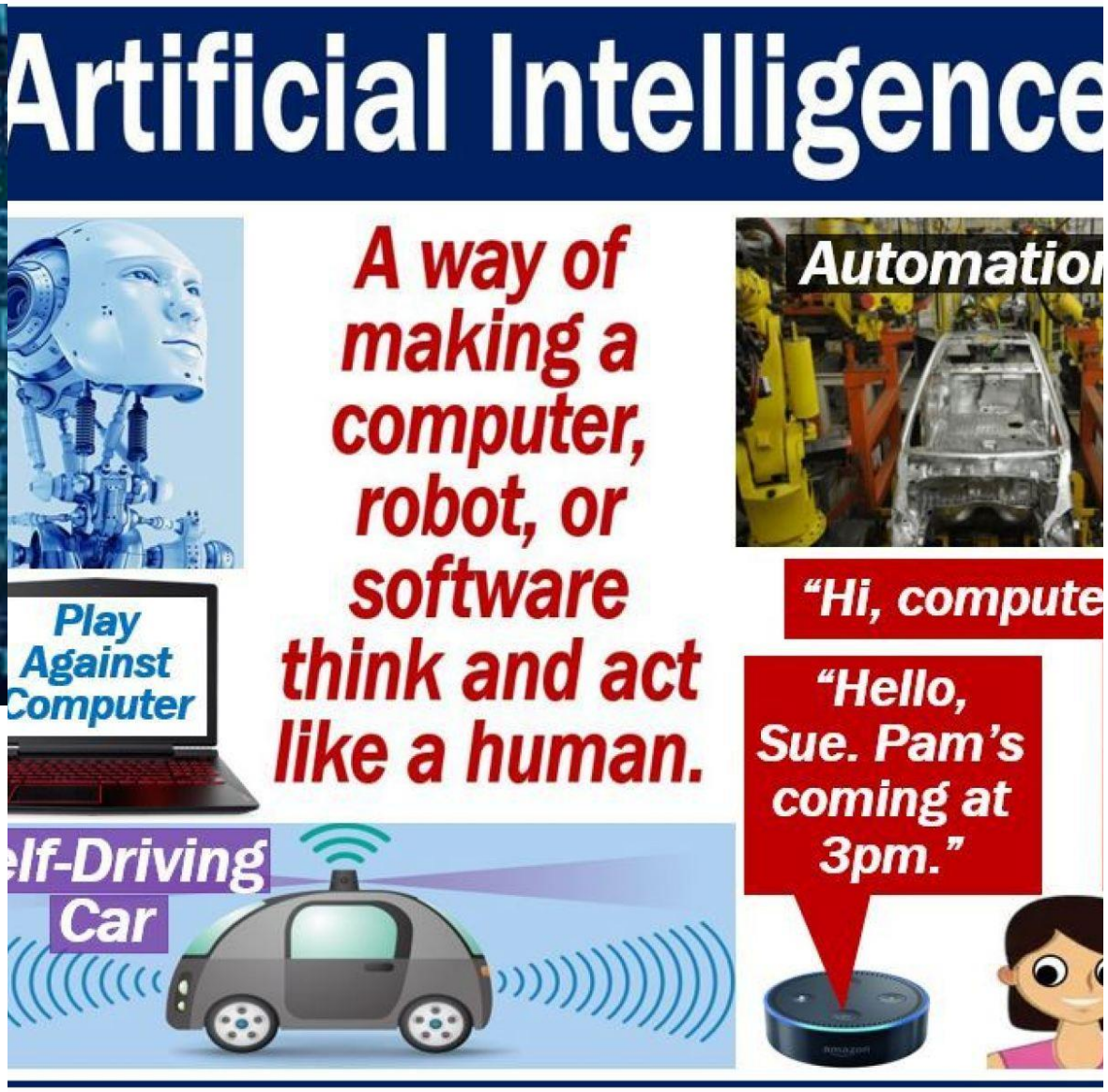


"Artificial" + "Intelligence"

"Simulation of human **intelligence** processes by machines, especially computer systems"

COURSE OUTCOME

CO1

Design AI solution with appropriate choice of agent architecture

CO2

Analyze and solve problems for goal based agent architecture (searching and planning algorithms).

