ An Example of Expert System used to predict the degree and type of lung cancer

2) What is knowledge acquisition? (May 2014)

➢ Knowledge acquisition is the process of extracting, structuring and organizing knowledge from one source, usually human experts, so it can be used in software such as an ES. This is often the major obstacle in building an ES.

➢ There are three main topic areas central to knowledge acquisition that require consideration in all ES projects.

   • First, the domain must be evaluated to determine if the type of knowledge in the domain is suitable for an ES.

   • Second, the source of expertise must be identified and evaluated to ensure that the specific level of knowledge required by the project is provided.

   • Third, if the major source of expertise is a person, the specific knowledge acquisition techniques and participants need to be identified

3) List the types of expert systems? (Nov 2014,May 2015,May 2017)

   There are mainly five types of expert systems.

   • rule based expert system,

   • frame based expert system,

   • fuzzy expert system,

   • neural expert system and

   • neuro-fuzzy expert system..

4) Give the various control commands used in VB? (Nov 2014)

- Form.
- Command Button.
- Labels.
- Text box.
- Image control and Picture boxes.
- Frame controls.
- Option buttons.
- Check boxes

5) Define search? (May 2015)

Searching is the process of finding a given value position in a list of values. It decides whether a search key is present in the data or not. It is the algorithmic process of finding a particular item in a collection of items.

6) Define expert System? (Nov 2015)

➢ An expert system is a computer program that is designed to emulate and mimic human intelligence, skills or behavior.

➢ It is mainly developed using artificial intelligence concepts, tools and technologies, and possesses expert knowledge in a particular field, topic or skill.

7) Write note on medical data acquisition? (Nov 2015)

➢ Data acquisition is the process of sampling signals that measure real world physical conditions and converting the resulting samples into digital numeric values that can be manipulated by a computer.

➢ The components of data acquisition systems include: Sensors, to convert physical parameters to electrical signals.

8) What is constraint satisfaction? (Nov 2016)

In artificial intelligence and operations research, constraint satisfaction is the process of finding a solution to a set of constraints that impose conditions that the variables must satisfy.

9) Define automated clinical laboratory. (May 2019)

➢ **Automation in clinical laboratory** is used not only to assist the **laboratory's** test performance but also

   o To process and transport the specimens,

   o To load the specimens into automated analyzers,

   o To assess the test results obtained, and

   o To store and archive the specimens, which means the automation involves all the processes mentioned.

➢ To automate these additional functions is of crucial importance with respect to the future prosperity of clinical laboratory.

10) What is hematology test? (May 2019)

➢ **Hematology tests** includes **tests** on the **blood, blood proteins and blood producing organs.**

➢ These tests can evaluate a variety of blood conditions including infections, anemia, inflammation, hemophilia, blood-clotting disorders, leukemia and the body's response to chemotherapy treatments.

11) What is dynamic data exchange? (May 2016, Nov 2016, May 2017)

➢ Dynamic Data Exchange (DDE) is an interprocess communication system which allows data to be communicated or shared between the applications in operating systems such as Windows.

➢ Dynamic Data Exchange makes use of shared memory and a set of commands, message formats and protocols for communication and sharing.

12) What are the tools used in VB environment? (May 2016)

➢ Menu bar

➢ Toolbars

➢ Visual Basic toolbox

➢ Form window

➢ Properties window

➢ Project Explorer

➢ Immediate window

➢ Form Layout window

13) Mention the characteristics of EEG signal. (Nov 2018)

The EEG is a complex signal that represents the electrical activity of the brain. Like other signals, the EEG can also be split into a series of sinusoids. Most signal-processed EEG parameters are based on power spectral analysis, which represents the amplitude of sinusoids as a function of frequency.

14) What is sampling and quantization with respect to images? (Nov 2018)

The sampling rate determines the spatial resolution of the digitized image, while the quantization level determines the number of grey levels in the digitized image.The transition between continuous values of the image function and its digital equivalent is called quantization**.**

15) Computer assisted ECG analysis is dependent on what technique? (Nov 2019)

➢ Exercise ECG testing

➢ Ambulatory Electrocardiography

➢ ECG signal analysis ndepending on time-domain representation, the frequency-domain spectrum, and the relationship between them.

16) What is meant by LIMS? (Nov 2019)

Laboratory Information Management Systems (LIMS)

➢ Computerized information management system designed for laboratories

- Manages lab data from sample log-in to reporting
- Interfaces with analytical instruments
- Sorts and organizes data into various report formats
- Stores data for future reference and use

17) State the principle of NMR and how its used in medical field? (Nov 2017)

The principle behind NMR is that many nuclei have spin and all nuclei are electrically charged.The energy transfer takes place at a wavelength that corresponds to radio frequencies and when the spin returns to its base level, energy is emitted at the same frequency.

18) What is the advantage of long term video EEG monitoring? (Sep 2020)

➢ With prolonged analog EEG, no additional resources are needed, data are easy to interpret and are immediately accessible, no additional cost for equipment is incurred beyond standard EEG, and outpatient as well as inpatient studies may be performed.

19) Mention the ways by which EMG signals are assessed. (Nov 2017,Sep 2020)

➢ **EMG signals** are recorded by placing electrodes close to the muscle groups. Ehen the muscle is activated, the length of the muscle decreases and the muscle, skin and electrode move with respect to one another.

➢ At the same time, the electrodes will show some movements artifacts.

20) Specify the automated method used in hematology. (May 2018)

➢ At the highest level of hematology laboratory automation are scalable, configurable automation systems dedicated to shepherding lavender (EDTA) top tubes through the following analytic determinations: CBC, 6-part white blood count (WBC) differential, nucleated red blood cell (NRBC), reticulocyte count (RET) and immature retic fraction (IRF), automated immature platelet fraction (IPF), and automated smear preparation and staining.

21) What is the advantage of intelligent laboratory information system? (May 2018)

➢ A Laboratory Information Management System (LIMS) allows you to effectively manage the flow of samples and associated data to improve lab efficiency.

➢ A LIMS helps standardize workflows, tests and procedures, while providing accurate controls of the process.

.

11 MARKS

1) Give a detailed account on the signal processing and analysis of ECG signal. (May 2018, Sep 2020)

COMPUTERIZED ECG

➢ Electrocardiography (ECG) systems measure brain, heart, Muscle activity.

➢ Measuring electric potentials on surface of active tissue.

➢ Nervous stimuli & muscle contractions can be identified by measuring the ionic current flow in body.

➢ This is consummate using a bio potential electrode. Frequency range of bioelectric signal is ECG amplitude is $50\mu V$-$5\mu V$.

ECG-Electrocardiography (ECG)

➢ It is the process of displaying the electrical activity of the heart over a period of time using electrodes placed on a human body.

➢ These electrodes detect the electrical changes on the membrane that arise from heart muscle depolarizing during heartbeat.

➢ Recording of ECG-The normal cardiac cycle spontaneous depolarisation of sinus node, an area of specialized tissue situated in high right atrium (RA).

Block diagram of Computerized ECG

➢ A wave of electrical depolarization then spreads through RA and across the inter-atrial septum into LA.

➢ The atria are detached from the ventricles by electrically inert fibrous ring, i.e. normal heart only route of transmission of electrical depolarisation from atria to ventricles through atrioventricular (AV) node.

➢ The atrioventricular node stays the electrical signal for small time, and the wave of depolarisation spreads down the IVS (interventricular) septum via right and left bundle divisions, into the RV and LV ventricles.

➢ Hence normal conduction into the two ventricles contract simultaneously, which important in maximizing cardiac efficiency.

➢ After complete depolarisation of the heart, myocardium must then repolarize, before can be ready to depolarize again the next cardiac cycle.

➢ The preamplifier is followed by a power amplifier that's provide power to pen motor record ECG trace. ECG recorder used to the output of other device i.e. EMG that's record Achilles reflex.

➢ Position control the pen amplifier makes possible to center the pen on the recording paper.

➢ ECG are recorded paper speed of 25mm/s, but faster of 50mm/s.Better resolution of QRS band complex at very high heart rate.

➢ The CMRR of the overall system reduces interference i.e. reducing effect of current flow n right leg electrode.

➢ Digitization of ECG record- ECG has existed for century year, and digital ECG has existed than two decade.

➢ A cardiac patient history of heart disorders will always have to transfer & maintain a bulk of such ECG reports visiting a physician for consultation.

➢ Printed ECG reports includes some characters as well as annotations, while taking an image of such ECG strips it is desirable to remove printed characters. Efficient removal noise & image enhancing algorithms are required.

A) Scanning

- ECG paper recordings to be scanned. Scanning resolution can be 600/200 dpi (dots per inch).
- Algorithm for the image compression is JPEG. The image can also be acquired from a digital camera used in cell phones.

B) De-Skewing

- Skew is a common occurrence can appear in a scanned image. Skewing rotates the image angle, resulting in a rotated image.
- Skew angle is designed using the background grid outlines of scanned ECG image.

C) Image Enhancement

- This step enhances ECG image by manufacture the signal lines. Laplacian filtering is applied for making related noise lighter than main ECG signal.
- Threshold value is selected by comparing between noise pixels and representing real ECG signal. The resulting image will contain separate ECG signal in the image.

D) Color Based Segmentation

- Remove the background network of an ECG. Background grid is usually of daintier shade of color than actual signal waveform.
- ECG image is processed column by column. The darkest pixels are extracted in each column and are replaced by pure black pixel as pure white. Produces a binary image. However this may lead to extraction of undesired printed.

E) Region Based Segmentation

- The isolated pixels do not represent printed characters. This step comprises of the following steps

- Step 1-Eradicate the frame of the picture that's border of the input picture.

- Step 2- Scan the feedback ECG image column by column.

- Step 3- Repeat for each column

F) Signal Representation

- Each column is governed by a only pixel so the signal is denoted by the corresponding column pixel table. The signal is saved as a txt file

G) Median Filtration

- Actual ECG signal verified by an ECG machine can be tarnished due to presence of noise.

- Sources of clatter can be - Item Power Line Interface, low frequency noise, Muscle noise

2) **Explain the role of computers in radiation therapy and planning. (Nov 2017, May 2018, May 2019,Sep 2020)**

RADIATION THERAPY PLANNING

Radiotherapy Planning

➢ Before the treatment, the radiotherapy team carefully plan the external beam radiotherapy. This means working out how much radiation it need to treat the cancer and exactly where the patient need it.

➢ As cancer cells may sometimes spread into the tissues close to the tumour, the radiotherapy specialist will decide on the exact area to be treated around the cancer.

➢ They will also make allowances for possible movement of the tumour during treatment due to breathing or normal movement of body organs.

External Radiotherapy Planning

➢ The radiotherapy planning makes sure that the cancer gets the prescribed dose of radiation while normal body tissues get as little as possible.

- ➢ The area of patient body exposed to radiation is called the radiotherapy field. Some normal tissue immediately around the tumour will be exposed to the same dose but the doctors aim to keep this as low as possible to reduce the risk of side effects.
- ➢ The steps involved in radiotherapy planning vary with the type of cancer and its position in the body. Doctor will take into account
  - The type of cancer
  - The position of the cancer in the body
  - The size of the cancer
  - Whether it is close to structures that are sensitive to radiation
  - How far the radiation needs to travel into the body
  - General health and medical history of patient
- ➢ Sometimes it need more than one planning session. It depends on the size and position of the tumour.

Planning Appointment

- ➢ Patient's planning appointment may take from 15 minutes up to a couple of hours.Patient will have a planning CT scan to plan the radiotherapy.
- ➢ The scan shows the cancer and the structures around it. Before the planning appointment patient may also have an MRI scan, PET scan or Xrays.
- ➢ This is so that a radiotherapy doctor (clinical oncologist) has as much information as possible about the patient's treatment needs. They can feed the other scans into the planning scanner as part of the planning process.

How a patient will have radiotherapy planning

- ➢ The radiographer will measure patient's body size and shape in the treatment area. Sometimes they need to do extra things to get a clear picture of patient's body structures. For example
  - Patient may have an injection of dye to show up patient's kidneys
  - Patient may have wires put on scars or around lumps
  - Before the scan patient may need to drink a jug of liquid containing a dye that shows up patient's bladder
  - If patient is having treatment to chest area, patient may have barium liquid to drink to show up patient's food pipe (oesophagus) and stomach

Ink Marks

➢ While planning the radiotherapy, the radiographers may make pin point sized tattoo marks on the patient's skin to make sure they treat exactly the same area every day. They may also highlight the tattoo with pen marks that make it look like a cross.
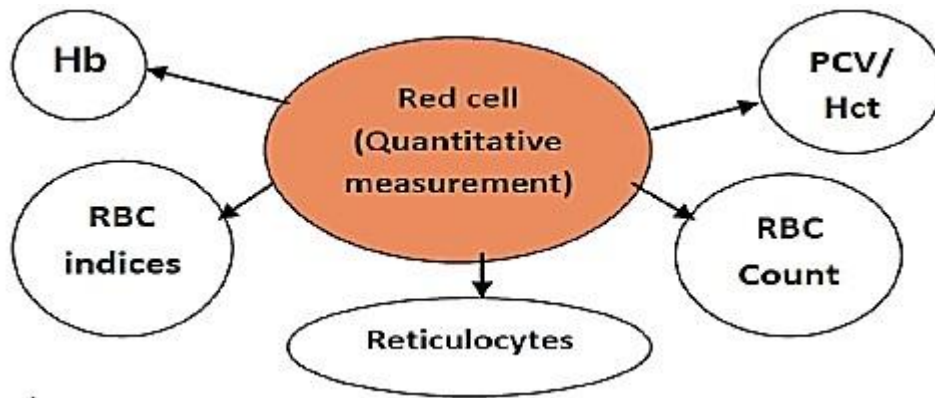
Moulds or Masks

➢ If the patient is having treatment to head or neck, patient may need to have a mould (shell) made to keep patient perfectly still while patient having treatment.

➢ Patient may also have a mould if patient have to keep an arm or leg perfectly still. The moulds are made in the mould room or in the CT scanning room.

After Planning Session

➢ Patient may have to wait a few days or up to 2 weeks before starting treatment. During this time the physicists and radiotherapy doctor decide the final details of plan.

➢ Doctor will plan the areas that need treatment and outline areas to limit the dose to or avoid completely.

➢ They call this contouring. Then the physicists and staff called dosimetrists plan the treatment very precisely using advanced computers.

3) **Describe in detail about automated methods in hematology. (May 2019, Nov 2017)**

Automation in haematology lab

Automated cell counted (Full blood count test)

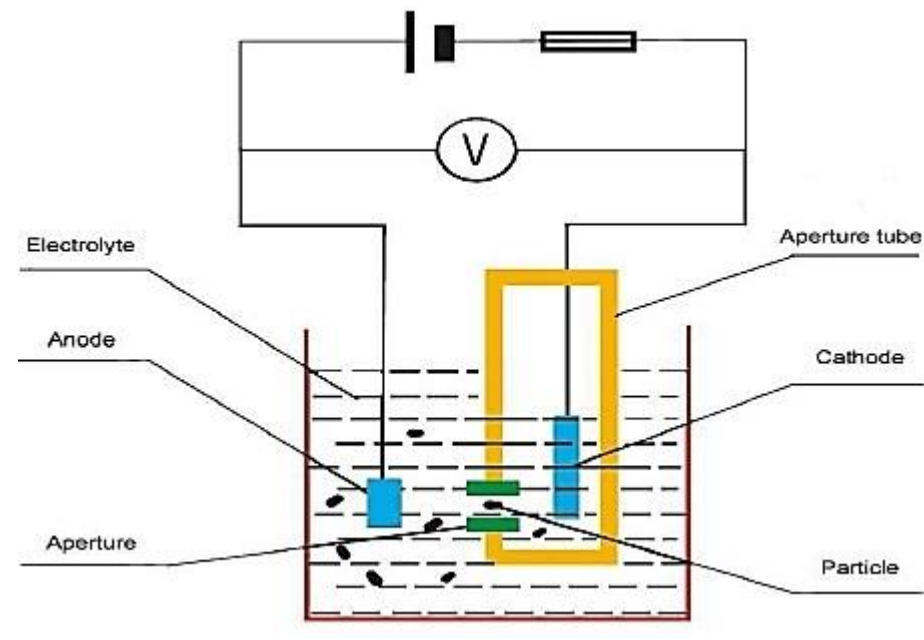| Advantages of automation	
1) High capital	6) No errors
2) Rapid performance	7) Improved quality of test
3) Less labour	8) Reduce cost of the running test
4) More precise	8) Need calibration and maintenance

Hb count (Automation)

➢ Direct measurement

➢ Modification of manual HiCN method (**Cyanmethemoglobin method**)

- Concentration of reagent, temperature and pH of reaction

- Addition of non-ionic detergent to ensure rapid cell lysis, reduce turbidity

- Measurement at set interval before the reaction is completed

- Utilization of non-cyanide reagent

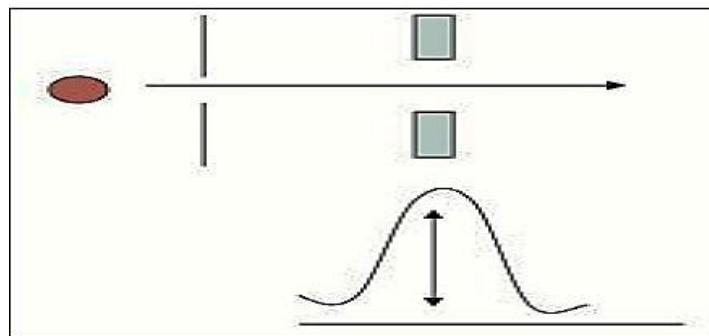➢ **Another technique:** High-angle light scattering method

PCV/ Hct (Automation)

➢ Passage of a cell through the aperture of an impedance counter or through the beam of light in a light scattering instrument

➢ Lead to the generation of an electrical impulse (Direct obtained)

➢ **Another technique:** (MCV X RBC) / 10 RBC count (automation).

Electrical impedance

- ➢ Example: Beckman-Coulter, Sysmex, Abbott, Roche
- ➢ RBCs are poor conductors of electricity and therefore it was diluted in a buffered electrolyte solution
- ➢ Passage of a cell via the aperture of an impedance counter lead to the generation of an electrical impulse
- ➢ All electrical-impedance cell counters are based on Coulter's principle.

- ➢ No of pulses = count as cell
- ➢ Average pulse height =volume
- ➢ Summation of height = CV
- ➢ Cells through an aperture,causes a change in electrical resistance, this pulse is detected and amplified by the instrument.
- ➢ Amplitude of the pulse is proportional to cell size.

Light-scattering technology (cell counting)

➢ Diluted cell suspension flow in a single file

➢ A light source in front of the aperture (strike a cell; the beam is scattered at an angle).

➢ The angle is depend on the volume, size and index of the refraction

➢ Scatter lights is detected by photomultiplier or photodiode

➢ And converted into the electrical impulses (the values are read at readout device)
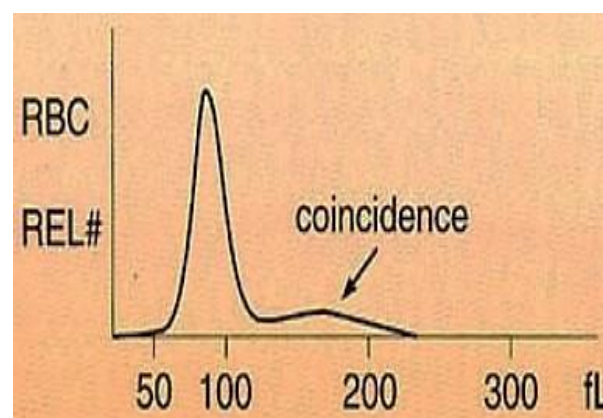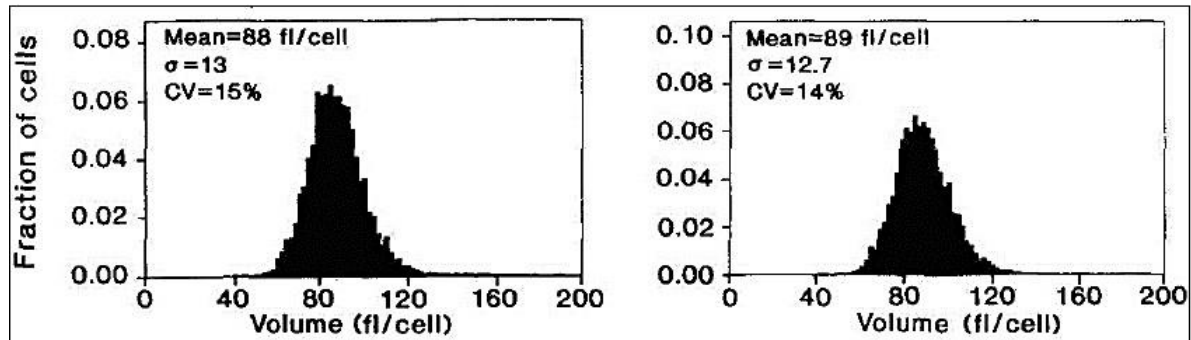

Red cell indices (Automation)

Red cell distribution width (HDW)

➢ **Technique:** Calculation

o $RDW - CV = \dfrac{SD \times 100}{MCV}$

o $RDW - SD = SD$ of RBC histogram

Hemoglobin distribution width (HDW)

➢ SD of Hb concentration distribution histogram

➢ Only obtained from Laser technology

➢ Degree of anisocytosis can be determined

➢ It derived from pulse height analysis

➢ CV (%) or SD (fl) Mean Corpuscular haemoglobin concentration (MCHC)

➢ **Technique**: Calculation

$$\circ \quad \frac{Hb}{Hct} \times 100$$

Mean Corpuscular haemoglobin (MCHC)

➢ **Technique:** Calculation

$$\circ \quad \frac{Hb}{Hct} \times 10$$

Corpuscular haemoglobin concentration means (CHCM)

➢ **Technique:** Direct measurement using light scattering at different angle (5 – 15°C) in Bayer-Technicon

➢ To replace the role of MCHC. Sensitivity to iron deficiency has improved.

