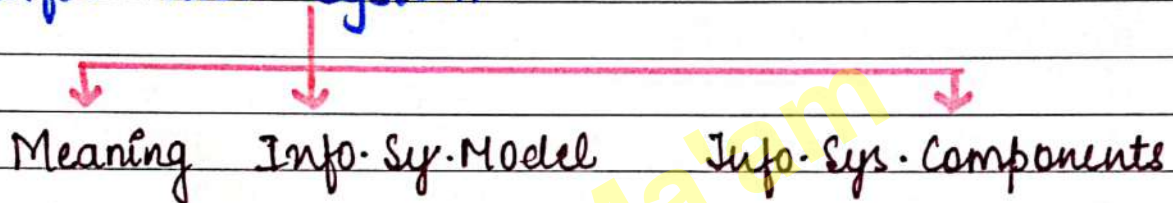


CHAPTER - 3

INFORMATION SYSTEMS & ITS COMPONENTS

Information System



Meaning

- IS is a combination of people, H/w, S/w, communication devices, network & data resources
- System needs input from user, which is then processed using technology devices [computers] & produces output, that is sent to another user or other system via network & a feedback method that controls the operation.

Information Sys. Model **AMENDED MAY 2022**

Input

Data is collected from an org/external envt and converted into suitable format reqd for processing

Processing

- Process is a series of steps to achieve goal
- I.S are becoming more & more integrated with org processes, bringing more output

Output

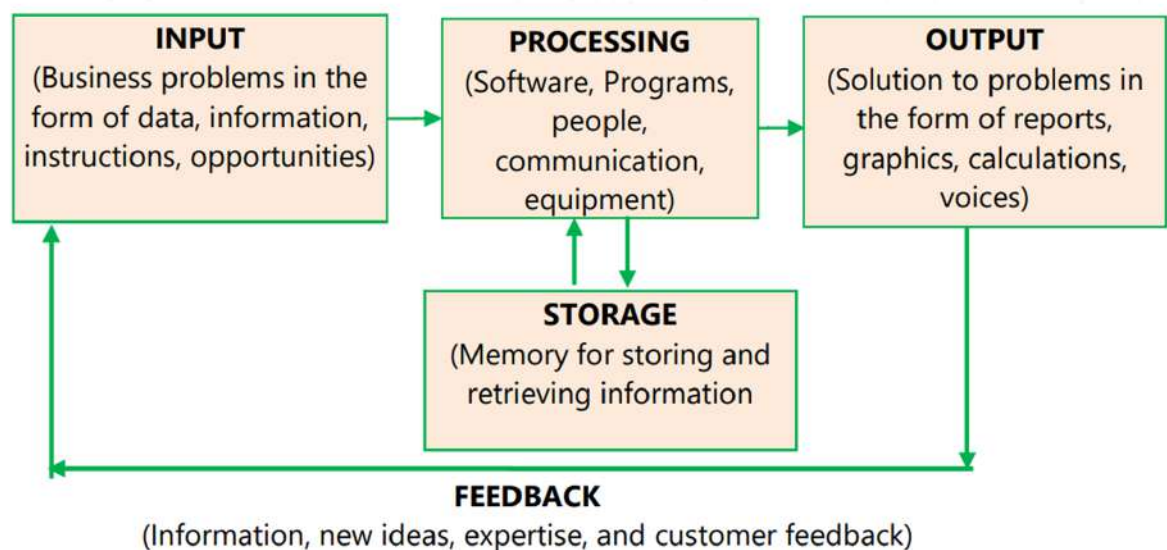
The System processes the data by applying the appropriate procedure on it & the info, thus produced is stored for future use or communicated to User

Storage
(Added May 2022)

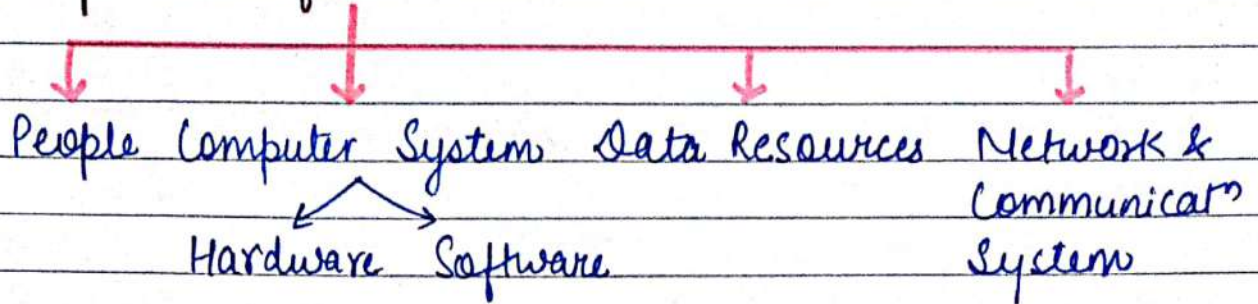
- Storage of data shall be done at the most detailed level possible.
- Regular backups should be stored in a geographically diff. locations to avoid impact on both data [original, backup]

Feedback

I.S also needs feedback that is returned to appropriate members of the enterprises to help them to evaluate at the Input stage

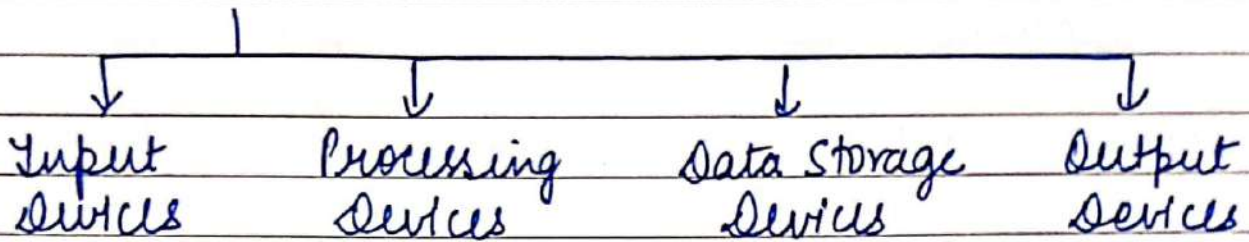


Components of I.S.



People	All those who operate, manage, maintain & use the system i.e. system administrator, IS personnel, programmers, end users.
Hardware	Means the physical components of the computers that can be servers, nodes with different configurations
Software	System software (operating systems) Application software (diff. computer programs) Utility software (tools)
Data	It is a raw fact which is input to the system It may be alphanumeric, text, img, video, audio.
Network	It means communication media like Internet, Intranet that allow sharing of information/resources.

Hardware

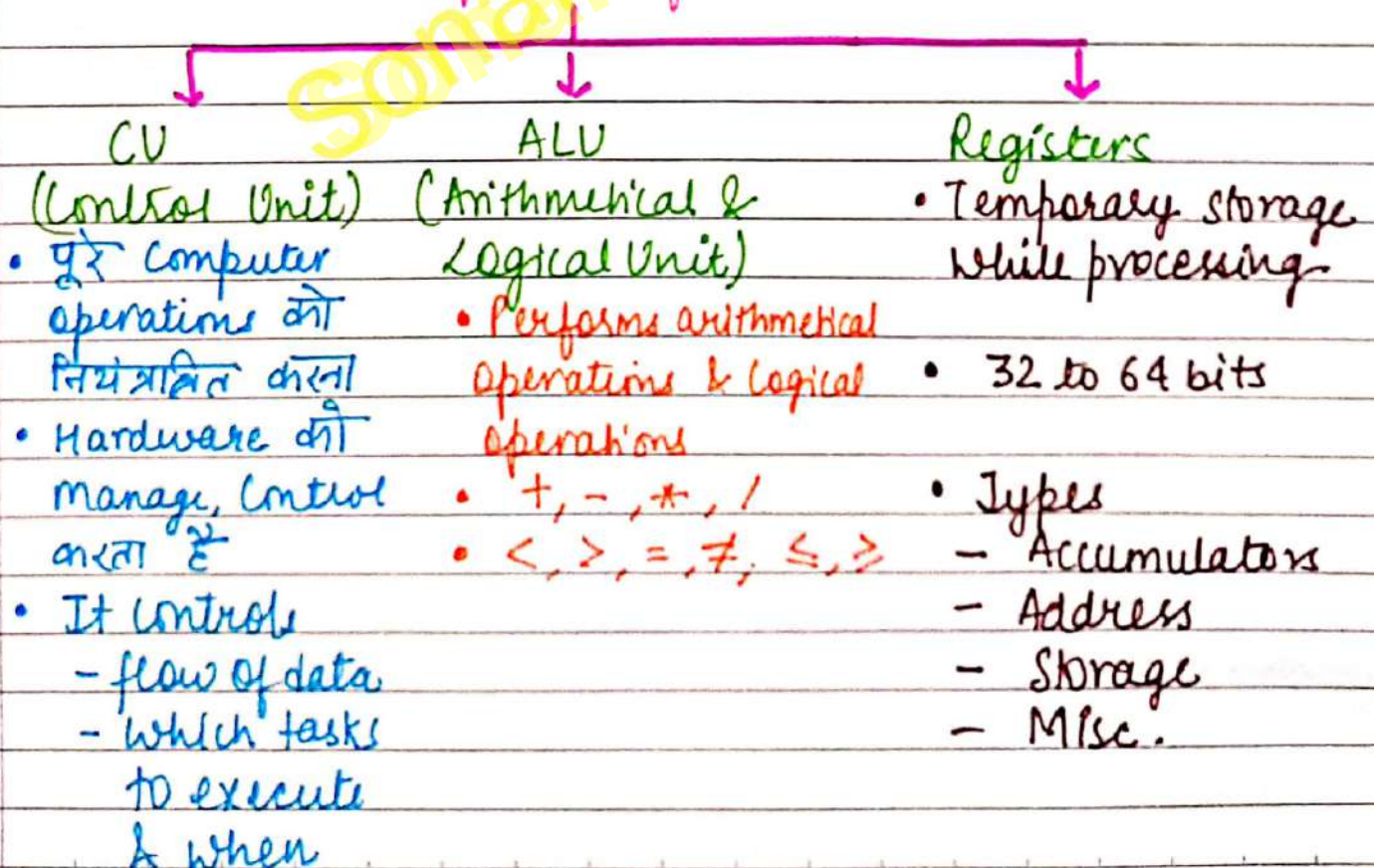


Input Devices

- Devices through which we interact with systems
- Eg- keyboard, Mouse, etc.

Processing Devices

- Includes computer memory used for processing of data
- Main function of CPU is to execute programs.
- It consists of three functional units



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"Accumulator"

- Keep Running Total of arithmetic value
- Accumulate data & Result ko Before final outcome

$$\begin{aligned} \text{Eg } &= 3 + [(4-2) * 2] \\ &= 3 + (2 * 2) \\ &= 7 \end{aligned}$$

"Address"

- Store addresses which tells CPU as to where in the memory an instruction is located
- Location ko Address (Route) ko store krta h.

