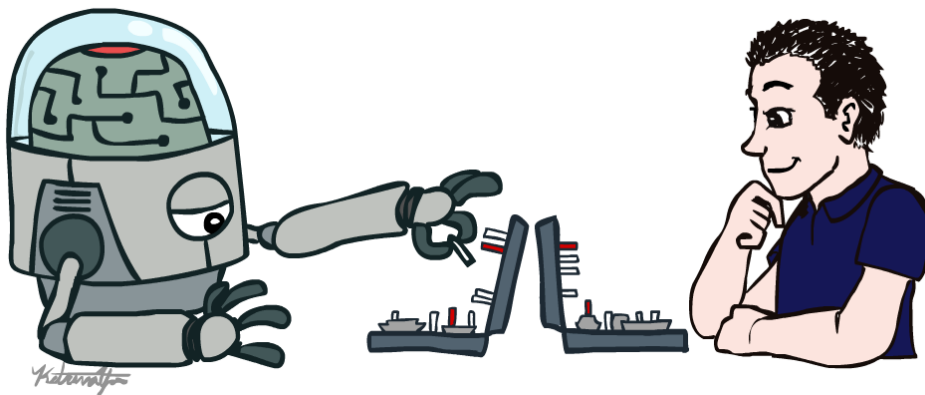


Artificial Intelligence: Basics & Applications

Introduction



Instructor: *Mahdi Javanmardi*



Amirkabir University of Technology

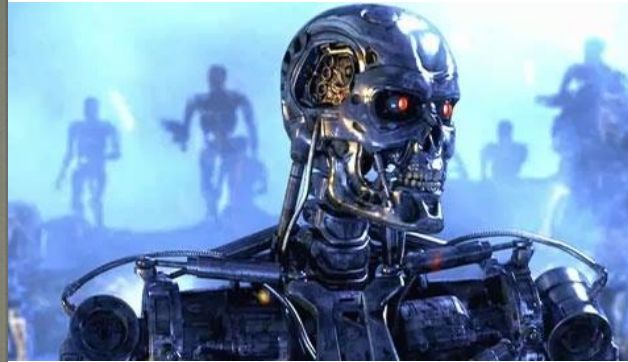
[slides adapted from Dan Klein, Pieter Abbeel, Anca Dragan @ai.berkeley.edu]

Sci-fi & AI

1970s



1980s



1990s

2000s







TUG
CAUTION
MAY CONTAIN
CHEMOTHERAPY DRUG

CAUTION
MAY CONTAIN
CHEMOTHERAPY DRUG



AI



۱۰۵ متر آپارتمان دو خواب فاز ۸ پردیس

محلتهای پیش در تهران، پردیس | فروش آپارتمان

چیت	اطلاعات تماس
متراژ	۱۰۵
مساحت	۳۹۹
اتاق	۲
قیمت کل	۸۵۰۰۰۰۰۰ تومان
قیمت هر متر	۸۰۰۰۰۰۰ تومان
آژانس املاک	پردیس
تلفن	۲ از ۵

ویژگی‌ها و امکانات

- آسانسور
- پارکینگ
- انباری

آگهی‌های مشابه در این محله



آگهی‌های مشابه در دیگر محله‌ها



Snapp!™



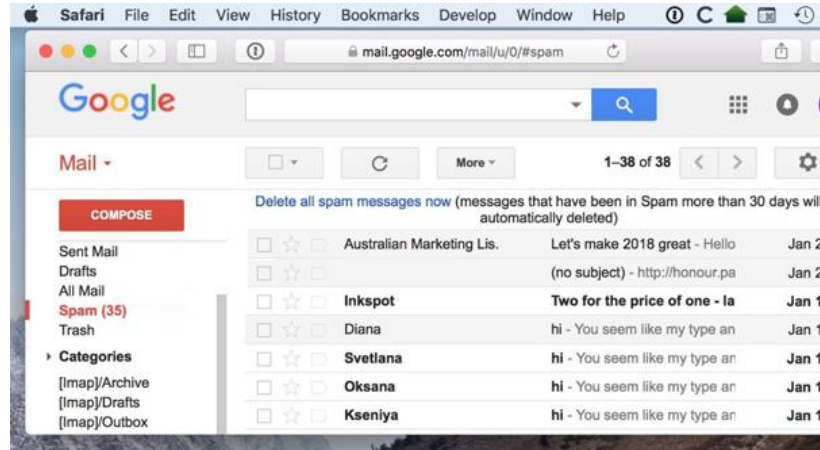
AI

Google

Search Google or type a URL

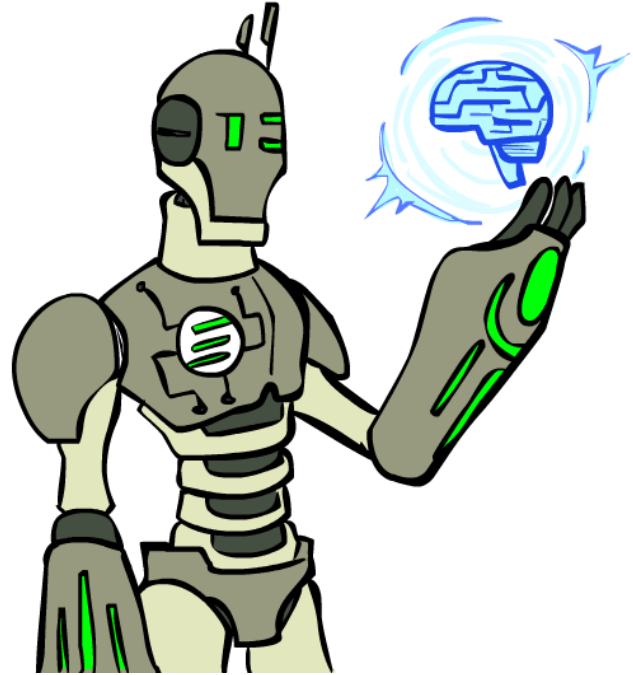


waze



Today

- What is artificial intelligence?
- Where did it come from/What can AI do?
 - What should we and shouldn't we worry about? What can we do about the things we should worry about?
- What is this course?



