Conversion Masters in IT (MIT)
AI as Representation and Search

('De'/Motivation and Course Outline)

Lecture 001

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Books (you'll need during this course)

- My notes are based on the book 'Artificial Intelligence – Structures and Strategies for Complex Problem Solving' by George Luger (4th Edt)

- …but there are other very good books on AI, namely:
  - Nils Nilsson. Artificial Intelligence, A New Synthesis
  - Russell, Norvig. Artificial Intelligence, A Modern Approach
  - + various others …

Let's start off with a definition of AI

- *Artificial Intelligence (AI) may be defined as the branch of computer science that is concerned with the automation of intelligent behaviour.*

- *Note the terms :*
  - *Branch of computer science. This means that it is based on sound theoretical principles*
  - *Data structures (knowledge representation) →*
  - *Algorithms (apply/use the knowledge) →*
  - *Languages (programming used in implementations)*

But what exactly defines 'intelligent behaviour'

- Do we recognise intelligent behaviour when we see it? (chess player eg.)
- Is intelligence a single faculty? Is it a collection of distinct abilities? Is intelligence learned? Is it innate? What happens when we learn? What is creativity then? What is intuition?
- Most important → *Can intelligence be inferred from observable behaviour, or does it require evidence of a particular internal mechanism?*
- *Is it possible to achieve intelligence on a computer?*

Too difficult to define 'intelligence' so …

- … we will simply define artificial intelligence (AI) as *the collection of problems and methodologies studied by artificial intelligence researchers*.

- And this is what we'll be looking at throughout this course.
  - Problems and methodologies studied in order to solve these problems.

A note on the complexity of problems

- How intelligent are you?
  - Who's the more intelligent of you all ?
  - How can we define a distance function between to compare your intelligence?
  - Eg. Let's play a game of Sudoku !!
    - Who finished first is the most intelligent
  - But what is the complexity of the Sudoku problem?

Various degrees of complexities

- Sorting algorithms : Does fastest to sort mean most intelligent program?
- … or most intelligent programmer?
- Where does intelligence lie (program or programmer?). Note that this is not a trivial question!!
- Eg. Neural nets, genetic algorithms

Various degrees of problem complexities

- P, NP, NPC, Undecidable problems …
- P : deterministic polynomial
- NP : non-deterministic polynomial
- NPC : NP Complete (SAT)
- Undecidable (Halting Problem)

The Turing Test

- If we cannot define intelligence … let us come up with an empirical test (Turing)
- The Turing test measures the performance of an allegedly intelligent machine against that of a human being (arguably the best and only standard of intelligent behaviour)

Important Features of the Turing Test

- It gives us an objective notion of intelligence
- It prevents us from asking unanswerable questions such as whether of not the machine is actually conscious of it's actions
- It eliminates any bias in favour of living organisms by forcing the interrogator to focus solely on the content of the answer to questions.
- BUT … Do we really wish a machine to do mathematics as slowly and inaccurately as a human? … so perhaps the Turing Test is not enough to describe machine intelligence.

Agents / Daemons / Processes

- In Basic Intelligent Systems you have discussed what Agents should be capable of doing. What's important is the development of :
  - Structures for the representation of information (knowledge representation)
  - Strategies for the search through alternative solution, and
  - The creation of architectures that can support the interaction of agents (communication protocols)

AI Application Areas

- Game Playing
- Automated Reasoning and Theorem Proving
- Expert Systems
- Natural Language Understanding
- Planning and Robotics
- Machine Learning
- Neural Nets and Genetic Algorithms

Summary of AI

- The use of computers to do reasoning, pattern recognition, learning, or some other form of ***inference***.
- A focus on problems that do not respond to algorithmic solutions. This underlies the reliance on ***heuristic search*** as an AI problem-solving technique.
- 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.
- … read book ☺

What will be covered in this course

- By Myself
  - Introduction to AI systems
  - Knowledge Representation and Search Strategies
  - 'Intelligent' Game Playing
  - Grammatical Inference – Inductive Learning
  - String Algorithms – Syntactic Pattern Recognition
  - Reasoning with Logic

- By Kris Guillaumier (no particular order)
  - Expert Systems
  - Fuzzy Logic
  - Genetic Algorithms
  - Ant Colony Optimisations
  - Neural Networks.