



SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35

Accredited by NBA-AICTE and Accredited by NAAC – UGC with A+ Grade
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai



19EET401 / AI TECHNIQUES IN ELECTRICAL ENGINEERING

IV YEAR / VII SEMESTER

UNIT-I: INTRODUCTION TO ARTIFICIAL INTELLIGENCE

AI ?



TOPIC OUTLINE



Areas of AI

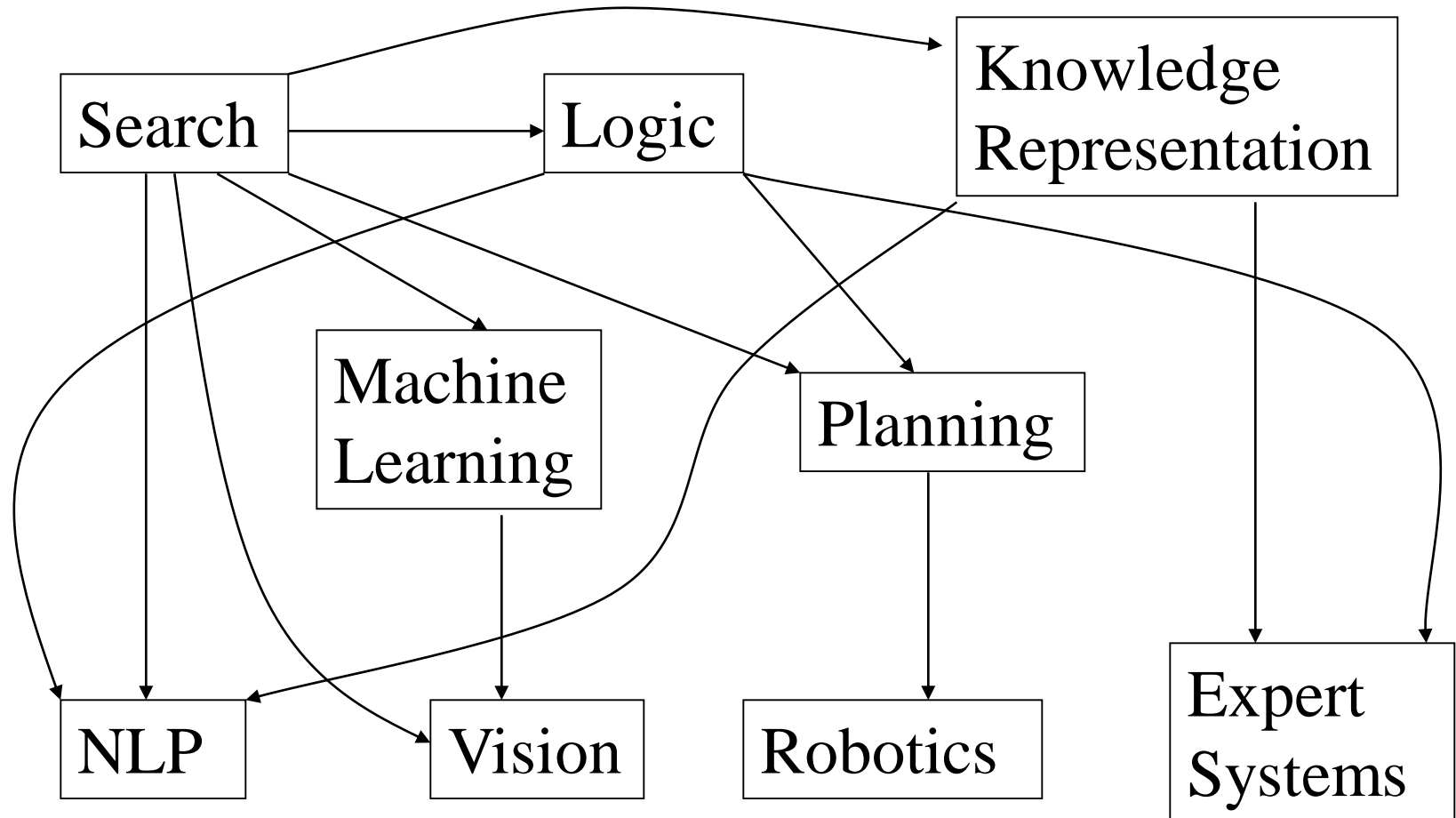
What is AI?