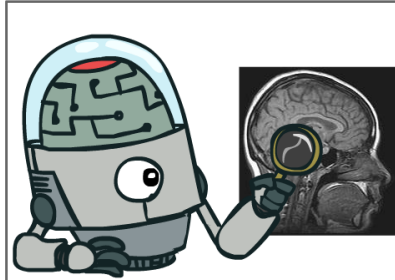
This lecture:

- What is it / what are the basics of how it works?
- What are things we should and should not worry about?
 - How might we fix the things we should worry about?

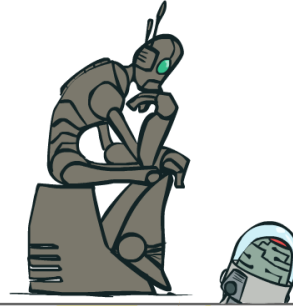
What is AI?

The science of making machines that:

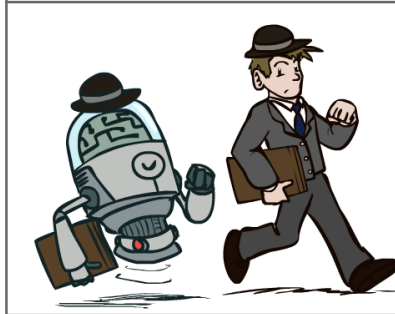
Think like
people



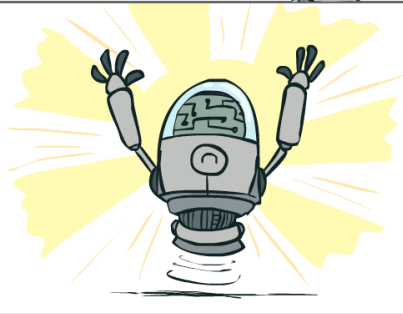
Think rationally



Act like people



Act rationally



Rational Decisions

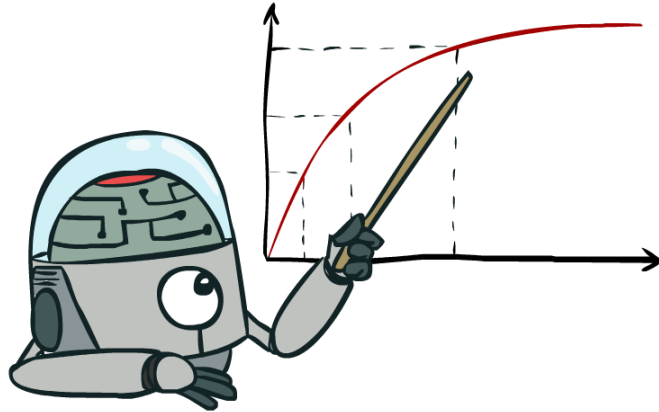
We'll use the term **rational** in a very specific, technical way:

- Rational: maximally achieving pre-defined goals
- Rationality only concerns what decisions are made
(not the thought process behind them)
- Goals are expressed in terms of the **utility** of outcomes
- Being rational means **maximizing your expected utility**

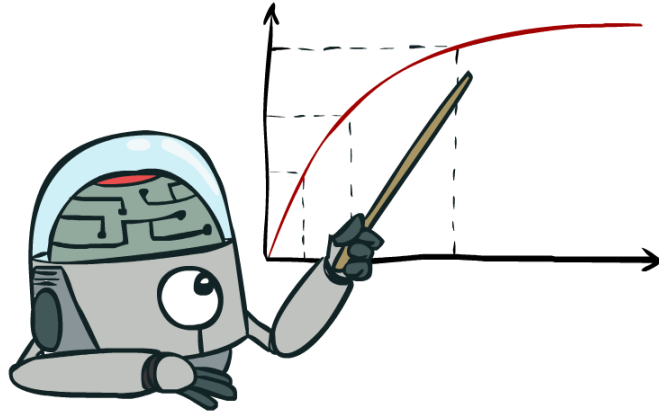
A better title for this course would be:

Computational Rationality

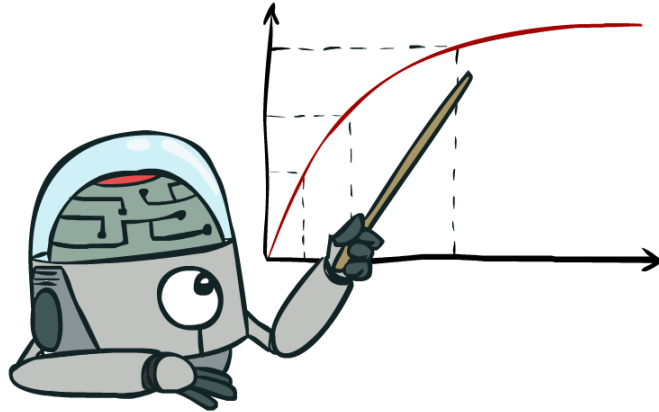
Maximize Your Expected Utility



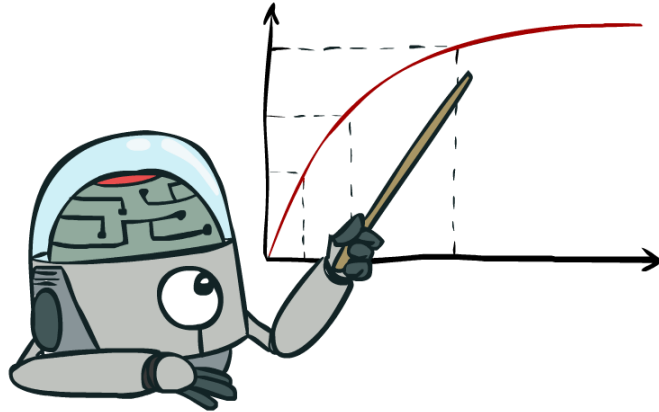
Maximize Your Expected Utility



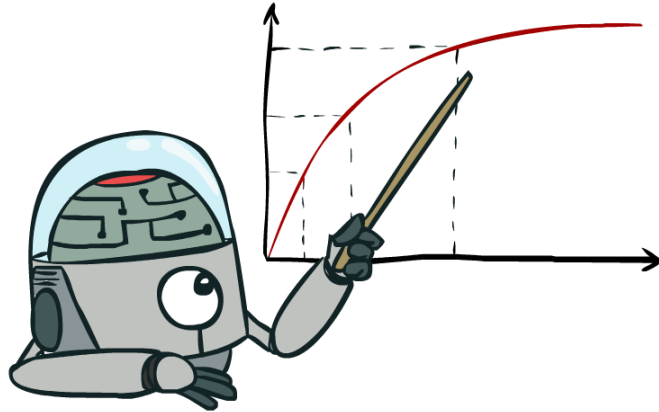
Maximize Your Expected Utility



Maximize Your Expected Utility



Maximize Your Expected Utility



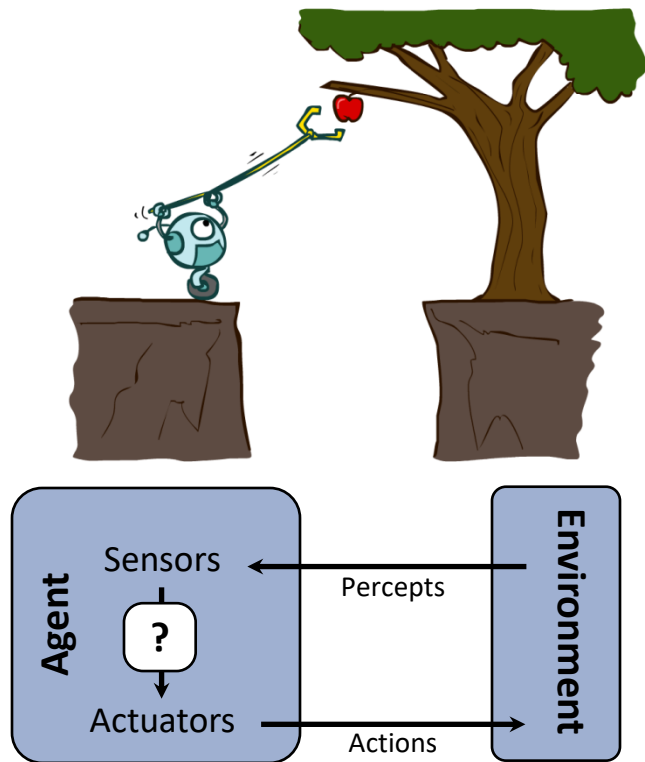
What About the Brain?

- Brains (human minds) are very good at making rational decisions, but not perfect
- Brains aren't as modular as software, so hard to reverse engineer!
- “Brains are to intelligence as wings are to flight”
- Lessons learned from the brain: memory and simulation are key to decision making

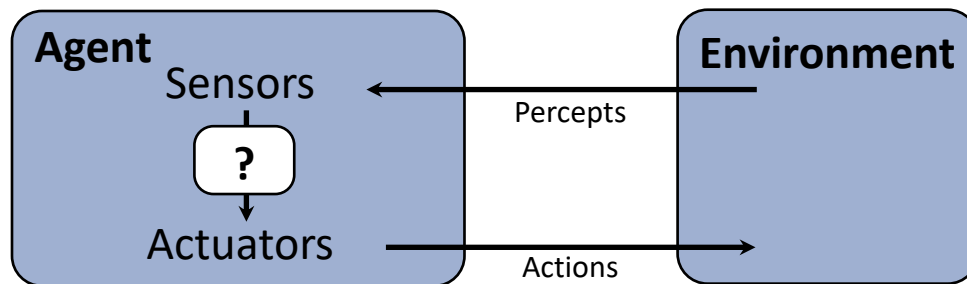
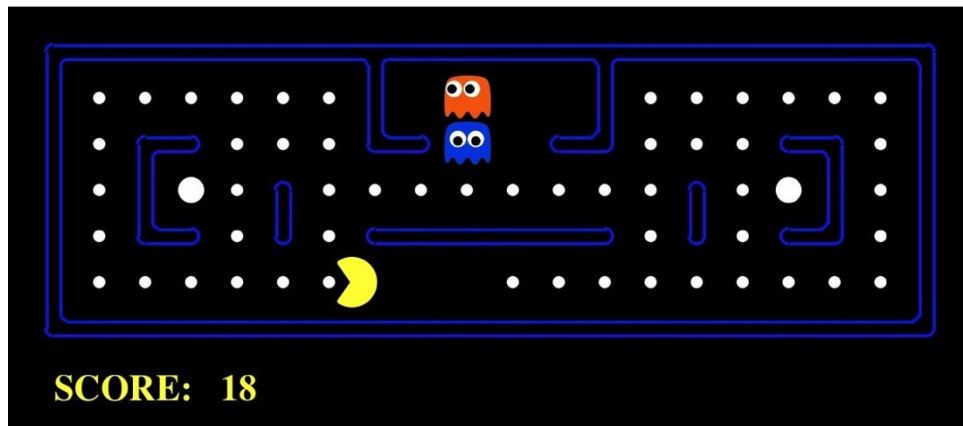


