Agent Based Intelligent Systems (SW318)

Dr. Areej Fatemah Meghji
email: areej.fatemah@faculty.muet.edu.pk

Agent Based Intelligent Systems (SW318)

Course Learning Outcomes:

Upon successful completion of this course, you will be able to:

CLOs	Description	Taxonomy level	PLO
1	Explain basic principles of Agent based Intelligent Systems, related theory and terminology.	C3	1
2	Understand and analyze NLP and NLP based techniques	C4	2
3	Create agent-based systems for different computing problems.	C5	3

Course Contents

- AI principles and application areas
- Intelligent Agents
- Searching
- Game Playing
- Natural Language Processing
- Artificial Neural Networks
- Machine Learning (Classification)

Recommended Reading

1. Russell S., Norvig P., “**Artificial intelligence – A Modern Approach**”, Latest Edition, Prentice Hall.
2. Michael Wooldridge, "**An Introduction to Multi Agent System**", John Wiley Latest Edition.
3. Coppin B., “**Artificial Intelligence Illuminated**”, Latest Edition, Jones and Bartlett Publishers USA.

What is Intelligence?

The concept of intelligence has been a widely debated topic among members of psychology.

Defining and classifying intelligence is extremely complicated.

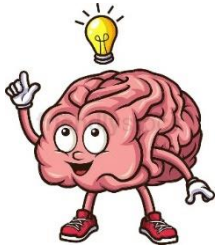
- Theories of intelligence range from having one general trait/ability, to certain primary mental abilities, to multiple category-specific abilities.

One could certainly define intelligence by the properties one exhibits:

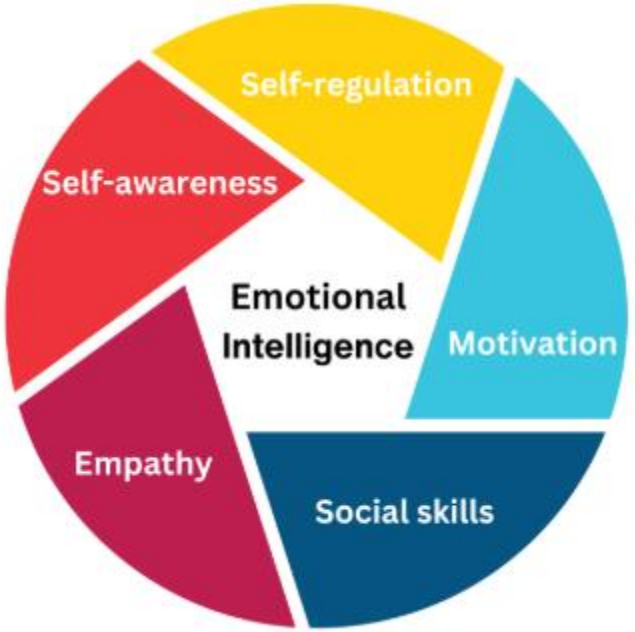
- the ability to acquire and apply knowledge and skills.
- the ability to deal with new situations, solve problems, answer questions or devise plans.

Intelligence can be observed in terms of:

Creativity
Memory
Reasoning
Perception
Problem Solving
Learning
Communication
Adaptation
Logic



Intelligence:



Intelligence can be considered the ability to:

- Learn or understand from experiences
- Make sense out of ambiguous and contradictory messages
- Respond quickly and effectively to a new situation
- Deal with complex situations
- Apply knowledge to manipulate the environment

- Intelligence does not necessarily mean how fast information is processed, but it is the ability to **demonstrate intelligence** by *communicating effectively (by any means) and by learning new concepts (by any means).*

Artificial Intelligence: Definition

- It is the science and engineering of making intelligent machines, especially intelligent computer programs.

