Lab 1

Fundamentals of Natural and Artificial Intelligence

Activity 1: Questions about AI. We propose to reflect on the most common philosophical questions related to the study of Artificial Intelligence. Answer the following questions shortly.

A) How could be defined the term "intelligence"? How could be measured intelligence? Are these measurements useful?

B) What would convince you that a machine is accurately intelligent?

C) What is your definition of Artificial Intelligence (AI)?

D) why is problem-solving so central to AI?

E) How can logic programming be useful for AI applications?

F) Can artificial intelligence become self-aware? Can AI think? Can AI be human? Can AI write code?

G) Can applied artificial intelligence be fully ethical?

H) Can artificial intelligence applications think? Or learn? Or be creative with human supervision?

I) What kind of tasks does Artificial Intelligence not solve yet accurately?

J) What is the next trends or promising research areas in AI?

Activity 2: The Turing Test. In this activity, we propose to study the Turing Test for AI. Do you think the Turing test is valid for AI? What types of intelligent human behaviors are challenged by the Turing Test?

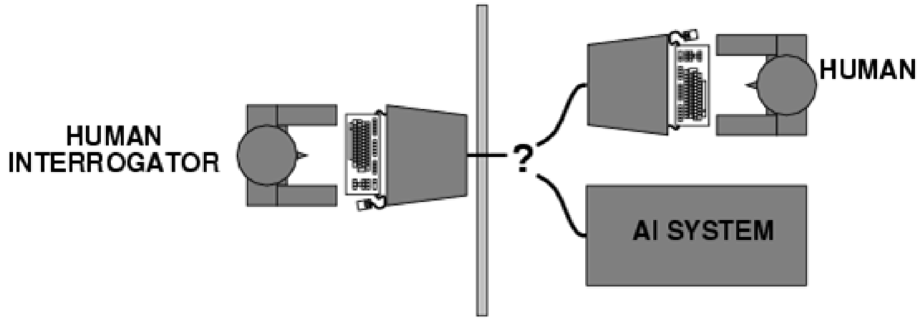

Figure 1: Turing Test (Image courtesy of https://prsnblog.wordpress.com/category/modern-computing/)

A) What could differentiate a human being and a computer machine if we ask the same questions to both of them?

B) What type of questions would make a Turing test effective to defeat a machine?

C) Propose a metric to measure and differentiate several levels of intelligence needed to answer a question.

D) The design of a Turing Test: propose a collection of questions for a Turing Test to confuse a clever chatbot. Speculate on what the answer provided by the machine is going to be.

E) How to evaluate the accuracy of a Turing Test?

Activity 3: World of Cubes. In this activity, we propose to study the representation in the world of cubes. We represent the proposed initial state in the world of cubes using the following predicates:

- *ontable(a)*: the cube A has a contact point with the table.
- *ontable(c)*: the cube C has a contact point with the table.
- *ontable(d)*: the cube D has a contact point with the table.
- *on(b,a)*: the cube B is on the cube A.
- *on(e,d)*: the cube E is on the cube D.
- *clear(b)*: there is no other cube on the top of B.
- *clear(c)*: there is no other cube on the top of C.
- *clear(e)*: there is no other cube on the top of E.
- *gripping()*: the list of cube currently gripped.

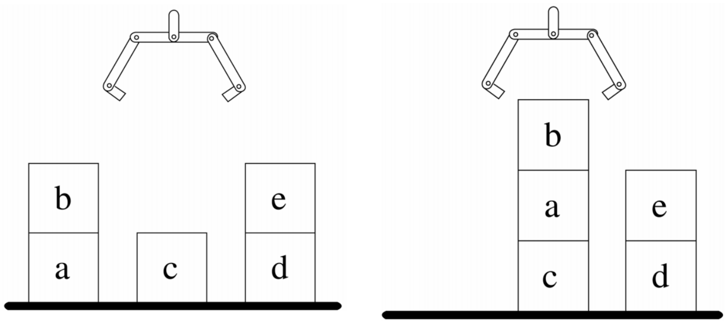

Figure 2: The world of cubes: the initial state (left) and the goal state (right).

A) We assume that the robot arm can precisely reach the block and that the robot arm can perform the following tasks:

- *pickup(W)*: pick up block W from its current location on the table and hold it
- *putdown(W)*: place block W on the table
- *stack(U, V)*: place block U on top of block V
- *unstack(U, V)*: remove block U from the top of block V and hold it

Assuming that we do not have the full power of predicate logic, an operator is defined in terms of its:

- P: Preconditions
- A: add lists,
- B: delete lists

P, A and B are all defined as conjunctions of the predefined predicates *ontable*, *on*, *clear*, and *gripping*. Define the Four operators *pickup*, *putdown*, *stack* and *unstack* for the blocks world.

B) Provide the portion of the search space of the blocks.

C) Write down the algorithm to reach the obtain the goal state.

Activity 4: Seven Bridges of Konigsberg. In this activity, we propose to study the Konigsberg bridge problem that it proved to be a difficult problem. Konigsberg is a Russian town on the Preger River. Within the town are two river islands that are connected to the banks with seven bridges (as shown in the provided figures). It is a tradition to try to walk around the town in a way that only crossed each bridge once.

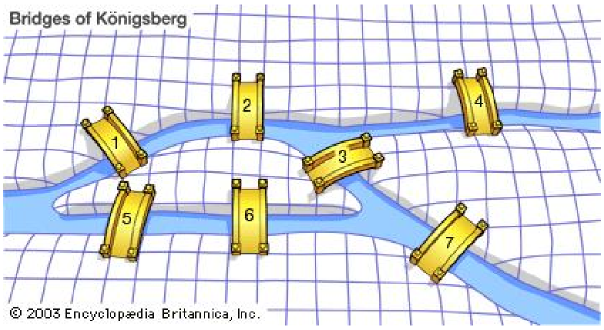

Figure 3: Seven Bridges of Konigsberg (image courtesy of `https://www.britannica.com/topic/Konigsberg-bridge-problem`)

The Konigsberg bridge problem is stated as follows: Is it possible to traversed all the seven bridges of the city of Konigsberg in a single trip without doubling back and with the additional requirement that the trip ends in the same place it began?

A) How to solve this problem intuitively?

B) How to abstract the representation of this problem?

C) How to reformulate this problem? (using the mathematical model)

D) Write a technically-sound solution to this problem using Graph Theory.

E) Optional: Verify the correctness of the Leonard Euler's Solution to the Konigsberg Bridge Problem.

To prepare the next steps: Software and Coding. In this activity, we propose to test and get familiar with softwares an libraries that we are going to use during the semester. Here the list of software that we are going to use:

- Prolog: `http://www.swi-prolog.org/download/stable`
- Jade: `http://jade.tilab.com/`
- MASON: `http://cs.gmu.edu/~eclab/projects/mason/`
- Netlogo: `https://ccl.northwestern.edu/netlogo/`

For each software:

A) Open the software.

B) Learn how to use the graphic interface (if any).

C) Experiment few tutorials or simple examples offered with on the software webpage.

D) Have a look the online documentation to become familiar with the software.