CHAPTER 4: DECISION SUPPORT AND INTELLIGENT SYSTEM

ANKU JAISWAL(ASSISTANT PROFESSOR), IOE, PULCHOWK

SYLLABUS

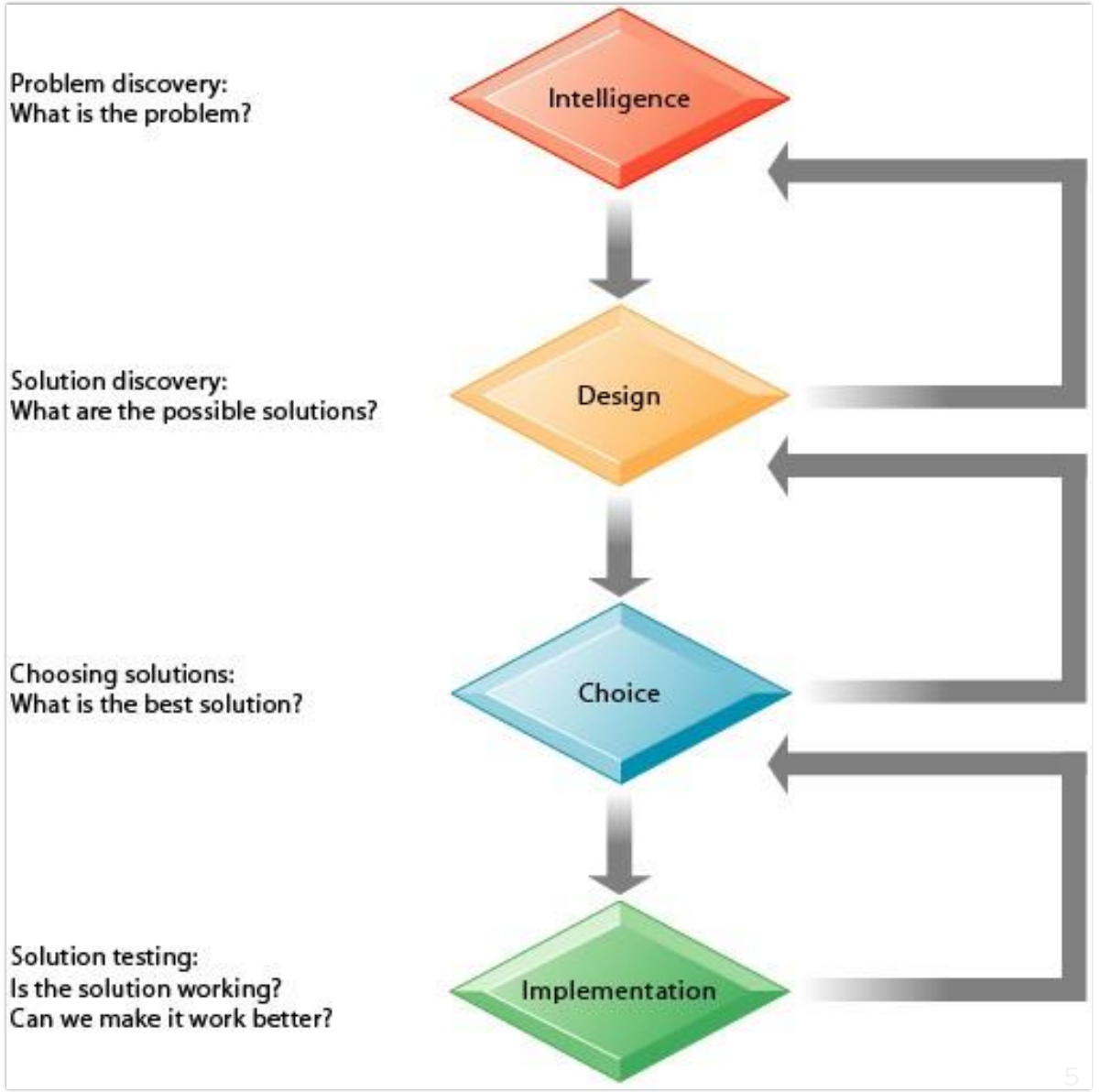
- Decision support and Intelligent systems
- DSS, operations research models
- Group decision support systems
- Enterprise and executive decision support systems
- Knowledge Management, Knowledge based Expert system
- AI Neural Networks, virtual reality, Intelligent Agents
- Data mining, Data warehousing, OLAP, OLTP

DECISIONS

- "a choice that you make about something after thinking about several possibilities"
- the action or process of deciding something or of resolving a question.
- A choice made between alternative courses of action in a situation of uncertainty.

- Information is used to make decisions. Decision making is not a single activity that takes place all at one.
- The process consists of several different activities that take place at different times.
- The decision maker has to identify and understand problems.
- Four different stages in decision making are
  - Intelligence
  - Design
  - Choice
  - Implement

DECISION MAKING STAGES



DECISION SUPPORT SYSTEM

- "A computer-based information system that combines models and data in an attempt to solve semi-structured problems with extensive user involvement."(Turban et al, 2002)

Route optimization.

A DSS can be used to plan the optimal route between two points by analyzing the available options. These systems often include the capability to monitor traffic in real-time to route around congestion.

- is an integrated set of computer tool
- allows a decision maker to interact directly with computers to create information useful in making decisions.
- help decision makers and to identify and solve problems and make decisions.

- helps the information system in the intelligence phase to identify the problem and then go to the design phase for solution.
- The choice of selection criteria varies from problem to problem.
- It is required to go through these phase again and again till the satisfactory solution is found.

- **Structured Decisions:** Structured or Programmed decisions are the ones where the organization has already faced such decisions. And the employees are used to solving such problems. For instance the hiring of new IT specialists in a firm.
- **Unstructured Decisions:** With unstructured decisions, for example, each decision maker may use different data and processes to reach a conclusion. An example of an unstructured decision might be **setting policy for a new technology**.
- **A semi-structured** decision is one in which most of the factors needed for making the decision are known but human experience and other outside factors may still play a role. A good example of an semi-structured decision would be diagnosing a medical condition

- Decision may be rapidly changing and not easily specified in advance.
- DSS are used to collect data, analyze and shape the data that is collected, and make sound decisions
- The nature of the decision is such that the decision makers need a variety of information
- serve the management, operations, and planning levels of an organization and help to make decisions

Uses of DSS – Some Examples

- **Forecast passenger demand and schedule aircraft**
- Predicts customer buying patterns
- Corporate forecasting and planning
- Risk evaluation on major projects

Characteristics of DSSs

- Can be used by individual managers and groups of managers at all levels of the organisation to solve unstructured problems
- Supports all stages of the decision-making process and different styles of decision-making
- Can be adapted over time to meet changing circumstances
- Easy to construct and use
- Promotes learning which creates demands for improvements
- Allows the easy execution of sensitivity analyses

Computerized Support for Decision Making

Why use computerized decision support systems?

