ucc
Coláiste na hOllscoile Corcaigh, Éire
University College Cork, Ireland

CS4618 Artificial Intelligence I

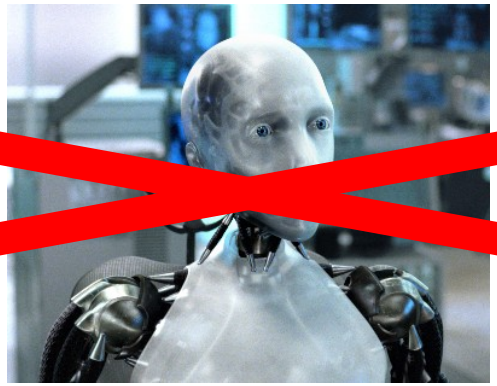
Today: Introduction

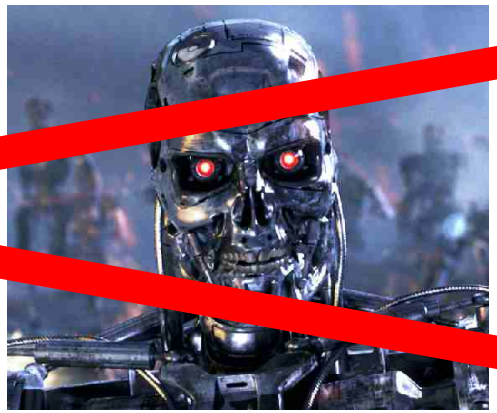
Thomas Jansen

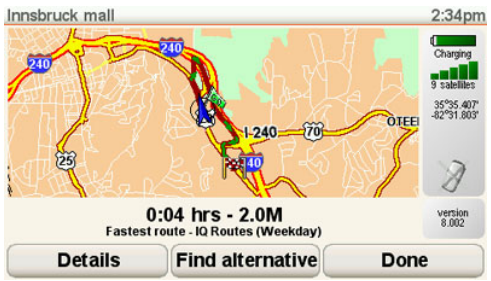
September 26th

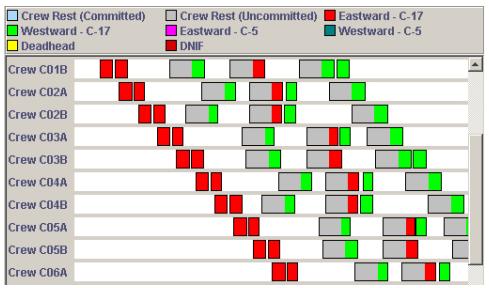
Plans for Today

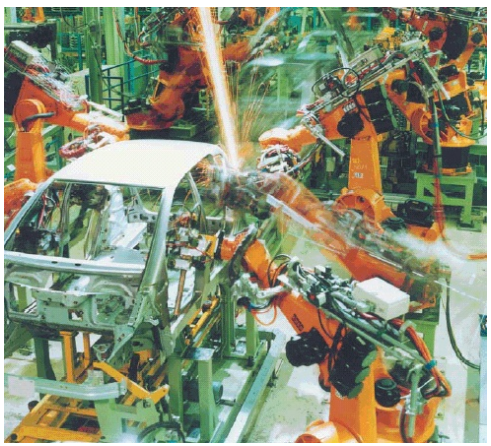
Artificial Intelligence

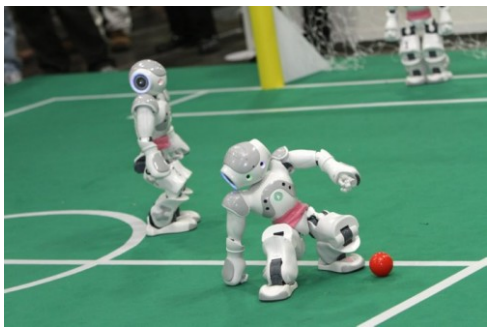












Boring Formal Stuff

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What and where

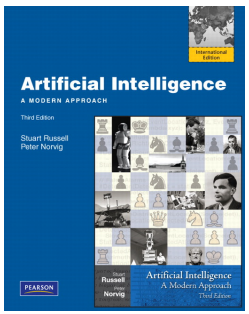
Lecture	Wednesdays, 2pm–3pm	WGB 15
	Fridays, 11am–12pm	WGB 09
Practicals	to be announced	

Assessment	Weekly Assignments	10 marks
	In-Class Test	10 marks
	End of Year Examination	80 marks
	1×1.5 hrs paper	

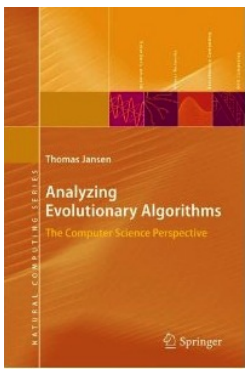
Course Material

Slides http://www.cs.ucc.ie/~tj2/cs4618

Books S. Russel, P. Norvig
Artificial Intelligence. A Modern Approach.
Third Edition. Pearson, 2010.



