KIIS: Kunstig Intelligens & Intelligente Systemer

Artificial Intelligence & Intelligent Systems

Henning Christiansen

Introduction and overview
Autumn Semester 2008

Datalogi
Roskilde Universitetscenter

Program for today

- What do we mean by Artificial Intelligence
- Overview of the course, practical issues
- (Artificial) intelligence and knowledge
- Examples of AI technology and applications
- A detour into the philosophical issues
- Prolog: An AI language :) *workshop* *2.5h at least*

Read MN, chap 1, historical overview, etc. by yourself

Two views of Artificial Intelligence

1. *Philosophical:* Understanding "intelligence", how to define "intelligence", can "intelligence" be implemented by a machine designed by human? [paper by A. Turing, 1950]
2. *Pragmatic:* Practically relevant technology, doing tasks that we usually associate with human intelligence [no matter how it is done]
3. *Salesmanship:* Smart people sell intelligent solution, no one sells stupid solutions

Two views of Artificial Intelligence

1. *Philosophical:* Understanding "intelligence", how to define "intelligence", can "intelligence" be implemented by a machine designed by human? [paper by A. Turing, 1950]
2. *Pragmatic:* Practically relevant technology, doing tasks that we usually associate with human intelligence [no matter how it is done]
3. *Salesmanship:* Smart people sell intelligent solution, no one sells stupid solutions

Datalogi
Roskilde Universitetscenter

This course

- An overview of the area:
  - Basic concepts
  - Important applications
  - ... and techniques
- In depth with specific topics
- Book: *M. Negnevitsky: Artificial Intelligence, A Guide to Intelligent Systems, 2nd ed., Addison-Wesley, 2004*
- Complemented with
  - Articles, presentations by you
  - Course notes
  - Practical exercises, practical exercises, etc.!

Overall goals

- You get an overview of AI and AI methods so that
  - you can participate in AI development projects (e.g., student projects)
  - you get an idea of present state of the art
- You will be presented for current research topics, reflection (or course) the teachers' research interests
  - ideas for MSc theses and new research
- You get some experiences developing small toy AI applications (Prolog, CHR, other high-level tools)

List of possible topics in the course

- Rule-based expert system
  (forward, backward chaining, etc.)
- Reasoning in logic based systems:
  - Deduction, Induction & Abduction modelled in logic programming.
  - Applications for diagnosis, natural language understanding (discourse analysis ...)
- Uncertainty: Probabilities, Probabilistic-Logic models, Bayesian reasoning, related machine learning techniques
  - as above, but with probabilities,...
  - Perhaps robot control (interpret sensor, decide, act)
- To level of "know-about":
  - Fuzzy logic, neural nets, evolutionary computation, genetic programming, ...

Experimental tools

Central tools:

- Prolog ***NB: We use SICTUS Prolog… (or SWI) to have:***
- Constraint Handling Rules

Additional specialized tools, perhaps

- Neural Networks in Excel
- some genetic programming system
- PRISM (T.Sato & al) for parameter learning
- ….

Practical

- Everything announced at the course web
  Ecampus -> http://www.ruc.dk/~henning/KIIS2008
- Reading etc. for a next Tue, latest Wed (Thu)
- We aim at:
  - Each course day is seen as a whole, so practical exercises reflects the day's theoretical material
- We combine
  - traditional lectures, presentation by you
  - practical & theoretical exercises
  - workshop: mixing it all together
- Exam (more info at course www soon)
  - You give in some assigment(s) during course
  - Oral exam in January

Intelligence and intelligent systems

Requires

- Knowledge and knowledge representation
- Knowledge processing capabilities

May or may not involve

- ability to learn and adapt

NB: distinction between "knowledge" and "data" may be quite subtle; example: a rescue robot

- knowing about buildings, 3D geom., etc.
- can learn a 3D map from its obs., share with other robots...
- learn strategies from its earlier rescue tasks

Knowledge representation can be

- Explicit
  - An encyclopedia
  - Rule based

    IF rains AND go-out AND NOT umbrella THEN get-wet
- Implicit or encoded
  - A 1000000 line assembler program that plays chess
  - The weights in a trained neural network for recogizing my face

Knowledge representation can be

- Explicit
  - An encyclopedi
  - Rule based

    IF rains AND go-out AND NOT umbrella THEN get-wet
- Implicit or encoded
  - A 1000000 line assembler program that plays chess
  - The weights in a trained neural network for recogizing my face

Processing is (often) "logical"