"Storage"

- Store data that is being used
- Data ko store krta

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Data Storage Devices

(Refers to the memory where data & programs are stored)

a) PRIMARY MEMORY (MAIN MEMORY)

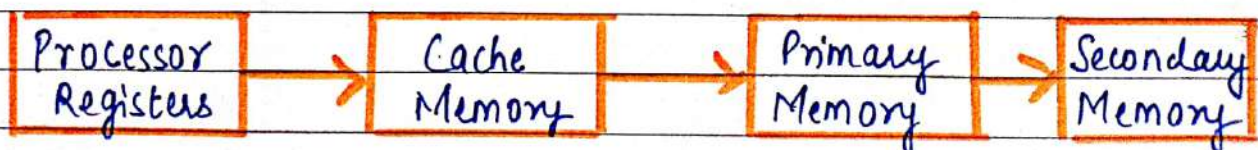
- It is directly accessed by the processor using data bus
- It is volatile & Non-volatile in nature
- Being small in storage capacity, it can't be used to store data on permanent basis.
- It is of two types RAM & ROM

Cache Memory

- To bridge the huge diff of speed b/w registers & primary memory, cache memory is introduced
- It is smaller, extremely fast memory type built into CPU
- CM stores copies of data from the most frequently used main memory locations, so that CPU can access it more rapidly than main memory
- ∴ Act as a buffer b/w RAM & CPU

b) SECONDARY MEMORY

- Secondary memory devices are non-volatile, have greater capacity, greater Economy but slower speed compared to registers & primary storage.
- Eg. Hard-disk, Pen-drive, Memory card.



RAM vs ROM

(AMENDED MAY 2021)

Aspect	Random Access Memory (RAM)	Read Only Memory (ROM)
Data Retention	Volatile in nature means Information is lost as soon as power is turned off.	Non-volatile in nature (contents remain intact even in absence of power).
Persistence	The purpose is to hold program and data while they are in use.	These are used to store small amount of information that is rarely changed during the life of the system for quick reference by CPU. For example – Basic Input/Output System (BIOS).
Information Access	Information can be read as well as modified.	Information can be read only and not modified.
Storage	These are responsible for storing the instructions and data that the computer is using at that present moment, that is why it is a Temporary memory.	These are generally used by manufacturers to store data and programs like translators that is used repeatedly, that is why it is a Permanent memory.
Impact	Volatile memory such as RAM has high impact on system's performance.	Non-volatile memory has no impact on system's performance.
Cost	Volatile memory is costly per unit size.	Non-volatile memory is cheap per unit size.
Speed	RAM speed is quite high.	ROM speed is slower than RAM.
Capacity	RAM memory is large and high capacity.	ROM is generally small and of low capacity.

Primary Memory vs Secondary Memory

(ADDED MAY 2021)

Aspect	Primary/Main Memory	Secondary Memory
Basic	Primary memory is directly accessible by Processor/CPU.	Secondary memory is not directly accessible by CPU.
Data	Instructions or data to be currently executed are copied to main memory.	Data to be permanently stored is kept in secondary memory.
Volatility	Primary memory is usually volatile.	Secondary memory is non-volatile.
Formation	Primary memories are made of semiconductors.	Secondary memories are made of magnetic and optical material.
Access Speed	Accessing data from primary memory is faster.	Accessing data from secondary memory is slower.
Access	Primary memory is accessed by the data bus.	Secondary memory is accessed by input-output channels.
Size	The computer has a small primary memory.	The computer has a larger secondary memory.
Expense	Primary memory is costlier than secondary memory.	Secondary memory is cheaper than primary memory.
Memory	Primary memory is an internal memory.	Secondary memory is an external memory.

Processor Registers vs Cache Memory (ADDED MAY 2021)

Processor Registers	Cache Memory
These are high speed memory units within CPU for storing small amount of data (mostly 32 or 64 bits).	It is fast memory built into a computer's used to reduce the average time to access data from the main memory. The data that is stored within a cache might be values that have been computed earlier or duplicates of original values that are stored elsewhere.
The registers are the only things most processors can operate on directly.	Cache memory is an interface between CPU and Main storage. It is not directly accessible for operations.

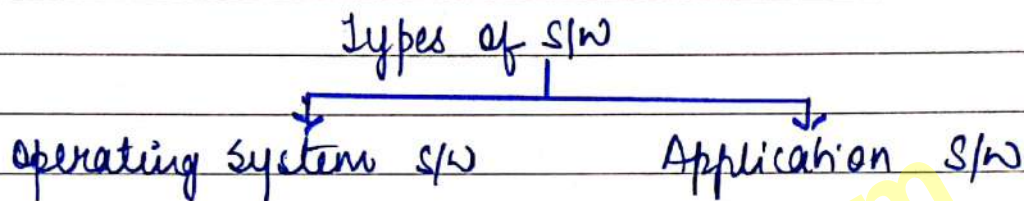
Output Devices

- Information shown on a display device
- displayed for a temporary period.
- Includes, Monitors, LCD Screens etc [Speaker, Headfon]
- Types of Output -

Textual	Words, sentences, paragraphs & Used characters
Graphical	digital Representations such as drawings, charts, photo etc
Audio	• Music, speech, any sound etc
Video	Movie played with Audio
Tactile	Raised drawings (Used for blind)

Software

- It is a set of instructions that tell the hardware what to do.
- Software is not tangible, it can't be touched
- It is created through the process of programming.
- When programmers create software, they are simply typing out lists of instructions that tell the H/W what to execute



Operating system Software (AMENDED MAY 2021)

- It is a set of computer programs that manages the computer hardware resources.
- It acts as an interface b/w hardware & user.
- For personal computers - most popular OS are
 - Microsoft, Apple's OS X
- For smart phones & tablets, - most popular OS are
 - Apple's iOS, Google Android

Activities performed by OS are

<p>1) Performing Hardware functions</p>	<ul style="list-style-type: none"> • Intermediary b/w Application & Hardware • Obtain input from keyboards, retrieve data from disk & display output on monitors.
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ii) <u>User Interface</u>	The interface (GUI) with which the user interacts will be functional with the help of OS
iii) <u>Memory Mgt.</u>	<ul style="list-style-type: none"> • OS allows Controlling how memory is accessed • OS also provides VIRTUAL MEMORY * as & when required.
iv) <u>Task Mgt.</u>	<ul style="list-style-type: none"> • This facilitates a user to work with MORE than one application at a time i.e. MULTI-TASKING that allows more than one user to use the system i.e. TIME-SHARING • Eg Play MP4 music & working on MS
v) <u>Networking Capability</u>	<ul style="list-style-type: none"> • Helps to connect diff Computer Networks • Eg- Connectivity to internet
vi) <u>Logical Access Security</u>	Establishes a procedure for identification & authentication using ID & plw.
vii) <u>File Mgt.</u>	Keeps a track of where each file is stored & who can access it & provides file retrieval

(MC: MINUS)

VIRTUAL MEMORY (AMENDED MAY 2021)

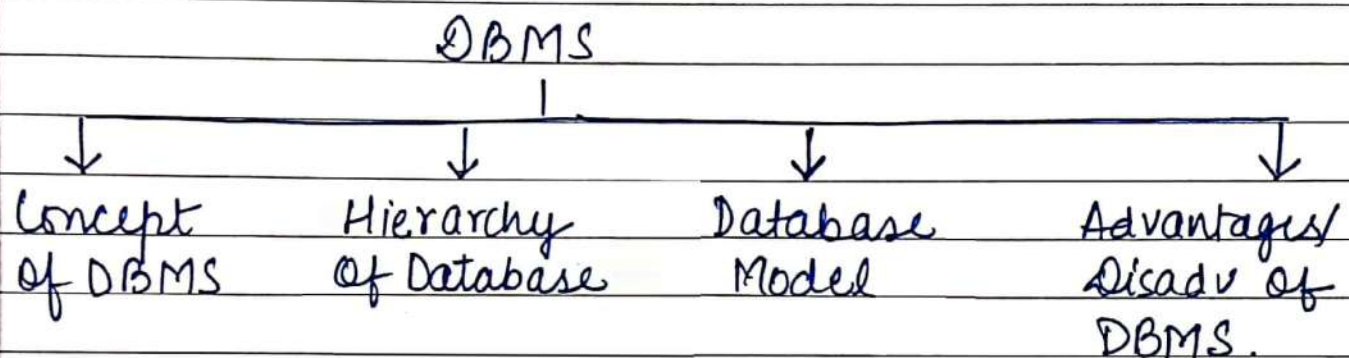
- It is an imaginary memory area supported by some operating system (eg windows), that combines computer RAM with a temporary space on the hard-disk
- If a computer lacks in required size of RAM needed to run a program/operation, windows uses virtual memory to move data from RAM to a space called a PAGING FILE
- Moving data to & from paging file frees up RAM to complete its work
- Thus, virtual memory is an allocation of harddisk space to help RAM

Application Software (AMENDED MAY 2020 & 2021)

- Category of programs that do some useful processing or task for the user
- It includes computer S/W that causes a computer to perform useful tasks beyond just the simple running of computer.
- It addresses a real life problem of its end users
- Eg MS Office which includes word, Excel etc.
Enterprise software like SAP.

DBMS (Database Mgt System)

- **Data** : Raw bits of information
- **Database** : Organised collection of Related Informⁿ
- **DBMS** : To Manage Database, a Software is Used, named DBMS



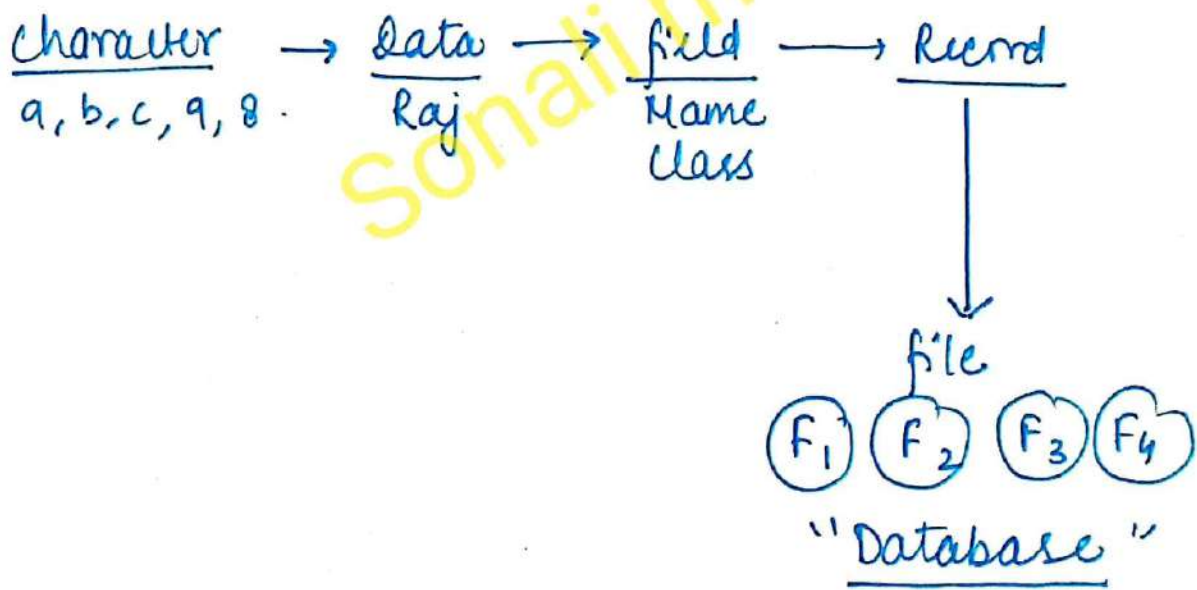
Concept

- DBMS is just a Computerised Record Keeping
- It helps to do the following operations -
 - Adding New files to database
 - Deleting existing files to database
 - Inserting data in existing files
 - Modifying data in existing files
 - Deleting data in existing files
 - Retrieving data from existing files
- It is a Software that helps in Organising, controlling, using data needed by the application programme.
- Eg. of DBMS - MySQL, Oracle, DB2 etc.