- Speedy computations
- Improved communication and collaboration
- Improved data management
- Managing giant data warehouses

Computerized Tools for Decision Support

- Data management
- Reporting status tracking
- Visualization
- Business analytics
- Strategy and performance management
- Communication and collaboration
- Knowledge management
- Intelligent systems
- Enterprise systems

TYPES OF DECISIONS

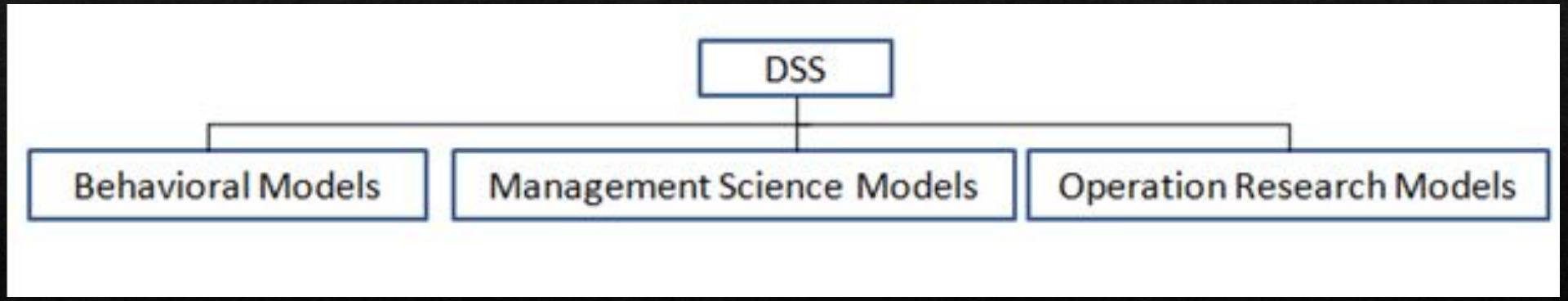
- A structured decision is one in which the phases of the decision-making process (intelligence, design, and choice) have standardized procedures, clear objectives, and clearly specified input and output. There exists a procedure for arriving at the best solution.
- An unstructured decision is one where not all of the decision-making phases are structured and human intuition plays an important role.
- A semi-structured decision is one in which most of the factors needed for making the decision are known but human experience and other outside factors may still play a role. A good example of an semi-structured decision would be diagnosing a medical condition

- Structured / Programmed Decisions :
  - Schedule decisions
  - Organization develops specific process for handling
  - Rules of decision making system are predetermined

- Semistructured Decisions:
  - Some decision procedures can be specified in advance, but not enough to lead to a definite recommended decision

- Unstructured / Non-programmed Decisions :
  - Repetitive decisions
  - Handled by general problem solving process
  - Decision taken by Decision Support Systems
  - Rules of decision making system are not fixed or predetermined
  - It requires every time the user has to go through the decision-making cycle.

DECISION SUPPORT SYSTEM MODELS



Behavioural Models

These models focus on studying and understanding the different behavior/trends amongst the variables.

A behavioral model is built by observing the previous behavior of an entity or a system; the resulting model can then be used to predict future behavior and performance.

Examples of such a model can be trend analysis, correlation, regression etc.

- The decision maker can make the decisions for such behavioral relationships.
- For eg: The trend (development) analysis, forecasting and statistical analysis models.
- The trend analysis indicates how different variables behave in trend setting in the past and hence in future.
- In Market Research method, they can forecast or judge the behavior of the customers buying decisions. (i.e. The questionnaire are designed and computerized to evaluate customer's buying behavior).

Management Science Models

Management science modeling process is the application of scientific methods to complex organizational problems.

Models are aimed at assisting the decision-maker in decision-making process.

Management science modeling process is one of the innovative decision making tool of the twentieth century.

The management science modeling process helps businesses to improve their operations through the use of scientific methods and the development of specialized techniques.

It is the process of researching for an optimal solution to the existing problem.

- These models are developed on the principles of the business management, accounting and economics.
- For eg: the budgetary systems, cost accounting system, inventory management system.
- Another example can be applying the scientific method to management, enabling managers to make decisions for an organization and improve its performance.
- For example, health care facilities can use management science to determine the information systems they need, while airlines can use management science to schedule planes and crew.

Operation Research Models

- Operations research (OR) is **an analytical method of problem-solving and decision-making**
- In operations research, problems are broken down into basic components and then solved in defined steps by mathematical analysis.

Operation Research model is an idealised representation of the real life situation and represents one or more aspects of reality.

Examples of operation research models are: **a map, activity charts balance sheets, PERT network, break-even equation, economic ordering quantity equation** etc.

The application of operational research model and algorithm is mainly **to determine the long-term goal of the system, provide data reference for making important decisions of the system, and serve the management of all levels in the system**.

BENEFITS OF DECISION SUPPORT SYSTEM

Fast: DSS is a fast method for taking decisions. Computers give us results fast. The data we need is displayed on the screen within a few minutes.

Enhance effectiveness. A second category of advantage that has been widely discussed and examined is improved decision making effectiveness and better decisions.

Communication: The top company authority gets accurate data from the computerized software. The company CEO and managerial staff communicate with each other and make decisions.

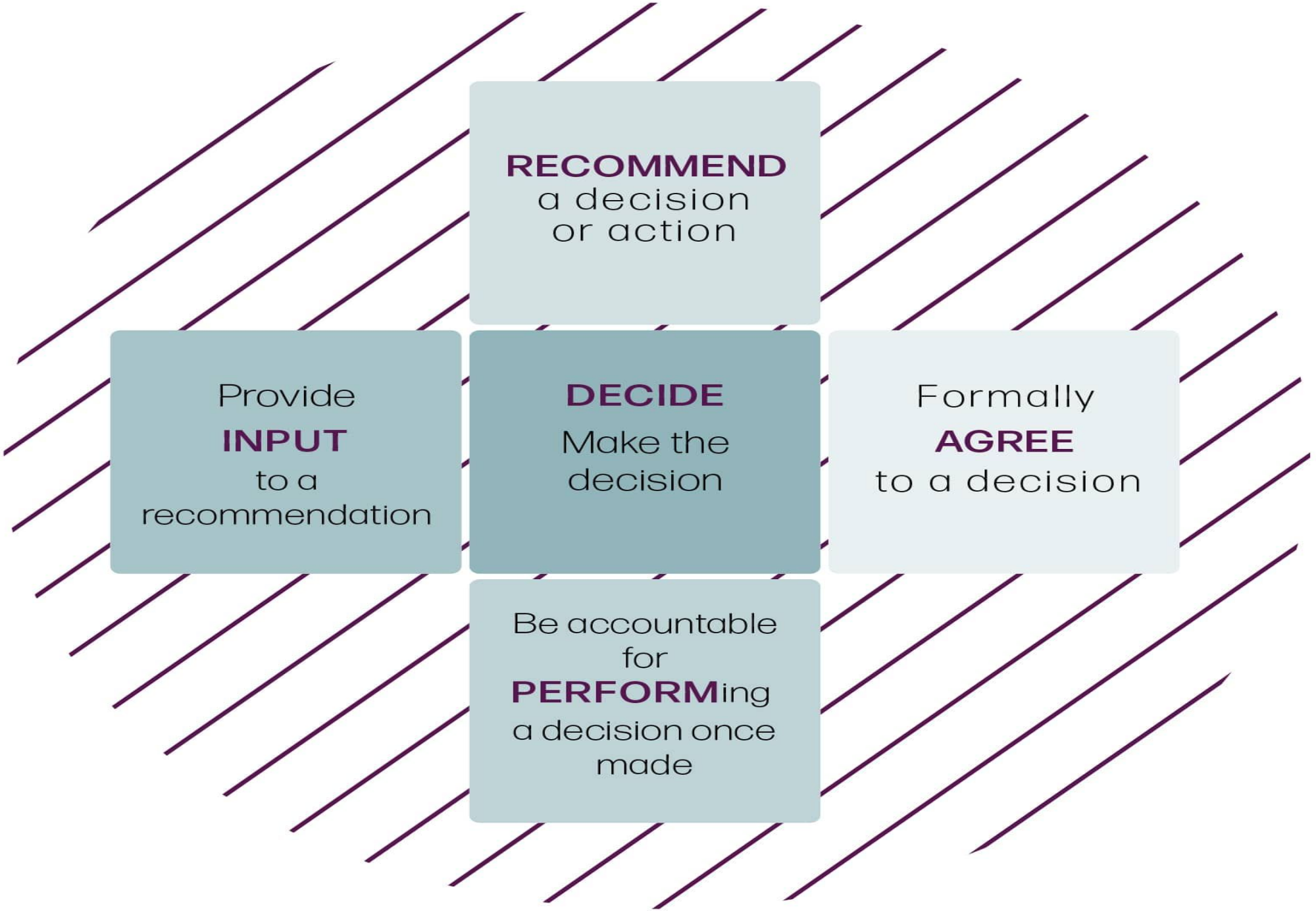
Automation: If you want to reward any customer then you don't need to worry. The software will know which consumer buy most of the company products and you will give them a 50% discount on their next purchase. So it automates the process of decision making.

