THINKING

In general, thinking can be a complex process that uses concepts, their interrelationships, and inference or deduction, to produce new knowledge or fact.

However, thinking is often used to describe such disparate acts as memory recall, arithmetic calculations, creating stories, decision making, puzzle solving, and so on.

The term “thinking” is frequently loosely defined and ambiguously applied.

The philosopher Rene´ Descartes proclaimed his famous observation “Cogito, ergo sum,” he demonstrated the power of thought at the most basic level by deriving an important fact from the act of thinking and self-awareness.

INTELLIGENT: individual can be identified as intelligent if they have accurate memory recall, the ability to apply valid and correct logic, and the capability to expand their knowledge through learning and deduction.

Intelligent Web Applications

These applications go beyond traditional web apps by incorporating features that enable them to make decisions, learn from data, and adapt to user behavior.

Intelligent web applications are sophisticated software tools that leverage artificial intelligence (AI), machine learning (ML), and advanced algorithms to provide enhanced functionality and user experiences.

Intelligent web applications are continuously evolving as AI and machine learning technologies, offering increasingly sophisticated and valuable tools for users and businesses.

Characteristics:

Personalization: Intelligent web applications use AI to customize user experiences based on individual preferences and behavior. For example, recommendation systems on e-commerce sites or streaming platforms suggest products or content based on past interactions.

Natural Language Processing (NLP): These applications can understand, interpret, and generate human language. Chatbots and virtual assistants use NLP to interact with users in a conversational manner.

Machine Learning: Intelligent web applications often incorporate machine learning models that continuously improve their performance and accuracy as they are exposed to more data.

Automation: AI-driven web applications can automate repetitive tasks, such as data entry, email responses, or social media management, increasing efficiency and reducing the need for manual intervention.

Examples:

Recommendation Engines: Platforms like Netflix and Amazon use intelligent algorithms to recommend movies, shows, or products based on user behavior and preferences.

Chatbots and Virtual Assistants: Applications such as Google Assistant, Siri, and customer service chatbots use NLP and AI to provide assistance and answer queries in a conversational manner.

Fraud Detection: Financial institutions use intelligent web applications to detect unusual transaction patterns and potential fraudulent activities by analyzing large volumes of transaction data.

Health Diagnostics: Web-based health applications use AI to analyze medical data, assist in diagnosing conditions, and recommend treatments or lifestyle changes.

Information Age

The **Information Age**, also known as the Digital Age or Computer Age, refers to the period in human history where the creation, distribution, and manipulation of information became a significant economic, social, and cultural force. It began in the late 20th century and continues into the 21st century.

Information Age Includes:

•**Advancements in Technology**: Rapid developments in information and communication technologies (ICT) such as computers, the internet, smartphones, and software have revolutionized how information is processed and shared.

•**Digitalization**: The transition from analog to digital technologies has transformed industries, economies, and daily life. Data is now stored, processed, and transmitted in digital form, leading to more efficient and accessible information management.

•**Internet and Connectivity**: The rise of the internet has been a cornerstone of the Information Age, enabling global communication, social networking, e-commerce, and access to vast amounts of information.

•**Data and Big Data**: The ability to collect, analyze, and leverage large volumes of data (big data) has become crucial for decision-making in business, science, and government.

The Information Age has greatly influenced how people live and interact, leading to both opportunities and challenges in a rapidly evolving digital world.

World Wide Web

The World Wide Web (WWW):

•The World Wide Web (WWW) or the Web is a **repository of information** spread all over the world and linked together. The WWW has a unique combination of flexibility, portability and user friendly features that distinguish if forms other services provided by the internet.

•The WWW today is a **distributed client-server service**, in which a client using a browser can be access a service using a server. However, the service provided is distributed over many locations called Websites.

•The web consists of **many web pages** that incorporate text, graphics, sound, animation and other multimedia components.

•Web pages are **connected to one another by hypertext**. In a hypertext environment the information is stored using the concept of pointers.

•WWW uses a concept of **HTTP which allows communicate between a web browser and web server**. The web page can be created by using a HTML.

•HTML language **has some commands** while which are used to inform the web browser about the way of displaying the text, graphics and multimedia files. HTML also has some commands through which we can give links to the web pages.

WWW-World Wide Web

•The **WWW today is a distributed client-server**, in which a client using a web browser can access a service from a server.

Working of a web:

Web page is a document available on World Wide Web. Web Pages are stored on web server and can be viewed using a web browser.

