BLG435E
Artificial Intelligence

Instructor:

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About the Course

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- Course information and the documents are avaliable at: Ninova

Text Book & Readings

- S. Russell and P. Norvig,"Artificial Intelligence A Modern Approach", 3/e, Prentice Hall, 2010
  - Rezerved at the library (3/e)
- Additional Readings

Grading

- 70% attendance is required
- Midterm – 30%
- Final exam – 40%
  - Prerequisite
    - midterm grade > 20
    - Each assignment grade > 20 (for at least 2 assignments)
- 3 Assignments – 30%
  - 2 Quizzes

Course Objectives

- Introductory knowledge of AI
- Key to advanced topics in AI
- Present state-of-the-art AI techniques

Course Overview and Content

- Introduction and Brief History
- Intelligent Agents
- Problem Solving
- Knowledge and Reasoning
- Planning
- Learning
- Robotics

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Artificial Intelligence

Lecture 1: Introduction

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Outline

- What is AI
- A brief history
- The state of the art

What is intelligence?

- Defining intelligence by the properties it exhibits:
  - The ability
    - to solve problems
    - to answer questions
    - to devise plans
    - to deal with new situations, and so on..

What is Artificial Intelligence?

- The scientific understanding of the mechanisms underlying thought and intelligent behavior; and their embodiment in machines.
  - The Association for the Advancement of Artificial Intelligence (AAAI)
- Artificial Intelligence is the study of systems that act in a way that to any observer would appear to be intelligent.

Why study AI?

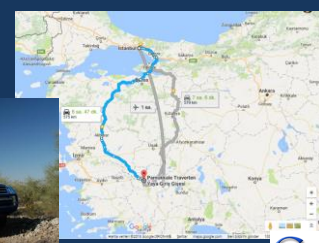
- Build intelligent systems

- Understand the nature of intelligence
- Make computers more effective
- Make computers easier for humans to work with
- Explore interesting intellectual questions
- Make money

Why study AI?





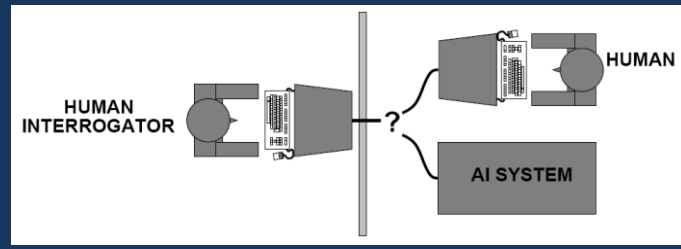



What is Artificial Intelligence? Different school of thoughts

Systems that **act** like **humans**	Systems that **think rationally**
"The art of creating machines that perform functions that require intelligence when performed by people" (Kurzweil, 1990)	"The study of mental faculties through the use of computational models" (Charniak et al. 1985)
Systems that think like humans	**Systems that act rationally**
"The exciting new effort to make computers thinks … machine with minds, in the full and literal sense" (Haugeland 1985)	"Computational Intelligence is the study of the design of intelligent agents" (Poole et al., 1998)

Acting humanly: The Turing Test

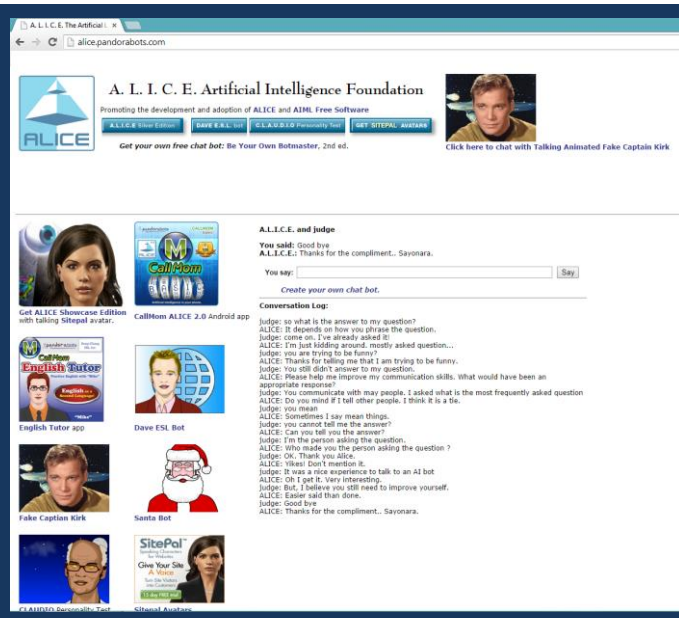
- Turing (1950) "Computing machinery and intelligence"
- Can machines think?



