

# LECTURE 1: OVERVIEW

CS 4100: Foundations of AI

Instructor: Robert Platt

(some slides from Chris Amato, Magy Seif El-Nasr, and Stacy Marsella)

# SOME LOGISTICS

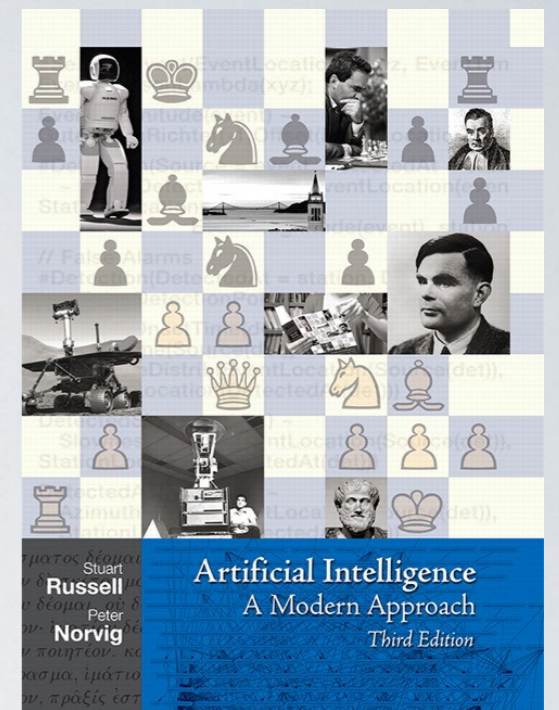
Class webpage:

[http://www.ccs.neu.edu/home/rplatt/cs4100\\_spring2018/index.html](http://www.ccs.neu.edu/home/rplatt/cs4100_spring2018/index.html)

Course staff office hours:

- Rob Platt ([rplatt@ccs.neu.edu](mailto:rplatt@ccs.neu.edu))
  - Tuesdays, 10:30-11:30, 526 ISEC, or by Appt.
- Bharat Vaidhyanathan ([vaidhyanathan.b@husky.neu.edu](mailto:vaidhyanathan.b@husky.neu.edu))
  - ? (programming assignments)
- Ruiyang Xu ([xu.r@husky.neu.edu](mailto:xu.r@husky.neu.edu))
  - ? (problem sets)
- Piazza: <https://piazza.com/northeastern/fall2018/cs4100/home>

# BOOK



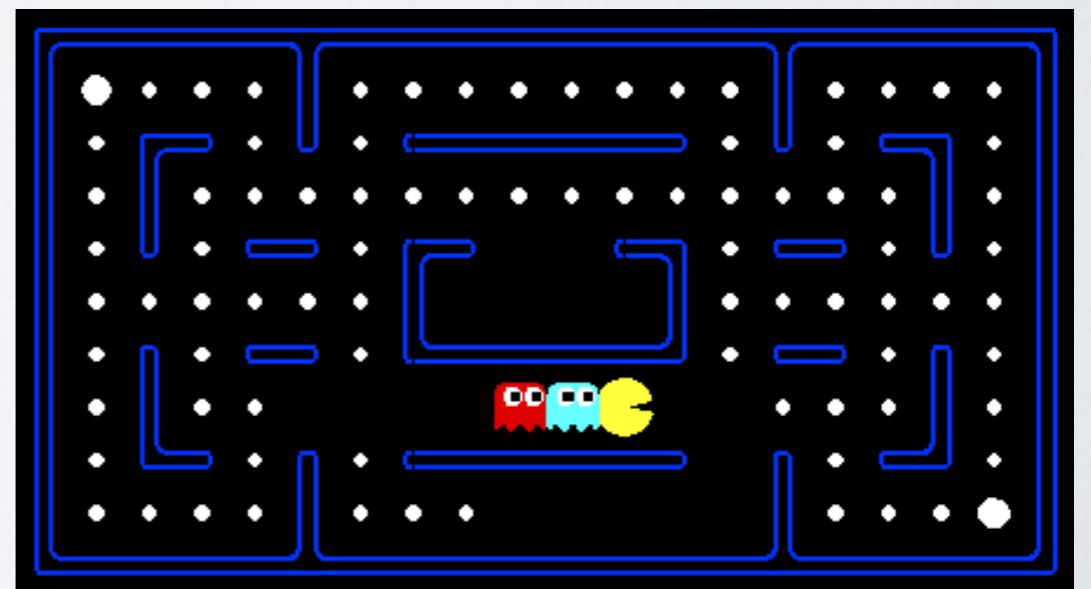
- Required
  - AI: A Modern Approach by Russell and Norvig, 3<sup>rd</sup> edition (general text)
  - Reinforcement Learning: An Introduction, <http://incompleteideas.net/sutton/book/the-book.html>
- Optional
  - Machine Learning: A Probabilistic Perspective by Murphy