➢ As an internal quality control. If all measurement accurate, MCHC = CHCM

Reticulocytes count (Automation)

➢ **Technique:**

- Fluorescence detection of red cells stained with RNA specific fluorochroms (Auramine O, Ethidium bromide, Oxazine 750, Thiazole orange)
- Direct count via volume, light scattering and opacity of cells

➢ **Type after fluorescence detection:**
- Low Fluorescence Ratio (LFR): Most mature
- Middle Fluorescence Ratio (MFR): mid mature
- High Fluorescence Ratio (HFR): Most immature

Total WBC count (Automation)

➢ **Electrical Impedance** (Number of pulse obstructed) @
➢ **Light scattering** (Number of signal from low-angle light scattering)
➢ **WBC count:**
- Red cells are lysed, residual particles are counted
- Threshold are set for WBC to exclude platelet
- Error for WBC: giant platelet, nRBC, white cell agglutination

Platelet count (Automation)

➢ **Electrical Impedance** (Volume cut-off at 2fl-20fl) @
➢ **Light scattering** (High-angle light scattering for size and Hb content)
➢ **Platelet count:**
- Counted in WB using electrical electro-optical detection
- Threshold is set to separate red cells, debris and electronic noise
- New plates parameter: MPV, PDW.

WBC Differential count (Automation)

➢ More precise but sometimes inaccurate
➢ Using flow cytometry principle
➢ Diluted WB, RC lysed, WC categorised into 3 or 5 part diff
➢ Single channel or 2/ more channels
➢ Based on: Volume, Physical characteristics, Activity of cellular enzyme
➢ Techniques:
- By volume
- By volume + conductivity + light scattering

- By light scattering + cytochemistry
- By light scattering + RF impedance

3 part	5 part or more

• Single channel
• Based on volume of various cells
• **3 categories** detected:
  o Granulocytes/LC
  o Lymphocytes/SC
  o Monocytes/MNC
• Eosinophil/basophiles are included in MNC
	• 2 or more channel
	• Cell volume and other characteristics
	• **5 categories** detected:
	  o Neutrophils
	  o Eosinophils
	  o Basophils
	  o Lymphocytes
	  o Monocytes
	• Other may have LIC, AL...

Instrument principle

➢ Light scattering and absorbance
➢ Impedance measurement with low and high frequency electromagnetic current or radiofrequency current
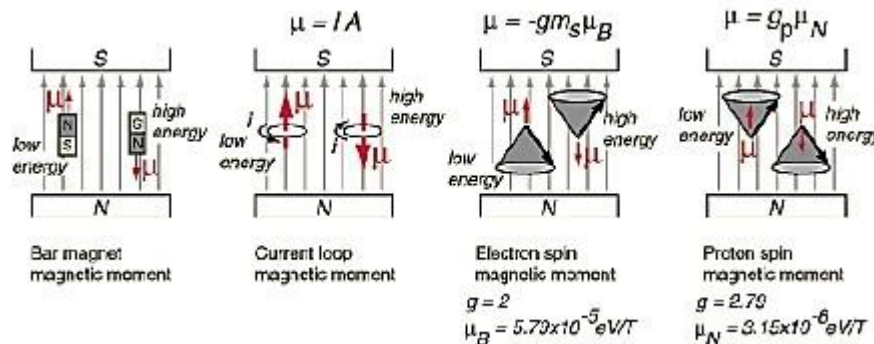➢ Cytochemical reaction

Analysis

➢ 2 parameter or more complex
➢ Cells are divided into cluster
➢ Threshold (fixed and variable)

4) How computer assisted medical imaging helps in NMR? (Nov 2019, May 2014)

Nuclear Magnetic Resonance

➢ When the nuclear magnetic moment associated with a nuclear spin is placed in an external magnetic field, the different spin states are given different magnetic potential energies.

➢ In the presence of the static magnetic field which produces a small amount of spin polarization, a radio frequency signal of the proper frequency can induce a transition between spin states.

➢ This "spin flip" places some of the spins in their higher energy state. If the radio frequency signal is then switched off, the relaxation of the spins back to the lower state produces a measurable amount of RF signal at the resonant frequency associated with the spin flip. This process is called Nuclear Magnetic Resonance (NMR).

➢ A magnetic dipole moment (usually just called "magnetic moment") in a magnetic field will have a potential energy related to its orientation with respect to that field.

➢ Note that the electron spin magnetic moment is opposite to the electron spin while the proton spin magnetic moment is in the direction of the proton spin.

➢ The electron spin or proton spin will tend to precess around the magnetic field with a frequency traditionally called the Larmor frequency.

➢ For a 1 Tesla magnetic field this Larmor frequency would be

$$\omega_{electron\,spin} = \frac{2\mu_e B}{\hbar} = \frac{2 \cdot 2 \cdot \frac{1}{2}(5.79 x 10^{-5} eV/T)(1T)}{6.58 x 10^{-16} eV \cdot s} = 1.7608 x 10^{11} s^{-1}$$

$$v = \frac{\omega}{2\pi} = 28.025\,GHz \quad Larmor\ frequency$$

$$\omega_{proton\,spin} = \frac{2\mu_p B}{h} = \frac{2(2.79)(3.15 x 10^{-8} eV/T)(1T)}{6.58 x 10^{-16} eV \cdot s} = 2.6753 x 10^8 s^{-1}$$

$$v = \frac{\omega}{2\pi} = 42.5781\,MHz \quad Larmor\ frequency$$

➢ The Larmor frequency can be visualized classically in terms of the precession of the magnetic moment around the magnetic field, analogous to the precession of a spinning top around the gravity field.

➢ It can also be visualized quantum mechanically in terms of the quantum energy of transition between the two possible spin states for spin 1/2. This can be expressed as a photon energy according to the Planck relationship.
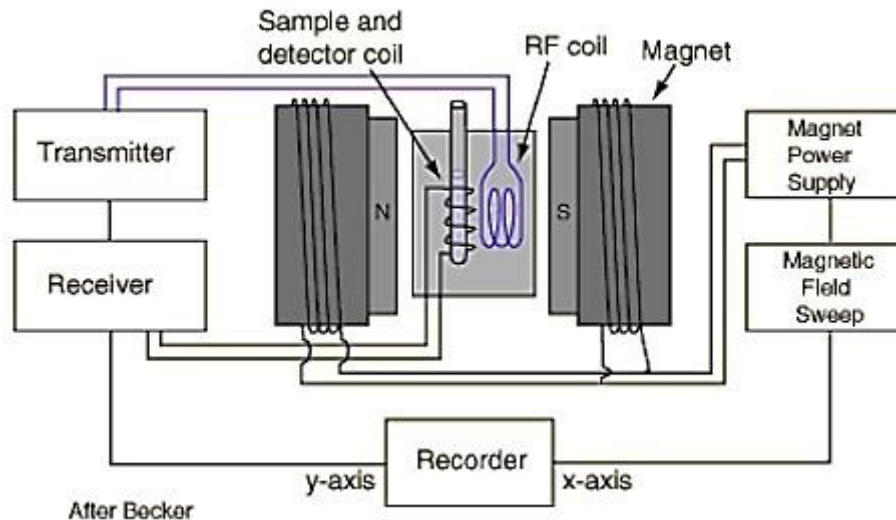
➤ The magnetic potential energy difference is $h\nu = 2\mu B$. The short table of Larmor frequencies below is from Hobbie, Ch 17 and Becker.

➤ An extensive list including the magnetic moments and Larmor frequencies of most elements can be found in Appendix A of Becker.

Particle	Spin	ω_{Larmor}/B $s^{-1}T^{-1}$	ν/B
Electron	1/2	1.7608×10^{11}	28.025 GHz/T
Proton	1/2	2.6753×10^{8}	42.5781 MHz/T
Deuteron	1	0.4107×10^{8}	6.5357 MHz/T
Neutron	1/2	1.8326×10^{8}	29.1667 MHz/T

^{25}Na	3/2	0.7076×10^{8}	11.2618 MHz/T
^{31}P	1/2	1.0829×10^{8}	17.2349 MHz/T
^{14}N	1	0.1935×10^{8}	3.08 MHz/T
^{13}C	1/2	0.6729×10^{8}	10.71 MHz/T
^{19}F	1/2	2.518×10^{8}	40.08 MHz/T

➤ The Larmor frequency of the electron spin is in the microwave region of the electromagnetic spectrum and is used in electron spin resonance.

➤ The precession of the proton spin in the magnetic field is the interaction which is used in proton NMR.

➤ As a practical technique, a sample containing protons (hydrogen nuclei) is placed in a strong magnetic field to produce partial polarization of the protons.

➤ A strong RF field is also imposed on the sample to excite some of the nuclear spins into their higher energy state.

➤ When this strong RF signal is switched off, the spins tend to return to their lower state, producing a small amount of radiation at the Larmor frequency associated with that field.

➤ The emission of radiation is associated with the "spin relaxation" of the protons from their excited state.

➤ It induces a radio frequency signal in a detector coil which is amplified to display the NMR signal.

➢ Since the Larmor frequency of the detected signal is proportional to the applied magnetic field, changing the magnitude of that field produces a different detected frequency.

➢ Placing a magnetic field gradient across a sample allows you to locate the source of the proton NMR signal in the sample. This is used to great advantage in the medical imaging process known as Magnetic Resonance Imaging.

5) Adding multimedia capabilities to the hospital computer systems enhances the level of accuracy in diagnosis. Justify. (Nov 2019, May 2014, Nov 2014,May 2017)

Hospital Information System

➢ A hospital information system (HIS) is an element of health informatics that focuses mainly on the administrational needs of hospitals.

➢ In many implementations, a HIS is a comprehensive, integrated information system designed to manage all the aspects of a hospital's operation, such as medical, administrative, financial, and legal issues and the corresponding processing of services.

➢ Hospital information system is also known as hospital management software (HMS) or hospital management system.

➢ Hospital information systems provide a common source of information about a patient's health history.

➢ The system has to keep data in a secure place and controls who can reach the data in certain circumstances.

➢ These systems enhance the ability of health care professionals to coordinate care by providing a patient's health information and visit history at the place and time that it is needed.

➢ Patient's laboratory test information also includes visual results such as X-ray, which may be reachable by professionals.

➢ HIS provide internal and external communication among health care providers. Portable devices such as smartphones and tablet computers may be used at the bedside.

➢ Hospital information systems are often composed of one or several software components with specialty-specific extensions, as well as of a large variety of sub-systems in medical specialties from a multi-vendor market.

➢ Specialized implementations name for example laboratory information system (LIS), Policy and Procedure Management System, radiology information system (RIS) or picture archiving and communication system (PACS).[citation needed]

Potential benefits of hospital information systems include

➢ Efficient and accurate administration of finance, diet of patient, engineering, and distribution of medical aid.

➢ It helps to view a broad picture of hospital growth Improved monitoring of drug usage, and study of effectiveness.

➢ This leads to the reduction of adverse drug interactions while promoting more appropriate pharmaceutical utilization. Enhances information integrity, reduces transcription errors, and reduces duplication of information entries.

➢ Hospital software is easy to use and eliminates error caused by handwriting. New technology computer systems give perfect performance to pull up information from server or cloud servers.

Assessing the Diagnostic Accuracy of Multimedia Messaging for the Diagnosis of Scaphoid Fractures

Introduction

➢ Use of smartphone messaging applications, such as WhatsApp, for communication within clinical teams is widespread.

➢ Various studies have shown multiple uses for smartphones and multimedia messaging in orthopedic clinical practice for coordinating clinical duties and diagnosing various injuries but none have assessed scaphoid fractures.

➢ Our aims were to: (1) assess diagnostic accuracy (sensitivity, specificity, positive predictive value, and negative predictive value) of viewing scaphoid X-rays on smartphones compared with desktop computers by using radiologist reports on the same X-rays as a reference test and (2) assess the intra-observer reliability of these studies.

Methods

➢ This was a prospective cross-sectional study of diagnostic accuracy using paired tests. The standard for reporting diagnostic accuracy (STARD) guidelines were used in its design.

➢ We asked orthopedic specialist registrars to interpret whether a scaphoid fracture was present on 20 scaphoid X-rays, obtained from the National Integrated Medical Imaging System (NIMIS).

➢ These were viewed on a desktop and on a smartphone. Data were then analyzed by using STATA 14 to run McNemar's test and to compare the sensitivity and specificity of the two index tests.

Results

➢ Phone and desktop interpretation had good sensitivity (72.7% and 78.2%) and specificity (75.2% and 77.9%) in assessing scaphoid fractures with no significant difference in sensitivity (p-value = 0.507) or specificity (p-value = 0.547).

➢ There was fair to moderate intra-observer reliability (kappa score 0.436; 95% confidence interval 0.295–0.577).

Discussion

➢ The fair to moderate scores of intra-observer agreement reflect the difficulty of diagnosing scaphoid fractures on X-rays.

➢ This study supports the use of smartphones for the diagnosis of scaphoid fractures.

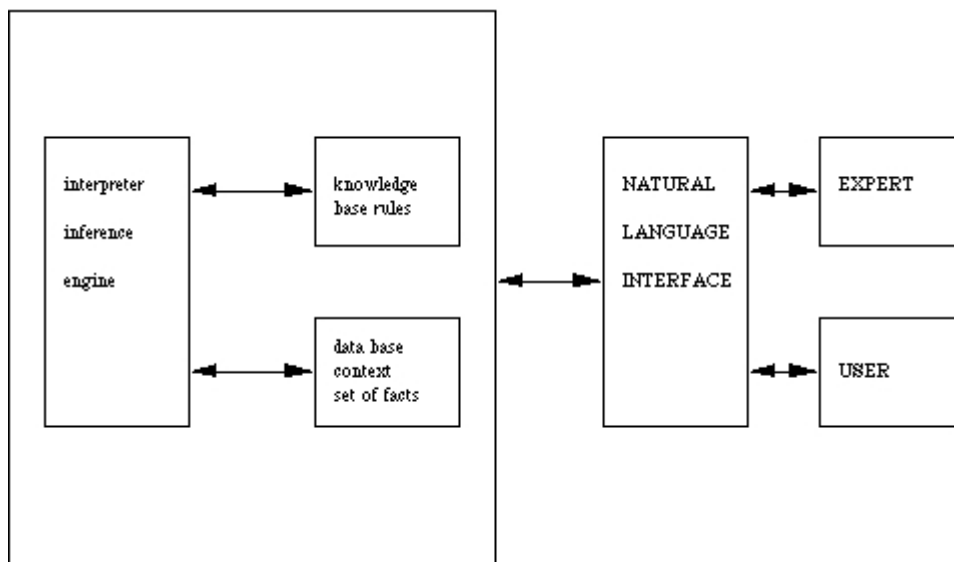**6) Describe the structure and types of expert system. (Nov 2015, May 2015, May 2016, Nov 2016,Nov 2014)**

EXPERT SYSTEMS

➢ One of the largest area of applications of artificial intelligence is in expert sytems, or knowledge based systems as they are often known.

➢ This type of system seeks to exploit the specialised skills or information held by of a group of people on specific areas.

➢ It can be thought of as a computerised consulting service. It can also be called an information guidance sytem.

➢ Such systems are used for prospecting medical diagnosis or as educational aids.

➢ They are also used in engineering and manufacture in the control of robots where they inter-relate with vision systems.

➢ The initial attempts to apply artificial intelligence to generalised problems made limited progress as we have seen but it was soon realised that more significant progress could be made if the field of interest was restricted.
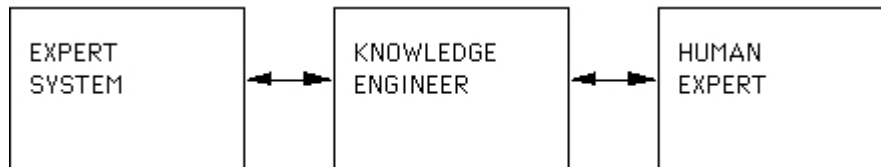
STRUCTURE

The internal structure of an expert system can be considered to consist of three parts:

➢ the knowledge base ; the database; the rule interpreter.

➢ This is analagous to the production system where we have

➢ the set of productions; the set of facts held as working memory and a rule interpreter.

➢ The knowledge base holds the set of rules of inference that are used in reasoning. Most of these systems use IF-THEN rules to represent knowledge. Typically systems can have from a few hundred to a few thousand rules.

➢ The database gives the context of the problem domain and is generally considered to be a set of useful facts. These are the facts that satisfy the condition part of the condition action rules as the IF THEN rules can be thought of.

➢ The rule interpreter is often known as an inference engine and controls the knowledge base using the set of facts to produce even more facts. Communication with the sytem is ideally provided by a natural language interface. This enables a user to interact indelendently of the expert with the intelligent system.

OPERATION OF THE SYSTEM

➢ Again there are three modes to this:

➢ the knowledge acquisition mode;

➢ the consultation mode;

➢ and the explanation mode.

➢ We shall consider each in turn.

➢ KNOWLEDGE ACQUISITION

➢ The system must liaise with people in order to gain knowledge and the people must be specialised in the appropriate area of activity. For example medical doctors, geologists or chemists. The knowledge engineer acts as an intermediary between the specialist and the expert system. Typical of the information that must be gleaned is

➢ vocabulary or jargon, general concepts and facts, problems that commonly arise, the solutions to the problems that occur and skills for solving particular problems.

➢ This process of picking the brain of an expert is a specialised form of data capture and makes use of interview techniques.

➢ The knowledge engineer is also responsible for the self consistency of the data loaded.

➢ Thus a number of specific tests have to be performed to ensure that the conclusions reached are sensible.

7) Explain the dynamic data exchange concept in detail. (November 2015, May 2016)

    Introduction

- DDE is a protocol built into Microsoft Windows that allows users to share data between applications, either on a local machine or across a Windows Network connection.

- Visual PRO/5 offers a low-level interface to this protocol.

- Visual PRO/5 programmers can write code that takes advantage of DDE as a client accessing non-Visual PRO/5 applications.

- Visual PRO/5 only supports the CF_TEXT data format.

- As the name suggests, DDE is a method for Windows applications to communicate with one another and share information in a dynamic fashion.

- It can be thought of as a conversation between two programs.

- The first program will initiate the conversation by asking a question and the second will oblige by sending the answer.

- The conversation continues until one of the applications closes the connection.

Uses of DDE

- DDE is usually used to share data between two applications, but can also be used to send commands to another application. For example, you could use DDE to allow Visual PRO/5 to get the year-to-date sales from an Excel spreadsheet.

- Another use would be the manipulation of the Windows Program Manager groups.

- DDE will allow Visual PRO/5 to create and delete groups, as well as add, delete, and modify programs within the group.

- Another possible use would involve a Visual PRO/5 application starting up Microsoft Word, running a macro, and then retrieving the pertinent information for use in the application.

- A Visual PRO/5 program can be written to act as a DDE client to any DDE server application running on any machine on the network.

- A few of the applications that support DDE under Windows are Microsoft's Word, Excel, Visual Basic, and Program Manager, as well as other programs such as JSB's Multiview.

Windows, Client, and Server

- When an application initiates the DDE process, the application is said to be the client because it requests information from another application.

- The other application is called the server because it provides its services to a DDE client.

- Despite what the name implies, a client and server communicating through DDE never talk directly to each other.

➢ Rather, they send messages to Windows, which passes the information on to the correct destination.