Thought / Behaviour

Human / Rational



Areas of AI and Some Dependencies



What is Artificial Intelligence ?

- making computers that think?
- the automation of activities we associate with human thinking, like decision making, learning ... ?
- the art of creating machines that perform functions that require intelligence when performed by people ?
- the study of mental faculties through the use of computational models ?

What is Artificial Intelligence ?

- the study of computations that make it possible to perceive, reason and act ?
- a field of study that seeks to explain and emulate intelligent behaviour in terms of computational processes ?
- a branch of computer science that is concerned with the automation of intelligent behaviour ?
- anything in Computing Science that we don't yet know how to do properly ? (!)

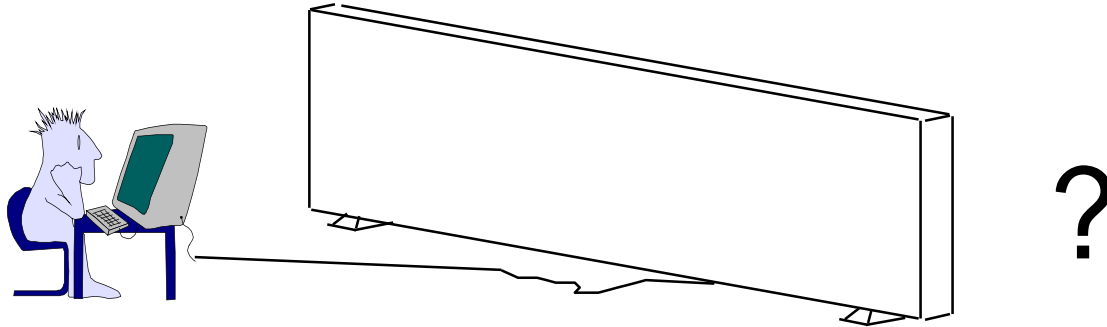
What is Artificial Intelligence ?

THOUGHT	Systems that think like humans	Systems that think rationally
BEHAVIOUR	Systems that act like humans	Systems that act rationally
	HUMAN	RATIONAL

Systems that act like humans: Turing Test

- “The art of creating machines that perform functions that require intelligence when performed by people.” (Kurzweil)
- “The study of how to make computers do things at which, at the moment, people are better.” (Rich and Knight)

Systems that act like humans



- You enter a room which has a computer terminal. You have a fixed period of time to type what you want into the terminal, and study the replies. At the other end of the line is either a human being or a computer system.
- If it is a computer system, and at the end of the period you cannot reliably determine whether it is a system or a human, then the system is deemed to be intelligent.

Systems that act like humans

- The Turing Test approach
 - a human questioner cannot tell if
 - there is a computer or a human answering his question, via teletype (remote communication)
 - The computer must behave intelligently
- Intelligent behavior
 - to achieve human-level performance in all cognitive tasks

Systems that act like humans

- These cognitive tasks include:
 - *Natural language processing*
 - for communication with human
 - *Knowledge representation*
 - to store information effectively & efficiently
 - *Automated reasoning*
 - to retrieve & answer questions using the stored information
 - *Machine learning*
 - to adapt to new circumstances

The total Turing Test

- Includes two more issues:
 - *Computer vision*
 - to perceive objects (seeing)
 - *Robotics*
 - to move objects (acting)

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Systems that think like humans: cognitive modeling

- Humans as observed from ‘inside’
- How do we know how humans think?
 - Introspection vs. psychological experiments
- Cognitive Science
- “The exciting new effort to make computers think ... machines with *minds* in the full and literal sense” (Haugeland)
- “[The automation of] activities that we associate with human thinking, activities such as decision-making, problem solving, learning ...” (Bellman)

What is Artificial Intelligence ?