CO3

Represent and formulate the knowledge to solve the problems using various reasoning techniques

CO4

Analyze applications of AI and understand planning & learning processes in advanced AI applications

Recommended Books

1. Stuart J. Russell and Peter Norvig, "Artificial Intelligence A Modern Approach “Third Edition" Pearson Education.

2. Elaine Rich and Kevin Knight "Artificial Intelligence "Third Edition

3. George F Luger “Artificial Intelligence” Low Price Edition , Pearson Education., Fourth edition

4. Davis E.Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.

5**. Ivan Bratko "PROLOG Programming for Artificial Intelligence", Pearson Education, Third Edition.**

MODULE 1

Reference - Chapter 1

1	**Introduction to Artificial Intelligence**		**03**	**CO1**
	1.1	History of Artificial Intelligence, The AI problem*, The AI technique*, Foundations of AI		
		Categorization of Intelligent System, Components of AI Program,		
		Sub-areas of AI, Applications of AI, Current trends in AI.		

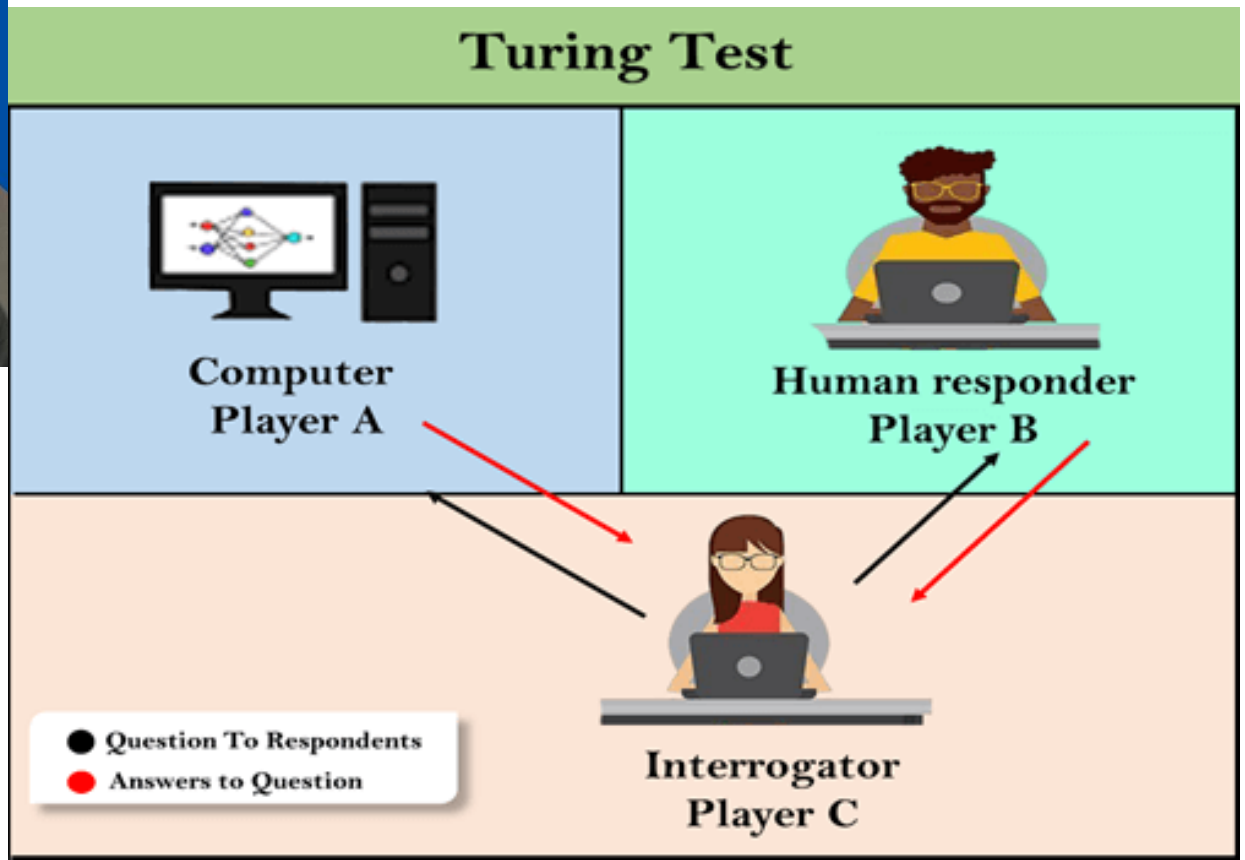
- Artificial intelligence (AI) is the **simulation** of **human intelligence** processes - by machines, especially **computer systems**
  - These processes include
    - **LEARNING** (the acquisition of information and rules for using the information),
    - **REASONING** (using rules to reach approximate or definite conclusions) and self-correction
- Particular applications of AI include
  - Expert Systems, Speech Recognition And Machine Vision

Thinking Humanly	**Thinking Rationally**
"The exciting new effort to make computers think . . . *machines with minds*, in the full and literal sense." (Haugeland, 1985)	"The study of mental faculties through the use of computational models." (Charniak and McDermott, 1985)
"[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning . . ." (Bellman, 1978)	"The study of the computations that make it possible to perceive, reason, and act." (Winston, 1992)
Acting Humanly	**Acting Rationally**
"The art of creating machines that perform functions that require intelligence when performed by people." (Kurzweil, 1990)	"Computational Intelligence is the study of the design of intelligent agents." (Poole *et al.*, 1998)
"The study of how to make computers do things at which, at the moment, people are better." (Rich and Knight, 1991)	"AI . . . is concerned with intelligent behavior in artifacts." (Nilsson, 1998)

Figure 1.1 Some definitions of artificial intelligence, organized into four categories.

