SNS COLLEGE OF TECHNOLOGY

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ARTIFICIAL INTELLIGENCE FOR ELECTRICAL ENGINEERING
UNIT 2

TOPIC:knowledge based agents

TOPIC OUTLINE

Introduction to KBA
Logic: A General Idea
The Wumpus World Problem
Propositional Logic

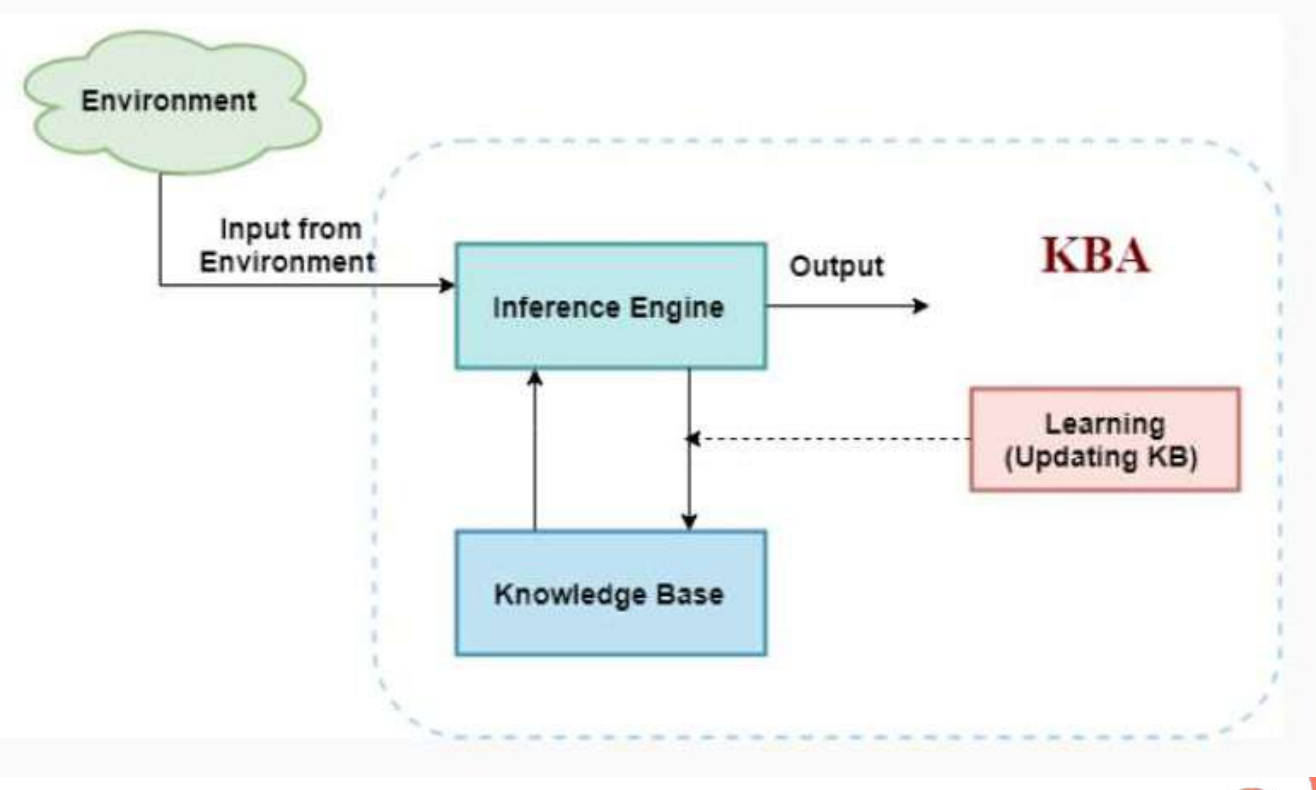
Knowledge based Agents

- KB consists of a set of sentences (related to but not identical to English sentences)
- Each sentence is expressed in a language called a knowledge representation language and represents some assertion about the world
- Axiom $\longrightarrow$ When the sentence is taken as given without being derived from other sentences
- Operations on KB:
  - Add new sentences (TELL)
  - Query for what is known (ASK)
- Inference $\longrightarrow$ Deriving new sentences from old
- There can be some background knowledge in KB already

