ACSC368: Artificial Intelligence

Lecture 1: Introduction to Artificial Intelligence

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Course Details

- **Optional books for further reading:**

What is Artificial Intelligence?

“Artificial intelligence is the science of making machines do things that would require intelligence if done by men.”

Marvin Minsky, co-founder of AI Lab at MIT

The Turing Test

- Proposed by Alan Turing in 1950
- Operational definition of intelligence

• What capabilities would a machine need to possess in order to pass the Turing test?

Major components of AI

- Language understanding
- Knowledge
- Reasoning
- Learning

Contributing disciplines:
- philosophy, maths, economics, psychology, linguistics, computer engineering / science, control theory, neuroscience, …
ELIZA

Weizenbaum's ELIZA (1966) can have a dialogue with a human. Here ELIZA is the questioner:

Q: tell me about your problem.
R: men are all alike.
Q: how do you feel about men?
R: none of them can be trusted.
Q: not any?
R: well, very few.
Q: could you be more precise please?
R: my grandfather was trustworthy.
Q: tell me about your grandfather.
R: he was my mother's father.
Q: tell me about your mother.
R: she is very nice.

Finlay & Dix, 1996

ELIZA

This dialogue can be easily produced in Prolog by templates for matching:

`pair([\‘I\’, feel, A], [why, do, you, feel, A, \‘?\’]).`
`pair([\‘I\’, A, you, B], [what, makes, you, A, me, B, \‘?\’]).`
`pair([A, men, B], [how, do, you, feel, about, men, \‘?\’]).`
`pair([A, women, B], [how, do, you, feel, about, women, \‘?\’]).`
`pair([A, none, B], [not, any, \‘?\’]).`
`pair([A, few, B], [could, you, be, more, precise, please, \‘?\’]).`
`pair([A, mother, B], [tell, me, about, your, mother, \‘?\’]).`
`pair(_, [\‘I\’, see, \‘.’, please, continue, \‘.’]).`

ELIZA

- ELIZA lacks:
  - Means of recognizing grammatical structure of language.
  - Means of converting users query into a representation of the underlying knowledge from which inferences can be drawn.
- It only uses tricks like string substitution and standard responses based on keywords.

Searle’s Chinese Room

In 1980 John Searle made the following argument about the Turing Test:

"Imagine a prisoner is locked in a room. He understands English but not Chinese. In the room he has pieces of Chinese writing and English rules to say how to manipulate these. An interrogator passes more Chinese writing into the room. The rules say how to give back Chinese symbols in response. Unknown to the prisoner, the original Chinese writing is a script that the interrogator is asking about. The prisoner uses the rules to answer the questions. Does the prisoner understand the script?"

Finlay & Dix, 1996

Two Philosophical Approaches:

- **Strong AI**: Replicate the human mind and its processes, so that the computing machine has genuine understanding and is capable of conscious thought.
- **Weak AI**: Simulate thought, so that the output behaviour of the machine is similar to that of a human behaving intelligently, once the machine has been suitably programmed.

When is a program an AI program?

- **Tax expert**: Helps a user work out their tax liability. Contains a database of tax rules and algorithms for calculating tax owed from information supplied by the user. Has a menu of questions to ask for this information, e.g. 'What was your gross earned income over the tax year 2006/7?'
- **Medical expert**: Diagnoses the disease of a patient and recommends appropriate treatment. Asks about symptoms, patient details and history, calls for tests if unsure, balances pro’s and con’s of possible treatments and risks of side-effects.
Exercise

• Using the previous slide as an example, list some characteristics of an AI program that cannot be handled by conventional programming techniques.

AI Paradigms

• **Traditional** (or classical, or symbolic) artificial intelligence uses representations and algorithms developed over the years since the start of AI research (normally dated from the mid 1950s). The knowledge representations used are expressed using symbols which have meaning for humans – for example, the symbols of mathematics and logic.

• **Connectionist** artificial intelligence uses ideas derived from biological understanding of the brain, based on neural networks. This research has been largely developed since the late 1980’s. The knowledge implicit in neural networks is not in a symbolic form which would be immediately understandable by a human.

• Both paradigms have their place, and modern AI systems may use either approach or a combination.

Practical Applications of AI

• **Game playing**: Complex games such as chess, used as a test bed for AI techniques including search and planning.

• **Automated reasoning and expert systems**: Research into domain-specific problem solving, leading to the early development of successful expert systems such as DENDRAL for the analysis of chemical structure and MYCIN for diagnosis of blood infections.

• **Natural language understanding**: Development of natural language interfaces and machine translation, and many other applications.

Practical Applications of AI

• **Planning and robotics**: Scheduling tasks and designing robots which can carry out a task flexibly and respond appropriately to changes in their environment.

• **Machine Learning**: One of the most important areas of AI research, since all intelligent systems need to be flexible and adapt to a changing environment.

• **‘Biological’ systems**: Include neural networks for AI problems such as pattern recognition, study of ‘artificial life’ and genetic algorithms providing a model for intelligent parallel processing.

Some real life applications of AI

• **Spacecraft autonomous control**: Spacecraft in a new unknown environment, with long communication times to control centre on Earth, need to be able to plan their own activities in response to local circumstances. NASA’s Deep Space 1 mission, launched in 1998, tested AI systems using planning with constraint satisfaction and heuristic search techniques.

• **Decision support tools**: Ascent Technology, founded by professors from the AI Lab at MIT, has developed an intelligent product called SmartAirport to help with decisions such as gate allocation, landing slots, baggage handling etc, and is now used in several airports throughout the world.

Some real life applications of AI

• **Information extraction from text**: Information extraction is concerned with summarising the important information from the many text sources of news, from newspapers to web sites. For example, investment companies may want to know about company take-overs and mergers. The FASTUS system developed by SRI International uses natural language processing and frames for knowledge representation.

• **Flight information conversational interface**: Developed at MIT, the aim of the Pegasus system is to answer telephone calls about flights, responding intelligently to user’s natural language questions.
Some real life applications of AI

- **Face recognition**: This has many potential uses, including security and surveillance systems. Faceit system from Visionic uses statistical AI techniques.
- **Data mining**: Extracts commercially useful information from historic databases, e.g. customer characteristics to target marketing and help customer retention.
- **Fraud detection**: Neural network technology is being used to detect fraud including use of stolen credit cards.

Some real life applications of AI

- **Bayesian inference**: Microsoft uses Bayesian inference systems, e.g. for diagnosis of computer network faults, and for ‘Clippy’, the irritating animated paper clip assistant! Current work aims for a better match of such assistants to user’s wishes, using more intelligent text analysis.
- **Robotics**: Robotics has many applications in industry, entertainment, exploration and in the home. Companies including NASA, iRobot, Honda and Sony are actively engaged in developing intelligent robots (e.g. Sony’s robot ‘dog’ AIBO and Honda’s humanoid robot ASIMO).