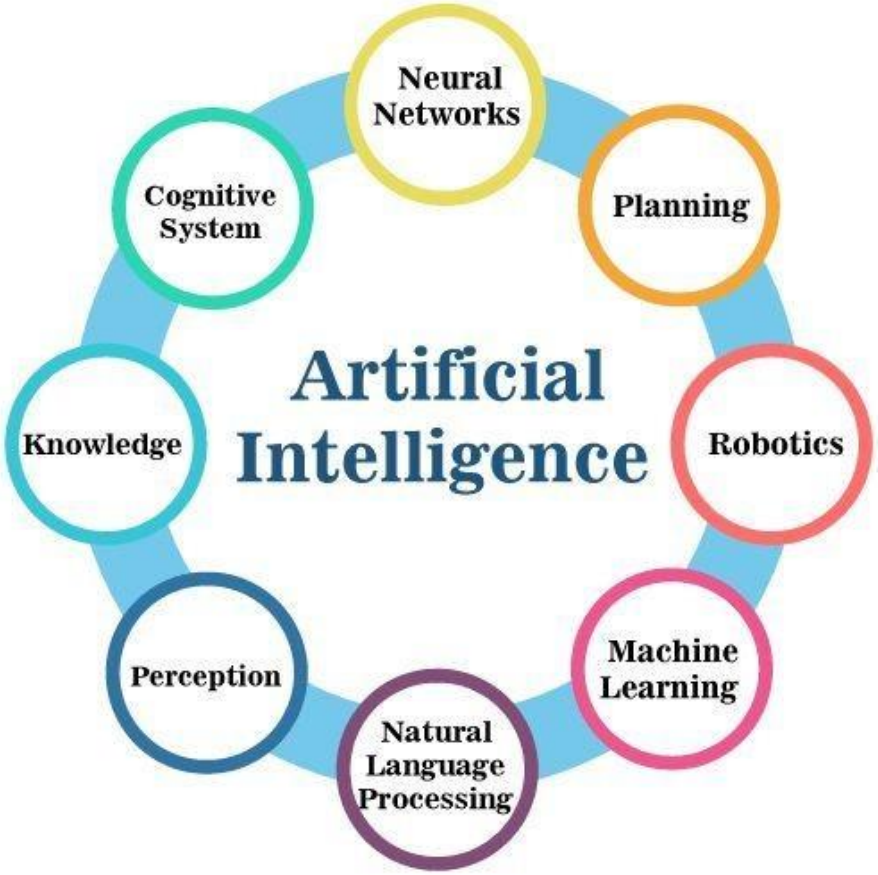
- Artificial intelligence is the study of systems that act in a way that to any observer would appear to be intelligent.

Artificial Intelligence: Definition

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

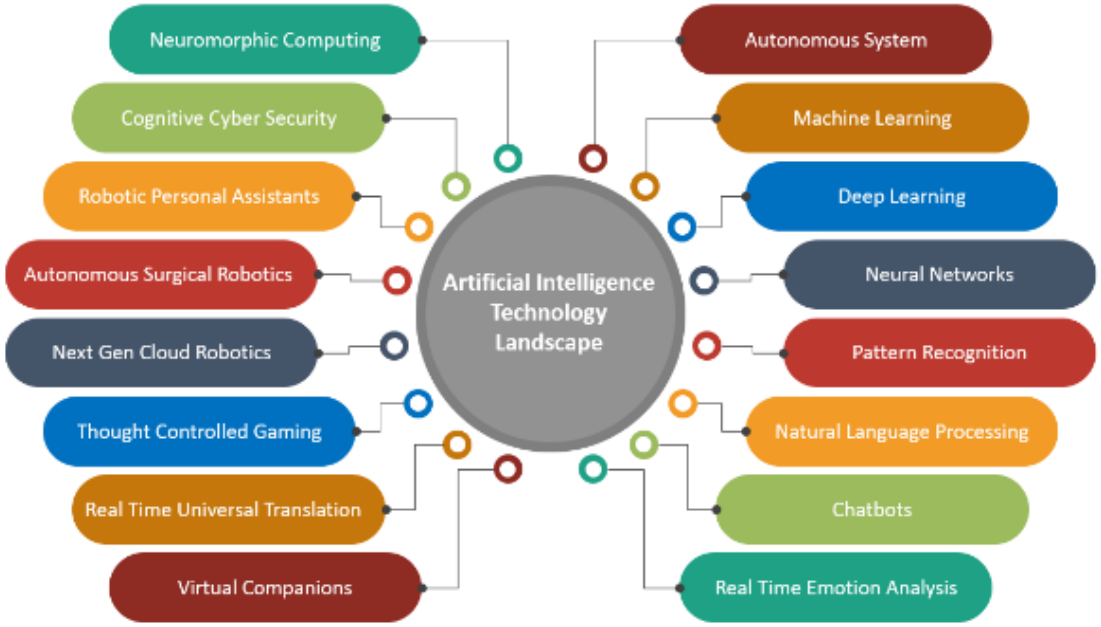
Typically, AI systems demonstrate at least some of the following behaviors associated with human intelligence:

- Planning
- Learning
- Reasoning
- Problem solving
- Knowledge representation
- Perception, motion, and manipulation and, to a lesser extent, social intelligence and creativity



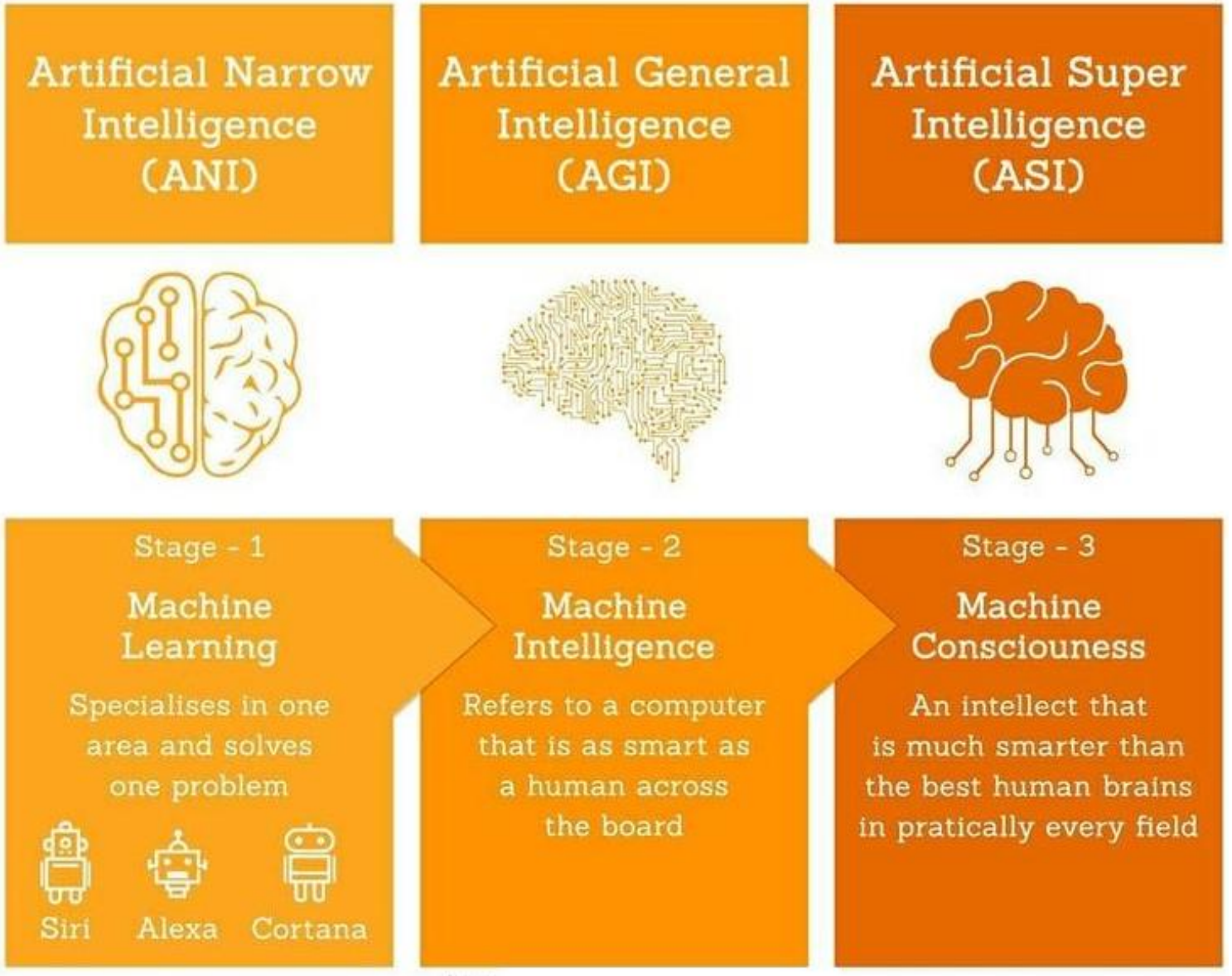
Artificial Intelligence: Definition

AI is an interdisciplinary science with multiple approaches but advancements in machine learning and deep learning are creating a paradigm shift in virtually every sector of the tech industry.