T. Jansen
Analyzing Evolutionary Algorithms.
Springer, 2013.



Course Outline

1. Introduction
   - 'Definition'
   - (a bit of) History
   - Intelligent Agents
2. 'Classical' AI
   - Uninformed Search (BFS, DFS)
   - Informed Search (A^*)
   - Game Play
3. Randomised Search Heuristics
   - Local Search
   - Simulated Annealing
   - Evolutionary Algorithms

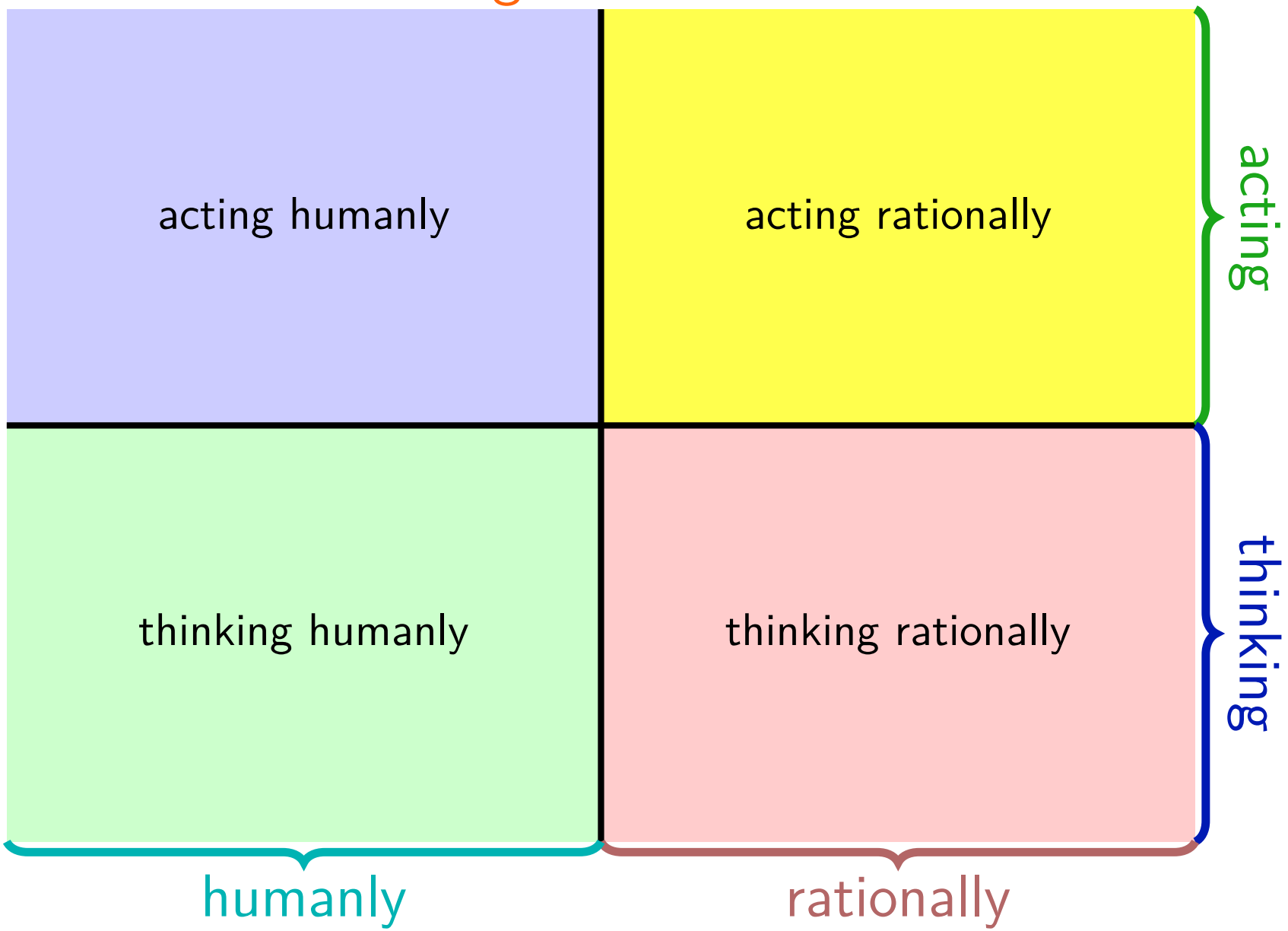
Point of View: Computer Science

I think that it's extraordinarily important that we in computer science keep fun in computing. When it started out, it was an awful lot of fun. Of course, the paying customers got shafted every now and then, and after a while we began to take their complaints seriously. We began to feel as if we really were responsible for the successful, error-free perfect use of these machines. I don't think we are. I think we're responsible for stretching them, setting them off in new directions, and keeping fun in the house. I hope the field of computer science never loses its sense of fun.

