Assignment 1 TDT4136

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August 2022

1 What is Artificial Intelligence (AI)? Include at least 3 definitions of AI that are not covered in the lecture.

IBM stated in an article that a definition of AI could be "It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable". [3] From Cambridge dictionary "The study of how to produce machines that have some of the qualities that the human mind has, such as the ability to understand language, recognize pictures, solve problems, and learn." [1] Lastly from the Oxford dictionary "The study and development of computer systems that can copy intelligent human behavior in computers." [6]

2 What is the Turing test? What is its purpose and how is it conducted?

The Turing test was a thought experiment proposed by Alan Turing, that would test if a machine could be preserved as being able to think. This is done by having a machine answer some question written. After the machine has answered it passes if a human interrogator can't tell if the answers came from a computer or a human. [4]

3 What is rationality?

The Camebridge dictionary defines rationality as "The quality of being based on clear thought and reason, or of making decisions based on clear thought and reason."[2] Some also use rationality to define intelligence by saying that something is intelligent if it does the right thing i.e is rational. [4]

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

Rational thinking is using logic to deduct the right decision for a problem. Acting rational is doing the right action in a given situation based on the given information and abilities. You cannot always use time to think logically in a given situation to make the right decision thus is why you don't have to think rationally to act rationally. Example of this is if your slip and fall you don't have time to think about if you should catch yourself with your hands or with your head, so you have to just act.[4]

5 What is the connection between knowledge and action according to Aristotle? How can his argument be used to implement his idea in AI?

Aristotle used a mathematical model syllogism to reach correct conclusions through deductive reasoning and logical argument structures. When applied correctly, it can be used to determine the most rational action based on logical reasoning. Aristotle's Laws of Thought is used in AI to give an agent the ability to preform rational actions based on some conditions we define. This in turn will lead the agent to act so that it reaches its goal.[4]

5.1 Who was (or were) the first AI researcher(s) to implement these ideas?

It was implemented by Allen Newell and Herbert Simon 2300 years after Aristotle proposed his ideas.[4]

5.2 What is the name of the program or system they developed? Write a short description about. it.

Their program was called General Problem Solver program. It worked by the user defining objects and what operations that could be done on sed object. The program then solves a given problem for the object by a means-ends analysis.[4]

6 Consider a robot with the task of crossing the road, and an action portfolio?

6.1 While crossing the road, an elk crashes on the robot and smashes it. Is the robot rational?

Yes, its acting rational because an elk crashing into one is not a scenario that is normal to concider given the action set of the robot, and considering every single outcome is not reasonable when acting rationally.

6.2 While crossing the road on a green light, a passing car drives into the robot and crashes, preventing the robot from crossing to the other side. Is the robot rational?

No, because event tho the light is green a rational action is the wait for the car to pass if you can see it coming, and since the robot that look around is should see that the car is coming.The problem does not state that the light was green for the robot to pass so, the green light could be for the car, making it even more irrational.

7 Consider the vacuum cleaner world described in Figure 2.2 (Chapter 2.1 of AIMA 4th Ed.). Let us modify this vacuum environment such that the agent is penalized 1 point for each movement

7.1 Could a simple reflex agent be rational for this environment? Why?

No, in an environment with no internal state the robot would just move back and forth and check if a square is dirty or not gaining a lot of penalty points.

7.2 Could a reflex agent with state be rational in this environment? Why?

Maybe, With state the robot could remember if a square was cleaned or not and thus does not move to a square that it has cleaned, but if a square can get dirty again it will lead to the robot not cleaning them since it thinks its already clean.

7.3 **Assume now that the simple reflex agent (i.e. no internal state) can perceive the clean status of both locations at the same time. Could this agent be rational? Why? In case it could be rational, write the agent function using mathematical notation.**

Yes, this robot could be rational, because it can clean its current square if its dirty and then move to the other if that is dirty, and do nothing if everything is clean this can be written like so

$$P = \{Currentdirty, Rightdirty, Leftdirty\}$$
$$A = \{Clean, Moveright, Moveleft\}$$
$$f : P^* -> A$$

8 Consider the original vacuum cleaner environment shown in Figure 2.2. Describe the environment using the properties from Chapter 2.3.2 (e.g. episodic/sequential, deterministic/stochastic, etc.) Explain why you chose such values and properties.

This environment is episodic because the outcome might very from previous iterations. It is a single agent, and the agent only has access to a limited part of the environment so its partially observable. The environment is deterministic because the actions of the robot changes the state of the environment. Its is dynamic because it changes based on what the robot does. All actions and outcomes are known so the environment is known. Because of the set number of action and outcomes the environment is discrete.

9 Write both advantages and limitations of the following types of agents

9.1 Simple reflex agents

A Simple reflex agent has a small and short program. It has a set number of actions it can preform. Its to simple for complex problems, but the condition to action rule is used in lager environments. It interprets the environment and creates rules for the environment that leads to actions. Because it has a limited intelligence it is dependent on a fully observable environment. If this is not the case it might lead to the agent being left in an infinite loop. This can be solved by using random action, but then the solution is no longer rational. [5]

9.2 Model-based reflex agents

A Model-based reflex agent tries to handle partially observable environments, with use of an internal state. The main possible on a model-based reflex agent is that the environment influences the agent, ant the agent influences the environment. This is hard to track accurately, which leads to large levels of uncertainty. [5]

9.3 Goal-based agents

A goal-based agent looks at the target and the state of the environment. The agent wil then know what states are good for the given goal, and because of this the agent considers the futures when acting. They are complex and less effective, but more flexible when being used on new information. [5]

9.4 Utility-based agents

A Utility-based agent is used when having a goals isn't enough. When there a multiple possible ways to achieve a goal utility vales can be used to pick the best way to reach the goal. It scores the option based on the utility and picks the best solution from this. Its more flexible than a goal-based agent, but its even more complex and hard to create. [5]

References

[1] Cambridge. *artificial-intelligence*. URL: `https://dictionary.cambridge.org/us/dictionary/english/artificialintelligenc` (visited on 08/25/2022).

[2] Cambridge. *Rationality*. URL: `https://dictionary.cambridge.org/dictionary/english/rationality` (visited on 08/25/2022).

[3] IBM. *Artificial Intelligence (AI)*. June 3, 2020. URL: `https://www.ibm.com/cloud/learn/what-is-artificial-intelligence` (visited on 08/25/2022).

[4] Stuart Russell Peter Norvig. "Artificial-Intelligence-A-Modern-Approach". In: 4th ed. New York: Pearson, 2021. Chap. 1.

[5] Stuart Russell Peter Norvig. "Artificial-Intelligence-A-Modern-Approach". In: 4th ed. New York: Pearson, 2021. Chap. 2.

[6] Oxford. *artificial-intelligence*. URL: `https://www.oxfordlearnersdictionaries.com/definition/english/artificial-intelligence` (visited on 08/25/2022).