Introduction Why AI is Important

Structure of the course

History of AI

AI as a field of study and in the SoCS in Birmingham
Introduction – Why AI is Important

Agricultural revolution ~6000 years ago
land many times more productive in food production

Industrial Revolution 1740 to now
workers many times more productive in manufacturing
  standardisation of parts
  concentration of labour and energy
  centralisation of authority
  specialisation of labour
  synchronisation of workers to machines
  maximization through strategic planning

Information Revolution 1940's to now
many times more productive in processing information
cost of information from dawn of writing to semantic web
previous step-changes: writing (Iraq ~5000 years ago, printing press ~500 years ago)
Introduction – Why AI is Important

How will the six characteristics of post-industrial-revolution industry change in the Information Revolution?

How will automated information processing change the human experience?

Examples of automated processing of information in this module.
  Search
  Automated logical reasoning
  Machine Learning
  Representations for the semantic web
  Planning

(Alesso and Smith – Thinking on the Web: Godel, Turing and Berners-Lee, chapter 1)
Structure of the course

The structure of the course is explained at:

http://www.cs.bham.ac.uk/~ddp/AIP

There are provisionally:
  15 lectures
  11 problem classes
  six student presentation sessions
  one open book class test

though things may change during the course!
Forms of assessment

There are three forms of assessment for this module:
- final exam – 80% (3 hour paper, half sem1, half sem2)
- open book exam on logic – 10%
- student presentations – 10%

Student presentations should be:
- 12 to 15 minutes long (with time after this for questions)
- They should present material that fits within the continuous assessment learning outcomes for this module

Continuous assessment learning outcomes from module page:
5. Provide examples of AI systems and applications, and explain common techniques, differences and limitations.
6. Provide examples of different types of AI systems, and explain their differences, common techniques, and limitations.
7. Describe and evaluate some of the most important knowledge representation formalisms and explain why they are needed, discussing their advantages and disadvantages
8. Apply these knowledge representation formalisms to unseen examples.
10. Employ the first order predicate calculus as a formalism for representation and reasoning, and describe its strengths and limitations.
Material for student presentations

History of AI: presented in the remainder of this lecture

Boundaries of Cognitive Science: presented next lecture

AI Applications: some ideas presented in this and next lecture, mostly down to you to find from textbooks, the web, other students, other lecturers, tutors, demonstrators etc

The important thing is that you choose an AI subject that you are interested in.

(Whatever aspect of AI interests you, you should then be able to present it so that it fits the learning outcomes, email/talk to me if you have questions.)
History of AI – contributions from other disciplines

Disciplines that contributed ideas, viewpoints and techniques to AI:

- Philosophy
- Mathematics
- Economics
- Neuroscience
- Psychology
- Computer engineering
- Control theory and Cybernetics
- Linguistics

(Russel & Norvig section 1.2)
Aristotle and other Greek philosophers were concerned with the question: what is rational thought?

In the Renaissance European philosophy reconsidered how human thought was created:

Dualism (ghost in the machine) versus materialism

More recently: Computers and functionalism

Philosophical criticisms of AI: Searle and Dreyfus

(reading list – see Gardner The Mind's New Science, chapters 4 and 6; Churchland, Matter and Consciousness; Haugeland, Mind Design II)
History of AI – Mathematical foundations

Algorithms and Logic

Godel – Incompleteness theorem

Turing – Turing Machines, Turing Test

(reading list – see Turing's important 1950 paper is in Haugeland Mind Design II. Much material in Hofstader, Godel, Escher, Bach is relevant)
History of AI – Psychological foundations

Early experimental psychology

Introspection

Behaviourism

The Hixon Symposium (1948) and the birth of the computational paradigm in psychology

(reading list – see Gardner *The Mind's New Science*, chapters 2 and 5)
History of AI - Linguistic foundations

From
Skinner – *Verbal behaviour*
to
Chomsky - *Syntactic Structures*

(reading list – see Gardner *The Mind's New Science* chapter 7)
The first work that we might now call AI was the Neural Networks created by McCulloch and Pitts (1943).

Other researchers in Control Systems and Cybernetics at this time included Norbert Wiener and W Gray Walter (and his famous Tortoises).

(reading list – see Gardner *The Mind's New Science*, page 19)
The term 'Artificial Intelligence' was reportedly coined by a mathematician named John McCarthy. In the summer of 1956 McCarthy was joined by a number of other researchers in a two month workshop in Dartmouth, New Hampshire. The other participants included:

- Marvin Minsky
- Allen Newell
- Herbert Simon

These four participants together did much to drive AI research in the direction it took up for many years. What they had in common was a dual interest in intelligent applications and models of human cognition. In fact, many of their applications were models of cognition.

(reading list – see Gardner *The Mind's New Science*, chapter 6)
History of AI – Stages and Trends

Stages

Look Ma, no hands!
Microworlds
GOFAI versus nouvelle AI
Weak methods to Strong methods

Current Trends

rigorous mathematical analysis
training with substantial real world data
consider the whole agent problem

(Russel & Norvig section 1.3)
History of AI – GOFAI versus nouvelle AI

Nouvelle AI is really a misnomer as some of the earliest examples of AI were NN. Interest in NN was lessened by the analysis of Minsky and Papert in *Perceptrons* (1968). After this symbolic AI became predominant.

Criticisms of Symbolic AI from philosophers

The discovery/invention of new NN learning rules, robot control systems without central representations, and the take-off of evolutionary programming,

Symbolic AI became labelled GOFAI (good old fashioned AI). NN, evolutionary programming (incl A-life), and Behaviour Based Robotics, were labelled nouvelle AI, and became increasingly important.

(Comparing NN and production systems as examples of Nouvelle and GOFAI in lectures concerned with Biological Intelligeence. Can computational cognitive neuroscience bring about a rapprochement between GOFAI and nouvelle AI?, in lecture 16. Reading list, see Franklin *Artificial Minds*, chapter 5 – The First AI debate)
Summary

Structure of the course: lectures, problem classes, presentations

Structure of assessment: final exam, open book exam, presentations

Ideas for presentations from this lecture:

Turing, Searle (plus Dreyfus), McCarthy, Minsky, Newell and Simon, Control theory and Cybernetics, The Hixon Symposium, Chomsky and linguistics, Rodney Brooks and Behaviour Based Robotics, Examples of early Microworlds

More ideas next lecture
Next lecture

Boundaries of Cognitive Science
  AI and Emotion
  AI and Consciousness
  Embodied AI
  Situated AI
  AI and Dynamic Systems
  AI and Mathematical knowledge

Brief Overview of Expert Systems
  Knowledge based system applications that use strong knowledge about problem domains (instead of using weak knowledge about a domain but with more general problem solving methods)

More AI applications
First Part of Homework for next Problem Class

1. Look up the module page for AI/CS at:

   www.cs.bham.ac.uk/resources/modules/

   Write a list of all the CS modules that you think are predominantly AI

2. Subdivide this list into those courses that you think are GOFAI or nouvelle AI. Can you make a neat division?

3. Look at the reading list on the module page at:

   http://www.cs.bham.ac.uk/resources/modules/2006/20417.html

   Look at the contents pages of some of the AI textbooks on the reading list and come up with a list of subfields that make up the field of AI.

4. Compare your lists from questions 1, 2 and 3. Any observations?

5. Look at the research pages for the SoCS and make a list of all lecturers involved in AI research which interests you.