➢ Because of this, the world of DDE encompasses entire networks and is not limited to a single workstation.

➢ With DDE it is possible for a Windows application on one machine to send data to an application that is running on another workstation, provided that they are on the same network.

➢ Additionally, it is possible for a single application to participate in multiple DDE conversations simultaneously.

➢ This flexibility allows a Visual PRO/5 program to communicate with many other programs - both as a DDE server and as a DDE client.

Protocol

➢ As with most communications, a set of rules applies to determine how and when data is sent.

➢ These rules determine the protocol that is used to govern the exchange of data. DDE requires its own protocol to oversee the communication between applications.

➢ This protocol outlines the procedures used to start and end a DDE session, send data to another application, receive data from another application, and instruct another application to execute a macro or command.

➢ There are relatively few parameters that constitute this protocol, making DDE communications fairly elementary.

8) Describe about medical data acquisition and database system. (May 2015, Nov 2016, May 2017, Nov 2018)

Data Acquisition (DAQ)

➢ Data acquisition (commonly abbreviated as DAQ or DAS) is the process of sampling signals that measure real-world physical phenomena and converting them into a digital form that can be manipulated by a computer and software.

➢ Data Acquisition is generally accepted to be distinct from earlier forms of recording to tape recorders or paper charts.

➢ Unlike those methods, the signals are converted from the analog domain to the digital domain and then recorded to a digital medium such as ROM, flash media, or hard disk drives.

Components of Data Acquisition System

Modern digital data acquisition systems consist of four essential components that form the entire measurement chain of physics phenomena:

➢ Sensors

➢ Signal Conditioning

➢ Analog-to-Digital Converter

➢ Computer with DAQ software for signal logging and analysis

The Purposes of Data Acquisition

➢ The primary purpose of a data acquisition system is to acquire and store the data.

➢ But they are also intended to provide real-time and post-recording visualization and analysis of the data.

➢ Furthermore, most data acquisition systems have some analytical and report generation capability built-in.

➢ A recent innovation is the combination of data acquisition and control, where a high quality DAQ system is connected tightly and synchronized with a real-time control system.

➢ You can read more about this topic in the related article: "Merging Data Acquisition with a Real-Time Control System".

➢ Engineers in different applications have various requirements, of course, but these key capabilities are present in varying proportion:

● Data recording

● Data storing

● Real-time data visualization

● Post-recording data review

● Data analysis using various mathematical and statistical calculations
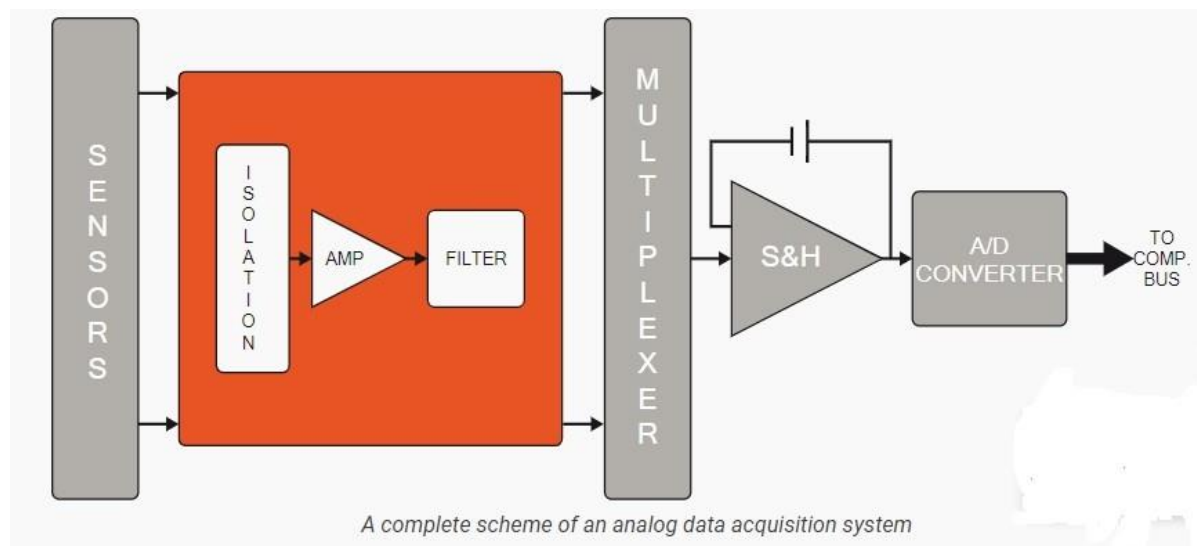
● Report generation

Importance of Data Acquisition Systems

➢ Data acquisition systems or DAQ devices are essential in the testing of products, from automobiles to medical devices - basically, any electro mechanical device that people use.

➢ Before data acquisition, products were tested in an unstructured, highly subjective manner. For example, when testing a new suspension in an automobile, engineers often relied on the opinions of test drivers as to how the suspension "felt" to them.

➢ With the invention and development of data acquisition systems, which could collect data from a wide variety of sensors, these kinds of subjective opinions were replaced with objective measurements.

➢ These could easily be repeated, compared, analyzed mathematically, and visualized in many ways

The Measurement Process

➢ Data acquisition is the process of converting real-world signals to the digital domain for display, storage, and analysis.

➢ Because physical phenomena exist in the analog domain, i.e., the physical world that we live in, they must be first measured there and then converted to the digital domain.

➢ This process is done using a variety of sensors and signal conditioners.

➢ The outputs are sampled by analog-to-digital converters (ADCs) and then written in a time-based stream to a digital memory media, as mentioned above. We usually call such systems the measurement systems.

A complete scheme of an analog data acquisition system

9) Elaborate the different automation methods employed for Histology. (Nov 2018)

➢ For the analysis of histology images (HI) in the market there is a wide range of software and hardware and software systems.

➢ They differ in functional abilities, specializations, architecture, level of automation of the process analysis.

➢ Histological image analysis systems are divided into three classes based on their purpose, type of output information and the resulting automation level:

1. image editors which provide micro objects manual selection, count their numbers, numerical attributes measurement, results statistical processing;

2. HI automated processing systems (HIAPS) which provide micro object automatic selection (classification),counting their number, numeric attributes calculation, statistical processing of results;

3. image analysis expert systems (IAES) which provide inference of the diagnosis based on the microbject features.

- Note that the means for morphometric measurements and counting objects, usually present in all systems.

- Simple editors limited features image acquisition and manual measurement of linear dimensions (ScreenMeter, Motic Images Advanced 3.2)

HISTOLOGICAL IMAGE ANALYSIS SOFTWARE CLASSIFICATION

Клас	I. Редактори	II. HIAAS	III. IAES
Images processing problems	acquisition, image pre-processing	image processing	diagnostic decisions support
Operations	microscope and camera control, background normalization, noise removal, borders detection, improving contrast	segmentation, contour analysis, texture analysis, detection of objects, images classification	image recognition, fuzzy logic reasoning, fuzzy knowledge base inference

Generalized structure of HIAAS

- Automation of processing can be achieved only through creation of high-resolution images that contain adjacent fields of view, because it is obligatory to block the creation of socalled virtual slides.

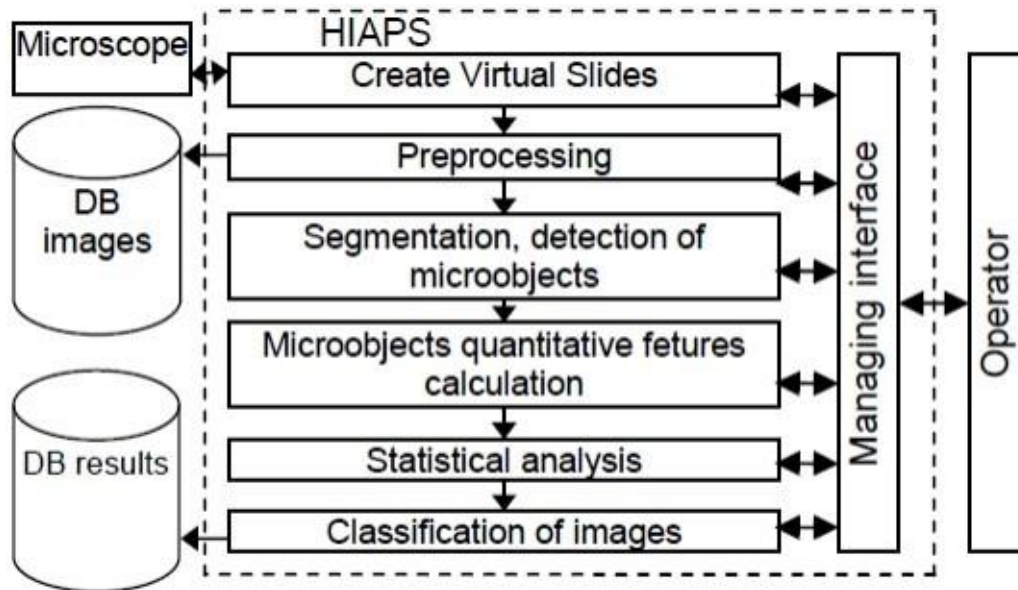- Virtual slides are created by stitching adjacent fields of view.

Fig. 1. Flow diagram of HIAAS

➢ Pre-processing block designed to eliminate noise and normalize the colour characteristics. Segmentation block and detection of microscopic intended to isolate boundaries of individual microscopic .

➢ The results of quantitative microscopic features calculating, statistical processing results and the classification of images stored in the results database.

➢ User interface can be based on interactive GUI and command-based script.

➢ Existing systems include tools for automating repetitive operations in a scripting language.

➢ This scenario is implemented textual command files (ImageJ) or visual arrangement of blocks in sequence (CellProfiler).

➢ However, existing automation systems do not allow to extend the functionality of plug-ins created by other programming languages.

➢ Actual is the development of tools that allow to combine modules built using different programming technologies.

➢ Analysis Automation The market today offers HIAAS different class and level of automation.

➢ At deserve attention system with open source software, developed by the community.

➢ Such systems are on the level of functionality and automation to compete with private pay systems.

➢ To write a software tool for testing software used IntellijIDEA environment and programming language Java.

➢ The basis of the system is taken library functions the software ImageJ.

➢ To integrate new modules developed visual means forming sequence features an image processing.

➢ Each function can be implemented as an existing plugin, Java function, dynamic library DLL .

➢ To process a sequence of functions designed shell containing conventional design and cycle.

➢ Separate function can be as independent algorithm and contain several algorithms.

➢ The advantage of the developed mechanism interpret commands it is possible to use complex Java objects as input and output parameters of the algorithms.

➢ Based on qualitative features microscopic derived conclusion about the type of malignancy based on fuzzy inference conclusion.

➢ During morphometric analysis specialist performs search of the desired object, allocation of its borders and calculating numerical attributes.

➢ We distinguish the following operations morphometric analysis: preprocessing, creating of virtual slide, expanding the depth of focus, intensity segmentation, texture segmentation, edge detection, detection of nuclei of cells cytoplasm detection, detection layers, assessment of structural changes.

➢ The level of automation morphometric studies is calculates the ratio of the number of automated spacecraft operations to the total number of transactions K:

$$P = \frac{K_A}{K} * 100\%.$$

➢ Separation of systems based on the level of automation is provided.

➢ Low level of automation processing HI is to apply operations pre-treatment's and segmentation of homogeneous regions based on intensity or color pixels.

➢ The average level achieved by applying operations segmentation based on textural features and detection cells.

➢ The high level of automation is achieved by creating virtual slide and expand the depth of focus. In a histogram of the level of automation systems counter parts.
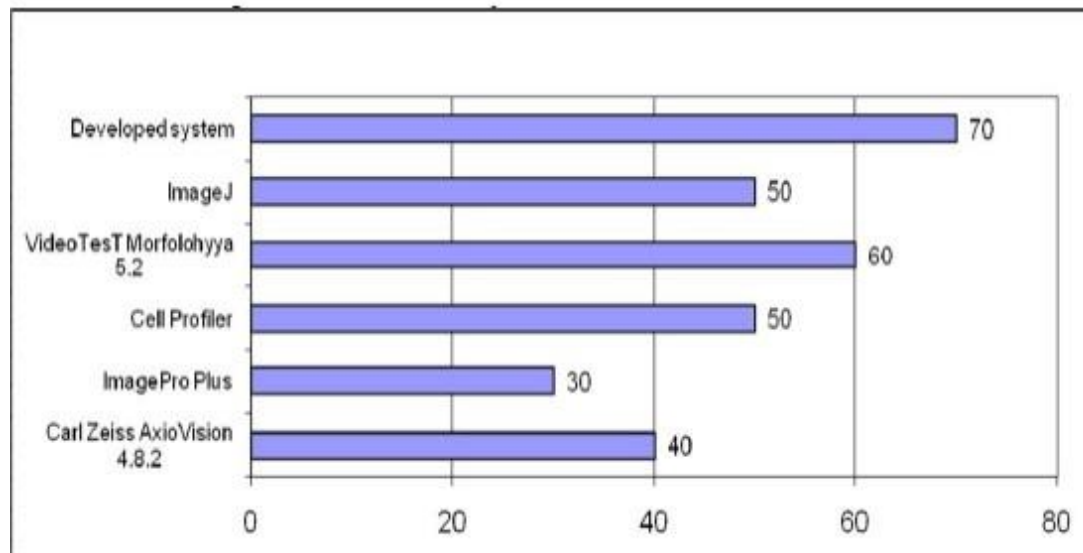
Fig. 2. The HIAPS level of automation

BM T65 – MEDICAL INFORMATICS AND EXPERT SYSTEMS

UNIT- 4

2 MARKS

1. How the Neural Networks are used in Medicine? (May 2016, Dec 2018)

❖ ANNs have been extensively applied in diagnosis, electronic signal analysis, medical image analysis and radiology.

❖ ANNs have been used by many authors for modelling in medicine and clinical research.

❖ Applications of ANNs are increasing in pharmacoepidemiology and medical data mining.

2. Define expert system. (May 2016, Dec 2017, May 2018, Sept 2020)

❖ An expert system is a computer expert that emulates the decision making ability of a human expert.

❖ Expert system, a computer program that uses artificial intelligence methods to solve complex problems within a specialized domain that ordinarily requires human expertis.

3. What are neuro computers? (May 2017)

The new neural computing paradigm, which mimics networks of biological neurons, may lead to breakthroughs in the design of computers for processing speech, vision and similar pattern recognition tasks.

4. What are the applications of ANN? (May 2017, May 2018, May 2019)

❖ Pattern Classification

❖ Clustering/Categorization

❖ Function approximation

❖ Prediction/Forecasting

❖ Optimization

❖ Content-addressable Memory

5. Write the application of computers in ICU's. (Nov 2018)

- ❖ Data management
- ❖ Closed loop system for the direct computer control of the infusions
- ❖ Computer assisted therapy
- ❖ Medical imaging

6. Define Artificial Intelligence in terms of rational acting. (May 2019)

- ❖ By acting rationally means achieving one's goals, given one's beliefs. An agent perceives and acts on those beliefs.
- ❖ In this approach, AI is viewed as the study and construction of these rational agents to implement the defined tasks.

7. What are the general components of expert system? (Dec 2019)

Components of an Expert System are:

- ❖ Knowledge Base
- ❖ Inference Engine
- ❖ User Interface

8. How production rule system helps in knowledge representation?(Dec 2019, Nov 2017)
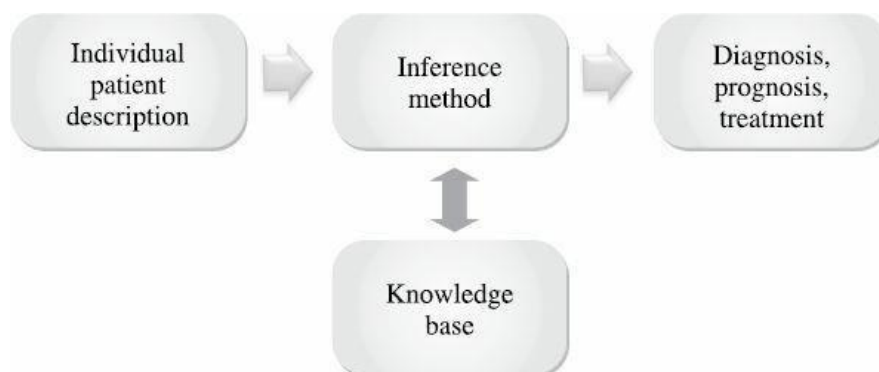
The structure of each sentence in a production system is unique and uniform as they use the "IF-THEN" structure. This structure provides simplicity in knowledge representation. This feature of the production system improves the readability of production rules.

9. What are the fundamental problems encountered in the creation of CMD system? (Sept 2020)

- ❖ Data Collection and Quality Assessment
- ❖ Developing Advanced Segmentation Approaches for Medical Imaging
- ❖ Developing Advanced Feature Extraction / Selection Approaches for Image and Signal
- ❖ Analysis
- ❖ Developing Better Classification and Other Data Mining Approaches
- ❖ Developing Standardized Performance Assessment for CAD Systems

11 MARKS

1. With neat diagram explain the general model of CMD and its various approaches to decision making.(May 2016,May 2017,Nov 2018)

❖ The large amounts of existing medical knowledge and the rapid growth of that knowledge have resulted in a situation where physicians and health scientists are unable to assimilate a significant part of the information they need to make decisions in an optimal fashion.

❖ Specialisation in the field of medicine has provided partial solutions, but this problem of "information explosion" extends across all the aspects of medical decision making, from diagnosis to treatment.

❖ Recent advancement in the field of Computer Assisted Medical Decision-Making (CMD) system might provide a solution to much of this problem.

❖ A CMD system can be defined to be an interactive computer system that directly assists physicians or other health scientists with the clinical decision-making task.

❖ Such systems are generally intended to support (not replace) the physician, thereby improving the quality (as opposed to efficiency) of medical decisions.

❖ Some of the advantages of CMD systems include their potential educational value, their use as "intelligent" interfaces to medical databases, and their role as models of the diagnostic reasoning process.

Structure of Computer Assisted Medical Decision-Making System

❖ The basic structure of the CMD system is given in Figure below. In this system, the input to a CMD system is a description of a specific case (e.g., the size and location of

a lung tumour), and the output is the useful information about that case (e.g., tumour stage, patient's prognosis).

❖ CMD system can be viewed as composed of two components: a knowledge base and an inference mechanism.

❖ The knowledge base is a collection of encoded knowledge that is needed to solve problems in some specific medical area.

❖ The inference mechanism is a program that, given a case description, uses the information in the knowledge base to reach conclusions about thatcase.

Basic structure of CMD system

Various Approaches to Computer Assisted Medical Decision-Making

There are variousapproaches to decision making which are described as follows:

Exhaustive approach: The exhaustive approach is taught to the medical student, but rarely practiced by the expert clinician except in difficult problem cases. Expert clinicians also use this approachwhen dealing with problems outside their domain.
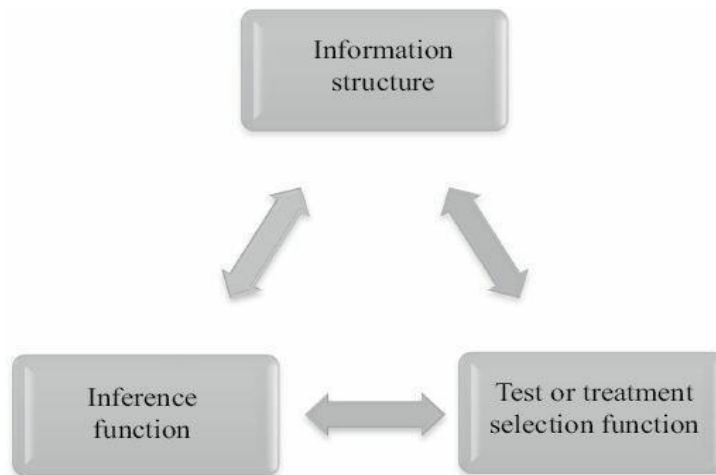
Gestalt approach: This approach utilizes an unified configuration and interpretation of data elements that cannot be derived from the sum of its parts. The semantic pattern recognition approach is closely related to that of the Gestalt.

Algorithmic or multiple branching approaches: It provides a sequential and categorical guide to decision and action. Although, the decisions made in this algorithm are deterministic, the design of algorithm may be based on probabilistic features. It provides a useful skeleton to illustrate the major features of decisions and may be used in pattern recognition.

Hypothetic-deductive approach: This approach is widely used by the expert clinician based on his or her mental model of the patho- physiological events, through which various combinations and patterns of associated findings are produced.