WWW works on client- server approach. Following steps explains how the web works:

1. User enters the URL (say, **http://www.acoe.edu.in) of the web page in the address bar of web browser.**

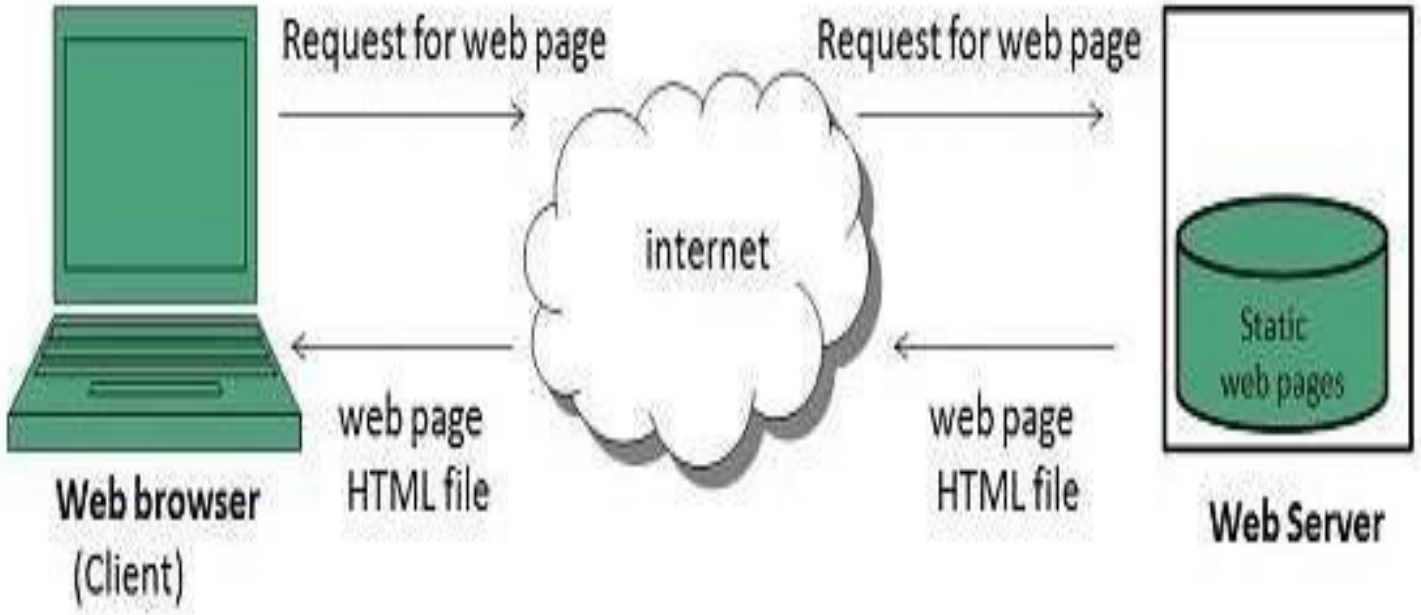
2. Then browser requests the Domain Name Server for the IP address corresponding to www.acoe.edu.in.

3. After receiving IP address, browser sends the request for web page to the web server using HTTP protocol which specifies the way the browser and web server communicates.

4. Then web server receives request using HTTP protocol and checks its search for the requested web page. If found it returns it back to the web browser and close the HTTP connection.

WWW

5. Now the web browser receives the web page, It interprets it and display the contents of web page in web browser‘s window.



LIMITATIONS OF TODAY'S WEB

LIMITATIONS OF TODAY'S WEB:

1. **Todays web still relies on HTM**L, which is responsibility for describing how information is to be displayed and laid out on a web.

2. The web today **do not have the ability of machine understanding and processing of web- based information**.

3. The web is **characterized by textual data** augmented web services as it involves human assistance.

4. The web is characterized by **textual data augmented by pictorial and audio-visual addition**.

LIMITATIONS OF TODAY'S WEB

5. The web today is limited to **manual keyboard searches** as HTML do not have the ability to exploit by information retrieval techniques

6. Web browsers are **limited to access existing information in a standard form**.

7. On web, development of **complex networks with meaningful content is difficult**.

8. Today‘s web is **restricted to search, database, support, intelligent, business logic, automation, security and trust**.

NEXT GENERATION WEB

•A new Web architecture called the ***Semantic Web*.** It offers users the ability to work on *shared knowledge* by constructing new meaningful representations on the Web.

