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TDT4136 Assignment 1 – AI Fundamentals and Intelligent Agents

QUESTION 1

What is Turing test, how is it conducted?

The Turing test is a test to check whether a computer has intelligent behavior or not. Hence, the Turing test is a behavioral test where as the computer behaves intelligently, then it must be intelligent. The test is not commonly known as an accurate test for artificial intelligence, more like a gimmick.

The test is conducted by letting a human being communicate through a computer to either a computer program or a real person on the other end – the human (or rather, the jury) does not know whether it is a human or a machine on the other end. The eventual computer program is to be considered complete if the jury cannot decide whether they are communicating with a real person or a machine.

QUESTION 2

What is the relationship between thinking rationally and acting rationally?
Is rational thinking an absolute condition for acting rationally?

To act rationally is to be able to do the correct action based on the current state. The current state describes what the human (or agent) knows at the current time, the environment it is in and the functions it exhibits. Acting rationally means that it acts so that the expected value of performance measurement is maximized.

To think rationally is to be able to use logic and common sense to deduct a rational conclusion. To act rationally, you must be able to think rationally and logically deduct a rational conclusion – however, acting rationally can also be done reflexively, and therefore not contain any conscious rational thinking. Therefore, rational thinking may not be an absolute condition for acting rationally.

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QUESTION 3

What is Tarskis "theory of reference" about?

Tarski's theory of reference shows how to relate objects in logic language to objects in the real world.

QUESTION 4

Describe rationality. How is it defined?

A rational agent is an agent that will choose the action that maximizes the expected value of measured performance, given the current limitations. Such limitations may be the percept sequence known currently, or a priori knowledge about the environment.

QUESTION 5

Consider a robot of which task is to cross the road. Its action portfolio looks like this: look-back, look-forward, look-left-look-right, go-forward, go-back, go-left and go-right.

(a) While crossing the road, a helicopter falls down on the robot and smashes it. Is the robot rational?

Yes, the robot is rational. A helicopter dropping from the sky must be considered to be outside of the robots knowledge limitations. Since the robot has no action to look up to see if there are any constraining objects in the air, it will always just check for cars and other objects on street level, and therefore it can only act rationally while interacting with objects on the ground, not in the air. Therefore, based on the robots current percept sequence, the robot is rational.

(b) While crossing the road on a green light, a passing car crashes into the robot preventing it from crossing. Is the robot rational?

This must be considered a multi-agent environment. The passing car, call it agent B, will do actions independently from the robot, call it agent A. Agent A will also perform actions independently. Since agent A's task is to cross the road, we must assume that it cannot cross the road if there are currently any restrictions on the road. Given agent A's knowledge about the world and it's current percept sequence, it must be rational, because the actions performed by agent B are not something that agent A is in control over, and therefore, agent A's actions are optimal given the current limitations.

QUESTION 6

Consider the vacuum cleaner world described on page 38 of the textbook. Let us modify this vacuum environment so that the agent is penalized 1 point for each movement.

(a) Can a simple reflex agent be rational for this environment? Explain your answer.
A simple reflex agent cannot be rational in this environment because it is lacking internal state and is therefore not able to expect the negative points that will accumulate over time. The negative points will accumulate over time because the agent will move from square to square, not knowing whether it is finished or not.

(b) Can a reflex agent with state be rational in this environment? Explain your answer.
Since the reflex agent, in this case, has an internal state, it will remember if the previously visited square was cleaned or not, and hence it will not return to that square. Therefore, this reflex agent will be rational in this environment,

(c) Assume now that the simple reflex agent (i.e., no internal state) can perceive the clean/dirty status of both locations at the same time. Can this agent be rational? Explain your answer. In case it can be rational, design the agent function.
In the previous two tasks, the environment was only partially observable – the robot could only see whether the square it was currently in was clean or not. In this task, the environment is fully observable, meaning the simple reflex agent does not need to keep an internal state of the environment. Because of this, it will not make any unnecessary actions to move to already cleaned squares.

QUESTION 7

Consider the vacuum cleaner environment shown in figure 2.3 in the textbook. Describe the environment using properties from chapter 2.3.2, e.g. episodic/sequential, deterministic/stochastic etc. Explain selected values for properties in regards to the vacuum cleaner environment.

Single agent: The agent does not compete or cooperate with other agents in order to collect the most dirt, so the environment is single agent.

Partially observable: This environment is only partially observable, because the agent has no information about whether the neighboring square is clean or dirty – it only has information about the square it is currently in.

Deterministic: The environment is deterministic because for whatever action the agent may take, there is only one single, guaranteed effect on the environment. There is no uncertainty about what state the environment will have after a completed action.

Episodic: In this case, the agents experience is divided into atomic episodes (or phases). Each episode comprises a percept sequence and a given action through its actuators, and all the episodes are independent from each other – if the agent chooses to suck up dirt in the current square, it has no effect on whether it should suck up dirt in the other square.

Static: The environment is static because it keeps the same state until the agent makes an action – there are no dynamic changes that are happening independently from the agent's actions.

Discrete: This environment has a finite number of distinct states, and is therefore discrete.

Known: The outcome for every action in this environment will be known beforehand – all the laws of the environment are known, and does not need to be learned by exploring.

QUESTION 8

Discuss the advantages and limitations of four basic kinds of agents:

(a) Simple reflex agents

This agent architecture is the simplest of the different types of architectures – it is only effective in fully observable environments. If the environment is only partially observable, the agent may not be able to make the right choice, and may get stuck in an infinite loop. However, if the agent is implemented with the ability to randomize its actions, infinite loops can be avoided.

(b) Model-based reflex agents

Maintains an internal state to keep track of aspects of the world that does not currently exist in the agents percept sequence. The agent must be programmed with two forms of knowledge:

- How the world changes dynamically independently from the agents actions.
- How the agents own actions affect the world.

(c) Goal-based agents

Works the same way as model-based reflex agents, but also takes into consideration its own goals.

(d) Utility-based agents

Works the same way as the other three architectures, but will in addition have a utility function to decide which actions leads to the highest value of measured performance.