SNS COLLEGE OF TECHNOLOGY

Coimbatore-35
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DEPARTMENT OF INFORMATION TECHNOLOGY

19CSE303 - ARTIFICIAL INTELLIGENCE
III YEAR IV SEM

UNIT I – PROBLEM SOLVING

TOPIC – AI problems, Problem Characteristics

Contents:

1. From Eden to ENIAC: Attitudes toward intelligence, Knowledge, and Human Artifice
2. Overview of AI Application Areas
3. Artificial Intelligence – A Summary

An Attempted Definition

- AI – *the branch of computer science that is concerned with the automation of intelligent behavior*
  - *Sound theoretical and applied principles*
  - *Data structures for knowledge representation*
  - *Algorithms of applying knowledge*
  - *Languages for algorithm implementation*

- Problem
  - What is Intelligence?

- This course discusses
  - *The collection of problems and methodologies studied by AI researchers*

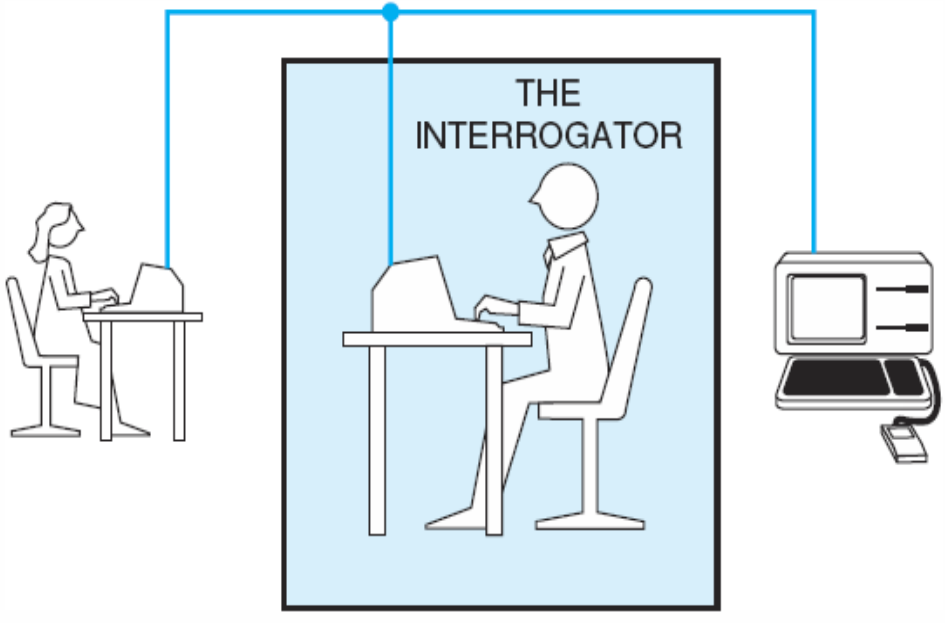
Brief Early History of AI

- Aristotle – 2000 years ago
  - The nature of world
  - Logics
  - Modus ponens and reasoning system
- Bacon – 1620s
  - Search
  - Induction
- Calculating machines
  - Ancient Chinese abacus (4000 years ago)
  - John Napier – multiplication and exponents (1614)
  - Pascal – Pascaline (1642, 1670)
  - Leibniz – Lebniz Wheel (1694)
- Descrates (1680)
  - Thought and mind
  - Separate mind from physical world
  - Mental process

Modern History

- Formal logic
  - Leibniz
  - Boole
  - Godel
  - Turing
  - Frege – first-order predicate calculus
- Graph theory
  - Euler
- State space search

The Turing Test



The interrogator

•cannot see and speak to either

• does not know which is actually machine

•May communicate with them solely by textual device

If the interrogator cannot distinguish the machine from the human, then the machine may be assumed to be intelligent.