Acting humanly: The Turing Test approach

- The Turing Test, proposed by Alan Turing (1950), was designed to provide a satisfactory TURING TEST operational definition of intelligence.



Thinking humanly: The cognitive modeling approach

- If we are going to say that a given program thinks like a human, we must have some way of determining **how humans think.**
- We need to get inside the actual workings of human minds.
  - There are three ways to do this:
    - through **introspection**-trying to catch our own thoughts as they go by;
    - through **psychological experiments**—observing a person in action;
    - through **brain imaging**—observing the brain in action

Thinking rationally: The "laws of thought" approach

"Logicist tradition within artificial intelligence hopes to build on programs to create intelligent systems"

- First, it is not easy to take informal knowledge and state it in the formal terms required by logical notation
  - particularly when the knowledge is less than 100% certain.
- Second, there is a big difference between solving a problem "in principle" and solving it in practice.

Acting rationally: The rational agent approach

- A rational agent is one that **acts** so as to achieve the best outcome or, when there is **uncertainty**, the best expected outcome.
  - All the skills needed for the Turing Test also allow an agent to act rationally

Computer Would Need To Possess the following Capabilities:

1. **NATURAL LANGUAGE PROCESSING** to enable it to communicate successfully in English
2. **KNOWLEDGE REPRESENTATION** to store what it knows or hears
3. **AUTOMATED REASONING** to use the stored information to answer questions and to draw new conclusions
4. **MACHINE LEARNING** to adapt to new circumstances and to detect and extrapolate patterns.
5. **COMPUTER VISION** to perceive objects
6. **ROBOTICS** to manipulate objects and move about

Applications of AI*

- AI has been dominant in various fields such as −
- **Gaming** − AI plays crucial role in strategic games such as chess, poker, tic-tac-toe, etc., where machine can think of large number of possible positions based on heuristic knowledge.
- **Natural Language Processing** − It is possible to interact with the computer that understands natural language spoken by humans.
- **Expert Systems** − There are some applications which integrate machine, software, and special information to impart reasoning and advising. They provide explanation and advice to the users.
- **Vision Systems** − These systems understand, interpret, and comprehend visual input on the computer. For example,
  - A spying aeroplane takes photographs, which are used to figure out spatial information or map of the areas.
  - Doctors use clinical expert system to diagnose the patient.
  - Police use computer software that can recognize the face of criminal with the stored portrait made by forensic artist.
- **Speech Recognition** − Some intelligent systems are capable of hearing and comprehending the language in terms of sentences and their meanings while a human talks to it. It can handle different accents, slang words, noise in the background, change in human's noise due to cold, etc.
- **Handwriting Recognition** − The handwriting recognition software reads the text written on paper by a pen or on screen by a stylus. It can recognize the shapes of the letters and convert it into editable text.
- **Intelligent Robots** − Robots are able to perform the tasks given by a human. They have sensors to detect physical data from the real world such as light, heat, temperature, movement, sound, bump, and pressure. They have efficient processors, multiple sensors and huge memory, to exhibit intelligence. In addition, they are capable of learning from their mistakes and they can adapt to the new environment.

INTELLIGENT SYSTEMS

- The ability of a system to :-
  - calculate,
  - reason,
  - perceive relationships and analogies,
  - learn from experience,
  - store and retrieve information from memory,
  - solve problems,
  - comprehend complex ideas,
  - use natural language fluently,
  - classify, generalize, and adapt new situations.

COMPONENTS OF INTELLIGENT SYSTEMS

Comprehend,Speak, Write..