Development of Computer Program

The computer programs need to provide diagnostic and therapeutic strategies as depicted in Figure below:

Components of computer program

Information structure:

- ❖ It contains the information processed and obtained from different sources of the program.
- ❖ It can convert the program for use in a new problem area by reforming the information structure.
- ❖ It is application-based structure changing from one program to another.
- ❖ It consists of information about patient history along with probabilities and utilities.
- ❖ The probabilities relate with the diseases and their symptoms.
- ❖ The utility part highlights the conditions associated with a given test, the costs involved, the trained manpower for the test, the associated risks involved and so forth.

Inference function:

- ❖ The inference part of the program encompasses the reasoning process undermining the aptitude and skills of the physician.
- ❖ It employs the probabilistic inference based on Baye's theorem for obtaining the probability distribution providing the likelihood of each disease under the available evidence to date and medical experience.
- ❖ The Baye's theorem can be expressed as:

$$P(Disease \mid Findings) = \frac{P(Findings \mid Disease) * P(Disease)}{P(Findings)}$$

❖ This could be explained as; P (Disease | Findings) is the disease probability for which any system is under consideration, given the findings for a new patient.

❖ P (Findings| Disease) is the conditional probability of the findings in the disease and P (Disease) the probability of disease with frequency of disease in the population.

Test or treatment selection function:

❖ The purpose of treatment function is to select appropriate test or treatment procedure to be followed at each stage in the problem-solving process on the patient.

❖ With the probability distribution associated with the problem and the utilities of the different treatment consequences, it can determine the best available treatment, considering no further tests are to be performed.

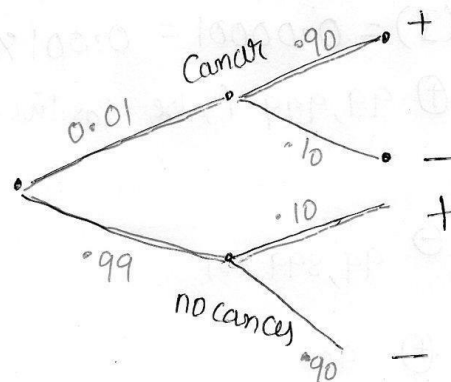Example 3: BAYES THEOREM AND TEST RESULTS FROM THE DOCTOR

$$P(A|B) = \frac{P(B|A) \cdot P(A)}{P(B)}$$

Approximately 1% of women aged 40-50 have breast Cancer. A woman with breast cancer has a 90% change of a positive from a mammogram, while a woman without has a 10% chance of a false positive result. what is the probability of woman has breast cancer given that she just had a positive test?

Solution :-

Let B = " The Woman has breast Cancer

and A = " a positive test "

$$P(cancer|+) = \frac{P(+|cancer) \cdot P(cancer)}{P(+)}$$

$$= \frac{(0.90)(0.01)}{(0.01)(0.90) + (0.99)(.10)}$$

$$\frac{\cdot 009}{0.009 + 0.099}$$

$$= \frac{0.009}{\cdot 108} = \frac{9}{108}$$

$$= 0.08\bar{3}$$

$$= 8.3\%$$

Example 4: In a medical test, it is found that the

$P(\oplus | I) = 0.9 \ (90\%)$

$P(\ominus | I) = 0.1 \ (10\%)$

$P(\oplus | H) = 0.001 \ (0.1\%)$

$P(\ominus | H) = 0.999 \ (99.9\%)$

In the population of 100 million (100,000,000) the conditional probability $P(H) = 0.99999 = 99.999\%$

$P(I) = 0.00001 = 0.001\%$

Decesion Tree :-

What is the probability of $P(I | \ominus) = ?$

$$P(I \mid \oplus) = \frac{P(\oplus \mid I) \cdot P(I)}{P(\oplus)}$$

$$= \frac{P(\oplus \mid I) \cdot P(I)}{P(\oplus \mid I) \cdot P(I) + P(\oplus \mid H) \cdot P(H)}$$

$$= \frac{900 \times 1000}{(900 \times 1000) + 99,999 \times (99,999,000)}$$

$$= \frac{900,000}{100098999} = \boxed{0.008}$$

$$\simeq 0.01$$

which is equal to 1%

Bayesian Belief Network :-

A Bayesian Belief Network (BBN) defines a various events the dependencies between them, and the conditional Probabilities involved in those dependencies.

A BBN can use this information to calculate the probabilities of various possible causes being the actual case of an event

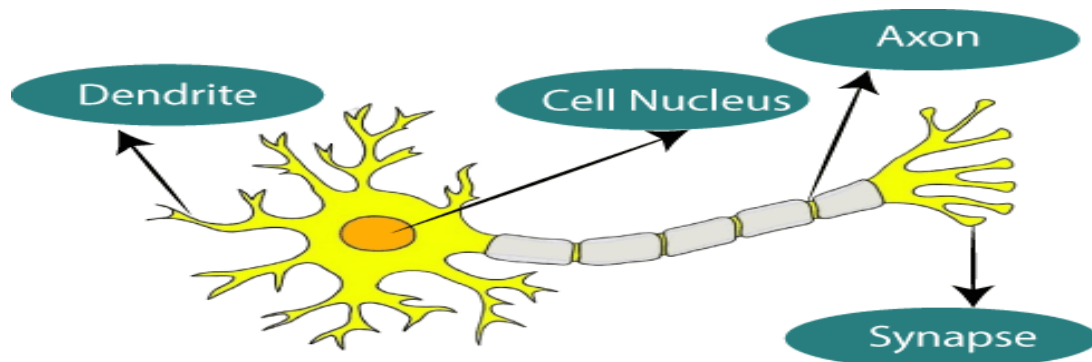**Modeling the Diagnostic and Treatment Problem**

- ❖ The CMD system could be employed as a deductive reasoning tool which is built into the hospital health care system that can augment or replace the activities or requirements of the physician in patient care.

- ❖ CMD. It can assist the physician in meaningful dialogue taking note of patient history, clinical findings, laboratory tests reports, and alerting the physician during diagnoses, and suggesting remedial treatment procedures to be followed in patient care.

- ❖ It stores huge amount of information programmed into the system to assist the physician in decision making and providing health care solutions.

- ❖ It reduces routine jobs to be carried out by the physician on daily basis and allow him to concentrate on the application of bedside skills, the management of disease, and the application of clinical knowledge and acumen for making good judgement in providing clinical care.

- ❖ The CMD system also allows non-physician personnel to assist the physician in patient care and management.

- ❖ This allows computer(s) to be used as an intellectual resource in patient diagnosis and providing treatment and may also be linked for developing

- ❖ New types of highly specialised allied health personnel performing modernised functions well beyond the scope of traditional doctors' assistants.

- ❖ These "health care specialists," supported by computerised know-how and aided by a variety of automated devices like collecting patient history, blood and laboratory test reports could be trained to perform physical examination usually undertaken by the physician, to assist him by taking over the chunk of responsibility for the delivery of primary medical care to patients visiting these centres.

- ❖ They can overcome the difficult and unsolvable problem of shortage of health care personnel in hospitals/clinics/diagnostic laboratories by providing health care and clinical services to the masses located in the remote and far-flung areas of the country with the aid of this computerised technology.

2. **Explain the principle involved in Artificial Neural Network with a diagram. How it is used in minimization? Explain with an example.(May 2016,Nov 2018,Nov 2019)**

❖ The term "Artificial neural network" refers to a biologically inspired sub-field of artificial intelligence modeled after the brain.

❖ An Artificial neural network is usually a computational network based on biological neural networks that construct the structure of the human brain.

❖ Similar to a human brain has neurons interconnected to each other; artificial neural networks also have neurons that are linked to each other in various layers of the networks. These neurons are known as nodes.
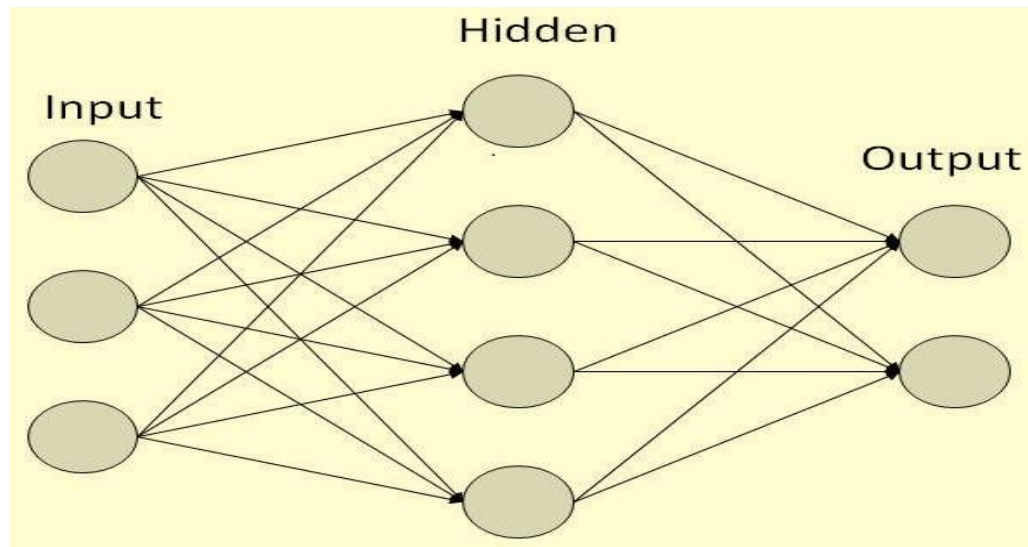
Structure of Artificial Neural Network:

❖ Generally, the working of a human brain by making the right connections is the idea behind ANNs. That was limited to use of silicon and wires as living neurons and dendrites.

❖ Here, neurons, part of human brain. That was composed of 86 billion nerve cells. Also, connected to other thousands of cells by Axons.

❖ Although, there are various inputs from sensory organs. That was accepted by dendrites.

❖ As a result, it creates electric impulses. That is used to travel through the artificial neural network. Thus, to handle the different issues, neuron sends a message to another neuron.

❖ As a result, we can say that ANNs are composed of multiple nodes. That imitates biological neurons of the human brain. Although, we connect these neurons by links. Also, they interact with each other.

❖ Although, nodes are used to take input data. Further, perform simple operations on the data. As a result, these operations are passed to other neurons. Also, output at each node is called its activation or node value.

❖ As each link is associated with weight. Also, they are capable of learning. That takes place by altering weight values.

Biological Neural Network	Artificial Neural Network
Dendrites	Inputs
Cell nucleus	Nodes
Synapse	Weights
Axon	Output

❖ We can understand the artificial neural network with an example, consider an example of a digital logic gate that takes an input and gives an output. "OR" gate, which takes two inputs. If one or both the inputs are "On," then we get "On" in output.

❖ If both the inputs are "Off," then we get "Off" in output. Here the output depends upon input. Our brain does not perform the same task. The outputs to inputs relationship keep changing because of the neurons in our brain, which are "learning."

Architecture of an artificial neural network:

Artificial Neural Network primarily consists of three layers:

Input Layer:

As the name suggests, it accepts inputs in several different formats provided by the programmer.

Hidden Layer:

The hidden layer presents in-between input and output layers. It performs all the calculations to find hidden features and patterns.

Output Layer:

The input goes through a series of transformations using the hidden layer, which finally results in output that is conveyed using this layer.

The artificial neural network takes input and computes the weighted sum of the inputs and includes a bias. This computation is represented in the form of a transfer function.
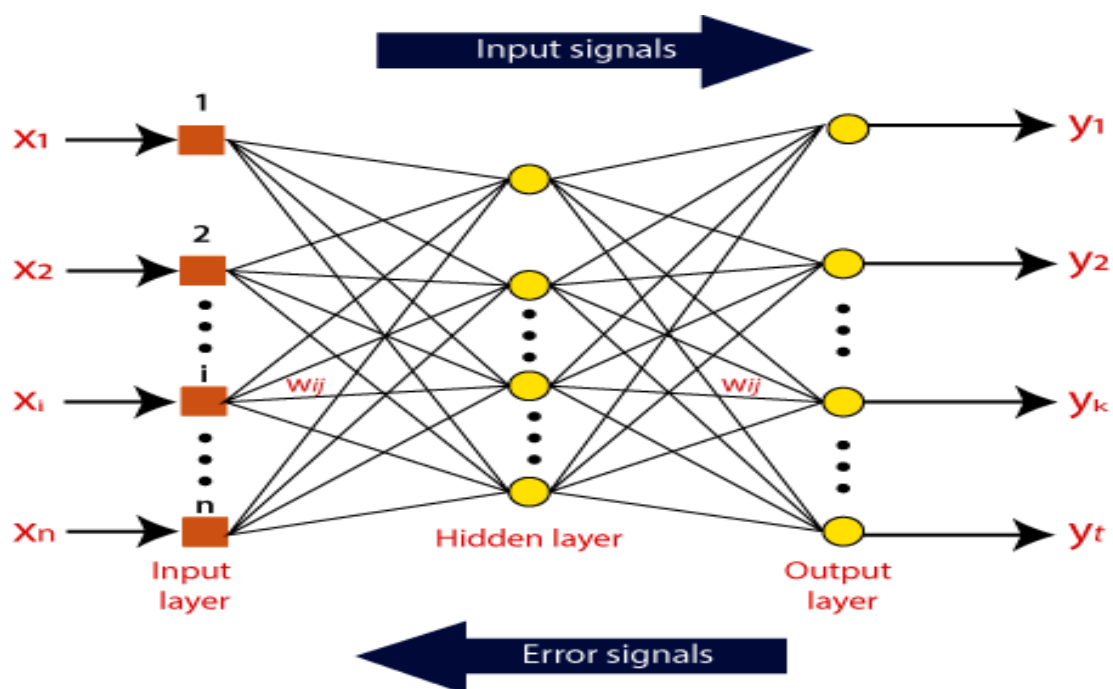
$$\sum_{i=1}^{n} Wi * Xi + b$$

It determines weighted total is passed as an input to an activation function to produce the output. Activation functions choose whether a node should fire or not. Only those who are fired make it to the output layer. There are distinctive activation functions available that can be applied upon the sort of task we are performing.

Working of ANN:

❖ Artificial Neural Network can be best represented as a weighted directed graph, where the artificial neurons form the nodes.

❖ The association between the neurons outputs and neuron inputs can be viewed as the directed edges with weights.

❖ The Artificial Neural Network receives the input signal from the external source in the form of a pattern and image in the form of a vector.

❖ These inputs are then mathematically assigned by the notations x(n) for every n number of inputs.

❖ Afterward, each of the input is multiplied by its corresponding weights (these weights are the details utilized by the artificial neural networks to solve a specific problem).

❖ In general terms, these weights normally represent the strength of the interconnection between neurons inside the artificial neural network. All the weighted inputs are summarized inside the computing unit.

❖ If the weighted sum is equal to zero, then bias is added to make the output non-zero or something else to scale up to the system's response. Bias has the same input, and weight equals to 1.

❖ Here the total of weighted inputs can be in the range of 0 to positive infinity. Here, to keep the response in the limits of the desired value, a certain maximum value is benchmarked, and the total of weighted inputs is passed through the activation function.
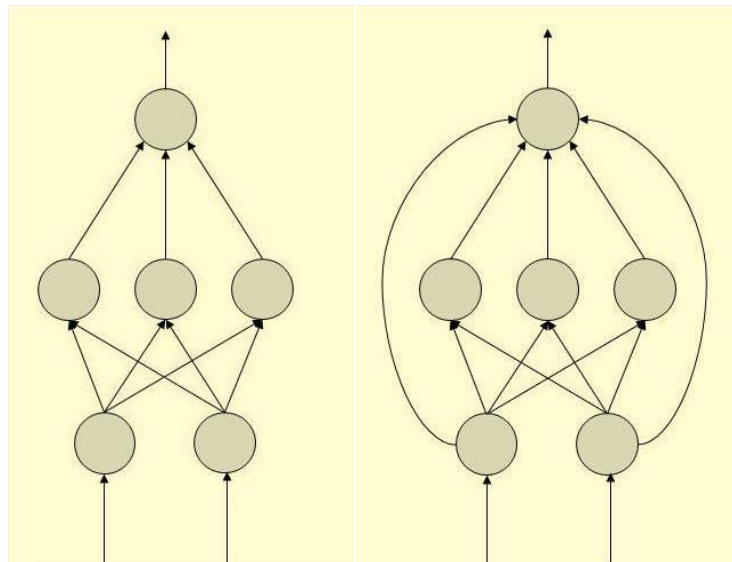

❖ The activation function refers to the set of transfer functions used to achieve the desired output.

❖ There is a different kind of the activation function, but primarily either linear or non-linear sets of functions.

❖ Some of the commonly used sets of activation functions are the Binary, linear, and Tan hyperbolic sigmoidal activation functions.

Types of Artificial Neural Network:

a. Feed-Forward ANN

In this network flow of information is unidirectional. A unit used to send information to another unit that does not receive any information. Also, no feedback loops are present in this. Although, used in recognition of a pattern. As they contain fixed inputs and outputs.

Feed-forward ANN   **Feedback ANN**

b. Feedback ANN:

In this type of ANN, the output returns into the network to accomplish the best-evolved results internally. The feedback networks feed information back into itself and are well suited to solve optimization issues. The Internal system error corrections utilize feedback ANNs.

Learning:

- ❖ Learn the connection weights from a set of training examples
- ❖ Different network architectures required different learning algorithms

Supervised Learning

- ❖ The network is provided with a correct answer (output) for every input pattern.
- ❖ Weights are determined to allow the network to produce answers as close as possible to the known correct answers T
- ❖ The back-propagation algorithm belongs into this category.

Unsupervised Learning

❖ Does not require a correct answer associated with each input pattern in the training set.

❖ Explores the underlying structure in the data, or correlations between patterns in the data, and organizes patterns into categories from these correlations.

❖ The Kohonen algorithm belongs into this category

Hybrid Learning

❖ Comnines supervised and unsupervised learning.

❖ Part of the weights are determined through supervised learning and the others are obtained through a unsupervised learning.

3. Write in brief about back propagation approach and learning vector quantization. (May 2019)

❖ A neural network is a group of connected I/O units where each connection has a weight associated with its computer programs.

❖ It helps you to build predictive models from large databases. This model builds upon the human nervous system.

❖ It helps you to conduct image understanding, human learning, computer speech, etc.

BACK PROPAGATION:

❖ Back-propagation is the essence of neural net training.

❖ It is the method of fine-tuning the weights of a neural net based on the error rate obtained in the previous epoch (i.e., iteration).

❖ Proper tuning of the weights allows you to reduce error rates and to make the model reliable by increasing its generalization.

❖ The back-propagation algorithm used in supervised learning.

❖ Back-propagation is a short form for "backward propagation of errors." It is a standard method of training artificial neural networks.

❖ This method helps to calculate the gradient of a loss function with respects to all the weights in the network.
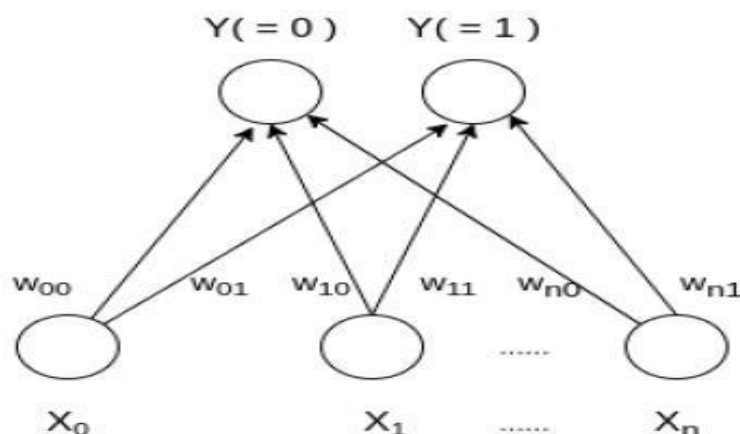
Types of Back-propagation Networks

● Static Back-propagation

● Recurrent Back-propagation

Advantages of Back-propagation are:

- Back-propagation is fast, simple and easy to program.

- It has no parameters to tune apart from the numbers of input.

- It is a flexible method as it does not require prior knowledge about the network.

- It is a standard method that generally works well.

- It does not need any special mention of the features of the function to be learned.

Disadvantages of using Back-propagation:

- The actual performance of back-propagation on a specific problem is dependent on the input data.

❖ Back-propagation can be quite sensitive to noisy data.

❖ You need to use the matrix-based approach for back-propagation instead of mini-batch.

❖ Learning Vector Quantization (or LVQ) is a type of Artificial Neural Network which also inspired by biological models of neural systems.

❖ It is based on prototype supervised learning classification algorithm and trained its network through a competitive learning algorithm similar to Self Organizing Map.

❖ It can also deal with the multiclass classification problem. LVQ has two layers, one is the Input layer and the other one is the Output layer.

