Theoretical Questions

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

lecture.

“At its simplest form, artificial intelligence is a field, which combines computer science and robust datasets, to enable problem-solving. It also encompasses sub-fields of machine learning and deep learning.”1 (IBM, u.d.)

“Artificial intelligence (AI) is a wide-ranging branch of computer science concerned with building smart machines capable of performing tasks that typically require human intelligence.” (Schroer, 2023)

**“**Artificial intelligence (AI) is the ability of machines to perform tasks that are typically associated with human intelligence, such as learning and problem-solving.” (Wikipedia contributors, 2023)

2. What is the Turing test? What is its purpose and how is it conducted? Are there any new proposals for the Turing Test?

The Turing Test is a test proposed by Alan Turing that tests a machine’s ability to show intelligent behavior indistinguishable from humans. It is conducted in an environment where a person engages with both a machine and a human using a keyboard, without the knowledge of which is which. If the person cannot consistently distinguish between human or machine interaction, then the machine is considered to have passed the Turing Test.

There are numerous other proposals with varying requirements. some tests like the Total Turing Test include audio and video interactions and some tests like the CAPTCHA Tests focus more on general intelligence.

3. What is rationality and what is the difference between thinking rationally and acting rationally?

Is rational thinking an absolute condition for acting rationally?

Rationality is the ability to make logical decisions out of available information. Thinking rationally focuses on the cognitive processes for decision making, while acting rationally is a consequence of the cognitive processes and involves choosing actions that align with one’s goals.

Due to external factors, rational thinking is not an absolute condition for acting rationally. As an example, we humans tend to be influenced by emotions and instincts which do not always result in rational actions.

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

Aristotle argued (in De Motu Animalium) that actions are justified by a logical connection between goals and knowledge of the action’s outcome. If AI should be capable of taking actions, in a thoughtful manner, it could be argued that a logical connection between goals and knowledge of the outcome is needed.

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

The first researcher to implement these ideas was John McCarthy.

(b) What is the name of the program or system they developed? Write a short description about

it.

Lisp, which was to become the dominant AI programming language for the next 30 years (starting from 1958). Lisp was originally created as a practical mathematical notation for computer programs which quickly became a favored language AI (Wikipedia contributors, 2023).

5. Consider a robot with the task of crossing the road, and an action portfolio A:

A = {lookBack, lookF orward, lookLef t, lookRight, goF orward, goBack, goLef t, goRight}

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

No it is not, assuming it was not crossing on a zebra cross or with no right of way. This is because the responsibility lies with the one crossing the road (jaywalking) to make sure that it would not cause any unwanted incidents when planning such maneuvers.

• 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?

The car illegally crashed into the robot and the robot is rational.

6. 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 penalised with 1 point for each

movement:

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

No, because after all the cleaning is done it would fare poorly because of continuation of movement after the job is done.

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

Yes, a reflex agent with state can keep track of its current position and whether it has visited all the squares. Once it determines that all squares are clean, it can refrain from further movements, thus avoiding unnecessary penalties.

• Assume now that the simple reflex agent (i.e., with 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 or a table.

Yes it could be rational with the following agent function.

f(Cleanliness of Square A, Cleanliness of Square B) =

{

Suck if both squares are dirty or one square is dirty.

Rest if both squares are clean.

}

This way it avoids unnecessary movement when the work is done.

7. Consider the original vacuum cleaner environment shown in Figure 2.2. Describe the envir-

onment using the properties from Chapter 2.3.2 (e.g. episodic/sequential, deterministic/stochastic,

etc.) Explain why you chose such values and properties.

It is sequential environment: because cleaning one square might affect its future decision.

It is a static environment: because the dirt distribution is constant and the environment is not changing while the cleaning operation is ongoing.

It is a deterministic environment: sucking dirt will result in a cleaner square with certainty.

It is a known environment: The agent knows that sucking dirt will lead to cleaner squares. The agent is aware of the physics of cleaning

It is a discrete environment: because all states of clean and dirty can be calculated (assuming the cleanliness is not measured on a spectrum).

It is a single agent environment: only one agent in the environment.

It is a partially observable environment: because the agent doesn’t know the state of square B until it moves there.

8. Write both advantages and limitations of the following types of agents:

• Simple reflex agents

* Pros: Simple to implement, fast response, low computational cost
* Cons: Limited intelligence, not flexible for more demanding tasks or special cases, No planning

• Model-based reflex agents

* Pros: Handling Partial Observability, adaptability, improved decision making, longer term planning
* Cons: Complexity, model uncertainty, computational overhead

• Goal-based agents

* Pros: Goal achievement, flexibility, consideration of future outcomes, long term planning
* Cons: Complexity, not suitable for simple tasks, goal conflicts, computational overhead

• Utility-based agents

* Pros: Prioritize actions, can handle goal conflicts, can make decisions on probabilistic outcomes
* Cons: Complexity, computational overhead, creating an accurate utility function is challenging

# References

IBM. (n.d.). *What is artificial intelligence (AI)?* Retrieved 08 31, 2023, from IBM.com: https://www.ibm.com/topics/artificial-intelligence

Schroer, A. (2023, Jul 27). *Artificial Intelligence. What Is Artificial Intelligence (AI)? How Does AI Work?* Retrieved from builtin.com: https://builtin.com/artificial-intelligence

Wikipedia contributors. (2023, 07 21). *Lisp (programming language)*. Retrieved from Wikipedia.org: https://en.wikipedia.org/w/index.php?title=Lisp\_(programming\_language)&oldid=1166413855

Wikipedia contributors. (2023, 08 30). *Artificial intelligence*. Retrieved from Wikipedia.com: https://en.wikipedia.org/w/index.php?title=Artificial\_intelligence&oldid=1173002442