Judge , Predict

Awareness,studying ,practising

Sensing,Organizing, interpreting

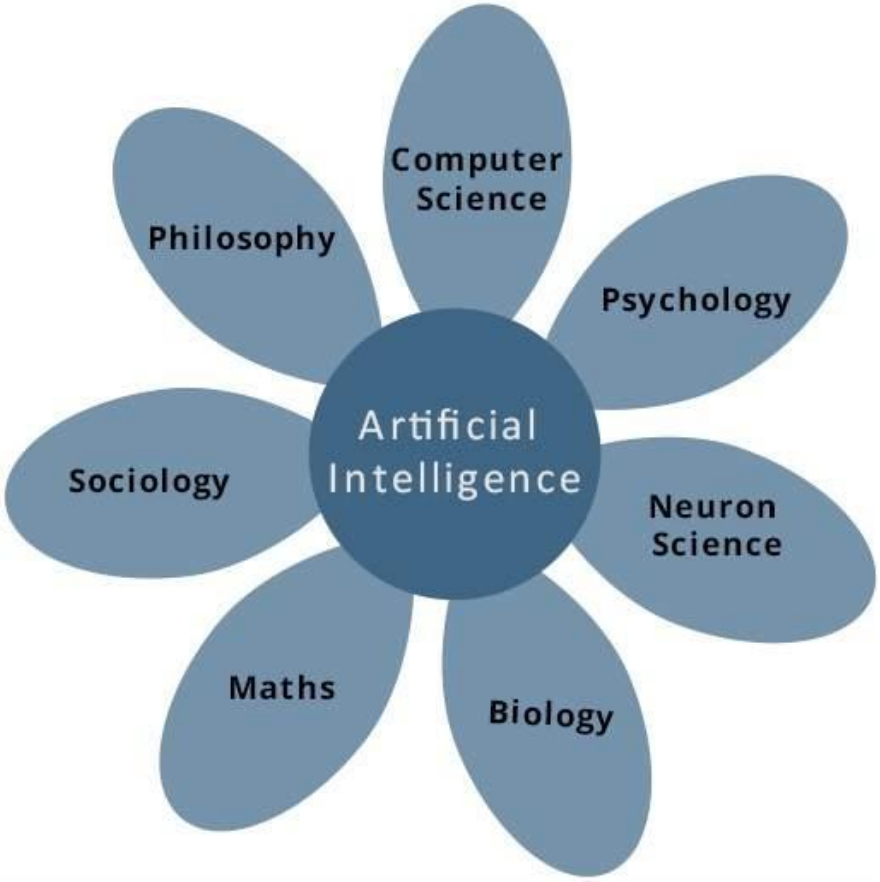
Decision Making

Difference between Human and Machine Intelligence

- Humans perceive by **patterns** whereas the machines perceive by set of rules and data.
- Humans **store and recall information by patterns**, machines do it by searching algorithms.
  - For example, the number 40404040 is easy to remember, store, and recall as its pattern is simple.
- Humans can figure out the complete object even if some part of it is missing or distorted; whereas the machines cannot do it correctly.

FOUNDATION OF AI

- Philosophy
- Mathematics
- Economics
- Neuroscience
- Psychology
- **COMPUTER ENGINEERING**
- Linguistics



- **Philosophers** (going back to 400 B.C.) made AI conceivable by considering the ideas that the **mind** is in some ways **like a machine**, that it operates on knowledge encoded in some internal language, and that thought can be used to choose what actions to take.
- **Mathematicians** provided the **tools** to manipulate statements of logical certainty as well as uncertain, probabilistic statements.
  - They also set the groundwork for understanding computation and reasoning about algorithms.
- **Economists** formalized the problem of making decisions that **maximize** the expected **outcome** to the decision maker.
- **Neuroscientists** discovered some facts about **how the brain works** and the ways in which it is similar to and different from computers.

- **Psychologists** adopted the idea that **humans and animals** can be considered information- processing machines.
- **Linguists** showed that **language** use fits into this model.
- **Computer engineers** provided the ever-more-powerful machines that make AI applications possible.
- **Control theory** deals with designing devices that act **optimally** on the basis of **feedback from the environment.**
  - Initially, the mathematical tools of control theory were quite different from AI, but the fields are coming closer together.

Turing Test

“HUMAN BEINGS ARE INTELLIGENT”

- To be called intelligent, a machine must produce **responses that are indistinguishable from those of a human**

Alan Turing

Does AI have applications?

