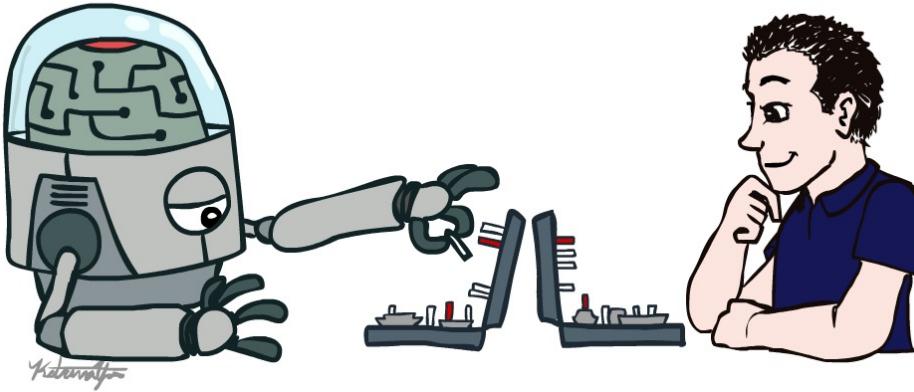


# CS3568 Intelligent Systems

## Introduction



Instructor: Tara Salman

Texas Tech University

Computer Science Department

[These slides were created by Stuart Russell and Dawn Song for CS188 Intro to AI at UC Berkeley. All materials available at <http://ai.berkeley.edu>.]

# Course Information

- ❑ TAs:
  - TBA
- ❑ Communication:
  - Announcements on blackboard and the course webpage  
<https://sites.google.com/view/tsalman/teaching/cs-5368>
  - Questions? Ask on piazza:  
<https://piazza.com/ttu/fall2021/cs33685368/home>
  - Use private questions if necessary!
- ❑ Course technology:
  - Blackboard for programming assignments. Autograded projects (you can nail it!)
  - Gradescope for other electronic/written assignments (unlimited submissions!)
  - Videos, etc. are also available, thanks to the generosity of CS 188 course creators at UC Berkeley!

# Course Information

- Prerequisites:
  - CS 2382 (discrete mathematics), CS 2413 (data structures and programming principles), CS 3364 (design and analysis algorithms), or permission
  - Knowledge of Python (you can learn as you go if you like, but that's on you!)
  - Knowledge of statistics and probability strongly recommended!
  - **There will be a lot of math (and programming)**
- Work and Grading:
  - 4 programming projects: 40% (submitted via blackboard. You grade yourself)
  - 5 homeworks: 10% (submitted via Gradescope. As many trials as possible)
  - Due at beginning of class. **Online learning: Due before 12 PM (NOT AM)**
  - Can turn in **the project** in the upcoming class only twice a semester without penalty (but not after that!)
- Exams (25% of grade each)
  - Exam 1: in-class, Thursday, October 7th (TBA for distance learning)
  - Exam 2: in-class, TBA

# Exam Policy

- ❑ For face to face: Non-curricular activities (Job interviews, flying home early for winter break, etc.) are **NOT** valid reasons for missing an exam, and no special accommodation will be made!
- ❑ For online learning: you will be given Thursday through Saturday to take the exam. Once you start, you will have 90 minutes.

# Academic Integrity: Cheating vs. Not Cheating

## ❑ Cheating:

- You visit a homepage with solutions
- You copy any code from others
- Someone dictates a solution to you
- Someone else writes the code for you
  - ❑ You *pay* someone else to write the code for you!

## ❑ Not cheating:

- You work with your project partner
- You talk with someone about the project
- You find and use pseudocode in a book or on a webpage

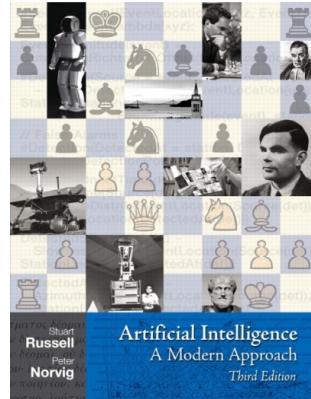
## ❑ If in doubt, ask!

# Academic Integrity

- ❑ Zero tolerance!
  - Immediate failure and referral to the Office of Academic Integrity.
  - In the past, people have failed, had troubles with the school, and deported. *So don't do it!*
  
- ❑ Active search
  - Testing code for statistical similarity; renaming variable names is not going to fool us!
  - Other technologies.

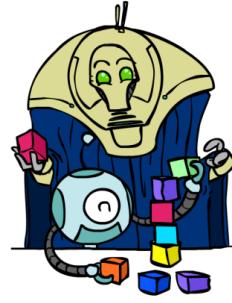
# Textbook

- Not strictly required, but for students who want to read more, I strongly recommend
  - Russell & Norvig, AI: A Modern Approach, 3<sup>rd</sup> (or 2<sup>nd</sup>) Ed.



- Warning: The presentation here does not necessarily follow the presentation in the book.