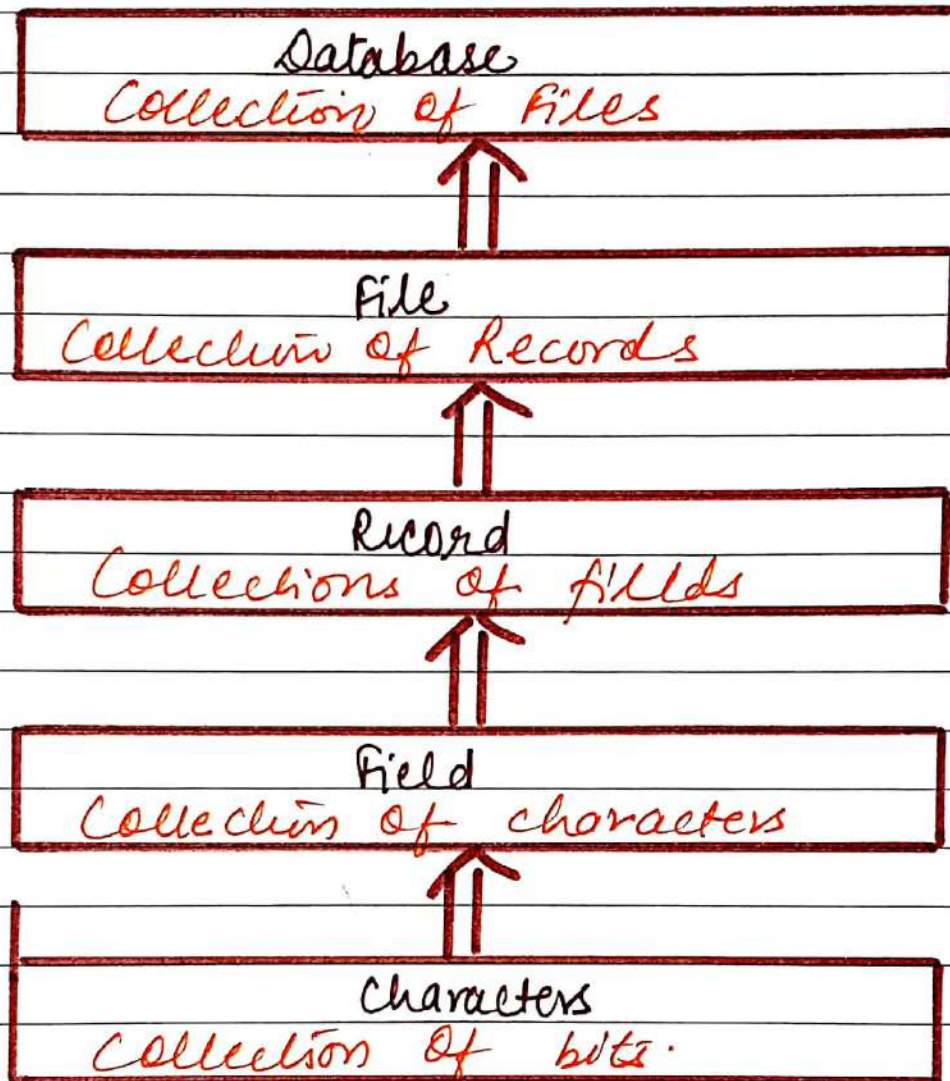
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Example of DBMS

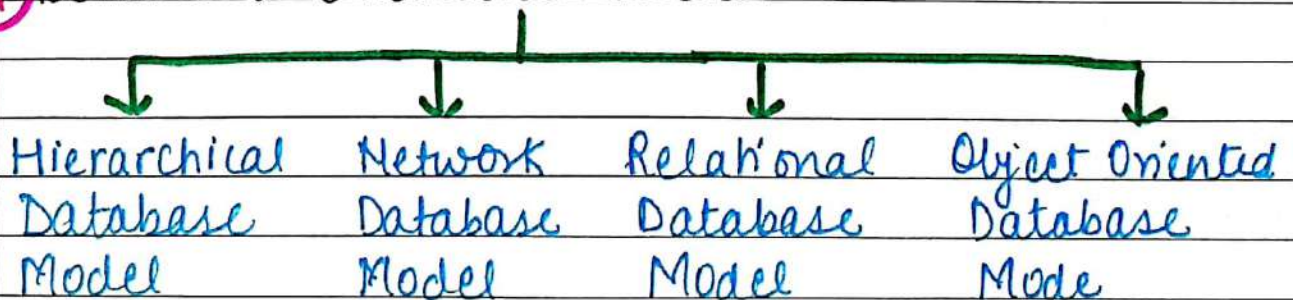
	<u>field</u>	<u>field</u>	
	S.No	Name	Contact No.
Record {	1	Amit	9808068091
Record {	2	Suraj	999,7861334
	3	Rahul	9412024803
	4	Raj	7896210070
			Class.
			XI
			X
			XII
			XII



Hierarchy of database

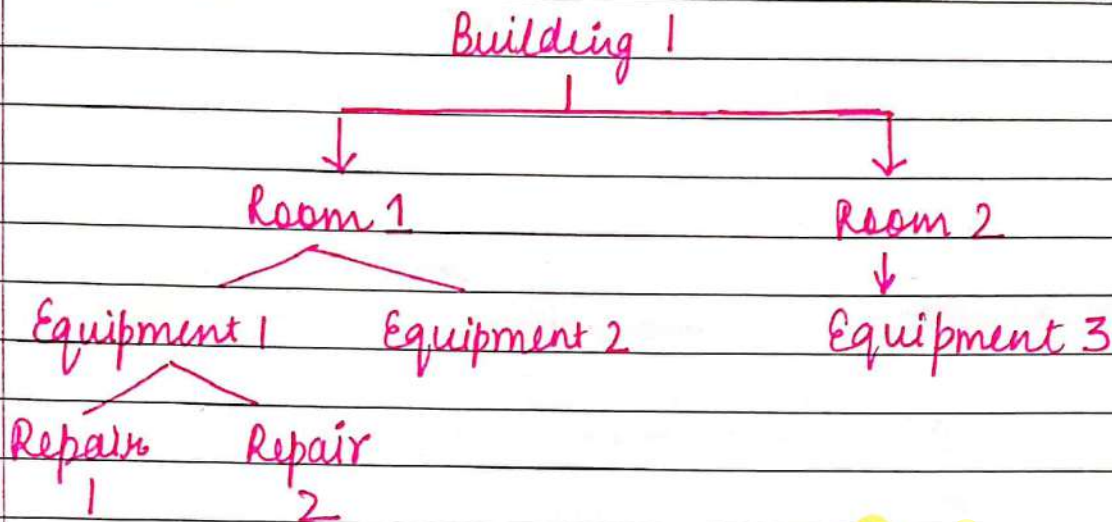


4 Prominent Database Models



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Hierarchical Database Model



- Database Model is arranged in a parent & child R/Ship
- It start with Root parent & flows top to bottom
- Only work with pre-defined Relationships (fixed)
- Inverted V or Inverted tree
- Only two type of Relationship 1 to 1, 1 to many
- Many to one / many to many Not possible
- Only top to bottom is allowed
- Bottom to top travelling Not Allowed.
- Top parent Record is called ROOT RECORD
- All records in hierarchy are called NODES
- There can be many levels of Node Records.

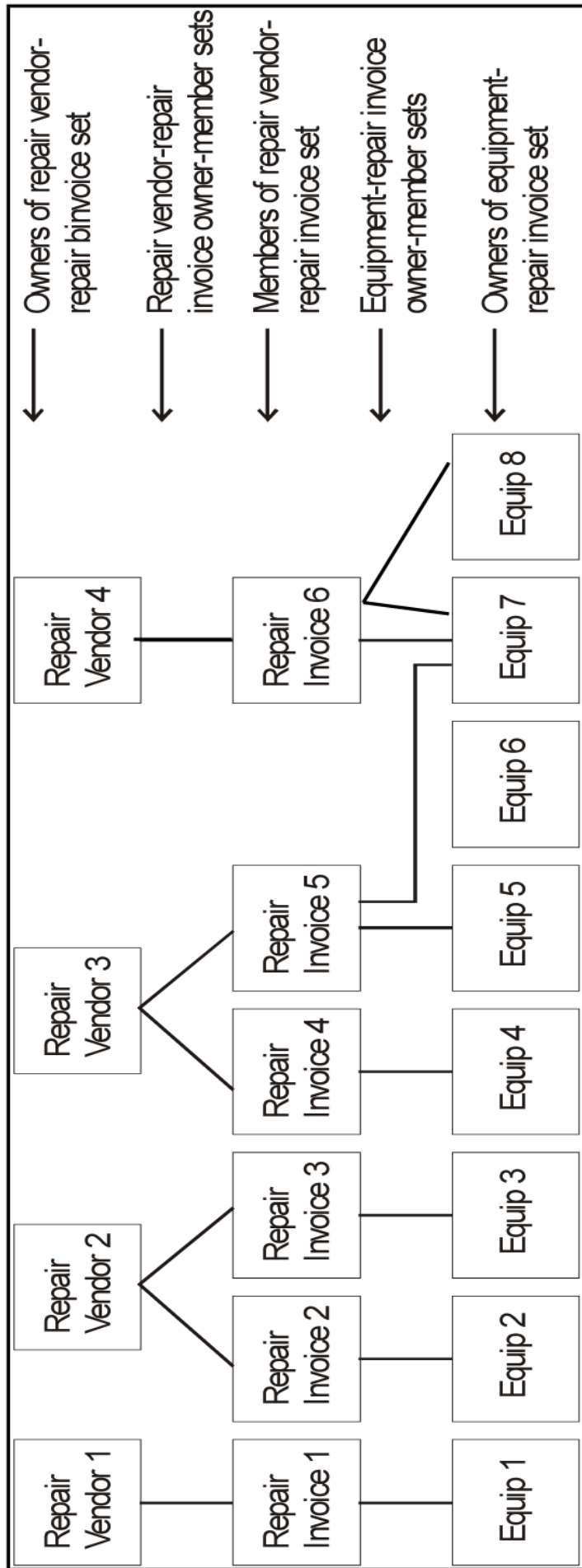
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Network Database Model

- It works with Individual groups or Set
- Therefore no ROOT
- Top to bottom & bottom to top is allowed
- All 4 Relationship allowed
- Works with parent child Relationship
- Only work with pre-defined R/ship [fixed]
- The network model also permits a record to be a member of more than one set at one time.
- The network model would permit the Equipment records to be the children of both room records & the vendor records.