- Autonomous planning and scheduling of tasks aboard a **spacecraft**
- Beating Gary Kasparov in a **chess** match
- Steering a **driver-less** car
- Understanding **language**
- Robotic assistants in **surgery**
- Monitoring trade in the stock **market** to see if insider trading is going on

COMPONENTS OF AI

There are three types of components in AI

1) Hardware Components of AI

2) Software Components

3) Architectural Components

HARDWARE COMPONENTS OF AI

a) Pattern Matching

b) Logic Representation

c) Symbolic Processing

d) Numeric Processing

e) Problem Solving

f) Heuristic Search

g) Natural Language processing

h) Knowledge Representation

i) Expert System

j) Neural Network

k) Learning

l) Planning

SOFTWARE COMPONENTS

a) Machine Language

b) Assembly language

c) High level Language

d) LISP Language

e) Fourth generation Language

f) Object Oriented Language

g) Distributed Language

h) Natural Language

i) Particular Problem Solving Language

ARCHITECTURAL COMPONENTS

a) Uniprocessor

b) Multiprocessor

c) Special Purpose Processor

d) Array Processor

e) Vector Processor

f) Parallel Processor

g) Distributed Processor

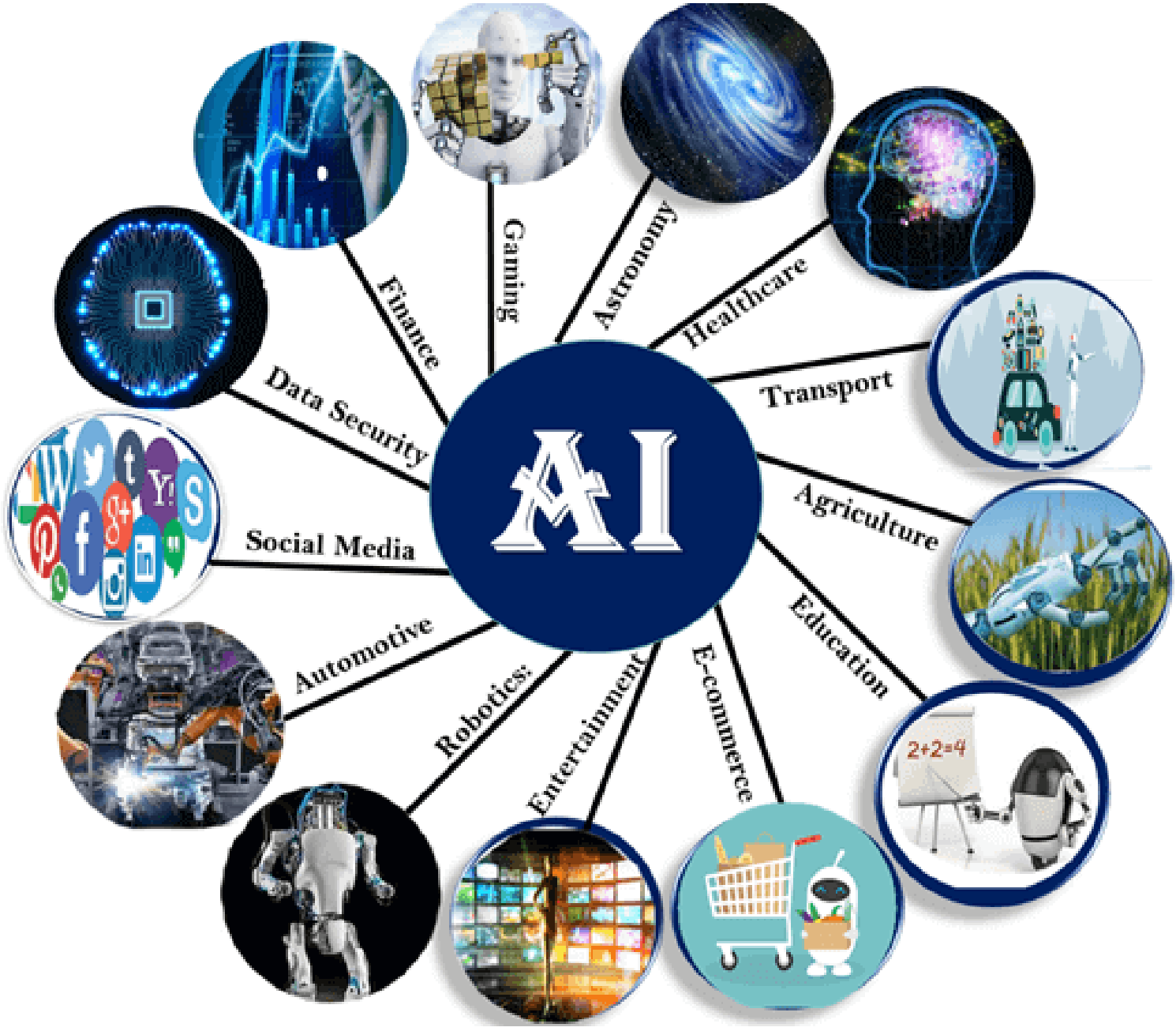
Artificial intelligence can be considered under a number of headings:

- Search (includes Game Playing).
- Representing Knowledge and Reasoning with it.
- Planning.
- Learning.
- Natural language processing.
- Expert Systems.
- Interacting with the Environment