Models of Intelligence

- Logic Models
  - Formal logic
  - Probability logic
  - Fuzzy logic
  - Non-monotonic logic
- Biological Models
  - Connectionist model
  - Genetic algorithms
  - Evolution
- Social Models
  - Network models
  - Behaviors
- Agents -- Combination

Agents Theories

- Intelligence is reflected by a collective behaviors of large numbers of very simple interacting, semi-autonomous individuals – agents
- Various agents
  - Rote agents
  - Coordination agents
  - Search agents
  - Learning agents
  - Decision agents
- Agents design
  - Structure for information representation
  - Search strategies
  - Architecture for supporting the interaction of agents

AI Research and Application Areas

- Game Playing
- Automated Reasoning and Theorem Proving
- Expert Systems
- Natural Language Understanding and Semantic Modelling
- Modelling Human Performance
- Planning and Robotics
- Languages and Environments for AI
- Machine Learning
- Alternative Representations: Neural Nets and Genetic Algorithms
- AI and Philosophy

Important Features of Artificial Intelligence

1. The use of computers to do reasoning, pattern recognition, learning, or some other form of inference.
2. A focus on problems that do not respond to algorithmic solutions. This underlies the reliance on heuristic search as an AI problem-solving technique.
3. A concern with problem-solving using inexact, missing, or poorly defined information and the use of representational formalisms that enable the programmer to compensate for these problems.
4. Reasoning about the significant qualitative features of a

Important Features of Artificial Intelligence (Cont.)

5. An attempt to deal with issues of semantic meaning as well as syntactic form.
6. Answers that are neither exact nor optimal, but are in some sense “sufficient”. This is a result of the essential reliance on heuristic problem-solving methods in situations where optimal or exact results are either too expensive or not possible.
7. The use of large amounts of domain-specific knowledge in solving problems. This is the basis of expert systems.
8. The use of meta-level knowledge to effect more sophisticated control of problem-solving strategies. Although this is a very difficult problem, addressed in relatively few current systems,

Part II:

Artificial Intelligence as Representation and Search

A proposal for the Dartmouth summer research project on Artificial Intelligence (url IIa).

We propose that a 2 month, 10 man [sic] study of artificial intelligence be carried out during the summer of 1956 at Dartmouth College in Hanover, New Hampshire. The study is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described that a machine can be made to simulate it. An attempt will be made to find how to make machines use language, form abstractions and concepts, solve kinds of problems now reserved for humans, and improve themselves. We think that a significant advance can be made in one or more of these problems if a carefully selected group of scientists work on it together for a summer.

J. McCARTHY, *Dartmouth College*
M.L. MINSKY, *Harvard University*
N. ROCHESTER, *I.B.M Corporation*
C.E.SHANNON, *Bell Telephone Laboratories*

Main topics for discussion at the AI conference, Dartmouth College 1956 (url IIa).

1. Automatic Computers
2. How Can a Computer be Programmed to Use a Language
3. Neuron Nets
4. Theory of the Size of a Calculation
5. Self-Improvement (Machine Learning)
6. Abstractions

Representation Systems

- What is it?
  - *Capture the essential features of a problem domain and make that information accessible to a problem-solving procedure*
- Measures
  - Abstraction – how to manage complexity
  - Expressiveness – what can be represented
  - Efficiency – how is it used to solve problems
- Trade-off between efficiency and expressiveness

Representation of π

Different representations of the real number π.

