Lecture 1: Introduction and Overview

Artificial Intelligence

CS-6364

QE session

Today's Lecture objectives

- Course administration
- Introduce course objectives and syllabus
- Motivate the study of AI (for PhD Quals)
- Define 'AI' and agent as used in this course

Introduction (1/3)

- **Background**
  - ***Goal:*** to provide clear learning objectives of this class for the PhD QE, subject matter: ARTIFICIAL INTELLIGENCE, prepare for the testing during QE
  - New format this year: REMOTE/VIRTUAL Learning
- **Overall course goals**
  - Learn how to *build* intelligent systems
  - Homeworks will test this
  - Exams & Quizzes will test knowledge

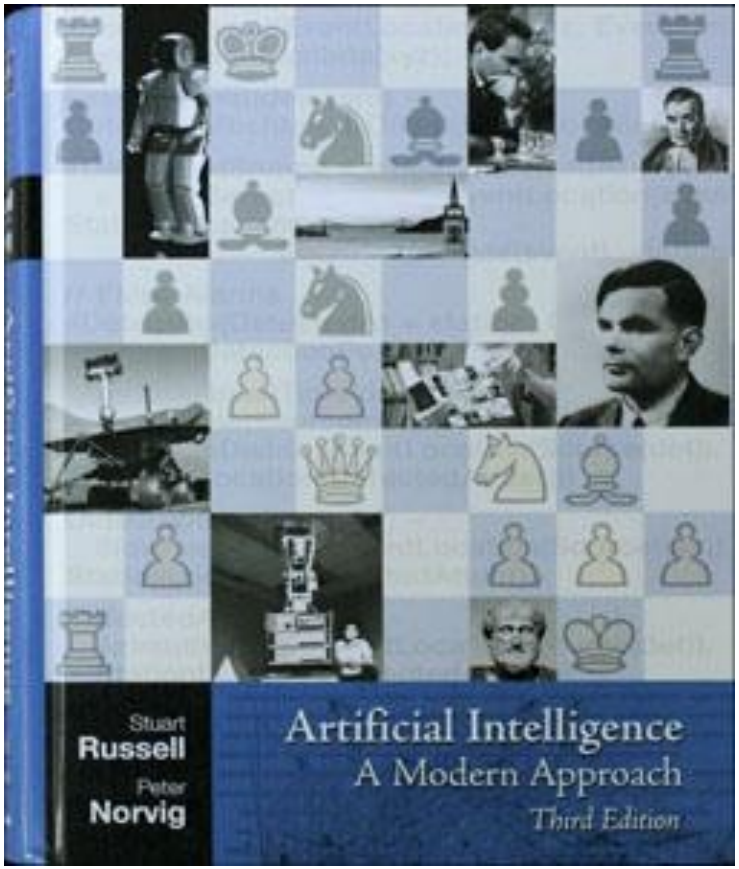
Introduction (2/3)

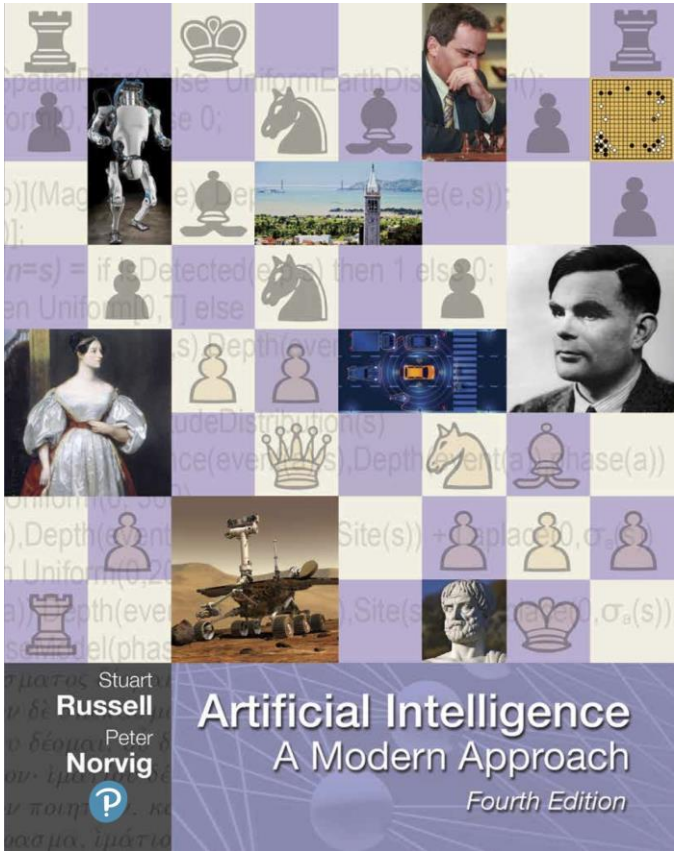
- Deal with the following 4 categories:
  - systems that think like humans
  - systems that act like humans
  - systems that think rationally
  - systems that act rationally

Introduction (3/3)

