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?

Solution: The following definition is a composite from various authors. Intelligence is a combination of the ability to:

- Learn = all kinds of informal and formal learning via any combination of experience, education, and training.
- Pose problems = recognizing problem situations and transforming them into more clearly defined problems.
- Solve problems = accomplishing tasks, fashioning products, and doing complex projects.

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

Solution: What would convince you that a given machine is truly intelligent? `http://www.loebner.net/Prizef/loebner-prize.html` How good are machines at playing chess? If a machine can consistently beat all the best human chess players, does this prove that the machine is intelligent? `http://www.aaai.org/AITopics/html/chess.html`

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

Solution: Artificial intelligence is:

- the technological process of automating systems to limit humans direct ongoing involvement.
- computers/machines and software that are capable of learning.
- means smart devices that learn more as you use them more.

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

Solution:

- Theoretical issue
- Business applications and commercial solution

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

Solution: If we have a database of rules and facts, Logic can be use to make rational decisions as well as to infer new knowledge, or find the answer of a query. Prolog is a general-purpose logic programming language associated with artificial intelligence.

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

Solution:

- Self-awareness is mirroring. You could train a robot to recognize itself.
- Can AI write code? If AI is capable of creating its own cryptography then its probably able to sling some code as well.
- Can AI replace humans? Yes it can and this is what everyone is so worried about.
- Can AI think? No
- Can AI be human? No

G) Can applied artificial intelligence be fully ethical?

Solution: AI will be as ethical as those who create it are.

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

Solution:

- Can artificial intelligence think? In respect to neural networks and how they are trained, it is not so dissimilar to the manner in which you might train a child to learn.
- Can artificial intelligence learn? Yes. We use big data to train AI to do things.
- Can artificial intelligence be creative? It sure can.

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

Solution:

- Those that require creativity, intuition, and common sense to solve problems.
- Tasks that are precisely defined, carefully formulated, and rigorously modeled by humans.
- Such creative, critical, lateral, and holistic thinking capabilities are currently not available to AI systems.
- For instance, AI algorithms are not good at discovering and defining a problem.

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

Solution:

- Computer vision is one of the most promising disciplines
- Another area is in systems engineering.
- machine learning and reasoning that are effective beyond straightforward prediction tasks

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?

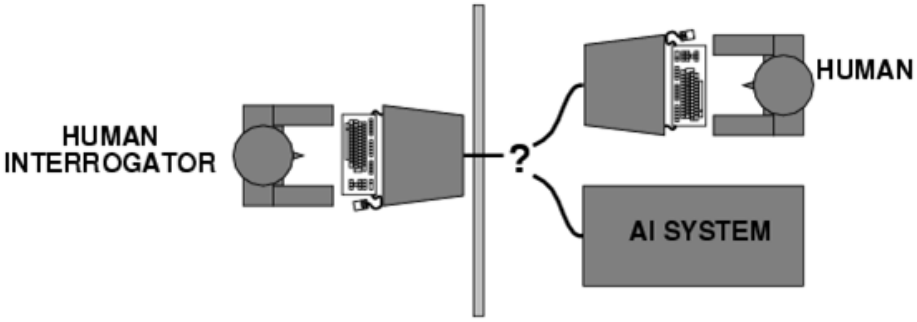


Figure 1: Turing Test (Image courtesy of `https://prsnblog.wordpress.com/category/modern-computing/`)

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

Solution:

- The time taken to answer.
- The ability to deal with ambiguities.
- The ability to be creative.

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

Solution: Turing proposed that a human evaluator would judge natural language conversations between a human and a machine designed to generate human-like responses. The evaluator would be aware that one of the two partners in conversation is a machine, and all participants would be separated from one another. The conversation would be limited to a text-only channel such as a computer keyboard and screen so the result would not depend on the machine's ability to render words as speech. If the evaluator cannot reliably tell the machine from the human, the machine is said to have passed the test. The test does not check the ability to give correct answers to questions, only how closely answers resemble those a human would give. It is possible to defeat a machine at Turing test by ask irrational questions, or questions that cannot solved by mathematics or logic.

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

Solution: We used a self-made metrics called AI Scores (1100), which differentiates intelligence in 5 levels (5th is the human level).

- AIS core 1-10 Questions (Answering simple questions) :
- AI Score 11-25 Questions (Connecting dots, complex interpretation understanding)
- AI Score 26-50 Questions (Deep logic and reasoning)
- AI Score 51-75 Questions (Artificial personality and EQ)
- AI Score 76+ (Human level) Questions (Artificial consciousness)

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.

Solution:

Question	In the first line of the sonnet which reads "Shall I compare thee to a summer's day," would not "a spring day" do as well or better?
Answer	It wouldn't scan.
Question	How about "a winter's day"? That would scan all right.
Answer	Yes, but nobody wants to be compared to a winter's day.
Question	Would you say Mr. Pickwick reminded you of Christmas?
Answer	In a way.
Question	Yet Christmas is a winter's day, and I don't think Mr. Pickwick would mind the comparison.
Answer	I don't think you're serious. By a winter's day one means a typical winter's day, rather than a special one like Christmas.

Figure 2: Probably a human is replying.

Question	Please write me a sonnet on the subject of the Forth Bridge.
Answer	Count me out on this one. I never could write poetry.
Question	Add 34957 to 70764.
Answer	*pause for about 30 seconds* . . . 105621.
Question	Do you play chess?
Answer	Yes.
Question	My King is on the K1 square, and I have no other pieces. You have only your King on the K6 square and a Rook on the R1 square. Your move.
Answer	*after a pause of about 15 seconds* . . . Rook to R8, checkmate.

Figure 3: Probably a computer is replying.