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Systems that think ‘rationally’ "laws of thought"

- Humans are not always ‘rational’
- Rational - defined in terms of logic?
- Logic can’t express everything (e.g. uncertainty)
- Logical approach is often not feasible in terms of computation time (needs ‘guidance’)
- “The study of mental facilities through the use of computational models” (Charniak and McDermott)
- “The study of the computations that make it possible to perceive, reason, and act” (Winston)

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Systems that act rationally: “Rational agent”

- **Rational** behavior: doing the right thing
- **The right thing**: that which is expected to maximize goal achievement, given the available information
- Giving answers to questions is ‘acting’.
- I don't care whether a system:
 - replicates human thought processes
 - makes the same decisions as humans
 - uses purely logical reasoning

Systems that act rationally

- Logic → only *part* of a rational agent, not *all* of rationality
 - Sometimes logic cannot reason a correct conclusion
 - At that time, some *specific (in domain) human knowledge* or information is used
- Thus, it covers more generally different situations of problems
 - Compensate the incorrectly reasoned conclusion

Systems that act rationally

- Study AI as rational agent –

2 advantages:

- It is more general than using logic only
 - Because: LOGIC + Domain knowledge
- It allows extension of the approach with more scientific methodologies



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UNIT-I: INTRODUCTION TO ARTIFICIAL INTELLIGENCE

2. DEFINITIONS AND IMPORTANCE OF AI



TOPIC OUTLINE



Definition of AI
Role, Goals of AI?
Foundation
Topics



Definitions:

Rational agents

- An **agent** is an entity that perceives and acts
- This course is about designing rational agents
- Abstractly, an agent is a function from percept histories to actions:

$$[f: P^* \rightarrow A]$$

- For any given class of environments and tasks, we seek the agent (or class of agents) with the best performance
- Caveat: computational limitations make perfect rationality unachievable
 - → design best program for given machine resources

- **Artificial**
 - Produced by human art or effort, rather than originating naturally.
- **Intelligence**
- is the ability to acquire knowledge and use it“
[Pigford and Baur]
- **So AI was defined as:**
 - **AI** is the study of ideas that enable computers to be intelligent.
 - **AI** is the part of computer science concerned with design of computer systems that exhibit human intelligence(From the Concise Oxford Dictionary)

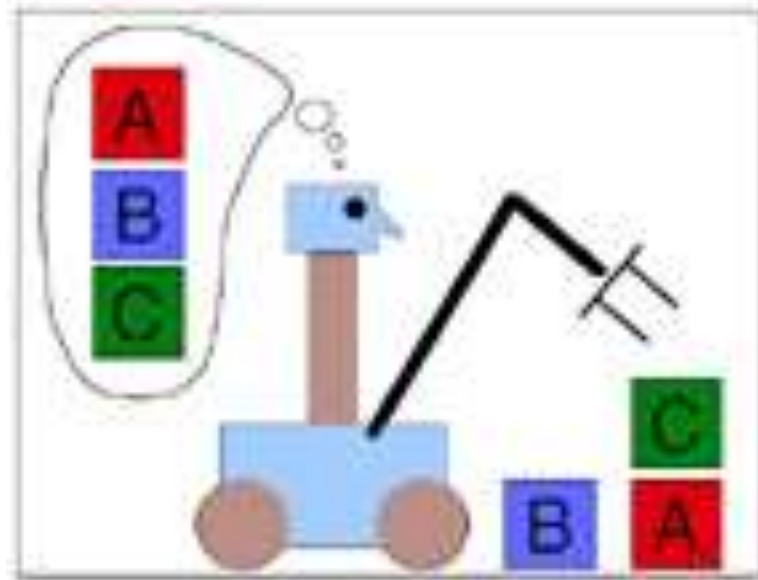
AI Roles:

From the above two definitions, we can see that AI has two major roles:

- Study the intelligent part concerned with humans.
- Represent those actions using computers.

