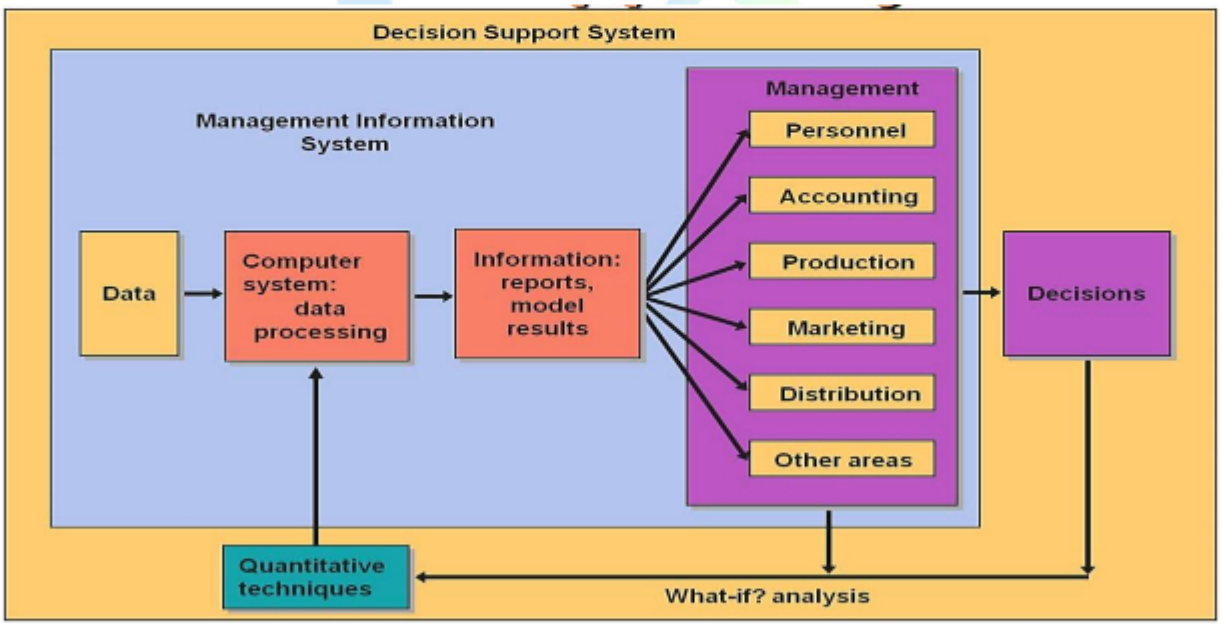
Unit V: Decision Support System and Artificial Intelligence - Management Information System

Concept of Decision Support System (DSS):

Decision Support Systems are a computer-based information system that provides interactive information to support managers and business professionals during the decision making process. Decision Support System uses:

a. Specialized databases containing internal as well as external data.
b. Different types of data analytical models.
c. Interactive user interface to interact with the system.
d. Decision-makers own insights and judgments.

Decision Support System helps managers to make decisions that are unique rapidly changing and not easily specified in advance. They address problems where the procedure for arriving at solutions may not be fully predefined in advance.



Although the Decision Support System uses internal information from Transaction Processing System and Management Information System, they often use the information from external sources such as share market, internet news, product price of competitors, government rules and policies, etc.

Decision Support System has more analytical power than other information system. They are developed with a variety of model to analyze data and such that users can work them directly.

Components of Decision Support System:

There are different types of Decision Support System according to nature and applications. All Decision Support System has three components in common and they are:

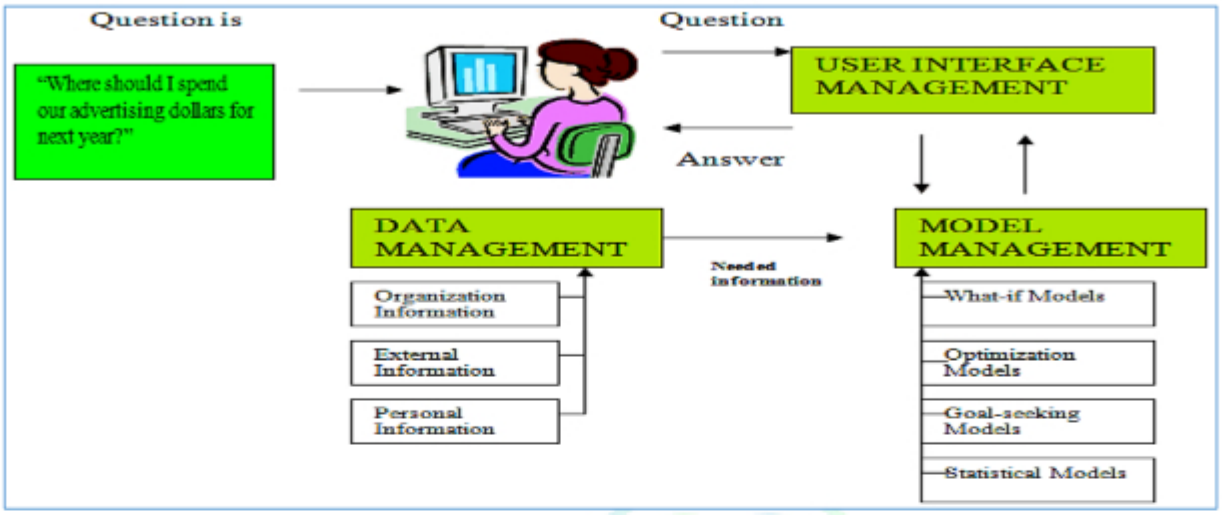


Fig: Components of Decision Support System

1. User Interface:

It is the part of the system that is visible to a user through which users enter information, command and other things and receive output results. So, it must be simple, adaptable, flexible, consistent, interactive and easy to use.

2. Model Management:

It consists of various Decision Support System to analyze information in many different ways. The strength of any Decision Support System depends on the model used by the Decision Support System to analyze data. Few commonly used models are:

a. What-IF analysis model?
b. Optimization Model
c. Goal seeking model
d. Statistical model
e. Sensitivity analysis model

3. Database Management:

This component performs the function of storing and manipulation of data needed by the Decision Support System. Data are organized in databases and managed by some DBMS. Data are collected from different sources such as:

a. Organizational/Internal data

b. Personal data
c. External data

Characteristics of Decision Support System:

1. Facilitation:

DSS facilitate and support specific decision- making activities and/or decision processes.

2. Interaction:

DSS are computer-based systems designed for interactive use by decision-makers or staff users who control the sequence of interaction and the operations performed.

3. Ancillary:

DSS can support decision-makers at any level in an organization. They are NOT intended to replace decision-makers.

4. Repeated Use:

DSS are intended for repeated use. A specific DSS may be used routinely or used as needed for ad hoc decision support tasks.

5. Identifiable:

DSS may be independent systems that collect or replicate data from other information systems OR subsystems of a larger, more integrated information system.

6. Task-Oriented:

DSS provide specific capabilities that support one or more tasks related to decision-making, including intelligence and data analysis; identification and design of alternatives; choice among alternatives; and decision implementation.

7. Decision Impact:

DSS are intended to improve the accuracy, timeliness, quality and overall effectiveness of a specific decision or a set of related decisions.

8. Supports Individual And Group Decision Making:

It provides a single platform that allows all users to access the same information and access the same version of the truth, while providing autonomy to individual users and development groups to design reporting content locally.

9. Comprehensive Data Access:

It allows users to access data from different sources concurrently, leaving organizations the freedom to choose the data warehouse that best suits their unique requirements and preferences.

10. Easy to Develop and Deploy:

DSS delivers an interactive, scalable platform for rapidly developing and deploying projects. Multiple projects can be created within a single shared metadata. Within each project, development teams create a wide variety of re-usable metadata objects.

11. Integrated Software:

DSS's integrated platform enables administrators and IT professionals to develop data models, perform sophisticated analysis, generate analytical reports, and deliver these reports to end-users via different channels (Web, email, file, print and mobile devices).

12. Flexibility:

DSS features are flexible and can be altered according to need providing a helping hand in the work process.

