

Artificial Intelligence

ENCS 434

Introduction

Aziz M. Qaroush

Syllabus

Course Information	
Course Title	Artificial Intelligence
Course Number	ENCS 434
Text Book	<ul style="list-style-type: none">• Artificial Intelligence: A modern approach 3rd edition• Artificial Intelligence: A Guide to Intelligent Systems 3rd edition
Instructor	Aziz Qaroush
Email	aqaroush@birzeit.edu
Office Hours	SMW (8:00 – 9:00, 10:00 – 11:00) , R (9:00 – 11:00)

Grading Scheme		
Assessment Type	Date	Weight
Midterm Exam	TBA	30%
Final Exam	TBA	40%
Assignments	TBA	30%

Syllabus

Topics	Time (Lectures)
• Introduction - Intelligent Agents	2
• Problem Solving by Search	4
• Heuristic (Informed) Search	4
• Constraint Satisfaction	3
• Games	3
• Knowledge-Based Agents - Propositional and First-Order Logic	3
• Inference in First-Order Logic, Logic Programming and Prolog	3
• Knowledge Representation	2
• Uncertainty and Probabilistic Reasoning	6
• Fuzzy Logic	4
• Machine Learning - Basic Concepts, Decision Trees, Neural Networks	8
• Introduction to Natural Language Processing	2

Course Learning Outcomes

- Upon completion of this course, you will have the ability to:
 - Understand the meaning of AI, its alternative approaches.
 - Know the techniques and technologies that currently exist and are "evolving" in the field of AI.
 - Know a variety of ways to represent and retrieve knowledge; Logic, semantic networks, frames, production rules.
 - Expand your knowledge about blind and heuristic search algorithms.
 - Know the fundamentals of AI programming languages; Prolog or Lisp.
 - Know machine learning techniques and apply them in an AI programming language.
 - Understand the basic methods in planning and reasoning using both logic and uncertain inference.

What is Artificial Intelligence ?

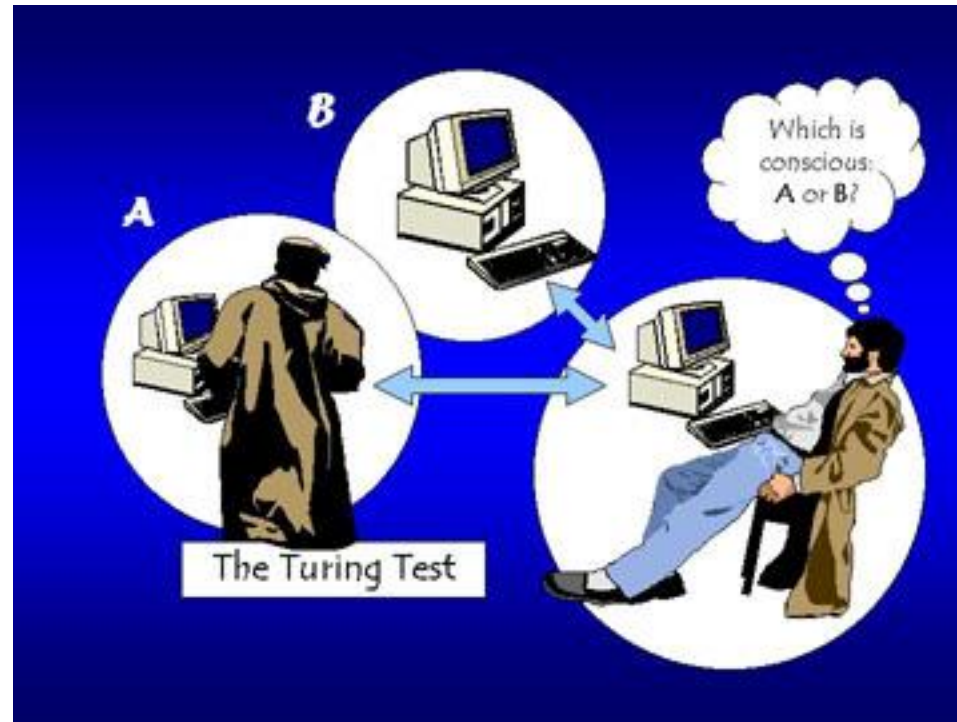
- Intelligence = Knowledge + ability to perceive, feel, understand, process, communicate, judge, and learn.
- **What is Artificial Intelligence?**
 - There is no official agreed upon definition of Artificial Intelligence.
 - In practice, it is an “umbrella term”
 - It is multidisciplinary subject
 - Technologies enter and exit the AI “umbrella” regularly.