  (e.g. Vision, Speech recognition, Robotics)

History of Artificial Intelligence(Pg No 16-28)

- The gestation of artificial intelligence (1943–1955)
- The birth of artificial intelligence (1956)
- Early enthusiasm, great expectations (1952–1969)
- A dose of reality (1966–1973)
- **Knowledge-based systems**: The key to power(1969–1979)
- AI becomes an industry (1980–present)
- The return of neural networks (1986–present)
- AI adopts the scientific method (1987–present)
- The emergence of intelligent agents (1995–present)
- The availability of very large data sets (2001–present)


AI
Finance
Gaming
Astronomy
Healthcare
Transport
Agriculture
Education
E-commerce
Entertainment
Robotics
Automotive
Social Media
Data Security
2+2=4


reasoning
probability
intelligent
knowledge
AI
general intelligence
futuristic
ethic
brain
artificial
fiction
cyberspace
mind
tech
artificial intelligence
communication
AI research
behavior
cybernetics
bionic
machine
cyborg
cybernetic
intelligent machine
humanity
model
intelligence
planning
study
digital
system
scifi
computer software
information
perception
general
computer
psychology
learning
logic
future
science
binary
intelligent behavior
intelligent agent
artificial being
idea
cyber
data
virtual
software
thinking
agent
design
robotic
informatics
code
android
person
technology
robot
artificial psychology
binary code
reality

AI Problems (Rich & Knight)

Mundane Tasks

- Perception
  - Vision
  - Speech
- Natural language
  - Understanding
  - Generation
  - Translation
- Commonsense reasoning
- Robot control

Formal Tasks

- Games
  - Chess
  - Backgammon
  - Checkers -Go
- Mathematics
  - Geometry
  - Logic
  - Integral calculus
  - Proving properties of programs

Expert Tasks

- Engineering
  - Design
  - Fault finding
  - Manufacturing planning
- Scientific analysis
- Medical diagnosis
- Financial analysis

1.1 *Some of the Task Domains of Artificial Intelligence*

AI Techniques

- Technique is a method that exploits knowledge that should be represented in a way that:
  1. Knowledge captures generalizations.
  2. Understood by people who must provide it
  3. Can be easily modified to correct errors and reflect changes.
  4. Can be used in almost all situations
  5. Able to narrow down the possibilities on it s own knowledge

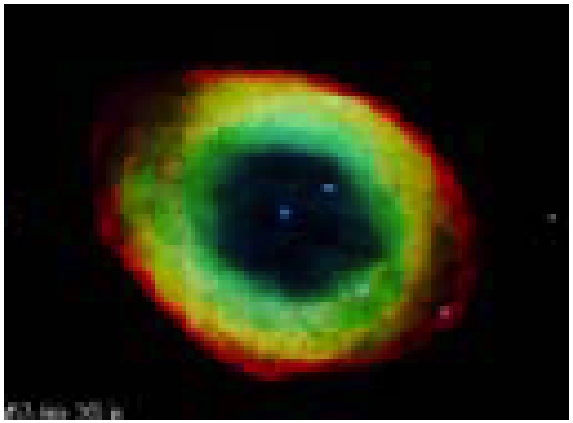
AI Techniques

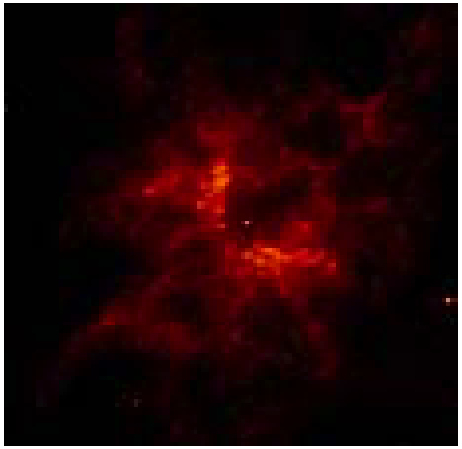
- The knowledge captures generalizations. In other words, it is not necessary to represent separately each individual situation. Instead, situations that share important properties are grouped together. If knowledge does not have this property, inordinate amounts of memory and updating will be required. So we usually call something without this property "data" rather than knowledge.
- It can be understood by people who must provide it. Although for many programs, the bulk of the data can be acquired automatically (for example, by taking readings from a variety of instruments), in many AI domains, most of the knowledge a program has must ultimately be provided by people in terms they understand.

- It can easily be modified to correct errors and to reflect changes in the world and in our world view.
- It can be used in a great many situations even if it is not totally accurate or complete.
- It can be used to help overcome its own sheer bulk by helping to narrow the range of possibilities that must usually be considered.