Phases of the Decision Support System:

In business decision making, there are four distinct phases and these phases are:

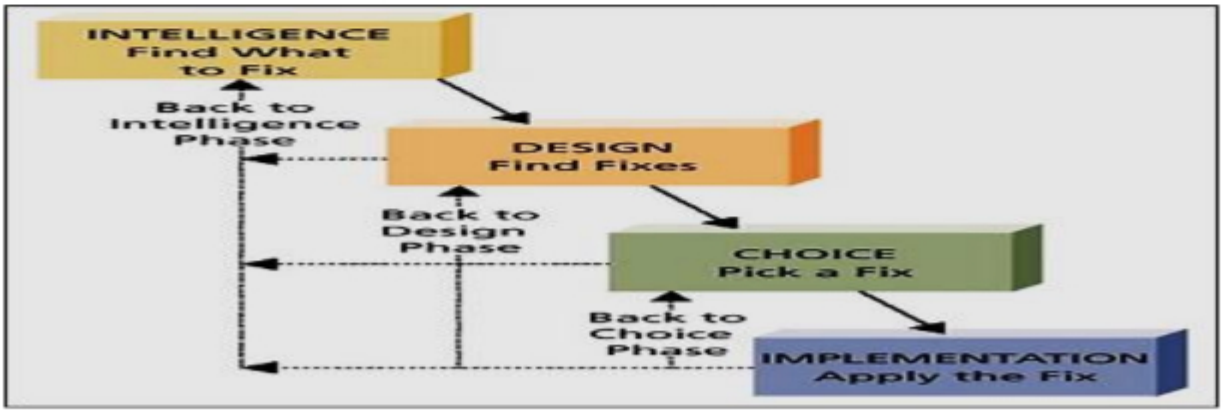


Fig: Four Phases of Decision Making Process

1. Intelligence Phase:

This phase is also called the diagnosis phase of decision making. The intelligence phase involves detecting and interpreting sign that indicates a situation which needs attention. These signs may be in different forms like consistent customer request for new product features, the threat of new competition, decline sales, raising cost, etc.

2. Design:

In this phase, we consider possible ways of solving the problem, filling the need or taking advantage of the opportunity. In this phase, we develop all the possible solutions that we can.

3. Choice:

In this phase, we examine the merits of each solution, estimate the consequences of each and choose the best one. The best solution may depend on various factors like cost, ease of implementation staffing requirement, timing, etc. This is the prescriptive phase of decision making in which a course of action is prescribed.

4. Implementation:

In this phase, we carry out the chosen solution, monitor the results and make adjustments as necessary. Simply implementing the solution may not be enough most of the time. The chosen solution will always need fine-tuning, especially for complex problems or changing environment.

These four-phase process are not necessarily linear. They will be useful or necessary to cycle back to an earlier phase for better decision making.

Types of Decision Support System:

There are several Decision Support Systems. These can be categorized into five types:

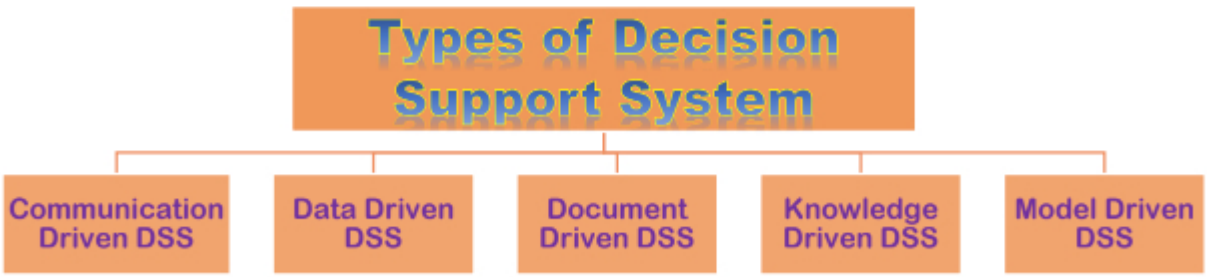


Fig: Types of Decision Support System

1. Communication-Driven DSS:

Most communications-driven DSSs are targeted at internal teams, including partners. Its purpose is to help conduct a meeting, or for users to collaborate. The most common technology used to deploy the DSS is a web or client-server. Examples: chats and instant messaging software, online collaboration and net-meeting systems.

2. Data-Driven DSS:

Most data-driven DSSs are targeted at managers, staff and also product/service suppliers. It is used to query a database or data warehouse to seek specific answers for specific purposes.

It is deployed via a mainframe system, client/server link, or via the web. Examples: computer-based databases that have a query system to check (including the incorporation of data to add value to existing databases.

3. Document-Driven DSS:

Document-driven DSSs are more common, targeted at a broad base of user groups. The purpose of such a DSS is to search web pages and find documents on a specific set of keywords or search terms. The usual technology used to set up such DSSs are via the web or a client/server system.

4. Knowledge-Driven DSS:

Knowledge-driven DSS or 'knowledgebase' are they are known, are a catch-all category covering a broad range of systems covering users within the organization setting it up, but may also include others interacting with the organization - for example, consumers of a business.

It is essentially used to provide management advice or to choose products/services. The typical deployment technology used to set up such systems could be client/server systems, the web, or software running on stand-alone PCs.

5. Model-Driven DSS:

Model-driven DSSs are complex systems that help analyses decisions or choose between different options.

These are used by managers and staff members of a business, or people who interact with the organization, for several purposes depending on how the model is set up scheduling, decision analyses etc.

These DSSs can be deployed via software/hardware in stand-alone PCs, client/server systems, or the web. According to the **organization level** and the information available, the decisions can be classified into three categories as:

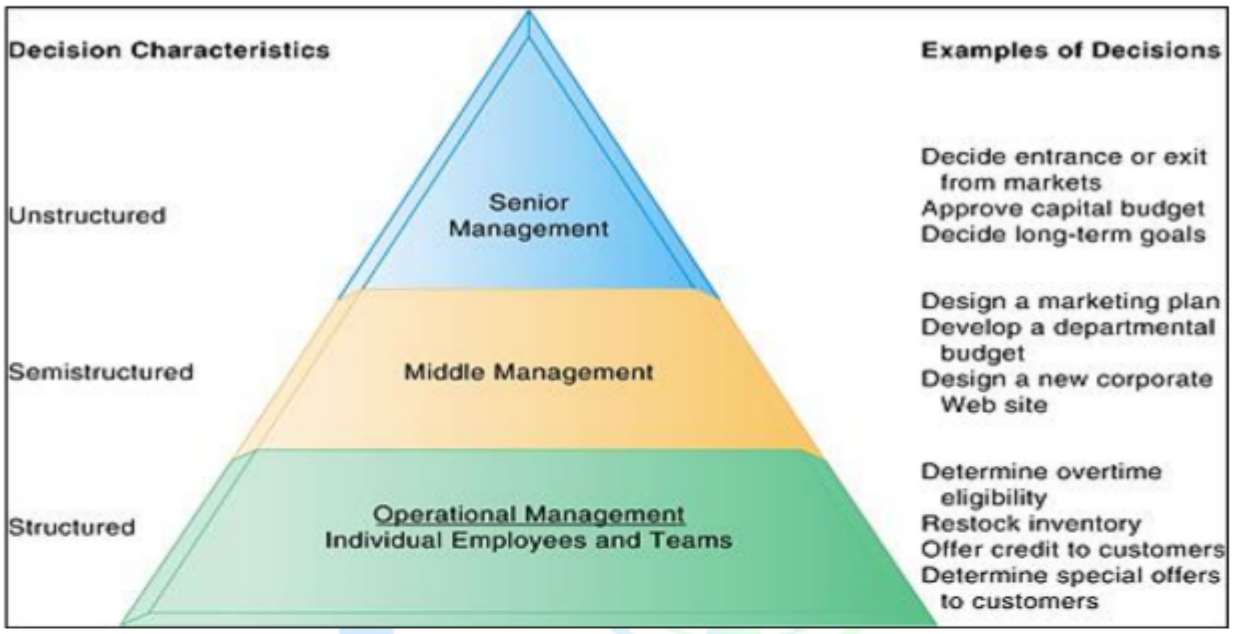


Fig: Information Requirement of Key Decision Making Groups in a Firm

1. Structured Decision:

It involves processing a certain kind of information in a specified way so that we will always get the right answer. In other words, the decision making procedure and the information required are completely known in advance are called structured decisions.

Such decisions are taken mostly at the operational level of the organization. For example: Preparing a purchase order, calculating the gross pay for hourly employees, etc.

2. Semi-Structured Decision:

Some decision procedures can be pre-specified but not enough to lead a definite decision and such decisions are called semi-structured decisions. For example, Decisions involving to start up a new e-commerce service making changes to employee benefits, etc. Semi-structured decisions are mostly made at the tactical level of the organization.

3. Unstructured Decision:

They involve decision situations, where it is not possible to specify in advance most of the decision-making procedures to follow. So, it involves processing a certain kind of information but there is no precise way to get the right answer. No rules or criteria exist that guarantee a good solution.

For example: Deciding whether to introduce a new product line, implementing a new marketing campaign. Such types of decisions are mostly taken at the strategic level of the organization by senior business executives.

Another way to view decisions is by the **frequency** with which the decision has to be made. According to these criteria, there are two types of decisions as:

1. Recurring Decision:

A recurring decision is one that happens repeatedly and often periodically like daily, weekly. While taking decisions we usually use the same set of rules each time. For example: When we calculate pay for an hourly employee, the calculation process is always the same regardless of employee or time.

2. Non Recurring Decision:

A non-recurring decision or ad hoc decision is one that we make infrequently and we may even have different criteria for determining the best solution each time, for example, A company merging decisions.