What is Artificial Intelligence ?

- ❑ **Winston:** “AI is the study of ideas which enable computers to do things which make people seem intelligent.”
- ❑ **Steven Tanimoto,** “Computational techniques for performing tasks that apparently require intelligence when performed by humans.”
- ❑ **David Parnas,** “Artificial intelligence is to artificial flowers as natural intelligence is to natural flowers.”
- ❑ **Luger:** The branch of computer science that is concerned with automation of intelligent behavior.
- ❑ **Rich:** “AI is the study of how to make computers do things which, at the moment, people do better.”
- ❑ **Fahlman:** AI is the study of intelligence using the ideas and methods of computation.”
- ❑ **Found on the Web:** AI is the reproduction of the methods or results of human reasoning or intuition.
- ❑ **We can define it too:** AI is a field of computer science that simulates human performance to make a computer reasons in a manner similar to humans.

What is Artificial Intelligence?

Turing Test



The computer passes the “test of intelligence” if a human, after posing some written questions, cannot tell whether the responses were from a person or not.

What is Artificial Intelligence?

- To give an answer, the computer would need to possess some capabilities:
 - Natural language processing: To communicate successfully.
 - Knowledge representation: To store what it knows or hears.
 - Automated reasoning: to answer questions and draw conclusions using stored information.
 - Machine learning: To adapt to new circumstances and to detect and extrapolate patterns.
 - Computer vision: To perceive objects.
 - Robotics to manipulate objects and move.

Intelligent System Should do:

- ❑ **How can we make computer based systems more intelligent?**
- ❑ **In practical terms, intelligent systems:**
 - Should have the ability to *automatically perform tasks* that normally require a human expert.
 - Should have more *autonomy*; less requirement for human intervention or monitoring.
 - Should have *Flexibility in dealing with variability* in the environment in an appropriate manner.
 - Are *easier to use*: able to understand what the user wants from limited instructions.
 - *Can improve their performance* by learning from experience.

Can we build hardware as complex as the brain?

□ How complicated is our brain?

- ⇒ A neuron, or nerve cell, is the basic information processing unit
- ⇒ Estimated to be on the order of 10^{12} neurons in a human brain
- ⇒ Many more synapses (10^{14}) connecting these neurons
- ⇒ Cycle time: 10^{-3} seconds (1 millisecond)

□ How complex can we make computers?

- ⇒ 10^6 or more transistors per CPU
- ⇒ Supercomputer: hundreds of CPUs, 10^9 bits of RAM
- ⇒ Cycle times: order of 10^{-8} seconds

□ Conclusion

- ⇒ **YES**: we can have computers with as many basic processing elements as our brain, but with
 - Far fewer interconnections (wires or synapses) than the brain
 - Much faster updates than the brain
- ⇒ **But** building hardware is very different from making a computer behave like a brain!

Must an Intelligent System be Foolproof?

- ❑ **A “foolproof” system is one that never makes an error:**
 - Types of possible computer errors
 - Hardware errors, e.g., memory errors
 - Software errors, e.g., coding bugs
 - “Human-like” errors
 - Clearly, hardware and software errors are possible in practice
 - What about “human-like” errors?
- ❑ **An intelligent system can make errors and still be intelligent**
 - Humans are not right all of the time
 - We learn and adapt from making mistakes
- ❑ **Conclusion:**
 - **NO:** intelligent systems will not (and need not) be foolproof