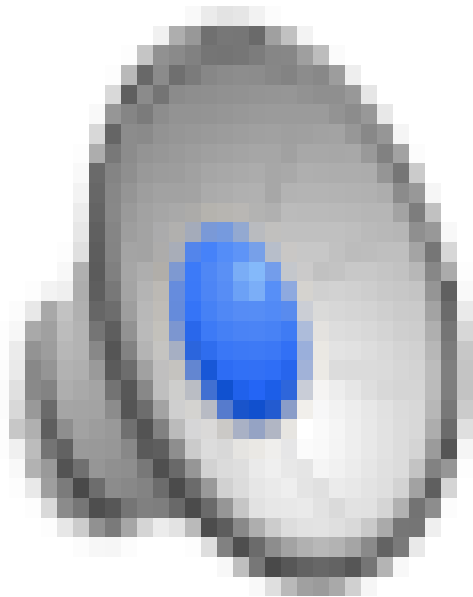
Designing Rational Agents

- An **agent** is an entity that *perceives* and *acts*.
- A **rational agent** selects actions that maximize its (expected) **utility**.
- Characteristics of the **percepts**, **environment**, and **action space** dictate techniques for selecting rational actions
- **This course is about:**
 - General AI techniques for a variety of problem types
 - Learning to recognize when and how a new problem can be solved with an existing technique



Pac-Man as an Agent





Instructor



Mahdi Javanmardi

email: mjavan@aut.ac.ir | office: 4th floor CE department

Courses:

Artificial Intelligent: Basics & Applications

Introduction to Algorithms

Introduction to Robotics

Applied Machine Learning

Probabilistic Robotics

3D Computer Vision

HTA



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Jafaraghaei

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TAs



Mohamad.H
Mohamadirad



Soroush
Mortazavi



Ali
Azizi



Elham
Razi



Milad
Esrafilian



Hedieh
Pourghasem



M.Amin
Habibollah

Course page

- Course page
 - schedules
 - resources
 - lecture slides and notes
 - video recordings
 - course policies, etc.
- <https://courses.aut.ac.ir/course/>

courses.aut.ac.ir

- Communication:

- courses – ask and answer questions; announcements

- <https://courses.aut.ac.ir/course/>

- private matters – private messages

- if your message is not answered promptly enough, here is my email:

- mjavan@aut.ac.ir

- Assignments/Projects – email head TA matinaghahi.1377@gmail.com

Course Format

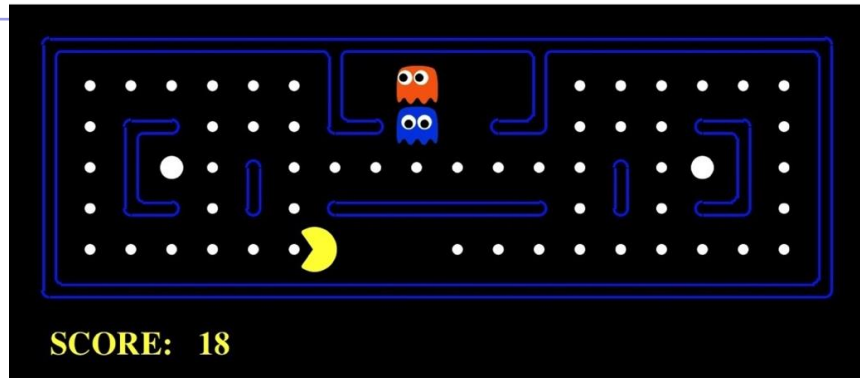
- Lectures Sunday-Tuesday
 - I'd love for you to show up and actively engage; participation credit (Maybe)
 - Raise your hand to ask question (preferred; chat also ok)
 - Actively participate polls!
- Recorded, will be available on course page
 - Slides will be posted before lecture (most of the times)
 - Lecture notes will be posted after lecture

Course Format (continued)

- Written Homeworks (3 points)
 - Total 5 homeworks
 - Exercises based on class material
 - Get you comfortable with the basics
 - Give you a more conceptual understanding of the material
 - More exam-style questions
 - Solve together, submit alone
 - Academic integrity!
 - I expect you to get 100% on electronic homework
 - *No slip days* (might change)

Course Format (continued)

- Projects (5 points)
 - 4 or 5 projects, done individually
 - Python
 - Give you hands-on experience with the algorithms
 - I expect you to get 100% on projects
 - 5 slip days, max 2 per project (might change!)
 - After that, loose 20% per day turned in late

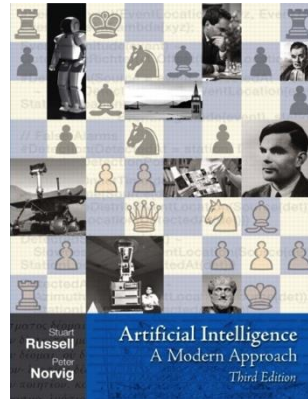


Course Format (continued)

- Exams
- Midterm (6 points) Date: TBA
- Final Exam (7 points) Date: [13:30-16] 1400/10/29
- **Exams are the main assessment tool, so they are hard**
 - Exam practice sessions!
 - Written homework, exam style!
- **These scores might change slightly...**