- Course Objectives & Scope
  1. Understand and use *problem searching agents* (informed and uninformed methods)
     - Understand the structure of an intelligent agent
  2. Understand and use *game playing* techniques
  3. Understand and use agents that *reason logically*
  4. Understand and build knowledge bases and use theorem proving
  5. Understand uncertainty perform probabilistic reasoning

TextBook


Stuart
Russell
Peter
Norvig
Artificial Intelligence
A Modern Approach
Third Edition


Stuart
Russell
Peter
Norvig
Artificial Intelligence
A Modern Approach
Fourth Edition

TODAY

- Introduce a brief history of AI (note: this is not a survey course)

- Start discussing the structure of an intelligent agent

Administrative overview - 1

- This is an *online* class.
  - All instruction and testing will be online.
  - I will teach Mondays and Wednesdays *live* 2:30-3:45pm, but it is also possible that sometimes I will record the class and post it on eLearning/ MS Streams
  - You should be able to get in MS Teams for the live lectures.
  - Announcements regarding classes will be made on eLearning as well as the class web page.

Administrative overview - 2

- Class web page:
  http://www.utdallas.edu/~sanda/courses/AI/cs6364.html
- Office hours: Wednesday 5-6pm by appointment
  - On eLearning Collaborate
- Course notes & Syllabus form are posted at:
  http://www.utdallas.edu/~sanda/AI/cs6364.html
- My e-mail address: sanda@utdallas.edu
- Pre-requisites: in E-Learing as Quiz1

Artificial Intelligence

- What is intelligence?
- What is an intelligent agent?

What kinds of **behavior** are intelligent?

- Examples: recognize a friend, recognize who is calling, translate from one language to another, interpret a photograph, talk, cook a dinner
- Formal tasks: prove a logic theorem, geometry, calculus, play chess, checkers, or Go
- Expert tasks: engineering design, medical designers, financial analysis, car driving
- What else?

What kinds of **behavior** are intelligent? (2)

Which of these tasks is harder? Why?

- Depends on what information is accessible and how amenable it is to formalization. Need to be able to write down at least some of the rules and identify critical properties
- Expert skills: often knowledge that is easier than "everyday" knowledge to write down and more amenable to formal manipulation
- Result: expert systems the first successful application area

What kinds of **behavior** are intelligent? (3)

- What would we want an intelligent system to do? What would we leave out?
  - Don’t need to eat
  - System design problems similar to rest of CS
  - No single right answer - part of AI’s challenge is defining appropriate tasks

What kinds of behavior are intelligent? (4)

- Turing test (1950)
  - Designed to provide an operational definition of intelligence
  - Intelligent behavior is the ability to achieve human-level performance in all cognitive tasks, sufficient to fool an interrogator
  - The computer would be interrogated by a human via a teletype. It passes the test if the interrogator can't tell if a human or a computer is at the other end.
  - Predicted by year 2000 a computer has 30% chance of passing a five minute interrogation. Did it happen? What was required?

The Turing Test

- **Turing's prophecy that computers would one day think**
- Turing's 1950 paper in *Mind*, *Computing Machinery and Intelligence,* has become one of the most cited in philosophical literature

The Turing Test

- **Turing's claim**
  - Turing held that computers would in time be programmed to acquire abilities rivaling human intelligence. As part of his argument Turing put forward the idea of an *'imitation game*', in which a human being and a computer would be interrogated under conditions where the interrogator would not know which was which, the communication being entirely by textual messages. Turing argued that if the interrogator could not distinguish them by questioning, then it would be unreasonable not to call the computer intelligent.
- Turing's 'imitation game' is now usually called 'the Turing test' for intelligence.

LOEBNER PRIZE

In 1991 Dr. Hugh Loebner started the annual Loebner Prize competition. Since 2014 it has been organised by the AISB at Bletchley Park. Within the field of artificial intelligence, the Loebner Prize is somewhat controversial; the most prominent critic, Marvin Minsky, called it a publicity stunt that does not help the field along.

https://en.wikipedia.org/wiki/Loebner_Prize

A Transcript

2005-09-18-10-30-36 CONFEDERATE: Hello, my name is Gianluca and I am the human.
2005-09-18-10-34-21 JUDGE: Hello. SOrry for the delay.
2005-09-18-10-34-40 CONFEDERATE: No problem.....
2005-09-18-10-34-49 JUDGE: HOw's it going so far?
2005-09-18-10-35-18 CONFEDERATE: It's going pretty well. How is going for you?
2005-09-18-10-35-42 JUDGE: The entity on the other terminal just said it was going to smash my face with a baseball bat!
2005-09-18-10-36-43 CONFEDERATE: Nice....Thats a mad entity. So tell me about yourself, and I promise I wont smash your face with a baseball hat :).