Group Decision Support System (GDSS):

GDSS is an interactive computer-based system that facilitates several decision-makers, working together in a group, in finding solutions to problems that are generally unstructured or semi-structured in nature. They are designed in such a way that they take input from multiple users interacting simultaneously with the systems to arrive at a decision as a group.

Tools and techniques provided by GDSS improve the quality and effectiveness of group meetings and decisions. Groupware and web-based tools for electronic meeting and video conferencing also support some of the group decision-making process, but their main function is to make communication possible between the decision-makers.

Fig: Group Decision Support System (GDSS)

In the GDSS electronic meeting, each participant is provided with a computer. The computers are connected to each other, to the facilitator's computers and to the file server. The facilitator and participants can project digital text, images and other form of information to the projection screen that is available at the meeting room.

So, GDDS is a class of electronic meeting system, a collaboration technology designed to support meetings and group work.

Phases of GDSS:

A typical GDSS session includes four phases:

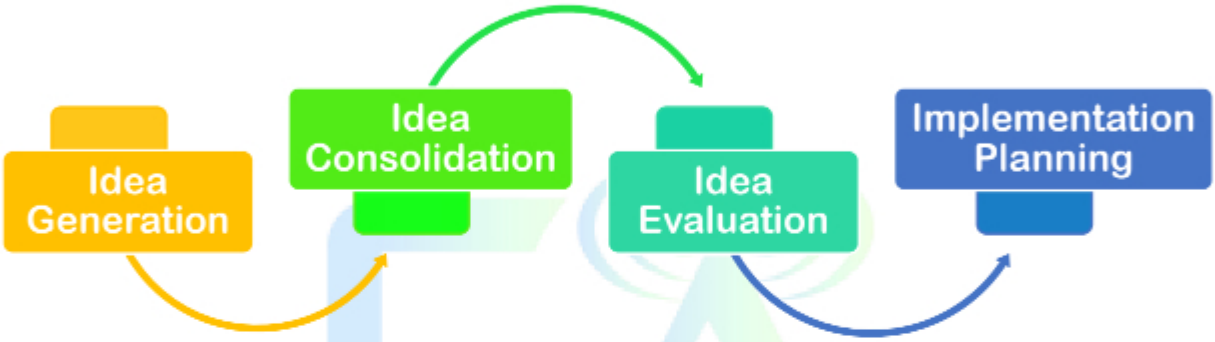


Fig: Phases of GDSS

a. Idea Generation:

The process of creating, developing, and communicating ideas which are abstract, concrete, or visual. The process includes the process of constructing through the idea, innovating the concept, developing the process, and bringing the concept to reality.

Idea generation is an essential component of management concepts such as the continuous improvement process (CIP), idea management and innovation management of companies. The early phase of the idea management process and innovation process is often referred to as the fuzzy front end of innovation.

b. Idea Consolidation:

Idea consolidation is a process in which comments from an **idea** generation session are examined, cross-compared, and synthesized so that salient points are integrated with less redundancy. **Idea consolidation** groups together comments with a common focus or theme in order to gain understanding of the set.

c. Idea Evaluation:

The evaluation of ideas is one of the most complex and demanding tasks in idea management, innovation management as well as in the management of digital

transformation in a company. The challenge is to filter out ideas that are within strategic search fields, that are not too obvious but also not unrealistic. Successful ideas are within a narrow range.

A convincing idea may sound compelling, be well formulated and there are good reasons to believe in it.

But whether the idea really turns out to be successful is often only revealed after an evaluation of all ideas in the innovation process, in which different criteria are incorporated: For example, the sales and profit potential, opportunities for differentiation from the competition, implementation and risk.

d. Implementation Planning:

Once we have identified a creative idea or a solution to a problem, the next step is to transform the idea from concept to practical reality by implementing it. Every successfully implemented idea or product is a result of a long and painstakingly supervised innovation process.

GDSS does not replace human interaction, but rather supports and enhances the group's decision-making process; typically 30% of interactions take place on computers.

Importance of GDSS:

a. More Information in Less Time:

Since GDSS allows group members to contribute in parallel, significantly more information can be gathered in a shorter period.

b. Greater Participation:

The anonymity provided by GDSS enables group members to express themselves freely, reducing the risk of 'group think' and conformance pressure. The loudest voice need not dominate the discussion.

c. More Structure:

More focused and concentrated discussions result with GDSS than would be possible in traditional meetings. Irrelevant digressions are minimized.

d. Automated Documentation:

Comments are never forgotten, results are available immediately, and excellent graphics make it easy to see (and therefore discuss) areas of dispute.

Applications of GDSS:

a. **Strategic Planning:** Analyze the environment, develop a vision, identify objectives, and build action plans

b. **Project Evaluation:** Assess objectives achievement, impacts, relevance, cost effectiveness, and future directions.

c. **Focus Groups and Expert Panels:** Elicit opinions and understand needs.

d. **Conflict Resolution:** Compare points-of-view, understand differences, and seek common ground.

e. **Problem Solving:** Identify causes, suggest alternatives, choose solutions, and develop implementation plans.

Components of GDSS:

Three basic components of GDSS are:

Fig: Components of GDSS

1. Hardware:

It includes electronic hardware like computer, equipment used for networking, electronic display board and audiovisual equipment. It also includes the physical setup like the room, the table, the chairs, etc. arranged in such a way that they can support group discussion and teamwork.

2. Software:

It includes various tools and techniques such as electronic questionnaires, electronic brainstorming tools, idea organizes, tools for setting priority, policy formation tools, etc. The use of these software tools in a group meeting helps the group decision-makers to

plan, organize ideas gather information, and establish priorities take decisions and to document the meeting proceeding. As a result, the meeting becomes more productive.

3. People:

It includes the members participating in a meeting, a trained facilitator who helps with the proceeding of the meeting and an expert staff to support the hardware and software.

The GDSS components together provide a favorable environment for carrying out group meetings.

Features of GDSS:

1. Ease of Use:

It consists of an interactive interface that makes working with GDSS simple and easy.

2. Better Decision Making:

It provides the conference room setting and various software tools that facilitate users at different locations to make decisions as a group resulting in better decisions.

3. Emphasis on Semi-structured and Unstructured Decisions:

It provides important information that assists middle and higher-level management in making semi-structured and unstructured decisions.

4. Specific and General Support:

The facilitator controls the different phases of the group decision support system meeting (idea generation, discussion, voting and vote counting etc.) what is displayed on the central screen and the type of ranking and voting that takes place, etc. Also, the facilitator provides general support to the group and helps them to use the system.

5. Supports all Phases of the Decision Making:

It can support all the four phases of decision making, via intelligence, design, choice and implementation.

6. Supports Positive Group Behavior:

In a group meeting, as participants can share their ideas more openly without the fear of being criticized, they display more positive group behavior towards the subject matter of the meeting.

Geographical Information System (GIS):

A geographic information system (GIS) is a system designed to capture, store, manipulate, analyze, manage, and present all types of geographical data. The keyword to this technology is Geography – this means that some portion of the data is spatial. In other words, data that is in some way referenced to locations on the earth.

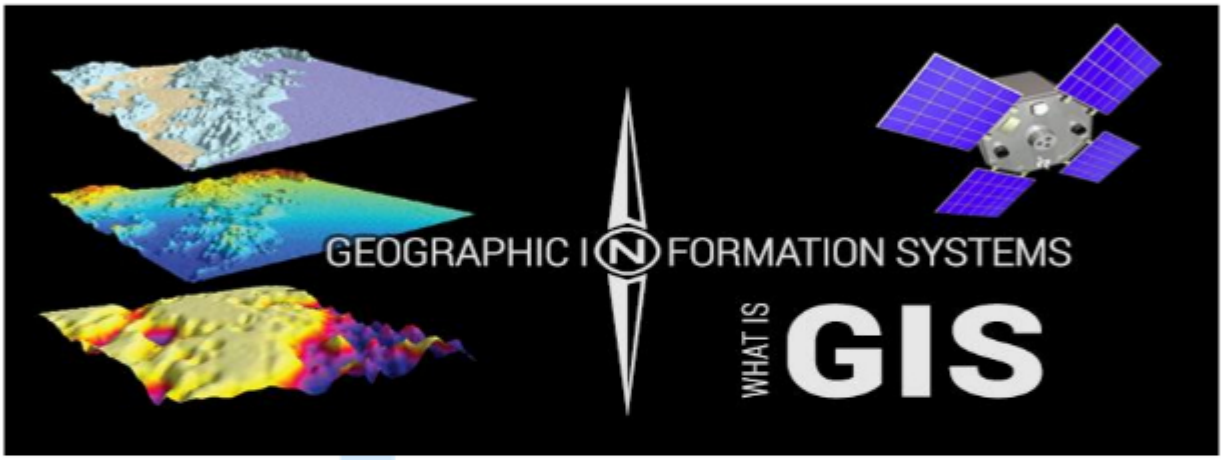


Fig: Geographic Information Systems

Coupled with this data is usually tabular data known as attribute data. Attribute data can be generally defined as additional information about each of the spatial features. An example of this would be schools. The actual location of the schools is the spatial data. Additional data such as the school name, level of education taught, student capacity would make up the attribute data.