❖ The architecture of the Learning Vector Quantization with the number of classes in an input data and n number of input features for any sample is given below:

❖ Let say an input data of size (m, n) where m is number of training example and n is the number of features in each example and a label vector of size (m, 1).

❖ First, it initializes the weights of size (n, c) from the first c number of training samples with different labels and should be discarded from all training samples.

❖ Here, c is the number of classes. Then iterate over the remaining input data, for each training example, it updates the winning vector (weight vector with the shortest distance (e.g Euclidean distance) from training example).
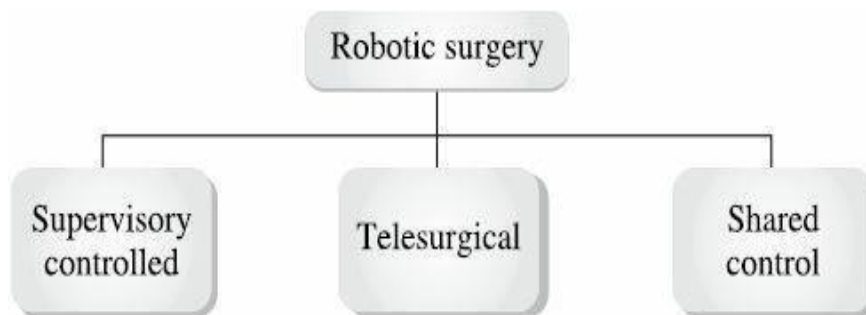
4. Explain the designing of computer assisted surgery with an example. (May 2017, May 2019)

❖ As the technological interventions are advancing, robotic devices and complex imaging modalities are revolutionising the medical field. The age of minimally invasive surgery is encompassing many common procedures which were inexistence before the introduction of robotic devices in order to perform different surgical procedures with ease and efficiency, such as gall bladder excisions.

❖ The process of robotic surgery avoids long and deep incisions by entering the body through small (usually, about   1 cm) cuts, through which sophisticated instruments are employed by surgeons to operate on problematic tissue within the body.

❖ Endoscopes (to visualise objects) instead of robots are generally used while guiding these operations. However, computer-assisted and robotic surgeries are categorised under minimally invasive surgical procedures.

❖ In preoperative planning and registration processes, the computer assisted and robotic surgeries have many similarities.

❖ Before employing robotic surgery procedures on the patient, the computer simulation tools are employed by the surgeon to run a practice demo session.

❖ Hence, there is a close linkup between these two categories, thereby creating confusion among people for their interchangeable use. However, the main difference here lies in the intra-operative phase of the procedure as robotic surgeries may use a large degree of computer assistance, whereas computer-assisted surgeries do not employ robots.

❖ Image-guided surgery or Computer- assisted Surgery (CAS) isa3-D surgical intervention and navigation tool that uses computer-based technologies, such as 3- D imaging and real-time sensing in the planning, execution and follow-up of the surgical procedures.

❖ Targeting and visualization of surgical sites is improved by it with improved diagnostic it another conventional techniques. Robotic surgery employs a surgical robot, on the other hand, with or without the involvement of a surgeon during the procedure.

❖ A robot may be defined as a computerised system with a motorised construction (usually, an arm) capable of interacting with its environment. In order to provide feedback data on the robot's present situation it employs sensors, which provide feedback data on the present situation of the robot.

❖ In order to process this information a system is employed so that the subsequent action can be determined. The ease of accuracy and ability to repeat similar tasks are the major advantages of the robotic surgery over computer-assisted surgery.

Types of Robotic Surgery

❖ The robotic surgery can be divided into following three sub-categories on the basis of the degree of surgeon interaction and involvement during the procedure as: supervisory-controlled, tele-surgical and shared-control.

Types of robotic surgery

Supervisory-controlled system:

❖ A robot which has been trained and supervised by the surgeon is used for performing the surgical procedure prior to performing the surgical task.

❖ Direct involvement of the surgeon during the procedure does not happen however, his presence is indispensable as he is involved in the planning of the procedure and overall supervision of the operation.

❖ In order to perform the supervisory controlled surgical procedure immense planning, gathering of large number of images from different angles, time consuming tasks of programming the robot and high expenses are involved.

Telesurgical system:

❖ The tele surgical or remote surgical procedure involves the manoeuvring of robotic arms by the surgeon, if the surgery is performed from a remote location.

❖ The program is not predetermined as it is employed in supervisory controlled systems and works as pre-determined surgical procedure.

❖ The surgeon is able to operate from a remote location with the use of sensory data provided by the robot employing real-time image feedback.

❖ As the robot is technically performing the procedure, so it is considered as sub-group of robotic surgery.

Shared control system:

❖ The involvement of surgeon is unavoidable during the procedure.

❖ A robot with steady- hand manipulations of the surgeon with precise localised interventions of the instrument is used in the shared control system. Both the entities work closely and mutually perform the task in order to give good results.

Steps in Robotic Surgery

❖ Robotic surgery requires the use of high- end computer imaging to diagnose and perform the operation before any surgical procedure can be carried out.

❖ By using Computed Tomography(CT) and Magnetic Resonance Imaging (MRI) the imaging modalities can produce 3-D images. 2-D images can be produced by utilising Ultrasonography (US), fluoroscopy, and X-ray radiography. Out of all these methods, CT is used widely.

❖ In order to obtain cross-sectional images of the organs, the CT scans employ back projection technique and detectors. While diagnosing cancers or viewing the chest and abdomen, these images are particularly useful and critical to diagnosis.

❖ In order to precisely locate possible pathologies or disease, these images are used and the surgeon is provided with high level of accuracy and precision in controlling the instruments around healthy tissues in order to reduce injury level to them to as minimum as possible.

❖ This also improves patient time of recovery and obtaining full functionality. Three steps are planning, registration and navigation, as depicted in Figure below must be performed before this procedure can be carried out.

Steps before robotic surgery

❖ Planning is achieved by careful observation of the images generated through the different imaging modalities.

❖ This information is utilized to determine surgical pathways and methodologies for performing the procedure by the surgeon.

❖ Following this is the registration where the surgeon must coordinate these image data with the actual patient profile.

❖ Once this is achieved, a surgeon or robot can implement the navigation step. Now, the surgeon can manually guide instruments through the patient(computer-assisted)orroboticarmstocarryoutthesurgicaltasks using sensor feedback.

❖ The decision to employ either robotic or manual navigation depends on the cost, effectiveness, safety concerns, difficulty of execution, and other factors. These variables are changing, however, with the advent of cheaper robotic production methods and added safety features the use of robots in surgical tasks would increase in near future.

Aadvantages of Robotic Surgery

❖ Good geometric accuracy

❖ Reliable for stable and untiring use

❖ Robots can be designed for wide range of scales

❖ Resistance from any radiation and infection

❖ Robots can use diverse sensors(chemical, acoustic,etc.) in control

Disadvantages of Robotic Surgery

❖ Poor judgement ability of the robot

❖ Limited dexterity and hand-eye coordination

❖ Limited to comparatively simple procedures

❖ Highly expensive to use and deploy

❖ Prone to system faults and difficult to debug a robot

5. Explain in detail about the structure and working of medical expert system. (Sept 2020, Nov 2019)

❖ A medical   expert is a highly skilled individual with advanced training and knowledge in a particular field.

❖ An expert serves as a consultant to provide knowhow in a particular area of expertise. However, it is difficult for an expert to provide adequate time for all consultations or be available all times for consultation.

❖ To overcome this problem, a computerised expert system having skills of a human expert could be employed.

❖ However, computer expert system can perform the patient's history, but it is quite poor at interpersonal skills like physical examination and invasive complex procedure.

❖ There use is still recommended as these systems provide superb intellectual skills as it processes information to create knowledge   and also this   information can be used to organise knowledge to produce differential diagnosis to recommend testing procedure and treatment.

❖ Expert medical computer systems are classification systems based upon a measure of how close the findings from a patient (signs, symptoms, and lab tests) are to a diagnosis, and a general form of expert system is shown in Figure below:

So, overall expert system is defined as "a set of programs that manipulate encoded knowledge to solve problems in a specialized domain (engineering, law, chemistry, finance, biology) that normally require human expertise". It is a subset of artificial intelligence.

Features of Expert System:

❖   Use knowledge instead of databases to provide solution.

❖   Knowledge is encoded and kept as a separate entity not complied with system program.

❖   It is self-explanatory as it explains the user about the decision made and helps him to understand the system, thereby increasing his confidence in the system further.

❖   It provides symbolic representations for knowledge (rules/frames) as it performs computations symbolically.

Difference between Human Expert Problem Solving and Expert System Problem Solving:

An expert system is needed because of two reasons: either to replace or to help an expert.

Factors	Expert system	Human expert
• Cost	• Intermediate	• High
• Speed	• Consistent	• Changes
• Time	• Anytime	• Working days
• Damage	• No damages	• Yes liable
• Safety	• Can be replaced	• Cannot be replaced
• Geography	• Anywhere	• Local

Figure shows comparison between expert system and that of human expert.

Basic Working of Expert System:

Any expert system is primarily made up of three major components or parts as shown in Figure below :

1. **User interface:** The user interface formulates a query or a question from the user to the expert system, to seek advice or guidance based on the available medical knowledge stored in the system. It is important to have a user-friendly interface while designing this component and it should be quite simple and easy to use for promoting its widespread use in the organisation as well as globally.
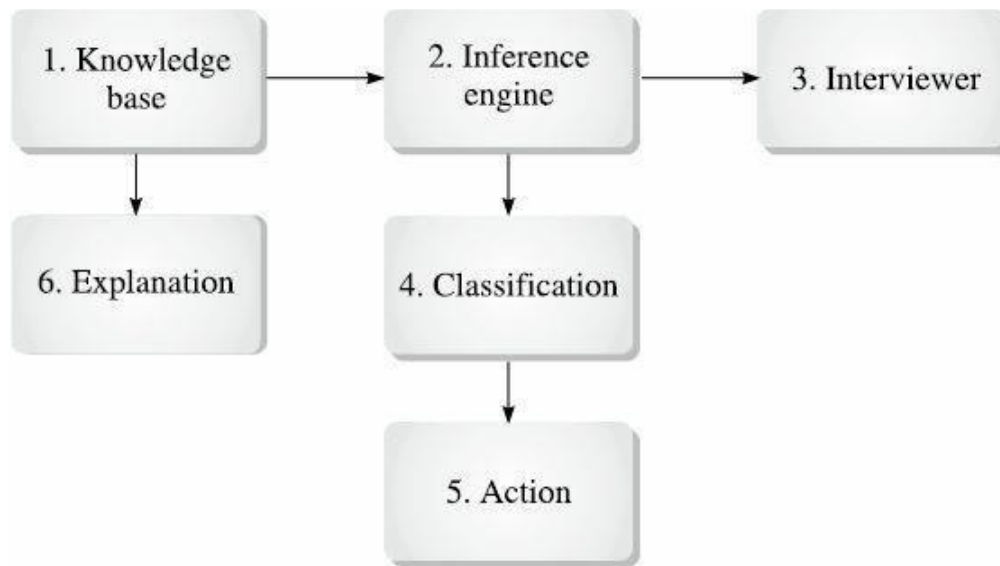
2. **Knowledge base:** It is one of the most important and crucial component of any expert system based on the collection of relevant rules and facts. The knowledge base is created over a period of time from the information collected from experts in the field and from analysis of the data collected from the user(s) of the expert system over a period of time.

3. **Inference engine:** The inference engine is the heart of any expert system and acts as a search engine.   It examines the knowledge base for information to   match the   user's query or specific problem provided. The inference engine applies analytical and logical reasoning techniques to examine or search the knowledge base to provide relevant and suitable answers to user's query.

In any expert system, the non-expert user questions the expert system to find possible solution to a stated problem area. This is examined by the expert system and available information searched by the inference engine from the system's knowledge base to find meaningful and relevant solutions to answer the query of the user or provide guidance/advice.

<u>**Components of Expert System:**</u>

The different components of an expert system are depicted in the block diagram.

Flow of Information in Expert System

Expert system consists of three major sections:

❖ Expert system, user interface and user (Figure below). Firstly,

❖ Findings are gathered from patient via doctor, then these findings passes through user interface where individual patient description is built and is further fed to expert system section,

❖ Where knowledge base consisting of various facts and heuristics, act to resolve problems and the inferring mechanism is carried out by inference engine and finally useful information about the patient is obtained.

❖ This information from expert is then provided to the doctor; which further implies onto patient and in turn receives queries from patient that are further discussed through same chain of process.

Characteristics of Expert System:

The expert system has   the   following characteristics:

- Domain specific
- Need based programming languages
- User based interactive system

- Ability to filter knowledge and meaningful information
- Makes logical inference with available knowledge
- Provide justification
- Cheap alternative to human expert

Applications of expert system:

Following are the applications of expert system;

- Electrolyte and acid-base disorder
- Determination of drug dosage

Disadvantages of expert system:

- Most medical problems cannot be handled through precise quantitative formulae.
- These systems do not involve probabilities information.
- They do not provide relative probabilities of one disease to another.
- They do not   provide information about multiple diseases present at the same time.

6. Discuss in detail about the production rule system in computer-assisted decision support system. (May 2018)

Expert knowledge is often represented in the form of rules or as data within the computer. So, depending upon the problem requirement, these rules and data can be recalled to solve problems.

Rule- based system progresses from:

- Algorithm-based system
- Production rule system
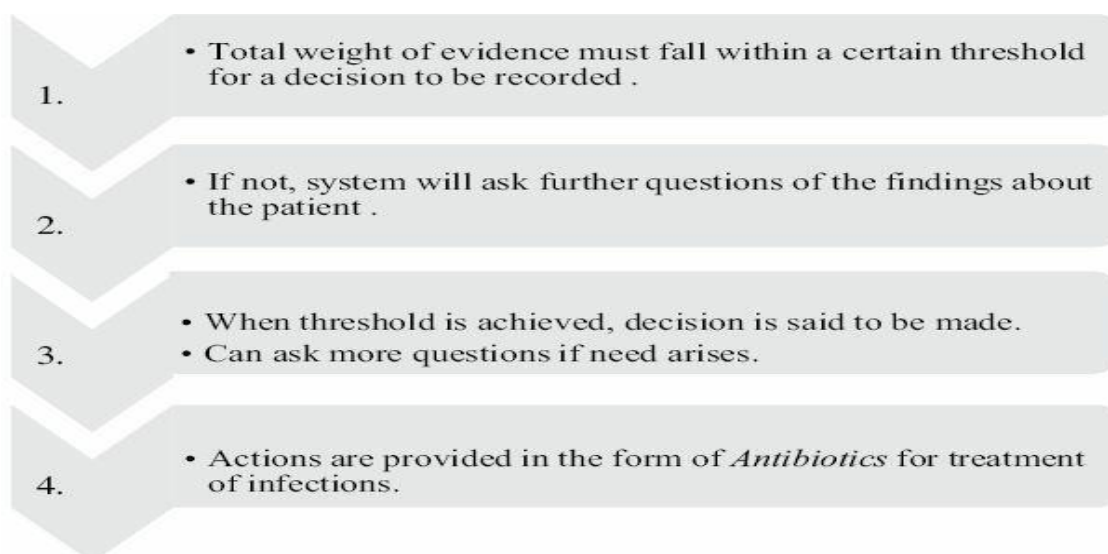- Frame-based systems
- Semantic network systems

Production rule, frame and semantic network systems have been referred to as artificial intelligence systems.

Algorithm-based systems:

❖ An Algorithm is a fixed step of all instructions on how to accomplish some tasks.

❖ These are essentially computerised protocols. These protocols are fixed, i.e., binary answers are offered as YES or NO.

❖ Knowledge base is encoded in mathematical formulas and in branching logic of the program statements and inferences are generated by simply executing the statements in the program.

❖ It is used successfully when the path physiology is clearly understood and categorical decisions can be made based upon reliable laboratory information.

❖ For e.g, in oncology, protocols involve procedures for selection of patients, treatment regimen, dose modification, study parameters and evaluating criteria of response.

Production rule system:

❖ These systems are based upon "production rules".

❖ Each of these rules has a premise and an action (if statement, then action statement).

❖ MYCIN is a well-known production rule system applied to the area of infectious diseases.

❖ A typical rule would be as follows:

1. • Total weight of evidence must fall within a certain threshold for a decision to be recorded .

2. • If not, system will ask further questions of the findings about the patient .

3. • When threshold is achieved, decision is said to be made.
   • Can ask more questions if need arises.

4. • Actions are provided in the form of *Antibiotics* for treatment of infections.

IF:

- ❖ The infection is a primary bacteria.
- ❖ The site of the culture is one of the sterile sites.
- ❖ The suspected portal entry of the organism is the gastrointestinal tract.

THEN:

- ❖ There is suggestive evidence (0.7) that the identity of the organism is bacteroides.
- ❖ The number used to indicate the strength of a rule (0.7) is termed as certainty factor.
- ❖ Advantages of production rule system:
- ❖ Following are the advantages of production rule system:
- ❖ The storage of knowledge is independent of rules, thus rules can be easily added or removed.
- ❖ Knowledge acquisition by the system   is simplified with the addition of rules without considering prior rule organisation.
- ❖ Explanation of the rules used for an inference offers semantic advantage, but is not unique.

The disadvantages of production rule system:

- ❖ Rules do not organise diagnostic information.
- ❖ There is difficulty in managing all the necessary rules, applications and antecedent clauses.
- ❖ Expressing medical problem solving knowledge as a set can be fairly a difficult task.
- ❖ Collection of rules does not seem to be a good organisation of diagnostic knowledge as it is intuitively known to the physician and found in books.

Frame-based system:

- ❖ It is a production rule system, but information is stored in terms of packet.
- ❖ Frames are structured sets of closely related knowledge, such as an object or concept name.
- ❖ The frame system is packet oriented with pieces of knowledge being stored about a disease category. All these packets can be assembled /compiled to give a proper picture.

❖ Frame-based model allows for weights to be applied at each node in the decision process in order to conduct its search for diagnosing a medical condition.
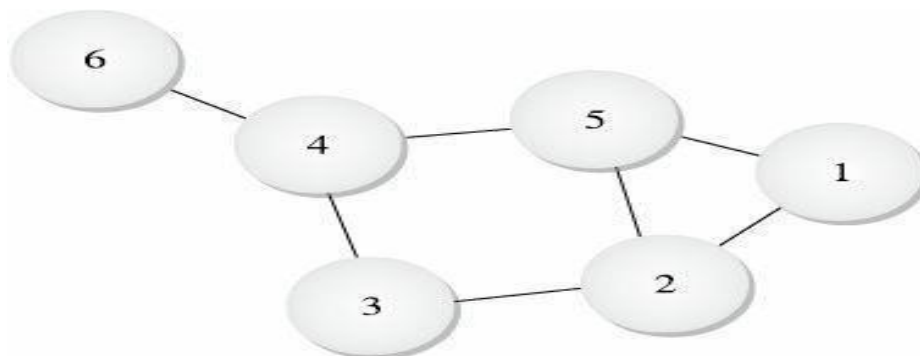

Semantic network system:

❖ It is a system of allotting weights to feature values and using a counting rule search procedure to come to a decision as shown in Figure below.

❖ It creates a master differential diagnosis when the findings about a patient are presented. It then tests the differential diagnosis depending on the scores of the weights.

This system is trained with weights called:

- Evoking strength: How strongly the diagnosis is to be considered, given the 6
- Frequency: How often a patient with disease will have the similar findings.
- Importance: How important is the manifestation for the disease.

❖ The system uses rules of search called pursuing rules, rule out rules and discriminating rules.

❖ It allows for the activation of interconnected subsystems in order to find complex classes (more than a single disease present at the same time in the patient).

❖ Rule-based expert system interacts iteratively with the semantic network as indicated in Figure.

Role of Expert System

Interactive System: Expert system directly helps doctors or healthcare professionals with clinical decision making.

Support: Expert system supports doctors to make judgements.

Potential: Expert system creates an encouraging potential for education values.

Interface: Expert system creates intelligent interfaces to medical databases.

Merits of Expert System

❖ Organization of physician's knowledge of diseases.

❖ Facilitate real time, low cost expert level decisions by the non-expert.

❖ Ability to compose and collect records for later retrieval.

❖ Make complex inferences about new patient record based on past knowledge and experience.

❖ Multidimensionality and sensitivity to laboratory tests.