Alan Perlis (1922–1990)

(taken from H. Abelson, G. J. Sussmann, J. Sussman (1985): *Structure and Interpretation of Computer Programs*. MIT Press.)

What is Artificial Intelligence?



Different Answers to 'What is Artificial Intelligence?'

- acting humanly
  Turing test
  A. Turing (1950): Computing Machinery and Intelligence.
  Mind 59(236):433–460.
- thinking humanly
  cognitive modelling
- thinking rationally
  logic
- acting rationally
  rational agents approach

Related and Relevant Fields

- philosophy
  logic, mind-body problem, knowledge and action, ...
- mathematics
  logic, computability, probability, ...
- economics
  decision making, planning, ...
- neuroscience
  natural information processing
- psychology
  theory of thinking and acting
- computer engineering
  efficient hardware platforms
- control theory and cybernetics
  theory of self-controlled systems
- linguistics
  language and thought, formal grammars, ...

History of Artificial Intelligence

- 1943–1955: prior to AI
  - W. McCulloch, W. Pitts (1943): artificial neural nets
  - D. Hebb (1949): Hebbian learning
  - A. Turing (1950): Computing Machinery and Intelligence
- 1956: birth of AI

  Dartmouth workshop (Newell, Simon, McCarthy, Minsky, . . .)
- 1952–1969: early years
  - A. Newell, H. Simon: General Problem Solver
  - H. Gelernter: Geometry Theorem Prover
  - A. Samuel: checkers
  - J. McCarthy: Lisp
  - M. Minsky: AI Lab (several microworlds)
  - F. Rosenblatt: perceptron

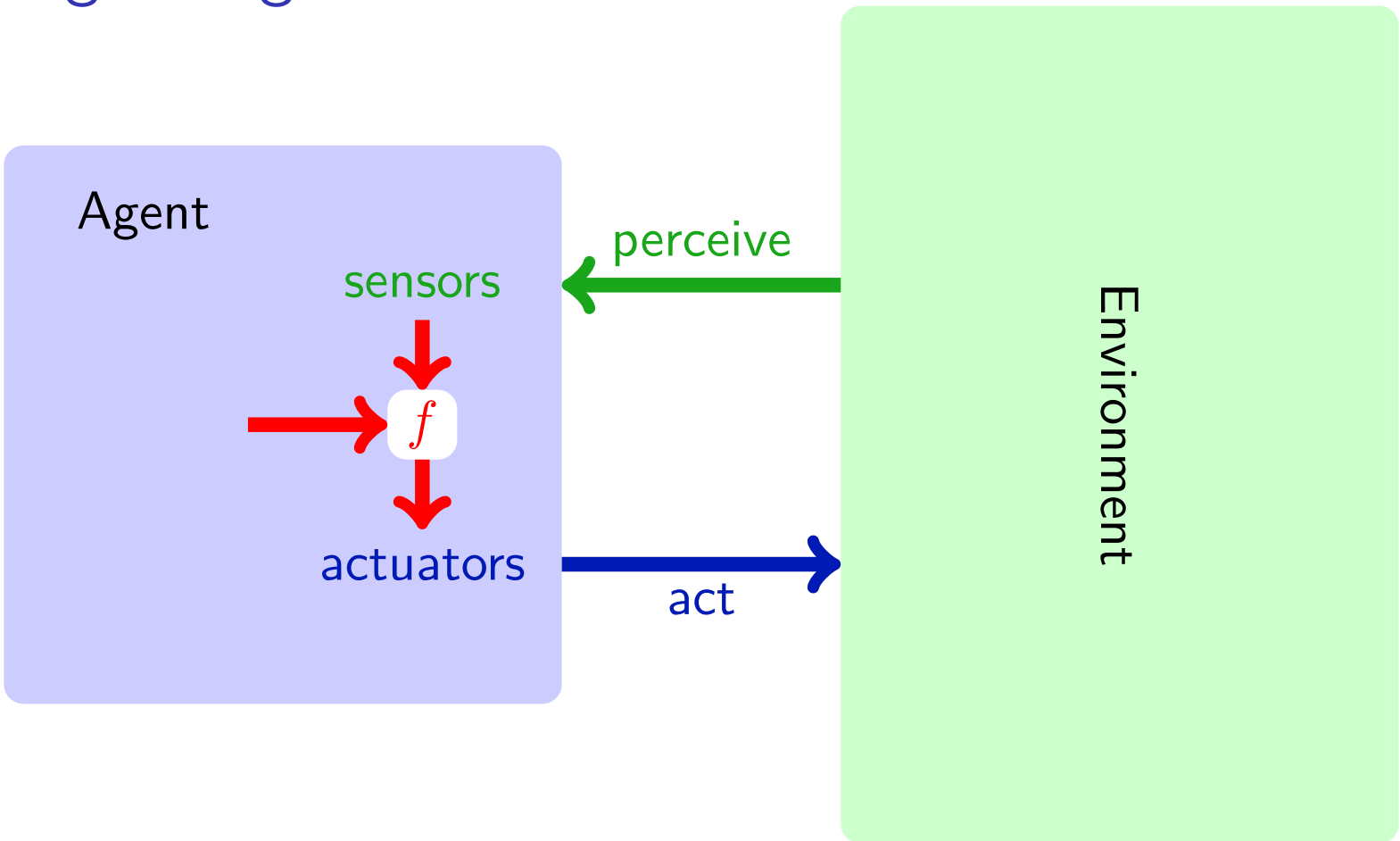
History of Artificial Intelligence (continued)