Increase decision maker satisfaction. The novelty of using computers has and may continue to confound analysis of this outcome.

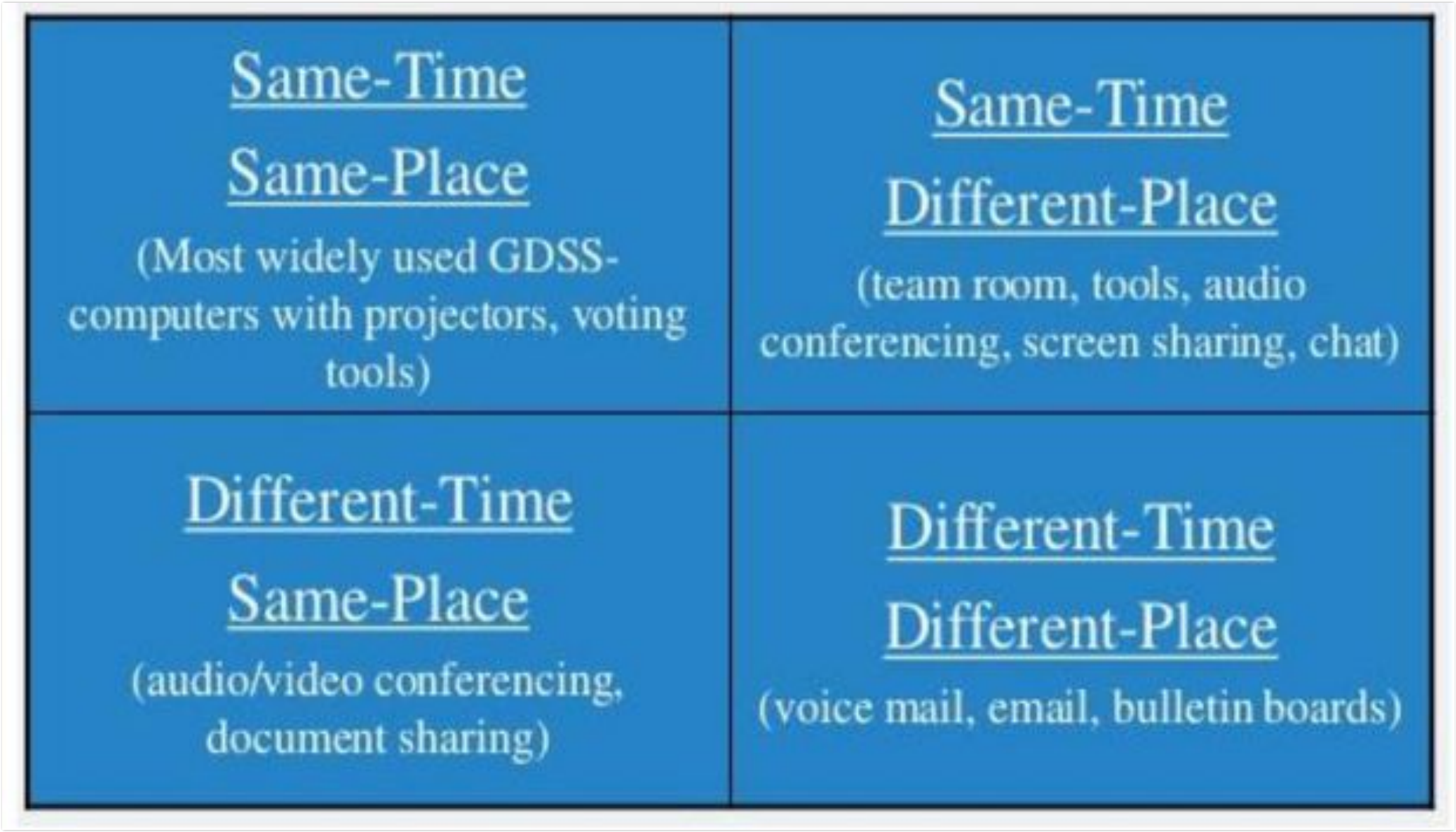
Competitive advantage. Vendors frequently cite this advantage for business intelligence systems, performance management systems, and web-based DSS.

GROUP DECISION SUPPORT SYSTEM

- A **group decision support system** (GDSS) is an interactive computer-based **system** that facilitates a number of **decision**-makers (working together in a **group**) in finding solutions to problems.
- Information technology supports decision-making where there is a group participation. Such decision support system is called as Group Decision Support Systems (GDSS).
- GDSS use computer software and hardware to support group functions and processes.
- GDSS supports Manager and Staff working in groups.


RECOMMEND
a decision
or action
Provide
INPUT
to a
recommendation
DECIDE
Make the
decision
Formally
AGREE
to a decision
Be accountable
for
PERFORMing
a decision once
made

- There are four configurations of group members are possible.
  - Group members in one room operating on network with common display screen to share the display for all members.
  - Group members sit at their respective locations and use their desktop to interact with other members.
  - Group members are in different cities and they come together through teleconferencing or video conferencing with prior planning GDSS operations.
  - Group members are at remote locations may be in different countries and they come together through long distance telecommunication network.


Same-Time
Same-Place
(Most widely used GDSS-computers with projectors, voting tools)
Same-Time
Different-Place
(team room, tools, audio conferencing, screen sharing, chat)
Different-Time
Same-Place
(audio/video conferencing, document sharing)
Different-Time
Different-Place
(voice mail, email, bulletin boards)

WHY USE GDSS?

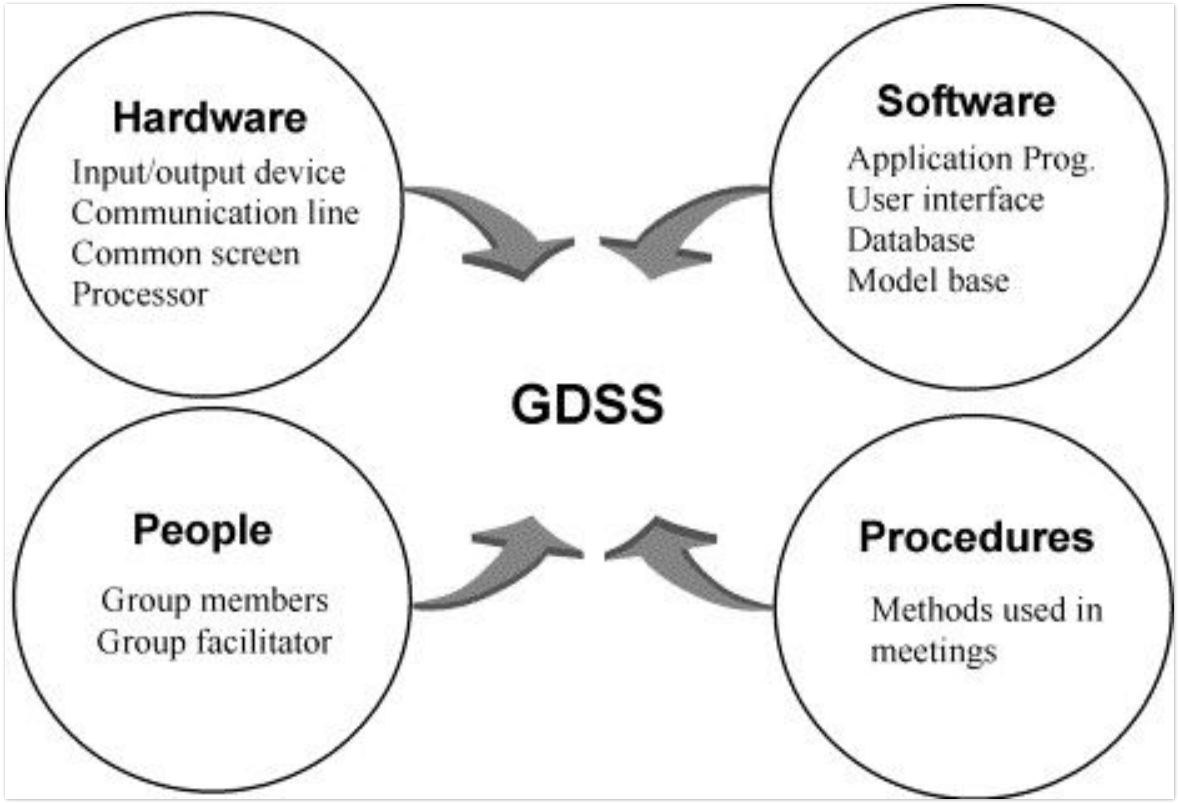
- High level managers can spend 80% of their time making decisions in groups.
- Applied correctly, GDSS can reduce this time, arriving at a better decision faster.
- GDSS provides the hardware, software, databases and procedures for effective decision making.