•Semantic Web research has developed from the traditions of AI and ontology languages. It offers automated processing through machine-understandable metadata.

•Ontology is an agreement between software agents that exchange information.

• Semantic Web agents could utilize metadata, ontologies, and logic to carry out its tasks.

•Agents are ***pieces of software*** that work autonomously and proactively on the Web to perform certain tasks. In most cases, agents will simply collect and organize information.

•Agents on the Semantic Web will receive some tasks to perform and seek information from Web resources, while communicating with other Web agents, in order to fulfill its task.

Machine Intelligence

MACHINE INTELLIGENCE (Also called artificial or computational intelligence):

•Combines a wide variety of advanced technologies to give **machines the ability to learn, adapt, make decisions, and display behaviors not explicitly programmed into their original capabilities.**

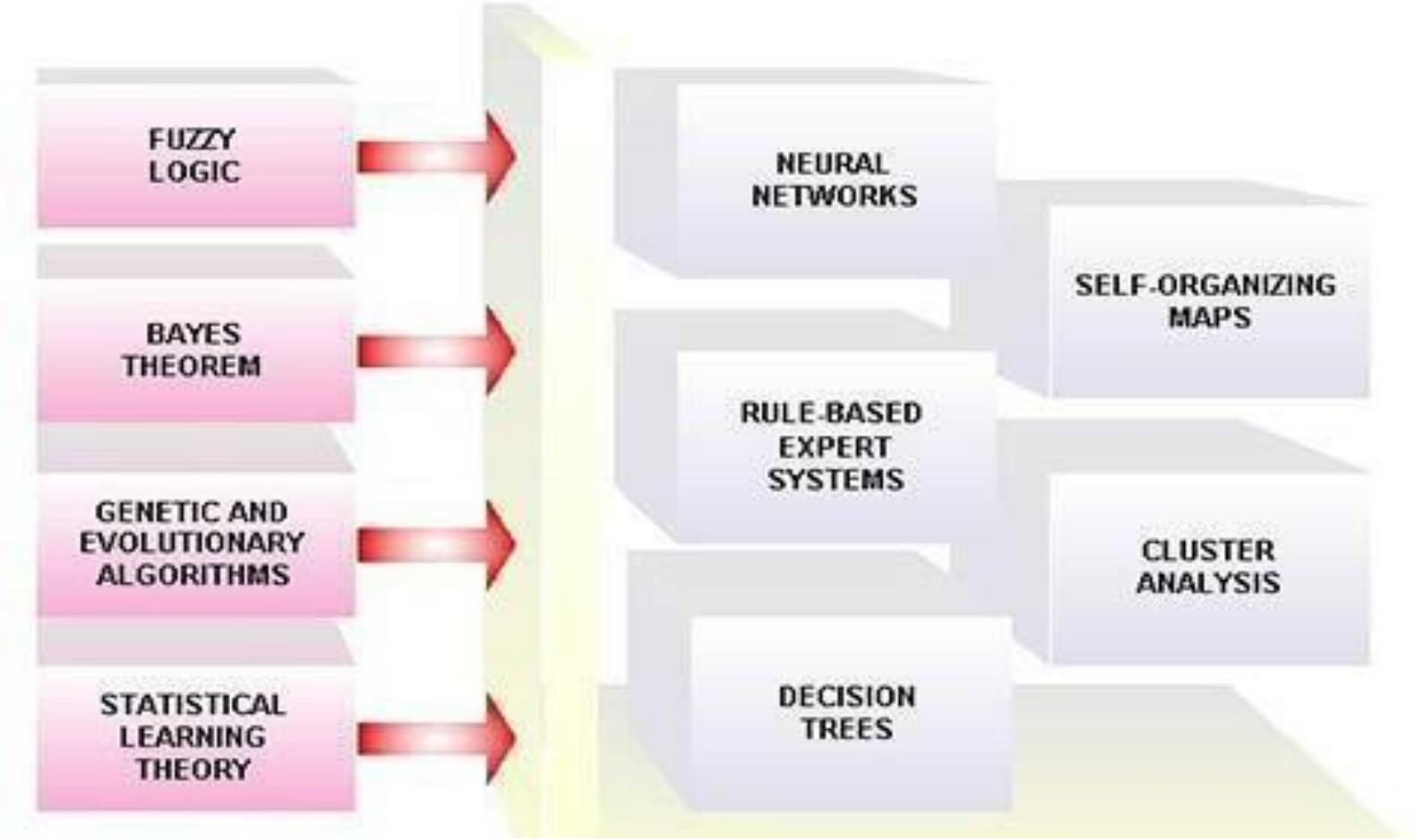
•Some of the machine intelligence capabilities, such as **neural networks, expert systems, and self-organizing maps, are plug-in components – they learn and manage processes at a very high level.**

•Other capabilities, such as fuzzy logic, Bayes Theorem, and genetic algorithms are building blocks – they often provide advanced reasoning and analysis capabilities.