Do not ask a simple question. The more complex a request through a conversation becomes the less capable an Artificial Intelligent bot will be able to comprehend and respond.

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

Solution:

- better test for artificial intelligence - Specifically the test is of something called Winograd schemas.
- test computers for common sense

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.

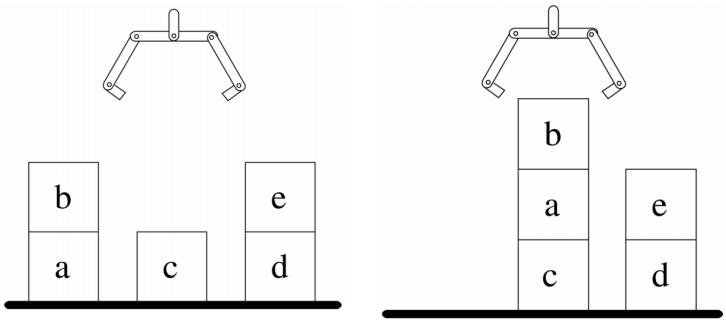


Figure 4: The world of cubes: the initial state (left) and the goal state (right).

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.

Solution: Four operators for the blocks world:
pickup(X)

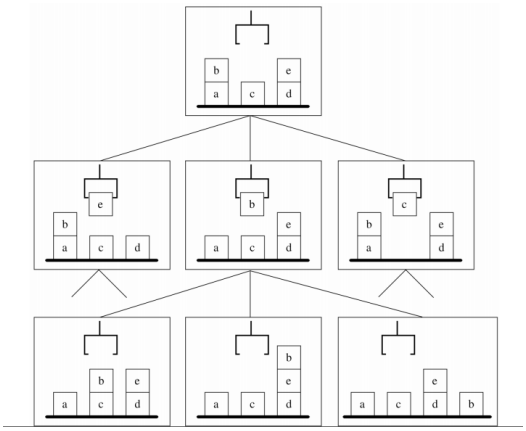
P: gripping() and clear(X) and ontable(X)
A: gripping(X)
D: ontable(X) and gripping()

putdown(X)
P: gripping(X)
A: ontable(X) and gripping() and clear(X)
D: gripping(X)

stack(X,Y)
P: gripping(X) and clear(Y)
A: on(X,Y) and gripping() and clear(X)
D: gripping(X) and clear(Y)

unstack(X,Y)
P: gripping() and clear(X) and on(X,Y)
A: gripping(X) and clear(Y)
D: on(X,Y) and gripping()

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



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

unstack(b,a)
putdown(b)
pickup(a)
stack(a, c)
pickup(b)
stack(b, a)

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.

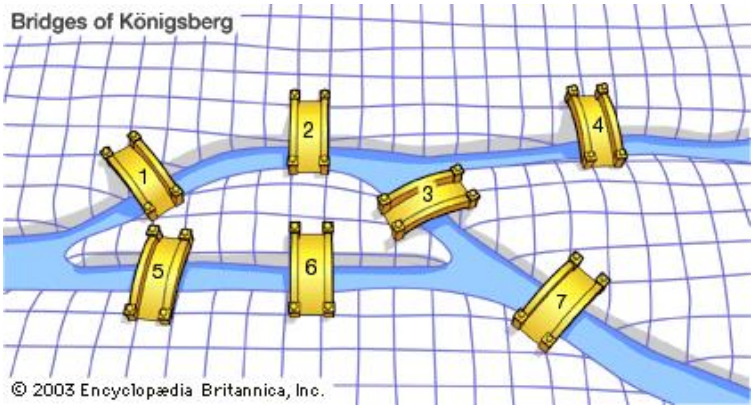


Figure 5: Seven Bridges of Konigsberg (image courtesy of `https://www.britannica.com/topic/Konigsberg-bridge-problem`)

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?

Solution: Intuitively, this problem can be solve by brute force, namely generating all potential solutions and then returning the first valid candidate solution.
B) How to abstract the representation of this problem? Solution: with graph.

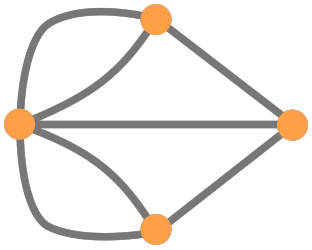


Figure 6: Courtesy of MathWorld.

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

Solution: Using graph theory.
D) Write a technically-sound solution to this problem using Graph Theory.

Solution: This is equivalent to asking if the multigraph on four nodes and seven edges (right figure) has an Eulerian cycle. This problem was answered in the negative by Euler (1736), and represented the beginning of graph theory.
E) Optional: Verify the correctness of the Leonard Euler's Solution to the Konigsberg Bridge Problem.

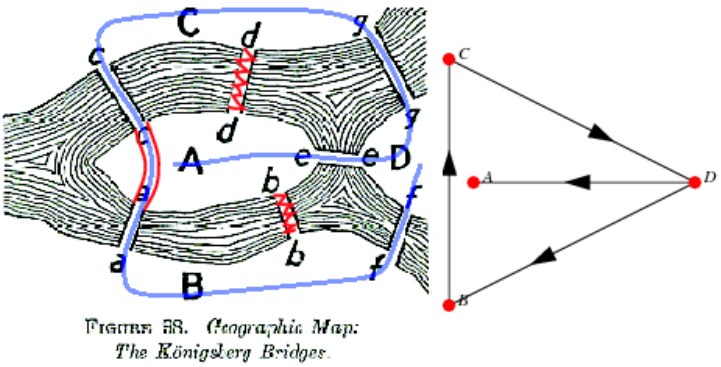


Figure 7: Courtesy of MathWorld.

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.