AI Applications

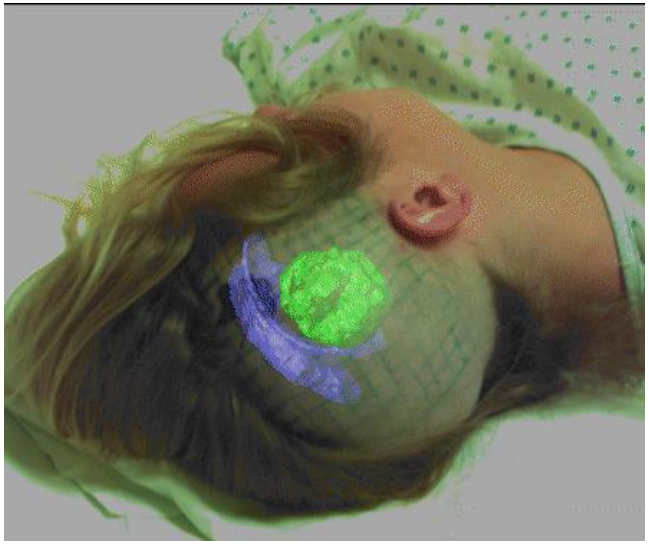
- Autonomous Planning & Scheduling:
  - Analysis of data:

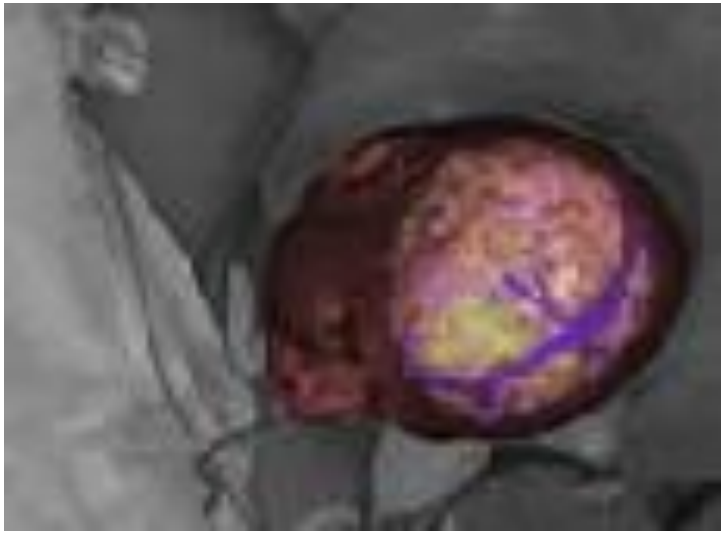




AI Applications

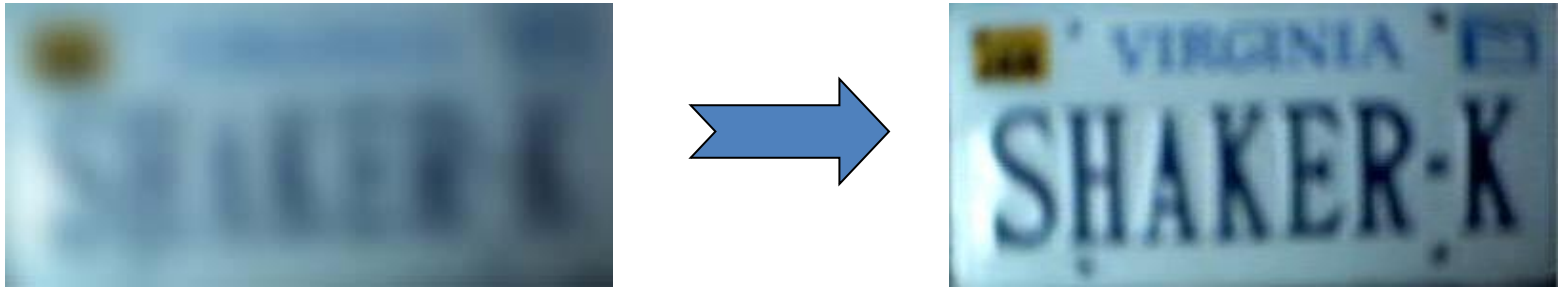
- **Medicine**:
  - Image guided surgery