GOAL: NOT get-wet GIVEN rains
PROCESS: Apply logical law of contraposition to get
RESULT: NOT go-out OR umbrella

esentation can be

Knowledge interesting by itself
Process may generate explanation

Processing is (often) "logical"

GOAL: NOT get-wet GIVEN rains
PROCESS: Apply logical law of contraposition to get
RESULT: NOT go-out OR umbrella

- Explicit
  - An encyclopedi
  - Rule based

    IF rains AND go-out AND NOT umbrella THEN get-wet
- Implicit or encoded
  - A 1000000 line assembler program that plays chess
  - The weights in a trained neural network for recogizing my face

esentation can be

Knowledge interesting by itself
Process may generate explanation

Processing is (often) "logical"

GOAL: NOT get-wet GIVEN rains
PROCESS: Apply logical law of contraposition to get
RESULT: NOT go-out OR umbrella

- Explicit
  - An encyclopedi
  - Rule based

    IF rains AND go-out AND NOT umbrella THEN get-wet
- Implicit or encoded
  - A 1000000 line assembler program that plays chess
  - The weights in a trained neural network for recogizing my face

Processing is opague
KnowledgeRepr.+Process only recognizable by sufficiently high percentage of successful results

Datalogi
Roskilde Universitetscenter

esentation can be

Knowledge interesting by itself
Process may generate explanation

Processing is (often) "logical"

GOAL: NOT get-wet GIVEN rains
PROCESS: Apply logical law of contraposition to get
RESULT: NOT go-out OR umbrella

- Explicit
  - An encyclopedi
  - Rule based

    IF rains AND go-out AND NOT umbrella THEN get-wet
- Implicit or encoded
  - A 1000000 line assembler program that plays chess
  - The weights in a trained neural network for recogizing my face

In place for knowledge difficult to formalize

Processing is opague
KnowledgeRepr.+Process only recognizable by sufficiently high percentage of successful results

Datalogi
Roskilde Universitetscenter

Knowledge about real world may often be

- incomplete (for given problem...)
- imprecise (temp is 800 degrees ± 50)
- stochastic (75% chance that Powerpoint chrashes during my lecture)
- fuzzy (Peter is tall)
- wrong
- inconsistent

This calls for

- sophisticated knowledge repr. formalisms
- add-hoc tricks, rule-of-thumbs, etc.

- **sophisticated knowledge repr. formalisms**
  - logic with open and closed predicates ("null values"),
  - fuzzy logic ~ graduated truth, linguistic quantifiers
  - probability theory
  - integration of probability theory and logic
  - paraconsistent logic
  - 10^6 different "uncertainty logics"
- **add-hoc tricks, rule-of-thumbs, etc.**
  - meta-rules in rule-based systems
  - hacks in the code, shifting algorithm, ...
  - behaviour of implicit representations, e.g., neural nets capable of recognizing my face when I have cleaned the fire place

Machine learning

Extracting knowledge from sets of observations

- Supervised learning
  - Data annotated manually (typ.) with classification
  - Machine identifies relationships Data --> class
- Unsupervised learning
  - Machine identifies regularities in data
  - Perhaps helped by "bias"

Supervised learning

- Train neural net with different faces with info.
  "this shows NN1", "this shows also NN1", "this shows NN2", ..
- Learn rules to classify words from annotated text, "tagging"
- "Give/V-IMP-XP help/N! Help/V-IMP-XP me/PN-1P-OBJ"
- Protein chemical formulas --> shape of molecule, or the other way round!

Unsupervised learning

- Datamining in data warehouses
  "80% of those who bought gin bought also tonic"
  "50% of those who bought gin and tonic bought also peanuts"
- Learning logic programs from facts
- Learning Integrity Constraints in databases

A detour into the philosophical issues

Alan Turing (1950):

Computing Machinery and Intelligence

~philosophical considerations by one of the greatests computer scientists

The paper is very interesting — read it if you have time!

We touch upon a single issue: ***The Turing test***

The Turing test: A computer is intelligent if it can fool you to believe it's human

Think of a convincing chat program, ...

To abstract irrelevant features away, assume all communication goes via keyboard and text windows

Turing's original version:

1: A: Man, B: Woman, C: "Interrogator"

2: A: ***Machine***, B: Woman, C: "Interrogator"

Game: A does what he/it can to fool C to believe A is the woman.

If C is fooled equally many times by A="Man" and A="Machine", the Machine is Intelligent

Rest of today

- Prolog workshop
- short lecture with online demo
- you work with exercise
- ... and you have written you first intelligent programs by the end of the day ;-)

If time permits, another short lecture, and more exercises....