# Instruction vs. Assessment



## Instruction

Grow knowledge, collaborate,  
work until success

These two goals don't mix



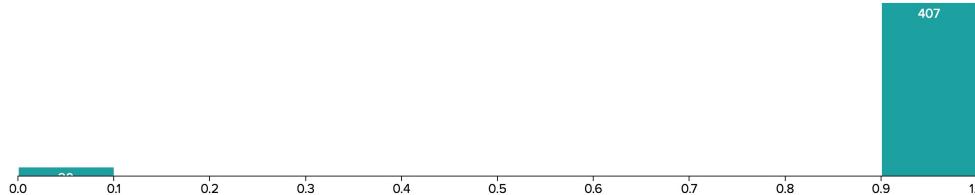
## Assessment

Measure knowledge and ability to  
deploy

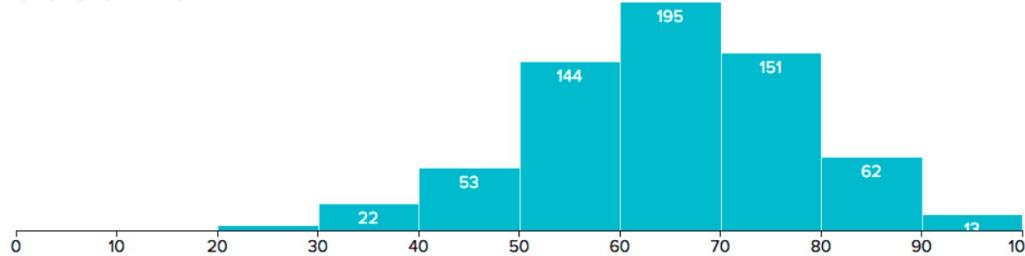
- Lecture / Section / OH / Piazza / Homework / Projects are instruction
  - ▣ collaborative, work until success (but please no spoilers, no cheating)
- Exams are assessment
  - ▣ on your own

# Some Historical Statistics

- ❑ Homework and projects: instruction (iterate/learn till you nailed it)



- ❑ Exams: assessment



# Important This Week

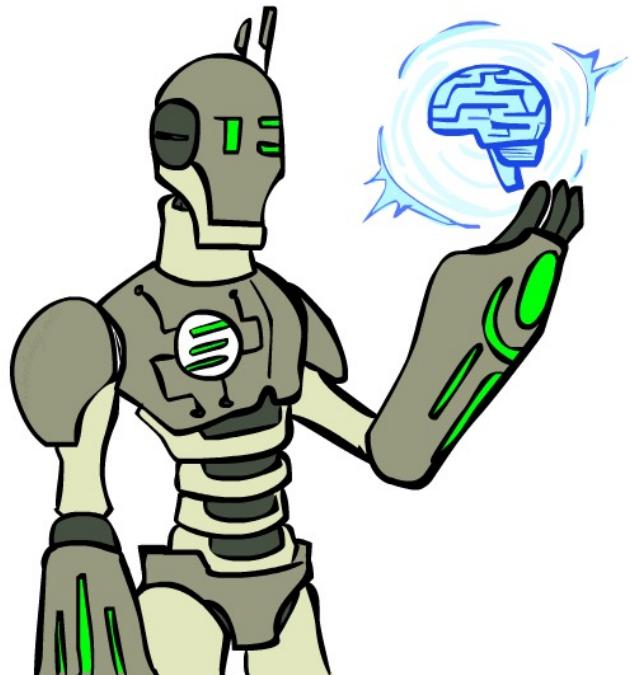
- **Register** for the class on Piazza! Please ask all questions there!
  - <https://piazza.com/ttu/fall2021/cs33685368/home>
- Register for gradescope
  - Next slide
- **Project 0 and Homework 0:** Will be out this week
  - Should not be difficult. These are to test your “readiness” for the class
  - Due on September 6<sup>th</sup>
- **If you are waitlisted,** the waitlist is being managed carefully by the department and there will be **no exceptions.**

# GradeScope

- ❑ you will be able to add yourself as a student with course code (entry code will be posted on Piazza)
- ❑ **New users:** If you don't have a Gradescope account yet, go to the Gradescope website, click **Sign Up** in the upper right corner, select **Student**, and put in your entry code in the sign-up form.
- ❑ **Existing users:** If you already have a Gradescope account, log into that account and navigate to your **Account Dashboard** by clicking the Gradescope logo in the top left and click **Add Course** in the bottom right corner. Then enter your course code.

# Today

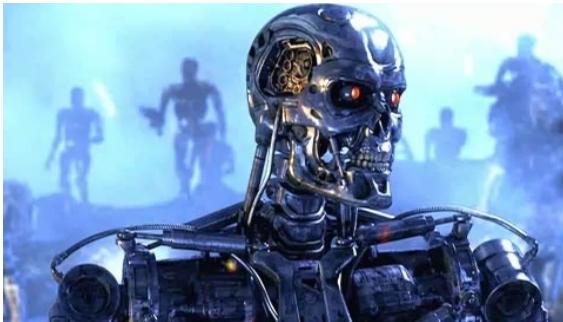
- ❑ What is artificial intelligence?
- ❑ What can AI do?
- ❑ What is this course?