Goals of AI

- To make computers more useful by letting them take over dangerous or tedious tasks from human
- Understand principles of human intelligence



The Foundation of AI

- ***Philosophy***

- At that time, the study of human intelligence began with no formal expression
- Initiate the idea of mind as a machine and its internal operations

The Foundation of AI

- Mathematics formalizes the three main area of AI: *computation*, *logic*, and *probability*
 - Computation leads to analysis of the problems that can be computed
 - *complexity theory*
 - Probability contributes the “*degree of belief*” to handle *uncertainty* in AI
 - *Decision theory* combines *probability theory* and *utility theory* (bias)

The Foundation of AI

- Psychology
 - How do humans think and act?
 - The study of human reasoning and acting
 - Provides reasoning models for AI
 - Strengthen the ideas
 - humans and other animals can be considered as information processing machines

The Foundation of AI

- Computer Engineering
 - How to build an efficient computer?
 - Provides the artifact that makes AI application possible
 - The power of computer makes computation of large and difficult problems more easily
 - AI has also contributed its own work to computer science, including: time-sharing, the linked list data type, OOP, etc.

The Foundation of AI

- **Control theory and Cybernetics**
 - How can artifacts operate under their own control?
 - The artifacts adjust their actions
 - To do better for the environment over time
 - Based on an objective function and feedback from the environment
 - Not limited only to linear systems but also other problems
 - as language, vision, and planning, etc.

The Foundation of AI

- Linguistics
 - For understanding natural languages
 - different approaches has been adopted from the linguistic work
 - Formal languages
 - Syntactic and semantic analysis
 - Knowledge representation

The main topics in AI

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)

We won't have time in this course to consider all of these.



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3. ADVANTAGE, DISADVANTAGE, KNOWLEDGE



TOPIC OUTLINE



Advantage and Disadvantage
Knowledge
Interacting with Environment
History



Some Advantages of Artificial Intelligence

- more powerful and more useful computers
- new and improved interfaces
- solving new problems
- better handling of information
- relieves information overload
- conversion of information into knowledge

The Disadvantages

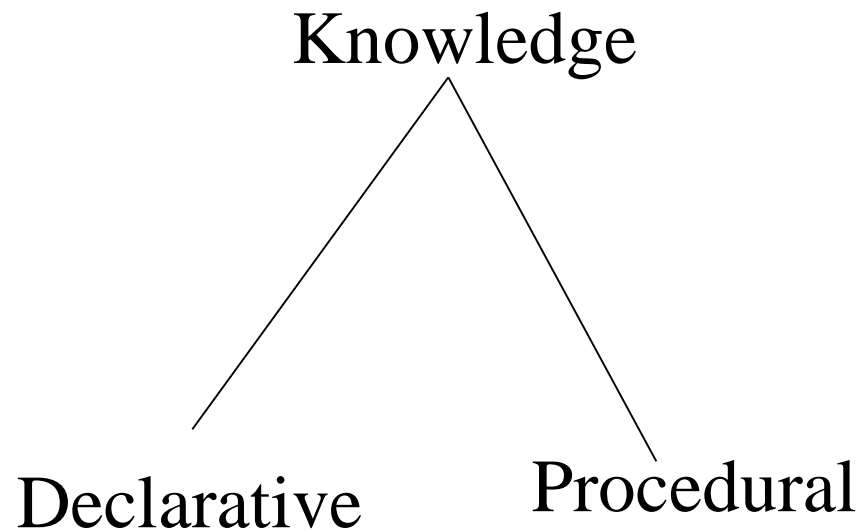
- increased costs
- difficulty with software development - slow and expensive
- few experienced programmers
- few practical products have reached the market as yet.