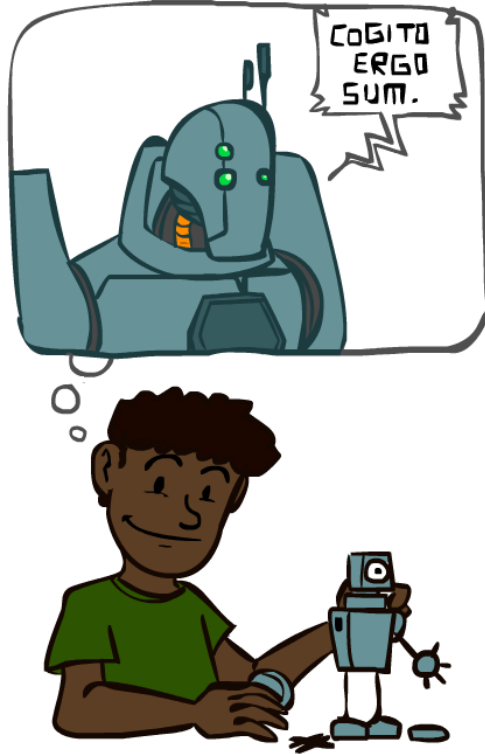
Textbook

- Not required, but for students who want to read more we recommend
 - Russell & Norvig, AI: A Modern Approach



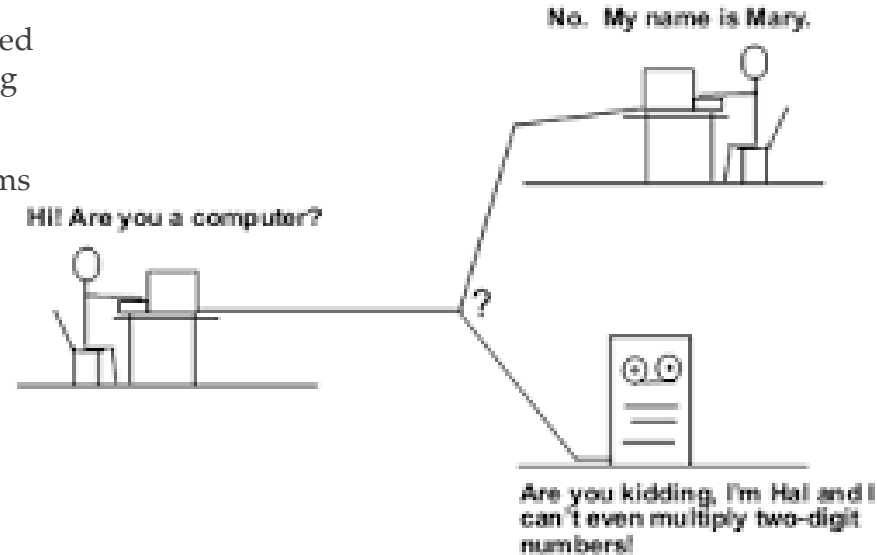
- Warning: Not a course textbook, so our presentation does not necessarily follow the presentation in the book.

A (Short) History of AI



A (Short) History of AI

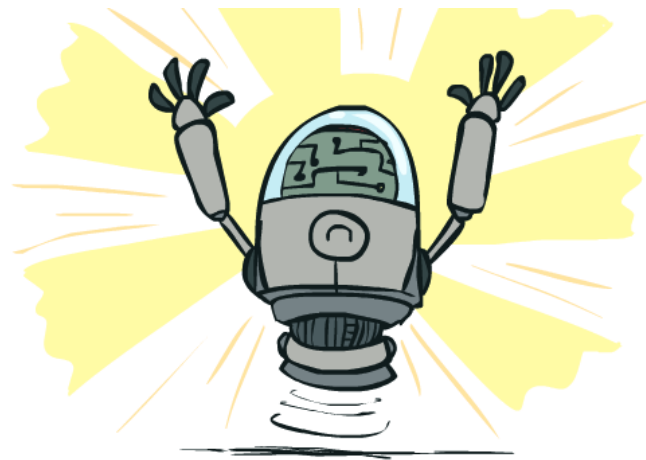
- 1940-1950: Early days
 - 1943: McCulloch & Pitts: Boolean circuit model of brain
 - 1950: Turing's "Computing Machinery and Intelligence"
- 1950—70: Excitement: Look, Ma, no hands!
 - 1950s: Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
 - 1956: Dartmouth meeting: "Artificial Intelligence" adopted
 - 1965: Robinson's complete algorithm for logical reasoning
- 1970—90: Knowledge-based approaches
 - 1969—79: Early development of knowledge-based systems
 - 1980—88: Expert systems industry booms
 - 1988—93: Expert systems industry busts: "AI Winter"
- 1990—: Statistical approaches
 - Resurgence of probability, focus on uncertainty
 - General increase in technical depth
 - Agents and learning systems... "AI Spring"?
- 2000—: Where are we now?



What Can AI Do?

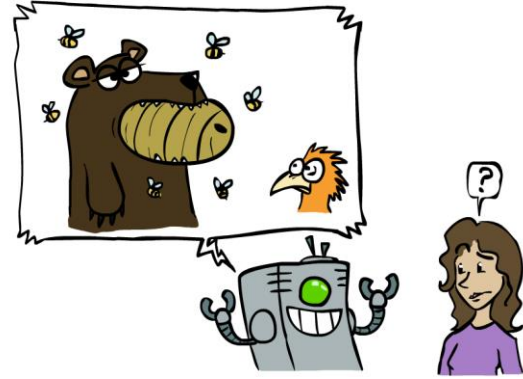
Quiz: Which of the following can be done at present?