# PROBLEM SETS

- Written problems
- Can discuss problems with others, but each student should turn in their own answers
- Out every Thursday, due every Tuesday

# PROGRAMMING ASSIGNMENTS

- Use AI to control Pac Man
- 4 or 5 assignments using different methods
- Coded in Python/Matlab



# CLASS PROJECT

- Apply an AI method to a problem of your choice or learn a new method
- Conduct experiments and write up report
- Alone or in pairs

- Examples:

kaggle™



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Built in 2009, perfectly blending elegance with functional living space. Excellent floor plan with 3 beds up and 1 on main. Open living, kitchen & dining w/ huge fireplace & Sound views. Spacious kitchen w/ slab granite surfaces & center island. Huge master suite with Jacuzzi tub & separate shower. Features; hwd floors, all

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I am inter  
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 I want f

# GRADING

- Problem sets: 20%
- Programming assignments: 30%
- Midterms: 30%
- Final project (presentation and paper): 20%

# TOPICS COVERED

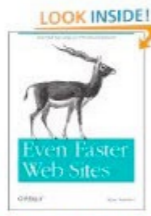
- Search
  - Uninformed search
  - Informed search
  - Adversarial search
  - Constraint satisfaction
- Decision making under uncertainty
  - Probability refresher
  - Markov Decision Processes
  - Reinforcement Learning
- Graphical Models
  - Bayes Nets
  - Hidden Markov Models
- Machine Learning
  - Supervised learning
  - Unsupervised learning
  - Deep learning




# AI ALL AROUND US

**Today's Recommendations For You**


Here's a daily sample of items recommended for you. Click here to [see all recommendations](#)



**Even Faster Web Sites: Performance...** (Paperback) by Steve Souders  
★★★★★ (7) \$23.10  
[Fix this recommendation](#)

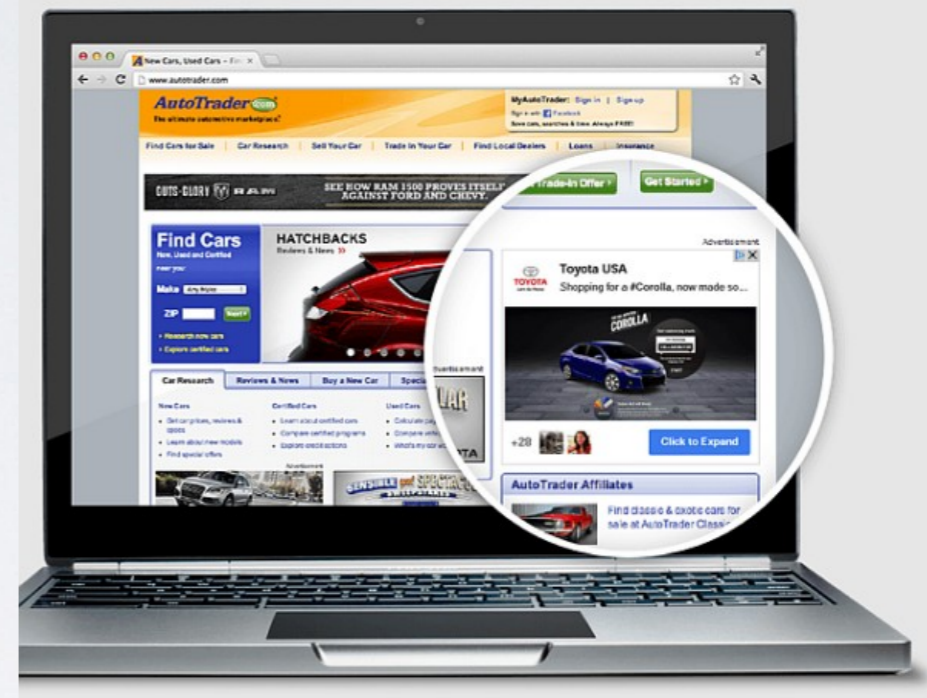


**Simply JavaScript** (Paperback) by Kevin Yank  
★★★★☆ (19) \$26.37  
[Fix this recommendation](#)



**The Art & Science of Java** (Paperback) by...

**Any Category** Algorithms Boxed Sets Business & Culture Java  
Graphic Design Microsoft Networking Networks, Protocols & APIs New SQL