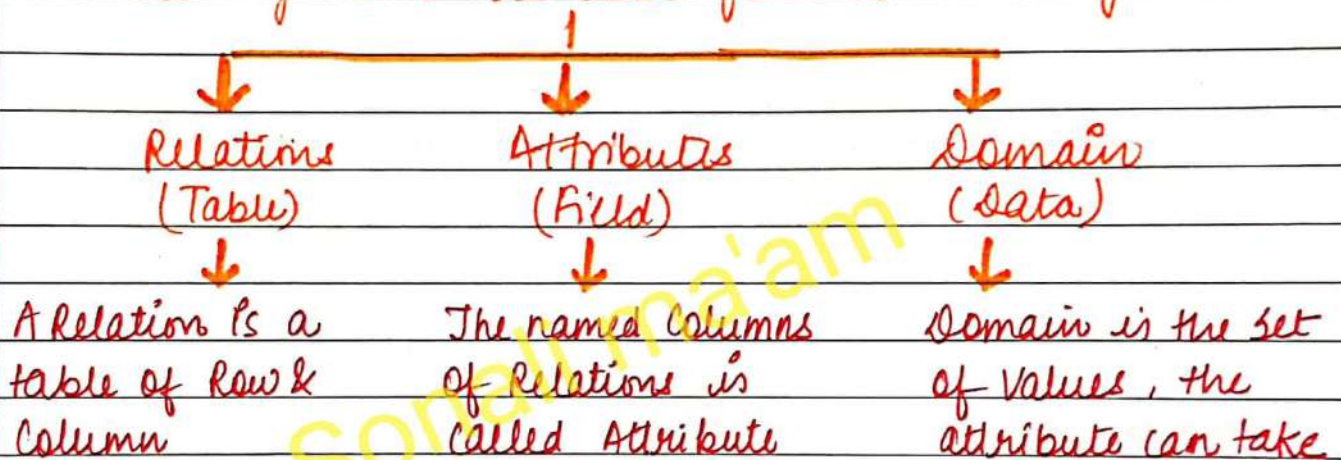
Notice the Relationships :-

- Repair Vendor 1 record is the owner of Repair Invoice 1 record. This is "one to one R/ship".
- Repair Vendor 2 record is the owner of Repair Invoice 2 & 3 records. This is "one to Many R/ship".
- Repair Vendor 3 record is the owner of Repair Invoice 4 & 5 records, & the Equipment 7 records owns both the Repair Invoice 5 & 6 records because it was fixed by different vendors twice. Because many equipment records can own many repair invoice records, these database represents "many to many R/ship".
- Equipment 7 & 8 own Repair Invoice 6 because the repairs to both machines were listed on the same invoice by Repair vendor 4. This is called "many to one R/ship".









Relational Database Model

- A Relational Database structure allows to store, retrieve, integrate data in TABLE STRUCTURE
- TABLE:- is a collection of records & each record in a table contains the same fields, which define the nature of the data stored in the table.
- Three Key Terms are used for understanding RDBMS



- A RELATIONAL DATABASE CONTAINS MULTIPLE TABLES WITH ATLEAST SIMILAR VALUE OCCURRING IN TWO DIFF RECORDS (belonging to same table) THAT IMPLIES A RELATIONSHIP AMONG THOSE TWO RECORDS.
- All tables are related by one or more fields for connecting through common field. One of the field is identified as PRIMARY KEY which is Unique Identifier for each record in the table. Key are commonly used to join/combine data from 2 or more tables
- If Primary Key of one table is used in another table it is called foreign key (ADDED MAY 2021)
- Eg MS ACCESS

Object Oriented Database Model

S.No	Name	PhoneNo.	Photo	Video
1	Sonali	8447824414		
2	Shirangi	842974414		
3	Sonam	8929474414		

- An object oriented database provides mechanism to store complex data [IMAGES, AUDIO, VIDEO]
- OODBMS is a set of objects
- An OODBMS is a kind of Relational DBMS which has the mechanism to store images, audio, video as well.

(ADDED MAY 2021)

- It combines diff aspects of OOP into DBMS like complex data types, multi-valued attributes
Eg - address field can have many attributes like H.no, Location, Zipcode etc.
- OODBMS helps programmers make objects which are independently functioning application or program, assigned with a specific task/role to perform.

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ADV/ DISADVANTAGES OF DBMS

Advantages

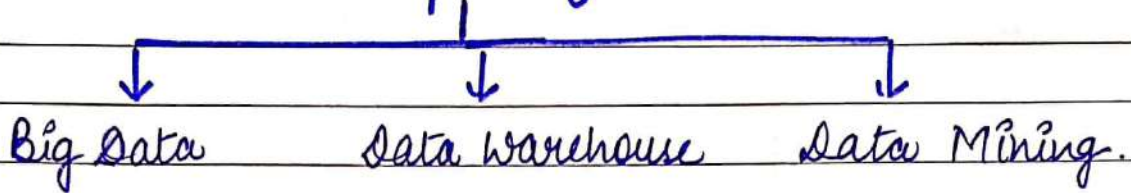
i) Permitting data sharing	Same information can be used by different users
ii) Minimize data redundancy	No need to repeat the same data over & over again due to PRIMARY KEY.
iii) Integrity can be maintained	If DBMS can be there, all data can be store at one place
iv) Program & file consistency	file formats & programs are standardized
v) User friendly	Easier access.
vi) Independence	Not dependent on each other
vii) Improved Security	PLW के द्वारा एक ही जगह में data Secured

Disadvantages

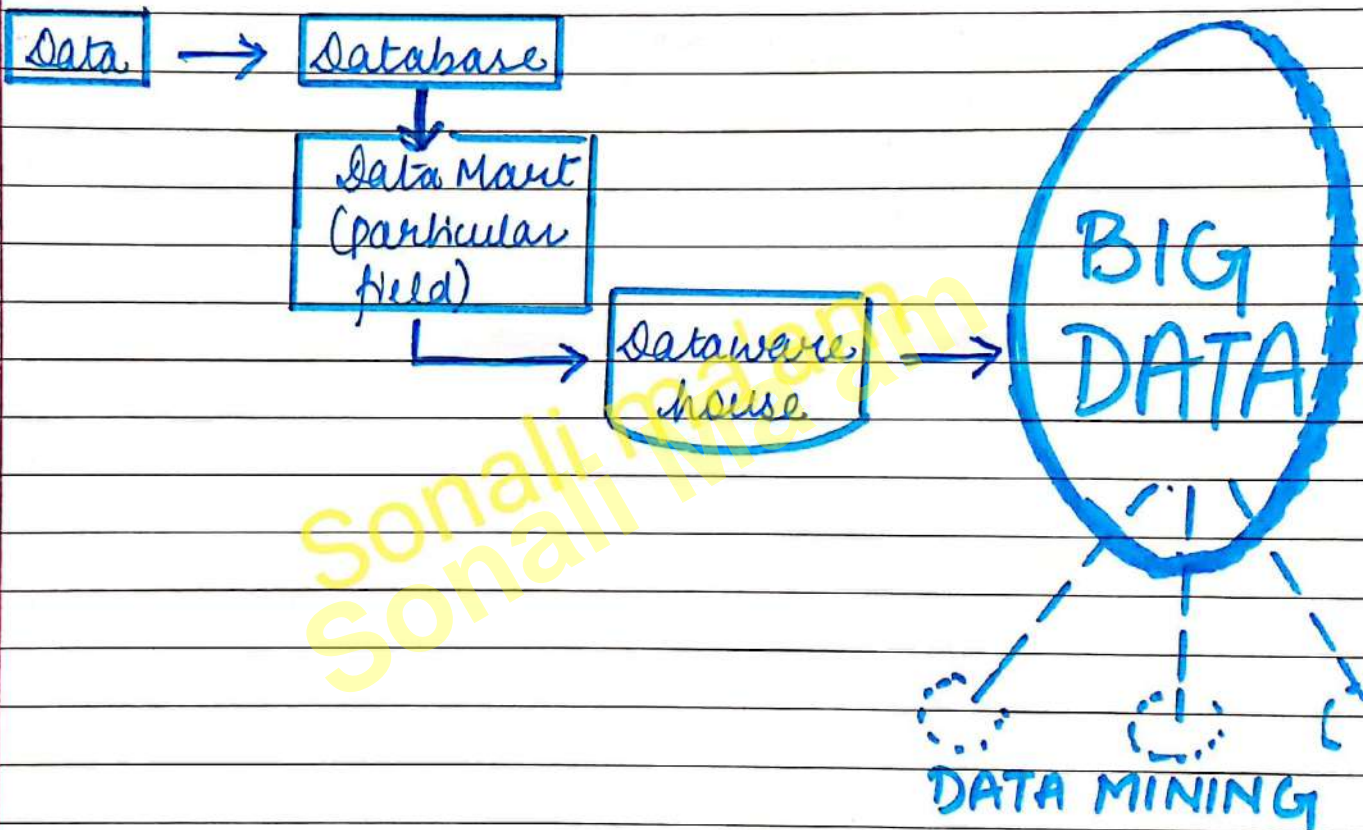
i) Cost	Expensive & Time Consuming
ii) Security	Not secured if Used by Unautho-sized.

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Some Related Concepts of Database



BIG DATA.



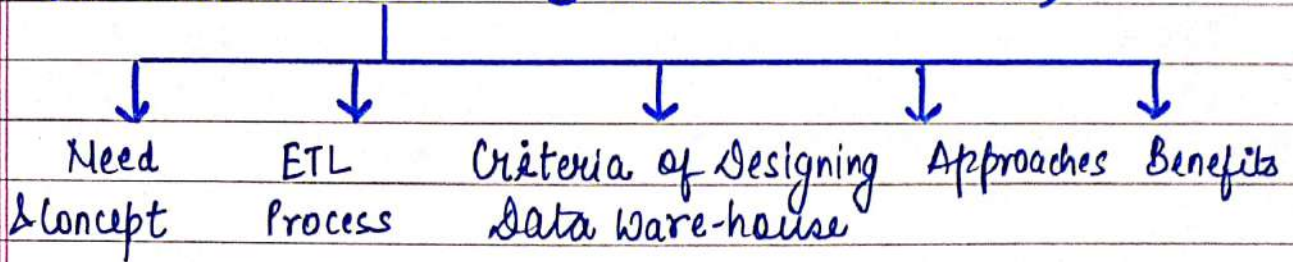
- It refers to the Massive / large data
- This is an interesting space to explore from a career prospective since everything is nothing more than data.
- Infact, you & I are nothing more than data points in database on various companies.

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BENEFITS OF BIG DATA (ADDED MAY 2020)

- i) Ability to process big data brings in multiple benefits such as
 - Businesses can utilize outside intelligence while taking decisions.
 - Access to social data through fb, twitter etc
 - Early identification of Risk to P&S
- ii) Improved Customer Service
 - Traditional systems (customer feedback) are getting replaced with BD technology
- iii) Better operational efficiency
 - it is due to integration of BD (data warehouses) which helps org to access data easily.

DATA WAREHOUSE (AMENDED MAY 2021)



Need & Concept

- Org. wants to analyze data in historical sense like comparing (today's data with some historical data)
- Here comes the need of Data Warehouse.
- It includes collection of various data-marts
- Via Data Warehouses, data is loaded into Big data.

ETL Process

The process of Extracting data from source & bringing it into Data Warehouse is commonly called ETL which stands for Extraction, Transformation & Loading.

