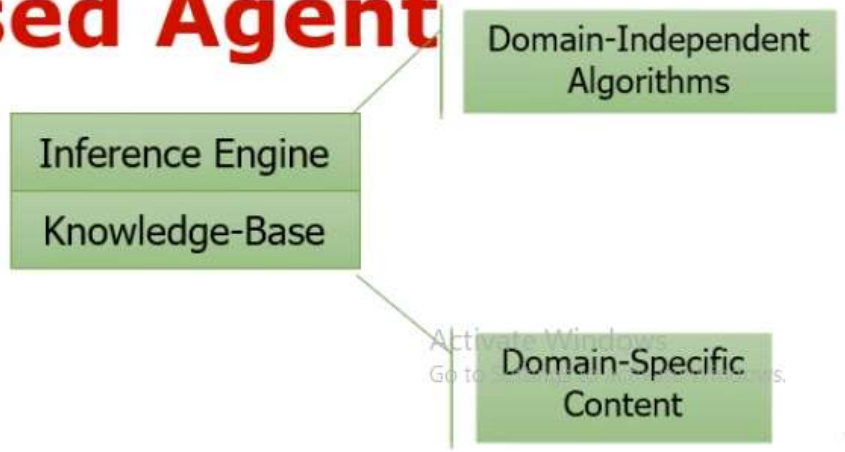
Artificial Intelligence

Unit – 3 – Logical Reasoning

Logical Agent

Knowledge Based Agent



T1	Logical agent – Knowledge based agent		Period:	1
LU Outcomes	Level:	K2	CO Number:	2
1	Convert natural language statement to Knowledge base			
2	Make knowledge base ready to infer new knowledge’s			

1. Knowledge base
2. Sentence
3. Knowledge representation
4. Inference
5. Background Knowledge

Logical Agent

- An **agent** can represent knowledge of its world, its goals and the current situation.
- Logical Agent has a collection of sentences in **logic** (Logical sentences)
- By using these logical sentences, the agent decides what to do by inferring knowledge (conclusion(s))
- The conclusions are achieved by certain action or set of actions, is appropriate to achieve its goals.
- Knowledge and reasoning are important to logical agents because they enable successful behaviors to achieve a desired goal

Current situation – Current state of the world

1. **Logical Agent**: Agents with some representation of complex knowledge about the world / its environment and uses INFERENCE (by taking new inputs from the old knowledge and generate new concepts) to derive new information from the knowledge combined with new inputs

2. Key Issues of Logical Agents : Representation of the Knowledge and its reasoning
3. Logical Agent is completely based on Knowledge Base

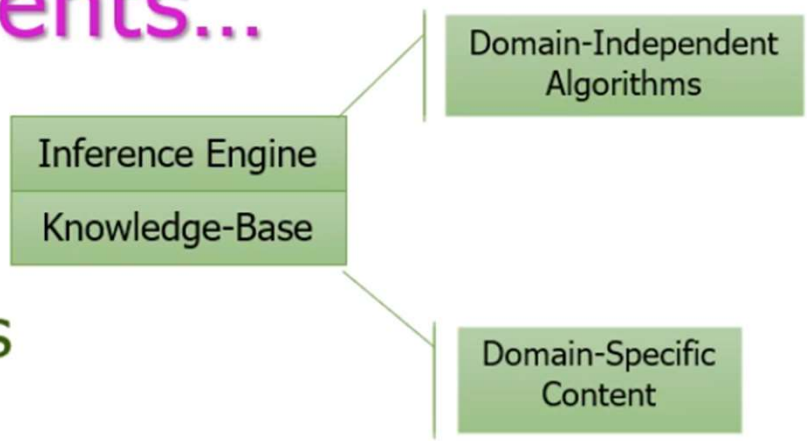
4. **Knowledge Base:** It's a set of sentences in a formal language representing facts about the world
    - Knowledge should be used to represent everything logically

Knowledge Based Agent

- ✓ Intelligent agents need knowledge about the world to choose good actions / decisions
- ✓ Knowledge = {Sentences} in a knowledge representation language (formal language)
- ✓ A sentence is an assertion about the world