It is the partnership of these two data types that enables GIS to be such an effective problem-solving tool through spatial analysis.

GIS is more than just software. People and methods are combined with geospatial software and tools, to enable spatial analysis, manage large datasets, and display information in a map/graphical form.

Application of GIS:

1. GIS in Mapping:

Mapping is a central function of Geographic Information System, which provides a visual interpretation of data. GIS store data in a database and then represent it visually in a

mapped format. People from different professions use map to communicate. It is not necessary to be a skilled cartographer to create maps. Google map, Bing map, Yahoo map are the best example for web-based GIS mapping solution.

2. Telecom and Network services:

GIS can be a great planning and decision making tool for telecom industries. GDi GISDATA enables wireless telecommunication organizations to incorporate geographic data into the complex network design, planning, optimization, maintenance and activities.

This technology allows telecom to enhance a variety of application like engineering application, customer relationship management and location-based services.

3. Accident Analysis and Hot Spot Analysis:

GIS can be used as a key tool to minimize accident hazard on roads, the existing road network has to be optimized and also the road safety measures have to be improved. This can be achieved with proper traffic management.

By identifying the accident locations, remedial measures can be planned by the district administrations to minimize the accidents in different parts of the world. Rerouting design is also very convenient using GIS.

4. Urban Planning:

GIS technology is used to analyze urban growth and its direction of expansion, and to find suitable sites for further urban development. To identify the sites suitable for urban growth, certain factors have to consider which is: land should have proper accessibility, land should be more or less flat, land should be vacant or having low usage value presently and it should have a good supply of water.

5. Environmental Impact Analysis:

EIA is an important policy initiative to conserve natural resources and the environment. Many human activities produce potential adverse environmental effects which include the construction and operation of highways, railroads, pipelines, airports, radioactive waste disposal and more.

Environmental impact statements are usually required to contain specific information on the magnitude and characteristics of environmental impact. The EIA can be carried out efficiently by the help of GIS, by integrating various GIS layers, assessment of natural features can be performed.

6. Agricultural Applications:

GIS can be used to create more effective and efficient farming techniques. It can also analyze soil data and to determine: what are the best crop to plant? Where they should go to? How to maintain nutrition levels to best benefit crop to plant?

It is fully integrated and widely accepted for helping government agencies to manage programs that support farmers and protect the environment. This could increase food production in different parts of the world so the world food crisis could be avoided.

7. Disaster Management and Mitigation:

Today a well-developed GIS systems are used to protect the environment. It has become an integrated, well developed and successful tool in disaster management and mitigation. GIS can help with risk management and analysis by displaying which areas are likely to be prone to natural or man-made disasters. When such disasters are identified, preventive measures can be developed.

8. Determine Land Use/Land Cover Changes:

Land cover means the feature that is covering the barren surface. Land use means the area in the surface utilized for particular use. The role of GIS technology in land use and land cover applications is that we can determine land use/land cover changes in different areas.

Also, it can detect and estimate the changes in land use/ land cover pattern within time. It enables to find out sudden changes in land use and land cover either by natural forces or by other activities like deforestation.

9. Navigation (Routing And Scheduling):

Web-based navigation maps encourage safe navigation in the waterway. Ferry paths and shipping routes are identified for better routing. ArcGIS supports safe navigation system and provides accurate topographic and hydrographic data.

Recently DNR, s Coastal Resources Division began the task of locating, documenting, and cataloguing these no historic wrecks with GIS. This division is providing public information that makes citizens aware of these vessel locations through a web map.

The web map will be regularly updated to keep the boating public informed of these coastal hazards to minimize the risk of collision and injury.

10. GIS Solutions in Banking Sector:

Today rapid development occurs in the banking sector. So it has become more market-driven and market-responsive. The success of this sector largely depends on the ability of a bank to provide customer and market-driven services. GIS plays an important role in providing planning, organizing and decision making.

Advantages of GIS:

a. It can improve organizational integration. GIS would then integrate software, hardware and also data to capture, analyze, manage and so display all forms of information is geographically referenced.

b. GIS would also allow viewing, questioning, understanding, visualizing and interpreting the data into numbers of ways which will reveal relationships, trends and patterns in the form of globes, maps, charts and reports.

c. Geographic Information System is to provide help in answering questions as well as solve problems through looking at the data in a way which is easily and quickly shared.

d. GIS technology could also be integrated into framework of any enterprise information system.

e. And there would be numbers of employment opportunities.

Disadvantages of GIS:

a. GIS technology might be considered as expensive software.

b. It as well requires enormous data inputs amount that are needed to be practical for some other tasks and so the more data that is to put in.

c. Since the earth is round and so there would be a geographic error that will increase as you get on a larger scale.

d. GIS layers might lead to some costly mistakes once the property agents are to interpret the GIS map or the design of the engineer around the utility lines of the GIS.

e. There might be failures in initiating or initiating additional effort to fully implement the GIS but there might be large benefits to anticipate as well.

Artificial Intelligence:

Artificial intelligence (AI) is the science of making machines mimic human thought processes and behavior. Such systems would be able to learn languages, accomplish physical tasks, use perceptual equipment, and imitate human expertise and decision making.

Although AI applications do not exhibit the complexity, originality and generality of human intelligence, they play an important role in existing knowledge management.

Artificial intelligence is based on the principle that human intelligence can be defined in a way that a machine can easily mimic it and execute tasks, from the most simple to those that are even more complex. The goals of artificial intelligence include learning, reasoning, and perception.

AI is continuously evolving to benefit many different industries. Machines are wired using a cross-disciplinary approach based in mathematics, computer science, linguistics, psychology, and more.

Types of Artificial Intelligence:

1. Expert System:

An expert system also called a knowledge base system is an artificial intelligence system that applies reasoning capabilities to reach a conclusion. Expert systems work as an expert consultant for a particular problem domain and gives suggestion accordingly. The strength of the expert system is based on the knowledgebase and inference rules used by the expert system.

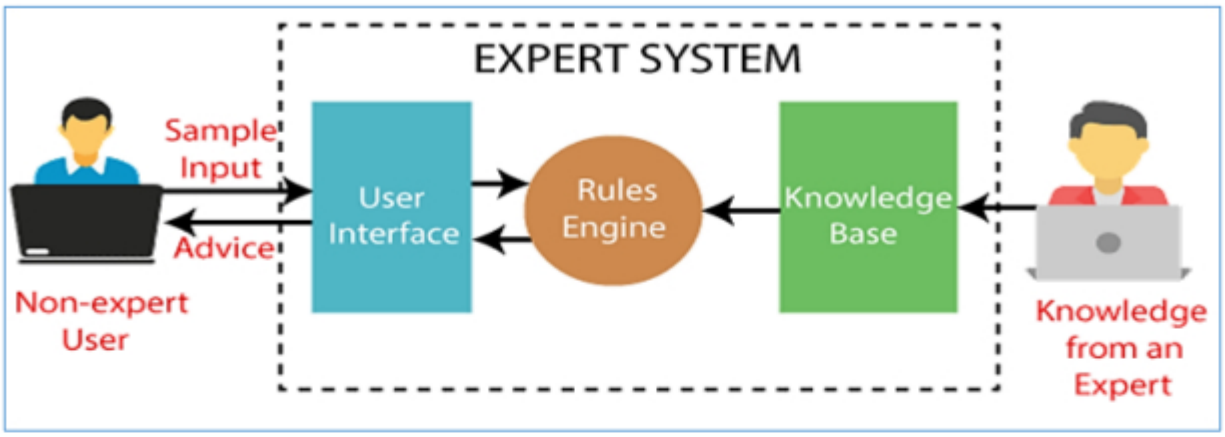


Fig: Expert System

Expert systems are excellent for diagnosis and prescriptive problems. Diagnostic problems are those requiring an answer to the question like "what is wrong?" correspond to the intelligence phase of decision making prescriptive problems are those that require an answer to the question, "what to do?" and corresponds to the choice phase of decision making.

Application Areas of Expert Systems:

1. Diagnosis and Troubleshooting of Devices and Systems of All Kinds:

This class comprises systems that deduce faults and suggest corrective actions for a malfunctioning device or process. Medical diagnosis was one of the first knowledge areas to which ES technology was applied (for example, see Shortliffe 1976), but the diagnosis of engineered systems quickly surpassed medical diagnosis.

There are probably more diagnostic applications of ES than any other type. The diagnostic problem can be stated in the abstract as given the evidence presented itself, what is the underlying problem/reason/cause?

2. Planning and Scheduling:

Systems that fall into this class analyze a set of one or more potentially complex and interacting goals to determine a set of actions to achieve those goals, and/or provide a detailed temporal ordering of those actions, taking into account personnel, materiel, and other constraints.