Search

- *Search* is the fundamental technique of AI.
 - Possible answers, decisions or courses of action are structured into an abstract space, which we then search.
- Search is either "blind" or "uninformed":
 - blind
 - we move through the space without worrying about what is coming next, but recognising the answer if we see it
 - informed
 - we guess what is ahead, and use that information to decide where to look next.
- We may want to search for the first answer that satisfies our goal, or we may want to keep searching until we find the best answer.

Knowledge Representation & Reasoning

- The second most important concept in AI
- If we are going to act rationally in our environment, then we must have some way of describing that environment and drawing inferences from that representation.
 - how do we describe what we know about the world ?
 - how do we describe it *concisely* ?
 - how do we describe it so that we can get hold of the right piece of knowledge when we need it ?
 - how do we generate new pieces of knowledge ?
 - how do we deal with *uncertain* knowledge ?



- Declarative knowledge deals with factoid questions (what is the capital of India? Etc.)
- Procedural knowledge deals with “How”
- Procedural knowledge can be embedded in declarative knowledge

Planning

Given a set of goals, construct a sequence of actions that achieves those goals:

- often very large search space
- but most parts of the world are independent of most other parts
- often start with goals and connect them to actions
- no necessary connection between order of planning and order of execution
- what happens if the world changes as we execute the plan and/or our actions don't produce the expected results?

Learning

- If a system is going to act truly appropriately, then it must be able to change its actions in the light of experience:
 - how do we generate new facts from old ?
 - how do we generate new concepts ?
 - how do we learn to distinguish different situations in new environments ?

Interacting with the Environment

- In order to enable intelligent behaviour, we will have to interact with our environment.
- Properly intelligent systems may be expected to:
 - accept sensory input
 - vision, sound, ...
 - interact with humans
 - understand language, recognise speech, generate text, speech and graphics, ...
 - modify the environment
 - robotics

History of AI

- AI has a long history
 - Ancient Greece
 - Aristotle
 - Historical Figures Contributed
 - Ramon Lull
 - Al Khowarazmi
 - Leonardo da Vinci
 - David Hume
 - George Boole
 - Charles Babbage
 - John von Neuman
 - As old as electronic computers themselves (c1940)

History of AI

- Origins
 - The Dartmouth conference: 1956
 - John McCarthy (Stanford)
 - Marvin Minsky (MIT)
 - Herbert Simon (CMU)
 - Allen Newell (CMU)
 - Arthur Samuel (IBM)
- The Turing Test (1950)
- “Machines who Think”
 - By Pamela McCorckindale



