Introduction to Artificial Intelligence

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1 Homework 1

1. Please use your own words to define:

    (a) **Artificial Intelligence** - Artificial Intelligence is the attempt at mimicking human beings' ability to reason and think by capturing the processes of the brain in detailed algorithms.

    (b) **Utility Function in AI** - Gives values (weights) to the different actions an AI system can take. The Agent Function will then use the most desirable action determined by the utility function.

    (c) **Agent Function** - An Agent Function is a function that accesses and utilizes a percept sequence to map to an action.

    (d) **Percepts and Actions** - A percept is the input to an AI system. (Cameras, Lidar, Sensors, etc.) An action is what the agent does based on the percept sequence and the agent function.

    (e) **Intelligent Agent** - The agent will use all resources at its disposable (This includes: sensory information, database information, pattern recognition and any other resources it may have) to arrive at the "best" decision.

    (f) **Rational Agent** - The agent will act to try and achieve the best outcome. (Best - acts in an outcome favorable to itself, as defined in Game Theory. I suppose you could also define it as acting in the best interest of a defined whole as well, like society).

    (g) **Turing Test** - The Turing Test is a test used to conclude whether intelligence exists in a machine or not. Also known as the Imitation Game, this is where an interrogator, another human being and a machine are all part of the experiment. There is no physical interaction between them and none can see the other. The goal of the interrogator is to ask questions and use the answers from the two entities to identify which entity is the machine and which is the human. If the machine is identified as the human, it is said to have passed the Turing Test.

(h) **Strong AI vs. Weak AI** - Weak AI refers to algorithms used to complete specific tasks. This is what we come in contact with most often. (Alexa, Siri, Facebook identification algorithms, etc.) They can appear to be intelligent at times, but only in a limited field. Strong AI is a theoretical intelligence that rivals and/or exceeds that of human beings' intelligence. That is to say, they can think and arrive at decisions in any situation without the aid of a human being or interference.

2. What is PEAS task environment description for intelligent agent?

The PEAS task environment description for an intelligent agent is:
Performance measure, Environment, Actuators, and Sensors.

- **P**: A function the agent is maximizing (or minimizing).
- **E**: A formal representation for world states.
- **A**: Actions that change the state according to a transition model.
- **S**: Observations allowing agent to infer the world state.

For the following agents, develop a PEAS description of their task
environment.

- Automated Taxi Driver
- Interactive English Tutor

3. Figure 1 shows the relationship between an AI agent and its environment. Please explain the names and functionalities of the parts marked as A, B, C, and D, respectively.
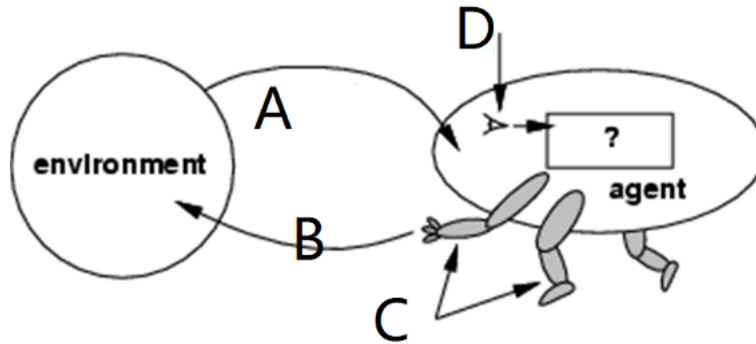

Figure 1

- **A** - Percepts.
- **B** - Actions.
- **C** - Actuators.
- **D** - Sensors.

4. When developing a vacuum-cleaner agent as shown in Figure 2, please describe the properties of the task environments, with respect to "Observable", "Agents", "Deterministic", "Episode", "Static", and "Discrete". Please explain your answers.

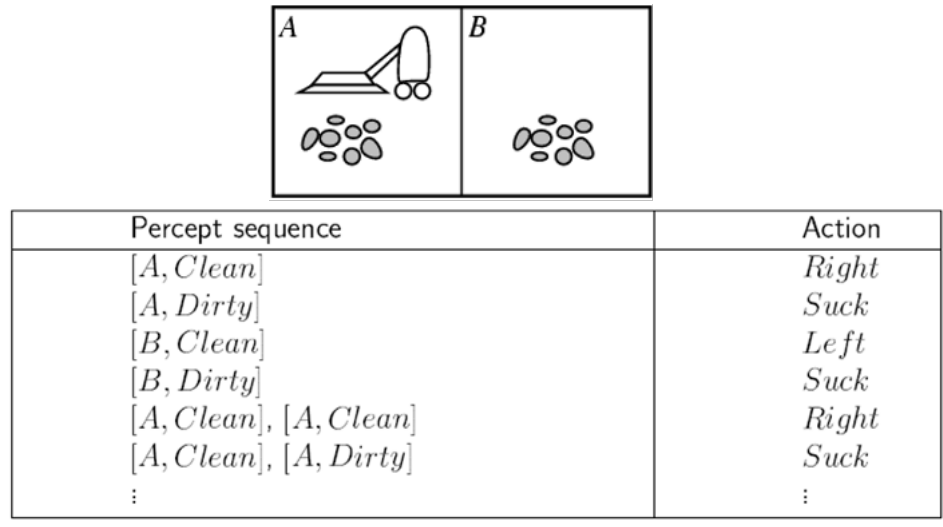| Percept sequence	Action
$[A, Clean]$	$Right$
$[A, Dirty]$	$Suck$
$[B, Clean]$	$Left$
$[B, Dirty]$	$Suck$
$[A, Clean], [A, Clean]$	$Right$
$[A, Clean], [A, Dirty]$	$Suck$
$\vdots$	$\vdots$

Figure 2

5. Please design pseudo-code of an energy efficient model-based vacuum-cleaner agent as follows:

- The environment has two locations (A and B) and three states ("Clean", "Dirty", "Unknown").

- The vacuum-cleaner has three actions "Switch location", "Suck", and "Idle",

- The vacuum-cleaner will clean the dirt as soon as it senses that the current environment is Dirty,

- If the vacuum-cleaner senses the current environment is "Clean" or "Unknown", it will remain Idle for one time point, and

- The vacuum-cleaner will switch location if it senses the current environment is "Clean" for two consecutive time points in a row, and

- The vacuum-cleaner will switch location if it senses the current environment is "Unknown" for two consecutive time points in a row.

6. Please summarize task environment types for the following three agents, in terms of "observable", "deterministic", "episodic", "static", "discrete", "number of agents".

Agent	observable	deterministic	episodic	static	discrete	num of agents
Tic-tac-toe						
Tetris						
Texas hold'em						
Robot Soccer						
Space X Drone						

Figure 3

7. Summarize similarities and differences between simple reflex agent and model-based reflex agent. Show one example of "model" in the model-based vacuum cleaner robot agent.

8. Summarize main differences between reflex agent (including simple reflex agent and model-based reflex agent) and goal-based agent. Use vacuum cleaner robot as an example, explain how reflex agent vs. goal-based agent may differ in their behaviors.