This class has great commercial potential, which has been recognized. Examples involve airline scheduling of flights, personnel, and gates; manufacturing job-shop scheduling; and manufacturing process planning.

3. Configuration of Manufactured Objects from Sub-assemblies:

Configuration, whereby a solution to a problem is synthesized from a given set of elements related by a set of constraints, is historically one of the most important expert system applications.

Configuration applications were pioneered by computer companies as a means of facilitating the manufacture of semi-custom minicomputers (McDermott 1981).

The technique has found its way into use in many different industries, for example, modular home building, manufacturing, and other problems involving complex engineering design and manufacturing.

4. Financial Decision Making:

The financial services industry has been a vigorous user of expert system techniques. Advisory programs have been created to assist bankers in determining whether to make loans to businesses and individuals.

Insurance companies have used expert systems to assess the risk presented by the customer and to determine a price for the insurance. A typical application in the financial markets is in foreign exchange trading.

5. Knowledge Publishing:

This is a relatively new, but also potentially explosive area. The primary function of the expert system is to deliver knowledge that is relevant to the user's problem, in the context of the user's problem.

The two most widely distributed expert systems in the world are in this category. The first is an advisor which counsels a user on appropriate grammatical usage in a text. The second is a tax advisor that accompanies a tax preparation program and advises the user on tax strategy, tactics, and individual tax policy.

6. Process Monitoring and Control:

Systems falling in this class analyze real-time data from physical devices to notice anomalies, predict trends, and controlling for both optimality and failure correction. Examples of real-time systems that actively monitor processes can be found in the steelmaking and oil refining industries.

7. Design and Manufacturing:

These systems assist in the design of physical devices and processes, ranging from high-level conceptual design of abstract entities all the way to factory floor configuration of manufacturing processes.

Components of Expert System:

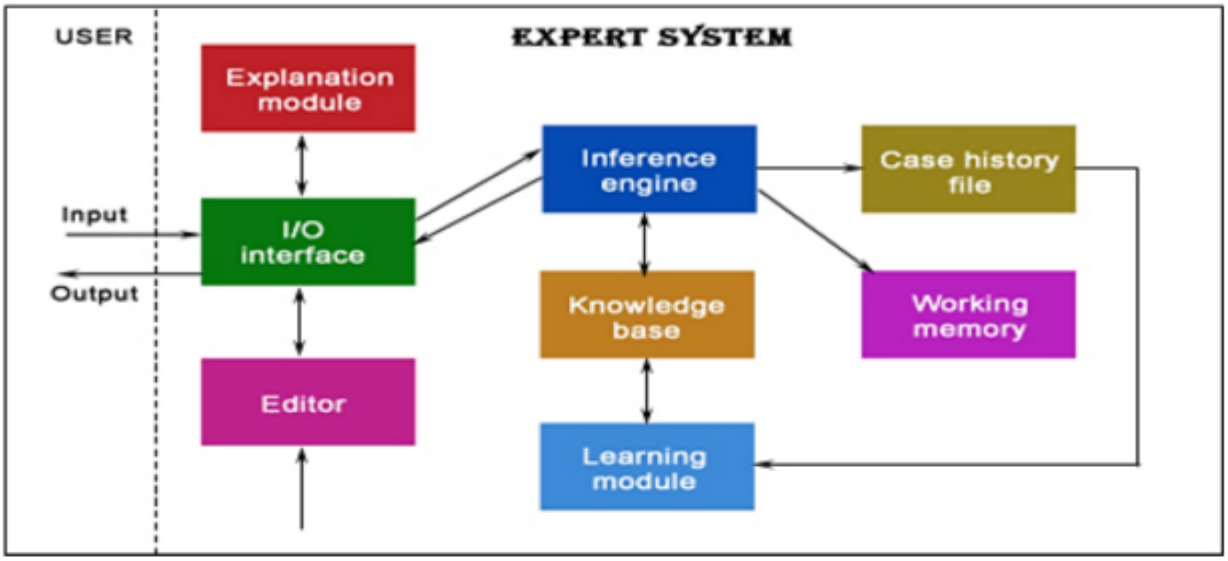


Fig: Components of Expert System

1. Input/output User Interface:

It enables the users to enter instructions and information into the expert system and to receive information from it. The interface permits users to communicate with the system in a more natural way. Especially use in language which is close to the natural language. The user interface has two parts:

a. Expert System Input:

A user can use a method for input command, natural language and customize the interface.

b. Expert System Output:

Expert systems are designed to provide output or solution for the specific problem domain and also has the ability to explain the solution.

2. Inference Engine:

The inference engine is one of the most important components that accept user input queries and responses to questions through the user interface and uses this dynamic information with the static knowledge base.

So, the inference engine acquires and manipulate the knowledge from the knowledge base to arrive at a particular solution. In case of rule-based expert system, inference engine:

a. Applies rules repeatedly to the facts, which are obtained from earlier rule application.

b. Adds new knowledge into the knowledge base if required.
c. Resolves rules conflicts when multiple rules apply to a particular case.

To recommend a solution the inference system uses the following strategies:

a. Forward Chaining:

It is a strategy of an expert system to answer the question, "what can happen next?" here, the inference engine follows the chains of conditions and derivations and finally provide the outcomes.

b. Backward Chaining:

With this strategy, an expert system find out the answer to the question "why this happens?" based on what has already happened, the inference engine tries to find out which conditions could have happened in past for this result.

3. Knowledge Base:

It contains domain-specific and high-quality knowledge especially in the form of facts and rules. Knowledge is required to show intelligent behavior and the success of any expert system mainly depends upon the collection of highly accurate and précised knowledge.

The knowledge base of an expert system is a store of both factual and heuristic knowledge. In knowledge base knowledge acquisition and knowledge representation plays an important role knowledge are acquired from various sources and organize the knowledge using different knowledge representation methods.

Characteristics of Expert System:

1. High-Level Performance:

The system must be capable of responding at a level of competency equal to or better than expert system in the field. The quality of the advice given by the system should be at a high level integrity and for which the performance ratio should be also very high.

2. Domain Specificity:

Expert systems are typically very domain-specific. For example, a diagnostic expert system for troubleshooting computers must actually perform all the necessary data manipulation as a human expert would.

The developer of such a system must limit his or her scope of the system to just what is needed to solve the target problem. Special tools or programming languages are often needed to accomplish the specific objectives of the system.

3. Understandable:

The system should be understandable i.e. be able to explain the steps of reasoning while executing. The expert system should have an explanation capability similar to the reasoning ability of human experts.

4. Adequate Response Time:

The system should be designed in such a way that it can perform within a small amount of time, comparable to or better than the time taken by a human expert to reach a decision point. An expert system that takes a year to reach a decision compared to a human expert's time of one hour would not be useful.

5. Use Symbolic Representations:

Expert system use symbolic representations for knowledge (rules, networks or frames) and perform their inference through symbolic computations that closely resemble manipulations of natural language.

6. Linked with Meta-knowledge:

Expert systems often reason with meta-knowledge i.e. they reason with knowledge about themselves and their own knowledge limits and capabilities. The use of meta-knowledge is quite interactive and simple for various data representations.

7. Expertise Knowledge:

Real experts not only produce good solutions but also find them quickly. So, an expert system must be skilful in applying its knowledge to produce solutions both efficiently and effectively by using the intelligence human experts.

8. Justified Reasoning:

This allows the users to ask the expert system to justify the solution or advice provided by it. Normally, expert systems justify their answers or advice by explaining their reasoning. If a system is a rule-based system, it provides to the user all the rules and facts it has used to achieve its answer.

9. Explaining Capability:

Expert systems are capable of explaining how a particular conclusion was reached and why requested information is needed during a consultation. This is very important as it

gives the user a chance to access and understand the system's reasoning ability, thereby improving the user's confidence in the system.

10. Special Programming Languages:

Expert systems are typically written in special programming languages. The use of languages like LISP and PROLOG in the development of an expert system simplifies the coding process.

The major advantage of these languages, as compared to conventional programming languages is the simplicity of the addition, elimination or substitution of new rules and memory management capabilities.

Some of the distinguishing characteristics of programming languages needed for expert system work are as follows:

a. Efficient mix of integer and real variables.
b. Good memory management procedures.
c. Extensive data manipulation routines.
d. Incremental compilation.
e. Tagged memory architecture.
f. Efficient search procedures.
g. Optimization of the systems environment.

2. Neural Networks:

A neural network also known as Artificial Neural Network (ANN) is an artificial intelligence system that is capable of finding and differentiating patterns like a human brain. A neural network can learn by examples and adept new concepts and knowledge. Neural networks are widely used for visual pattern and speech recognition system.

Neural network is inspired by biological neural networks that constitute an animal brain. Such a system learn to perform the task by considering examples, generally without being programmed and with any task-specific rules.