• Machine Intelligence capabilities add powerful analytical, self-tuning, self-healing, and adaptive behavior to client applications. They also comprise the core technologies for many of advanced data mining and knowledge discovery services.

Machine Intelligence

Machine Intelligence:



Artificial Intelligence

ARTIFICIAL INTELLIGENCE:

•Artificial intelligence (AI) is the intelligence of machines and the branch of computer science that aims to create it.

•John McCarthy, who coined the term in 1955, defines it as "*the science and engineering of making intelligent machines.*"

•AI textbooks define the field as "***the study and design of intelligent agents***" where an intelligent agent is a system that perceives its environment and takes actions that maximize its chances of success.

•**Intelligent agent:** Programs, used extensively on the Web, that perform tasks such as **retrieving and delivering information and automating repetition .**

•More than 50 companies are currently developing intelligent agent software or services, including **Firefly and WiseWire.**

Artificial Intelligence

- **Agents** are designed to make computing easier.
- Currently they are used as Web browsers, news retrieval mechanisms, and shopping assistants.
- By specifying certain parameters, agents will "search" the Internet and return the results directly back to your PC.

Branches of AI:

- **Pattern recognition**

When a program makes observations of some kind, it is often programmed to compare what it sees with a pattern. For example, a vision program may try to match a pattern of eyes and a nose in a scene in order to find a face.

Search

AI programs often examine large numbers of possibilities, e.g. moves in a chess game or inferences by a theorem proving program. Discoveries are continually made about how to do this more efficiently in various domains.

Artificial Intelligence

Branches of AI:

•Common sense knowledge and reasoning

This is the area in which AI is farthest from human-level, in spite of the fact that it has been an active research area since the 1950s. While there has been considerable progress, e.g. in developing systems of *non-monotonic reasoning and theories of action, yet more new ideas are needed.*

•Representation

Facts about the world have to be represented in some way. Usually languages of mathematical logic are used.

•Learning from experience

Programs do that. Programs can only learn what facts or behaviors their formalisms can represent, and unfortunately learning systems are almost all based on very limited abilities to represent information.

Artificial Intelligence

Branches of AI:

•Planning

Planning programs start with general facts about the world (especially facts about the effects of actions), facts about the particular situation and a statement of a goal. From these, they generate a strategy for achieving the goal. In the most common cases, the strategy is just a sequence of actions.

•Ontology

Ontology is the study of the kinds of things that exist. In AI, the programs and sentences deal with various kinds of objects, and we study what these kinds are and what their basic properties are. Emphasis on ontology begins in the 1990s.

•Genetic programming

Genetic programming is a technique for getting programs to solve a task by mating random Lisp programs and selecting fittest in millions of generations.

Artificial Intelligence

Applications of AI:

•Game playing :

You can buy machines that can play master level chess for a few hundred dollars. There is some AI in them, but they play well against people mainly through brute force computation--looking at hundreds of thousands of positions. To beat a world champion by brute force and known reliable heuristics requires being able to look at 200 million positions per second.

•Speech recognition:

In the 1990s, computer speech recognition reached a practical level for limited purposes. Thus United Airlines has replaced its keyboard tree for flight information by a system using speech recognition of flight numbers and city names. It is quite convenient. On the the other hand, while it is possible to instruct some computers using speech, most users have gone back to the keyboard and the mouse as still more convenient.

•Understanding natural language :

Just getting a sequence of words into a computer is not enough. Parsing sentences is not enough either. The computer has to be provided with an understanding of the domain the text is about, and this is presently possible only for very limited domains.

Artificial Intelligence

Computer vision: The world is composed of three-dimensional objects, but the inputs to the human eye and computers' TV cameras are two dimensional. Some useful programs can work solely in two dimensions, but full computer vision requires partial three-dimensional information that is not just a set of two-dimensional views. At present there are only limited ways of representing three- dimensional information directly, and they are not as good as what humans evidently use.