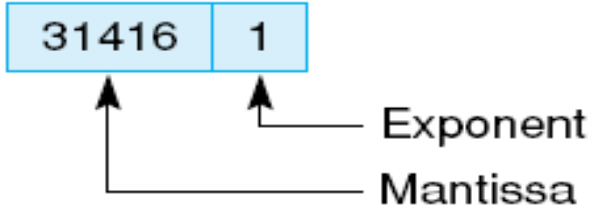
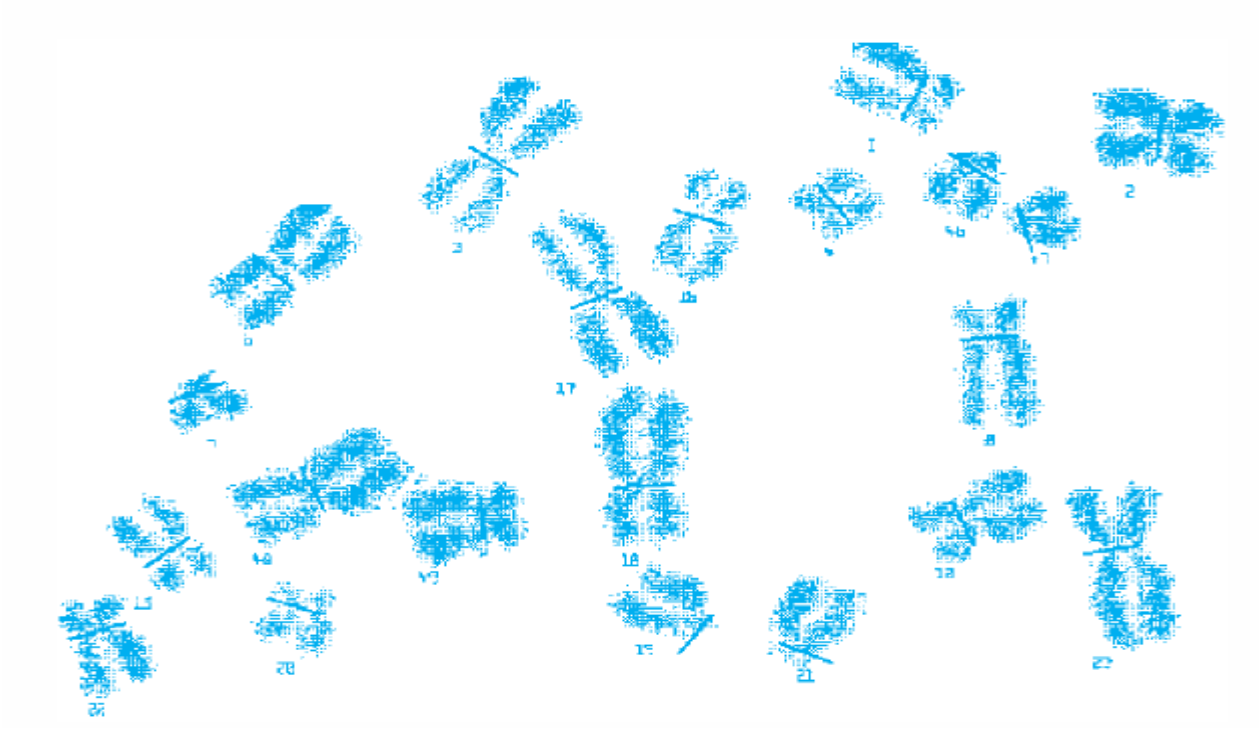
The real number:	π
The decimal equivalent:	3.1415927 . . .
The floating point representation:	
The representation in computer memory:	11100010

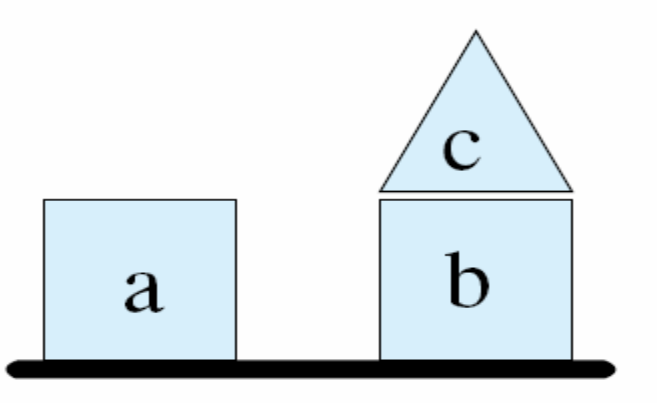
Image Representation

- Array representation – 2D
- Image representation -- Digitized image of chromosomes in metaphase.



Block World Representation

A blocks world



Logical Clauses describing some important properties and relationships

clear(c)
clear(a)
ontable(a)
ontable(b)
on(c, b)
cube(b)
cube(a)
pyramid(c)