ADVANTAGES OF GDSS

- Parallel Communication – eliminate monopolizing, providing increased participation, better decisions
- Automated record keeping – no need to take notes, they're automatically recorded
- Ability for virtual meetings – only need hardware, software and people connected
- Portability - Can be set up to be portable example using laptop
- Global Potential - People can be connected across the world.

DISADVANTAGES OF GDSS

- Cost – infrastructure costs to provide the hardware and software/room/network connectivity can be very expensive
- Security – especially true when companies rent the facilities for GDSS; also, the facilitator may be a lower level employee who may leak information to peers
- Technical Failure – power loss, loss of connectivity, relies heavily on bandwidth and LAN/WAN infrastructure properly setup system should minimize this risk

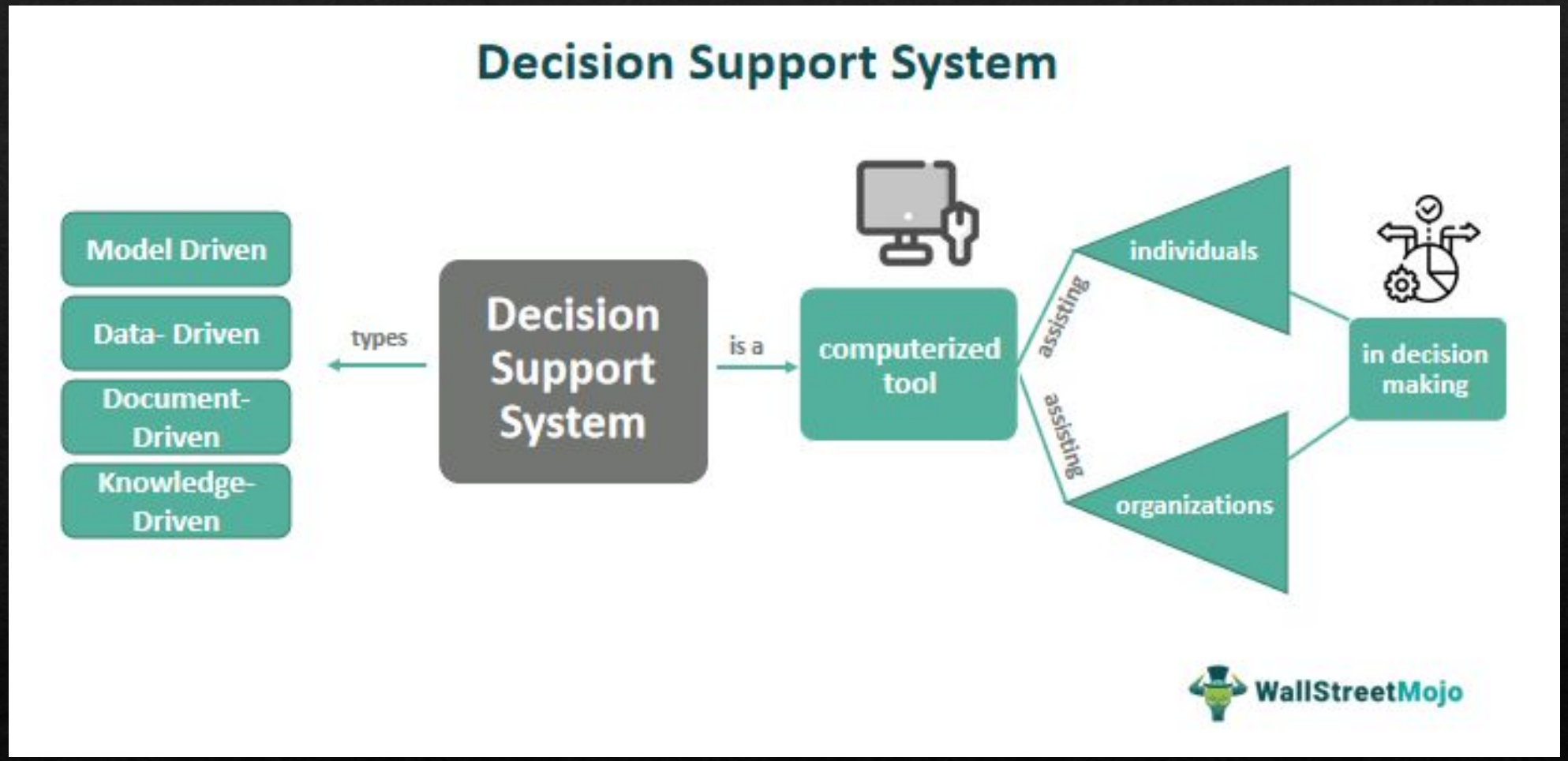


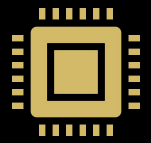
USING IS FOR GDSS

ENTERPRISE DECISION SUPPORT SYSTEM

Organisational Decision Support Systems

It use decision support systems to quickly perform complex analyses over large amounts of data whose results are used to inform critical business decisions.


Decision Support System
Model Driven
Data- Driven
Document-Driven
Knowledge-Driven
types
Decision Support System
is a
computerized tool
assisting
assisting
individuals
organizations
in decision making
WallStreetMojo



DSS to provide enterprise-wide support system

Many decision makers in different locations

helps executive level people

- Used mainly by specialists such as planners, analysts and researchers
- Used for an organizational task that involves a sequence of operations and decision-makers, e.g constructing a marketing plan


Decision Structure
Information Characte
Unstructured
Semistructured
Structured
Decisions
Information
Strategic Management
Executives and Directors
Tactical Management
Business Unit Managers and Self-Directed Teams
Operational Management
Operating Managers and Self-Directed Teams

Enterprise Systems: Concepts and Definitions

Executive information systems (EIS)-senior management

- Executive support systems (ESS)
- Enterprise information systems (EIS)

EXECUTIVE DECISION SUPPORT SYSTEM

- Executive Decision Support System is a computer-based technology designed specifically for the information needs of **top executives level** and provides for:
  - Rapid access to timely information;
  - Direct access to management reports;
  - Very user friendly and supported by graphics.

- An executive information system (EIS) is **a decision support system (DSS) used to assist senior executives in the decision-making process**.
- It does this by providing easy access to important data needed to achieve strategic goals in an organization.
- An EIS normally features graphical displays on an easy-to-use interface.
- Executive Decision Support Systems support the informational roles of executives.

- Executive Support Systems – specialized decision support systems designed to meet the needs of senior management.
- Exception reporting – reporting of only the results that deviate from a set of standards.
- Drill down reporting – investigating information in increasing detail.
- Include analysis support, communications, office automation and intelligence support.

Executive Support System (ESS)

Comprehensive support system that goes beyond EIS to include

- Communications
- Office automation
- Analysis support
- Intelligence

Enterprise Information System

- An **Enterprise Information System** (**EIS**) is any kind of information system which improves the functions of enterprise business processes.
- Provides complete information
- Part of enterprise resource planning (ERP) systems
- For business intelligence
- Leading up to enterprise information portals and knowledge management systems

4 category of EIS

- Sales team.
- Marketing team.
- Tech team.
- Customer service team.