Expert systems :A "knowledge engineer'' interviews experts in a certain domain and tries to embody their knowledge in a computer program for carrying out some task. How well this works depends on whether the intellectual mechanisms required for the task are within the present state of AI. When this turned out not to be so, there were many disappointing results.

One of the first expert systems was MYCIN in 1974, which diagnosed bacterial infections of the blood and suggested treatments.

Heuristic classification : One of the most feasible kinds of expert system given the present knowledge of AI is to put some information in one of a fixed set of categories using several sources of information. An example is advising whether to accept a proposed credit card purchase. Information is available about the owner of the credit card, his record of payment and also about the item he is buying and about the establishment from which he is buying it (e.g., about whether there have been previous credit card frauds at this establishment).

ONTOLOGY

ONTOLOGY : Ontology is an agreement between software agents that exchange the information.

•**Ontologies are considered one of the pillars of the *Semantic Web, although they do not have a universally accepted definition.***

•A Semantic Web **can be considered as a special form of (usually light-weight) ontology.**

•Ontology specifies the concepts, relationships, and other distinctions that are relevant for modeling a domain.

•The specification takes the form of the definitions of representational vocabulary (classes, relations, and so forth), which provide meanings for the vocabulary and formal constraints on its coherent use.

Applications of Ontology:

Ontologies are part of the W3C standards stack for the Semantic Web, in which they are used to specify standard conceptual vocabularies in which to **exchange data among systems,**

Provide services for answering queries, publish reusable knowledge bases,

and offer services to facilitate **interoperability across multiple, heterogeneous systems and databases.**

W3C standards improve web security through the development of authentication technologies that can replace weak passwords and reduce phishing and other sophisticated cyber attacks.

Ontology

Few Applications

- e-Science, e.g., Bioinformatics
  - The Gene Ontology (GO)
  - The Protein Ontology (MGED)
- Databases
  - Schema design and integration
  - Query optimisation
- User interfaces
- The Semantic Web & so-called Semantic Grid

Inference Engine

An **Inference** is an idea or conclusion that's drawn from evidence and reasoning. An inference is an educated guess(i.e the process of inferring things based on what is already known)

Inference Engine: an inference engine is a "**computer program that tries to derive answers from a knowledge base**

Inference engine is a **component of the system that applies logical rules to the knowledge base to deduce new information**(new **facts, rules, and their relations.)**. The **first inference engines were components of expert systems**. *Inference means a conclusion* reached on the basis of evidence and reasoning.

In computer science, specifically the **branches of knowledge engineering and artificial intelligence**,".

It is the "brain" that expert systems use to reason about the information in the knowledge base for the **ultimate purpose of formulating new conclusions**.

Inference engines are considered to be a special case of **reasoning engines**, which can use more general methods of reasoning.

An inference engine **interprets and evaluates the facts in the knowledge base** in order to provide an answer.

There are two major methods that are utilized by inference engines to gather new knowledge:

- Backward chaining
- Forward chaining

Backward chaining: is a problem-solving method used in various fields such as artificial intelligence, logic, and decision-making. It involves working backward from a desired goal to determine the necessary steps to achieve that goal.

Forward chaining: begins with the available data, analyzes it, and infer new details and facts based on a specific rule.

Both approaches are based on deductive reasoning in artificial intelligence that if A implies that B is true and A is true, then B must also be true. Forward chaining in artificial intelligence can be demonstrated through an example of the rule like this:

Rule1: Cat(x) => Mammal(x)

states that all cats are mammals.

In a **rule-based inference engine**, the simplest actions taken go **through 3 stages**: (1)**Matching**, (2)**Selecting**, and (3)**Executing** rules.

Match rules are a process in which **all the rules are found and triggered by the contents of a knowledge base**.

The **selecting rule** is an action recognize the **order of the rules** that should be applied.

Execute rules is **applying rules to the knowledge base** exists with the help of either forward or backward chaining.

Architecture:
The separation of inference engines as a distinct software component stems from the typical production system architecture. This architecture relies on a data store,

1. An **interpreter.** The interpreter executes the chosen agenda items by applying the corresponding base rules.

2. A **scheduler.** The scheduler maintains control over the agenda by estimating the effects of applying inference rules in light of item priorities or other criteria on the agenda.

3. A **consistency enforcer.** The consistency enforcer attempts to maintain a consistent representation of the emerging solution.