General rule

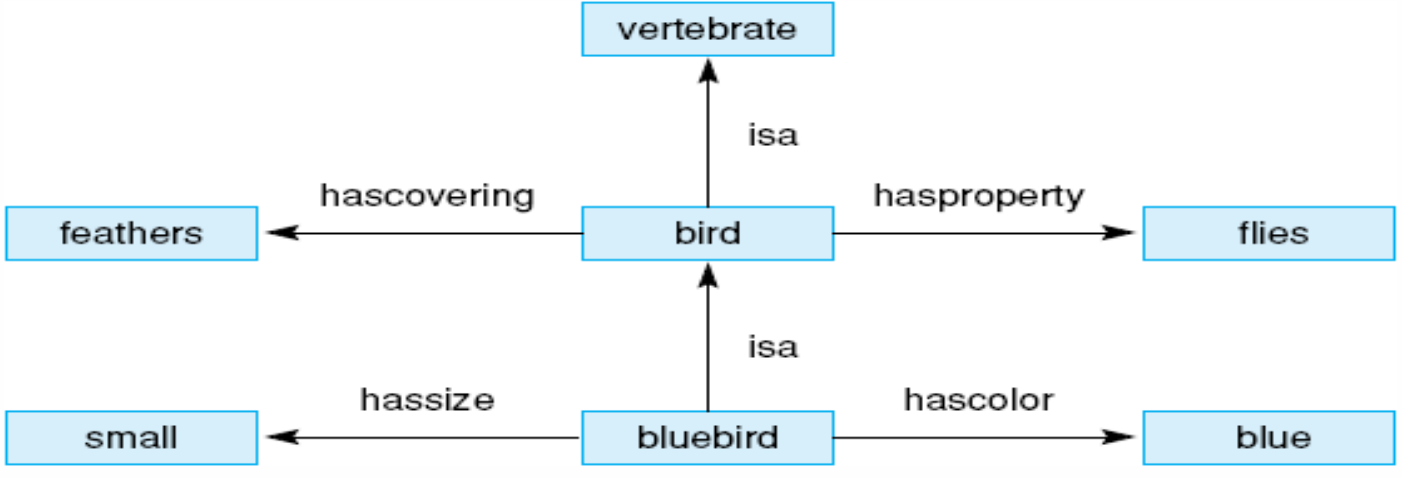
$$\forall X \neg \exists Y \; on(Y,X) \Rightarrow clear(X)$$

Bluebird Representations

Logical predicates representing a simple description of a bluebird.

```
hassize(bluebird,small)
hascovering(bird,feathers)
hascolor(bluebird,blue)
hasproperty(bird,flies)
isa(bluebird,bird)
isa(bird,vertebrate)
```