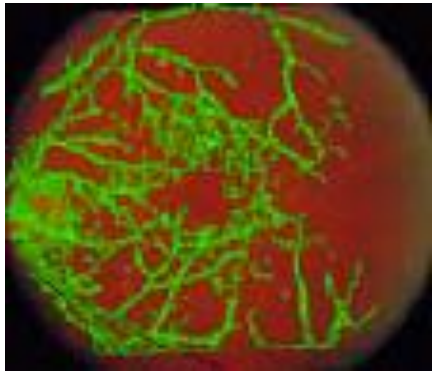


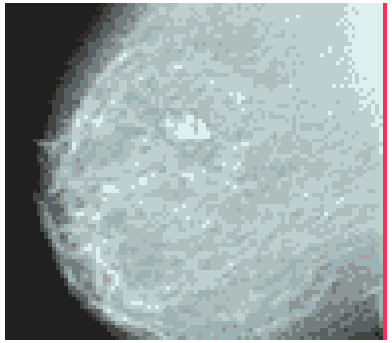


AI Applications

- **Medicine**:
  - Image analysis and enhancement







AI Applications

- **Transportation**:
  - **Autonomous vehicle control:**

AI Applications

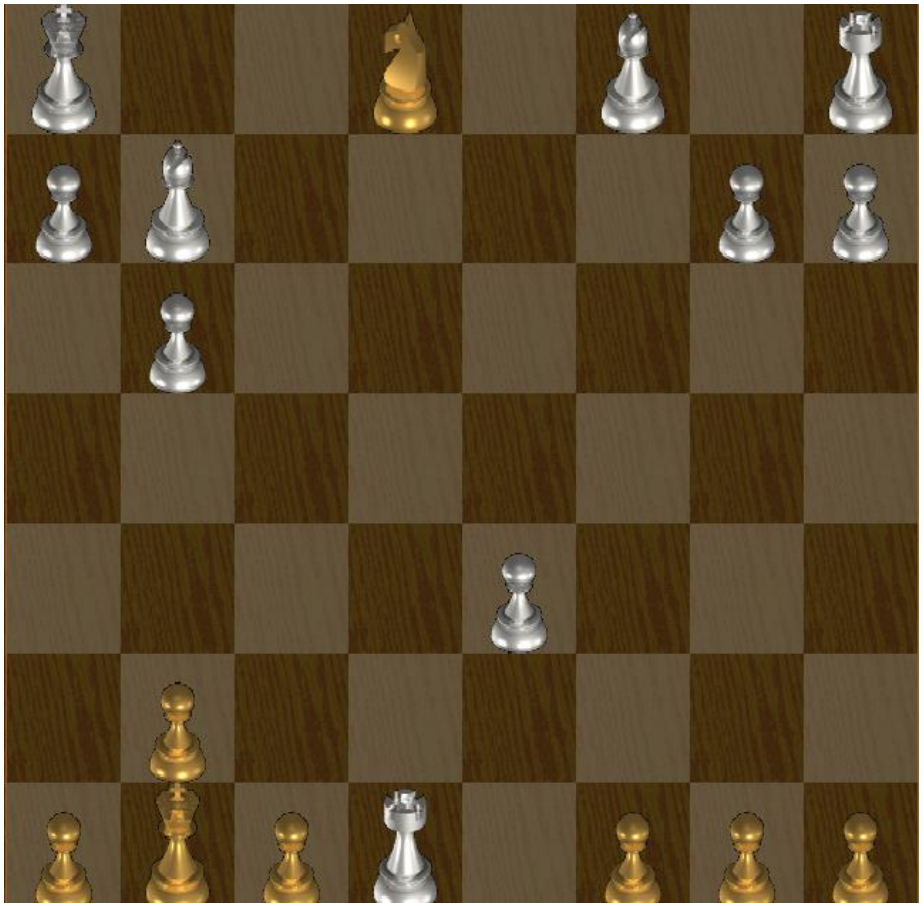
- **Transportation**:
  - **Pedestrian detection:**

AI Applications

Games:

AI Applications

- **Games**:



AI Applications

- **Robotic toys**:

AI Applications

Other application areas:

- **Bioinformatics:**
  - Gene expression data analysis
  - Prediction of protein structure
- **Text classification, document sortin**g:
  - Web pages, e-mails
  - Articles in the news
- **Video, image classification**
- **Music composition, picture drawing**
- **Natural Language Processing** .
- **Perception.**

AI in daily life

Commuting (Google Maps)

Email (Spam)

Plagiarism (Turnitin)

Social Networking (FB (?),Snapchat, Instagram

Online Shopping-Recommendations

Things AI cannot do (Yet)

- Conversational interfaces—ask Siri something off script, and it breaks down
- Automated scientific discovery
- Automated medical diagnosis
- Automated scene comprehension for blind people
- Cannot write software
- Safe and reliable driverless cars
- Computers cant Think/Understand/
- Creative writing
- AI cannot exercise free will