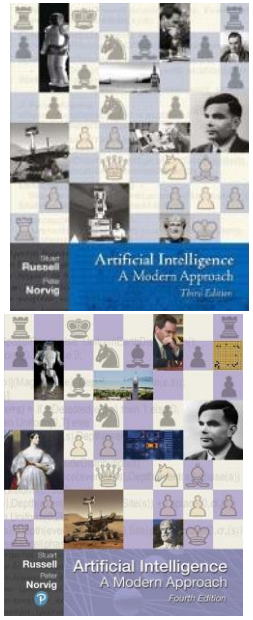
What kinds of **behavior** are intelligent? (5)

- Required capabilities:
  - natural language processing
  - knowledge representation
  - automated reasoning
  - machine learning
- Total Turing test includes video signal
  - would require computer vision to perceive objects and robotics to move them

Approach of course/textbook: systems that act rationally

- Textbook contrasts:

	Human-like	Rational
Think	**(A)Systems that think like humans**	**(C)Systems that think rationally**
Act	**(B)Systems that act like humans**	**(D)Systems that act rationally**



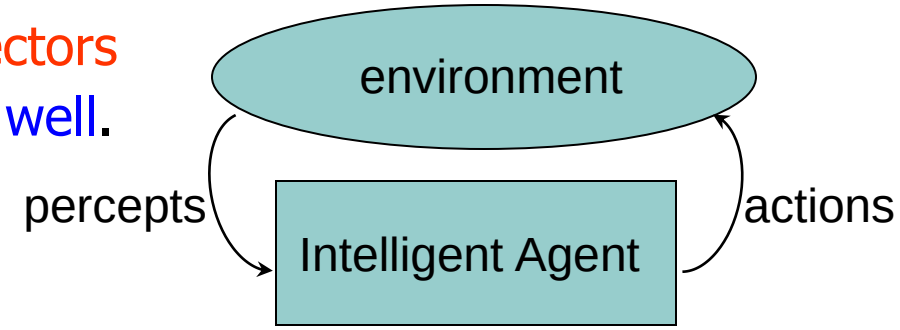
(A)=cognitive modeling, (B)=Turing test, (C)="laws of thought" - difference between in-principle and in-practice, (D)=act in such a way to achieve one's goals given one's beliefs "do the best you can"

Rational agents: Intelligent agents (1/3)

- Typical situations
  - Robot:
    - world, percepts, actions, sensors, effectors
  - Computer:
    - percepts=get information (e.g., from network)
    - effectors=take action (e.g., get a file)
    - major difference from robot: missing arms and legs.
- The Agent is in an environment

Rational agents: Intelligent agents (2/3)

- The Agent is in an environment
- perceives environment through sensors
- acts on environment through effectors
- goal: design agents that perform well.



Intelligence is based on: (1) perception and (2) capability of actions.

Agents must perform actions to obtain useful information (acquire more percepts).

An agent may be regarded as a mapping of percepts into actions.

- A *performance measure* is needed to determine how successful an agent is.

An ideal rational agent provides an action that maximizes its performance measure, based on the percepts received and its built-in knowledge.

Rational agents: Intelligent agents (3/3)

- Simple examples: dirt cleaning robot/cab driver
  - succeed at task
    - the room is clean/the car gets to destination
  - resource consumed
    - energy/cost of trip, efficiency of route
  - time consumed
  - for systems: how flexible, friendly is interaction with person?

Problems studied in AI (1/3)

- AI studies problems also addressed in philosophy, linguistics, decision theory, math, physics, but brings to its study the computer as a tool.
- Chapter 1 of text is excellent history; provides a discussion of the relation between fields.

Problems studied in AI (2/3)

- Philosophy:
  - Descartes: dualism (part of mind is not subject to physical laws. Free will.)
  - Leibniz: materialism (everything operates according to physical laws.)
  - intermediate position: accept that mind has a physical basis, but it cannot be explained by physical processes
  - Bacon, Locke: empiricism ("nothing in the understanding, which was not in the senses")
- Mathematics:
  - algorithms, formal logic, decidability, completeness, computability, intractability, probability, decision theory

Problems studied in AI (3/3)

- Psychology:
  - Helmholtz: vision
  - Wundt: scientific methods
  - Watson & Thorndike: behaviorism (objective study only, does not examine role of knowledge)
  - James: cognitive psychology, information processing
- Computer engineering: computers
- Linguistics:
  - Chomsky: theory of language that accounts for creativity in language

What are the basic building blocks for constructing an intelligent artifact?

- The need for the building blocks arise across different application areas:
  - vision/perception, **natural language**, motor skills, reasoning abilities
  - recall Turing test

What are the basic building blocks for constructing an intelligent artifact?

- ***Problem solving by searching*** through a space of possibilities to find a solution
  - Search space, generate as go
  - Blind search (e.g. depth-first, breadth-first - bit can do better)
  - Informed/heuristic search

What are the basic building blocks for constructing an intelligent artifact?

- ***Knowledge Representation*** of facts of the world in such a way that the AI system can reason with them effectively
  - agents that reason logically
  - first-order logic
  - building a knowledge base
  - inference in first-order logic
  - logical reasoning systems

What are the basic building blocks for constructing an intelligent artifact?

- Machine Learning
- Natural Language Processing
- Dialog
- Vision
- Planning

Relation to other courses at UTD

- Cool AI: Natural language processing
- Machine Learning: Modern AI
- Advanced classes in NLP and ML
- Robotics/Vision: Advanced AI