Knowledge based Agents

- Also known as logical agents
- Knowledge-based agents are those agents who have the capability of maintaining an internal state of knowledge, reason over that knowledge, update their knowledge after observations and take actions. These agents can represent the world with some formal representation and act intelligently.
- Knowledge-based agents are composed of two main parts:
  - Knowledge-base and
  - Inference system

KBA Architecture



Logic- General terminologies

- Syntax $\longrightarrow$ The rules of the representation language used to represent sentences in KB
  - Ensures the sentence is well formed (eg. $x + y = 4$ and $x4y+ =$)
- Semantics $\longrightarrow$ The meaning of the sentences
  - Defines **truth** of each sentence with respect to each **possible world**
  - eg. $x + y = 4$ is true in a world where x is 2 and y is 2, but false in a world where x is 1 and y is 1
  - In standard logics, every sentence must be either true or false in each possible world—there is no "in between" (except, Fuzzy logic)
- The **possible world** above is called **model**, with added precision

More on Model

- Possible world $\longrightarrow$ Real environments where the agent is in
- Models $\longrightarrow$ Mathematical abstractions of real environments
  - Used to fix the truth or falsehood of sentences
- Satisfaction
  - If a sentence α is true in model m, $\longrightarrow$ m satisfies α or m is a model of α
  - $M(\alpha) \longrightarrow$ the set of all models of α

Logical Reasoning

- Involves the relation of logical **entailment** between sentences
- Entailment $\longrightarrow$ The idea that a sentence follows logically from another sentence
  - Mathematically, $\alpha \models \beta \longrightarrow \alpha$ entails β
  - $\alpha \models \beta$ if and only if, in every model in which α is true, β is also true
  - $\alpha \models \beta$ if and only if $M(\alpha) \subseteq M(\beta)$
  - Here α is a stronger assertion than β
  - Eg. $x = 0 \models xy = 0$, because in any model where x is zero, it is the case that xy is zero (regardless of the value of y)

Logical Reasoning in KB

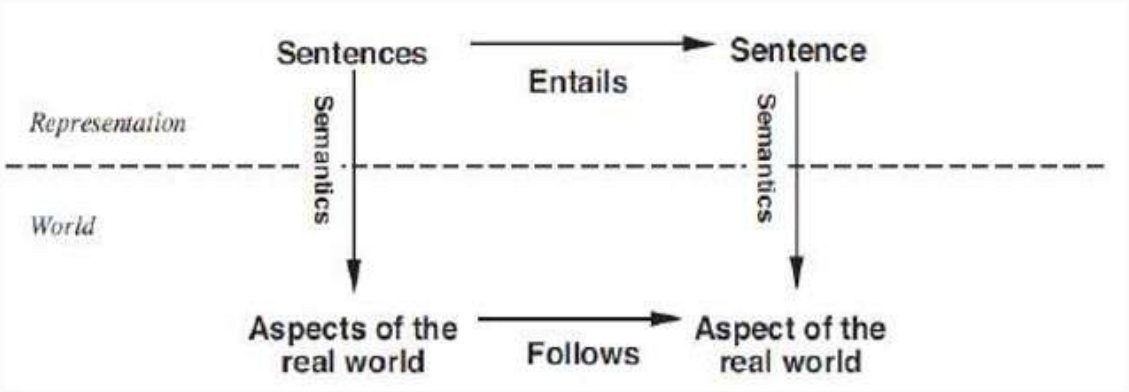
- Explanation by example
- Let KB consists of
  - $\alpha : x = 2$
  - $\beta : y < 4$
  - $\gamma : z = x + y$
- Consider two sentences
  - $\alpha_1 : z \leq 6$
  - $\alpha_2 : z = x$
- Here
  - $KB \models \alpha_1$ whereas
  - $KB \not\models \alpha_2$
  - Or $M(KB) \subseteq M(\alpha_1)$
- This is how the definition of **entailment** can be applied to derive **conclusions**—that is, to carry out **logical inference**

