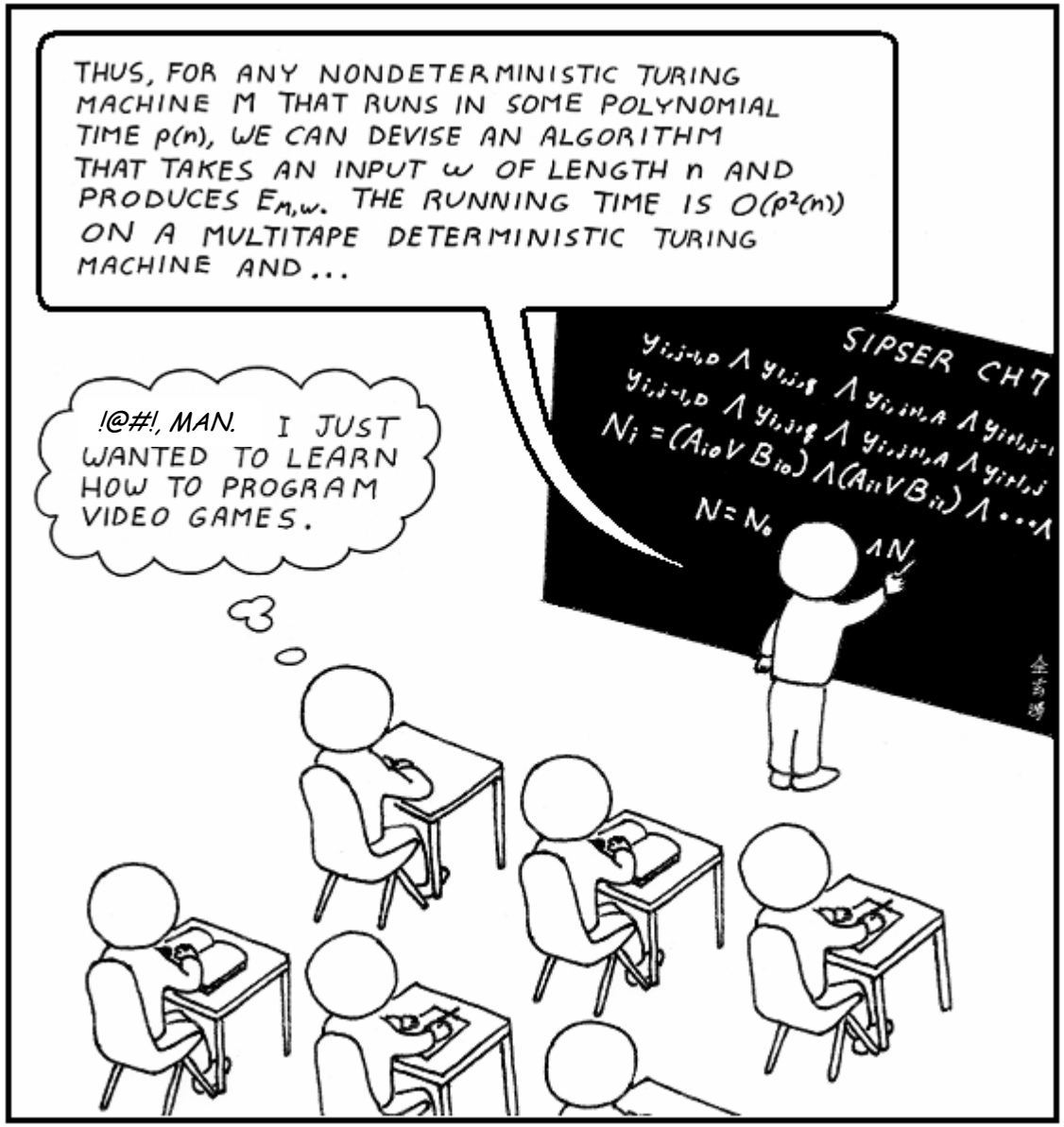
Welcome to CSC384: Intro to Artificial Intelligence



CSC384: Intro to Artificial Intelligence
Winter 2011

Instructor: Prof. Sheila McIlraith

Lectures/Tutorials:

- Monday 1-2pm GB 221
- Wednesday 1-2pm GB 221
- Friday* 1-2pm GB 244

**The Friday hour will be a continuation of the lecture period and/or time to go over extra examples and questions. Don't plan to miss it!*

CSC384: Textbook

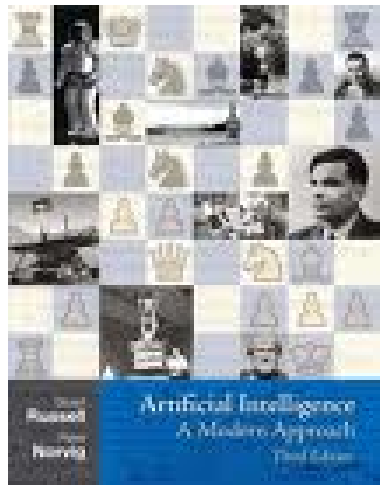
Recommended Text:

Artificial Intelligence: A Modern Approach

Stuart Russell and Peter Norvig.