Semantic network description of a bluebird

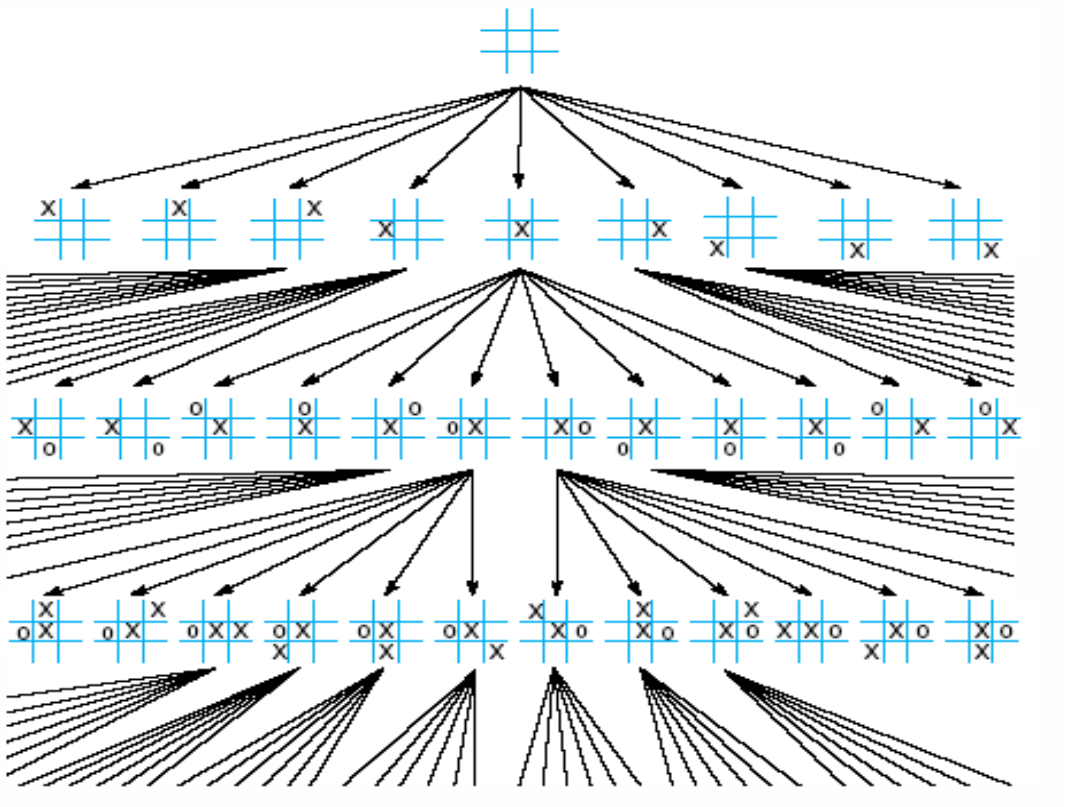


State Space Search

- State space
  - State – any current representation of a problem
  - State space
    - All possible state of the problem
    - Start states – the initial state of the problem
    - Target states – the final states of the problem that has been solved
  - State space graph
    - Nodes – possible states
    - Links – actions that change the problem from one state to another
- State space search
  - Find a path from an initial state to a target state in the state space
  - Various search strategies
    - Exhaustive search – guarantee that the path will be found if it exists
      - Depth-first
      - Breath-first
    - Best-first search
      - heuristics

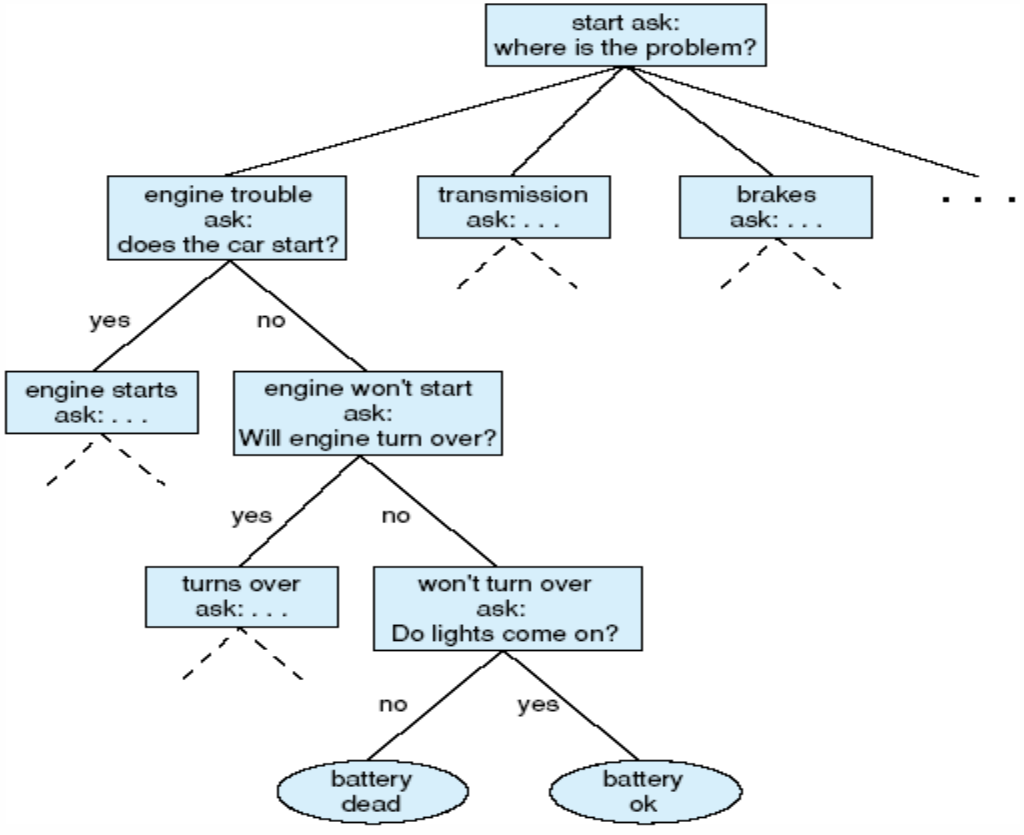
Tic-tac-toe State Space

Portion of the state space for tic-tac-toe.



Auto Diagnosis State Space

State space description of the automotive diagnosis problem.



THANK YOU