

# Artificial Intelligence

CS482, CS682, MW 1 – 2:15, SEM 201, MS 227

Prerequisites: 302, 365

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# Syllabus

- Webpage: <http://www.cse.unr.edu/~sushil/class/ai/>
- Textbook: Russell and Norvig's [\*Artificial Intelligence a Modern Approach, Third edition\*](#)
  
- 40 % Assignments
- 40% Exams
- 20% Final Project
- Pairs encouraged
- Read the syllabus
- First assignment due Sept 11

# Outline

- What is AI?
- A Brief History of AI
- What is the state of the Art

# What is AI?

- AI seeks to understand and build intelligent entities
  - AI is new
    - AI coined in 1956 at Workshop at Dartmouth
  - AI is hard
- 
- But what is it?

# Definitions

## Thinking Humanly

The automation of activities that we associate with human thinking...

(Haugeland)

## Acting Humanly

The study of how to make computers do things at which, at the moment, people are better (Rich and Knight)

Human performance metric

## Thinking Rationally

The study of the computations that make it possible to perceive, reason, and act (Wilson)

## Acting Rationally

AI is concerned with intelligent behavior in artifacts (Nilsson)

Ideal or rational performance metric

# Acting humanly – Turing

- Turing Test is an operational test for intelligent behavior (Turing, 1950)
- Turing predicted that by 2000, a machine might have a 30% chance of fooling a lay person for 5 minutes
- Language, knowledge, reasoning, learning
- Natural language processing
- Knowledge representation
- Automatic reasoning
- Machine learning
- Total Turing test:
  - Computer vision
  - Robotics

# Thinking humanly

- How do we answer how do we think?
  - Introspection
  - Experimentation – observing a person in action
  - Brain imaging
- Once we know sufficiently precisely how we think , we can write a computer program to do this
- This is Cognitive Science
  - Distinct from AI but cross fertilization

# Thinking rationally

- Socrates is a man, All men are mortal, Therefore Socrates is mortal
- Logic and derivation rules
- Once you have Facts, and a set of rules for manipulating facts, you can (automatically) derive conclusions (prove theorems)
  
- We will study logic and the limits of theorem proving



# Acting Rationally

- Rational behavior: doing the right thing
  - Maximize goal achievement given the available information
- An agent is just something that acts
- Doesn't necessarily involve "thinking rationally"
  - Hot stove reflex is not the effect of a logical sequence of rule applications that deduce the optimal action is to move hand away from stove

# Rational Agents

- An agent is an entity that perceives and acts
- $F(P^*) \rightarrow \text{Action}$
- For any given class of environments and tasks, we seek the agent (or class of agents) with the best performance
  
- Perfect rationality is computationally intractable
- So we design the best program for given machine resources

# Foundations and History

- Philosophy
  - Logic, methods of reasoning, foundations of learning, language, rationality
- Mathematics
  - Formal representations and proof. Algorithms, computation, decidability, tractability, probability
- Economics
  - Rational agents maximize profits (payoff), OR
- Psychology
  - Adaptation, learning, Experimental techniques
- Neuroscience
  - Neural nets, when will computers reach human level computing capacity
- Control Theory
  - Homeostatic systems, agents maximize an objective function, agents minimize error between goals state and current state

# History

- 1942: Boolean circuit model of the brain
- 1950: Turing
- 1950s:
  - Samuel: Checkers
  - Newell and Simon: Logic Theorist
  - Gelernter: Geometry engine
- 1956: Dartmouth Meeting. The term: Artificial Intelligence coined
- 50s-60s: Everyone: Cannot do X. AI: Here's a program for X. Lisp invented
- Mid 60s: Computational Complexity kills scaling up in AI
- 70s: Expert systems
- 80s+: Industrial Expert systems
- 90s: AI winter + Neural Nets, GAs, NNs, Fuzzy logic
- 90s: Agents
- 2003+: Human level competitiveness with very large data sets

# State of the Art: Stanley



# State of the Art: Robotics



# State of the art

- Speech recognition
  - United Airlines' speech recognition system for support, booking
  - Siri,
- Planning and Scheduling
  - Spacecraft ops (Nasa's rovers)
- Games
  - Deep blue and chess. Humans are no longer competitive
- Spam fighting
  - 80 – 90 % filtered out
- Logistics
  - DART generated plans in hours that would have taken weeks
  - DARPA stated that this single application paid back DARPA's 30 year investment in AI
- Machine Translation: Google translate?