# AI in movies?



70's



80's



2000's



90's

13



After that

Tara Salman

# News AI (Scary AI)

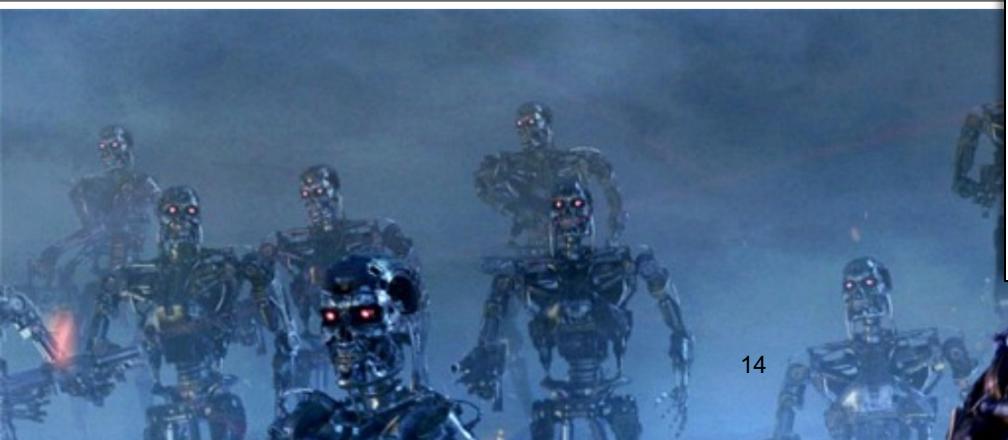
AI is the biggest risk we face as a civilisation, Elon Musk says

## Billionaire burn: Musk says Zuckerberg's understanding of AI threat 'is limited'

[HOME](#) » [FINANCE](#) » [FINANCE TOPICS](#) » [DAVOS](#)

'Sociopathic' robots could overrun the human race in a generation

Computers should be trained to serve humans to reduce their threat to the human race, says a leading expert on artificial intelligence



14

Texas

LIVE SCIENCE

NEWS TECH HEALTH PLANET EARTH

Live Science > Tech

## Lifelike 'Sophia' Robot Granted Citizenship to Saudi Arabia

By Mindy Weisberger, Senior Writer | October 30, 2017 03:39pm ET



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Tara Salman

# News AI (Funds)

TECH • ARTIFICIAL INTELLIGENCE

**United Kingdom Plans \$1.3 Billion Intelligence Push**

France to spend \$1.8 billion on compete with U.S., China

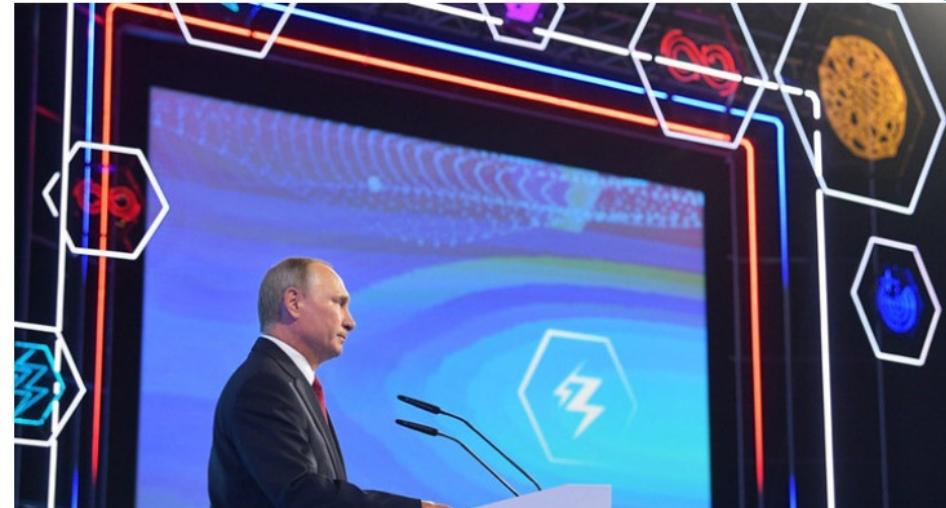
EU wants to invest £18b development

**China's Got a Huge Artificial Intelligence Plan**

**'Whoever leads in AI will rule the world': Putin to Russian children on Knowledge Day**

Published time: 1 Sep, 2017 14:08

Edited time: 1 Sep, 2017 14:40



# News AI (Games)

NATURAL 'PROZAC': DOES IT REALLY WORK?