Inference algorithms

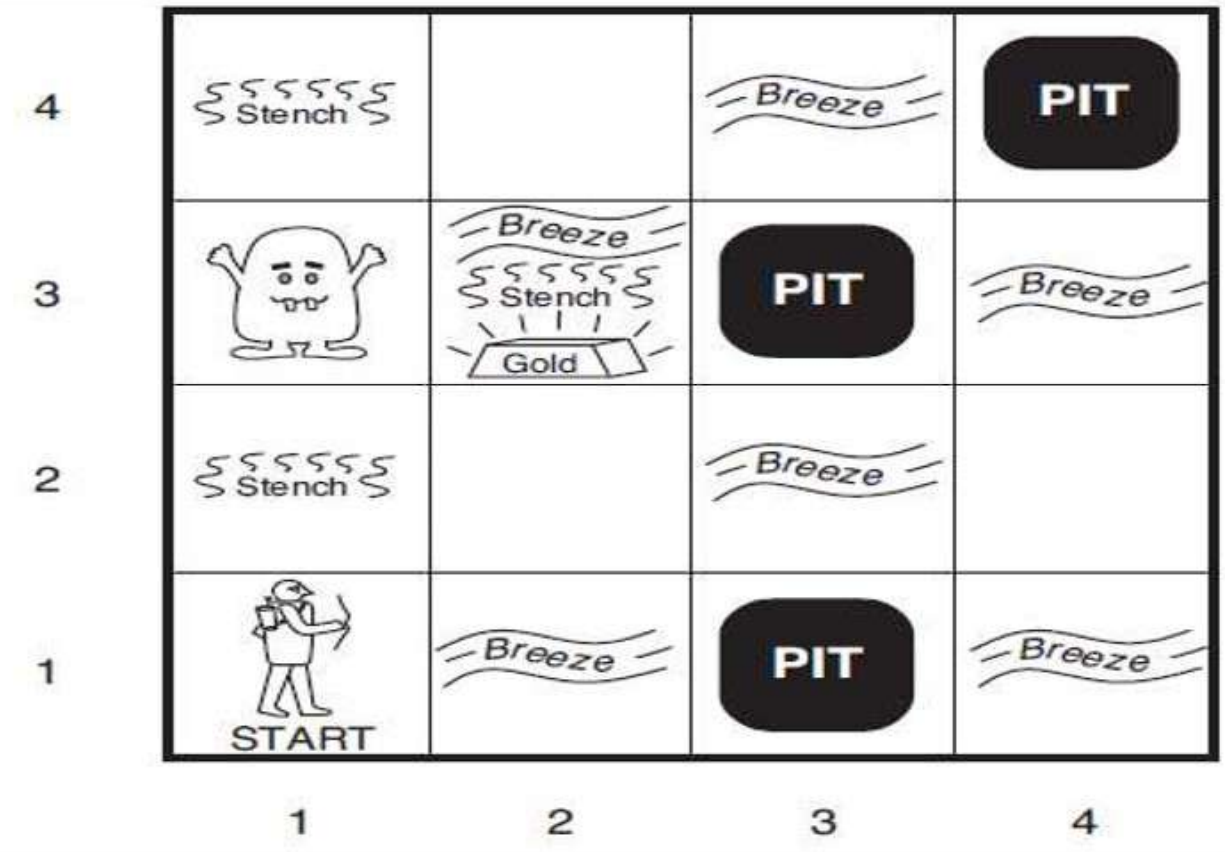
- Needle in haystack analogy
- If an inference algorithm i can derive α from KB, we write $KB \models_i \alpha$
- Pronounced "α is derived from KB by i" or "i derives α from KB
- An inference algorithm that derives only entailed sentences is called sound or truth-preserving; An unsound inference procedure announces the discovery of nonexistent needles
- Soundness is a highly desirable property
- Completeness $\longrightarrow$ An inference algorithm is complete if it can derive any sentence that is entailed
- Completeness is also desirable

Connecting models to real world

- Models are mathematical abstractions of real world
- If KB is true in the real world, then any sentence α derived from KB by a sound inference procedure is also true in the real world



Wumpus World Problems



PEAS for Wampus World

- Performance:- +1000 for climbing out of the cave with the gold, –1000 for falling into a pit or being eaten by the wumpus, –1 for each action taken and –10 for using up the arrow
- Environment:- A 4×4 grid of rooms. The agent always starts in the square labeled [1,1], facing to the right
- Actuators:- Move *Forward*, *TurnLeft by* 90^0, or *TurnRight by* 90^0, *Die* if fallen in pit or eaten by wampus, if went into its room, *Bump*- if hits a wall, *Grab* gold, *Shoot* arrow (only once), *Climb* out of the cave
- Sensors:- *[Stench, Breeze, Glitter, Bump, Scream]*.


ARTIFICIAL INTELLIGENCE
RISE OF ROBOTS
THANKS