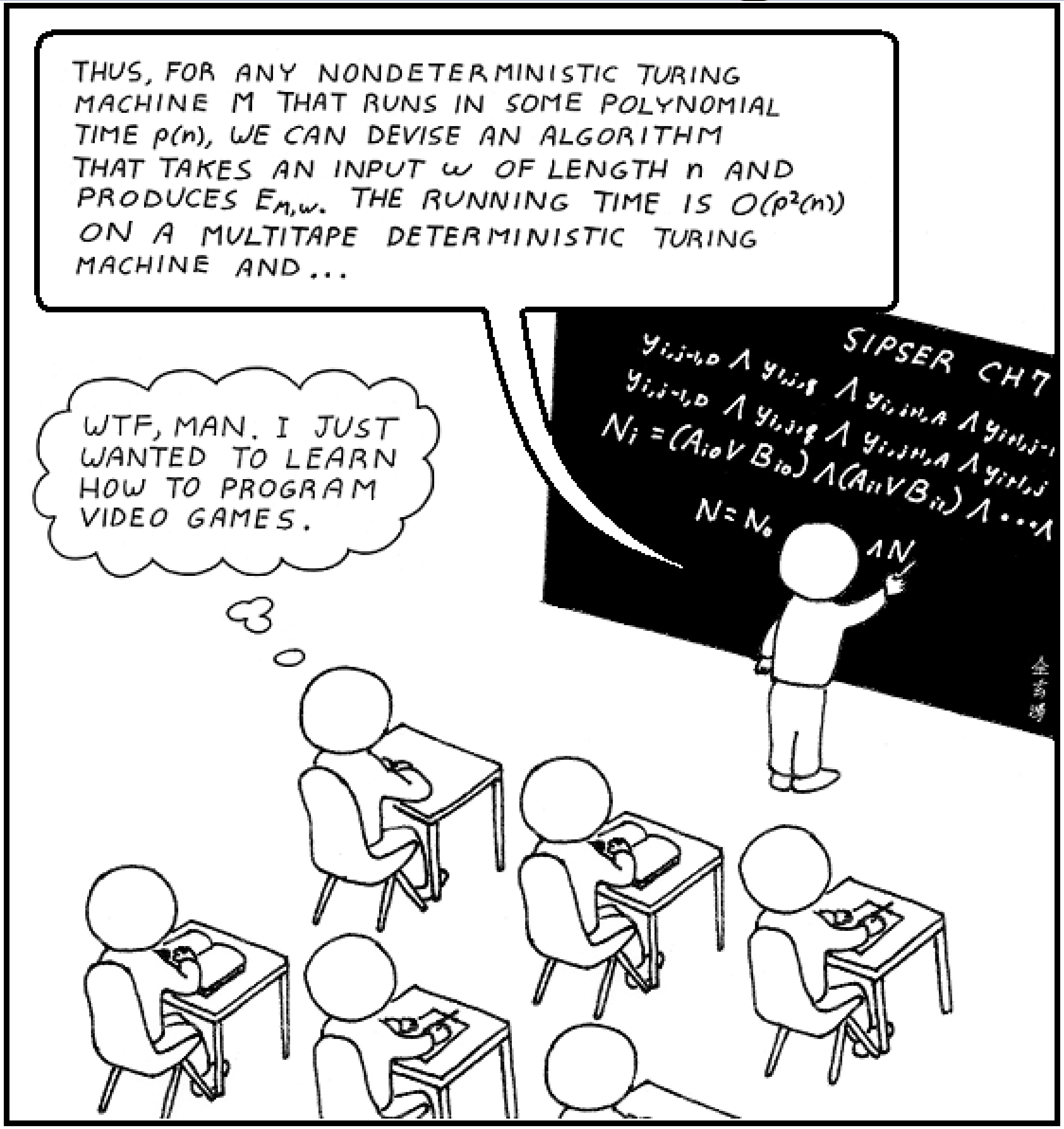
Welcome to CSci 5512 Artificial Intelligence II



Instructor (me)