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4.NEUMANN ARCHITECTURE, PERIODS AND APPLICATIONS



TOPIC OUTLINE



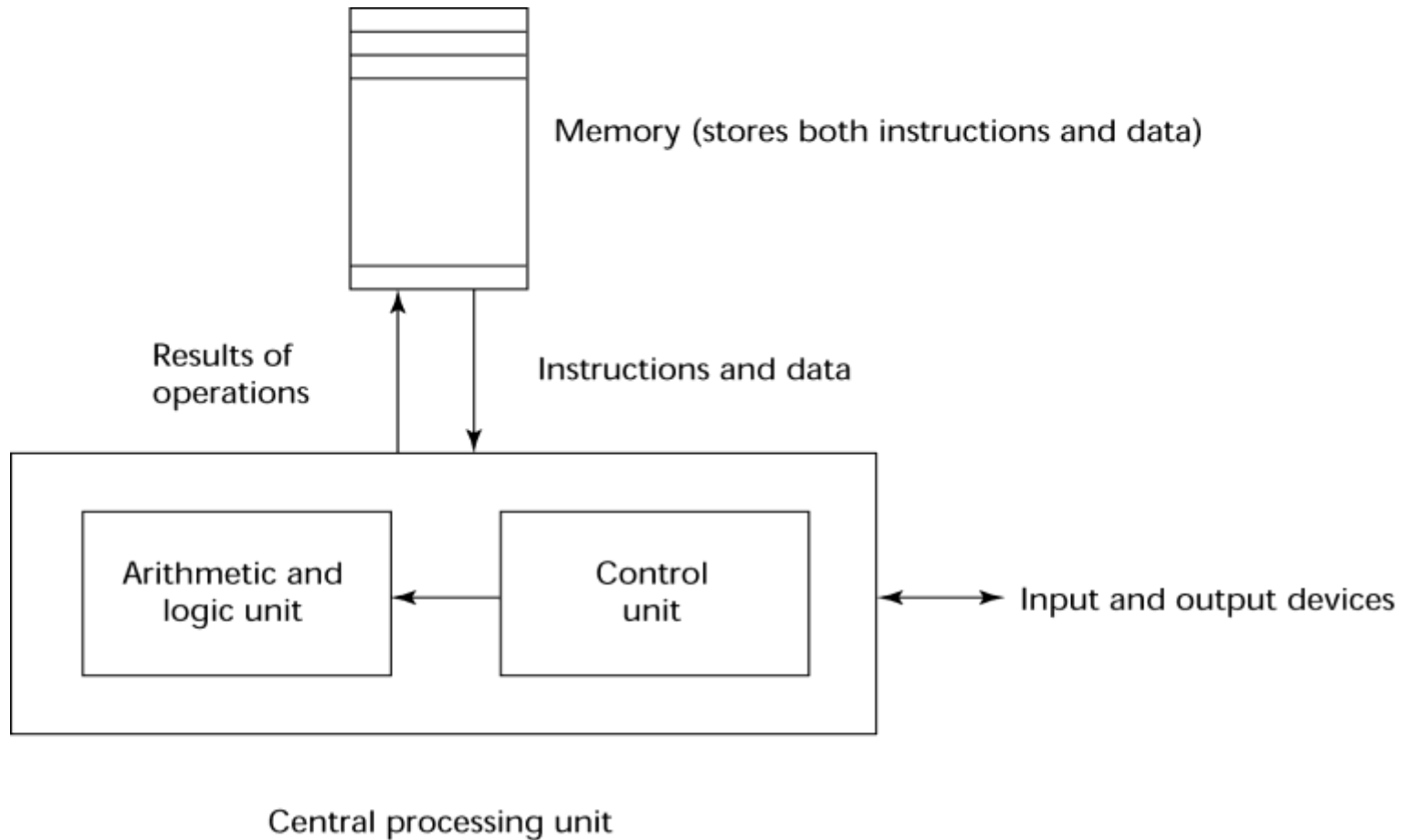
Van Neumann Architecture

Periods

Application



The 'Von Neuman' Architecture



Periods in AI

- Early period - 1950's & 60's
 - Game playing
 - brute force (calculate your way out)
 - Theorem proving
 - symbol manipulation
 - Biological models
 - neural nets
- Symbolic application period - 70's
 - Early expert systems, use of knowledge
- Commercial period - 80's
 - boom in knowledge/ rule bases

Periods in AI cont'd

- ? period - 90's and New Millenium
- Real-world applications, modelling, better evidence, use of theory,?
- Topics: data mining, formal models, GA's, fuzzy logic, agents, neural nets, autonomous systems
- Applications
 - visual recognition of traffic
 - medical diagnosis
 - directory enquiries
 - power plant control
 - automatic cars

Fashions in AI

Progress goes in stages, following funding booms and crises: Some examples:

1. Machine translation of languages

1950's to 1966 - Syntactic translators

1966 - all US funding cancelled

1980 - commercial translators available

2. Neural Networks

1943 - first AI work by McCulloch & Pitts

1950's & 60's - Minsky's book on "Perceptrons" stops nearly all work on nets

1986 - rediscovery of solutions leads to massive growth in neural nets research

The UK had its own funding freeze in 1973 when the Lighthill report reduced AI work severely -

Lesson: Don't claim too much for your discipline!!!!