## IBM's Watson Jeopardy Computer Shuts Down Humans in Final Game

DAILY NEWS 9 March 2016

Sili

'I'm in shock!' How world's best human



## Blizzard will show off Google's Deepmind AI in StarCraft 2 later this week

By Andy Chalk 4 hours ago

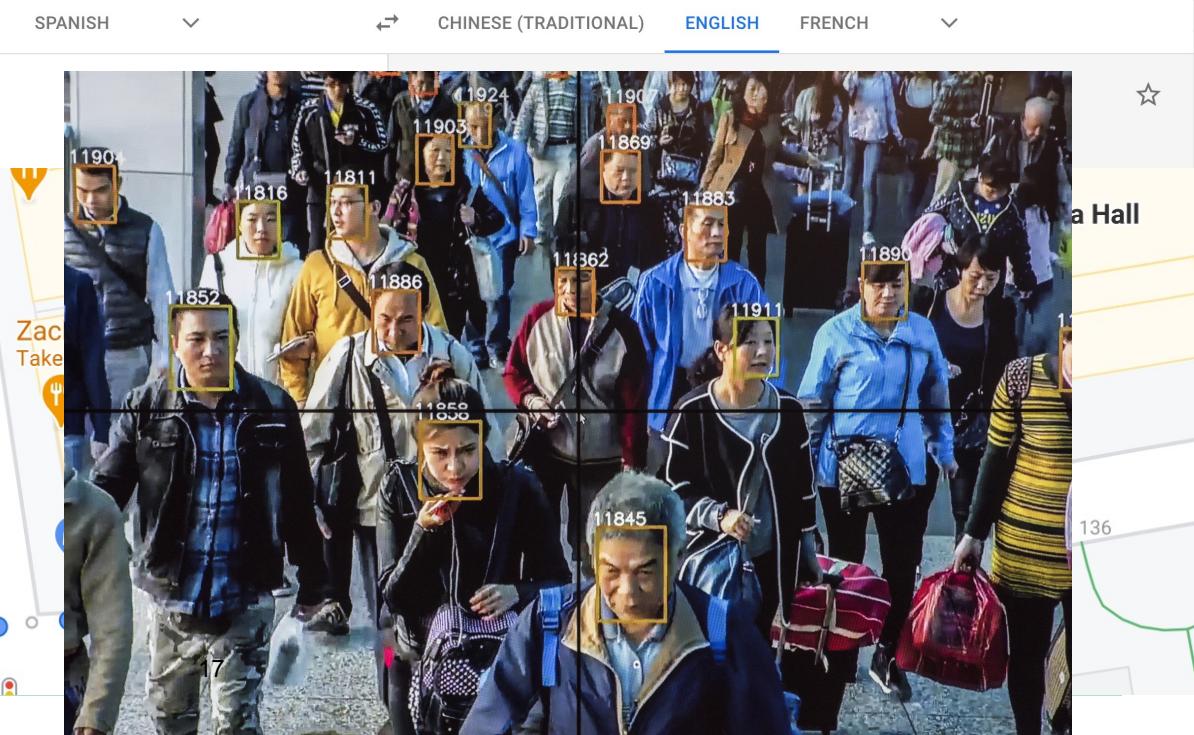
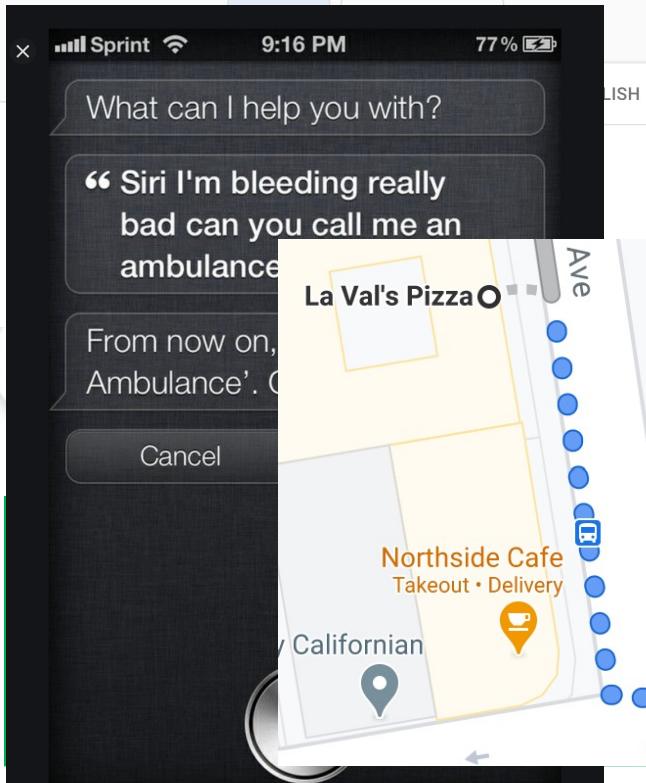
Google and Blizzard launched the artificial intelligence project in 2016.