Knowledge-Based Agents…

Knowledge base agent is composed of



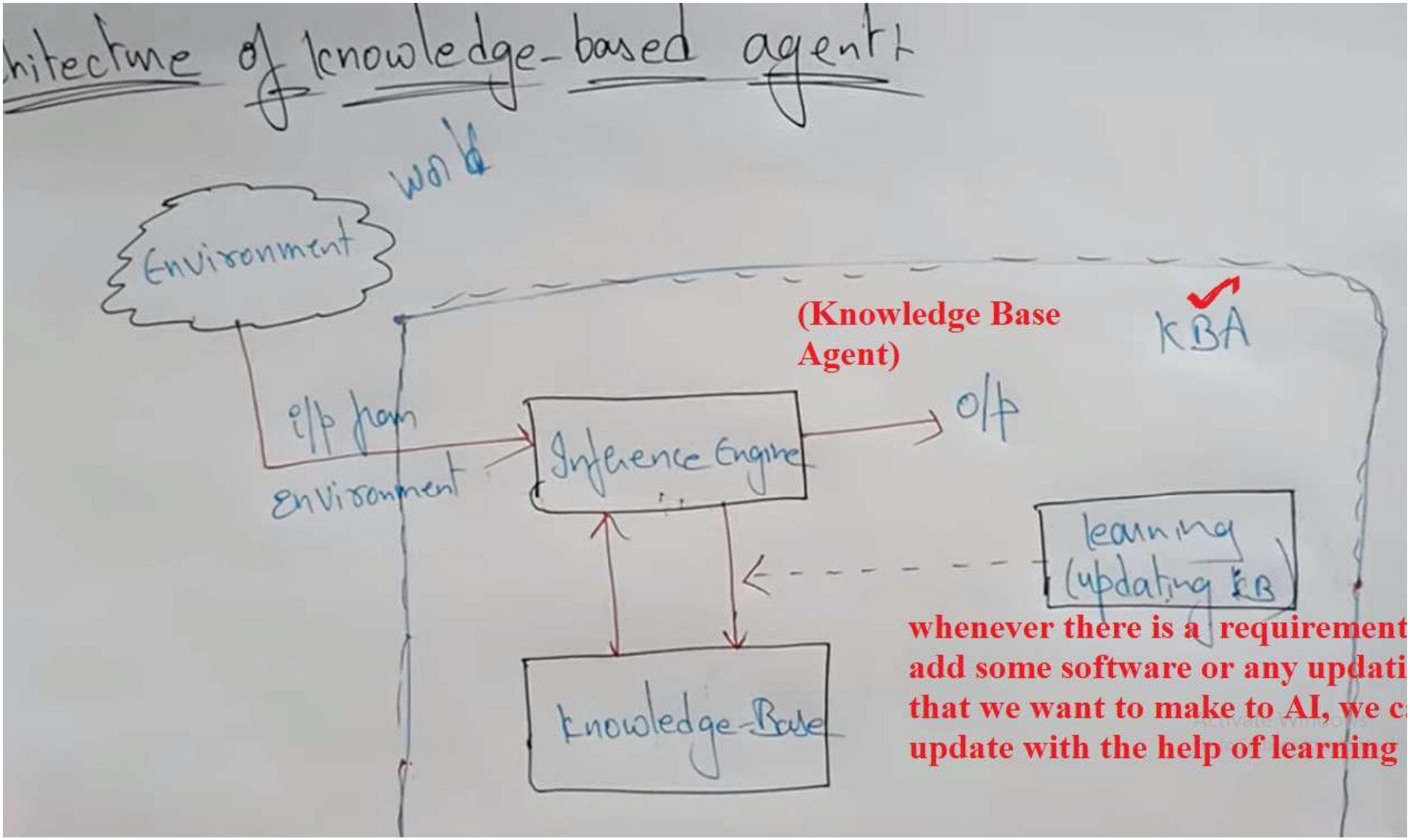
- The agent must be able to:
  - Represent states and actions
  - Incorporate new percepts
  - Update internal representations of the world
  - Deduce hidden properties of the world
  - Deduce appropriate actions

- Inference Mechanism : Deriving a new sentence from the old
- Knowledge base agent is composed of knowledge base and deriving od new sentence (i.e., KB and Inference => old knowledge and new knowledge)

Knowledge-Based Agents

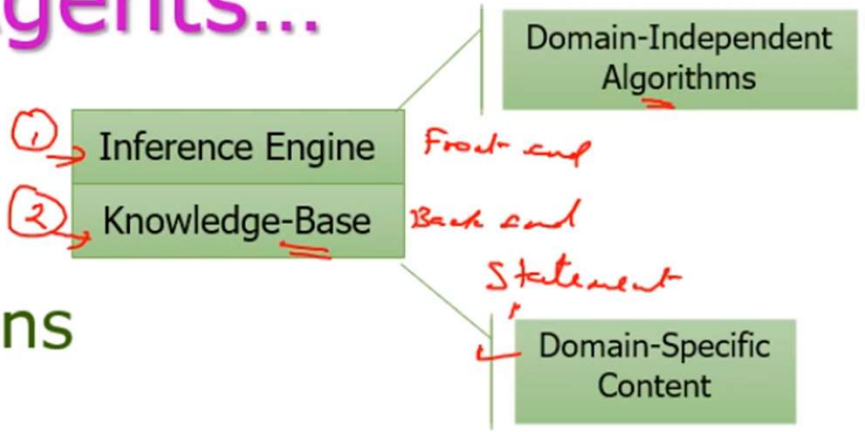
- Central component of a Knowledge-Based Agent is a **Knowledge-Base (KB)**
- KB contains a set of sentences in a formal language
  - Sentences are expressed using a knowledge representation language