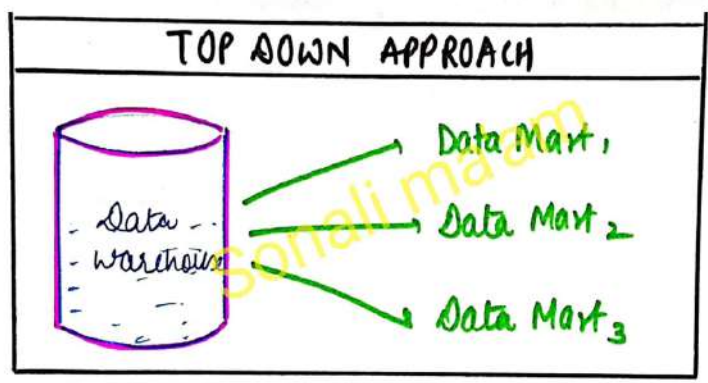
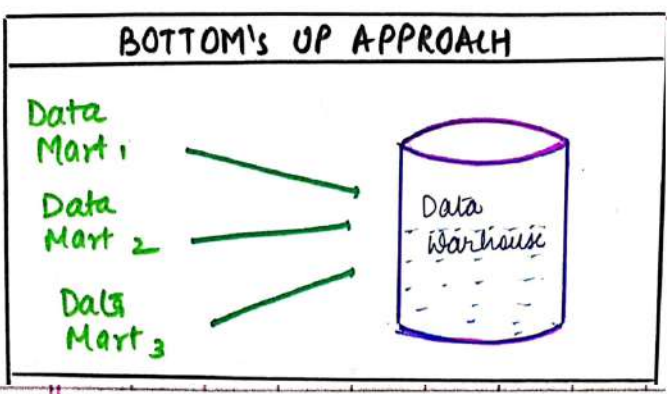
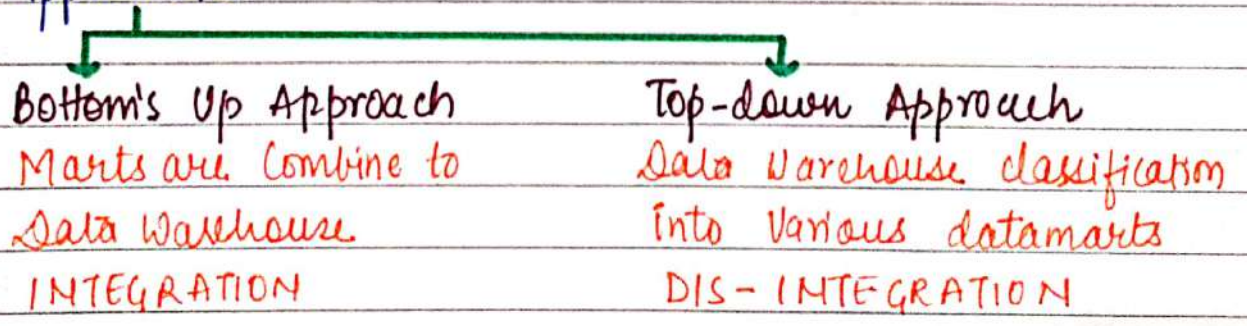
- In the first stage, data is Extracted from one or more of the Org's database
- In the second stage, data so extracted is placed in a temporary area called Staging Area, where it is transformed like cleaning, sorting, filtering etc as per the requirements
- The final stage involved the loading of data so transformed into a Data Warehouse.

Criteria of Designing Data Warehouse

A data warehouse should be designed so that it meets the following criteria -

- i) It uses non-operational data
Data Warehouse is using a copy of data from the active database that the company/org uses
- ii) Data is time-variant
Whenever data is loaded into DW, it receives a time stamp which allows comparisons b/w diff time periods.
- iii) Data is Standardized
For the datawarehouse to match up (dates) content, a standard format should be used which means all data loaded into the DW would have to be converted in a standard format before loading.

Approaches



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BENEFITS OF DATA WAREHOUSE

The benefits are as follows -

- a) Better Understanding of Data
- b) Centralized View
- c) Consistent (Same alltime, everywhere)
- d) Creates historical data
- e) Supports Analysis of Data.

DATA MINING

- Process of Analysing data



To find out previously unknown

trends

Patterns

Associations



To make the decisions

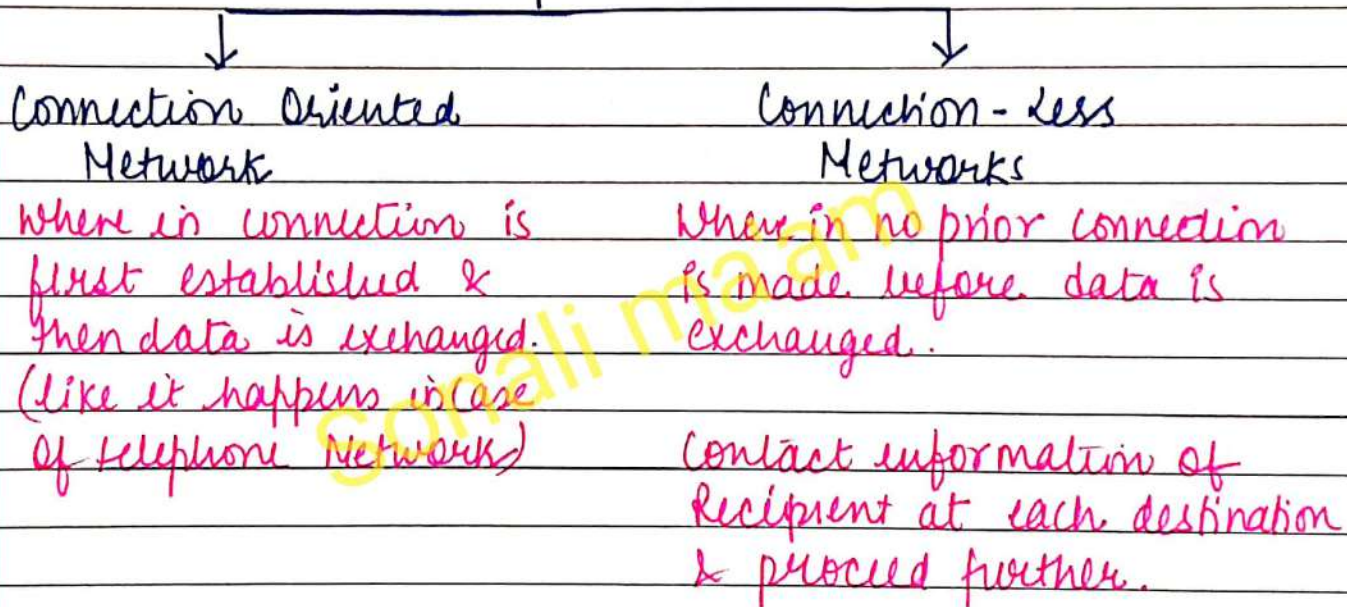
- Generally, data mining is accomplished through automated Means.
- It is used to gain Business knowledge now a days.

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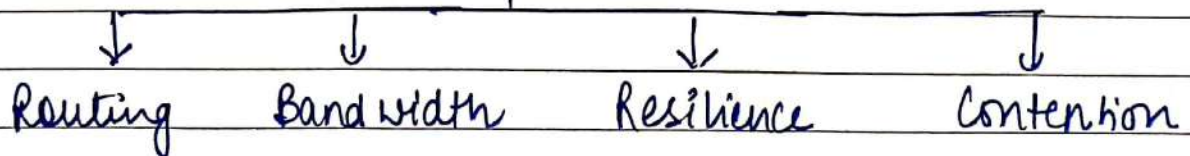
Network & Communication System

- A Network is a group of devices connected to each other
- It consist of connecting physical devices (S/W H/W)
- It transfers data from one location to another
- Data consists of voice, data, images, sound, video

Network types



Issues in Networking



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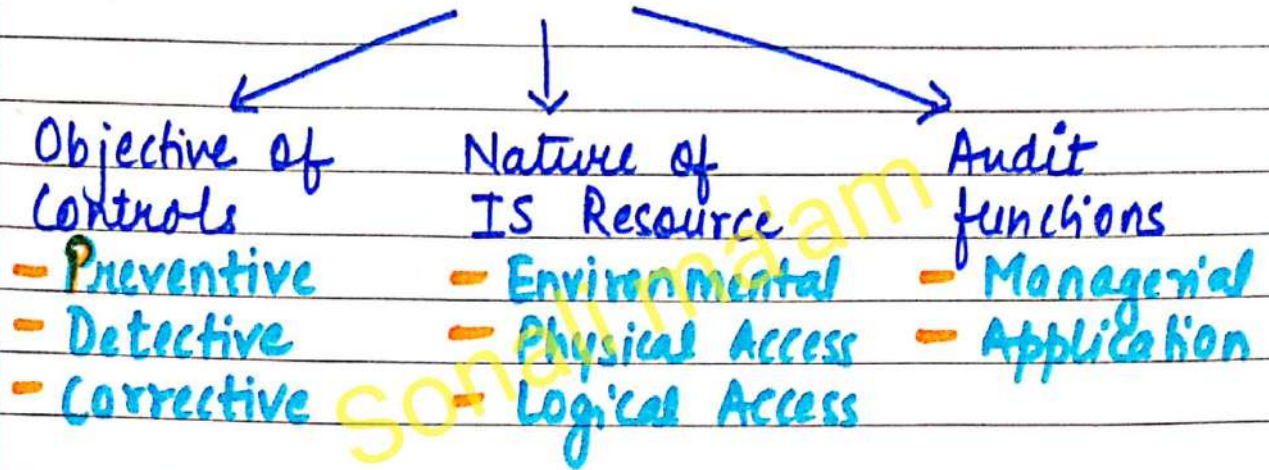
Routing (Route)	How to communicate data from its source to destination
Bandwidth (width)	Amount of data which can be send in a given time
Resilience (Recovery)	Ability of a Network to recover from error like connection failure
Contention (Conflict)	When two or more data stations attempt to transmit at same time over same connection

Benefits of Computer Network

↓	↓	↓	↓
Distribution	Resource Sharing	Reliability	Communication
Information can be distributed according to need	Data is stored at one place [Centralized] but is shared through networks	• Can Access 24x7 • Hence, Reliable (Also, due to Resiliency)	User can communicate through Video Call, E-mail etc easily.

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INFORMATION SYSTEM'S CONTROLS CLASSIFICATION



CLASSIFICATION BASED ON "OBJECTIVE OF CONTROLS"