- ✓ Play a decent game of Barandeh Sho?
- ✓ Win against any human at chess?
- ✓ Win against the best humans at Go?
- ✓ Play a decent game of table tennis?
- ✓ Grab a particular cup and put it on a shelf?
- ✗ Unload any dishwasher in any home?
- ❓ Drive safely along the highway?
- ✗ Drive safely along Jomhoori Avenue?
- ✓ Buy a week's worth of groceries on the web?
- ✗ Buy a week's worth of groceries at Ofoghe Koorosh?
- ❓ Discover and prove a new mathematical theorem?
- ✗ Perform a surgical operation?
- ✗ Unload a known dishwasher in collaboration with a person?
- ✓ Translate spoken Chinese into spoken English in real time?
- ✗ Write an intentionally funny story?



Unintentionally Funny Stories

- One day Joe Bear was hungry. He asked his friend Irving Bird where some honey was. Irving told him there was a beehive in the oak tree. Joe walked to the oak tree. He ate the beehive. The End.
- Henry Squirrel was thirsty. He walked over to the river bank where his good friend Bill Bird was sitting. Henry slipped and fell in the river. Gravity drowned. The End.
- Once upon a time there was a dishonest fox and a vain crow. One day the crow was sitting in his tree, holding a piece of cheese in his mouth. He noticed that he was holding the piece of cheese. He became hungry, and swallowed the cheese. The fox walked over to the crow. The End.





Game Agents

- Classic Moment: May, '97: Deep Blue vs. Kasparov
 - First match won against world champion
 - “Intelligent creative” play
 - 200 million board positions per second
 - Humans understood 99.9 of Deep Blue's moves
 - Can do about the same now with a PC cluster
- 1996: Kasparov Beats Deep Blue

“I could feel --- I could smell --- a new kind of intelligence across the table.”
- 1997: Deep Blue Beats Kasparov

“Deep Blue hasn't proven anything.”

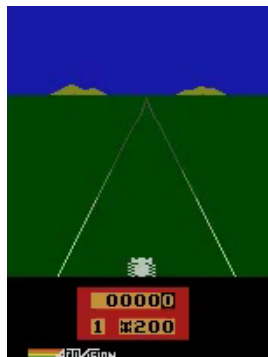


Game Agents

- Reinforcement learning



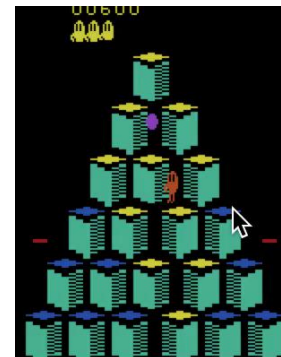
Pong



Enduro



Beamrider



Q*bert

○ Reinforcement learning



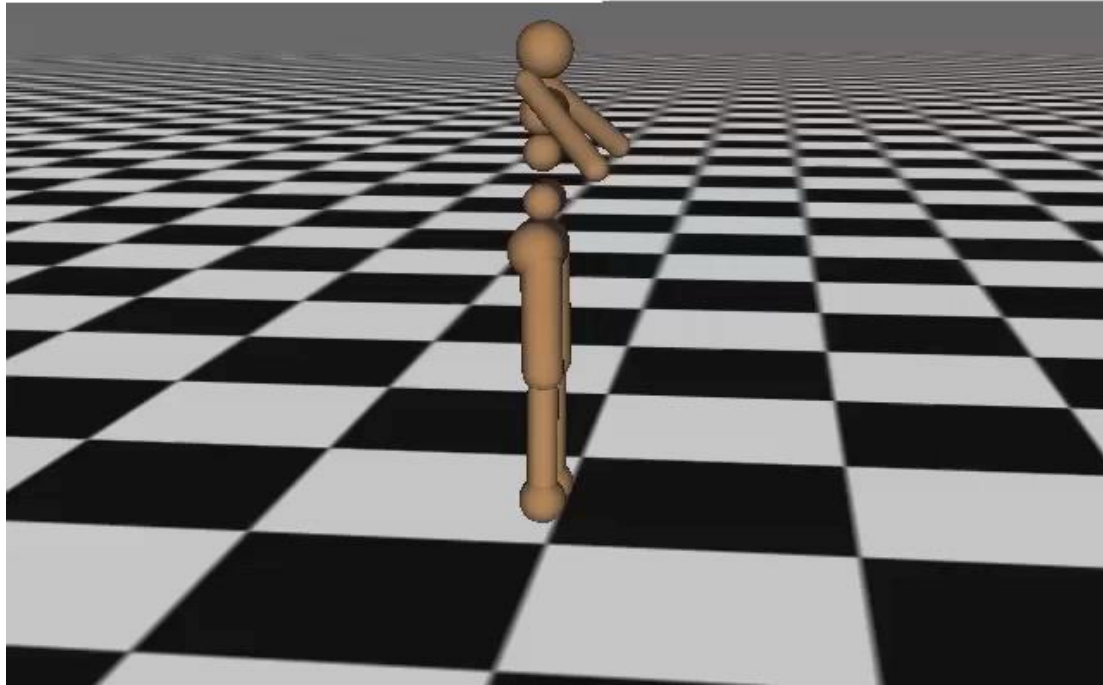
AlphaGo

October 2015 - 2017



Simulated Agents

Iteration 0



Robotics

Demo 1: ROBOTICS – soccer.avi

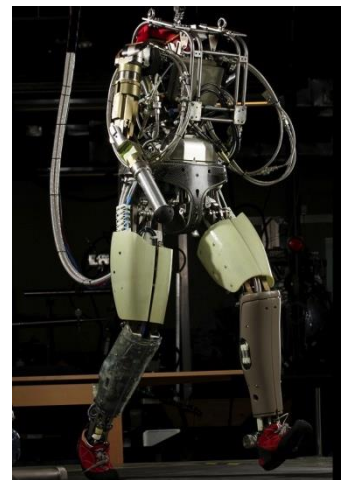
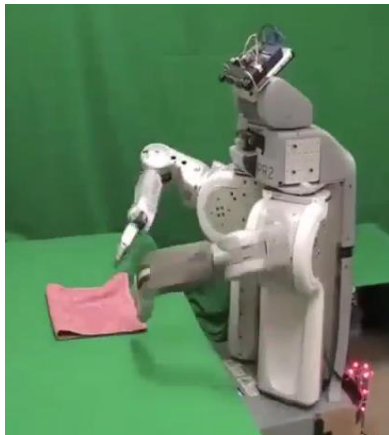
Demo 4: ROBOTICS – laundry.avi