- Two generic functions:
  - TELL - add new sentences (facts) to the KB
    - "Tell it what it needs to know"
  - ASK - query what is known from the KB
    - "Ask what to do next"



Updating KB is connected to KB.
With the help of KB and Updating KB, Inference engine performs the operation and generates OUTPUTS by taking the INPUT from the environment

Knowledge-Based Agents…



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- Represent current state and corresponding action performed in the Environment
- From the existing information, it should retrieve some new percepts
- The new percepts should be updated in the KB
- The agent should infer the hidden properties
- From the hidden properties, it should be able to take appropriate actions on the environment
- All the above are updated in KB now and then

What happens when the agent program is called?

Each time the agent program is called, it does three things.

1. It **TELLs** the knowledge base what it perceives
2. Second, it **ASKs** the knowledge base what action it should perform. In the process of answering this query, extensive reasoning may be done about the current state of the world, about the outcomes of possible action sequences, and so on.
3. Third, the agent program **TELLs** the knowledge base which action was chosen, and the agent executes the action.

What happens when the agent program is called?...contd

The details of the representation language are hidden inside three functions that implement the interface between the sensors and actuators on one side and the core representation and reasoning system on the other.

1. **MAKE-PERCEPT-SENTENCE** constructs a sentence asserting that the agent perceived the given percept at the given time.
2. **MAKE-ACTION-QUERY** constructs a sentence that asks what action should be done at the current time.
3. **MAKE-ACTION-SENTENCE** constructs a sentence asserting that the chosen action was executed.

Knowledge-Based Agents…

```
function KB-AGENT(percept) returns an action
    static: KB, a knowledge base
            t, a counter, initially 0, indicating time

    TELL(KB, MAKE-PERCEPT-SENTENCE(percept, t))
    action ← ASK(KB, MAKE-ACTION-QUERY(t))
    TELL(KB, MAKE-ACTION-SENTENCE(action, t))
    t ← t + 1
    return action
```

Figure 7.1 A generic knowledge-based agent. Given a percept, the agent adds the percept to its knowledge base, asks the knowledge base for the best action, and tells the knowledge base that it has in fact taken that action.

KB – Knowledge Base

Percept – current environment status

Tell(KB, Make-Percept-Sentence(percept,t)) =>

Make-Percept-Sentence(..) gives “At time t, how the current environment is”

This sentence will be written in KB

Knowledge-Based Agents…

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    t ← t + 1
    return action
```

Figure 7.1 A generic knowledge-based agent. Given a percept, the agent adds the percept to its knowledge base, asks the knowledge base for the best action, and tells the knowledge base that it has in fact taken that action.

action ← Ask (KB, Make-Action-Query(t))

For this current percept, what action is suitable

Tell(KB, Make-Action-Sentence(action,t)) => action at time t will be written to KB

t is updated

return action which is inferred from KB

2 Approaches :

- Procedural : Encode desired behaviors directly as program code
  - Minimizing the role of explicit representation and reasoning can result in a much more efficient system
- Declarative : Building Knowledge Base for Agent.
  - You can build a knowledge-based agent simply by "TELLing" it what it needs to know

Procedural - Algorithm

The two approaches are:

1. Declarative approach

   Get me a cup of tea.

2. Procedural approach

   - **Go to kitchen**
   - **Get sugar, milk, and tea,**
   - **Mix them, and heat over the fire till it boils**
   - **Put that in a cup and bring it to me**

Conclusion

- What is Knowledge Based Agent
- Parts of Knowledge based agent
- Algorithm

Possible Assessment Questions:		
Test Questions	**Level**	
Define knowledge base	K1	
Name few knowledge representation language	K1	
Write the algorithm for simple KB-agent	K1	
What do you mean by knowledge level and implementation level?	K1	
Differentiate declarative approach and procedural approach.	K1	
Comment on MAKE-PERCEPT-SENTENCE, MAKE-ACTION-QUERY, TELL and ASK	K2	