Logic:

In logic, a rule of inference, inference rule, or transformation rule is **the act of drawing a conclusion** based on the form of premises interpreted as a function which takes premises, analyses their syntax, and returns a conclusion (or conclusions).

Expert System

In artificial intelligence, an expert system is a **computer system that emulates the decision- making ability of a human expert**. Expert systems are designed to solve complex problems by reasoning about knowledge, like an expert, and not by following the procedure of a developer as is the case in conventional programming.

SOFTWARE AGENTs

In computer science, *a software agent* is a software program that acts for a user or other program in a relationship of agency, which derives from the Latin agere (to do): an agreement to act on one's behalf.

The basic attributes of a software agent are that

- Agents are not strictly invoked for a task, but activate themselves,
- Agents may reside in wait status on a host, perceiving context,
- Agents may get to run status on a host upon starting conditions,
- Agents do not require interaction of user,
- Agents may invoke other tasks including communication.

SOFTWARE AGENTs

Various authors have proposed **different definitions** of agents; these commonly include concepts such as:

- **Persistence** (code is not executed on demand but runs continuously and decides for itself when it should perform some activity)
- **Autonomy** (agents have capabilities of task selection, prioritization, goal-directed behavior, decision-making without human intervention)
- **Social ability** (agents are able to engage other components through some sort of communication and coordination, they may collaborate on a task)
- **Reactivity** (agents perceive the context in which they operate and react to it appropriately).

SOFTWARE AGENTs

Distinguishing agents from programs

Related and derived concepts include:

- ***Intelligent agents*** *(in particular exhibiting some aspect of Artificial Intelligence, such as learning and reasoning),*
- ***Autonomous agents*** *(capable of modifying the way in which they achieve their objectives),*
- ***Distributed agents*** *(being executed on physically distinct computers),*
- ***Multi-agent systems*** *(distributed agents that do not have the capabilities to achieve an objective alone and thus must communicate), and*
- ***Mobile agents*** *(agents that can relocate their execution onto different processors).*

SOFTWARE AGENTs

Examples of intelligent software agents:

Haag (2006) suggests that there are only four essential types of intelligent software agents:

1. Buyer agents or shopping bots
2. User or personal agents
3. Monitoring-and-surveillance agents
4. Data Mining agents

1.Buyer agents (shopping bots):

Buyer agents travel around a network (i.e. the internet) retrieving information about goods and services.

These agents, also known as '**shopping bots**', work very efficiently for commodity products such as CDs, books, electronic components, and other one-size-fits-all products.

SOFTWARE AGENTs

2.User agents (personal agents):
User agents, or personal agents, are the intelligent agents that take action on your behalf. In this category, the intelligent agents that already perform, or will shortly perform, the following tasks:

- **Check your e-mail**, sort it according to the user's order of preference, and alert you when important emails arrive.
- **Play computer games** as your opponent or patrol game areas for you.
- **Assemble customized news reports** for you.
- **Find information** for you on the subject of your choice.
- **Fill out forms** on the Web automatically for you, storing your information for future reference
- **Scan Web pages** looking for and highlighting text that constitutes the "important" part of the information there
- "**Discuss**" topics with you ranging from your deepest fears to sports
- **Facilitate with online job search duties** by scanning known job boards and sending the resume to opportunities who meet the desired criteria.
- **Profile synchronization** across heterogeneous social networks

SOFTWARE AGENTs

3.Monitoring-and-surveillance (predictive) agents:

Monitoring and Surveillance Agents are **used to observe and report on equipment, usually computer systems**. The agents may keep track of company **inventory levels**, observe competitors' prices and relay them back to the company, watch stock manipulation by insider trading and rumors, etc.

For example, NASA's Jet Propulsion Laboratory has an agent that monitors inventory, planning, and scheduling equipment ordering to keep costs down, as well as food storage facilities.

4.Data mining agents:

This agent uses *information technology* to find trends and patterns in an abundance of information from many different sources. **The user can sort through this information in order to find whatever information they are seeking.**

- ***A data mining agent operates in a data warehouse discovering information. A 'data warehouse' brings together information from lots of different sources.***
- ***'Classification' is one of the most common types of data mining, which finds patterns in information and categorizes them into different classes.***

TIM BERNERS-LEE WWW:

TIM BERNERS-LEE WWW: (Born in London, England, in 1955)

•He wrote a computer program **to store information and use random associations** that he called, "Enquire-Within-Upon- Everything," or "**Enquire.**" This system provided links between documents.

