# COMP219: Artificial Intelligence

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University of Liverpool



# COMP219: Artificial Intelligence

**Lecture 1: Introduction**



# Today

- Admin and module info
- Introduction to AI



# Module Outline

- The module consists of
  - 28 lectures
  - 4 labs (exercises not assessed)
  - Enough self study to understand the material
- Assessment
  - 2 class tests
  - A two hour exam
- Module information page:
  http://www.fransoliehoek.net/comp219/

# Module Delivery

| | |
|---|---|
| **Lecturer:** | Dr. Frans Oliehoek<br>Room 222, Ashton Building<br>Email: frans.oliehoek@liverpool.ac.uk<br><br>I am available to answer short queries after lectures and will be happy to schedule an appointment to discuss any more detailed queries. |
| **Demonstrators**: | Joe Collenette – sgjcolle@student.liverpool.ac.uk<br><br>Gregory Palmer – G.J.Palmer@liverpool.ac.uk<br><br>Pavithra Rajendran – Pavithra.Rajendran@liverpool.ac.uk |



# Timetable

Lectures

Monday, 16:00-17:00, CTH-LTB.

Tuesday, 10:00-11:00, REN-LT6.

Friday, 11:00-12:00, CHAD-CHAD.

There will be no lectures on:

2-10-2017

9-10-2017

(Due to changes in lab times…) there **will** be a lecture on 6-10-2017



# Module Assessment

- Non-assessed lab exercises
  - You should have been assigned to one of the lab classes; check time and allocation on your online timetable.
  - Labs start in week 3
- 2 class tests each worth 10% of the final mark for the module
- Exam in January, which will last 2 hours and is worth 80% of the final mark for the module
  - Multiple choice exam



# Feedback

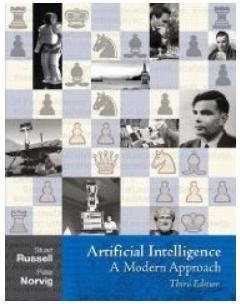
- Both continual assessment components will take the form of class tests.
- Results of the class tests will be returned within two working weeks (the departmental guideline).
- Feedback will be in the form of comments and suggestions noting where you went wrong (if applicable) and what you could have done differently.
- You can also receive feedback on the non-assessed lab exercises by submitting your answer sheets to the demonstrators.
- I will run through the solutions to the first class test during a lecture

# Notes

- Lecture note will be available for download from the COMP219 website.
- You should supplement with your own notes.
- **IMPORTANT:**
  In some lectures I will set exercises that DO NOT appear the notes – **if you miss the lecture it is up to you to catch up on missed exercises.**



# Reading




- Good AI books include:
  - S. Russell and P. Norvig. *Artificial Intelligence: A Modern Approach*. Prentice Hall, 2010 (3rd edition)
  - E. Rich and K. Knight. *Artificial Intelligence*. McGraw-Hill, 1991 (2nd edition)
- The following is a (cheap) text (not as comprehensive as the above) which covers standard material
  - A. Cawsey. *The Essence of Artificial Intelligence*. Prentice-Hall, 1998



# Prolog Books

- Comprehensive books:
  - I. Bratko. *Prolog Programming for Artificial Intelligence*. Addison Wesley, 1990
  - Sterling, Leon, and Ehud Y. Shapiro. *The art of Prolog: advanced programming techniques*. MIT press, 1994
- Straightforward book
  - D. Crookes. *Introduction to Programming in Prolog*. Prentice-Hall,1988



# Module Content

- Introduction to artificial intelligence
- Prolog - an AI programming language
- Search
- Knowledge representation
- Logic
- Planning
- Learning
- AI applications

# Module Aims

- To provide an introduction to the topic of artificial intelligence through studying ***problem solving***, ***knowledge representation***, ***planning*** and ***learning*** in intelligent systems.

- To provide a grounding in the AI programming language ***Prolog***.



# Learning Outcomes

At the end of this module, students should be able to:

- identify or describe the characteristics of intelligent agents and the environments that they can inhabit;
- identify, contrast and apply to simple examples the major search techniques that have been developed for problem-solving in AI;
- distinguish the characteristics, and advantages and disadvantages, of the major knowledge representation paradigms that have been used in AI, such as production rules, semantic networks, propositional logic and first-order logic;
- solve simple knowledge-based problems using the AI representations studied;
- identify or describe approaches used to solve planning problems in AI and apply these to simple examples;
- identify or describe the major approaches to learning in AI and apply these to simple examples;
- identify or describe some of the major applications of AI;
- understand and write Prolog code to solve simple knowledge-based problems.



# Please ensure that you...

- Switch off all mobile phones during lectures and practical classes.
- Do not scan/sign the register on behalf of other people.
- Attend lectures but do not talk during them or distract others.
  - A major distraction for me and others is laptops: please do not use these during lectures unless you have a valid reason that you have first discussed with me.
- Attempt the laboratory exercises.
- Do whatever reading and self study that is required to understand the material.
- Ask questions if there is anything that you do not understand.
- Sit the class tests!