- 1966–1973: first crisis
  - early promises (H. Simon (1957): *In a visible future, the range of problems they (intelligent machines) can handle will be coextensive with the range to which the human mind has been applied.*) not kept
  - no general success in machine translation
    "The spirit is willing but the flesh is weak." (into Russian and back)
    $\rightsquigarrow$ "The vodka is good but the meat is rotten."
  - Lighthill report (1973): failure to come to grips with the combinatorial explosion
  - M. Minsky, S. Papert (1969): Perceptrons. (formalizing what perceptrons cannot do)
- 1969–1979: knowledge-based systems expert systems
- 1980 and ongoing: AI as an industry
- 1986 and ongoing: return of artificial neural networks
- 1995 and ongoing: intelligent agents
- 2001 and ongoing: availability of very large data sets

Current Applications

- robotics
- robotic vehicles
- logistics planning
- autonomous planning and scheduling
- speech recognition
- machine translation
- game playing
- spam fighting
- ...

Intelligent Agents and Their Environment



Classifiy systems according to

- properties of the environment
- properties of the agent
- properties of the interplay

Rational Agents

Roughly speaking rational $\widehat{=}$ doing the right thing

What defines what is the right thing?

Crucial performance measure
maps sequence of environment states to performance

Definition (Rational Agent)

For each possible percept sequence, a rational agent should select an action that is expected to maximise the performance measure, given the evidence provided by the percept sequence and whatever built-in knowledge the agent has.

Note exploration, information gathering, learning
crucial in unknown (or partially known) environments

Task Environments

Problem statement for rational agent(s) $\widehat{=}$ task environment

Components

- performance measure
- environment
- actuators
- sensors

Helpful categorisation of task environments according to properties ('dimensions')

Dimensions of Task Environments

Remember task environment encompasses performance measure, environment, actuators, sensors

- fully observable vs. partially observable
  property of the sensors
- single agent vs. multiagent
  sub-dimension competitive vs. cooperative
  communication
- deterministic vs. stochastic
  property of the environment
  note other agents not taken into account
- episodic vs. sequential
- static vs. dynamic
  special case semidynamic: only performance measure changes over time

Dimensions of Task Environments (continued)

Remember task environment encompasses performance measure, environment, actuators, sensors

- fully observable vs. partially observable
- single agent vs. multiagent
- deterministic vs. stochastic
- episodic vs. sequential
- static vs. dynamic
- discrete vs. continuous
  applies to
  - environment, in particular time
  - percepts
  - actions
- known vs. unknown
  note different from observable

Looking at 'Dimensions of Task Environments'

Remember task environment encompasses
performance measure, environment, actuators, sensors

- fully observable vs. partially observable
- single agent vs. multiagent
- deterministic vs. stochastic
- episodic vs. sequential
- static vs. dynamic
- discrete vs. continuous
- known vs. unknown

Summary & Take Home Message

Things to remember

- AI in this course encompasses 'classical' AI algorithms and randomised search heuristics, concentrates on search
- AI between thinking↔acting, rationally↔humanly
- many related and relevant fields
- history with early enthusiasm, crisis, and continuing efforts and successful applications
- intelligent agents and environments: task environments

Take Home Message

- AI is a broad, diverse, rich, interesting, and important field.
- Intelligent agents and their environments are a flexible and general framework for AI (applications).