ARTIFICIAL INTELLIGENCE

Term Project Description
With
Example of an Intelligent System

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Term Project Components

- An application description
- Restriction, Actions, Goal, Metrics
- Creating Knowledge-base
- Creating State-Space Graph
- Searching
- Inference

Application Description

- Consider a real-life problem which has some restrictions, criteria, goals, etc.
- The example problems can be:
  - *Finding the best path from a city to another city*
  - *Finding the best flight considering the cost, lay over time, number of connections,*
  - *Games,*
  - *Healthcare advisor systems,*
  - *Investment advisor system*

Restriction, Actions, Goal, Metrics

- Your application includes some restrictions. A road has specific speed limit. Some medicines should not be used together. Age factor should be considered when a medicine is prescribed, etc. List the restrictions
- The agent has a set of defined possible actions. You need to list them.
- Clearly define the goal or goals of the agent/application.
- The agent should use some criteria to choose among possible options. For instance, cost or distance, or a combination of them can be a metric for a self driving agent.

Creating Knowledge-base

- All restrictions should be converted into rules and added to a knowledge base.
- You may use predicate logic to define the rules.
- Make sure that all rules have been included and there is not conflict between them

Creating State-Space Graph

- The agent gets input from the environment and acts accordingly.
- After each action, the agent finds itself in a new state.
- In order to move from one state to another, there should be a possible action.
- Define all possible sates.
- Consider the actions that take the agent from one state to another. In this way you will define your state space.

Searching

- Show the location of goal sates in your graph.
- Find the current state.
- Search for the best path that can take the agent to the goal state.
- Choose appropriate search algorithm.

Inference

- When the initial state and the goal state are defined, the agent can use the graph and/or the rules in its knowledge base to reach a conclusion.
- For instance, when the agent is asked “What is the best option for an investment given the current conditions?” it will use its knowledge base.
- Use forward or backward chaining to make a conclusion.

Deliverables

- A report containing the steps described so far.
- Sample use of the application. For instance, ask a question and show how the agent will analyze it and answer the question.
  - *Example: A patient has high fever but not coughing, He has no history of heart issues. What treatment the agent suggests?*
- Conclusion and discussion
- Coding is not mandatory but will be given extra bonus points.
- Presentations are necessary.
- Project groups can include up to 3 students

EXAMPLE INTELLIGENT SYSTEM

Knowledge Base Creation

- Assume a path_finder agent is trying to reach location B starting from location A. The agent has access to a map of the neighborhood and the connecting roads. The goal is finding the fastest path to reach B.
- The roads however, can be under construction from time to time. In these cases either the traffic goes more slowly (the agent can find out the new speed of the road), or the road is blocked altogether. In case that the road is blocked, the agent has to find a different path.
- The agent has its own copy of the graph of the locations, and the roads connecting them including the distances. The agent can update the graph using the data from its percepts.
- The agent can move forward, turn left or right (to side roads), U turn and go backward. In rainy days the agent is not allowed to make a U-turn or go back.
- The speed limits of the roads depends on the weather (sunny, rainy; in rainy weather the speed limit is reduced by 30%) and the time (at night the speed limits are reduced by 20%)

Modeling the Environment

- The environment is made of a set of locations and roads connecting them to each other
- The roads have attributes such as distance, speed limit and state
- The roads have conditions such as rainy, blocked, under construction

- The environment is a dynamic environment. The agent should percept the conditions and update the environment.

Knowledge-base using Propositional Logic

- List the locations:
  - *P1: A is a location*
  - *P2: B is a location*

- Define the roads connecting the locations:
  - *Q1: C is connected to F*
  - *Q2: G is connected to P*

Knowledge-base using Propositional Logic

- Define the attributes of the locations and roads:
  - *R1: The road connecting A to H is 15 km*
  - *R2: The speed limit on road connecting A to H is 80 km*

- Define the possible percepts:
  - *Read(Speed limit)*
  - *Read(Time)*
  - *Read(Weather)*
  - *Read(current location)*
  - *Read(status)*

Knowledge-base using Propositional Logic

- Define rules:
  - ***Read(current location)*** = *Road connecting A to H* ∧ ***Read(status)*** = *blocked* ➔ *R1: The road connecting A to H is infinity km.*
  - ***Read(current location)*** = *Road connecting A to H* ∧ ***Read(status)*** = *under construction* ➔ *R2: The speed limit on road connecting A to H is* ***Read(speed limit)*** *km*
  - ***Read(current location)*** = *Road connecting A to H* ∧ ***Read(Weather)***= *raining* ➔ *The speed limit on road connecting A to H is* ***Read(speed limit)*** */1.3 km*
  - ***Read(current location)*** = *Road connecting A to H* ∧ ***Read(Time)*** = *night* ➔ *The speed limit on road connecting A to H is* ***Read(speed limit)*** */1.2 km*
  - ***Read(current location)*** = *Road connecting A to H* ∧ ***Read(Time)*** = *night* ∧ ***Read(Weather)*** = *raining* ➔ *The speed limit on road connecting A to H is* ***Read(speed limit)*** */1.5 km*

Actions

- The actions that the agent can take are:
  - *move forward,*
  - *turn left*
  - *turn right*
  - *U turn*
  - *go backward*

- Conditional moves are decided about during inference:
  - *Example:* ***Read(Weather)*** *=* *raining* ➔ ¬ *Make U turn*

Create the Knowledge-base

- Add all propositions as sentences to the knowledge-base
- Assume the knowledge-base is called KB
- Using TELL:
  - *TELL(KB, R1: The road connecting A to H is 15 km)*
  - *TELL(KB,* ***Read(current location)*** *= Road connecting A to H* ***Λ Read(status)*** *= blocked ➔ R1: The road connecting A to H is infinity km)*
- Ask the agent to find the shortest path from A to B
  - *ASK(KB, what is the shortest path from A to B)*

What Agent Does?

- Agent has a graph connecting locations.
- The graph is in the form of a set of propositions (statements)
- Agent makes a copy of the original graph
- Agent runs a search algorithm to find the shortest path to its destination
- While agent is on the way, it senses the environment.
- Agent updates the graph based on its percepts
- Agent repeats the search algorithm after updating the graph

Using Predicate Logic

- Consider locations as constants
  - *A,B,C,…*

- Define roads as objects. Use predicates to assign attributes and connect the locations
  - *Road(x)*
  - *RoadFrom(x, L)*
  - *RoadTo(x, L)*
  - *RoadSpeed(x, v)*
  - *RoadLength(x, d)*

Define Rules

- ∀X, Road(X), Weather(X) = Raining , Speed(X) = V ➔ RoadSpeed(X, V/1.3)
- ∀X, Road(X), Status(X) = Blocked ➔ RoadLength(X,∞)

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