AI 2002 – Artificial Intelligence (Spring 2024)
Assignment 1

Topics Covered: Rational agents, environments & architectures, PEAS, search problem & state space	**Submission Deadline:** *Monday – February 19, 2024 by 16.00 sharp*

Submission Guidelines:

- **Group assignment: 2 members (at max.)**
- You may use internet for help but **do not submit "copy-paste" answers**.
- Submit a PDF file containing your responses on the Google Classroom (of your respective section).
- Plagiarism across different groups will not be accepted.

Question 1

Examine the AI literature to discover whether the following tasks can currently be solved by computers. If yes, then list the name of a successful application or otherwise, state a reason that why a specific task is not possible yet.

i. Drive safely on a highway.
ii. Drive safely in a busy city with other traffic and pedestrians.
iii. Buying a week's worth of groceries online.
iv. Buying a week's worth of groceries at a superstore.
v. Booking a doctor's appointment online.
vi. Win a soccer game against human(s).
vii. Win an art competition.
viii. Win a chess game against human(s).
ix. Discovering and proving new mathematical theorems.
x. Giving competent legal advice in a specialized area of law.
xi. Translating spoken Urdu into spoken English in real time.
xii. Writing an intentionally funny story.
xii. Writing a publishable research article.

Question 2

For each of the following assertions, say whether it is true or false and support your answer with examples or counter-examples where appropriate.

i. An agent that senses only partial information about the state cannot be perfectly rational.
ii. There exist task environments in which no pure reflex agent can behave rationally.
iii. There exists a task environment in which every agent is rational.
iv. Every agent function is implementable by some program/machine combination.
v. Suppose an agent selects its action uniformly at random from the set of possible actions. There exists a deterministic task environment in which this agent is rational.
vi. It is possible for a given agent to be perfectly rational in two distinct task environments.
vii. Every agent is rational in an unobservable environment.
viii. A perfectly rational poker-playing agent never loses.

Question 3

For each of the following activities, give a PEAS description of the task environment in a tubular form.

i. Playing soccer
ii. Exploring the subsurface oceans of Titan
iii. Playing a tennis match
iv. Practicing tennis against a wall
v. Performing a high jump
vi. Knitting a sweater
vii. Bidding on an item at an auction

Question 4

For each of the activities listed in the previous question, describe the environment type as:

i. Fully or partially observable
ii. Deterministic or stochastic
iii. Episodic or sequential
iv. Static or dynamic
v. Discrete or continuous
vi. Single or multi-agent

Provide your answers in a tubular form.

Question 5

Pick a real-world example of your choice (a robot or software agent/bot, except for the examples discussed in detail in the class e.g., taxi & vacuum-cleaner agents) and describe different scenarios in the context of the following agent types that solve the problem.

i. Reflex agent
ii. Model-based
iii. Goal-based
iv. Utility-based
v. Learning agent

Question 6

A problem can be described as a "search problem" by specifying the following components: (a) initial state, (b) actions, (c) transition model/successor function, (d) goal state, (e) path cost (assume a path cost of 1 per action, if not specified explicitly). For each of the following problems, identify the above components.

i. There are six glass boxes in a row, each with a lock. Each of the first five boxes holds a key unlocking the next box in line, the last holds a banana. You have the key to the first box, and you want the banana.

ii. Consider a 3-coins problem, C1-C2-C3 where each coin has two sides: a head (or H) and a tail (or T). Only one coin can be flipped at a time which will change an H to T or a T to H. Since, we have three coins, the coin position would tell the coin to be flipped, that is, C1 will flip coin 1 and so on. The initial state is H-H-H and the goal is to get at least two tails.

iii. In the "missionaries and cannibals" problem, three missionaries and three cannibals must cross a river using a boat which can carry at most two people, under the constraint that, for both banks, if there are missionaries present on the bank, they cannot be outnumbered by cannibals (if they were, the cannibals would eat the missionaries). The boat cannot cross the river by itself with no people on board.

Question 7

For each of the problem in the previous question:

i. Construct a state space and clearly show the initial state(s), possible actions, and goal state(s).
ii. Is the state space a graph or a tree?