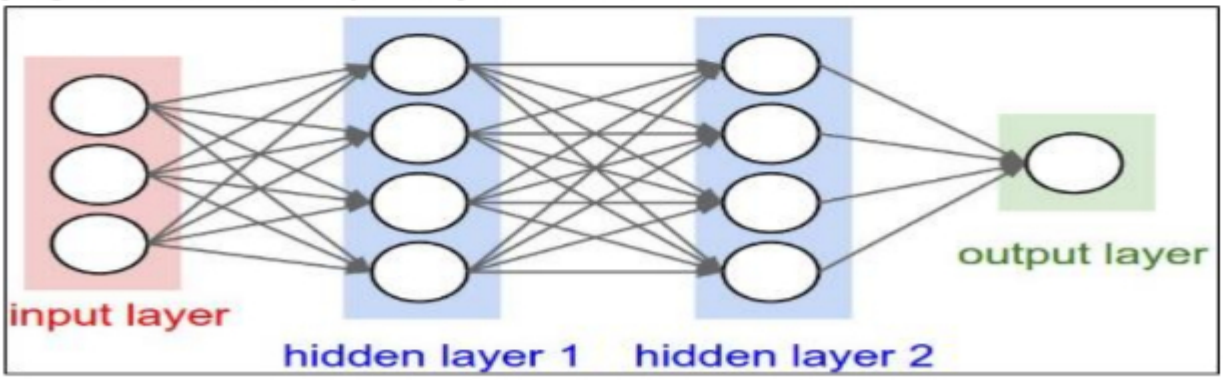


Fig: Neural Networks

An ANN is based on a collection of connected units or nodes called artificial neurons which loosely model the neurons in a biological brain. Each connection can transmit a signal from one neuron to another. An artificial neuron that receives a signal can process it and then provide some value.

Neural networks attempt to mimic the structure and functioning of the human brain. Conceptually neural network consists of three layers of virtual nerves cells (neurons) and these three layers are:

a. Input Layer
b. Output Layer
c. Middle Layer (Hidden Layer)

The input and output layers are connected to the middle layer by connections having different weights. All the inputs and the corresponding weights are computed to calculate a value. If the final value is greater than or equal to a particular threshold value then the system takes some action accordingly. There may be multiple hidden layers in between input and output layers.

Applications of Neural Networks:

1. Character Recognition:

The idea of character recognition has become very important as handheld devices like the Palm Pilot are becoming increasingly popular. Neural networks can be used to recognize handwritten characters.

2. Image Compression:

Neural networks can receive and process vast amounts of information at once, making them useful in image compression. With the Internet explosion and more sites using more images on their sites, using neural networks for image compression is worth a look.

3. Stock Market Prediction:

The day-to-day business of the stock market is extremely complicated. Many factors weigh in whether a given stock will go up or down on any given day. Since neural networks can examine a lot of information quickly and sort it all out, they can be used to predict stock prices.

4. Travelling Salesman's Problem:

Interestingly enough, neural networks can solve the travelling salesman problem, but only to a certain degree of approximation.

5. Medicine, Electronic Nose, Security, and Loan Applications:

These are some applications that are in their proof-of-concept stage, with the acceptation of a neural network that will decide whether or not to grant a loan, something that has already been used more successfully than many humans.

6. Face Recognition Using Artificial Neural Networks:

Face recognition entails comparing an image with a database of saved faces to identify the person in that input picture. Face detection mechanism involves dividing images into two parts; one containing targets (faces) and one providing the background. The associated assignment of face detection has direct relevance to the fact that images need to be analyzed and faces identified, earlier than they can be recognized.

7. Fraud Detection & Prevention Services:

XenonStack Fraud Detection Services offers real-time fraud analysis to increase profitability. Data Mining is used to quickly detect frauds and search for spot patterns and detect fraudulent transactions. Data Mining Tools like Machine Learning, Neural Networks, and Cluster Analysis are used to generate Predictive Models to prevent fraud losses.

8. Data Modeling Services:

XenonStack offers Data Modelling using Neural Networks, Machine Learning, and Deep Learning. Data modelling services help Enterprises to create a conceptual model based on the analysis of data objects. Deploy your Data Models on leading Cloud Service Providers like Google Cloud, Microsoft Azure, and AWS or on container environment - Kubernetes & Docker.

Advantages of Neural Networks:

a. A neural network can perform tasks that a linear program cannot.
b. When an element of the neural network fails, it can continue without any problem by their parallel nature.
c. A neural network learns and does not need to be reprogrammed.
d. It can be implemented in any application.
e. It can be performed without any problem.

Limitations of Neural Networks:

a. The neural network needs the training to operate.

b. The architecture of a neural network is different from the architecture of microprocessors, therefore, needs to be emulated.
c. Requires high processing time for large neural networks.

3. Genetic algorithms:

A genetic algorithm is an artificial intelligence system that mimics the evolutionary, survival of the fitness process to generate increasingly better solutions to a problem. In other words, a genetic algorithm is an optimizing system that finds the combination of input that gives the best output.

Genetic algorithms simulate the process of natural selection which means those species who can adapt to changes in their environment are able to survive and reproduce and go to next generation.

In simple words, they simulate "survival of the fittest" among individual of consecutive generation for solving a problem. **Each generation consist of a population of individuals** and each individual represents a point in search space and possible solution.

The **Main Characteristics Of A Genetic Algorithm** Are As Follows:

1. The genetic algorithm works with a coding of the parameter set, not the parameters themselves.
2. The genetic algorithm initiates its search from a population of points, not a single point.
3. The genetic algorithm uses payoff information, not derivatives.
4. The genetic algorithm uses probabilistic transition rules, not deterministic ones.

Genetic algorithms are best suited to decision making environment in which thousands or perhaps millions of solutions are possible. Genetic algorithms can find and evaluate solutions intelligently and can get through many more possibilities more thoroughly and faster than a human can.

Phases Considered in a Genetic Algorithm:

1. Initial Population:

The process begins with a set of individuals which is called a **Population**. Each individual is a solution to the problem we want to solve. An individual is characterized by a set of parameters (variables) known as **Genes**. Genes are joined into a string to form a **Chromosome** (solution).

In a genetic algorithm, the set of genes of an individual is represented using a string, in terms of an alphabet. Usually, binary values are used (string of 1s and 0s). We say that we encode the genes in a chromosome.

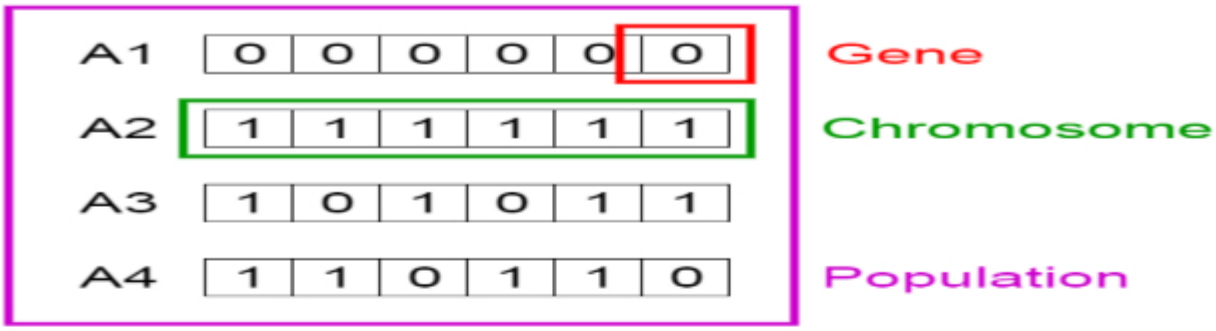


Fig: Population, Chromosomes and Genes

2. Fitness Function:

The **fitness function** determines how fit an individual is (the ability of an individual to compete with other individuals). It gives a **fitness score** to each individual. The probability that an individual will be selected for reproduction is based on its fitness score.

3. Selection:

The idea of **selection** phase is to select the fittest individuals and let them pass their genes to the next generation. Two pairs of individuals (**parents**) are selected based on their fitness scores. Individuals with high fitness have more chance to be selected for reproduction.

4. Crossover:

Crossover is the most significant phase in a genetic algorithm. For each pair of parents to be mated, a **crossover point** is chosen at random from within the genes. For example, consider the crossover point to be 3 as shown below.

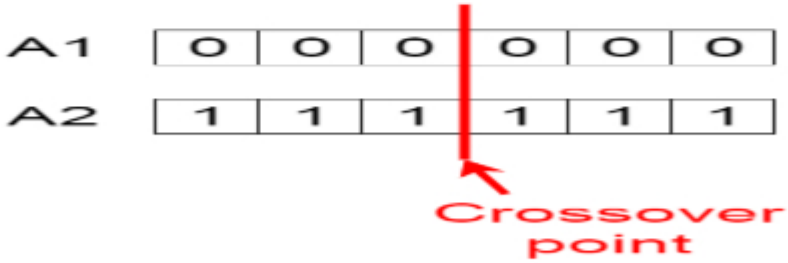


Fig: Crossover point

Offspring are created by exchanging the genes of parents among themselves until the crossover point is reached.