Characteristics of EIS

- **Drill down**
- Critical success Factors (CSF)
- Status access
- Analysis
- Exception reporting
- Navigation of information
- Communication

DATA, INFORMATION AND KNOWLEDGE

- Data- refers to isolated facts such as individual measurement
- No meaning on their own
- Information -fact about situation, person, events
- Knowledge- processed information

Data

- 100

Information

- 100 miles

Knowledge

- 100 miles is quite a far distance.

Wisdom

- It is very difficult to walk 100 miles by any person, but vehicle transport is okay

KNOWLEDGE

- Knowledge is something that comes from information processed by using data.
- Knowledge is information that is contextual, relevant, and actionable.

KNOWLEDGE MANAGEMENT

- **Knowledge management** (**KM**) is the collection of methods relating to creating, sharing, using and managing the knowledge and information of an organization.

KNOWLEDGE MANAGEMENT SYSTEM

- Knowledge Management System refers to a (generally IT based) system for managing knowledge in organizations for supporting creation, capture, storage and distribution of information.

- Knowledge Management System
  - Create : Knowledge must be created either within or outside the organization.
  - Store : Knowledge can be stored somewhere, for others to find and use.
  - Find : Those who need the specific knowledge must then find out where it is, when they need it, by searching in the right places and asking the right people.

- Acquire : Once the knowledge source is found, the user will then go through the act of actually acquiring it
- Use : Once acquired, the knowledge can be put to use towards some productive purpose.
- Learn : Having been used, perhaps repeatedly, the user will learn what worked well and not so well as a result of applying the knowledge gained.

- helps gather, organize, and share business knowledge within an organization databases that store and disseminate business knowledge. It may also be called knowledge bases.

KNOWLEDGE BASED EXPERT SYSTEM

- A Knowledge Based System is a computer program
- that uses artificial intelligence to solve problems within a specialized domain that ordinarily requires human expertise.
- involve classification, diagnosis, monitoring, design, scheduling, and planning for specialized tasks.

EXPERT SYSTEM

- Expert System is an extension of the decision support system.
- An **expert system** is a computer program that is designed to solve complex problems and to provide decision-making ability like a human expert.
- Expert systems are implemented with artificial intelligence technology, often called expert system shells.

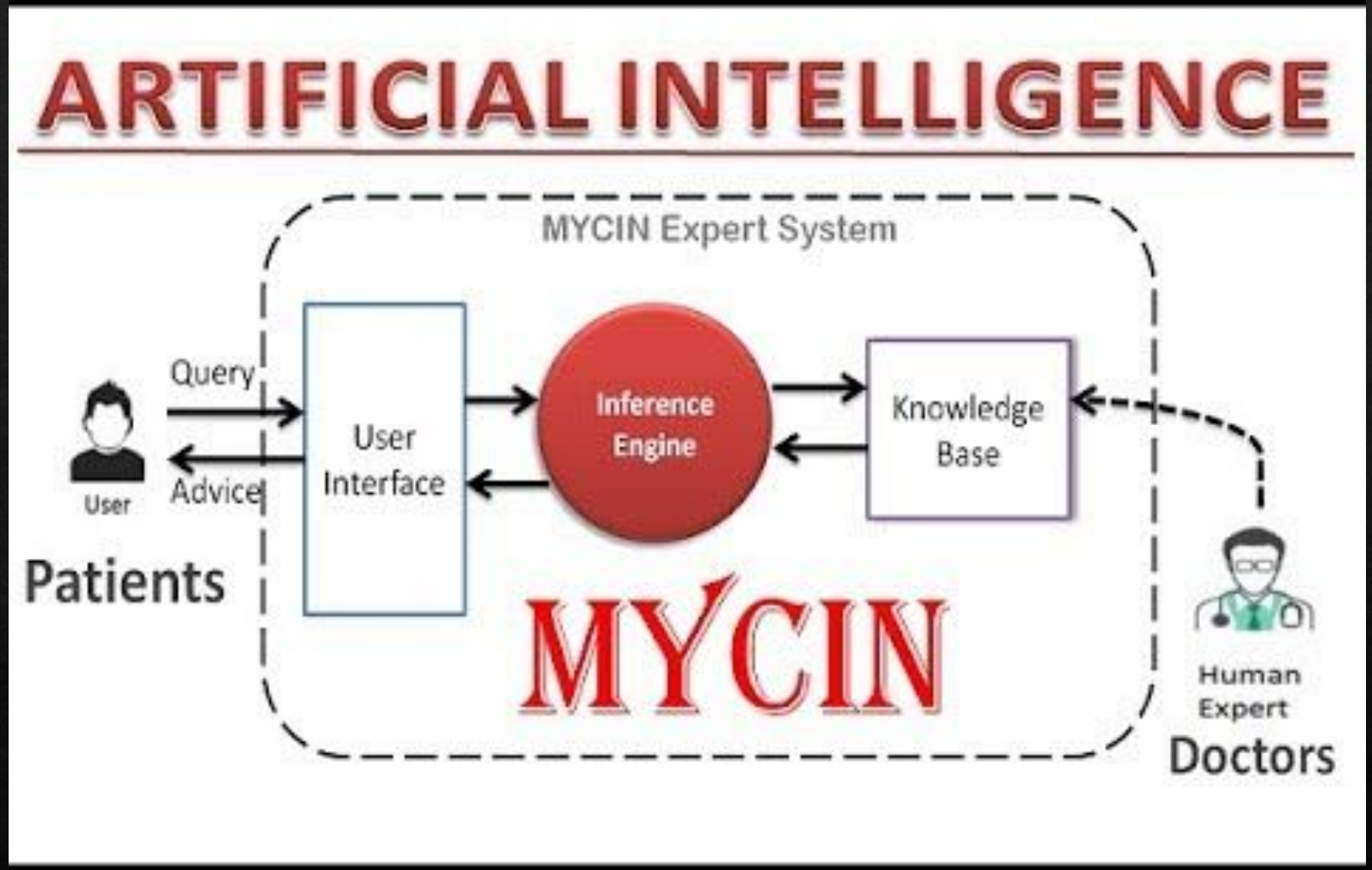
- Expert System application areas in action
- 1.Medical Diagnosis
- 2.Telephone Network Maintenance

EXAMPLE

MYCIN is **a computer-based consultation system designed to assist physicians in the diagnosis of and therapy selection for patients with bacterial infections**.

It has the ability to identify various bacteria that cause severe infections. It is also capable of recommending drugs based on a person's weight.

EXPERT SYSTEM ARCHITECTURE



INFERENCE ENGINE

- An inference engine tries to derive answers from a knowledge base.
- It is the brain of the expert systems that provides a methodology for reasoning about the information in the knowledge base, and for formulating conclusions.

USER INTERFACE

- It enables the user to communicate with an expert system.

KNOWLEDGE BASE

Knowledge base contains the factual and empirical knowledge of experts in a particular subject area and all the facts, rules and procedures, which are important for problem solving.

KNOWLEDGE ENGINEER

- Knowledge Engineer
  - A knowledge engineer is a computer scientist who knows how to design and implement programs that incorporate artificial intelligence techniques.
- Knowledge Engineering
  - The art of designing and building the expert systems is known as Knowledge Engineering, knowledge engineers are its practitioners.
  - Knowledge engineering relies heavily on the study of human experts in order to develop intelligent & skilled programs.

- The engineer then translates the knowledge into a computer- usable language, designs an inference engine, a reasoning structure, that uses the knowledge appropriately.
- He/she also determines how to integrate the use of uncertain knowledge in the reasoning process, and what kinds of explanation would be useful to the end user.
- An expert system is judged to be entirely successful when it operates on the level of a human expert.