Categories of AI

- Artificial Narrow Intelligence or ***Weak/Narrow AI***
- Artificial General Intelligence or ***Strong AI***
- Artificial Super Intelligence or ***Super Intelligent AI***



Categories of AI

- Weak (narrow) AI embodies a system designed to carry out one particular job.
  - This type of AI is designed to perform a narrow task (e.g., facial recognition, internet searches). Most current AI systems, including those that can play complex games like chess and Go, video games, industrial robots and personal assistants such as Amazon's Alexa and Apple's Siri fall under this category.
  - They operate under a limited pre-defined range or set of contexts
- Strong AI systems are systems that carry on the tasks considered to be human-like; *they replicate the cognitive abilities of the human brain*.
  - These systems tend to be more complex as they are programmed to handle situations in which they may be required to solve problems autonomously (without human intervention).
- Superintelligent systems represent a future form of AI where machines could surpass human intelligence across all fields, including creativity, general wisdom, and problem-solving. Superintelligence is speculative and not yet realized.

What is easy and what is hard for AI?

It has been easier to mechanize many of the high level cognitive tasks we usually associate with “intelligence” in people

- e. g., symbolic integration, proving theorems, playing chess, some aspect of diagnosis, etc.

It has been very hard to mechanize tasks that animals can do easily

- catching prey
- interpreting complex sensory information (visual, aural..)
- modeling the internal states of other animals from their behavior
- working as a team (ants, bees)

AI – The Ultimate Goal

The ultimate goal of AI is to create systems that:

- Act like humans (Turing test)
- Think like humans (human-like patterns of thinking steps)
- Act and think rationally (logically, correctly)

Artificial
vs
Natural Intelligence

Artificial Intelligence:

AI is more permanent. Natural intelligence is perishable from a commercial standpoint in that human can change their information. AI is permanent as long as the computer systems or programs remain unchanged.

AI offers ease of duplication and distribution. Transferring a body of knowledge from one person to another usually requires a lengthy process, yet fully expertise can never be transfer. However, knowledge embodied in computer systems can be copied or duplicated to another and so on.

AI can be less expensive that natural intelligence. Some times buying computer software costs less than having corresponding human power to carry out same task.

AI can be documented. Decisions made by a computer can be easily documented by tracing the activities of a system, while natural intelligence is difficult to trace out.

Natural Intelligence:

Natural Intelligence is creative, while AI is uninspired. The ability to acquire knowledge is inherent in human nature, but with AI customized knowledge must be built into a carefully constructed system.

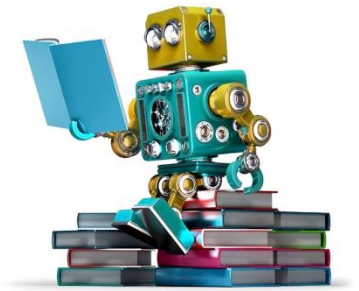
Natural intelligence enables people to benefit from and use sensory experience directly, while AI mostly works on symbolic inputs.

Natural intelligence is able to make reasons at all times by wide context of experience and bring it to bear on individual problems. While AI systems typically gain their power of knowledge by having a narrow focus of problem domain.

Natural Intelligence is powerful but has limitations. Humans are intellectual but have limited knowledge bases, and information processing is comparably slow in comparison to computers.

How AI Works:

1. **Think well**
2. **Act well**
3. **Think like human**
4. **Act like humans**



Think well

Develop:

- Formal models of knowledge representation
- Reasoning
- Learning
- Memory
- Problem solving that can be rendered in algorithms.

There is often an emphasis on systems that are provably correct, and guarantee finding an optimal solution.

Act well

- *For a given set of inputs, generate an appropriate output that is not necessarily correct but gets the job done.*

- A **heuristic** (**heuristic rule**, **heuristic method**) is a rule of thumb, strategy, trick, simplification, or any other kind of device which drastically limits search for solutions in large problem spaces.

- Heuristics do not guarantee optimal solutions; in fact, they do not guarantee any solution at all: all that can be said for a useful heuristic is that it offers solutions which are good enough most of the time.

Think like humans

- Cognitive science approach
- Focus not just on behavior and I/O but also look at reasoning process.
- Computational model should reflect “how” results were obtained.
- Provide a new language for expressing cognitive theories and new mechanisms for evaluating them

Think like humans

GPS (General Problem Solver): Goal not just to produce humanlike behavior, but to produce a sequence of steps of the reasoning process that was similar to the steps followed by a person in solving the same task.