•In 1989, Berners-Lee with a team of colleagues **developed HTML**, an **easy-to-learn document coding system** that allows users to click onto a link in a document's text and connect to another document.

•He also created an addressing plan that allowed each Web page to have a specific location known as a URL.

•Finally, completed HTTP a system for linking these documents across the Internet.

•He also wrote the **software for the first server and the first Web client browser** that would allow any computer user to view and navigate Web pages, as well as create and post their own Web documents.

TIM BERNERS-LEE WWW:

•The essential power of the World Wide Web turned out to be its universality though the use of HTML. The **concept provided the ability to combine words, pictures, and sounds** (i.e., to provide multimedia content) on Internet pages.

•Berners-Lee and his collaborators laid the groundwork for the open standards of the Web. Their efforts included inventing and refining the **Hypertext Transfer Protocol** (HTTP) for linking Web documents,

•the HTML for formatting Web documents and the **Universal Resource Locator** (URL) system for addressing Web documents.

•In the following years, Berners-Lee **improved the specifications of URLs, HTTP, and HTML as the technology** spread across the Internet.

TIM BERNERS-LEE WWW:

Hyper Text Markup Language is the primary language for **formatting Web pages**. The author of a web page uses HTML to describe the attributes of the documents such as,

- what the web page should look like
- what types of fonts to use
- what color text should be
- where paragraphs begin

Hypertext Transfer Protocol(HTTP): Hyper Text Transfer Protocol is the ***network protocol*** used to deliver files and data on the Web including: HTML files, image files, query results, or anything else.

- Usually, HTTP takes place through **TCP/IP sockets**.
- **Socket is the term for the package of subroutines** that provide an access path for data transfer through the network.

TIM BERNERS-LEE WWW:

HTTP uses the client–server model: An HTTP client opens a connection and sends a request message to an HTTP server;
•the server then returns a response message, usually containing the resource that was requested.
•After delivering the response, the server closes the connection.
•**The result of an implementation of XML is referred to as SOAP. Simple Object Access Protocol (SOAP).**
•Simple Object Access Protocol (**SOAP**) is an implementation of XML that represents **one common set of rules about how data and commands are represented and extended.**
SOAP consists of three parts:
•1. **An envelope** (a **framework** for describing what is in a message and how to process it)
•2. **Set of encoding rules** (for expressing instances of application-defined data types)
•3. **A convention** (It is used for identifying remote procedure calls and responses.)

SEMANTIC ROADMAP

SEMANTIC ROADMAP: Tim Berners - Lee, and his World Wide Web constortium (W3C) team are working collaboratively **to develop, extend, and standardize the Web's markup languages and tools**.

•In addition, they are designing the next generation Web architecture: called the **Semantic Web**.

•The goal of the Semantic Web architecture is **to provide a knowledge representation of linked data** in order to allow machine processing **on a global scale**.

This involves moving the Web from a repository of data without logic to a level.

•The vision of the Semantic Web is to **increase or expand the existing Web with resources** more easily interpreted by programs and intelligent agents.

SEMANTIC ROADMAP

The **existing web involves TWO methods to gain information** regarding documents:

1. The first method use a **directory, or portal site:** The **directory is constructed manually by searching the Web** and then **categorizing pages and links.**

• The problem with this approach is that **directories take a tremendous effort to maintain** i.e., Finding new links, updating old ones, and maintaining the database technology.

2. The second method uses **automatic Web crawling (**a process used to systematically browse and index the content of websites on the internet) **and indexing systems.**

•The future semantic web approaches can produce **effective results by using a system that combines the reasoning engine as well as search engine.**

SEMANTIC ROADMAP

•the Semantic Web can produce a meaningful content to the Web, then an environment is created where software agents can perform sophisticated tasks for users.

Logic on the semantic Web :

•The goal of the Semantic Web is different from most systems of logic.

•The Semantic Web‘s goal is **to create a unifying system** where a subset is constrained to provide the tractability and efficiency necessary for real applications.

•However, the Semantic Web itself does not actually define a reasoning engine, but rather follows a proof of a theorem.

•Semantic Web would actually be a proof validator rather than a theorem prover .

SEMANTIC ROADMAP

Logic on the semantic Web :

- The Semantic Web cannot find answers, it cannot even check that an answer is correct, but it can follow a simple explanation that an answer is correct.
- The Semantic Web as a source of data would permit many kinds of automated reasoning systems to function,
- The objective of the Semantic Web is **to provide a framework** that expresses **both data and rules** for reasoning for Web-based knowledge representation.
- Adding logic to the Web means using rules to make inferences, choose courses of action, and answering questions.
- A combination of mathematical and engineering issues complicates this task.
- The logic must be powerful enough to describe complex properties of objects.
- The logic of the Semantic Web is proceeding in a step-by-step approach building one layer on top of another.