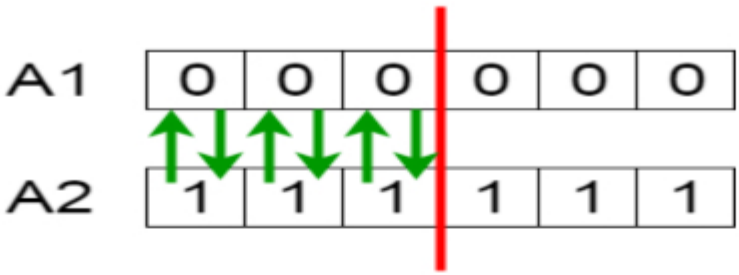


Fig: Exchanging Genes among Parents

The new offspring are added to the population.

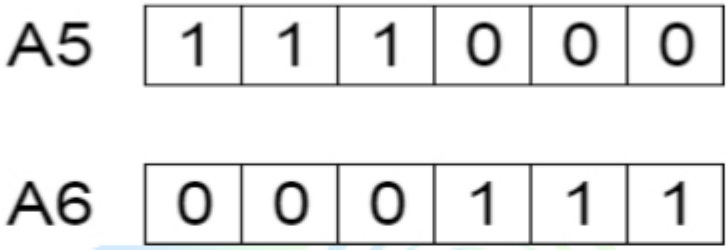


Fig: New offspring

5. Mutation:

In certain new offspring formed, some of their genes can be subjected to a **mutation** with a low random probability. This implies that some of the bits in the bit string can be flipped.

Fig: Mutation: Before and After

Mutation occurs to maintain diversity within the population and prevent premature convergence.

Applications Area of Genetic Algorithms:

1. **Optimization:** Genetic Algorithms are most commonly used in optimization problems wherein we have to maximize or minimize a given objective function value under a given set of constraints. The approach to solve Optimization problems have been highlighted throughout the tutorial.

2. **Economics:** GAs are also used to characterize various economic models like the cobweb model, game theory equilibrium resolution, asset pricing, etc.

3. **Neural Networks:** GAs are also used to train neural networks, particularly recurrent neural networks.

4. **Parallelization:** GAs also have very good parallel capabilities, and prove to be a very effective means in solving certain problems, and also provide a good area for research.

5. **Image Processing:** GAs are used for various digital image processing (DIP) tasks as well like dense pixel matching.

6. **Vehicle Routing Problems:** With multiple soft time windows, multiple depots and a heterogeneous fleet.

7. **Scheduling Applications:** GAs are used to solve various scheduling problems as well, particularly the timetabling problem.

8. **Machine Learning:** As already discussed, genetics-based machine learning (GBML) is a niche area in machine learning.

9. **Robot Trajectory Generation:** GAs have been used to plan the path which a robot arm takes by moving from one point to another.

10. **Parametric Design of Aircraft:** GAs have been used to design aircraft by varying the parameters and evolving better solutions.

11. **DNA Analysis:** GAs have been used to determine the structure of DNA using spectrometric data about the sample.

12. **Multimodal Optimization:** GAs are obviously very good approaches for multimodal optimization in which we have to find multiple optimum solutions.

13. **Travelling Salesman Problem and Its Applications:** GAs have been used to solve the TSP, which is a well-known combinatorial problem using novel crossover and packing strategies.

Advantages of Genetic Algorithms:

a. The concept is easy to understand.
b. Genetic Algorithms search from a population of points, not a single point.
c. Genetic Algorithms use payoff (objective function) information, not derivatives.
d. Genetic Algorithms support multi-objective optimization

e. Genetic Algorithms use probabilistic transition rules, not deterministic rules.
f. Genetic Algorithms are good for "noisy" environment.
g. Genetic Algorithms are robust to local minima/maxima.
h. Genetic Algorithms are easily parallelized.
i. Genetic Algorithms can operate on various representation.
j. Genetic Algorithms **are** stochastic.
k. Genetic Algorithms work well on mixed discrete or continuous problem.

Disadvantages of Genetic Algorithms:

a. Genetic Algorithms implementation is still an art.
b. Genetic Algorithms require less information about the problem, but designing an objective and getting the representation and operators right can be difficult.
c. Genetic Algorithms are computationally expensive i.e. time-consuming.

4. Intelligent Agent:

An agent is an intelligent autonomous software that assist us or acts on behalf of us in performing repetitive computer-related task. They are intelligent because they can learn from their previous experience and show human-like intelligent behavior. They are autonomous because they can start, control and stop themselves.

According to working, there are two types of agents as **static and dynamic agents**. A **static agent** also known as computer bound agent can work in only one host computer and cannot travel across the network from server to server.

For example, an agent used to prepare a purchase order in a departmental store. An agent that can travel the network from server to server is known as **dynamic or mobile agent**. For example, an agent uses an airline ticket.

Types of Intelligent Agent:

1. Information Agent:

They are intelligent agents that search for information of some kind and provides it back. For example, a buyer agent that helps the customers to find the appropriate products or services customers needed.

2. Monitoring and Surveillance Agent:

They are also called predictive agent and are the intelligent agent that constantly observe and report on some entity of interest, a network or manufacturing equipment. They are often used to monitor complex computer networks and to track out any problem in the network. Such agents are commonly used for various activities such as:

a. To watch the competitors and provide information about competitors price and special offers.
b. To monitor internet websites, discussion groups, mailing list, etc.
c. To monitor the auction website for products or prices that we want.
d. To monitor the changes in the share market and provide appropriate information.

3. Data Mining Agents:

A data mining agent operates in a data warehouse to discover the hidden pattern, trends or relationship between data. Such agents provide data patterns which are very much useful in business decision making.

4. User or Personal Agents:

They are an intelligent agent that take action on behalf of a user. They are useful in doing the repetitive personal tasks of common users for example:

a. To check email, to sort them in according to our priority alert us when an important email arrives.
b. Play computer game as our opponent.
c. To fill out forms on the web automatically and even to store information for future reference.

Combining IT Brainpower System:

A brain-computer interface (BCI system) records the brain's electrical activity using EEG (Electroencephalography) signals, which are detected with electrodes attached to the scalp. Machine learning software learns to recognize the patterns generated by each user as they think of a certain concept, such as "left" or "right".

Researchers are discovering, however, that they get better results in some tasks by combining the signals from multiple BCI users. Until now, this "collaborative BCI" technique has been used in simple pattern recognition tasks.

So they developed a simulator in which pairs of BCI users had to steer a craft towards the dead center of a planet by thinking about one of eight directions that they could fly in, like using compass points. Brain signals representing the user's chosen direction, as interpreted by the machine learning system, were merged in real-time and the spacecraft followed that path.

The results, to be presented at an intelligent user interfaces conferences in California in March strongly favored two brain navigation. Simulation flights were 67 percent accurate for a single user, but 90 percent on target for two users.

And when coping with sudden changes in the simulated planet's position, reaction times were halved, too. Combining signals eradicates the random noise that dogs EEG signals. "When our average signals from two people's brain, the noise cancels out a bit."

The technique can also compensate for a lapse in attention. "It is difficult to stay focused on the task at all time. So when a single user has momentary attention lapse, it matters."

Executive Information and Support Systems:

An executive information system also known as an executive support system is a type of management information system that facilitates and supports senior executive information and decision making needs.

Senior managers use ESS to address strategic issues and long term trends both within the firm and in the external environment. ESS serves the strategic level of the organization. They address unstructured, non-routine decisions requiring judgments, evaluation and experience because there is no common procedure to arrive at a solution.

ESS creates a generalized computing and communication environment rather than providing a fixed application.

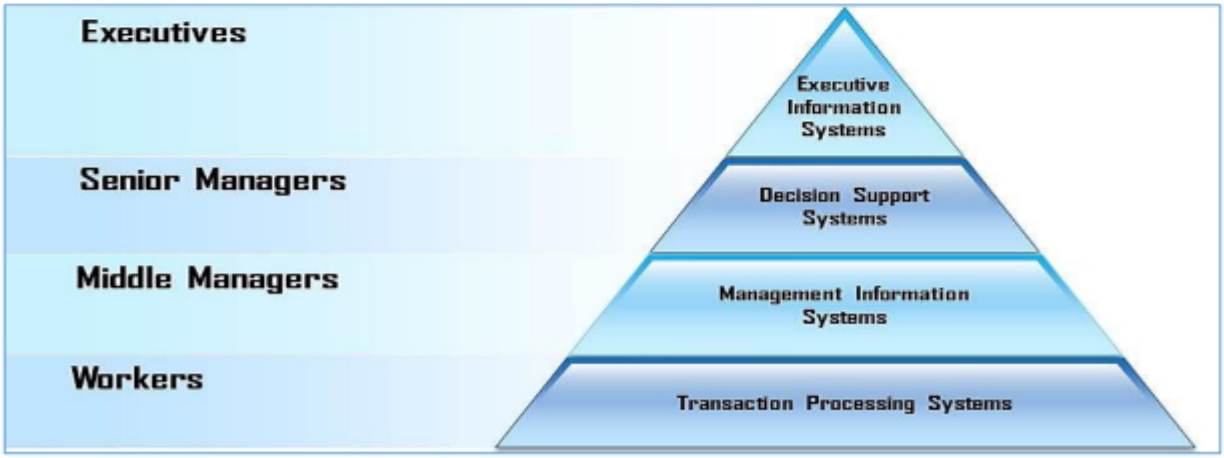


Fig: Executive Information and Support Systems

ESS is designed to incorporate data about external event such as new tax rules, competitors information, stock market trends, etc. as well as they draw the summarized information from internal MIS and DSS.