[f](#) [t](#) [r](#) [m](#) | [COMMENTS](#)



# AI in Our Daily Activities

≡ Google Translate





**TUG**  
CAUTION  
MAY CONTAIN  
CHEMOTHERAPY DRUG

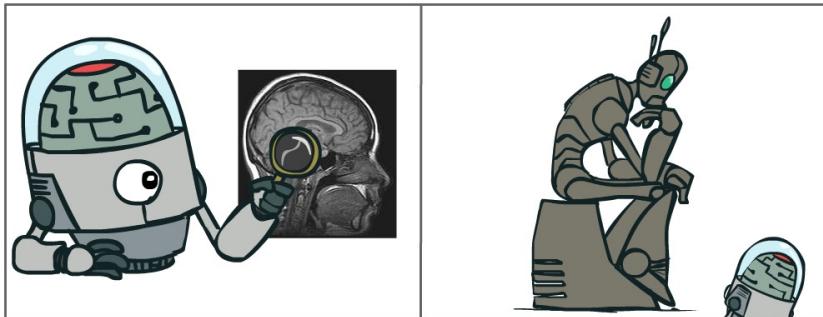
CAUTION  
MAY CONTAIN  
CHEMOTHERAPY DRUG



# What is AI?

The science of making machines that:

Think like people



Think rationally

Act like people



Act rationally

# Rational Decisions

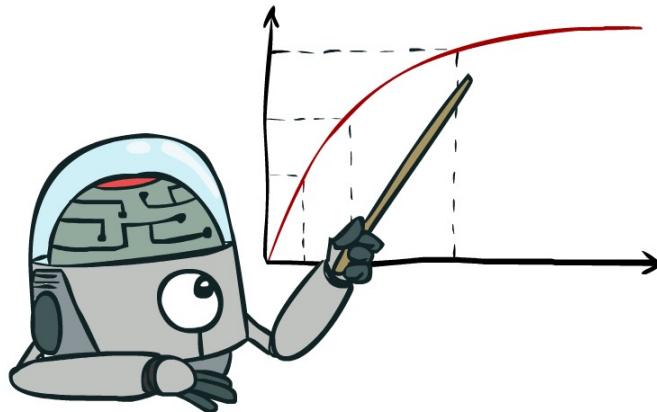
We'll use the term rational in a very specific, technical way:

- 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

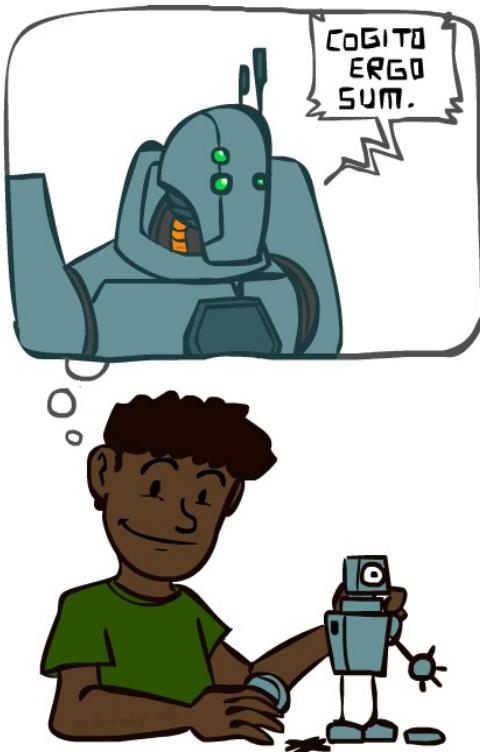
A better title for this course would be:

## Computational Rationality

# Maximize Your Expected Utility

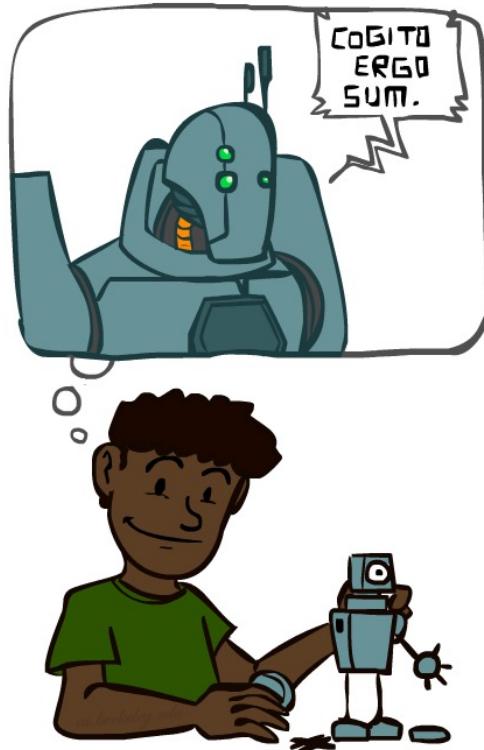


# A (Short) History of AI



# A (Short) History of AI

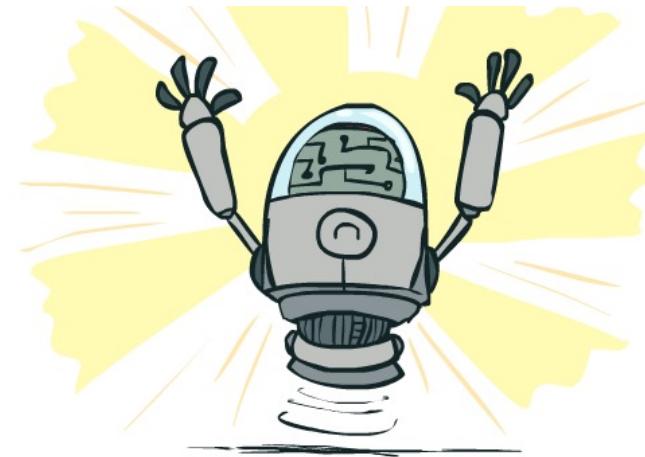
- ❑ 1940-1950: Early days
  - 1943: McCulloch & Pitts: Boolean circuit model of brain
  - 1950: Turing's "Computing Machinery and Intelligence"
- ❑ 1950—70: Excitement: Look, Ma, no hands!
  - 1950s: Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's 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?

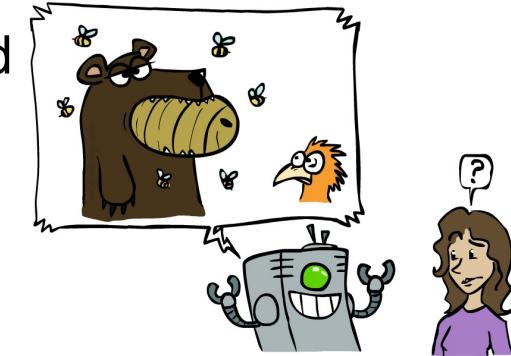
Quiz: Which of the following can be done at present?

- Play a decent game of Jeopardy (Q&A)?
- 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 a crowded road?
- Buy a week's worth of groceries on the web?
- Buy a week's worth of groceries at Walmart?
- Discover and prove a new mathematical theorem?
- Perform a surgical operation?
- Unload a know 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 looking for his friend Irving Bird where some bees were flying around him. He found him near a river bank where there was a beehive in the oak tree. He ate the honey and got stung. He ran away.
- Henry Squirrel was thirsty. He was sitting on a rock by the river bank where his good friend Henry Beaver was sitting. Henry Beaver slipped and fell into the water. Henry Beaver drowned.
- Once upon a time there was a crow who was very vain. He was sitting in his nest. He noticed that he was very hungry. He had a piece of cheese in his mouth. He swallowed it and became very full. He was so full that he fell out of his nest and landed on the ground. He crawled over to the crow. The End.



# 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'ilégalité".

**Les faits** Le dalaï-lama dénonce l'"enfer" imposé au Tibet depuis sa fuite, en 1959  
**Vidéo** Anniversaire de la rébellion



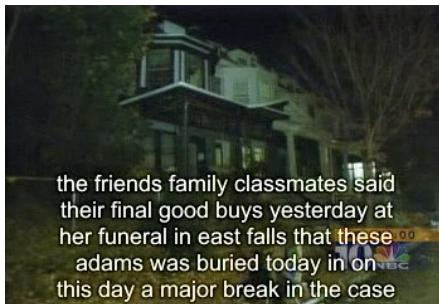
**"It is impossible for journalists to enter Tibetan areas"**

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."

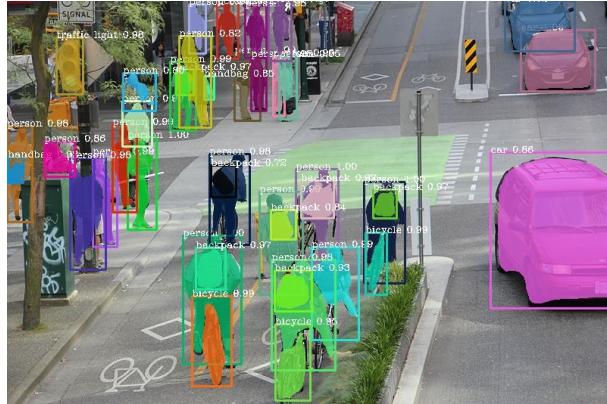


"girl in pink dress is jumping in air."

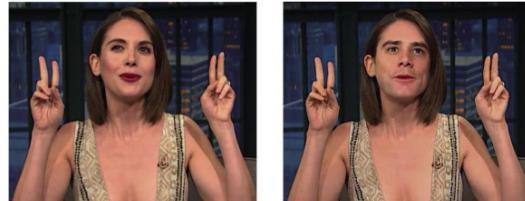


"black and white dog jumps over bar."