Demo 2: ROBOTICS – soccer2.avi

Demo 5: ROBOTICS – petman.avi

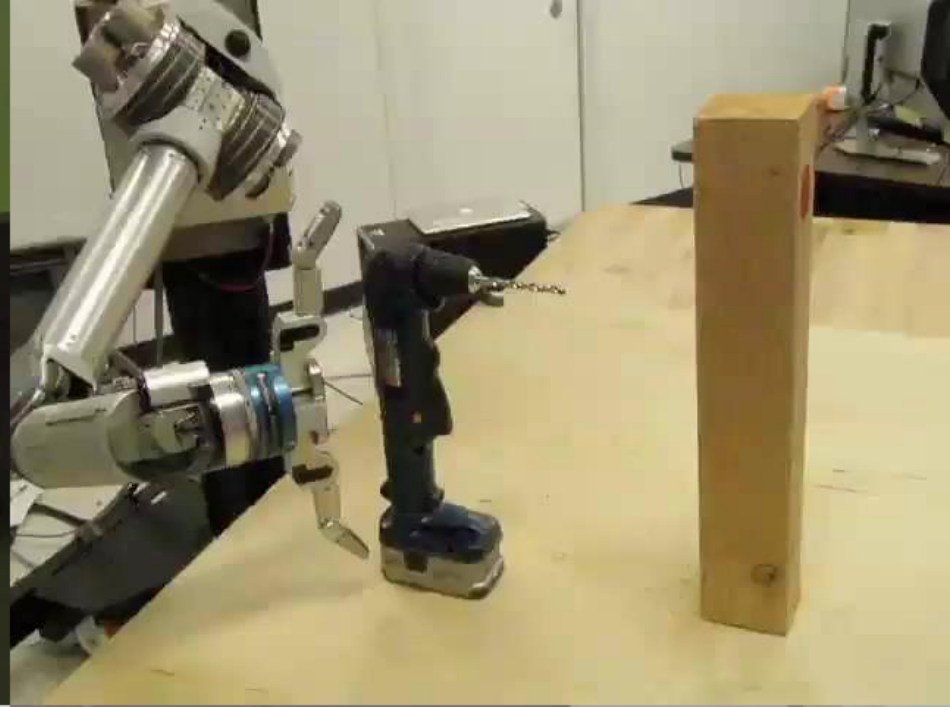
Demo 3: ROBOTICS – gcar.avi

- Robotics
 - Part mech. eng.
 - Part AI
 - Reality much harder than simulations!
- Technologies
 - Vehicles
 - Rescue
 - Help in the home
 - Lots of automation...
- In this class:
 - We ignore mechanical aspects
 - Methods for planning
 - Methods for control

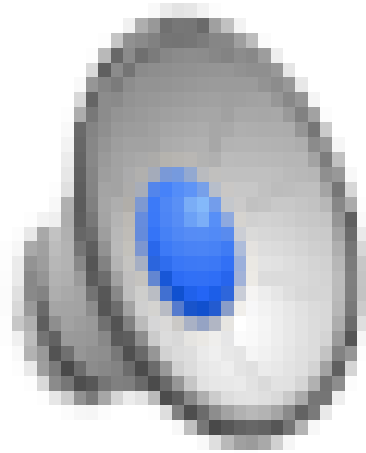


Images from UC Berkeley, Boston Dynamics, RoboCup, Google

Robots



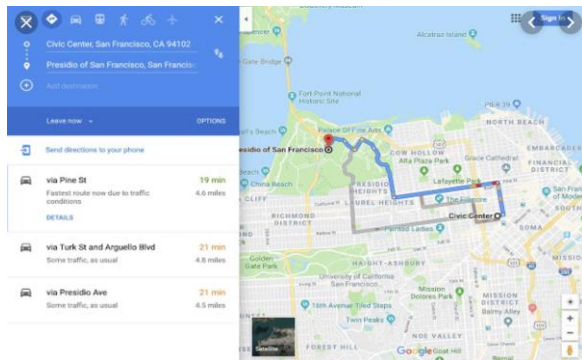
Robots



Human-AI Interaction

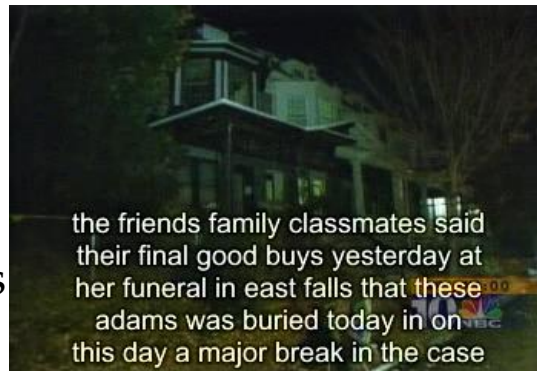


Tools for Predictions & Decisions



Natural Language

- Speech technologies (e.g. Siri)
 - Automatic speech recognition (ASR)
 - Text-to-speech synthesis (TTS)
 - Dialog systems
- Language processing technologies
 - Question answering
 - Machine translation



"Il est impossible aux journalistes de rentrer dans les régions tibétaines"

Bruno Philip, correspondant du "Monde" en Chine, estime que les journalistes de l'AFP qui ont été expulsés de la province tibétaine du Qinghai "n'étaient pas dans l'illégalité".