CHARACTERISTICS OF EXPERT SYSTEM

Like a human expert, an expert system is expected to

- Be specialist : know facts and procedural rules
- Use heuristics : interpolate from known facts
- Justify its conclusions : to establish credibility and confidence.
- The user can ask: be able to learn : be able to absorb new knowledge and apply it estimate the reliability of its answer.

BENEFITS OF EXPERT SYSTEM

- Increased output and productivity
- Decreased decision making time
- Increased process and product quality
- Reduced downtime (machine failure detect and repair time)

- Elimination of the need for expensive equipment
- Operations in hazardous environments (no human required.)
- Ability to work with incomplete or uncertain information
- Knowledge transfer to remote locations
- Enhancement of other information systems

INTELLIGENT SYSTEM

- Intelligent systems is a term that describes the various commercial applications of AI.
- Artificial Intelligence (AI) is a subfield of computer science concerned with:
  - studying the thought processes of humans;
  - recreating those processes via machines, such as computers and robots.
- Behavior by a machine that, if performed by a human being, would be considered intelligent.
- Turing test is a test for artificial intelligence, in which a human interviewer, conversing with both an unseen human being and an unseen computer, cannot determine which is which: named for British Mathematician AI pioneer (Alan Turing).

ARTIFICIAL INTELLIGENCE

- A field of science and technology based on disciplines such as computer science, biology, psychology, mathematics, & engineering
- At the machine level, think like human and act like human means Artificial Intelligence.
- Goal is to develop computers that can think, see, hear, walk, talk, and feel.
- Major thrust to development of computer functions normally associated with human intelligence reasoning, learning, problem solving

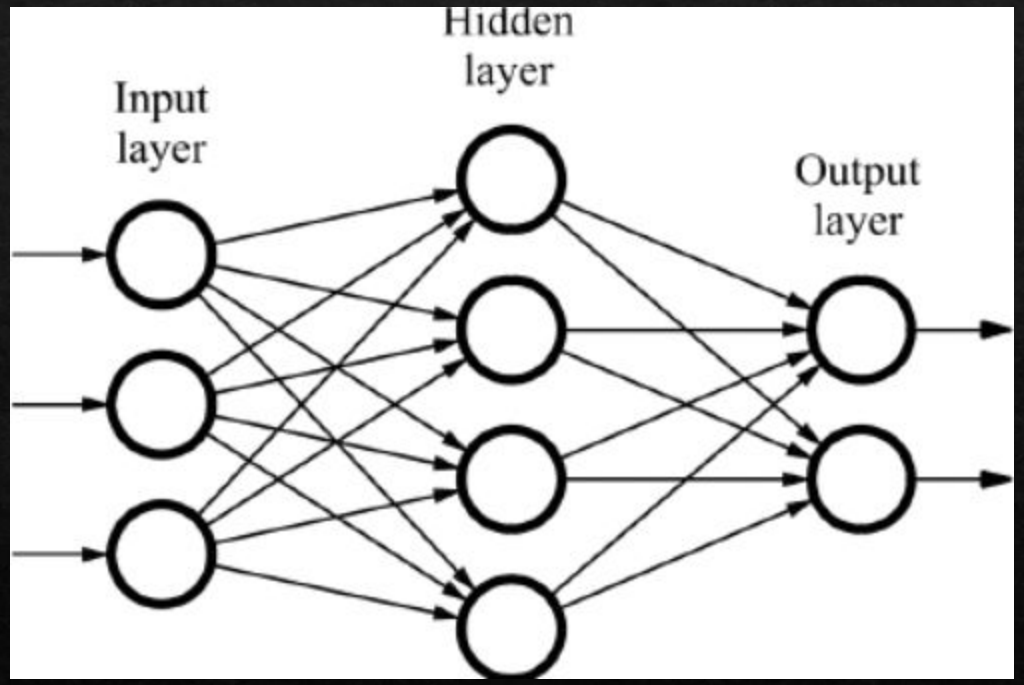
DOMAINS OF ARTIFICIAL INTELLIGENCE

- Robotics
  - Produces robot machines with computer intelligence and computer controlled, human like physical capabilities
- Natural interfaces
  - Natural language and speech recognition
  - Talking to a computer and having it understand
  - Virtual reality

NEURAL NETWORKS

A neural network is **a series of algorithms that endeavors to recognize underlying relationships in a set of data through a process that mimics the way the human brain operates**.

ARCHITECTURE



Input Layer

Information from the outside world enters the artificial neural network from the input layer. Input nodes process the data, analyze or categorize it, and pass it on to the next layer.

Hidden Layer

Hidden layers take their input from the input layer or other hidden layers. Artificial neural networks can have a large number of hidden layers. Each hidden layer analyzes the output from the previous layer, processes it further, and passes it on to the next layer.

Output Layer

The output layer gives the final result of all the data processing by the artificial neural network. It can have single or multiple nodes. For instance, if we have a binary (yes/no) classification problem, the output layer will have one output node, which will give the result as 1 or 0.

USES OF NEURAL NETWORK

- **Medical diagnosis by medical image classification**
- **Targeted marketing by social network filtering and behavioral data analysis**
- **Financial predictions by processing historical data of financial instruments**
- **Electrical load and energy demand forecasting**
- **Process and quality control**
- **Chemical compound identification**