## Image Captioning



## Image Segmentation



## Deep-Fake

# 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.”

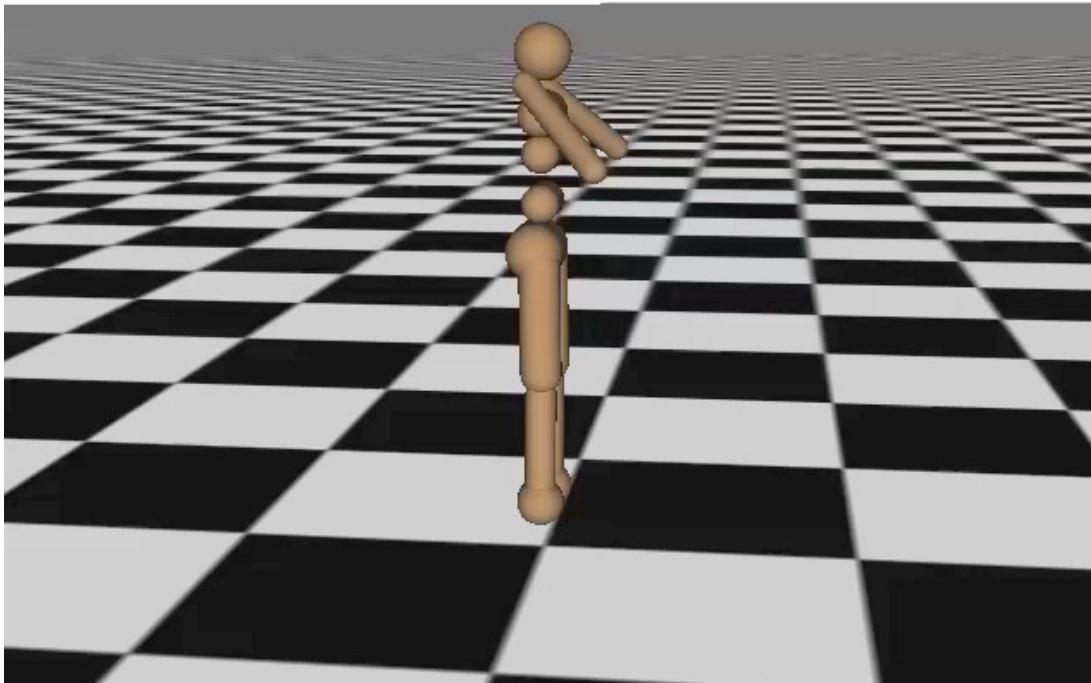


Text from Bart Selman, image from IBM's Deep Blue pages

# Simulated Agents

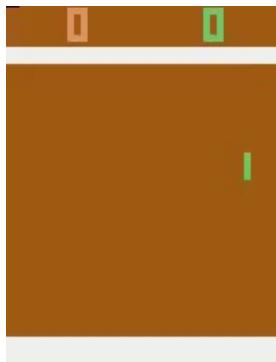
Iteration 0

[Schulman, Moritz, Levine, Jordan, Abbeel, ICLR 2016]



# Game Agents

- ❑ Reinforcement learning



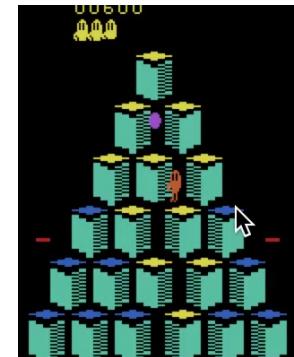
Pong



Enduro



Beamrider



Q\*bert

# Robotics

## ❑ Robotics

- Part mech. eng.
- Part AI
- Reality much harder than simulations!



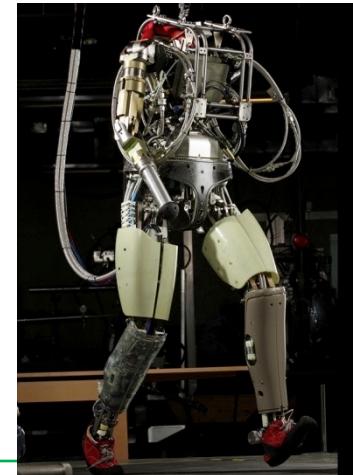
## ❑ Technologies

- Vehicles
- Rescue
- Help in the home
- Lots of automation...



## ❑ In this class:

- We ignore mechanical aspects
- Methods for planning
- Methods for control



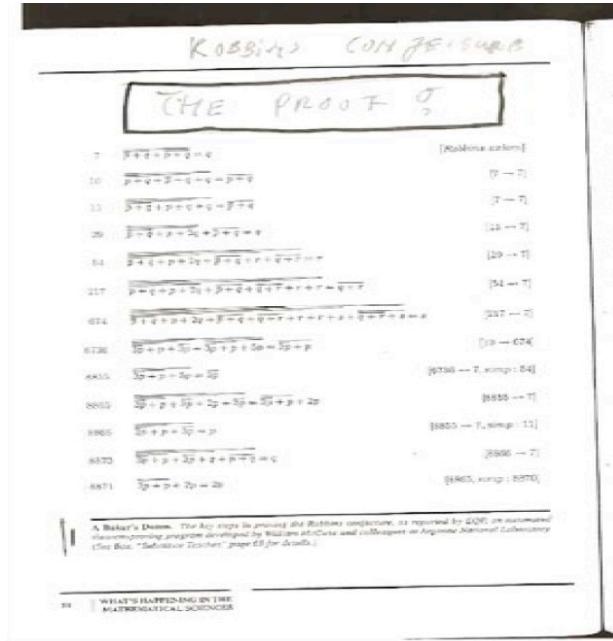
# Logic

## □ Logical systems

- Theorem provers
- NASA fault diagnosis
- Question answering

## □ Methods:

- Deduction systems
- Constraint satisfaction
- Satisfiability solvers (huge advances!)