James Parker
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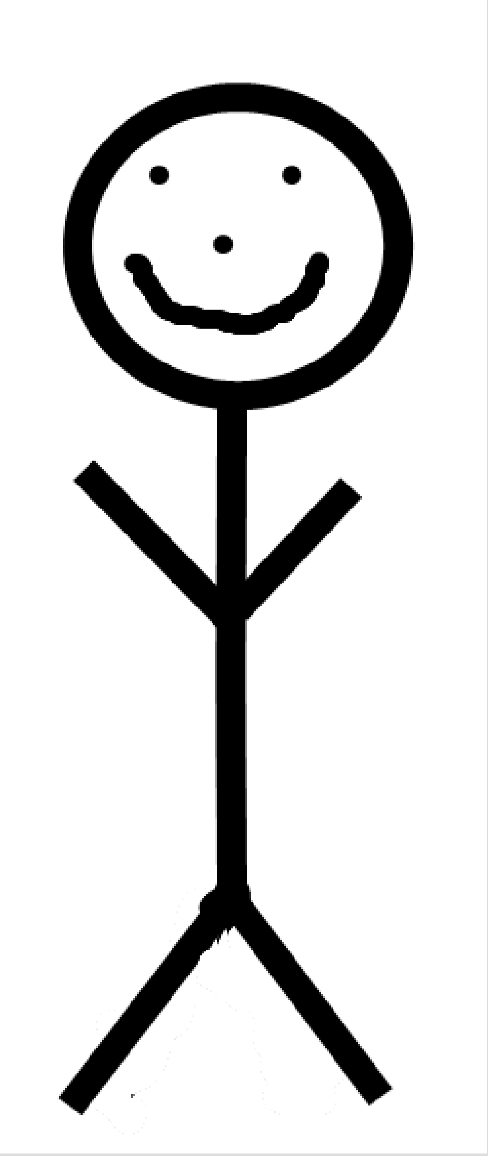
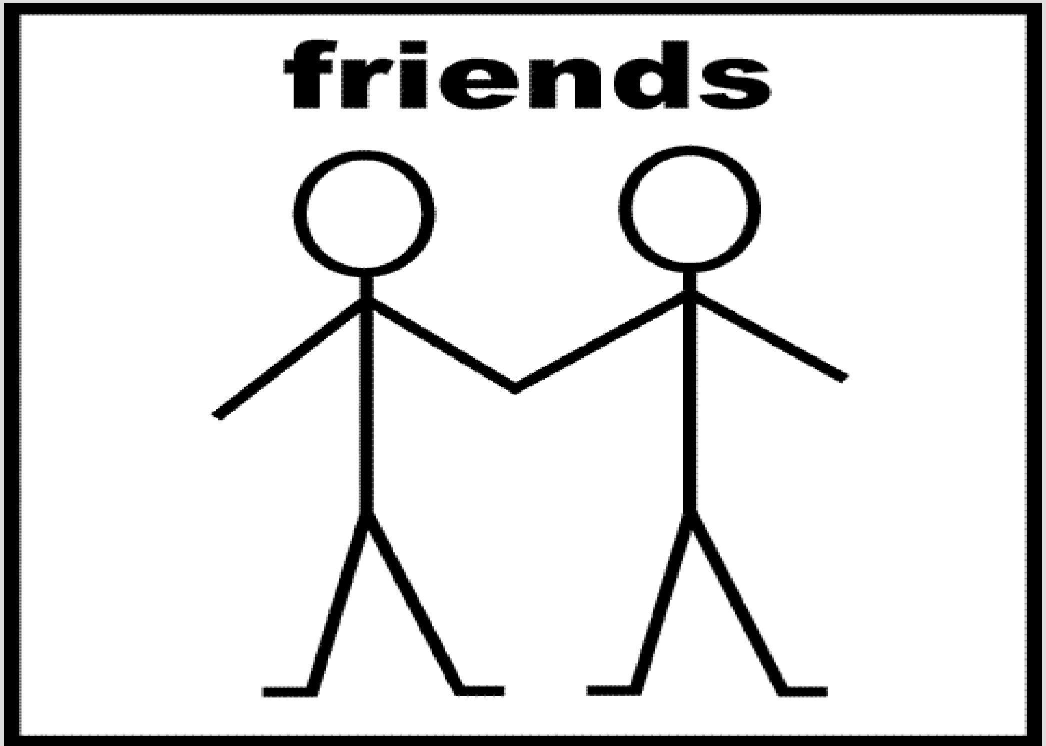