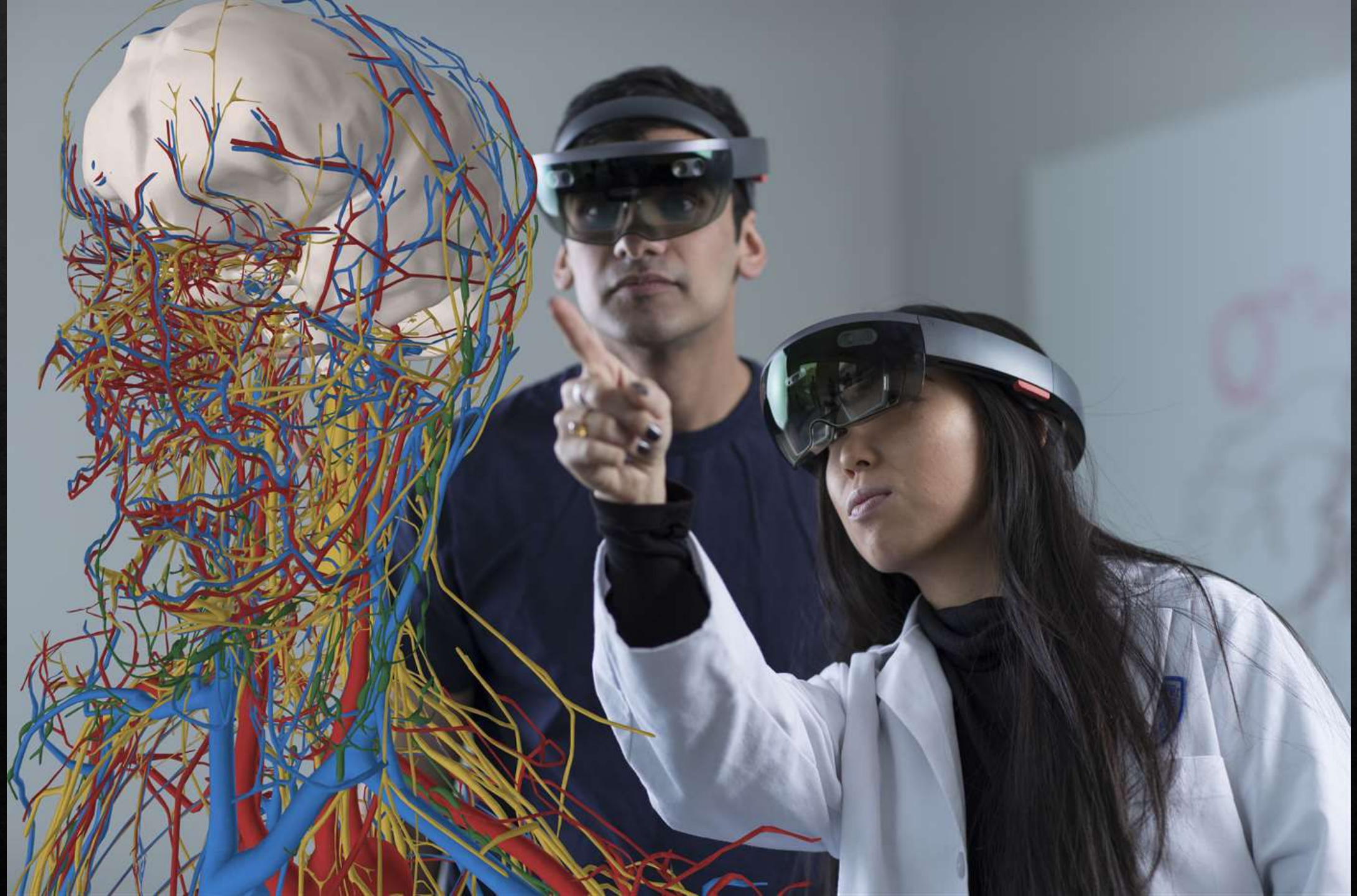
VIRTUAL REALITY

- Virtual reality is plainly speaking, seeing an imaginary world, rather than the real one.
- Seeing, hearing, smelling, testing, feeling.
- The imaginary world is a simulation running in a computer.
- The sense data is fed by some system to our brain.
- A medium composed of interactive computer simulations giving users the feeling of being present in the simulations.

- Why Virtual Reality is needed?
  - Operations in dangerous environments
    - There are still many examples of people working in dangerous or hardship environments that could benefit from the use of VR-mediated teleportation.
    - Workers in radioactive, space, or toxic environments could be relocated to the safety of a VR environment where they could handle any hazardous materials without any real danger using tele operation or tele presence.

- Scientific Visualization
  - Scientific Visualization provides the researcher with immediate graphical feedback during the course of the computations and gives him/her the ability to 'steer' the solution process.
  - Application at NASA Ames Research Center is the Virtual Planetary Exploration. It helps planetary geologists to remotely analyze the surface of a planet. They use VR techniques to roam planetary terrains.

- Medicine
  - Until now experimental research and education in medicine was mainly based on dissection and study of plastic models. Computerized 3D human models provide a new approach to research and education in medicine. Experimenting medical research with virtual patients will be a reality.
  - We will be able to create not only realistic looking virtual patients, but also histological and bone structures. With the simulation of the entire physiology of the human body.



VIRTUAL REALITY

Primarily uses a headset to create an immersive 3D experience.

AUGMENTED REALITY

Overlay digital images onto your view of the real world, often through a smart phone.

Data Mining

- Data mining refers to extracting knowledge from large amounts of data.
- The data sources can include databases, data warehouse, web etc.
- Data mining refers to the analysis of data.
- It is the computer-supported process of analyzing huge sets of data that have either been compiled by computer systems or have been downloaded into the computer.
- In the data mining process, the computer analyzes the data and extract useful information from it.
- It looks for hidden patterns within the data set and try to predict future behavior. Data mining is primarily used to discover and indicate relationships among the data sets.

- Data mining aims to enable business organizations to view business behaviors, trends relationships that allow the business to make data-driven decisions.
- It is also known as knowledge Discover in Database (KDD). Data mining tools utilize AI, statistics, databases, and machine learning systems to discover the relationship between the data.
- Data mining tools can support business-related questions that traditionally time-consuming to resolve any issue.

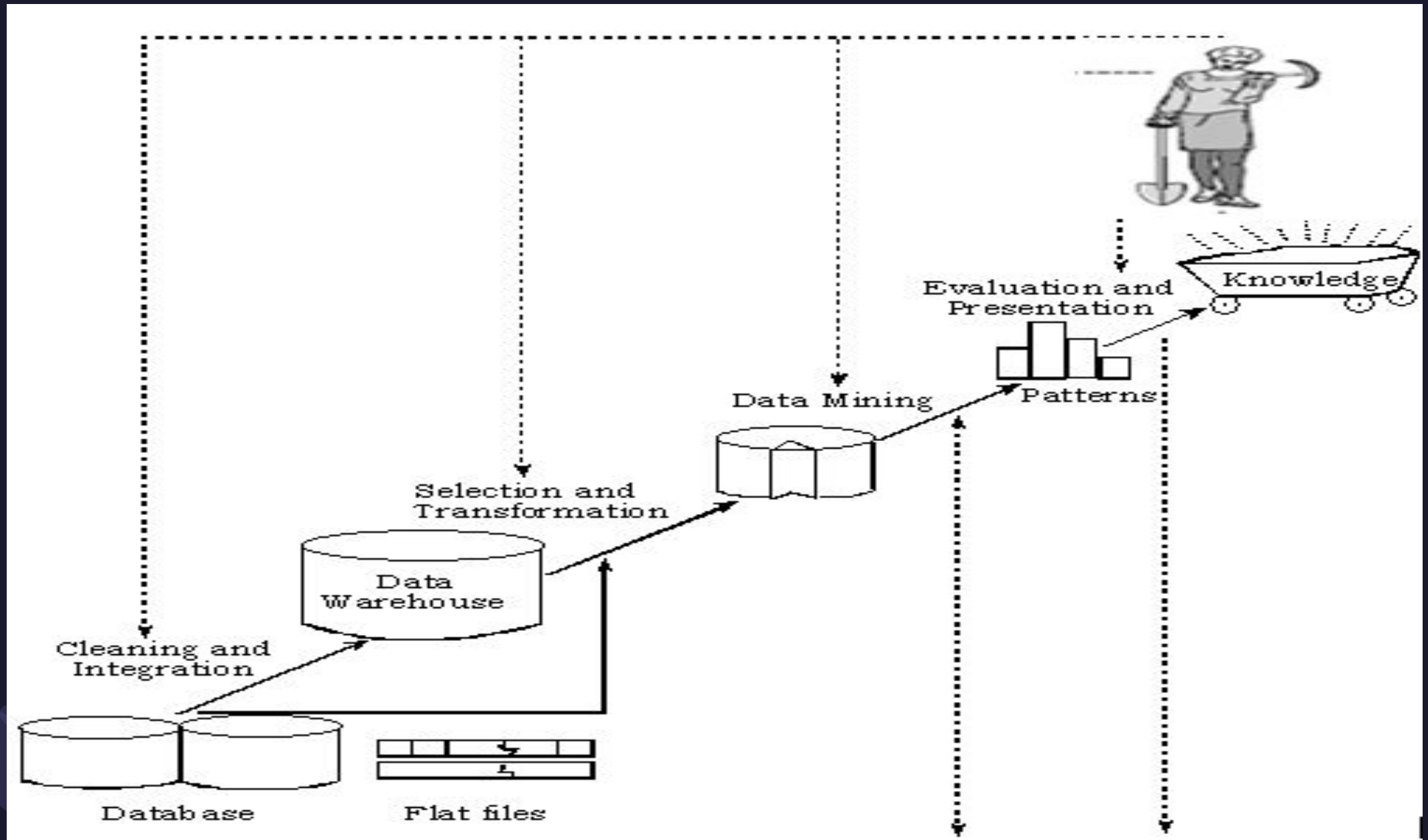


Fig: Data mining as a step in the process of knowledge discovery

- Data mining is also called **Knowledge Discovery in Database (KDD).**
- The knowledge discovery process includes Data cleaning, Data integration, Data selection, Data transformation, Data mining, Pattern evaluation, and Knowledge presentation.
- Here is the list of steps involved in the knowledge discovery process:
- Data Cleaning: In this step, the noise and inconsistent data is removed.
- Data Integration: In this step, multiple data sources are combined.