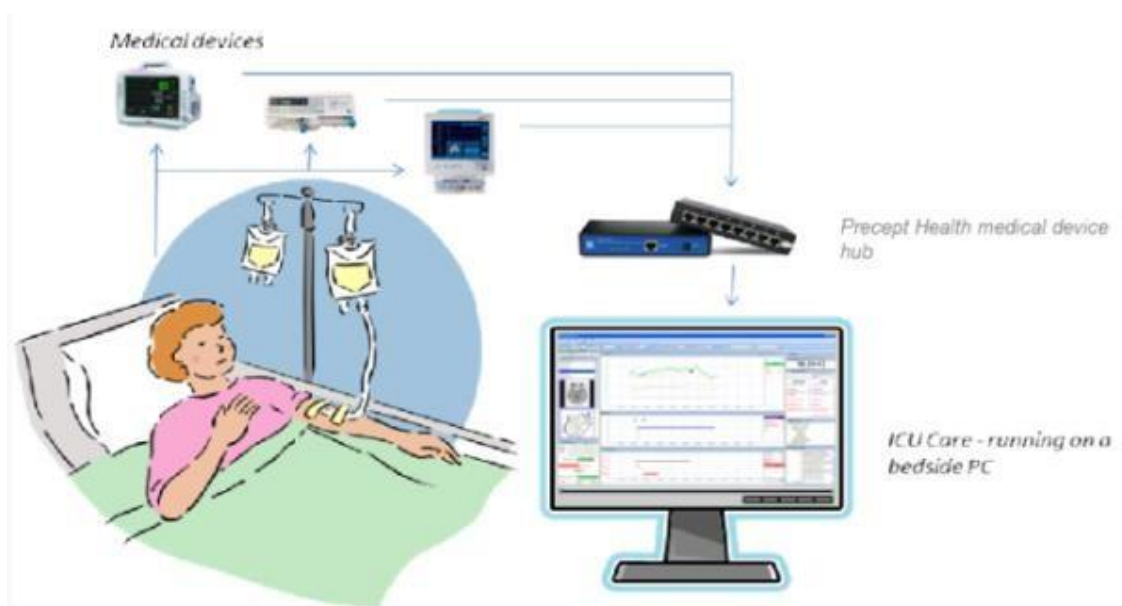❖ Enhance the utilisation of the entire available data.

Limitations of Expert System

❖ Expert system is not capable of performing physical examinations or medical biopsy.

❖ Extensive time taken to obtainconsultations.

7. Describe the role of computers in the care of critically ill patients. (May 2018)

Role of Computers in a Critical Care Unit (CCU):

ICU Care:

❖ Precept Health ICU Care is a critical care information system for Intensive Care Units (adult, neonatal, paediatric, and specialty intensive care).

❖ It is a domain specific, modular based unit management and point of care information system.

❖ The system delivers operational efficiencies as well as meeting ICUs' strategic needs to drive research based improvements.

❖ The system is a proprietary software and hardware solution.

❖ In relation to software, the system provides a platform for ICUs to manage clinical, administrative, and unit staff activities.

❖ ICU Care also comes with a suite of specialised ICU clinical tools, reports, and query tools and uses responsive service oriented architecture.

❖ In relation to hardware, the solution uses Precept Health's proprietary medical device integrator which collects, standardises and concentrates data from multiple medical devices (pumps, monitors, ventilators etc) and feeds this to our software for display and analysis.

❖ The ability to manage and link clinical, administrative and staff activities is unique.

❖ It gives the ability to draw inferences and performance trends of an ICU as a business unit.

❖ At the Patient Bedside ICU Care runs as a bedside point of care system. Clinicians use ICU Care to manage their clinical workflow and care plan for patients.

❖ The diagram below illustrates how ICU Care is used at the patient bedside.

❖ In a typical ICU environment, a patient has a range of medical devices at their bedside. These include patient monitors, pumps, and ventilators and so on.
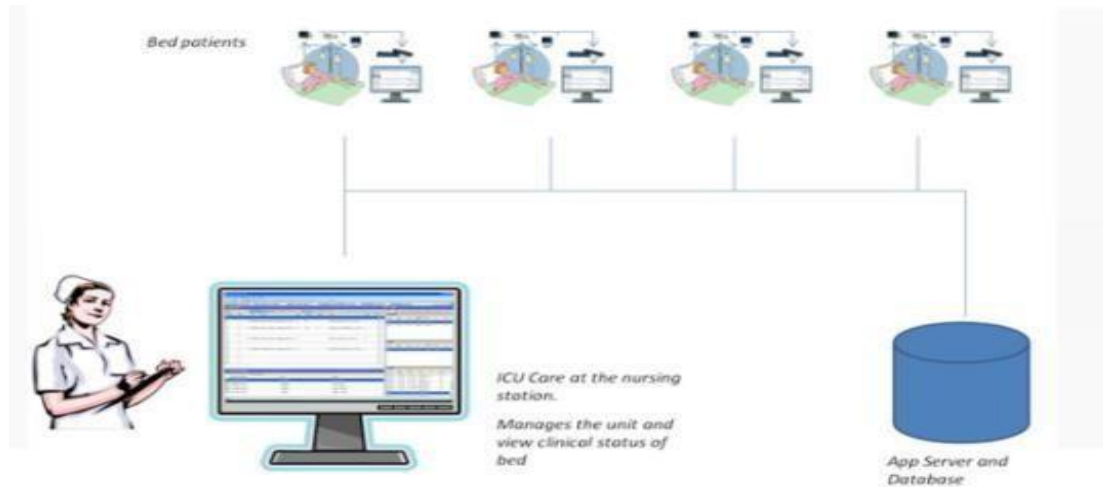
❖   First, we collect, standardise, and concentrate this data via our proprietary medical device hub (black/blue box in the diagram).

❖   Concentrated data is fed into our ICU Care software application which is running on a standard personal computer by the patient bedside.

❖   The computer displays clinical charting and clinical records for the patient. This replaces the traditional paper charts.

❖   The application is flexible enough to allow clinicians to look at patients' clinical charting and records from a different bay.

At the Nurse Station:

❖ A typical configuration has one bedside ICU Care per bed and one ICU Care at the nursing station.

❖ All stations are linked to a centralised application server and database.

❖ All data (clinical and management) can be viewed at any workstation running ICU Care located within the ICU, subject to individual login and authorisation settings.

❖ The ICU Care at the nurse station is primarily for administration purposes.

❖ That is, to handle patient admission, discharge, managing unit activities and other similar functions.

❖ In practice, this computer will show the "whiteboard" view most of the time, which manages unit activities, bed placement etc.

Integration with Other Systems:

ICU Care interfaces with other systems such as hospital information systems and PACs systems via industry standard HL7 messaging to provide seamless access of patient clinical records.

 Meaningful Data Collection:

❖ Precept Health ICU Care combines clinical, management, and staff performance management/roster functionalities into one system.

❖   Data collected in one area is intrinsically linked to other areas thereby allowing users to draw inferences and gain added insights to improve unit/ward performance overtime.

❖ This is the cornerstone of our database design.

ICU Care can be used for:

❖ Matching staff skills with patient clinical needs. This takes the guess work out of assigning appropriate staff to patients.

❖ Managing staff performance and training requirements/milestones; by clinical tasks, complexity and other parameters.

❖ Justifying resource needs and additional staffing.

❖ Cost control and analysis, and other functions.

8. What is cognitive model? Explain the principle involved in it? List the advantages. (Nov 2017)

❖ The cognitive model describes how people's thoughts and perceptions influence their lives.

❖ Often, distress can distort people's perceptions, and that, in turn, can lead to unhealthy emotions and behaviors.

❖ CBT helps individuals learn to identify and evaluate their "automatic thoughts" and shift their thinking to be healthier.

❖ The cognitive model is at the core of CBT, and it plays a critical role in helping therapists use gentle Socratic questioning to develop treatments.

❖ Cognitive learning is an active style of learning that focuses on helping you learn how to maximize your brain's potential. It makes it easier for you to connect new information with existing ideas hence deepening your memory and retention capacity.

❖ The ability of the brain's mental processes to absorb and retain information through experience, senses, and thought is known as cognition.

❖ There is a young branch of psychology known as cognitive psychology. It is the study of one's internal processes. These are the things going on in your brain, such as thinking, attention, learning, problem-solving, perception, among others.

Components of Cognitive Learning

❖ Traditional learning mainly focuses on memorization instead of trying to achieve mastery in a particular subject.

The following are fundamental aspects of cognitive learning:

1. Comprehension

For cognitive learning to be efficient and benefit you, understand the reason why you are learning a specific subject in the first place.

2. Memory

Cognitive learning discourages cramming of information, which is very ineffective in education. Having a deep understanding of a subject improves your ability to relate new knowledge with previous experiences or information.

3. Application

Cognitive learning strategies help you apply new information or skills in life situations. They encourage you as you continue to develop problem-solving skills.

Cognitive Learning Theory

❖ Caused on changes that take place in the internal cognitive structure. You can read more Cognitive learning theory explains how internal and external factors influence an individual's mental processes to supplement learning.

❖ Delays and difficulties in learning are seen when cognitive processes are not working regularly. These processes are such as attention, observation, retrieval from long-term memory, and categorization.

❖ Several researchers have made significant contributions to this theory. Jerome Bruner focused on how mental processes are linked to teaching

❖ Another researcher by the name Jean Piaget recognized that the environment plays a huge role and also foe about Piaget's theory of cognitive development in our previous article.

❖ Today, cognitive learning theory is dominant in psychology. It is broken down into two categories.

Social Cognitive Theory

❖ This theory helps us understand how people are influenced and their influence onthe environment.

❖ One of the major components of social cognitive theory is observational learning. It is the process of learning others' desirable and undesirable behaviors through observation.

❖ It is a quick way of acquiring information when you individually take action. A person who demonstrates behavior for another person is known as a model.

❖ These may be real people such as teachers, our peers, and supervisors, or symbolic models, also known as fictional characters that influence an observer's behavior.

❖ Observational learning teaches people both positive and negative behaviors.

❖ For example, a manager within a company can teach the employees how they are supposed to behave ethically and be socially conscious when interacting and dealing with rude customers.

❖ Moreover, the manager can also train his/her employees on the different procedures that they can take in case of fire or other low probability hazardous scenarios.

Cognitive Behavioral Theory

❖ This theory mainly refers to our mental processes, such as our thoughts and interpretations of life events.

❖ It explains how the thoughts, feelings, and behavior of a person interact with each other. Thoughts lead to particular emotions, which in turn lead to specific behavioral responses.

❖ When we change our thoughts, we can change our emotions and then our behaviors. It also works in reverse where changing how we behave leads to changes in our feelings and, ultimately, our thoughts.

❖ Let's take an example of a developer who encounters a problem in a particular sphere and automatically believes that the task is difficult for him/her right away. The employee is automatically likely to have a negative attitude towards this particular task, and his performance will likely be poor.

Benefits of Cognitive Learning

The following are the major positive effects of cognitive learning

1. Enhances learning

Cognitive learning theory enhances lifelong learning. Workers can build upon previous ideas and apply new concepts to already existing knowledge.

2. Boosts confidence

Employees become more confident in approaching tasks as they get a deeper understanding of new topics and learn new skills.

3. Enhances Comprehension

Cognitive learning improves learners' comprehension of acquiring new information. They can develop a deeper understanding of new learning materials.

4. Improves problem-solving skills

Cognitive learning equips employees with the skills they need to learn effectively. They are thereby able to develop problem-solving skills they can apply under challenging tasks.

5. Help learn new things faster

Through the experience of learning, the employee will be able to recycle and use the same learning methods that worked previously. This will help them learn new things a lot faster as they already know what works for them when it comes to obtaining new knowledge.

6. Teaches to form concept formation (think abstract)

Cognitive learning can also teach your employees to form a range of different concepts such as easily perceiving and interpreting information that could boostcreativity and lead to innovations at the workplace.

Cognitive Learning Strategies

Several psychologists have shaped the concept of cognitive learning through research. They came up with theories and learning strategies that can be implemented in a corporate learning environment.

Learner-centered strategy

❖ Jean Piaget termed learning as relating information to already existing knowledge. And each learner starts with their own knowledge and experience.

❖ According to his theories, learning begins with the accumulation of some basic knowledge and advancing deeper into the field with time.

Piaget suggested three vital components of learning:

• Accommodation - taking new information into account by modifying what we already know.

- Assimilation - the arrangement of new knowledge inside our heads beside what we know.

- Equilibration - balancing what we already know with the new information that we are trying to acquire

Each company should develop their training programs with a personalized learning approach to make it engaging for their employees to achieve better results.

To achieve that L&D professionals should focus on the following points:

- Develop and introduce their programs based on already existing knowledge.

- Provide more analogies to connect new knowledge with already existing knowledge.

- Divide learning materials into stages and maintain a logical flow of lessons taught.

- Provide examples or practical tasks that show how new information or

- principles can connect with previous knowledge, or enhance it.

- Encourage questions and comments from trainees.

Cognitive models provide several advantages over statistical models:

(1) They provide falsifiable descriptions of the cognitive process underlying behavioral responses in a specific task;

(2) Model parameters can be interpreted in an objective and formally described manner

9. **Explain the methodology involved in decision analysis in clinical medicine. How it is computerized? (Nov 2017)**

❖ A clinical decision support system (CDSS) is a health information technology system that is designed to provide physicians and other health professionals with clinical decision support (CDS), that is, assistance with clinical decision-making tasks.

❖ A working definition has been proposed by Robert Hayward of the Centre for Health Evidence: "Clinical decision support systems link health observations with health knowledge to influence health choices by clinicians for improved health care". CDSSs constitute a major topic in artificial intelligence in medicine.

❖ A clinical decision support system has been defined as an "active knowledge systems, which use two or more items of patient data to generate case-specific advice."

❖ This implies that a CDSS is simply a decision support system that is focused on using knowledge management in such a way so as to achieve clinical advice for patient care based on multiple items of patient data.

Purpose

❖ The main purpose of modern CDSS is to assist clinicians at the point of care. This means that clinicians interact with a CDSS to help to analyse, and reach a diagnosis based on, patient data.

❖ In the early days, CDSSs were conceived of as being used to literally make decisions for the clinician.

❖ The clinician would input the information and wait for the CDSS to output the "right" choice and the clinician would simply act on that output.

❖ The modern methodology of using CDSSs to assist means that the clinician interacts with the CDSS, utilizing both their own knowledge and the CDSS, to make a better analysis of the patient's data than either human or CDSS could make on their own. Typically, a CDSS makes suggestions for the clinician to look through, and the clinician is expected to pick out useful information from the presented results and discount erroneous CDSS suggestions.

The two main types of CDSS are knowledge-based and non-knowledge-based :

❖ An example of how a clinical decision support system might be used by a clinician is a diagnosis decision support system.

❖ A DDSS requests some of the patients data and in response, proposes a set of appropriate diagnoses.

❖ The physician then takes the output of the DDSS and determines which diagnoses might be relevant and which are not,and if necessary orders further tests to narrow down the diagnosis.

❖ Another example of a CDSS would be a case-based reasoning (CBR) system.

❖ A CBR system might use previous case data to help determine the appropriate amount of beams and the optimal beam angles for use in radiotherapy for brain cancer patients; medical physicists and oncologists would then review the recommended treatment plan to determine its viability.

❖ Another important classification of a CDSS is based on the timing of its use.

❖ Physicians use these systems at point of care to help them as they are dealing with a patient, with the timing of use being either pre-diagnosis, during diagnosis, or post diagnosis.

❖ [citation needed] Pre-diagnosis CDSS systems are used to help the physician prepare the diagnoses.

❖ CDSS used during diagnosis help review and filter the physician's preliminary diagnostic choices to improve their final results.

❖ Post-diagnosis CDSS systems are used to mine data to derive connections between patients and their past medical history and clinical research to predict future events. it has been claimed that decision support will begin to replace clinicians in common tasks in the future.

❖ Another approach, used by the National Health Service in England, is to use a DDSS (either, in the past, operated by the patient, or, today, by a phone operative who is not medically-trained) to triage medical conditions out of hours by suggesting a suitable next step to the patient (e.g. call an ambulance, or see a general practitioner on the next working day).

❖ The suggestion, which may be disregarded by either the patient or the phone operative if common sense or caution suggests otherwise, is based on the known information and an implicit conclusion about what the worst-case diagnosis is likely to be; it is not always revealed to the patient, because it might well be incorrect and is not based

on a medically-trained person's opinion - it is only used for initial triage purposes.[citation needed]

Knowledge-based CDSS

❖ Most CDSSs consist of three parts: the knowledge base, an inference engine, and a mechanism to communicate.

❖ The knowledge base contains the rules and associations of compiled data which most often take the form of IF-THEN rules.

❖ If this was a system for determining drug interactions, then a rule might be that IF drug X is taken AND drug Y is taken THEN alert user.

❖ Using another interface, an advanced user could edit the knowledge base to keep it up to date with new drugs.

❖ The inference engine combines the rules from the knowledge base with the patient's data.

❖ The communication mechanism allows the system to show the results to the user as well as have input into the system.

❖ An expression language such as GELLO or CQL (Clinical Quality Language) is needed for expressing knowledge artifacts in a computable manner.

❖ For example: if a patient has diabetes mellitus, and if the last hemoglobin A1c test result was less than 7%, recommend re-testing if it has been over 6 months, but if the last test result was greater than or equal to 7%, then recommend re-testing if it has been over 3 months.

❖ The current focus of the HL7 CDS WG is to build on the Clinical Quality Language (CQL).CMS has announced that it plans to use CQL for the specification of eCQMs.

Non-knowledge-based CDSS

CDSSs which do not use a knowledge base use a form of artificial intelligence called machine learning, which allow computers to learn from past experiences and/or find patterns in clinical data.

❖ This eliminates the need for writing rules and for expert input.

❖ However, since systems based on machine learning cannot explain the reasons for their conclusions, most clinicians do not use them directly for diagnoses, for reliability and accountability reasons.

❖ Nevertheless, they can be useful as post-diagnostic systems, for suggesting patterns for clinicians to look into in more depth.

❖ The three types of non-knowledge-based systems are support-vector machines, artificial neural networks and genetic algorithms.

❖ Artificial neural networks use nodes and weighted connections between them to analyse the patterns found in patient data to derive associations between symptoms and a diagnosis.

❖ Genetic algorithms are based on simplified evolutionary processes using directed selection to achieve optimal CDSS results.

❖ The selection algorithms evaluate components of random sets of solutions to a problem.

❖ The solutions that come out on top are then recombined and mutated and run through the process again.

❖ This happens over and over until the proper solution is discovered. They are functionally similar to neural networks in that they are also "black boxes" that attempt to derive knowledge from patient data.

❖ Non-knowledge-based networks often focus on a narrow list of symptoms, such as symptoms for a single disease, as opposed to the knowledge based approach which cover the diagnosis of many different diseases.

BM T65 - MEDICAL INFORMATICS AND EXPERT SYSTEMS

UNIT - V

2 MARKS

1. Give the functional design of hospital information system?(May 2014)

A Hospital Information System (HIS) basically is a synonym for information management system at use in hospitals. Hospitals generate a wealth of data round the clock, 365 days a year, all of which needs to be well managed to ensure efficient functioning.

2. What are the elements of decision analysis?(May 2014)

The three major elements of a decision that cause decision making to be troublesome are the creative generation of options; the identification and quantification of multiple conflicting criteria, as well as time and risk preference; and the assessment and analysis of uncertainty associated with the causal linkage.

3. Define bio medical informatics? (Nov 2014, Nov 2017)

Biomedical informatics (BMI) is the interdisciplinary field that studies and pursues the effective uses of **biomedical** data, information, and knowledge for scientific inquiry, problem solving, and decision making, motivated by efforts to improve human health.

4. What is markov model? (Nov 2014, Nov 2015)

Analytical structures that represent key elements of a disease

• Useful for diseases in which events may occur repeatedly over time

• Synthesizes data on costs, effects, and

HRQOL life of alternative clinical strategies

• Calculates life expectancy or quality adjusted life expectancy

Simple Markov Model

Time

t   Well   Sick   Dead

t+1   Well   Sick   Dead

5. Give the application of speech recognition system? (May 2015)

Speech recognition technologies such as Alexa, Cortana, Google Assistant and Siri are changing the way people interact with their devices, homes, cars, and jobs. The technology allows us to talk to a computer or device that interprets what we're saying in order to respond to our question or command.

6. What are the application of artificial intelligence? (May 2015)

Artificial Intelligence Applications

AI in E-Commerce. Personalized Shopping .

AI in Navigation. Based on research from MIT, GPS technology can provide users with accurate, timely, and detailed information to improve safety.

AI in Robotics.

AI in Human Resource.

AI in Healthcare.

AI in Agriculture.

AI in Gaming.

AI in Automobiles.

7. Define pattern recognition? (Nov 2015,May 2018)

Pattern recognition is the automated recognition of patterns and regularities in data. It has applications in statistical data analysis, signal processing, image analysis,

information retrieval, bioinformatics, data compression, computer graphics and machine learning.