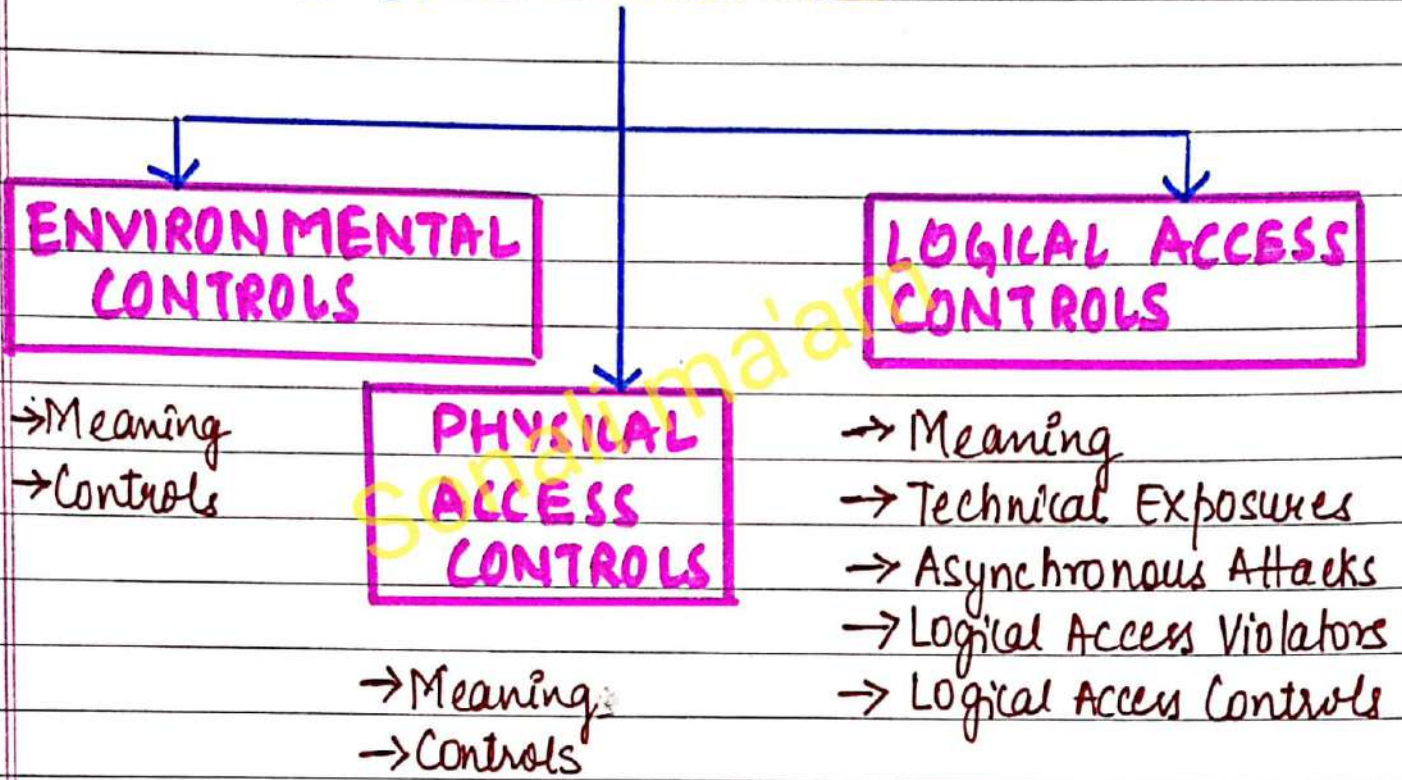
Preventive	<ul style="list-style-type: none"> • Preventive controls are, which are designed to prevent an error, or omission, or malicious act occurring. • Eg are <ul style="list-style-type: none"> - SOD - Anti-virus s/w - firewalls - Passwords • These controls can be implemented in both manual & computerized environment
Detective	<ul style="list-style-type: none"> • Detective controls are, which are designed to DETECT an error, or omission, or malicious act occurring.

- Egs are
 - Review of Payroll Reports
 - Monitor actual vs Budgeted figures
 - Cash/Bank Reconciliation.
- Characteristics of DETECTIVE Controls are
 - Deviation can be reported
 - Preventive controls can be implemented.
 - Surprise checks by supervisor

Corrective

- Corrective controls are designed to reduce the impact or correct an error once it has been detected.
- Egs are
 - Submit correct Journal entries after discovering an error
 - BCP
 - Backup procedure
- Characteristics of CORRECTIVE CONTROLS are
 - Identification of the problem & its cause
 - Minimizing impact of threat
 - Remedy to the problems discovered by detective controls.

CLASSIFICATION BASED ON "NATURE OF IS RESOURCES"

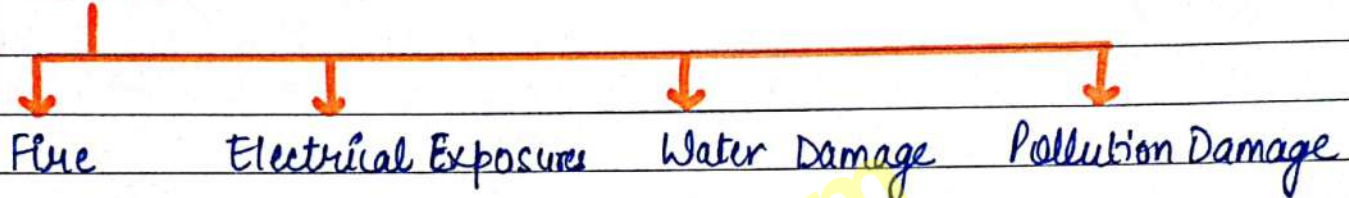


ENVIRONMENTAL CONTROLS

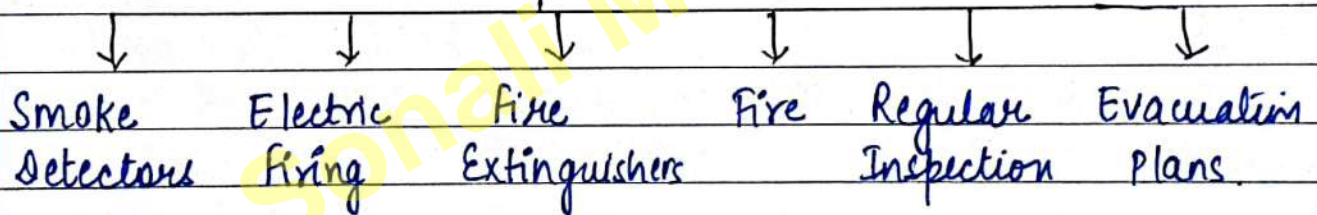
Meaning

- These are the controls relating of IT Env't
- Such as power, A.C, V.P.S, smoke detector, fire extinguishers etc

Controls



Fire [Physical security of computer]



Smoke Detectors

- It should be positioned at places above & below the ceiling tiles.
- Upon activities, these detectors should produce an audible alarm & must be linked to a monitored station

Norms to reduce Electric firing

- Location of computer room should not be basement / ground floor
- Less wood & plastic material should be used in computer rooms.
- Fire proof walls, floors & ceilings

Fire Extinguishers

- Manual fire extinguishers can be placed
- CO₂ based fire extinguishers should be well placed.

Fire Alarms

- Automatic & manual fire alarms may be placed & control panel may be installed
- A gas-based fire suppression system is preferable.

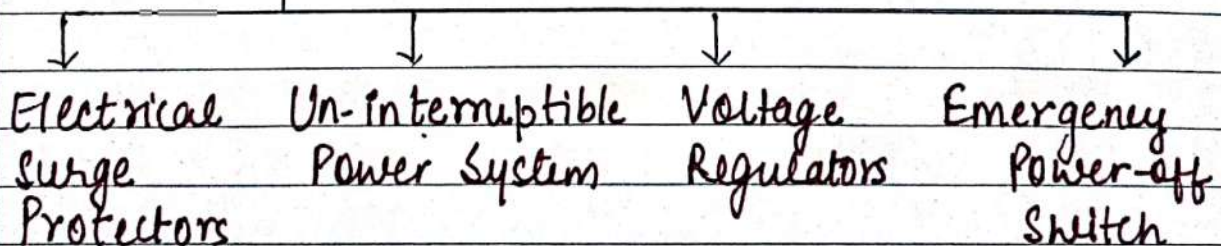
Regular Inspection

- Regular inspection by fire dept officials
- Fire exits should be clearly marked
- Staff members should know how to use the system in emergency

Documented & Tested Emergency Evacuation Plans

- Procedures should exist for a controlled shutdown of the company in an emergency
- Relocation plans should emphasize human safety but should not leave information processing facilities physically unsecured.

Electrical Exposures [Risk damages due to electrical faults]



Electrical Surge Protectors	Risk of damage due to power spikes can be reduced using Electrical Surge Protectors that are typically built into UPS.
UPS	It provides backup by providing electrical power from the battery to computer
Voltage Regulator	These protect the hardware from the temporary increase or decrease of power
Emergency Power Off Switch	During situations like computer room fire or emergency power off, they should be easily accessible.

Water Damage [Damage: outcome of water pipes]
Burst

↓ ↓ ↓

Water Detectors	Strategically locating computer room	Ways of protecting against water damage
-----------------	--------------------------------------	---

Water Detectors	These should be placed under the raised floor, near drain holes and near any unattended equipment storage facilities.
-----------------	---

Strategically locating the computer room.	To reduce the risk of flooding, the computer room should not be located in the basement of ground floor.
---	--

Ways of protect-
against water
damage.

- Waterproof Ceilings, walls & floors
- Ensure an adequate drainage Sys. exists.
- Install alarms at strategic points
- Water proofing & water leakage Alarms.

Pollution Damage [Major Pollutant : Sust]



Power leads from
Two Substations

Prohibitions against Eating, Drinking
within Info-Processing Facility.

Power leads from
Two Substations

- Electrical power lines are exposed to many environmental dangers such as water, fire, lightning etc
- Redundant power links should feed into so that it doesn't effect supply

Prohibitions ag.
Eating, Drinking

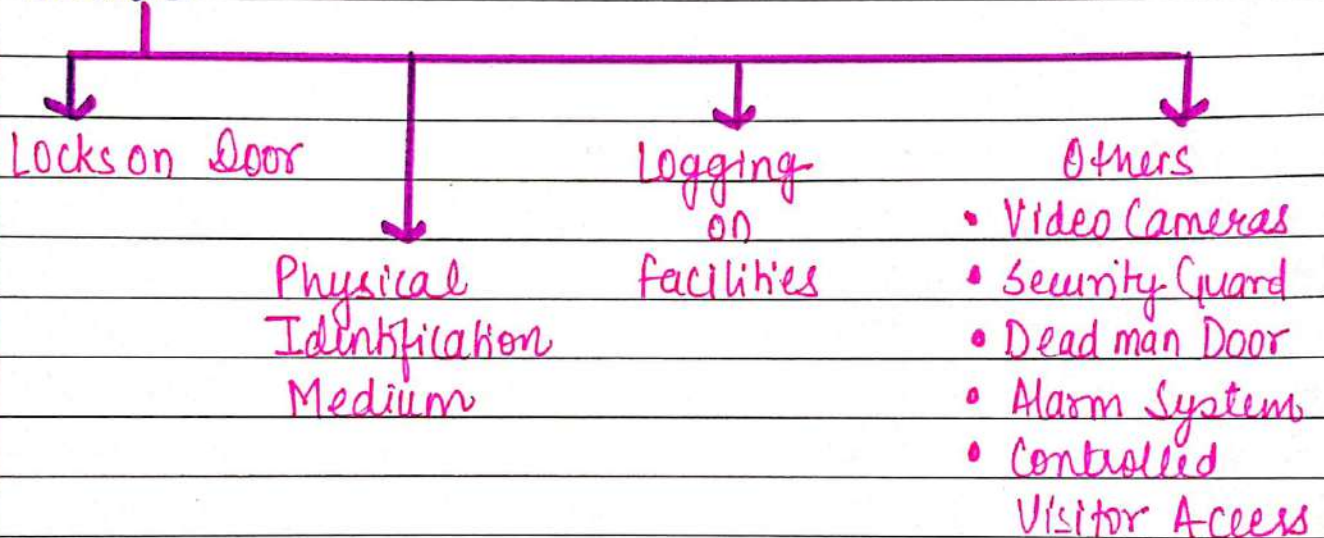
- These activities should be prohibited from the information processing facility
- This prohibition should be clear.
Eg: Sign on the entry door

PHYSICAL ACCESS CONTROLS

Meaning

- These are the controls relating to Physical Security of a) Tangible IS resources
b) Intangible resources stored on Tangible media.
- Such as, Security guards, CCTV monitoring, visitor logged access.

Controls



<p>Locks on Door</p>	<p>1. Cipher Locks To enter, a person presses a four digit number & the door will unlock for a pre-determined period usually 10 seconds</p> <p>2. Bolting Door Locks (BDL) A special metal key is used to gain entry when lock is BDL.</p>
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3. Electronic Door Locks

A magnetic or embedded chip-based plastic card key or token may be entered to gain access into systems.

Physical Identification Medium

1. PIN

A secret number will be assigned to the individual. Visitor will be asked to log on by inserting a card in some device & then enter their PIN via PIN keyboard. His/Her entry will be matched with the PIN in the security database.

2. Plastic Cards

Used for Authentication/Identification purpose.