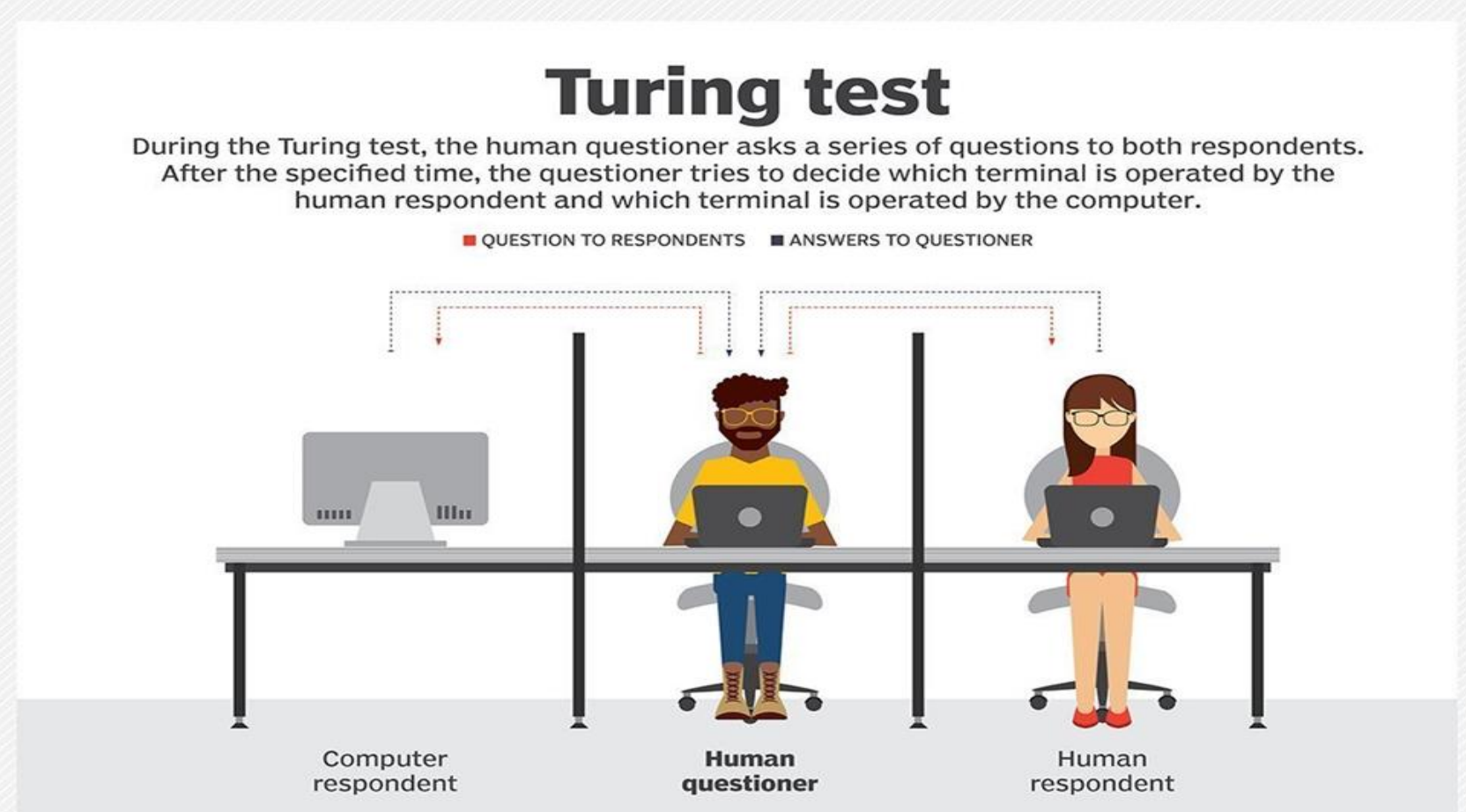
ELIZA:
A program that simulated a psychotherapist interacting with a patient and passed the Turing Test.

Act like humans

- Behaviorist approach.
- Not interested in how you get results, just the similarity to what human results are.
- Exemplified by the Turing Test (Alan Turing, 1950).

Turing Test

Three rooms contain a person, a computer, and an interrogator



Some Example Applications

Computer vision: face recognition from a large set (Interpreting Images)

Robotics: autonomous (mostly) automobile

Natural language processing: simple machine translation

Expert systems: medical diagnosis in a narrow domain

Spoken language systems: ~1000 word continuous speech

Planning and scheduling: Hubble Telescope experiments

Learning: text categorization into ~1000 topics

Games: Grand Master level in chess (world champion), checkers, etc.