Dipartimento di elettronica e informazione
Politecnico di Milano

Artificial Intelligence 2010-11

1. Introduction to the course

1.1 Course presentation

Two courses in parallel

- Artificial Intelligence, in English (Marco Colombetti, Mario Verdicchio, Viola Schiaffonati)
- Intelligenza artificiale, in Italian (Francesco Amigoni, Nicola Gatti, Viola Schiaffonati)

Program

- Introduction: goals, research areas, applications
- Representations: iconic vs. symbolic
- Iconic-based methods:
  - *State space search*: uninformed and informed search methods
  - *Constraint satisfaction problems*
- Symbolic-based methods:
  - *Logic*: knowledge representation in First Order Logic
  - *Planning*: Situation Calculus, STRIPS, plan space search
- Philosophical foundations

Textbook

- S. Russell, P. Norvig, 2010. *Artificial Intelligence: A modern approach*, 3rd ed., Prentice-Hall/Pearson (1,132 pages)
- Textbook's web site available at `http://aima.cs.berkeley.edu/`
- Parts covered by the course (for a total of 318 pages):
  - Part I: Artificial Intelligence. Chapters 1 and 2 (pages 1–63)
  - Part II: Problem solving. Chapters 3 and 6 (pages 64–119 and 202–233)
  - Part III: Knowledge, reasoning, and planning. Chapters 7–10 (pages 234–400)
- Additional lecture notes downloadable from the course's website (see below)

Final examination

- A written test, 2 hours, with conceptual questions and exercises.

Further details

- The Logic module is given by Mario Verdicchio, the two lessons on Philosophical foundations by Viola Schiaffonati, the rest by Marco Colombetti
- Marco Colombetti:
  - office hours: Thursday 14:30–16:00 (Department of Electronics and Information, 1st floor, ext. 3686)
  - home page: `http://www.dei.polimi.it/people/colombetti/`
  - email: `marco.colombetti@polimi.it` – please send messages from the official student address
- course website: `http://home.dei.polimi.it/colombet/AI/`

1.2 About AI

The birth of Artificial Intelligence

Artificial Intelligence (AI):

- officially born in 1956, during a summer seminar at Darthmouth College (Hanover, New Hampshire), attended by John McCarthy, Marvin Minsky, Allen Newell, Nathaniel Rochester, Claude Shannon, Herbert Simon (later Nobel Prize for Economics), and others

Goals:

- design and implement computer-based systems that exhibit intelligent behaviour
- understand intelligence as a computational processes

The context in 1956:

- computers are huge, awfully expensive, brittle, with very little computing power, still perceived as number-crunching machines
- still no high-level programming languages (apart from the first version of FORTRAN), no dynamic data structures, no databases, no object-oriented programming, no software engineering, ...
- cognitive psychology is just beginning: thought is starting to be conceived as information processing

What is an intelligent system?

Analysis of *Intelligent*(*x*):

- *applicability conditions*: for what values of *x* is the predicate meaningful?
- *truth conditions*: for what values of *x* is the predicate true?

As far as the applicability conditions are concerned, *x* has to be an *agent*, that is, a system capable of autonomous action. The term "intelligent" is applied to agents, and by extension to their actions and possibly to the results or products of their actions; examples:

- intelligent agents: John is intelligent, my dog is very intelligent, my car has intelligent suspensions
- intelligent actions: it was intelligent of John not to run away after breaking the glass
- intelligent product: this is a very intelligent chair (in the sense that it has been intelligently designed).

Being intelligent is not a simple concept (contrary to, for example, being a metal, or being a gas). As a consequence, there will be no simple theory of intelligence. Maybe "intelligent" cannot even be turned into a rigorous scientific term.

Among the typical features of intelligent organisms are:

- perception of the environment
- problem solving and rational action (mostly human, but also available to complex non-human animals)
- learning
- sociality and communication
- language use (humans only)

What is an artificial intelligent system?

Why do we obviously assume that an *artificial* intelligent system will be a system controlled by a suitably programmed digital computer?

Because digital computers are, in some sense, universal machines: given that cognitivism assumes that thought processes are just computations, digital computers can implement thought processes.

Main research areas

- "core" AI: problem solving, knowledge representation, reasoning
- natural language processing
- machine learning
- computer vision
- robotics

Main application areas

- expert systems
- planning and scheduling
- optimisation
- language technologies
- semantic web
- multiagent systems
- data mining
- industrial robotics
- ...

1.3 Some AI-related courses at Politecnico di Milano (Leonardo Campus)

- *Soft computing*: neural networks, fuzzy models, genetic algorithms (Italian)
- *Autonomous agents and multiagent systems*
- *Data mining and text mining*
- *Image analysis and synthesis*
- *Videogame Design and Programming*
- *Ingegneria della conoscenza* (*modelli semantici*): semantic modelling and reasoning for the Semantic Web (in Italian)
- *Robotica*, *Robotica 2*: robotics (in Italian)
- *Elaborazione del linguaggio naturale*: natural language processing (in Italian)
- *Tecniche di apprendimento automatico per applicazioni di data mining*: machine learning and data mining (in Italian)
- *Temi filosofici dell'informatica*: philosophical issues in Computer Science (in Italian)