3. Identification Badges

Special identification badges issued to diff personnels including visitors.

Logging on Facilities.

1. Manual logging

All visitors should be required to sign a visitor's log indicating their name, company represented, purpose of visit etc. following with the valid ID photo proof, identification tag.

Other means
of controlling
Physical
Access

2. Electronic Logging

This is feature combining electronic & biometric security systems. Users logging can be monitored & unsuccessful attempts may be highlighted.

1. Video cameras

Cameras to be placed at specific locations & continuously monitored

2. Security guards

Appointing guards for extra security aided with CCTV

3. Controlled visitor access

Responsible employee should escort all visitors.

4. Dead Man doors

These are the system where pairs of doors are there.

- The first entry door must be close & lock

- for second door to operate, only one person permitted in the area.

5. Alarm Systems

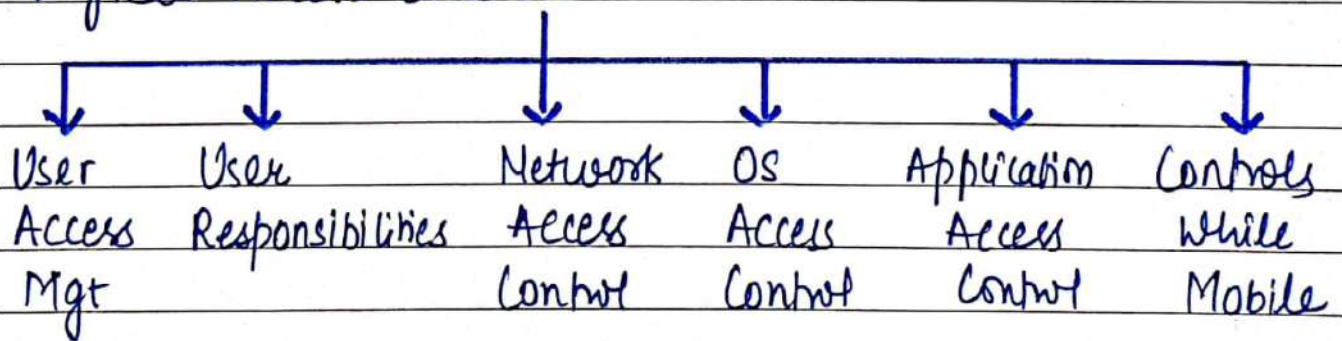
Illegal entry can be avoided by linking alarm system to entry points.

LOGICAL ACCESS CONTROLS

Meaning

- These are the controls relating to logical access to information resources such as Operating System controls, application CLW etc
- These controls are implemented to ensure that access to systems, data & programs is restricted to authorized users to safeguard information against un-authorized use, disclosure & modification, damage or loss.
- Compromise or absence of logical access controls in the org. may result in potential losses due to exposures that may lead to total shutdown of the computer functions.

Logical Access Controls

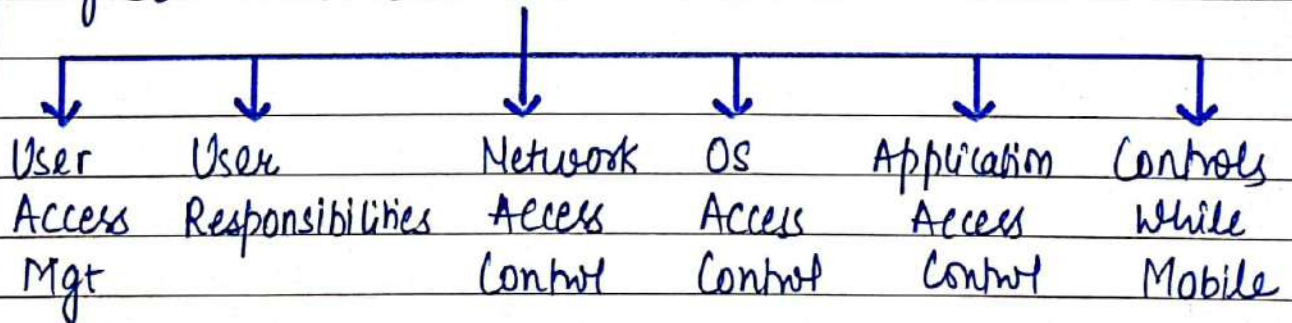


Logical Access Violators (LAV)

LAV are often the same people who exploit physical exposures, although the skills needed to exploit logical exposures are more technical & complex.

1. Hackers try their best to overcome restrictions to prove their ability.
2. Employees (Authorized / Unauthorized)
3. IS personnel - due it while discharging their duties
SOX helps to reduce this.
4. former employees - those specially who left on the unfavourable terms.
5. End Users - interested or educated outsiders, foreigners vendors, consultants etc

Logical Access Controls



User Access Management

- User Registration & de-registration
- User Privilege mgt (as per job function)
- User password mgt
- Review of User access Rights (as access changes with time)

User Responsibilities

- Password Use
- Unattended user Equipment (Should not leave it accessible to others)

Network Access Control

- Policy on Use of Network Services
- Enforced path
- Segregation of Networks
- Security of Network Services
- Firewall

Operating System Access Control

- Terminal login procedure
- Access token, Control
- Password mgt Systems
- Terminal time out
- Limitation of Connection time

Application Access Control

- Information access restriction
- Event Logging

- Clock Synchronization

Controls while Mobile

- Fingerprint
- Eye-iris
- Smart Cards

Sonali ma'am

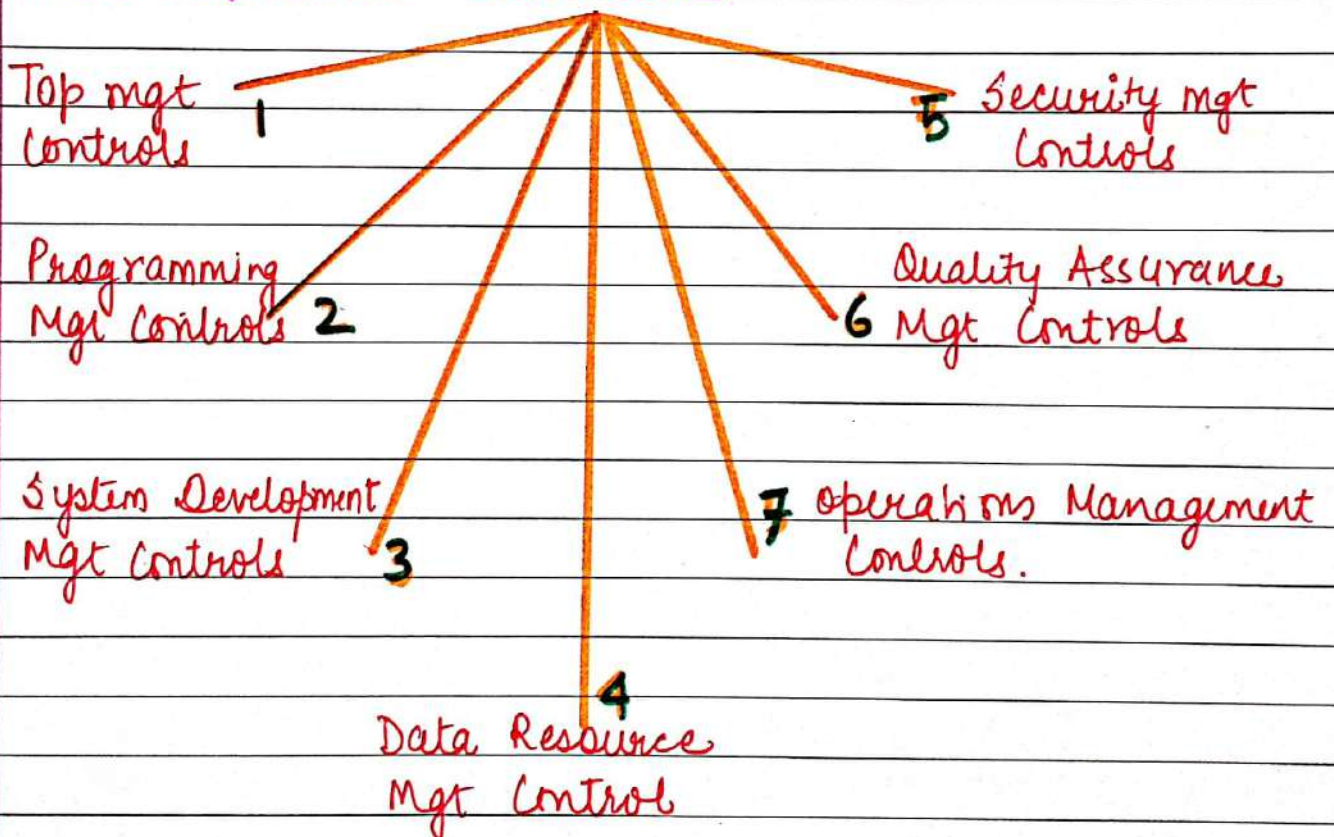
CLASSIFICATION BASED ON "AUDIT FUNCTIONS"

MANAGERIAL CONTROLS

APPLICATION CONTROLS

(Auditors have found two ways to be useful while conducting IS Audits)

MANAGERIAL CONTROLS



1. TOP MANAGEMENT CONTROLS

(Controls adapted by mgt to ensure I.S functions correctly & meet objectives)

Major f^{ns} that a Senior mgt must perform are -

Planning	Includes determining the goals of I.S. & the means of achieving them (either short term or long term)
Organising	Prescribed IT Org Structure with documented roles & responsibilities & agreed Job descriptions
Leading	Includes motivating, guiding & communicating with personnel
Controlling	Includes comparing actual performance with their planned performance as a basis for taking any corrective actions

2. SYSTEM DEVELOPMENT MGT CONTROLS

(AMENDED MAY 2022)

(Concerned with analyzing, designing, building, implementing & maintaining I.S)

S.D- Controls are targeted to ensure that proper documentat^{ns} & authorizations are available for each phase of S.D. process.

a Problem definition & feasibility assessment

- I.S can be developed to help resolve problems
- Stakeholders must reach to agreement on the problem & the feasibility assessment should be done to obtain effective solution

b Analysis of Existing System

- Designers need to analyse 2 major tasks
- Studying existing Organisational history, culture, the ways systems are coupled & the willingness of Shareholders to change
 - Strengths & weakness of existing product to determine extent of change.

c Info. Processing System design

- It includes the following
- Elicitation of detailed requirements
 - Design of data/information flow
 - Design of database & User Interface
 - Physical design
 - Design of H/W S/W platform.

d H/W S/W Acq. & Procedures development

- To purchase H/W S/W, a request proposal must be prepared
- Vendor proposals are sought & final decisions are based.

e Accepting^{ance} Testing & Conversion

- Acceptance Testing is carried

e Acceptance Testing & Conversation	<ul style="list-style-type: none"> • Acceptance Testing is carried out to identify errors/deficiencies in the system prior to final release.
f operation & Maintenance	<ul style="list-style-type: none"> • New system is run as a production sys. to better meet its objectives. • Maintenance activities associated with these systems need to be monitored.

3. PROGRAMMING MGT CONTROLS (AMENDED M-22)

(The primary objectives of this phase are to produce or acquire high quality programs)

PROGRAM DEVP LIFE CYCLE.

Planning	This phase estimates the resources reqd for s/w devp, acquisition & implementation
Design	Programmers seek to specify the structure & operation of programs
Coding	Programmers need to choose implementat ⁿ strategy, coding strategy, documentat ⁿ strategy
Testing	3 types of Testing - Unit Testing - Integration Testing - Whole of Program Testing
Operation & Maintenance	3 types of M - Repair, Adaptive & Perfective.