8. Name some of the components of virtual reality? (May 2016)

5 Important Elements of Virtual Reality (VR)

1: Viewing System.

2: Tracking System.

3: Interactivity Element.

4: Artistic Inclination.

5: Sensory Management System.

9. Give the use of fuzzy logic in medicine? (Nov 2016)

Fuzzy logic are used in Natural language processing and various intensive applications in Artificial Intelligence. Fuzzy logic are extensively used in modern control systems such as expert systems. Fuzzy Logic is used with Neural Networks as it mimics how a person would make decisions, only much faster.

10. List the application of Pattern Recognition? (Nov 2016)

Pattern recognition is used to extract meaningful features from given image/video samples and is used in computer vision for various applications like biological and biomedical imaging. Pattern recognition approach is used for the discovery, imaging and interpretation of temporal patterns in seismic array recordings.

11. What is Artificial intelligence? (May 2016)

Artificial intelligence (AI) refers to the simulation of human intelligence in machines that are programmed to think like humans and mimic their actions. The term may also be applied to any machine that exhibits traits associated with a human mind such as learning and problem-solving.

12. Define telesurgery? (May 2017)

Remote surgery (also known as telesurgery) is the ability for a doctor to perform surgery on a patient even though they are not physically in the same location. It is a form of telepresence.

13. Distinguish HL7 and DICOM application? (Nov 2018)

HL7 is often customized on-site, while DICOM is much more rigid. HL7 files are somewhat larger in size because of character-based encoding, which implies conversion of pixel data to characters. MPPS, the DICOM protocol can provide more timely and precise information about performed diagnostic studies.

14. What is surgical simulation ?(May 2017,May 2019, Nov 2018)

A surgery simulator is computer technology developed to simulate surgical procedures for the purpose of training medical professionals, without the need of a patient, cadaver or animal.

15. Street the principles of VR how it is used in medical fields?(Nov 2017,May 2018)

VR technology can be used to generate visual images to check the patient's specific conditions, such as using CAT scans or ultrasound diagnostic images to generate 3D models of patient anatomy. In addition, VR technology can also be used to recover patients.

16. What are the application of virtual reality in medicine ?(May 2019,Sep 2020)

VR is used effectively for better surgical technique. It creates detailed virtual models of a patient's anatomy. It helps physicians to effectively move around and view virtual 3D images from different angles. This technology is currently applied in cardiology and Neurology for monitoring and improves patient outcomes.

17. Write a short note on robotic?(Nov 2019)

A robot is a machine—especially one programmable by a computer— capable of carrying out a complex series of actions automatically. Robots can be guided by an external control device or the control may be embedded within.

18. Give the basic components of virtual reality components applied to the clinical side.(Dec 2019)

virtual reality systems consist of the computer and software—known as the reality engine—input sensors, and output sensors. The input sensors are the equipment to computer enthusiasts, and include the keyboard, mouse, knobs, and joysticks.

19. Write the disadvantage of framed stereotatic surgery? (Sep 2020)

The apparent dissociation between stereotactic accuracy and clinical outcome may be due to the inability to visualize the motor thalamus on preoperative imaging (i.e. superimposed anatomical variability) and the relatively large size of the motor thalamus that makes it more lenient to inaccuracies of targeting.

11 MARKS

1. Write a detail note on markov model decision system.(May 2014,Nov 2015,May 2015,Nov 2016)

- Markov models are useful when a decision problem involves risk that is continuous over time, when the timing of events is important, and when important events may happen more than once.
- Representing such clinical settings with conventional decision trees is difficult and may require unrealistic simplifying assumptions.
- Markov models assume that a patient is always in one of a finite number of discrete health states, called Markov states.
- All events are represented as transitions from one state to another.
- A Markov model may be evaluated by matrix algebra, as a cohort simulation, or as a Monte Carlo simulation.
- A newer representation of Markov models, the Markov-cycle tree, uses a tree representation of clinical events and may be evaluated either as a cohort simulation or as a Monte Carlo simulation.

- The ability of the Markov model to represent repetitive events and the time dependence of both probabilities and utilities allows for more accurate representation of clinical settings that involve these issues.

- Healthcare costs are increasing, as are the proportions of elderly people.

- This means that the care of geriatric patients is becoming an increasingly important problem, requiring careful planning and urgent attention.

- Old people are heavy users of hospital care largely because most people now live to die in old age.

- Using the Oxford Record Linkage study, have shown that "generally, hospital admissions either occurred in the years immediately before death and increased in the final year of life or were confined to that last year".

- With increasing longevity, old people, with their multiple medical, social and psychological problems, will inevitably place increasing demands on the health care system.

- An intelligent model-based approach to the planning of healthcare, based on large-scale data routinely collected, is essential to facilitate understanding of the whole process and develop a holistic method for costing and performance measurement of hospital use.

- Healthcare planning should therefore include ways of predicting patient numbers and future costs of geriatric services, otherwise policies may lead to an improvement in hospital care in the short-term with a subsequent build-up of patient numbers and costs at future time points.

- For example, patients who are not sufficiently rehabilitated at the proper time may end up becoming long-stay and block beds that could be better utilised for acute care.

- In previous work we have developed a model of patient flows within a hospital, where patients are initially admitted to an acute or rehabilitative state from which they are either discharged or die or are converted to a long-stay state .

- Long-stay patients are discharged or die at a slower rate.

- Patients may be thought of as progressing through stages of acute care, rehabilitation and long-stay care where most patients are eventually rehabilitated and discharged.

- Thus an acute phase may be relatively quick, lasting for days or possibly weeks.

- A long-stay phase, on the other hand, may involve patients remaining in hospital for months, or even years.

- These patients may be very consuming of resources and thereby distort the performance statistics and cost implications.

- The use of a Markov reward model to cost the movements of patients within a hospital department. Initially we assume a constant number of beds in the department.

- This corresponds to a situation where there is a waiting list of patients so that the total number of in-patients remains at a constant level and all admissions are from the waiting list.

- Costs are assigned according to the state the patient has reached, where state here corresponds to different phases of care and recovery.

- Thus by assigning differential costs to the different states of the model, we may estimate the costs involved in treating people with a range of health and social problems.

- Using local estimates of transition rates and costings, hospital planners may thus identify cost-effective strategies.

- In addition we develop a Markov model to determine patient numbers and costs at any time where, again, there is a waiting list, so admissions are taken from this list, but we now allow a fixed growth in the number of beds available, which declines to zero as time tends to infinity.

- The model we consider is a k-state discrete time Markov model, or phase type model, with costs associated with each time unit spent by each individual in each grade.

- Admissions to the system occur to each state to replace discharges, and we assume that the initial numbers of patients in each state

2. **Explain in detail about hospital management system?(May 2014, May 2016,May 2015)**

Hospital Management System (HMS):

Hospital management system is a computer system that helps manage the information related to health care and aids in the job completion of health care providers effectively. They manage the data related to all departments of healthcare such as,

- Clinical
- Financial
- Laboratory

- Inpatient

- Outpatient

- Operation theater

- Materials

- Nursing

- Pharmaceutical

- Radiology

- Pathology etc.

HMS came into the picture of hospital management as early as 1960 and have ever since been evolving and synchronizing with the technologies while modernizing healthcare facilities. In today's world, the management of healthcare starts from the hands of the patients through their mobile phones and facilitates the needs of the patient.

HMS important for a hospital

HMS was introduced to solve the complications coming from managing all the paper works of every patient associated with the various departments of hospitalization with confidentiality. HMS provides the ability to manage all the paperwork in one place, reducing the work of staff in arranging and analyzing the paperwork of the patients. HMS does many works like:

- Maintain the medical records of the patient

- Maintain the contact details of the patient

- Keep track of the appointment dates

- Save the insurance information for later reference

- Tracking the bill payments.

The advantages of HMS can be pinpointed to the following:

- Time-saving Technology

- Improved Efficiency by avoiding human errors

- Reduces scope for Error

- Data security and correct data retrieval made possible

- Cost effective and easily manageable
- Easy access to patient data with correct patient history
- Improved patient care made possible
- Easy monitoring of supplies in inventory
- Reduces the work of documentation
- Better Audit controls and policy compliance.

Features of Hospital Management System:

Appointment Management

For hospitals having their own site, appointment widgets will be integrated onto the site. Patients visiting the hospital's website can book online appointments with ease.

Billing Management

Integrated Billing with treatments, Lab and Radiology. Alerts will be sent on Discount Authorisation. Automatic due capture, Option to bill before and after consultation.

Prescription Management

Manage commonly and recently used medicines. Option to show medicines available in the pharmacy. SMS prescriptions to Patients.

Discharge Summary

Template based Discharge Summary. ICD10 integration. Option to prevent discharge summary till IP bill is closed.

Operation Theatre Management

Automatic notification can be sent to customers on test results. Lab notifications like email, SMS of the test reports sent from the Automated Lab notification module.

Pharmacy Management

Comprehensive Pharmacy Management handles stock, Prescription Integration, Ward Request, Stock Management, Stock Moment and intelligent reports.

Lab Management

Comprehensive Lab Management handles complete order management, Custom Reports, Smart Notifications, Credit Settlement, detailed MIS Reports, Analytics and App for Phlebotomist.

Master Information Systems

Lets you access entire MIS data from your palm.

Manage Multiple Locations

Any number of branches can be added and managed using a single account.

Benefits of Hospital Management System:

We have so far clarified on the importance of HMS, it is your responsibility to pick out the right kind of HMS for your needs and purposes. Here we give more information on the benefits of various HMS and the impact it creates on hospital systems.

Easy Patient data retrieval:

HMS makes it possible to access all the data related to a patient via a system by the means of a few simple clicks. Information like patient history, current illness, doctors involved, tests reports taken, billing information and many more can be made visible to the user. These data will help to connect the dots about the patient, like specific diagnosis, related treatment, and medication.

The Electronic Medical Record (EMR) or Electronic Health Record (EHR):

This electronic-based medical record system can be viewed as a patient's health chart. It retrieves information based on the patient's name or medical record number or the physician's record number.

Increased Data security:

The patient data can be kept a hundred percent safe by using HMS in your hospital. It can be made accessible by only a limited amount of authorized personnel. With HMS, all the data is stored on a server or cloud and kept safe by just securing the login information safe.

Improve Visibility and Transparency:

Hospital Management System (HMS) improves the visibility and transparency in the complete management process and in all records.

Streamline Accurate Reporting:

It helps in streamlining the accurate reporting with the help of updated and accurate records.

Improved Quality Control:

Hospital Management System improves the quality control on the products and services of the hospital.

Improved Management Visibility:

It also improves the management visibility of hospital, all information, and data regarding the patient, doctor and medicine could be seen by any department easily.

Ease to Access System Facilities:

Hospital Management System makes it easy to get access to the management system facilities for the authorized users and keep it safe from unauthorized users.

Cost Effective:
- HMS not only saves time in the hospital but also is cost-effective in decreasing the number of people working on the system of manual entry of data and paperwork.
- The implementation of His will decrease the human intervention into the system thereby avoiding human-caused errors.
- Every hospital has different needs, analyze what is best for your requirement and install the apt HMS system.

3. **Write in detail about the bayesian belief network?(Nov 2014,Nov 2016)**
- **Bayesian Belief Network** is a graphical representation of different probabilistic relationships among random variables in a particular set.
- It is a classifier with no dependency on attributes i.e it is condition independent.
- Due to its feature of joint probability, the probability in Bayesian Belief Network is derived, based on a condition — P(attribute/parent) i.e probability of an attribute, true over parent attribute.
- Probabilistic models can define relationships between variables and be used to calculate probabilities.

- For example, fully conditional models may require an enormous amount of data to cover all possible cases, and probabilities may be intractable to calculate in practice. Simplifying assumptions such as the conditional independence of all random variables can be effective, such as in the case of Naive Bayes, although it is a drastically simplifying step.

- An alternative is to develop a model that preserves known conditional dependence between random variables and conditional independence in all other cases.

- Bayesian networks are a probabilistic graphical model that explicitly capture the known conditional dependence with directed edges in a graph model.

- All missing connections define the conditional independencies in the model.

- As such Bayesian Networks provide a useful tool to visualize the probabilistic model for a domain, review all of the relationships between the random variables, and reason about causal probabilities for scenarios given available evidence.

- Bayesian networks are a type of probabilistic graphical model comprised of nodes and directed edges.

- Bayesian network models capture both conditionally dependent and conditionally independent relationships between random variables.

- Models can be prepared by experts or learned from data, then used for inference to estimate the probabilities for causal or subsequent events.

- Divided into five parts; they are:

    1.   Challenge of Probabilistic Modeling
    2.   Bayesian Belief Network as a Probabilistic Model
    3.   How to Develop and Use a Bayesian Network
    4.   Example of a Bayesian Network
    5.   Bayesian Networks in Python

Challenge of Probabilistic Modeling

- Probabilistic models can be challenging to design and use.
- Most often, the problem is the lack of information about the domain required to fully specify the conditional dependence between random variables.
- If available, calculating the full conditional probability for an event can be impractical.
- A common approach to addressing this challenge is to add some simplifying assumptions, such as assuming that all random variables in the model are conditionally independent.

- This is a drastic assumption, although it proves useful in practice, providing the basis for the Naive Bayes classification algorithm.
- An alternative approach is to develop a probabilistic model of a problem with some conditional independence assumptions.
- This provides an intermediate approach between a fully conditional model and a fully conditionally independent model.
- Bayesian belief networks are one example of a probabilistic model where some variables are conditionally independent.

Bayesian Belief Networks

- A Bayesian Belief Network, or simply "Bayesian Network," provides a simple way of applying Bayes Theorem to complex problems.
- The networks are not exactly Bayesian by definition, although given that both the probability distributions for the random variables (nodes) and the relationships between the random variables (edges) are specified subjectively, the model can be thought to capture the "belief" about a complex domain.
- Bayesian probability is the study of subjective probabilities or belief in an outcome, compared to the frequentist approach where probabilities are based purely on the past occurrence of the event.

- A Bayesian Network captures the joint probabilities of the events represented by the model.

To Develop and Use a Bayesian Network

Designing a Bayesian Network requires defining at least three things:

- **Random Variables**. What are the random variables in the problem?
- **Conditional Relationships**. What are the conditional relationships between the variables?
- **Probability Distributions**. What are the probability distributions for each variable?

- It may be possible for an expert in the problem domain to specify some or all of these aspects in the design of the model.

- In many cases, the architecture or topology of the graphical model can be specified by an expert, but the probability distributions must be estimated from data from the domain.

- Both the probability distributions and the graph structure itself can be estimated from data, although it can be a challenging process. As such, it is common to use learning algorithms for this purpose; for example, assuming a Gaussian distribution for continuous random variables gradient ascent for estimating the distribution parameters.

- Once a Bayesian Network has been prepared for a domain, it can be used for reasoning, e.g. making decisions.

- Reasoning is achieved via inference with the model for a given situation. For example, the outcome for some events is known and plugged into the random variables. The model can be used to estimate the probability of causes for the events or possible further outcomes.

4. **Explain about the role of fuzzy logic in medicine ?(Nov 2014, May 2016)**

The purpose of this paper is to present a general view of the current applications of fuzzy logic in medicine and bioinformatics. We particularly review the medical literature using fuzzy logic. We then recall the geometrical interpretation of fuzzy sets as points in a fuzzy hypercube and present two concrete illustrations in medicine (drug addictions) and in bioinformatics (comparison of genomes).

FUZZY LOGIC IN MEDICINE

The complexity of medical practice makes traditional quantitative approaches of analysis inappropriate. In medicine, the lack of information, and its imprecision, and, many times, contradictory nature are common facts. The sources of uncertainty can be classified as follows .

1. Information about the patient.

2. Medical history of the patient, which is usually supplied by the patient and/or his/her family. This is usually highly subjective and imprecise.

3. Physical examination. The physician usually obtains objective data, but in some cases the boundary between normal and pathological status is not sharp.

4. Results of laboratory and other diagnostic tests, but they are also subject to some mistakes, and even to improper behavior of the patient prior to the examination.

5. The patient may include simulated, exaggerated, understated symptoms, or may even fail to mention some of them.

6. We stress the paradox of the growing number of mental disorders versus the absence of a natural classification. The classification in critical (ie, borderline) cases is difficult, particularly when a categorical system of diagnosis is considered.

Fuzzy logic plays an important role in medicine]. Some examples showing that fuzzy logic crosses many disease groups are the following.

1. To predict the response to treatment with citalopram in alcohol dependence .

2. To analyze diabetic neuropathy and to detect early diabetic retinopathy .

3. To determine appropriate lithium dosage .

4. To calculate volumes of brain tissue from magnetic resonance imaging (MRI) , and to analyze functional MRI data .

5. To characterize stroke subtypes and coexisting causes of ischemic stroke .

6. To improve decision-making in radiation therapy .

7. To control hypertension during anesthesia .

8. To determine flexor-tendon repair techniques.

9. To detect breast cancer, lung cancer, or prostate cancer.

10. To assist the diagnosis of central nervous systems tumors (astrocytic tumors).

11. To discriminate benign skin lesions from malignant melanomas.

12. To visualize nerve fibers in the human brain .

13. To represent quantitative estimates of drug use.

14. To study the auditory P50 component in schizophrenia.

15. Many other areas of application, to mention a few, are

   a. to study fuzzy epidemics ,

   b. to make decisions in nursing ,

   c. to overcome electroacupuncture accommodation .

- We used the database MEDLINE to identify the medical publications using fuzzy logic. We used as keywords fuzzy logic and grade of membership.

- The total number of articles per year appears. The data is from 1991 to 2002 and includes also the number of those publications in 1990 and before.

- It results in a total of 804 articles and agrees essentially with the numbers .

- We plan to screen databases in the engineering literature that covers medicine-related articles since it is difficult to publish medical results using a fuzzy logic approach. In the future we will compare the figures obtained.

FUZZY LOGIC IN BIOINFORMATICS

- Bioinformatics derives knowledge from computer analysis of biological data.

- This data can consist of the information stored in the genetic code, and also experimental results (and hence imprecision) from various sources, patient statistics, and scientific literature.

- Bioinformatics combines computer science, biology, physical and chemical principles, and tools for analysis and modeling of large sets of biological data, the managing of chronic diseases, the study of molecular computing, cloning, and the development of training tools of bio-computing systems .

- Bioinformatics is a very active and attractive research field with a high impact in new technological development .

- Molecular biologists are currently engaged in some of the most impressive data collection projects.

- Recent genome-sequencing projects are generating an enormous amount of data related to the function and the structure of biological molecules and sequences.

- Other complementary high-throughput technologies, such as DNA microarrays, are rapidly generating large amounts of data that are too overwhelming for conventional approaches to biological data analysis.

- We have at our disposal a large number of genomes, protein structures, genes with their corresponding expressions monitored in experiments, and single-nucleotide polymorphisms (SNPs) .

- Handling this massive amount of data, in many cases imprecise and fuzzy, requires powerful integrated bioinformatics systems and new technologies.

Fuzzy logic and fuzzy technology are now frequently used in bioinformatics. The following are some examples.

1. To increase the flexibility of protein motifs .

2. To study differences between polynucleotides .

3. To analyze experimental expression data using fuzzy adaptive resonance theory.

4. To align sequences based on a fuzzy recast of a dynamic programming algorithm .

5. DNA sequencing using genetic fuzzy systems .

6. To cluster genes from microarray data .

7. To predict proteins subcellular locations from their dipeptide composition using fuzzy k-nearest neighbors algorithm.

8. To simulate complex traits influenced by genes with fuzzy-valued effects in pedigreed populations .

9. To attribute cluster membership values to genes applying a fuzzy partitioning method, fuzzy C-means.

10. To map specific sequence patterns to putative functional classes since evolutionary comparison leads to efficient functional characterization of hypothetical proteins . The authors used a fuzzy alignment model.

11. To analyze gene expression data .

12. To unravel functional and ancestral relationships between proteins via fuzzy alignment methods , or using a generalized radial basis function neural network architecture that generates fuzzy classification rules .

13. To analyze the relationships between genes and decipher a genetic network .

14. To process complementary deoxyribonucleic acid (cDNA) microarray images . The procedure should be automated due to the large number of spots and it is achieved using a fuzzy vector filtering framework.

15. To classify amino acid sequences into different superfamilies

5. Explain in detail about pattern recognition?(Nov 2015)

- Pattern recognition is the automated recognition of patterns and regularities in data.

- It has applications in statistical data analysis, signal processing, image analysis, information retrieval, bioinformatics, data compression, computer graphics and machine learning.

- Pattern recognition has its origins in statistics and engineering; some modern approaches to pattern recognition include the use of machine learning, due to the increased availability of big data and a new abundance of processing power.