# Credits

- This set of slides contains material provided by people who have previously taught this module in the University of Liverpool
  - John Fearnley,
  - Katie Atkinson
  - Annabel Latham
  - Adam Wyner
  - Boris Konev
  - Clare Dixon
  - Simon Parsons
  - Trevor Bench-Capon
- Russell & Norvig “AIaMA” supplement slides

# Introduction to Artificial Intelligence

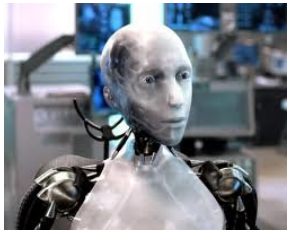


# What is AI?

- AI attempts to **build *intelligent* entities**
  - What is intelligence…?
  - Not a clear cut answer!
  - E.g.,:
    - must relate to tasks involving "higher mental processes": so ***not*** simple response to some stimulus (e.g. a thermostat)
    - ***not*** mechanical performance of some algorithm



# What is AI?



- "Hard" AI view
  - "The ultimate goal of AI research … is to build a person, or more humbly an animal" – *Charniak and McDermott*

- "Soft" AI view
  - "AI is the study of how to make computers do things, at which, at the moment, people are better" *- Elaine Rich*



# AI is both science and engineering

- the *science* of understanding intelligent entities – of developing theories which attempt to explain and predict the nature of such entities

- the *engineering* of intelligent entities

# Four views of AI

- **Systems that think like humans**
  - cognitive science, expert systems
- **Systems that act like humans**
  - The Turing Test, chess programs
- **Systems that think rationally**
  - Approaches based on logic and mathematics
- **Systems that act rationally**
  - Contemporary agent-based approaches

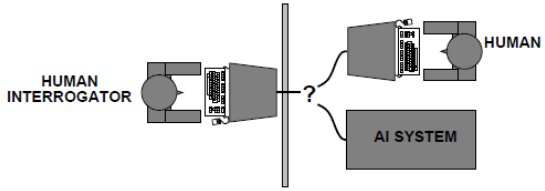


# Acting Humanly

- Emphasis on how to *tell* if a machine is intelligent, not on how to *make* it intelligent
- When can we count a machine as being intelligent?
- "Can machines think?" → "Can machines behave intelligently?"
- Most famous response due to Alan Turing, British mathematician and computing pioneer



# The Turing Test

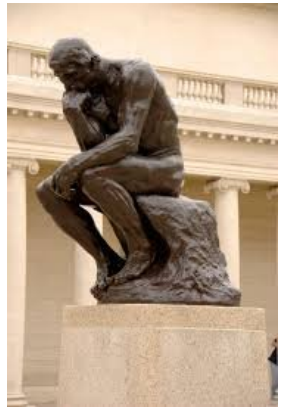



- System passes if the questioner cannot tell the difference
- ***No*** program has yet passed the test: most successful ones rely on ***tricks*** rather than intelligence
- But can obtain human level performance (or better) in some ***specific*** areas like chess



# Thinking Humanly

- Try to understand how the mind works - how do we think?
- Two possible routes to find answers:
  - by *introspection* - we figure it out ourselves!
  - by *experiment* - draw upon techniques of psychology (or neuroscience) to conduct controlled experiments
- The discipline of *cognitive science*: at one time influential in vision, natural language processing, and learning.



# Human vs Machine Thinking

- Expert systems – "AI success story in early 80s"
  - Human expert's knowledge and experience is represented as a computer program
  - Rule-based representation of knowledge
  - Typical domains are:
    - medicine (INTERNIST, MYCIN, . . . )
    - geology (PROSPECTOR)
    - chemical analysis (DENDRAL)
    - configuration of computers (R1)
    - law (British Nationality Act)


- Thinking humanly can work (sometimes)



# Human vs Machine Thinking

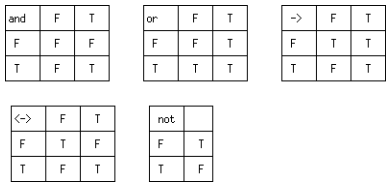
- Computer program playing chess
  - "Human way"
    - Tried by World champion Mikhail Botvinnik (who also was a programmer)
    - Poor performance
  - "Computer way"
    - Sophisticated search algorithms
    - Vast databases
    - Immense computing power
    - Human world champion beaten

- True also for vision, robotics, speech recognition etc.



# Thinking Rationally

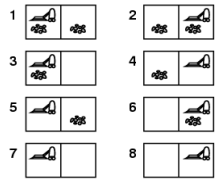
- Trying to understand how we actually think is one route to AI – but how about how we should think?
- Use logic to capture the laws of rational thought as symbols
- Reasoning involves shifting symbols according to well-defined rules (like algebra)
- Result is idealised reasoning






# Logic and AI

- Logical approach theoretically attractive
- Lots of problems:
  - Transduction - how to map the environment to symbolic representation
  - Representation - how to represent real world phenomena (time, space, . . . ) symbolically
  - Reasoning - how to do symbolic manipulation tractably



# Acting Rationally

- Acting rationally = acting to achieve one's goals, given one's beliefs
- An agent is a system that perceives and acts; an intelligent agent is one that acts rationally w.r.t. the goals we delegate to it
- Emphasis shifts from designing *theoretically* best decision making procedure to the best decision making procedure possible in *circumstances*
- Logic may be used in the service of finding the best action – not as an end in itself



# Acting Rationally

- Achieving *perfect rationality* – making the best decision theoretically possible – is not usually achievable because of
  - limited resources
  - limited time
  - limited computational power
  - limited memory
  - limited or uncertain information about environment
- The aim is to *do the best with what you've got*



# Summary

- Today
  - General module information
  - Overview of what AI is
    - The science of understanding intelligent entities, and engineering them
- Next time
  - Overview of some common AI techniques we will study during the module
  - Typical AI applications