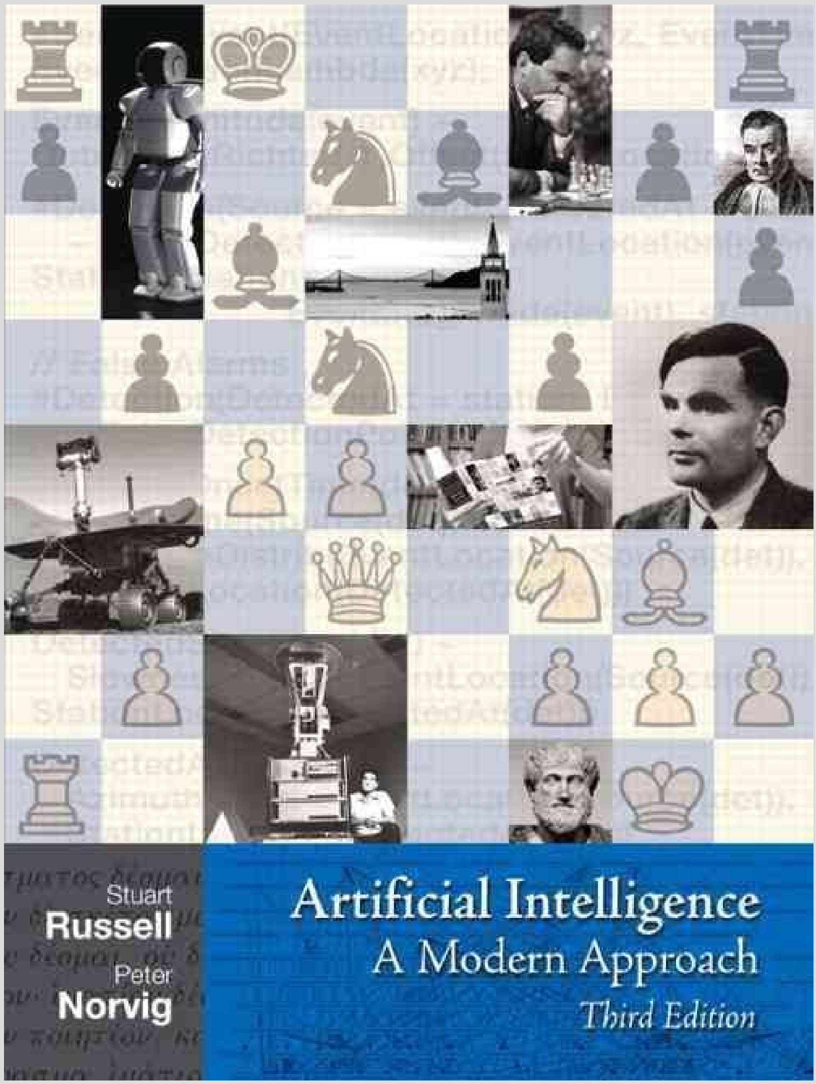
Teaching Assistants

Arun Kumar,
Nidhi Rajesh Patel



Textbook

Artificial Intelligence A Modern Approach, Russel and Norvig, 3rd edition



Class website

www.cs.umn.edu/academics/classes

Or google "umn.edu csci class"

Syllabus, schedule, other goodies

Moodle page will have grades and homework submission

www.cs.umn.edu

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- Home
- Office Hours
- Syllabus

CSci 5512: Artificial Intelligence II

Schedule*

This is an approximate schedule. It will be updated as the class progresses.