Les faits Le dalaï-lama dénonce l'"enfer" imposé au Tibet depuis sa fuite, en 1959

Vidéo Anniversaire de la rébellion



"It is impossible for journalists to enter Tibetan areas"

Philip Bruno, correspondent for "World" in China, said that journalists of the AFP who have been deported from the Tibetan province of Qinghai "were not illegal."

Facts The Dalai Lama denounces the "hell" imposed since he fled Tibet in 1959

Video Anniversary of the Tibetan rebellion: China on guard



- Web search
- Text classification, spam filtering, etc...

Computer Vision



"man in black shirt is playing guitar."



"construction worker in orange safety vest is working on road."



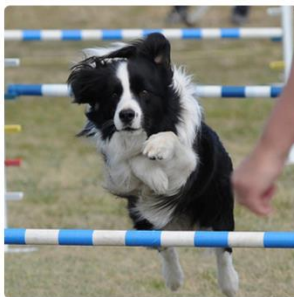
"two young girls are playing with lego toy."



"boy is doing backflip on wakeboard."



"girl in pink dress is jumping in air."



"black and white dog jumps over bar."



"young girl in pink shirt is swinging on swing."



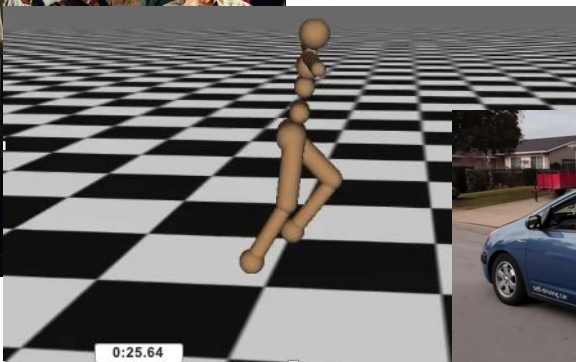
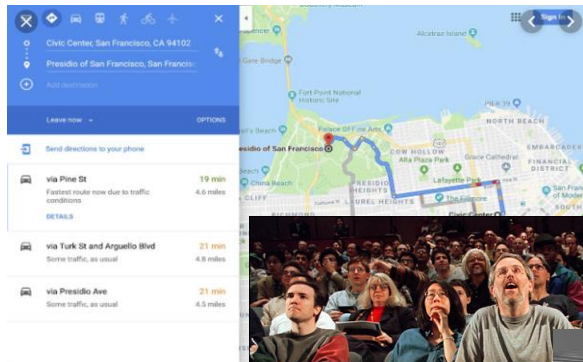
"man in blue wetsuit is surfing on wave."

Karpathy & Fei-Fei, 2015; Donahue et al., 2015; Xu et al, 2015; many more

Topics

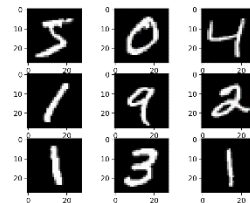
- Constraint satisfaction, e.g. scheduling
- Search, planning, reinforcement learning, e.g. routing, robot navigation
- Probabilistic inference, e.g. robot localization
- A bit of supervised machine learning, e.g. spam detection

The kinds of AI problems in this course

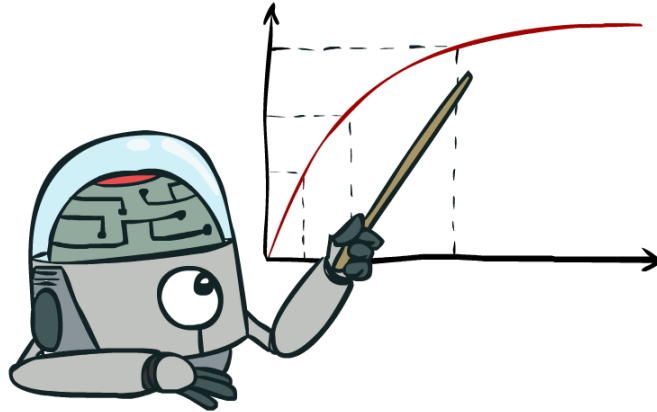


(*) need continuous time versions

(*)briefly in our ML topic

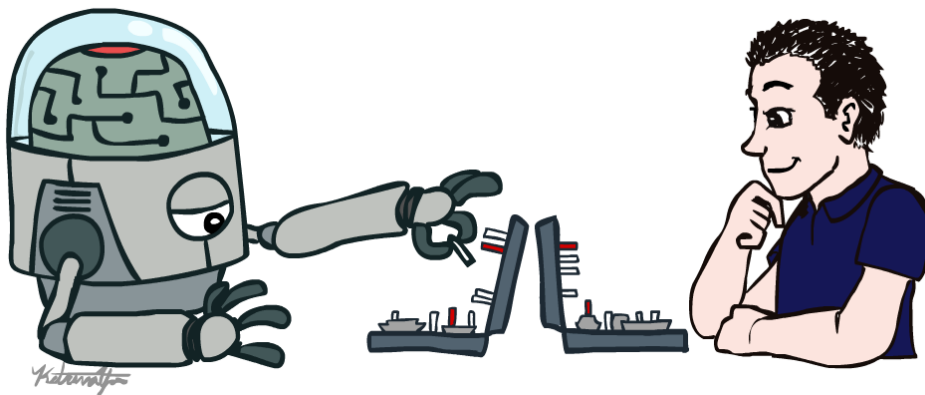


Maximize Your Expected Utility



Artificial Intelligence: Basics & Applications

Introduction



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[slides adapted from Dan Klein, Pieter Abbeel, Anca Dragan @ai.berkeley.edu]