# Decision Making

➤ Applied AI involves many kinds of automation

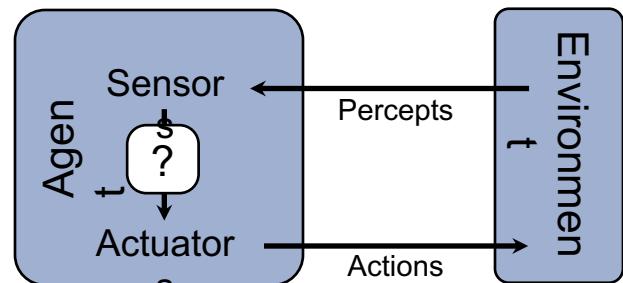
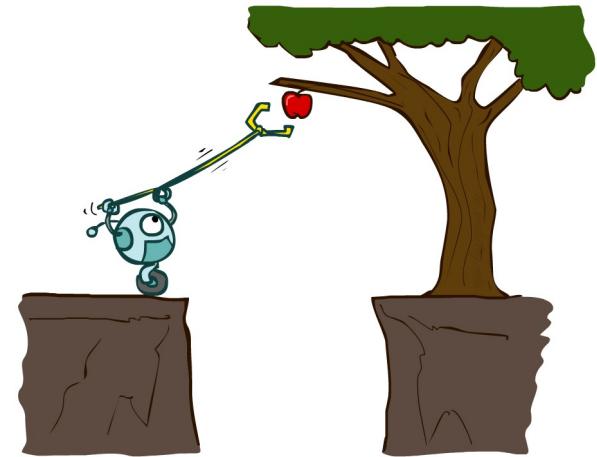


- Scheduling, e.g. airline routing, military
- Route planning, e.g. Google maps
- Medical diagnosis
- Web search engines
- Spam classifiers
- Automated help desks
- Fraud detection
- Product recommendations
- ... Lots more!

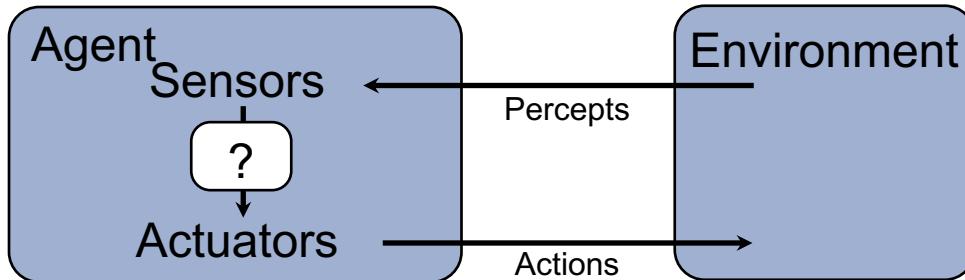
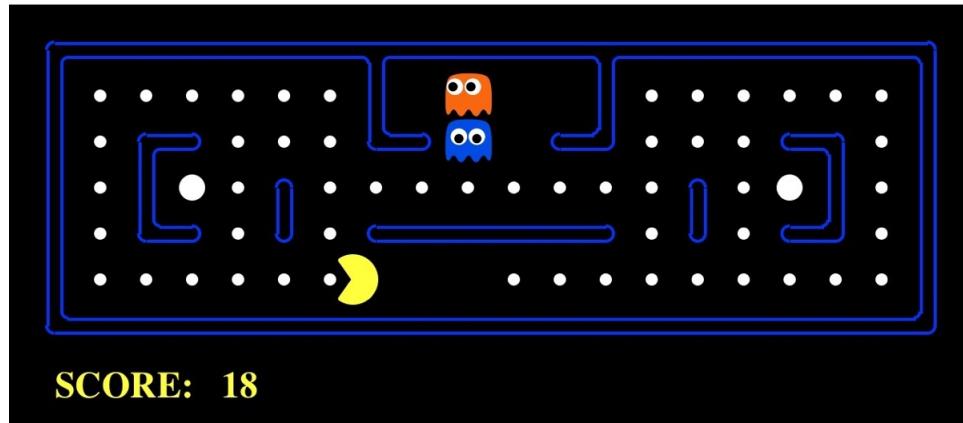


# Designing Rational Agents

- 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



Pac-Man is a registered trademark of Namco-Bandai Games, used here for educational purposes

# Course Topics

## ❑ Part I: Making Decisions

- Fast search / planning
- Constraint satisfaction
- Adversarial and uncertain search

## ❑ Part II: Reasoning under Uncertainty

- Bayes' nets
- Decision theory
- Machine learning

## ❑ Throughout: Applications

- Natural language, vision, robotics, games, ...

