ABHISHEK BASU
658369163

CS 411 - Artificial Intelligence I

Fall 2024

Assignment 2

Department of Computer Science, University of Illinois at Chicago

Total Points: 25

1. Explain the difference between goal-based agent and utility-based agent [4]

Ans:

Differentiating Goal-based agents and Utility – based agents considering few points

- **Decision Basis:**
  - ➔ Goal- Based Agents: This type of agents makes decisions based on predefined goals. Their primary task is to achieve specific objectives or reach states. The agent will select actions that directly contribute to accomplish these goals, often using methods like search algorithms or planning.
  - ➔ Utility-Based agents: These agents operate based on a utility function, which quantifies the desirability of different states. Instead of merely aiming to achieve goals, they evaluate actions by their ability to maximize overall utility, which often involves balancing multiple factors and preferences.
- **Action Evaluation:**
  - ➔ **Goal-Based Agents:** Actions are evaluated on whether they help in achieving the set goals. The agent follows a straightforward path towards fulfilling these goals, without necessarily considering other factors.
  - ➔ **Utility-Based Agents:** Actions are assessed according to how well they improve the agent's overall utility. The utility function allows the agent to make more nuanced decisions by weighing various trade-offs and optimizing overall satisfaction rather than just meeting specific goals.
- **Flexibility:**
  - ➔ **Goal-Based Agents:** Their behavior can be more rigid because they are focused solely on achieving specific goals. If multiple goals are present or if goals conflict, the agent may have difficulty adjusting its strategy.
  - ➔ **Utility-Based Agents:** They offer greater flexibility by incorporating multiple objectives and preferences into their decision-making process. This allows them to handle complex situations and adapt their actions to maximize overall benefit.
- **Complexity Handling:**
  - ➔ **Goal-Based Agents:** Generally simpler in scenarios with clear goals but may struggle with scenarios where goals are not well-defined or are conflicting.
  - ➔ **Utility-Based Agents:** Better suited for complex environments where there are multiple competing objectives, as they can optimize across various factors rather than focusing on achieving a single goal.

2. Imagine environment below, in which the agent can move left, right, up and down, andpick up stars.[21]

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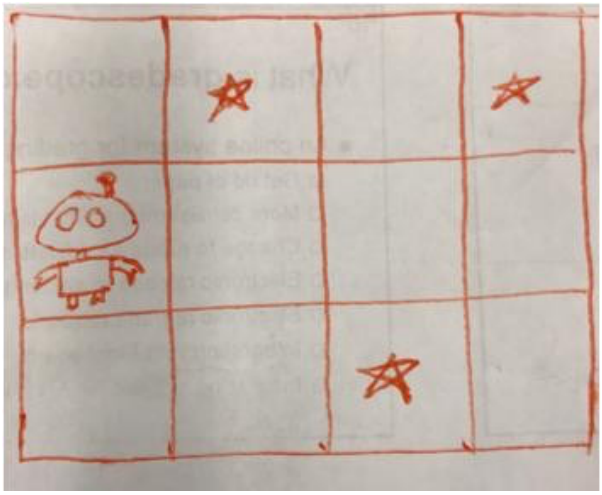

Try to specify as precisely as you can what conditions would make this environment:

a. Fully Observable

Condition: The environment is fully observable if the agent always has complete visibility of all parts of the environment. This means the agent can see the entire grid, including the position of all stars and obstacles, without any hidden or incomplete information.

Example: If the agent can view the entire grid where it operates and knows the exact locations of all stars and obstacles without any hidden information, the environment is fully observable.

b. Partially Observable

Condition: The environment is partially observable if the agent can only see a segment of the environment or if some information about the environment is not visible from it. This means that the agent might not have clear view of all locations or elements in the environment.

Example: If the agent has limited vision and can only see the cells immediately adjacent to its current location, or if some stars are hidden behind obstacles or out of view, the environment is partially observable.

c. Deterministic

Condition: The environment is deterministic if the outcomes of the agent's actions are predictable and consistent. This means that when the agent performs a specific action, the result is always the same given the same initial conditions.

Example: If moving left always results in the agent being one cell to the left of its current position, and picking up a star always succeeds if the star is in the same cell as the agent, the environment is deterministic.

d. Stochastic

Condition: The environment is stochastic if the outcomes of the agent's actions are not always predictable and can vary due to random factors. This means that the result of an action might change even under the same conditions.

Example: If the agent occasionally moves in an unintended direction due to some randomness, or if picking up a star sometimes fails due to unpredictable factors, the environment is stochastic.

e. Dynamic

Condition: The environment is dynamic if it changes while the agent is making decisions or performing actions. This means that the state of the environment can be altered during the agent’s actions.

Example: If stars move to new positions over time or obstacles appear/disappear while the agent is navigating, the environment is dynamic.

f. Static

Condition: The environment is static if it remains unchanged while the agent is acting. This

means that the environment's state does not alter during the agent's decision-making and actions.

Example: If the positions of stars and obstacles are fixed and do not change while the agent performs its actions, the environment is static.

g. Sequential

Condition: The environment is sequential if the agent's current actions affect future states and decisions. This means that the agent's actions have long-term consequences that impact subsequent decisions.

Example: If the agent's movement affects its future options, such as needing to navigate carefully to avoid missing stars or encountering obstacles later, the environment is sequential.

h. Episodic

Condition: The environment is episodic if the agent's experiences can be divided into separate episodes where each episode is independent of the others. This means that the outcome of one episode does not affect the next.

Example: If each star pickup is treated as an independent event and the state of the environment resets after each star is picked up, the environment is episodic.

i. Known

Condition: The environment is known if the agent has complete knowledge of the environment's rules and dynamics. This means the agent understands how its actions will affect the environment and how the environment operates.

Example: If the agent knows all the positions of the stars, the effects of its actions, and how these actions will change the environment, the environment is known.

j. Unknown

Condition: The environment is unknown if the agent lacks complete information about the environment's rules and dynamics. This means the agent must explore or learn about how its actions impact the environment.

Example: If the agent does not have complete information about the positions of the stars or the effects of its actions and must discover these through exploration, the environment is unknown.

k. Continuous

Condition: The environment is continuous if the state or action space is represented with infinite or highly precise possibilities. This means the agent can make actions or perceive states with a high degree of granularity.

Example: If the agent can move in very fine increments rather than discrete steps, or if the environment has many possible states and actions that are not limited to discrete values, the environment is continuous.

l. Discrete

Condition: The environment is discrete if it has a finite number of distinct states and actions. The environment and its state transitions can be clearly enumerated.

Example: If the grid is a fixed-size matrix with a finite number of cells, and the agent's possible movements and actions are limited and countable, the environment is discrete.

m. Single-Agent

Condition: The environment is single agent if only one agent interacts with the environment at a time, making decisions and taking actions independently of other agents.

Example: If only one agent navigates the grid and picks up stars, without the presence or interaction of other agents, the environment is single agent.

n. Multi-Agent

Condition: The environment is multi-agent if multiple agents interact within the environment, and their actions and decisions can influence one another.

Example: If there are several agents navigating the grid and competing for or cooperating to pick up stars, and their actions affect each other, the environment is multi-agent.