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Week	Week Of	Topics	Lecture Materials	Readings	Exams	Due
1	Jan. 21	Introduction: HI!	1/23	No readings		
2	Jan. 28	Uncertainty (review?)		Ch. 13		
3	Feb. 4	Probabilistic reasoning, exact		Ch. 14-14.4		
4	Feb. 11	Probabilistic reasoning, approximate		Ch. 14.4-14.7		Homework 1, Sunday Feb. 17 at 11:55 P.M.
5	Feb. 18	Probabilistic reasoning over time		Ch. 15-15.3		
6	Feb. 25	Probabilistic reasoning over time		Ch. 15.3-15.5		Homework 2, Sunday March 3 at 11:55 P.M.
7	March 4	Simple decisions		Ch. 16	**Midterm 1, Wednesday March 6** Covers chapters 13-15	
8	March 11	Complex decisions		Ch. 17.1-17.3		
	March 18	Spring Break				
9	March 25	Complex decisions		Ch. 17.4-17.6		Homework 3, Sunday March 31 at 11:55 P.M.
10	April 1	Learning from examples		Ch. 18.1-18.5,		

Don't like my slides? (tough)

http://aima.eecs.berkeley.edu/slides-pdf/

Constructing Bayesian networks

Need a method such that a series of locally testable assertions of conditional independence guarantees the required global semantics

1. Choose an ordering of variables $X_1, \ldots, X_n$
2. For $i = 1$ to n
   add X_i to the network
   select parents from $X_1, \ldots, X_{i-1}$ such that
   $\mathbf{P}(X_i | Parents(X_i)) = \mathbf{P}(X_i | X_1, \ldots, X_{i-1})$

This choice of parents guarantees the global semantics:

$$\begin{aligned}\mathbf{P}(X_1, \ldots, X_n) &= \prod_{i=1}^{n} \mathbf{P}(X_i | X_1, \ldots, X_{i-1}) \quad \text{(chain rule)} \\ &= \prod_{i=1}^{n} \mathbf{P}(X_i | Parents(X_i)) \quad \text{(by construction)}\end{aligned}$$

Prerequisites

1. Competent programmer
2. Common data structures (graph/tree)
3. Some statistics (probabilities, random variables)
4. Some math (calculus)

Prerequisites

You went to the doctor and tested for a rare disease (1/1,000 people have it)

Test chances	Detected	Not Detected
Have disease	100%	0%
Just fine	1%	99%

If the test "detects" the disease, what is the probability you are sick?

Prerequisites

These algorithms will often involve some math

Hopefully things like this are not that intimidating:

$$E[f(s)]_{\mathcal{P}} \approx \frac{1}{N} \sum_{i=1}^{N} f(s^{(i)})$$

$$p(x_{1:n}|\lambda_1)p(x_{n+1:N}|\lambda_2)p(\lambda_1)p(\lambda_2)p(n)$$
$$= \left(\prod_{i=1}^{n} p(x_i|\lambda_1)\right)\left(\prod_{i=n+1}^{N} p(x_i|\lambda_2)\right)p(\lambda_1)p(\lambda_2)p(n)$$

Syllabus

50% Homework (-15% per day late)
15% Midterm (Wed. March 6)
15% Midterm 2 (Wed. April 17)

Your choice:
20% Final OR project (Tues. May 14, 1:30-3:30pm, this room)

Project

For the project you have your choice of three different types:

(1) Experimental. Implement and compare interesting algorithms on a data set.

(2) Literature review. Read a wide range of papers and compare and contrast them.

(3) Theoretical. Prove an idea.

Project

An example layout of an experimental project would be 10-12 pages:

-Title, authors, abstract
-Introduction & problem description (1-2 pg)
-Literature review (2-3 pages)
-Description of your approach (2-3 pages)
-Analysis of results (1-2 pages)
-Conclusion and summary
-Bibliography