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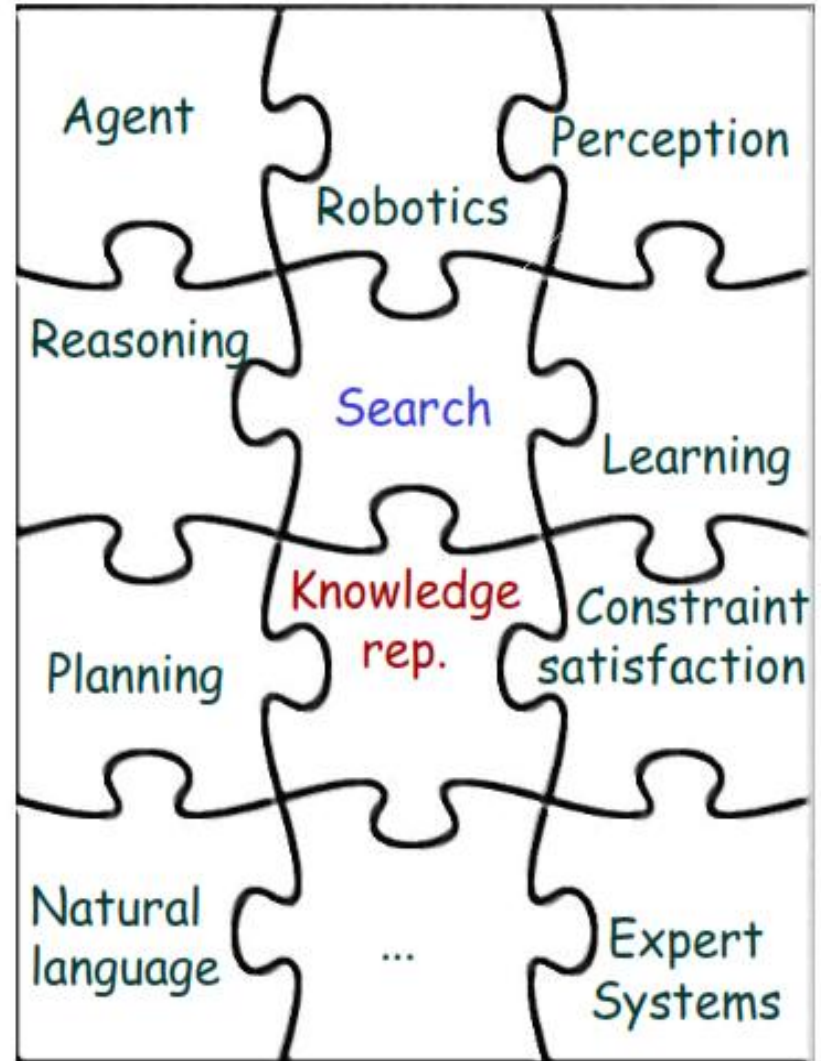
Goals of AI:

AI began as an attempt to understand the nature of intelligence, but it has grown into a scientific and technological field affecting many aspects of commerce and society. The main goals of AI are:

- **General Goal:** replicate human intelligence
- **Engineering:** solve real-world problems using knowledge and reasoning. AI can help us solve difficult, real-world problems, creating new opportunities in business, engineering, and many other application areas
- **Scientific:** use computers as a platform for studying intelligence itself. Scientists design theories hypothesizing aspects of intelligence then they can implement these theories on a computer.

Main Areas of AI

- Knowledge representation (including formal logic)
- Search, especially heuristic search (puzzles, games)
- Planning
- Reasoning under uncertainty, including probabilistic reasoning
- Learning
- Agent architectures
- Robotics and perception
- Natural language processing



What is Artificial Intelligence ?

Examples of AI Application systems:

- Game Playing
- Autonomous Planning & Scheduling
- Natural Language Understanding
- Pattern Recognitions
- Robotics
- Automated theorem proving
- Web search Engines

What is Artificial Intelligence ?

- To conclude:
 - AI is a very fascinating field. It can help us solve difficult, real-world problems, creating new opportunities in business, engineering, and many other application areas.
 - Even though AI technology is integrated into the fabric of everyday life. The ultimate promises of AI are still decades away and the necessary advances in knowledge and technology will require a sustained fundamental research effort.