The Turing Test

- Predicted that by 2000, a machine might have a 30% chance of fooling a lay person for 5 minutes
- Suggested major components of AI: knowledge representation, reasoning, language understanding, learning
- Total Turing Test components: computer vision, robotics to manipulate objects
- not reproducible, constructive, or amenable to mathematical analysis

Conversation with a bot



The Chinese Room Argument

- John Searle, 1980

- A rule might have the form:
  - IF input is c1 followed by c2 followed by c3
  - THEN output is c2 followed by c4
- where the c's are Chinese characters

The Chinese Room Argument

- Running a computer program that behaves in an intelligent way does not necessarily produce understanding, conciousness, or real intelligence

Thinking humanly: Cognitive Science

- Requires scientific theories of internal activities of the brain
  - What level of abstraction? “Knowledge” or “circuits“?
  - How to validate? Requires
    - Predicting and testing behavior of human subjects (top-down)
    - Direct identification from neurological data (bottom-up)

Thinking humanly: Cognitive Science

- A human-centered approach involves
  - hypothesis and experimental confirmation
- A rationalist approach involves
  - a combination of mathematics and engineering
- Both approaches (roughly, Cognitive Science and Cognitive Neuroscience) are now distinct from AI
- Both share with AI the following characteristic:
  - the available theories do not explain (or engender) anything resembling human-level general intelligence

Thinking rationally: Laws of Thought

- Normative (or prescriptive) rather than descriptive
- Aristotle (~ 450 B.C.) attempted to codify "right thinking":
  - what are correct arguments/thought processes?
  - e.g., "Socrates is a man, all men are mortal; therefore Socrates is mortal"

Thinking rationally: Laws of Thought

- Several Greek schools developed various forms of logic:
  - notation and rules of derivation for thoughts; may or may not have proceeded to the idea of mechanization
  - Direct line through mathematics and philosophy to modern AI

Thinking rationally: Laws of Thought

Problems:

- Uncertainty:
  - not all intelligent behavior is mediated by logical deliberation
  - It is not easy to take informal knowledge and state it in the formal terms (logical notation)
- Solving a problem in principle and doing so in practice

Acting rationally

- Rational behavior: Doing the right thing!
- The right thing: That which is expected to maximize the expected return
- Provides the most general view of AI because it includes:
  - Correct inference (“Laws of thought”)
  - Handling uncertainty
  - Resource limitation considerations (e.g., reflex vs. deliberation)

Rational Agents

- Abstractly, an agent is a function from percept histories to actions:

$$f : \mathcal{P}^* \rightarrow \mathcal{A}$$

- perceives and acts autonomously, adapts to changes to achieve the best (expected) outcome
  - computational limitations make perfect rationality unachievable

History of AI

1943	McCulloch & Pitts: Boolean circuit model of brain
1950	Turing's "Computing Machinery and Intelligence"
1952–69	Look, Ma, no hands!
1950s	Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
1956	Dartmouth meeting: "Artificial Intelligence" adopted
1965	Robinson's complete algorithm for logical reasoning
1966–74	AI discovers computational complexity Neural network research almost disappears
1969–79	Early development of knowledge-based systems
1980–88	Expert systems industry booms
1988–93	Expert systems industry busts: "AI Winter"
1985–95	Neural networks return to popularity
1988–	Resurgence of probability; general increase in technical depth "Nouvelle AI": ALife, GAs, soft computing
1995–	Agents, agents, everywhere . . .
2003–	Human-level AI back on the agenda

The State of the Art

Which of the following can be done at present?

- Play a decent game of table tennis
- Drive safely along a curving mountain road
- Drive safely along Taksim Square
- Buy a week's worth of groceries on the web
- Buy a week's worth of groceries at a supermarket
- Play a decent game of bridge
- Discover and prove a new mathematical theorem
- Design and execute a research program in molecular biology
- Write an intentionally funny story
- Give competent legal advice in a specialized area of law
- Translate spoken English into spoken Swedish in real time
- Converse successfully with another person for an hour
- Perform a complex surgical operation
- Unload any dishwasher and put everything away

AI journals, Conferences, Societies

- http://aaai.org/AITopics/

- Biennial International Joint Conference on AI (IJCAI)
- National Conference on AI (AAAI)
- Joint Conference on Autonomous Agents and Multi-Agent Systems (AAMAS)
- International Conference on Automated Planning and Scheduling (ICAPS)

- Artificial Intelligence (Journal)
- Journal of Artificial Intelligence Research (Journal)
- Computational Intelligence (Journal)
- IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI) (Journal)
- IEEE Intelligent Systems (Journal)
- Autonomous Agents and Multi-Agent Systems (Journal)
- AI Magazine

- AAAI-Association for the Advancement of Artificial Intelligence *(Formerly* American Association for Artificial Intelligence)
- SIGART -ACM Special Interest Group in AI