What is AI? 
This class 
Problems in AI 
Search 

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“Thinking inside the box.” 

5 handouts: course info, project info, schedule, slides, asst 1
What is AI?
My Definition of AI

What is AI?
■ My Definition
■ Robots
■ Intelligence
■ The Goal
■ Relations
■ AI Today
■ Robots Today

This class

Problems in AI

Search
What is a Robot?

Artificial physical system that takes adaptive action.

- remote-controlled car
- power tool
- robotic surgery
- motion sensor
- thermostat
- anti-lock brakes
- automated delivery
- autopilot
- self-driving car
- Ava, Data...
What is Intelligence?

What behaviors require intelligence?
What makes an agent intelligent?
How to understand Intelligence?

Cognitive modeling: behaves like a human

Engineering: achieve human performance

Rational: behaves perfectly, normative

Bounded-rational: behaves as well as possible

Subfields: knowledge representation and reasoning, computer problem-solving, planning, machine learning, natural language processing, (autonomous) robotics, intelligent agents, multi-agent systems, distributed AI, intelligent user interfaces, machine vision

Other terms: computational intelligence

Related: adaptive behavior, complex adaptive systems, artificial life, cognitive modeling
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- CS: algorithms
- Engineering: applications
- Cognitive psychology: modeling
- Philosophy: mind, rationality
- Math: logic
- Linguistics: language processing
- Operations research: optimization
- Economics: agents
- Game playing: chess, checkers, backgammon, Jeopardy!, crosswords, go
- Design: VLSI, jet engines
- Diagnosis: POS, NASD, loans, customer service, medical testing and classification, DS1
- Planning: airports, flight routes, Dell, DART, Orbitz
- Learning: Amazon, Netflix, Walmart
- Robotics: ping-pong, beer fetch, driving, flying
- Language: voice recognition (Siri), translation (Google)
- Vision: scene descriptions
- Hidden: logistics, server farm control
Honda Asimo: virtually no autonomy.
Robots Today: Beautiful Hardware

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Robots Today

NASA Mars Science Lab: some navigation autonomy.
Robots Today: Beautiful Hardware

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AUVs: dynamic environment, poor communication.
Boston Dynamics LS3: follow me.
Robots Today: Beautiful Hardware

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Kiva Systems: bring inventory to pickers.
KAIST Hubo: winner of the 2015 DRC.
Robots Today: Beautiful Hardware

Willow Garage PR2: 22 degrees of freedom.
Robots Today: Beautiful Hardware

Yamaha RMax at Linköping University: autonomous.
Google Self-Driving Car: over 1.8M miles, 13 minor accidents.
This class

What is AI?

This class
- The AI View
- An AI Agent
- Schedule
- Course Mechanics

Problems in AI

Search
The AI View of An Agent

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Problems in AI

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percepts $\rightarrow$ brain $\rightarrow$ actions
An AI Agent

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Problems in AI
Search

agent

sensing

actions

world

Wheeler Ruml (UNH)
Lecture 1, CS 730 – 12 / 23
An AI Agent

- What is AI?
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Diagram:
- Agent
  - World model
  - Planner
  - Sensing
  - Actions
  - World
An AI Agent

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Schedule

Course Mechanics

Problems in AI

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agent

world model

planner

search

sensing

world

actions
1. planning: vacuum tasks, hovercraft motion, puzzle
   state-space search
   constraint satisfaction
   combinatorial optimization
2. KR: theorem provers
   propositional logic
   first-order logic
3. more planning: general planner, probabilistic planner
   domain-independent planning
   Markov decision processes
4. perception: digits, shapes, localization
   supervised and unsupervised learning
   hidden Markov models

See also: Intro to mobile Robotics, Intro to Machine Learning
Not: NLP, cognitive modeling, philosophy
Course Mechanics

- General information
- Schedule
- Project
- Asst 1
Problems in AI

- Agent Designs
- Examples
- Environments

Search
Agent Designs

Agent \Leftrightarrow \text{Environment}

**Perception:** vision, state estimation

**Planning:** low/high-level, on/off-line, incremental/repair

**Acting:** dispatching, monitoring, diagnosis

**Reflex:** sensors $\rightarrow$ effectors

**Reflex with state:** sensors + state $\rightarrow$ effectors + new state

**Goal-based:** reason from goals to means

**Utility-based:** use quantitative measure of happiness
What kind of agent?

1. Thermostat
2. autonomous armed drone
3. Mail delivery robot
4. Medical diagnosis system
Environments

**Observability:** complete, partial, hidden
**Predictability:** deterministic, strategic, stochastic
**Interaction:** one-shot, sequential
**Time:** static, dynamic
**State:** discrete, continuous (also time, percepts, and actions)
**Agents:** single, multiagent (competitive, cooperative)
State-Space Search
This particular pattern of molecules known as a 'human being' has evolved an amazing depth of consciousness: an ability to internally model the reality beyond the senses, to imagine futures that have never happened, to use language, to use rationality to build and test theories about our universe, to become self-aware.
—Jeff Lieberman (artist, roboticist)
The ability to think is perhaps the most distinctive of human capacities. Typically, thinking involves mentally representing some aspects of the world (including aspects of ourselves) and manipulating these representations or beliefs so as to yield new beliefs, where the latter may aid in accomplishing a goal.

—Edward E. Smith (Psychology, U Michigan)

The ability to solve problems is one of the most important manifestations of human thinking. ... We might therefore suspect that problem solving depends on general cognitive abilities that can potentially be applied to an essentially unlimited range of domains.

—Keith Holyoak (Psychology, UCLA)
Please write down the most pressing question you have about anything related to the course (no need to include your name) and put it in the box on your way out.

Thanks!