- Data Selection: In this step, data relevant to the analysis task are retrieved from the database.
- Data Transformation: In this step, data is transformed or consolidated into forms appropriate for mining by performing summary or aggregation operations.
- Data Mining: In this step, intelligent methods are applied in order to extract data patterns.
- Pattern Evaluation: In this step, data patterns are evaluated.
- Knowledge Presentation: In this step, knowledge is represented.

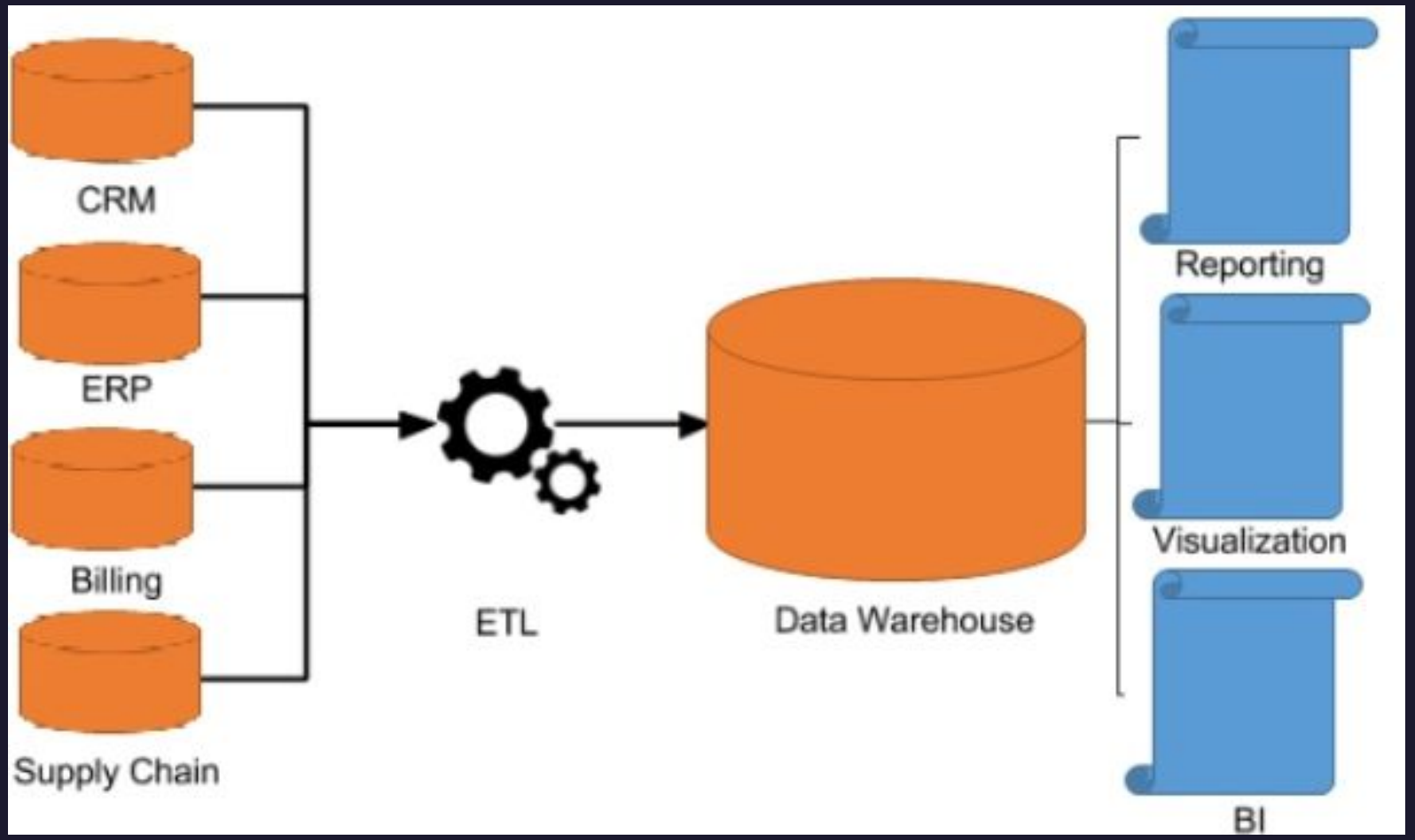
WHY IS DATA MINING NECESSARY?

- Make use of your data assets
- There is a big gap from stored data to knowledge; and the transition won't occur automatically.
- Many interesting things you want to find cannot be found using database queries
- "find me people likely to buy my products"
- "Who are likely to respond to my promotion"

- Credit ratings/targeted marketing:
  - Given a database of 100,000 names, which persons are the least likely to default on their credit cards?
  - Identify likely responders to sales promotions
- Fraud detection:
  - Which types of transactions are likely to be fraudulent, given the demographics and transactional history of a particular customer?
- Customer relationship management:
  - Which of my customers are likely to be the most loyal, and which are most likely to leave for a competitor?

Data warehouse

- Data warehousing is a collection of tools and techniques using which more knowledge can be driven out from a large amount of data.
- This helps with the decision-making process and improving information resources.
- Data warehouse is basically a database of unique data structures that allows relatively quick and easy performance of complex queries over a large amount of data.
- It is created from multiple heterogeneous sources.


CRM
ERP
Billing
Supply Chain
ETL
Data Warehouse
Reporting
Visualization
BI

Important Features of Data Warehouse

- The Important features of Data Warehouse are given below:
- **1. Subject Oriented**
- A data warehouse is subject-oriented. It provides useful data about a subject instead of the company's ongoing operations, and these subjects can be customers, suppliers, marketing, product, promotion, etc.
- **2. Time-Variant** The different data present in the data warehouse provides information for a specific period. Historical data is kept in a data warehouse. For example, one can retrieve data from 3 months, 6 months, 12 months, or even older data from a data warehouse. This contrasts with a transactions system, where often only the most recent data is kept. For example, a transaction system may hold the most recent address of a customer, where a data warehouse can hold all addresses associated with a customer.

- **3. Integrated**
- A data warehouse is constructed by integrating data from heterogeneous sources such as relational databases, flat files, etc. This integration enhances the effective analysis of data.
- **4. Non- Volatile**
- It means, once data entered into the warehouse cannot be change. The data resided in data warehouse is permanent. It also means that data is not erased or deleted when new data is inserted.

Key-Point	OLAP	OLTP
Full Form	Online Analytical Processing System	Online Transaction Processing System
Primary objective	Data Analysis	Data processing
System used	Information based system	Operations based system
Orientation	Analysis oriented/Column oriented	transaction oriented/Row oriented
Data characteristics	Volume	Transactions
Management system	Database query management system	Database modification system
Data store	Datawarehouse	Traditional RDBMS
SQL query used	Select	Select, Insert, Update, Delete
Backup activity	time to time and not as such important	Incremental and complete backup
Function	decision support	day to day operation
Data used	Summary/Historical	Current data
Schema	Start-schema	Entity model in 3NF
Examples	Reporting and analysis system	online banking, online message, online tickets etc..

Applications of data warehousing

- Financial services
- Banking services
- Consumer goals
- Retail sectors
- Controlled manufacturing
- Information Processing

- Analytical Processing
- Data Mining
- Real Life
- Various Industries
- Statistical Analysis
- Decision Making

PRACTICE QUESTION

- 1.Define and explain Decision Support System (DSS) with suitable diagram. Discuss key characteristics of GDSS system.
- 2.What is Data Warehouse? Why do you require data warehouse along with operational database? How is it related with data mining?
- 3.Discuss four different areas of Information system that uses data analytics and related techniques.
- 4.Describe GDSS for modern organization. How do they help organizational learning?
- 5.How do you differentiate between MIS and DSS system with respect to the information they present to users and the way information are processed?
- 6.How does decision support system help an organization? Explain the component of DSS. List some scope of operational research.
- 7.Describe the role of Analytical Modeling in DSS. What are the differences between MIS and Executive Support System?
- 8.Write short notes on:
- a.OLTP vs OLAP
- b.Data Mining and Data Warehouse