Look for similar stop/go effects in fields like genetic algorithms and evolutionary computing. This is a very active modern area dating back to the work of Friedberg in 1958.

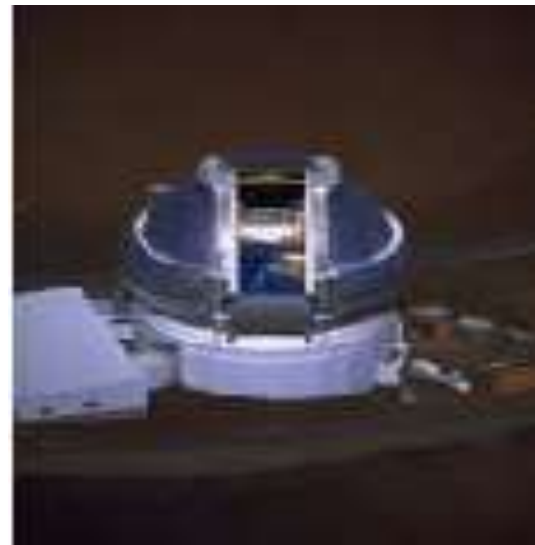
AI Applications

- Autonomous Planning & Scheduling:
 - Autonomous rovers.



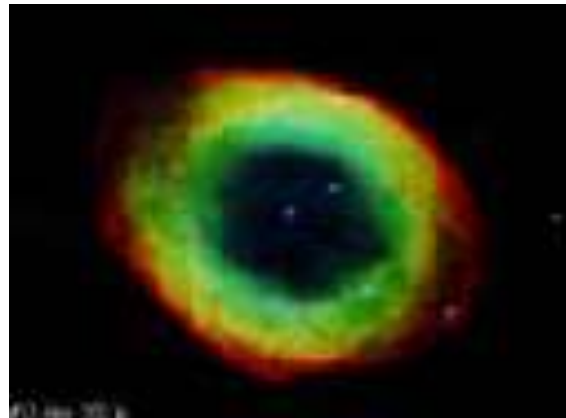
AI Applications

- Autonomous Planning & Scheduling:
 - Telescope scheduling



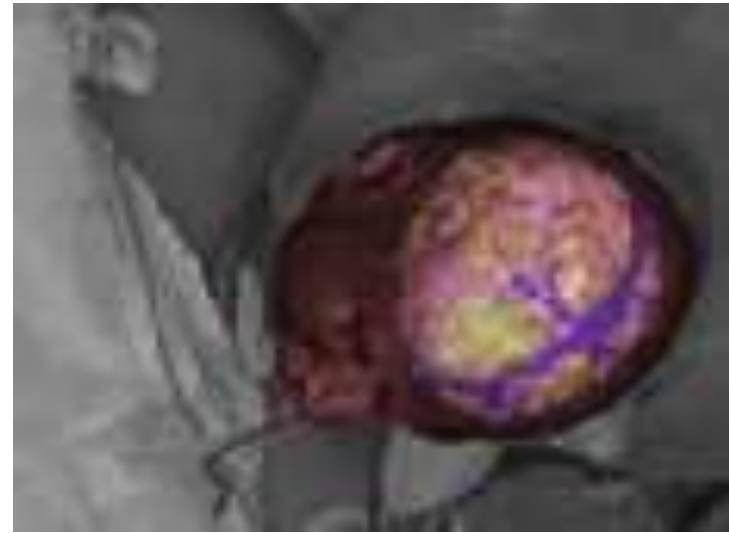
AI Applications

- Autonomous Planning & Scheduling:
 - Analysis of data:



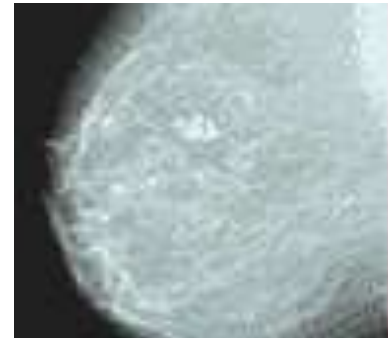
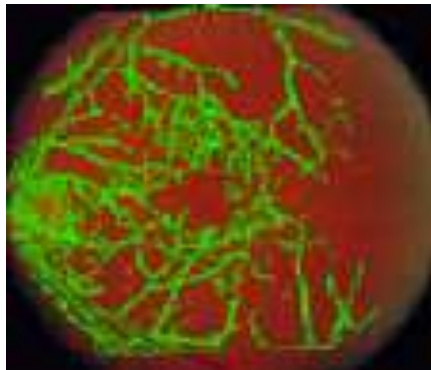
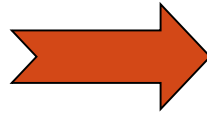
AI Applications

- **Medicine:**
 - Image guided surgery



AI Applications

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



AI Applications

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



AI Applications

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



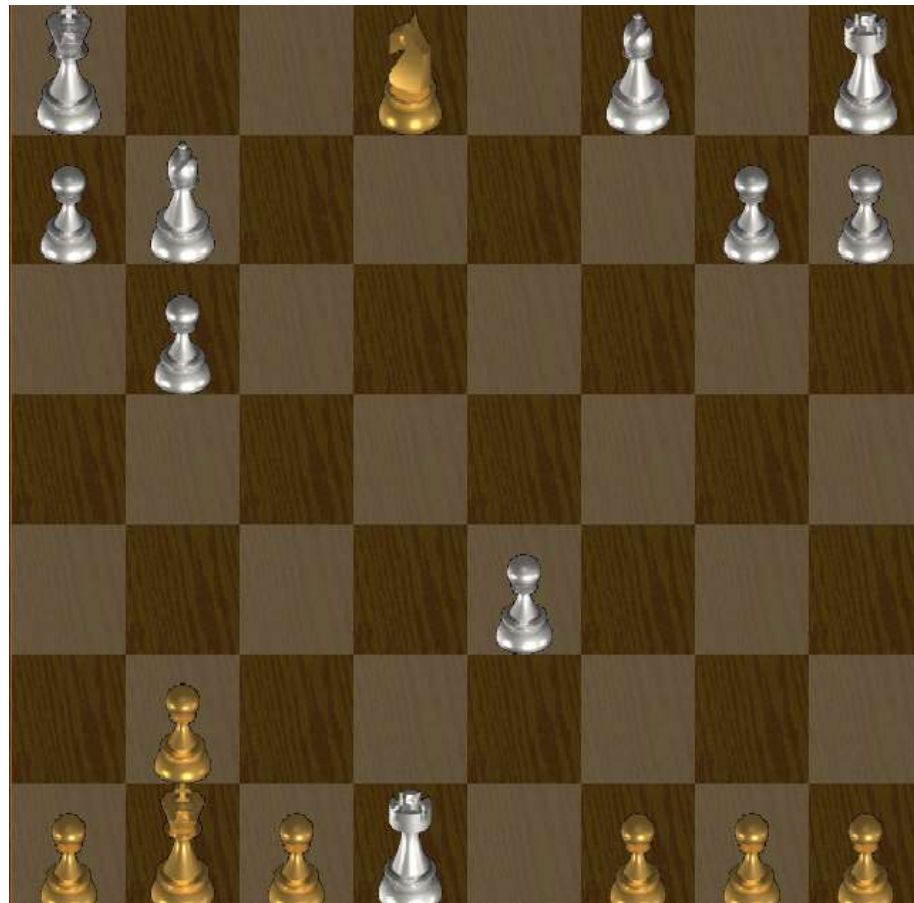
AI Applications

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 sorting:**
 - Web pages, e-mails
 - Articles in the news
- **Video, image classification**
- **Music composition, picture drawing**
- **Natural Language Processing .**
- **Perception.**