Project

You pick the project, but must be related to an advanced AI topic

If you are unsure about the scope/difficulty of a topic, feel free to ask me

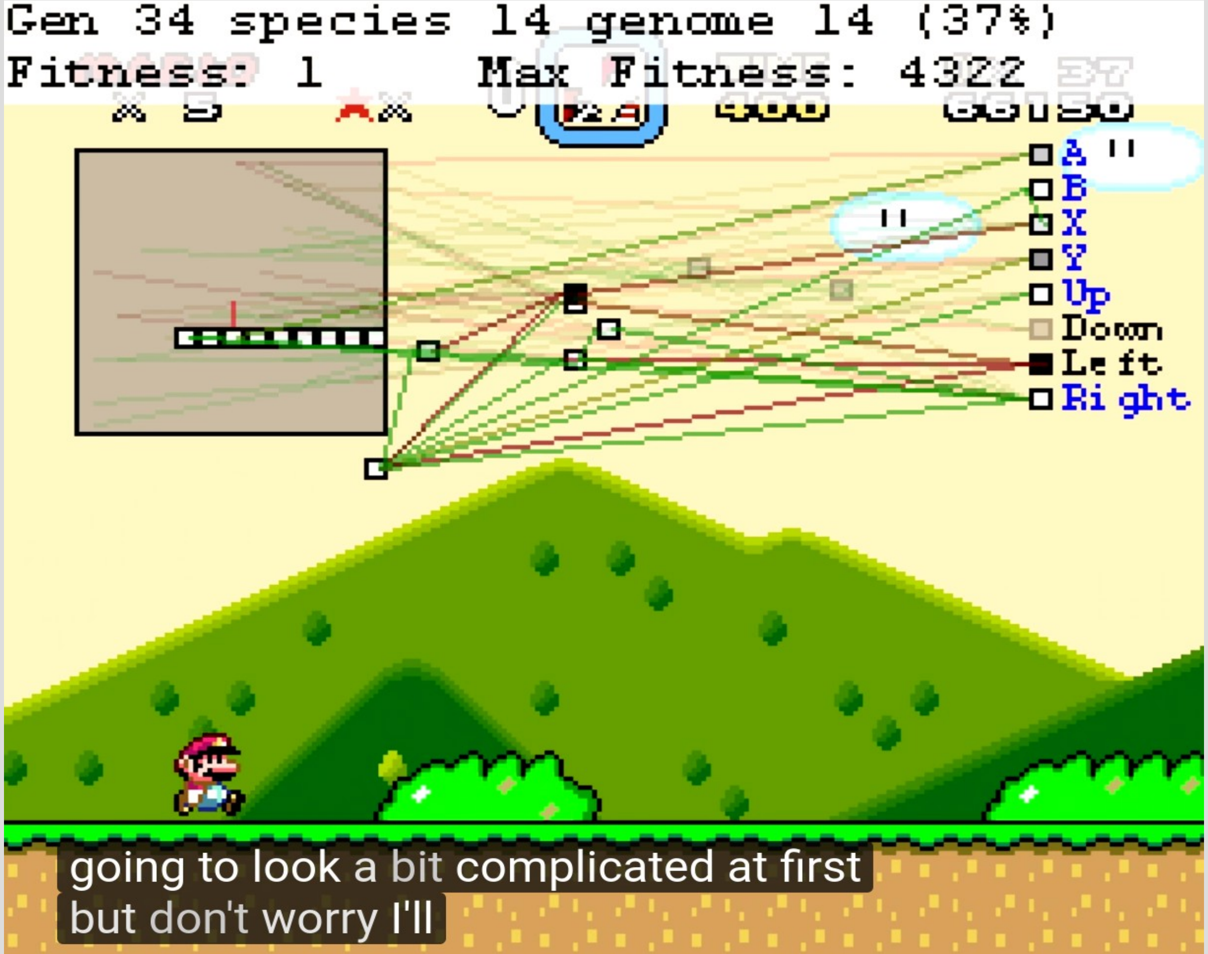
If you want to work in a group, you must receive my consent first

A short presentation *might* be required

Project

Mario?

https://www.youtube.com/watch?v=qv6UVOQ0F44



Syllabus

All exams are open book/notes (most people think they are hard)

You can use an electronic device if you want on exams, but no:

- phones
- internet
- running code (ish)

Syllabus

Homework are individual assessments (unless explicitly stated otherwise)

Please ensure the work you turn in is your own

Syllabus

Grading scale:
93% A
90% A-
87% B+
83% B
80% B-
77% C+
73% C
70% C-
67% D+
60% D
Below F

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10	April 1	Learning from examples		Ch. 18.1-18.5, 18.10		
11	April 8	Learning from examples		Ch. 18.6-18.7		Homework 4, Sunday April 14 at 11:55 P.M.
12	April 15	Learning from examples		Ch. 18.8-18.9	**Midterm 2, Wednesday April 17** Covers chapters 16-18	
13	April 22	Learning probabilistic models		Ch. 20		
14	April 29	Reinforcement learning		Ch. 21		Homework 5, Sunday May 5 at 11:55 P.M.
15	May 6	Extra topics		TBA		
16	May 13				**Final Exam,**	

Syllabus

Any questions?