3rd Edition, 2010.

- 2 copies of are on 24hr reserve in the Engineering and Computer Science Library.
- Recommended but not required.
- Lecture notes cover much of the course material and will be available online before class.
- Electronic version available online at a reduced price.

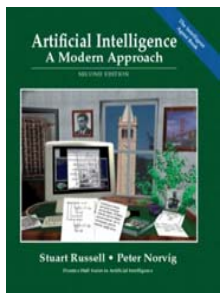


3rd edition:

Additional Reference:

Computational Intelligence: A Logical Approach

David Poole, Alan Mackworth & Randy Goebel.



2nd edition

CSC384: Prerequisites

- Prerequisites will not be checked for this course, except for the CGPA (cumulative grade point average).
  - You **don't** need to request a waiver.
  - You should have a stats course either the standard STA 247/255/257 or at least something like STA 250.
  - You need to have some familiarity with Prolog, CSC324 is the standard prerequisite. We will provide 1 tutorial on Prolog.
  - In all cases if you do not have the standard prerequisites ***you will be responsible*** for covering any necessary background on your own.

CSC384: Website

- **Course web site**
  http://www.cs.toronto.edu/~sheila/384/w11/

  - Primary source of more detailed information, announcements, etc.
  - Check the site often (at least every one or two days).
  - Updates about assignments, clarifications etc. will also be posted on the web site.

- **Course bulletin board** (will not be moderated)
  https://csc.cdf.toronto.edu/bb/YaBB.pl?board=CSC384H1S

CSC384: E-mail/board policies

- The course bulletin board will not be moderated.
- It can be used to communicate with your fellow students.
- Do not send questions there that you want answered by the instructor. Send e-mail directly.
- For each assignment, a TA will be assigned to answer questions. **Please send your questions about each assignment to the TA**.
- Answers that are important to everyone will be posted to the web site.
- Send only Plain Text (no HTML/MIME) using your CDF accounts.
- Start the subject of all your emails with "[CSC384]".
  Please see:
  http://www.cs.toronto.edu/~sheila/384/w10/contactpolicy.htm
- A silent period will take effect 24 hours before each assignment is due. I.e. no question related to the assignment will be answered during this period.

CSC384: How you will be graded

Course work:

- 3 Assignments (mostly programming, some short answer) **(12% each)**
- 2 term tests **(17% each)**
- 1 final exam **(30% each)**
- Assignments are worth a total of 36%
- Term tests are worth a total of 34%
- Final exam is worth a total of 30%

Late Policy/Missing Test:

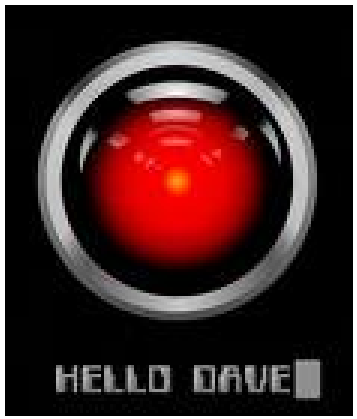
- You will have 2 grace days. Use them wisely!
- After that, you will be penalized for late assignments.
- For some assignments there may be a cut-off date after which assignments will no longer be accepted.

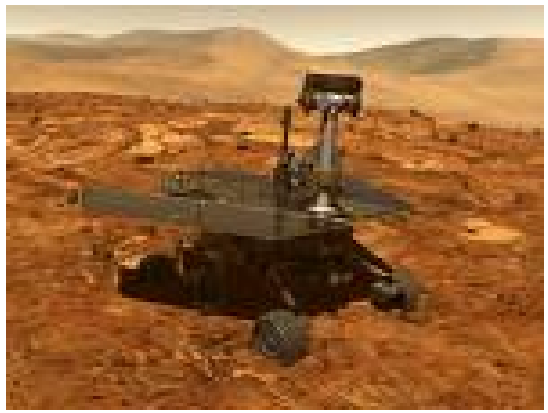
Plagiarism: (handing of work not substantially the student's own)
http://www.cs.toronto.edu/~fpitt/documents/plagiarism.html

Artificial Intelligence (AI)

How to achieve intelligent behaviour through computational means

For most people AI evokes:





But intelligence need not be embodied (Remember "Big Blue")

…or it could be embodied in ways that are not in keeping with our notion of an intelligent being.

Are these intelligent?

What about these?

Subareas of AI

- Perception: vision, speech understanding, etc.
- Machine Learning, Neural network
- Robotics
- Natural language understanding
- Reasoning and decision making ← **OUR FOCUS**
  - **Knowledge representation**
  - **Reasoning** *(logical, probabilistic)*
  - **Decision making** *(search, planning, decision theory)*

Cognitive Robotics

- Endow robots, (immobots, software agents) with the ability to **reason "soundly"** about some aspect of the world.