SEMANTIC ROADMAP

Three important technologies for developing the Semantic Web are:

1) **Resource Description Framework (RDF)**
2) **Ontology**
3) **Web Ontology Language**

1.Resource Description Framework (RDF):

•Resource Description Framework is a model of statements made about resources and associated URI(Uniform Resource Identifier); **URI identifies a resource** on the web **either by using location, name or both**.

•**RDF statements** have a uniform structure of **three parts**: **subject, predicate, and object.**

•Using RDF, the statements can be formulated **in a structured manner**. This allows **software agents to read as well as act on such statement**s.

SEMANTIC ROADMAP

1.Resource Description Framework (RDF):

•The set of statements can be **expressed as a graph**; **a series of (subject, predicate, object) triples, or even in XML forms:**

•The first form is the most convenient for communication between people
•The second for efficient processing
•The third one allows as flexible communication with agent software.

2. Ontology:

•Ontology is **an agreement between software agents that exchange information**.

• Thus, the required information is obtained by such an agreement in order to interpret the structure as well as understand the exchanged data and a vocabulary.

•Using ontology, agents can exchange new information can be inferred by applying and extending the logical rules present in the ontology.

SEMANTIC ROADMAP

3. Web Ontology Language [OWL]:

•This language is a vocabulary extension of RDF.

• It is currently evolving into the semantic markup language for publishing and sharing ontologies on the World Wide Web.

•Web Ontology Language **facilitates greater machine readability** of Web content than that supported by XML, RDF, and RDFS by providing additional vocabulary along with formal semantics.

•OWL can be expressed in three sublanguages:

OWL Lite,
OWL DL(description logic), and
OWL Full.

Logic on the Semantic Web

The Semantic Web is an extension of the World Wide Web that aims to make the web's data more understandable and usable by machines, as well as by the people.

It builds on existing web technologies but adds a layer of meaning to the data through the use of standardized formats and languages.

Logic plays a crucial role in the Semantic Web by providing the framework for reasoning about and manipulating the data.

Key Components are:

RDF (Resource Description Framework):

Purpose: RDF is a framework for representing information about resources in the web. It uses triples (subject-predicate-object) to express statements about resources.

RDFS (RDF Schema):

Purpose: RDFS provides a basic type system and vocabulary for RDF. It allows you to define classes and properties, providing a schema or ontology for the RDF data.

OWL (Web Ontology Language):

Purpose: OWL extends RDF and RDFS to provide richer and more complex descriptions of web resources. It supports more detailed class hierarchies, property restrictions, and logical relationships.

Logic on the Semantic Web

By **integrating logic with web data**, the Semantic Web aims to enhance the web's ability **to support complex queries** and **inferences**, making data more accessible and interoperable across different systems and domains.

Different Tools and Technologies

Protégé: A popular tool for creating and managing ontologies.

Apache Jena: A framework for building Semantic Web and Linked Data applications.

Stardog: A graph database with reasoning capabilities.

Applications:

Data Integration: Combining data from different sources into a unified view by mapping and aligning different schemas using RDF and OWL.

Intelligent Agents: Creating systems that can reason about and interact with web data in an intelligent way, such as virtual assistants or automated recommendation systems.

Enhanced Search Engines: Search engines that **understand the context and meaning of search queries and content**, leading to more relevant search results.

Important Questions

1. Discuss about intelligent web applications.
2. Mention the limitations of web application
3. Explain ontology and inference engines.
4. Difference b/w Machine intelligence and Artificial intelligence.
5. What is web intelligence? Discuss about applications of Web intelligence.
6. Describe the semantic web Road map.
7. What is ontology? Give its significance.
8. Examine the ethical considerations related to the implementation of Artificial Intelligence in the realm of web technologies.
9. Analyze the benefits and challenges of using Software Agents to automate tasks and enhance user interactions on the web.
10. Elaborate on the contributions of Tim Berners-Lee to the development of the World Wide Web and its impact on information accessibility.
11. Discuss the key components of a Semantic Road Map and how they contribute to the realization of a more intelligent web.
12. Explain the concept of Web Intelligence and its significance in the Information Age.