

Institute of Engineering, Jiwaji University

UNIT 1

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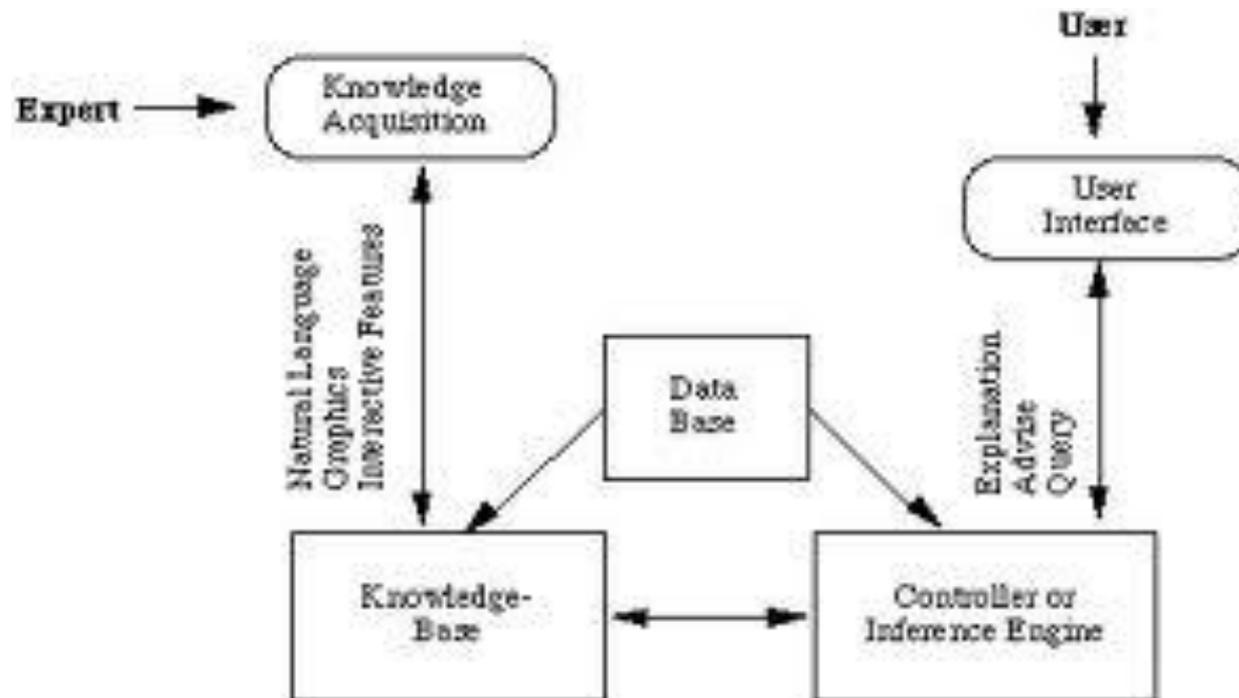
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Introduction to Artificial Intelligence

- AI holds a tendency to cause a machine to work as a human.
- Artificial Intelligence is composed of two words **Artificial** and **Intelligence**, where Artificial defines "*man-made*," and intelligence defines "*thinking power*", hence AI means "*a man-made thinking power*."
- *So we can define AI as:*
"It is a branch of computer science by which we can create intelligent machines which can behave like a human, think like humans, and able to make decisions."

Production System in Artificial Intelligence

- A production system is based on a set of rules about behavior. These rules are a basic representation found helpful in expert systems, automated planning, and action selection.



Knowledge representation

- Knowledge representation and reasoning is the part of Artificial intelligence which concerned with AI and how thinking contributes to intelligent behavior of agents.
- It is responsible for representing information about the real world so that a computer can understand and can utilize this knowledge to solve the complex real world problems such as diagnosis a medical condition or communicating with humans in natural language.

Knowledge representation

- Knowledge representation is not just storing data into some database, but it also enables an intelligent machine to learn from that knowledge and experiences so that it can behave intelligently like a human.

Types of knowledge



Propositional and Predicate Logic

- Propositional logic (PL) is the simplest form of logic where all the statements are made by propositions.
- A proposition is a declarative statement which is either true or false.
- It is a technique of knowledge representation in logical and mathematical .

Example:

- a) New Delhi is capital of India.
- b) The Sun rises from West (False proposition)
- c) $4+4= 7$ (False proposition)
- d) 5 is a prime number.

Syntax of propositional logic

- There are two types of Propositions
 - Atomic Propositions
 - Compound propositions

Atomic Proposition: Atomic propositions are the simple and single propositions symbol that can not be divided further. Sentences that can be either true or false.

Example: $4+3=8$, it is atomic but false fact.

Peacock is a national bird of India, it is atomic and true fact.

- **Compound proposition:** Compound propositions are constructed by combining simpler or atomic propositions using logical connectives.

Example:

"It is raining today, and street is wet."

Propositional logic connectives

| Name | Symbol | Connection | Meaning |
|----------------------|-------------------|-----------------------|--|
| AND (Conjunction) | \wedge | $P \wedge Q$ | $(P \wedge Q)$ is true if both P and Q are true otherwise false. |
| OR (Disjunction) | \vee | $P \vee Q$ | $(P \vee Q)$ is true if either P or Q is true (or both) otherwise false. |
| NOT (Negation) | \neg | $\neg P$ | $\neg P$ is the opposite of P. If P is true, $\neg P$ will be false and vice versa. |
| Exclusive OR | \oplus | $P \oplus Q$ | Either P or Q but not both. If both are different, then $P \oplus Q$ will be true otherwise false. |
| Implication | \rightarrow | $P \rightarrow Q$ | If P happens then Q happens. |
| Double Implication | \leftrightarrow | $P \leftrightarrow Q$ | P happens if and only if Q happens. |

Predicate logic

- Predicate logic is an extension of Propositional logic.
- It adds the concept of predicates and quantifiers to better understand the meaning of statements that cannot be appropriately expressed by propositional logic.
- Also called first order logic.

Quantification

- In predicate logic, predicates are used along with quantifiers to express the extent to which a predicate is true over a range of elements. Using quantifiers to create such propositions is called quantification.
- There are two types of quantification
 - Universal Quantification- a property is true for all the values of a variable in a particular domain, called the domain of discourse.

➤ Existential Quantification- Existential quantification can be used to form a proposition that is true if and only if $p(x)$ is true for at least one value of 'x' in the domain.

Some mathematical statements assert that there is an element with a certain property. Such statements are expressed by existential quantification.

Predicate logic-Quantifier

➤ **Universal quantifier: \forall**

$$\forall x: U(x): F(x)$$

“for every object x in the universe U, F(x) holds”

“for all (any) object x in the universe U, F(x) holds”

Example: All Flowers are beautiful

$$\forall x: \text{Flower}(x) \Rightarrow \text{Beautiful}(x)$$

➤ **Existential quantifier: \exists**

$$\exists x: U(x): F(x)$$

“for some object x in the universe U, F(x) holds”

“there exist an object x in the universe U such that F(x) holds”

Example: everyone likes someone

$$\forall x \exists y: \text{likes}(x,y)$$