- To do so with **higher-level cognitive functions** that involve reasoning about goals, perception, actions, and the mental states of other agents.

- Endow them with some form of **commonsense reasoning**:

  The reasoning that tells you that
  - *Things usually fall down;*
  - *When a child is crying they are likely upset and need comforting;*
  - *If you're travelling to San Francisco then your right eyeball is likely travelling with you!*

…but how do we build artificial intelligences?

Is Imitating Humans the Goal?

	Like humans	Not necessarily like humans
Think	Systems that think like humans	Systems that think rationally
Act	Systems that act like humans	Systems that act rationally

Human Intelligence

- The Turing Test:
  - A human interrogator. Communicates with a hidden subject that is either a computer system or a human. If the human interrogator cannot reliably decide whether on not the subject is a computer, the computer is said to have passed the Turing test.

- Turing provided some very persuasive arguments that a system passing the Turing test is intelligent.

- However, the test does not provide much traction on the question of how to actually build an intelligent system.

Human intelligence

- In general there are various reasons why trying to mimic humans might **not** be the best approach to AI:
  - Computers and Humans have a very different architecture with quite different abilities.
    - Numerical computations
    - Visual and sensory processing
    - Massively and slow parallel vs. fast serial

	Computer	Human Brain
Computational Units	1 CPU, 10^8 gates	10^{11} neurons
Storage Units	10^{11} bits RAM 10^{12} bits disk	10^{11} neurons 10^{14} synapses
Cycle time	10^{-9} sec	10^{-3} sec
Bandwidth	10^{10} bits/sec	10^{14} bits/sec
Memory updates/sec	10^9	10^{14}

Human Intelligence

- But more importantly, we know very little about how the human brain performs its higher level processes. Hence, this point of view provides very little information from which a scientific understanding of these processes can be built.

- However, Neuroscience has been very influential in some areas of AI. For example, in robotic sensing, vision processing, etc.

Rationality

- The alternative approach relies on the notion of **rationality**.
- Typically this is a precise mathematical notion of what it means to *do the right thing* in any particular circumstance. Provides
  - A precise mechanism for analyzing and understanding the properties of this ideal behaviour we are trying to achieve.
  - A precise benchmark against which we can measure the behavior the systems we build.

Rationality

- Mathematical characterizations of rationality have come from diverse areas like logic (laws of thought) and economics (utility theory how best to act under uncertainty, game theory how self-interested agents interact).

- There is no universal agreement about which notion of rationality is best, but since these notions are precise we can study them and give exact characterizations of their properties, good and bad.

- We'll focus on acting rationally
  - this has implications for thinking/reasoning

Computational Intelligence

- *AI tries to understand and model intelligence as a computational process.*
- Thus we try to construct systems whose computation achieves or approximates the desired notion of rationality.
- Hence AI is part of Computer Science.
  - Other areas interested in the study of intelligence lie in other areas or study, e.g., cognitive science which focuses on human intelligence. Such areas are very related, but their central focus tends to be different.

Degrees of Intelligence

- Building an intelligent system as capable as humans remains an elusive goal.
- However, systems have been built which exhibit various specialized degrees of intelligence.
- Formalisms and algorithmic ideas have been identified as being useful in the construction of these “intelligent” systems.
- Together these formalisms and algorithms form the foundation of our attempt to understand intelligence as a computational process.
- *In this course we will study some of these formalisms and see how they can be used to achieve various degrees of intelligence.*

What We Cover in CSC384

- Search
  - Heuristic Search. (Chapter 3,4)
    - Search spaces
    - Heuristic guidance
  - Backtracking Search (Chapter 5)
    - “Vector of features” representation
    - Case analysis search
  - Game tree search (Chapter 6)
    - Working against an opponent

What We Cover in CSC384 (cont.)

- Knowledge Representation (Chapter 7-10)
  - First order logic for more general knowledge
  - Knowledge represented in declarative manner
- Planning (Chapter 11-12)
  - Predicate representation of states
  - Planning graph
- Uncertainty (Chapter 13-16)
  - Probabilistic reasoning, Bayes networks
  - Utilities and influence diagrams
  - Temporal probabilistic reasoning (?)

Further Courses in AI

- **CSC321H "Introduction to Neural Networks and Machine Learning"**
- **CSC401H1 "Natural Language Computing"**
- **CSC411H "Machine Learning and Data Mining"**
- **CSC412H1 "Uncertainty and Learning in Artificial Intelligence"**
- **CSC420H1 "Introduction to Image Understanding"**
- **CSC485H1 "Computational Linguistics"**
- **CSC486H1 "Knowledge Representation and Reasoning"**
- **CSC487H1 "Computational Vision"**

For Next Day

- **Read Chapters 1 and 2 of Russell & Norvig**
- **Start reviewing Prolog tutorial material posted online**
- **Friday's class will be a Prolog tutorial (most likely an online demo)**

Next Class: Romanian Travel.

Currently in Arad, need to get to Bucharest by tomorrow to catch a flight.