4. DATA RESOURCE MANAGEMENT CONTROLS

(Amended May-2022)

(Data integrity is defined as maintenance, assurance, accuracy, consistency of data)

It includes the following

Definition Controls	Placed to ensure that the database is always corresponding & complying with standards.
Existence/ Backup Controls	Backup ensure the availability of system in the event of data loss [due to unauthorized access, equipment failure, disaster]
Access Controls	<ul style="list-style-type: none"> • Designed to prevent unauthorized individual from viewing, retrieving, computing or destroying data. • Its established through PW, tokens & biometric controls including encryption.
Update Controls	Controls restrict update of database (2 ways) - permitting only data addition - allowing change / delete data
Concurrency Controls	Controls provide solutions & strategies to overcome data integrity problems
Quality Controls	Measures such as program validation of input data & batch controls over data

5. SECURITY MANAGEMENT CONTROLS

- Information Security administrators are responsible for ensuring that IS assets (H/W, S/W, OS etc) are secure.
- These assets can be secured by applying controls
- But, despite of controls, disaster might happen. Therefore, it shall have a Disaster Recovery Plan (DRP)
- DRP consists of
 - Emergency Plan
 - Recovery Plan
 - Backup Plan
 - Test Plan
- In other words, BCP [Business Continuity Plan] should exist. to make sure IT services are available as required even in the event of major disruption

6. QUALITY ASSURANCE CONTROLS

- QA personnel should work to improve the quality of information systems produced in an Org. & to comply the standards of Quality.

- QA personnel perform a monitoring role to ensure that
 - Quality goals are established & understood clearly by all stakeholders &
 - Compliance occurs with the standards that are in place to attain Quality Information systems.

7. OPERATION MANAGEMENT CONTROLS

OM is responsible for daily running of H/W & S/W facilities.

It includes

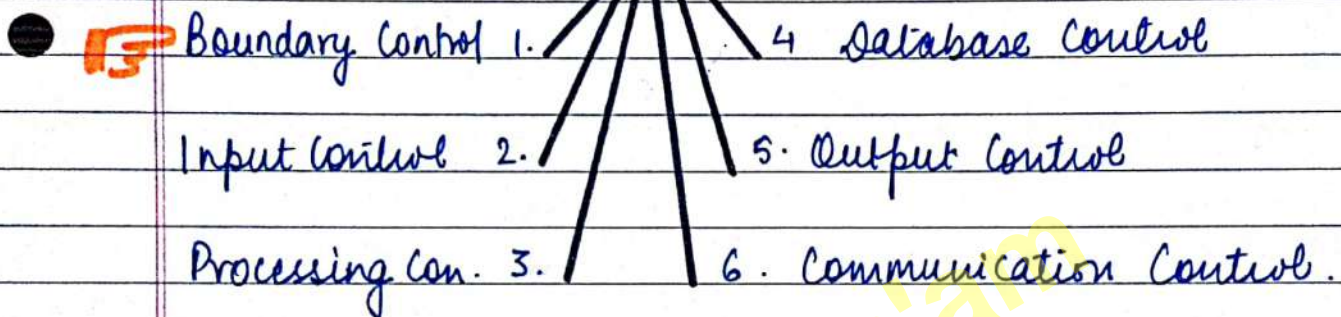
- Computer operations
Controls over computer operations govern the activities that directly support day to day execution on H/W or S/W platform.
- Network operations
Includes proper functioning of Network operations, monitoring network communication channels, network devices, network programs & files.
- Data preparation & Entry
Although the main/primary data will be provided but keyboard & other facilities should be designed to promote speedy & accuracy.

- Production Control
 - Includes functions like receipt & dispatch of input & output
 - Job Scheduling
 - Acquisition of Computer Consumables
- File Library
 - Includes mgt of Org's machine-readable storage media like magnetic tapes, Cartridges, disks etc
- Documentation & Program Library
 - Involves that documentation Librarians ensures that documentation is stored securely & only authorized personnel gains the access.
- Help desk
 - Assistance (such as spread-sheet packages, DBMS packages) to end users for their solutions to the emerging problems.
- Capacity Planning & Performance Monitoring
 - Wherein resource deficiencies are identified on time & made available, leaving no resource remain underutilized
- Mgt of outsourced operations
 - Responsibility for carrying out day to day monitoring of the "outsourcing Contract".

APPLICATION CONTROLS (AMENDED MAY 2022)

Application system controls involve ensuring that individual application system safeguard assets, maintain data integrity & achieve objectives E&E.

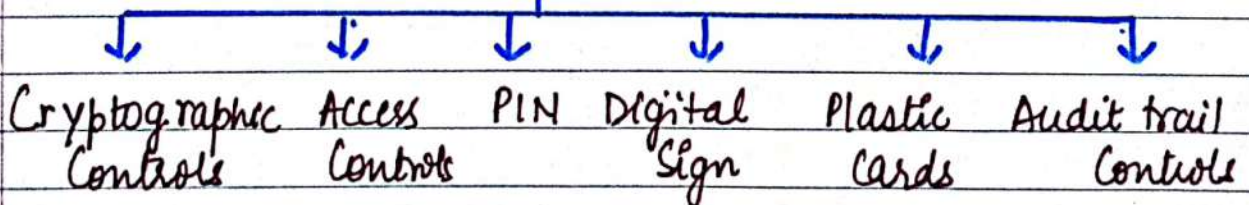
Application Controls



1. Boundary Controls. (Amended May 2022)

It includes access control mechanisms that links the authentic users to the authorized resources.

Major controls are:-



Cryptographic Controls

- These deal with programs for transforming data into cipher text that are meaningless to anyone
- Cryptographic technique transforms data into Cryptograms by Cryptanalyst
- 3 techniques of Cryptography
 - Transposition
 - Substitution
 - Product Ciphers.

Access Controls

- These restricts the use of Computer resources to authorized users. It includes 3 steps
 - User's Identification
 - Authentication
 - Authorization
- It's of 2 types - MAC & DAC.

PIN (Personal Identification Numbers)

- PIN is like a password assigned to user by random number
- It is independent of User Identification details.
- It includes following steps
 - Generation of PIN
 - Issuance & delivery of PIN
 - Validation upon entry at terminal
 - Transmission of PIN across commⁿ lines
 - Processing of PIN
 - Storage of PIN
 - Change of PIN

	<ul style="list-style-type: none"> - Replacement of PIN - Termination of PIN
Digital Sign.	Digital signature (a string of 0's & 1's) is used as analog signature to sign e-documents.
Plastic Cards	<p>Plastic cards are used primarily for Identification purpose</p> <p>It includes the phases namely</p> <ul style="list-style-type: none"> - application for a card - preparation of card - Issuance of card - Use of card - Card return / termination
Audit Trail Controls	<p>It maintains the chronology of events that occur when a user attempts to gain access to employ sys. resources</p> <p>It may be</p> <ul style="list-style-type: none"> - Accounting Audit Trail - operations Audit Trail.

2. INPUT CONTROLS

- Data that is presented to an application as input must be validated for authorization, reasonableness, completeness & integrity.
- Input controls are important as substantial time is spent on input of data & involves human intervention & therefore error & fraud prone.
- Types of Input Control
 - Source Document Control
 - Batch Control
 - Data Coding Control
 - Validation Control.

Source Document Controls

- In Systems that use physical source documents to initiate transactions, careful control must be exercised over these instruments
- Source Document fraud can be used to remove assets from the organisation

Data Coding Controls

- Two types of errors [Transcription & Transposition] can cause processing errors.
- **Transcription Errors**
It is a special type of data entry error that is commonly made by human operator OR OCR like
 - Addition errors: Extra digit added
 - Truncation errors: Digit removed
 - Substitution errors: Digit Replaced
- **Transposition Errors**
It is a simple error of data entry that occur when two digits that are either individual or part of larger numbers are reversed
 - Like 987654 transposed to 897654

Batch Controls

- Batching is the process of grouping together transactions that bear some type of relationship to each other
- Various controls can be exercised on Batch to prevent/detect errors.

- Three types of Batch Controls are -
 - Financial total
 - Hash total
 - Document / Record counts

Validation Controls

- Input Validation controls are intended to detect errors in the transaction data before data is processed.
- Some of these controls are
 - Field Interrogation
It involves programmed procedures that examine the characters of the data in the field
 - Record Interrogation
This includes reasonableness check
 - File Interrogation
This includes version usage, internal & external labelling, data file security, file updating etc.

3. PROCESSING CONTROLS

- It is responsible for Computing, sorting, classifying & summarizing data
- Its major components are
 - Central Processor
 - Real Memory & Virtual Memory
 - OS & App.

Therefore, Processing Controls are -

Processor Controls	Used to reduce expected losses from errors & irregularities associated with Central Processor.
Real Controls	seek to detect & correct errors that occur in memory cells & to protect areas of memory - assigned to a particular program from illegal access by another program.
Virtual Controls	It seeks to control the mechanism where addressable space is larger than the available real space.
Data Processing Control	Performs validation checks to identify errors during processing of data. They are required for accuracy of processing of the transactions.

4. Database Control (Amended May 2022) (Controls used within an application software)

It includes

- Access Controls
- Integrity Controls
- Application S/W Controls
- Concurrency Controls
- Cryptographic Controls
- File-Handling Controls

5. Output Controls (Amended May 2022) (Controls ensure that the data delivered to users will be presented, formatted, & delivered in secured manner)

Output controls are

- Inference Controls
- Batch Output Production & Distribution Controls
 - Report program execution Controls
 - Spooling file Controls
 - Printing Controls
 - Report collection
 - User / Client service Review
 - Report distribution Controls
 - User Output Controls
 - Storage Controls
 - Retention & destruction
- Batch Report Design Controls
- Online Output production & distribution Controls.

6. Communication Controls.

(Amended May 2022)

(Controls over Communication line errors, flows & links)

Some communication controls are -

Physical Component Controls	Major physical components that affect the reliability of communication sys. are - Transmission media Communication lines Port protection devices Multiplexes & Concentrators
Line Error Controls	Error over a communication line because of distortion or noise must be detected & corrected.
Flow Controls	<ul style="list-style-type: none">• Flow controls are needed because 2 nodes in a network can differ in terms of rate at which they send, receive & process data• Therefore, F.C will be used to prevent the data being lost
Link Control	<ul style="list-style-type: none">• It manages the link b/w 2 nodes in a network• The way these link mgt components operate is specified via a protocol.

<p>Topological Controls</p>	<ul style="list-style-type: none">• Topology specified the location of nodes within a network (linkage)• Network must be available for use at any one-time by a given no. of Users requiring alternative H/W, S/W.
<p>Channel Access Controls</p>	<ul style="list-style-type: none">• There is a possibility of Contention in communication• Therefore, Channel access controls like<ul style="list-style-type: none">— Polling method or— Contention methodmust be used.
<p>Controls over Subversive threats</p>	<ul style="list-style-type: none">• Physical barriers to be established• Secondly, In case intruder has somehow gained access, data needs to be rendered useless.
<p>Internet Working Controls</p>	<ul style="list-style-type: none">• Inter-networking includes bridge, router• Several controls wrt security & reliability of networks are reqd.
<p>Audit Trail Controls</p>	<ul style="list-style-type: none">• Chronology. maintenance• 2 ways<ul style="list-style-type: none">— Accounting Audit Trail— Operations Audit Trail.