Turing Test

For a long time, the Turing Test was a supposed indication of intelligence

A person would question two entities and have to determine which one is the computer and human

This is not very popular anymore

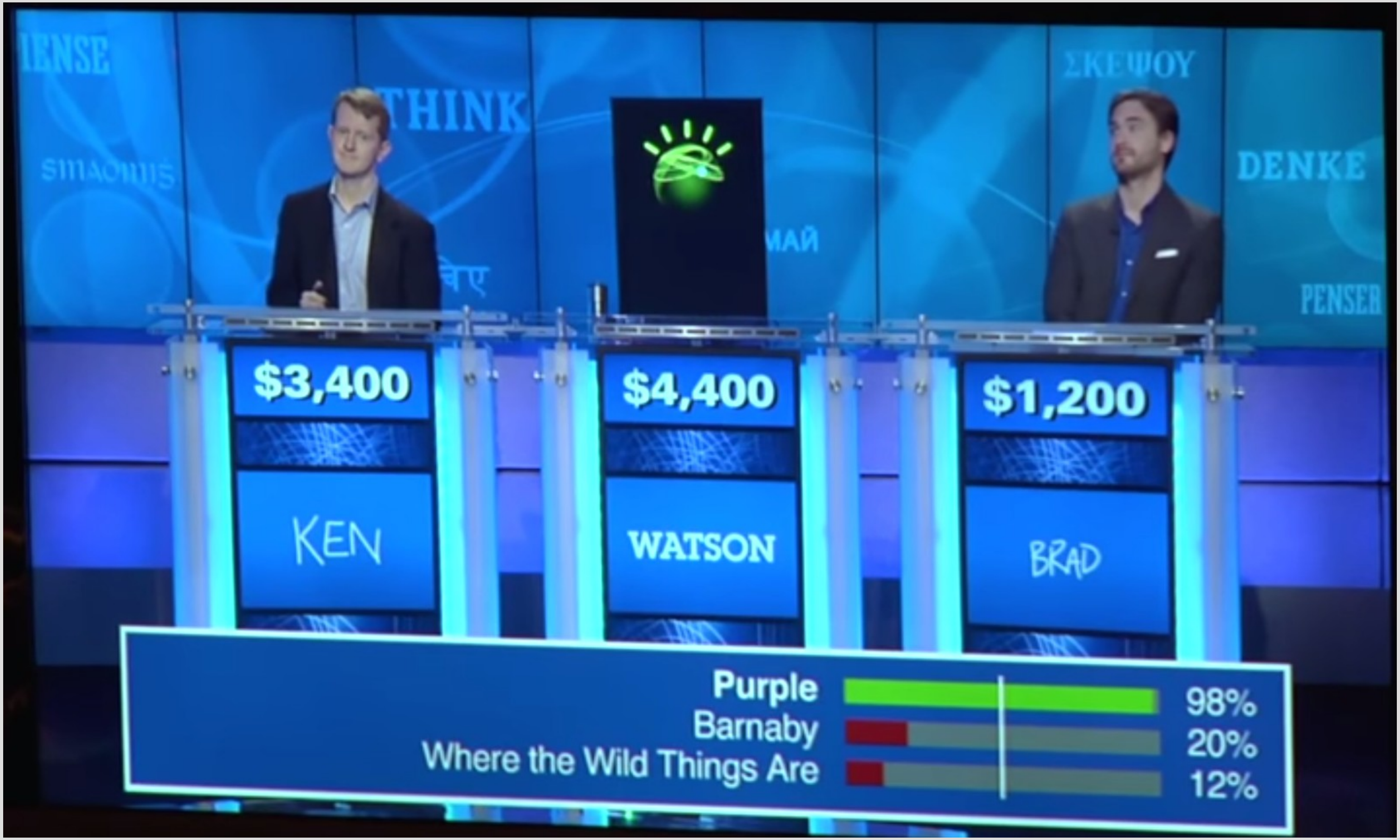
Turing Test

To pass the Turing Test, a computer needs the following:

- Natural language processing (as the test is written and not verbal)
- Knowledge representation (storage)
- Reasoning (logical conclusions)
- Machine Learning (extrapolation)

Turing Test

https://www.youtube.com/watch?v=WFR3lOm_xhE



AI

Often times, fully exploring all the options is too costly (takes forever)

Chess: 10^{47} states (tree about 10^{123})

Go: 10^{171} states (tree about 10^{360})

At 1 million states per second...

Chess: 10^{109} years

Go: 10^{346} years

AI

Simple computers have been built for hundreds of years

For artificial intelligence to mature, it needed to borrow from other fields:

Math - logic and proofs

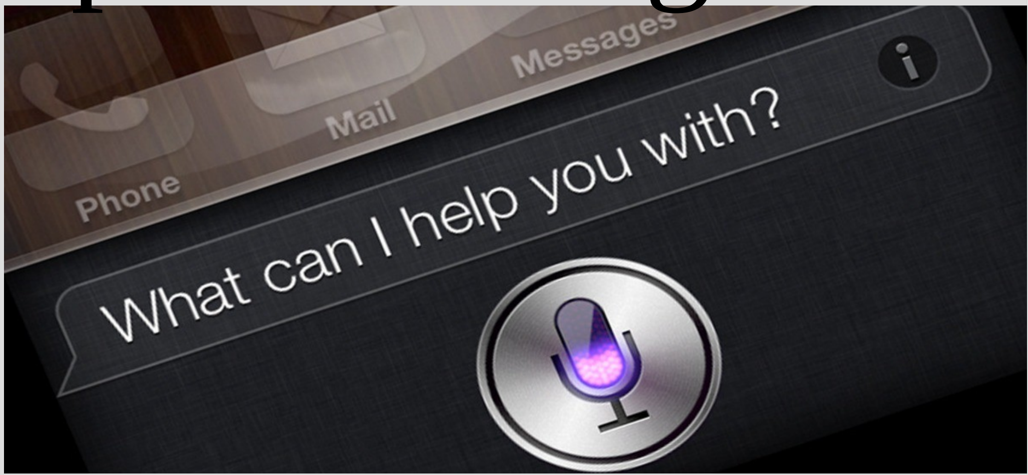
Statistics - probability

Economics - utility

AI

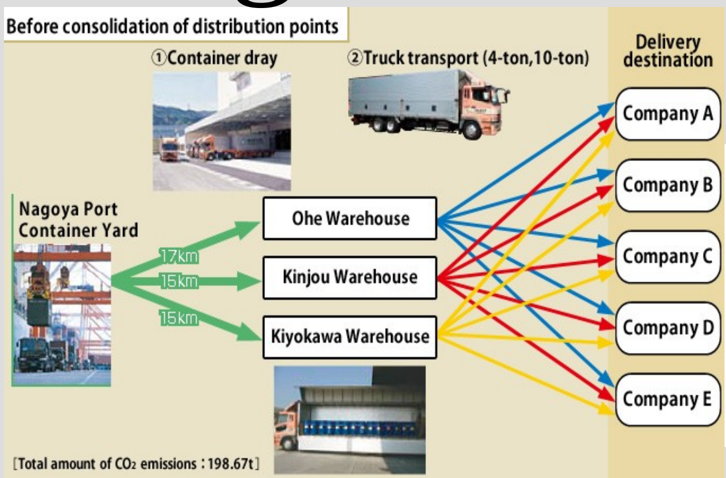
Self driving cars

Speech recognition



Game playing

Logistics



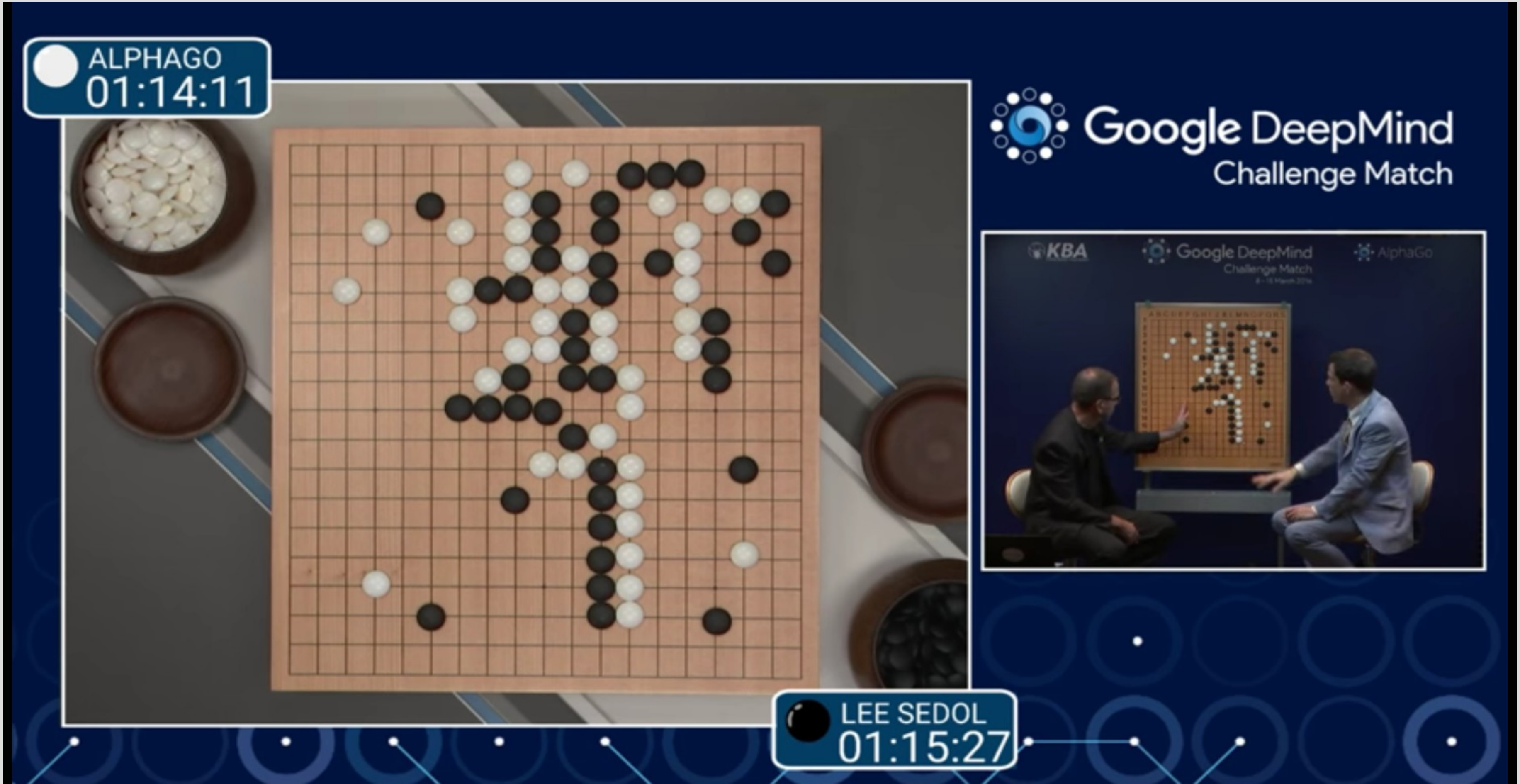
Spam filter

AI - Chess

Spring 1997 - Deep(er) Blue (CMU / IBM)

AI - Go

Spring 2016 - AlphaGo (Google)
December 2017- AlphaZero



AI - Dota2

August 2017 - OpenAI (Elon Musk)

https://www.youtube.com/watch?v=l92J1UvHf6M&feature=youtu.be