They filter compress and track critical data, focusing on the reduction of time and effort required to obtain information useful to executives. ESS employs the most advance graphic software and can deliver graph and data from many sources immediately to senior executive officer.

ESS provides a generalized communication environment where senior executives access the corporate data from anywhere at any time with a high level of security.

Components of ESS:

A typical model of an ESS consist of workstations of portals with menus, interactive graphics and communication capabilities that can be used to access historical and competitive data from an internal corporate system and external databases.

The information is presented in the form of digital dashboard which displays a single screen graph and chart of key performance indicator (KPI) for managing a company.

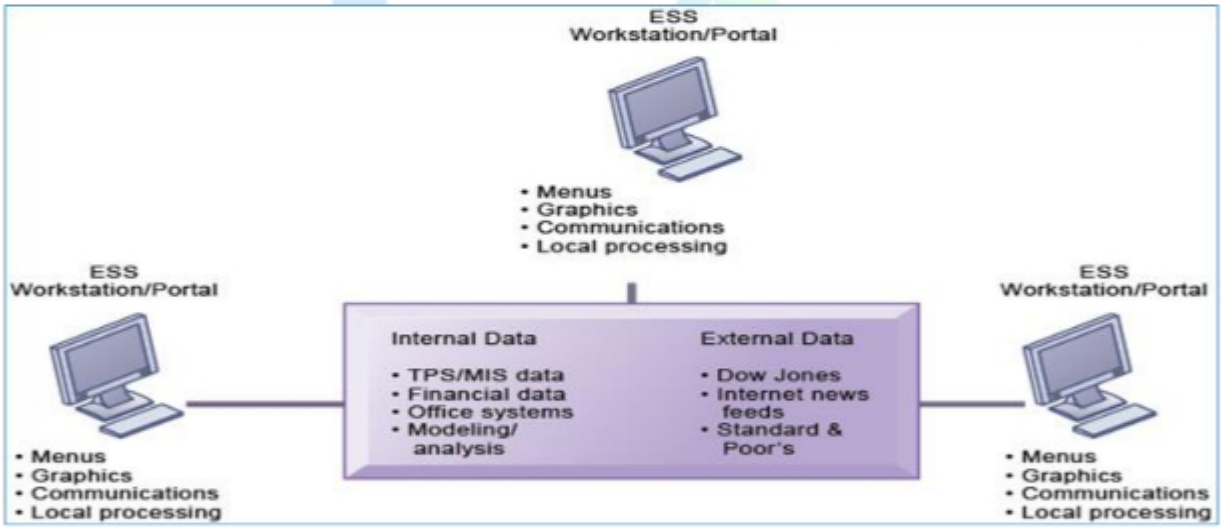


Fig: Typical Model of an Expert Support System

Characteristics of ESS:

1. Informational Characteristics:

a. Flexibility and ease of use.
b. Provides the timely information with the short response time and also with the quick retrieval.
c. Produces the correct information.
d. Produces relevant information.

e. Produces the validated information.

2. User Interface/Orientation Characteristics:

a. Consists of the sophisticated self-help.
b. Contains the user-friendly interfaces consisting of the graphic user.
c. Can be used in many places.
d. Offers secure reliable, confidential access along with the access procedure.
e. Is very much customized.
f. Suites the management style of the individual executives.

3. Managerial/Executive Characteristics:

a. Supports the overall vision, mission and strategy.
b. Provides the support for strategic management.
c. Sometimes helps to deal with the situations that have a high degree of risk.
d. Is linked to the value-added business processes.
e. Supports the need/ access for/ to the external data/ databases.
f. Is very much result oriented in nature?

Needs of ESS:

a. Helps in accessing the aggregated or macro or global information.
b. Provides the user with an option to use the external data extensively.
c. Enables analysis of the address and the hoc queries.
d. Shows the trends, the ratios and the various deviations.
e. Helps in incorporating the graphic and the text in the same display, which helps to have a better view.
f. It helps in the assessment of the historical as also the latest data.
g. Problem indicators can be highlighted with the help of the Executive Information System / executive support system.
h. Open ended problem explanation with the written interpretations can be done with the help of the Executive Information System / executive support system.
i. Offers management by the exception reports.
j. Utilizes the hypertext and the hypermedia.
k. Offers generalized computing.
l. Offers telecommunications capacity.

Benefits of ESS:

a. Achievement of the various organizational objectives.
b. Facilitates access to the information by integrating many sources of the data.

c. Facilitates broad, aggregated perspective and the context.
d. Offers broad highly aggregated information.
e. User's productivity is also improved to a large extent.
f. Communication capability and quality are increased.
g. Provides with better strategic planning and control.
h. Facilitates proactive rather than a reactive response.
i. Provides the competitive advantage.
j. Encourages the development of a more open and active information culture.
k. The cause of a particular problem can be founded.

Advantages of ESS:

a. Easy for upper-level executives to use, extensive computer experience is not required in operations.
b. Provides timely delivery of company summary information.
c. Information that is provided is better understood.
d. EIS provides timely delivery of information. Management can make decisions promptly.
e. Improves tracking information.
f. Offers efficiency to decision-makers.

Disadvantages:

a. System dependent
b. Limited functionality, by design
c. Information overload for some managers
d. Benefits hard to quantify
e. High implementation cost.
f. System may slow, large, and hard to manage
g. Need good internal processes for data management.
h. May leads to less reliable and less secure data

Differences:

DIMENSION	DSS	MIS	EIS
Focus	Analysis, decision Support	Information processing	Status Access
Typical Users Served	Analysts, professions, managers (via intermediaries)	Middle, lower levels, sometimes senior executives	Senior Executives Expediency
Impetus	Effectiveness	Efficiency	

Application	Diversified Areas where Managerial Decisions are made	Production control, sales forecasts, financial analysis, human resource management	Environmental scanning, performance evaluation, identifying problems and opportunities
Database(s)	Special	Corporate	Special
Decision Support Capabilities	Supports semi-structured and unstructured decision making; mainly ad-hoc, but sometimes repetitive decisions	Direct or indirect support, mainly structured routine problems, using standard operations, research and other models	Indirect support, mainly high level and unstructured decisions and policies
Type of Information	Information to support specific situations	Scheduled and demand reports; structured flow, exception reporting mainly internal operations	News items, external information on customers, competitors and the environment
Principal Use	Planning, Organizing, staffing and control	Control	Tracking and control
Adaptability to Individual User	Permits individual judgment, what-if capabilities, some choice of dialogue style	Usually none, standardized	Tailored to the decision-making style of each individual executive, offers several options of outputs
Graphics	Integrated part of many DSS	Desirable	A must
User Friendliness	A must where no intermediaries are used	Desirable	A must
Treatment of Information	Information provided by the EIS/or MIS is used as an input to the DSS	Information is provided to a diversified group of users who then manipulate it or summarize it as needed	Filters and compresses the information tracks critical data and information
Supporting Detailed Information	Can be programmed into DSS	Inflexibility of reports, cannot get the supporting details quickly	Instant access to the supporting details of any summary
Model Base	The Core of the DSS	Standard Models are available but	Can be added, usually not included or

		are not managed	limited in nature
Construction	By users, either alone or with specialists from IS or IC departments	By vendors or IS specialists	By Vendors or IS Specialists
Hardware	Mainframes, micros or distributed	Mainframes, Micros or distributed	Distributed system
Nature of Computing Packages	Large computational capabilities, modelling languages and simulation, applications and DSS generators	Application-oriented, performance reports, strong reporting capabilities, standard statistical, financial, accounting and management science models	Interactive, easy to access multiple databases, on-line access, sophisticated DBMS capabilities and complex linkages

Integrating EIS and DSS:

Enterprise applications are specifically designed for the sole purpose of promoting the needs and objectives of the organizations. Enterprise applications provide business-oriented tools supporting electronic commerce, enterprise communication and collaboration, and web-enabled business process both within a networked enterprise and with its customers and business partners.

Service Provided by Enterprise Applications:

a. Online shopping, billing and payment processing
b. Interactive product catalogue
c. Content management
d. Customer relationship management
e. Manufacturing and other business processes integration
f. IT services management
g. Enterprise resource management
h. Human resource management
i. Business intelligence management
j. Business collaboration and security
k. Form automation