- However, these activities can be viewed as two facets of the same field of application, and together they have undergone substantial development over the past few decades.

- **A modern definition of pattern recognition is**: The field of pattern recognition is concerned with the automatic discovery of regularities in data through the use of computer algorithms and with the use of these regularities to take actions such as classifying the data into different categories

Pattern Recognition

Pattern recognition is the process of recognizing patterns by using machine learning algorithm. Pattern recognition can be defined as the classification of data based on knowledge already gained or on statistical information extracted from patterns and/or their representation. One of the important aspects of the pattern recognition is its application potential.

Examples: Speech recognition, speaker identification, multimedia document recognition

(MDR),automatic medical diagnosis.

In a typical pattern recognition application, the raw data is processed and converted into a form that is amenable for a machine to use. Pattern recognition involves classification and cluster of patterns.

- In classification, an appropriate class label is assigned to a pattern based on an abstraction that is generated using a set of training patterns or domain knowledge. Classification is used in supervised learning.

- Clustering generated a partition of the data which helps decision making, the specific decision making activity of interest to us. Clustering is used in an unsupervised learning.

Features may be represented as continuous, discrete or discrete binary variables. A feature is a function of one or more measurements, computed so that it quantifies some significant characteristic soft the object.

Example: consider our face then eyes, ears, nose etc are features of the face.

A set of features that are taken together, forms the **features vector**.

Example: In the above example of face, if all the features (eyes, ears, nose etc) taken together then the sequence is feature vector([eyes, ears, nose]). Feature vector is the sequence of a features represented as a d-dimensional column vector. In case of speech, MFCC (Melfrequency Cepstral Coefficent) is the spectral features of the speech. Sequence of first 13 features forms a feature vector.

Pattern recognition possesses the following features:
- Pattern recognition system should recognise familiar pattern quickly and accurate
- Recognize and classify unfamiliar objects
- Accurately recognize shapes and objects from different angles
- Identify patterns and objects even when partly hidden
- Recognise patterns quickly with ease, and with automaticity.

Training and Learning in Pattern Recognition
- Learning is a phenomena through which a system gets trained and becomes adaptable to give result in an accurate manner.

- Learning is the most important phase as how well the system performs on the data provided to the system depends on which algorithms used on the data.
- Entire dataset is divided into two categories, one which is used in training the model i.e. Training set and the other that is used in testing the model after training, i.e. Testing set.

Training set:

- Training set is used to build a model.
- It consists of the set of images which are used to train the system.
- Training rules and algorithms used give relevant information on how to associate input data with output decision.
- The system is trained by applying these algorithms on the dataset, all the relevant information is extracted from the data and results are obtained. Generally, 80% of the data of the dataset is taken for training data.

Testing set:

- Testing data is used to test the system.
- It is the set of data which is used to verify whether the system is producing the correct output after being trained or not.
- Generally, 20% of the data of the dataset is used for testing.
- Testing data is used to measure the accuracy of the system.
- Example: a system which identifies which category a particular flower belongs to, is able to identify seven category of flowers correctly out of ten and rest others wrong, then the accuracy is 70 %

Real-time Examples and Explanations:

- A pattern is a physical object or an abstract notion.
- While talking about the classes of animals, a description of an animal would be a pattern.

- While talking about various types of balls, then a description of a ball is a pattern. In the case balls considered as pattern, the classes could be football, cricket ball, table tennis ball etc.
- Given a new pattern, the class of the pattern is to be determined.
- The choice of attributes and representation of patterns is a very important step in pattern classification.
- A good representation is one which makes use of discriminating attributes and also reduces the computational burden in pattern classification. An obvious representation of a pattern will be a **vector**.
- Each element of the vector can represent one attribute of the pattern. The first element of the vector will contain the value of the first attribute for the pattern being considered.

- **Example:** While representing spherical objects, (25, 1) may be represented as an spherical object with 25 units of weight and 1 unit diameter. The class label can form a part of the vector. If spherical objects belong to class 1, the vector would be (25, 1, 1), where the first element represents the weight of the object, the second element, the diameter of the object and the third element represents the class of the object.

Advantages:
- Pattern recognition solves classification problems
- Pattern recognition solves the problem of fake bio metric detection.
- It is useful for cloth pattern recognition for visually impaired blind people.
- It helps in speaker diarization.
- We can recognise particular object from different angle.

Disadvantages:
- Syntactic Pattern recognition approach is complex to implement and it is very slow process.
- Sometime to get better accuracy, larger dataset is required.
- It cannot explain why a particular object is recognized.
  Example: my face vs my friend's face.

Applications:

- **Image processing, segmentation and analysis**

  Pattern recognition is used to give human recognition intelligence to machine which is required in image processing.

- **Computer vision**

  Pattern recognition is used to extract meaningful features from given image/video samples and is used in computer vision for various applications like biological and biomedical imaging.

- **Seismic analysis**

  Pattern recognition approach is used for the discovery, imaging and interpretation of temporal patterns in seismic array recordings. Statistical pattern recognition is implemented and used in different types of seismic analysis models.

- **Radar signal classification/analysis**

  Pattern recognition and Signal processing methods are used in various applications of radar signal classifications like AP mine detection and identification.

- **Speech recognition**

  The greatest success in speech recognition has been obtained using pattern recognition paradigms. It is used in various algorithms of speech recognition which tries to avoid the problems of using a phoneme level of description and treats larger units such as words as pattern

- **Finger print identification**

  The fingerprint recognition technique is a dominant technology in the biometric market. A number of recognition methods have been used to perform fingerprint matching out of which pattern recognition approaches is widely used.

6.What is telemedicine? Write neat diagram and explain how it works and its applications in various files?(May 2017,Nov 2017,May 2018,Nov 2018,May 2019,Sep 2020)

Telemedicine : Telemedicine Means "distance healing". Derived from a Greek word "Tele" meaning "distance" and a Latin word "mederi" meaning "to heal". Is not one specific technology but a way of providing healthcare services at a distance using telecommunications technology, medical expertise & computer science. Telemedicine is the future of global healthcare.

Types of Telemedicine
• Real-time (synchronous)
• Store and Forward (asynchronous)

• Real-time (synchronous) Could be as simple as a telephone call or as complex as robotic surgery. Requires the presence of both parties at the same time.E.g. : Video-conferencing equipment

• There are also peripheral devices which can be attached to computers or the video-conferencing equipment which can aid in an interactive examination.

• For instance, a tele-otoscope allows a remote physician to 'see' inside a patient's ear; a tele-stethoscope allows the consulting remote physician to hear the patient's heartbeat Store and Forward (asynchronous)

• Involves acquiring medical data (like medical images, biosignals etc) and then transmitting this data to a doctor or medical specialist at a convenient time for assessment offline.

• Does not require the presence of both parties at the same time.
  Dermatology, radiology, and pathology.

• A properly structured Medical Record preferably in electronic form should be a component of this transfer Teleradiology, the sending of x-rays, CT scans, or MRIs (store-and-forwardimage)

• Many radiologists are installing appropriate computer technology in their homes, so they can have images sent directly to them for diagnosis, instead of making an off-hours trip to a hospital or clinic.

Application Adopted:

Most beneficial for populations living in isolated communities and remote regions and is currently being applied in virtually all medical domains.

Use a "tele-" prefix ;useful as a communication tool between a general practitioner and a specialist available at a remote location.

- Telepathology
- Telecardiology
- Teleradiology
- Telesurgery
- Teleopthalmology

Advantages of Telemedicine:

Resource utilization

Early intervention

Avoids unnecessary transportation

 Community based care

Medical education and research

Cost saving

Improved patient documentation

Increased range of care and education.

Telemedicine Infrastructure:

This will include minimum standards for all the hardware and software used in a telemedicine system. Under hardware it will include standards and guidelines for basic telemedicine platform, servers, clinical devices, video conferencing system, communication hardware and power support. The software standards address operating system, telemedicine software, and server software

Need of Telemedicine in India:

The advances in Medical science, biomedical engineering on one side and Telecommunication and Information Technology on the other side are offering wide opportunities for improved health care.Health coverage to majority of our population is still a distant dream. India is a vast country gifted with rich and ancient historic background and geographically the nature has provided India with all the varieties like the mountain regions like Ladakh deserts,green planes and far flung areas in the north east and offshore islands of Andaman''s and Lakshadweep.1 billion population.Predominantly rural and distributed in distant geographical locations

Advantages of Telemedicine for Patients:

No transportation time or costs.

No need to take time off of work.

Eliminate child or elder care issues.

On-demand options.

Access to Specialists.

Less Chance of Catching a New Illness.

Less Time in the Waiting Room.

Better Health.

6. **Explain in detail about Computer assist Patient education in health informatics? (Nov 2015,May 2017)**

   Computer assisted Patient Education:

   - Nursing informatics can be used for symptom management and patient education.

- The nurse can access the information for the patient or teach the patient where to find appropriate and helpful information.
- For example, on an oncology unit, nursing informatics can be used to teach patients effective symptom management of the treatment modalities which often cause pain, fatigue and poor nutritional status.
- Nursing informatics can also aid in other nursing interventions of the oncology nurse, such as analgesic administration and stress-reduction techniques.

  Nursing Information System:
- Nursing Information System (NIS) aid nurses in improving patient care and quality of health care treatment by generating timely, precise and orderly information collected from the clinical data acquired from variety of health care environments.
- It emphasises on the patient safety by focusing on reducing health care oriented errors arising either due to communication or management of this information.

Objectives of NIS:

The major objectives of any NIS system are as follows:

- Proper management and dissemination of information Developing of information contents for NIS Precise design, structure, and delivery of information
- To achieve the above stated objectives, many NIS are designed using a sophisticated database and a nursing classification language, such as Nursing Diagnosis Extension and Classification (NDEC), North American Nursing Diagnosis Association (NANDA) and Nursing Intervention Classification (NIC).

Features of NIS:

The major features available in most NIS are as follows:

Patient profile: Vital information about the patient‟s signs, symptoms,admission history and diagnosis, nursing care plan and notes can be entered into the system in structured form or as free text.These are then stored in the system‟s central repository and retrieved whenever needed.

Nursing staff schedules: Using this module, the nursing staff could schedule their shifts by using shift modules as per hospital guidelines available. These shifts need to be

confirmed or rescheduled depending on the requirement by the supervisor or manager. The shift modules are designed to handle absentia, staff overtime, staff requirements emphasising on cost-effective staffing for the hospital.

Integration of clinical data:
In this module, the clinical information from different domains could be retrieved, visualised and analysed by the nursing and support staff. This could further be integrated into a patient"s diagnostic treatment plan by the nursing staff.

Decision support system:
The decision support module could be integrated into nursing information systems. They provide prompts and reminders to the user, along with the information about the disease linkages through signs/symptoms, etiologies/related factors and patient populations.
 Access to medical resources can also be made online in the system.

Data management:
The data obtained from the diagnosis, clinical interventions, and the results of nursing care can be stored, retrieved and managed through the data management system.

Types of NIS:

Omaha system
- Standardised schemes of nursing, diagnosis (problems), interventions and outcome. Clinical data are used to improve the practice and administrative oversight and is added to the body of nursing knowledge Automated community health information system (ACHIS)
- Documentation of the daily processes and outcomes of care. Compose administrative and research agenda: questions such as the nature of client problems, prevention and intervention strategies used in care and the impact of care on outcomes.

Hettinger and Brazile system:

- Care map
- Care plan system is used for a case management resource overview. Automated bank of nursing diagnosis reports.Continuous quality improvement.

Benefits of NIS

The benefits of implementing a Nursing Information Systems include:

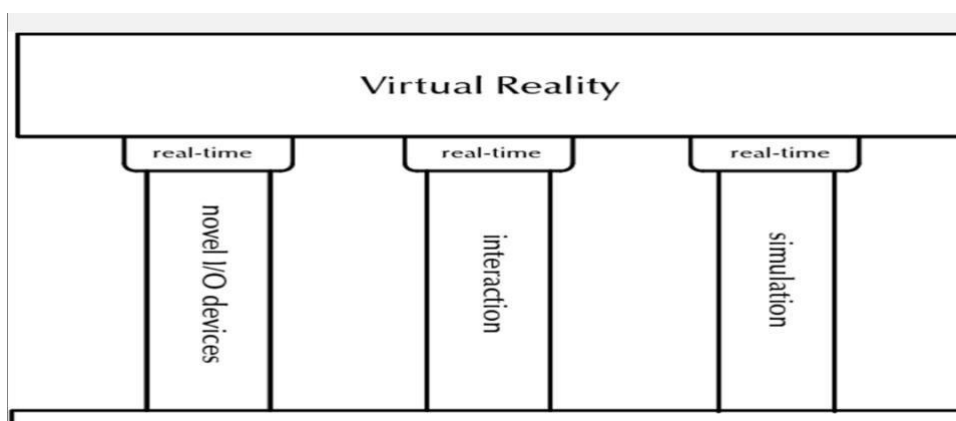Improved staffing workload functionality

Better patient care planning

Improved drug administration

8. What is medical virtual reality? Explain the techniques of virtual reality. (Nov 2017,May 2018,May 2019,Nov 2019, Nov 2018)

VIRTUAL REALITY TECHNOLOGY

Virtual Reality (VR) is the term commonly used to describe a novel human-computer interface that enables users to interact with computers in a radically different way. VR consists of a computer-generated, multi-dimensional environment and interface tools that allow users to:

1) immerse themselves in the environment,

2) navigate within the environment, and

3) interact with objects and other inhabitants in the environment

Techniques:

Virtual Reality (VR) is the use of computer technology to create a simulated environment. Unlike traditional user interfaces, VR places the user inside an experience.

Instead of viewing a screen in front of them, users are immersed and able to interact with 3D worlds.
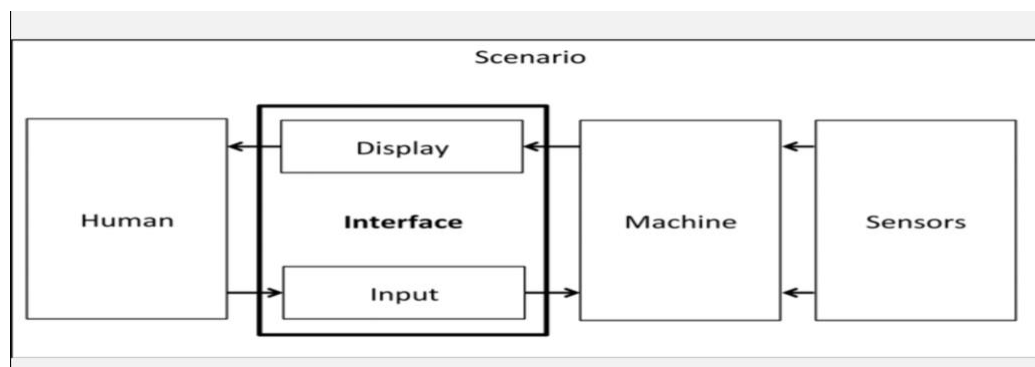
Computer-Aided Design:

Using VR to create "virtual prototypes" in software allows engineers to test potential products in the design phase, even collaboratively over computer networks, without investing time or money for conventional hard models. All of the major automobile manufacturers and many aircraft manufacturers rely heavily on virtual prototyping.

Military:

With VR, the military's solitary cab-based systems have evolved to extensive networked simulations involving a variety of equipment and situations. All levels of the military now have the ability to practice as teams in a verity of complex simulation scenarios, practicing search and rescue missions, for example, using acquired details from target-areas modeled into virtual words.

Architecture/Construction:

VR allows architects and engineers and their clients to "walk through" structural blueprints. Designs may be understood more clearly by clients who often have difficulty comprehending them even with conventional cardboard models.

Data Visualization:

- By allowing navigation through an abstract "world" of data, VR helps users rapidly visualize relationships within complex, multi-dimensional data structures.

- This is particularly important in financial-market data, where VR supports faster decision making.
- VR is commonly associated with exotic "fully immersive applications" because of the over dramatized media coverage on helmets, body suits, entertainment simulators and the like.
- Equally important are the "Window into World" applications where the user or operator is allowed to interact effectively with "virtual" data, either locally or remotely
- System features multiple problem schemes. Well-baby, health maintenance and immunisation tracking visits.
- Asthma, clinical management tools for asthma. Case management, referral tracking tool and appointment scheduling.Program to track community outer each clients in a program that tends to increase the accessibility of preventive, curative and health promotion services to rural elderly.
- Links formal community based services, informal community resources, volunteer efforts and academic resources to strengthen the self-reliance of members of rural communities so that they can take care for their elders.

9. How computers play a major role in telesurgery? (Nov 2019, Sep 2020)

Telesurgery:

- Telesurgery is another domain of interest, where an active interface could be worn by the surgeon in a master–slave system to provide better manoeuvrability, dexterity and ergonomic coupling: the surgeon could manoeuvre the system as if he were directly manipulating the remote object itself.
- Telesurgery, also called remote surgery, is performed by a surgeon at a site removed from the patient. Surgical tasks are directly performed by a robotic system controlled by the surgeon at the remote site.
- Teleoperation, also called telerobotics, is the technical term for the remote control of a robot called a telechir .
- In a telerobotic system, a human operator controls the movements of a telechir from some distance away.
- Since the user cannot see the robot directly, he or she must rely on feedback from the robot's worksite. This is presented to the user by way of the interface.
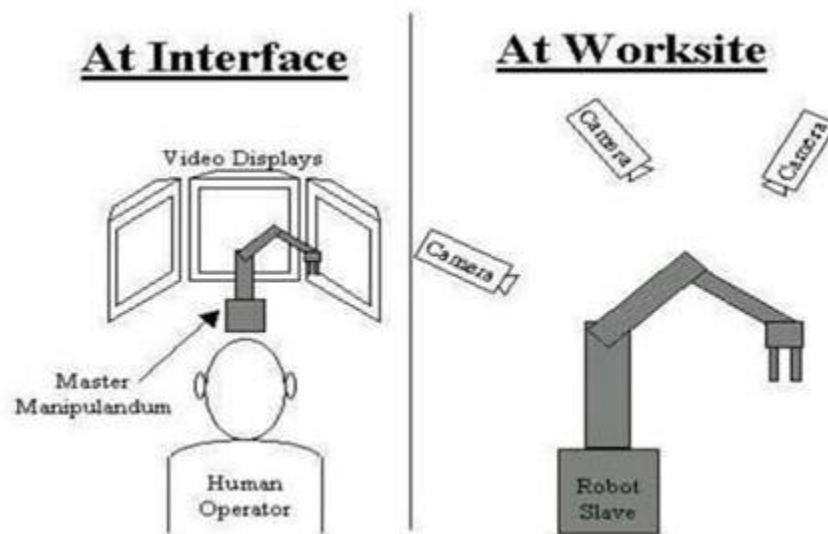
Forms of Feedback

● Live video from video cameras

● Haptic (touch, such as a vibration)

● Auditory (human ear range)

● Temperature

● Contact sensors

● Sonar images

Teleoperation

Signals are sent to the telechir to control it; other signals come back,telling the operator that the telechir has followed the instructions. These control and return signals are called telemetry .

Sample teleoperation setup:

Tele-surgery an real time Example

With the da Vinci Surgical System, surgeons operate through just a few small incisions. The da Vinci System features a magnified 3D highdefinition vision system and tiny wristed instruments that bend and rotate far greater than the human wrist. As a result, da Vinci enables your surgeon to operate with enhanced vision, precision, dexterity and control.

ADVANTAGES

This minimizes the surgical trauma and damage to the healthy tissue, resulting in shorter patient recovery time.

DISADVANTAGES

● Reduced dexterity

● Reduced workspace

● Reduced sensory input to surgeon which is only available through a single video image

Problems in Teleoperation

● The unreachable ideal transparency

● Time delay

● Industrial robotics is sometimes opposed to teleoperation solutions

● Reliability and safety The unreachable ideal transparency

● One of the most important teleoperator characteristics after stability

is transparency;

● The goal of teleoperation is to achieve transparency by mimicking human motor and sensory functions;

● An established fact is that ideal transparency can never be reached by conventional bilateral control unless it is redefined by other criteria or conceived differently.

Time Delay

● Communication time delay between master and slave is very crucial in teleoperation;

● Time delay affects not only transparency, because the operator

actions and feedback are delayed, but also stability.Problems with Industrial Robotics

● Industrial robotics is sometimes opposed to teleoperation solutions

from a flexibility viewpoint;

● Teleoperation flexibility is in many ways dependent on operator

adaptation to the teleoperation system;

● to perform a task the operator must be trained and specialized

Reliability and Safety

- Use of high-powered master/slave devices is very dangerous;

- Powered manipulation arms are very slow devices;

- quick or jerky motions should not be used