**House of Cards**  
★★★★★ 2013 TV-MA 1 Season

Sharks gliding ominously beneath the surface of the water? They're a lot less menacing than this Congressman.

*This winner of three Emmys, including Outstanding Directing for David Fincher, stars Kevin Spacey and Robin Wright.*

Because you watched Orange Is the New Black

Because you watched Red Lights

Search for people, places and things

Update Status + Add Photos/Video

What's on your mind?

Keegan Jones was tagged in Myles Baker's photo.  
5 minutes ago



Kari Lee  
5 minutes ago · 🌅  
Sunrise from the caboose... Headed back to the city!



2 events today

GET INTERESTING NEWS

Beaman  
Mac Tyler and 11 other friends like this

Green Things  
Kari Lee and 2 other friends like this

Hugger  
Matt Brown and 11 other friends like this

Matt Group  
Brandon Souza and 3 other friends like this

SUGGESTED GROUPS

Fans of Philz Food/Beverage  
1,801 members

2021 Open Group  
Matt Brown Joined

Panda Vegans  
Open Group  
65 members

Yuan Tian is listening to Alternative Rock. Global Top 50 on Song Universe.

Matt Brown likes Kari Lee's status.

Merrill Feather commented on Kristoffer Brady's post on Merrill Feather's wall: "What paint color did you use?"

Lucy Zhang recommends an article on Food Trends.

Mac Tyler and Matt Brown are now friends.

Ashwin Barambe

Joy-Vincent Nie...

Olivia Bishop

Kim Caldwell

Kristoffer Brady

Austin Bales

Kari Lee

Andrew Munn

Chris Kalani

Henry Bridge

Francis Luu

Dustin MacDonald

Brandon Souza

# ARTIFICIAL INTELLIGENCE

- What is AI?

# WHAT IS AI?

- Historical perspective:
  - Handbook of AI: the part of computer science concerned with designing intelligent computer systems, that is, systems that exhibit the characteristics we associate with intelligence in human behavior
- Thoughts on this definition?

# WHAT IS AI?

- Historical perspective:
  - Handbook of AI: the part of computer science concerned with designing intelligent computer systems, that is, systems that exhibit the characteristics we associate with intelligence in human behavior
- Which is harder? Why?

Decide on moves

vs

Recognize pieces and move them



# WHAT IS AI?

- Historical perspective:
  - Handbook of AI: the part of computer science concerned with designing intelligent computer systems, that is, systems that exhibit the characteristics we associate with intelligence in human behavior
- What we think requires intelligence is often wrong
  - Elephants don't play chess: Rodney Brooks
  - People perform behaviors that seem simple
    - They require little conscious thought
    - E.g., recognizing a friend in a crowd



# WHAT IS AI?

- Historical perspective:
  - Handbook of AI: the part of computer science concerned with designing intelligent computer systems, that is, systems that exhibit the characteristics we associate with intelligence in human behavior
- It's a moving Target: once we come up with an algorithm or technology to perform a task, we tend to re-assess our beliefs that it requires intelligence or is AI
  - Beating the best human chess player was a dream of AI from its birth
  - Deep blue eventually beats the best
  - “Deep Blue is unintelligent because it is so narrow. It can win a chess game, but it can't recognize, much less pick up, a chess piece. It can't even carry on a conversation about the game it just won. Since the essence of intelligence would seem to be breadth, or the ability to react creatively to a wide variety of situations, it's hard to credit Deep Blue with much intelligence.” Drew McDermott

# WHAT IS AI?

- Historical perspective:
  - Handbook of AI: the part of computer science concerned with designing intelligent computer systems, that is, systems that exhibit the characteristics we associate with intelligence in human behavior
- The algorithm or technology may not seem intelligent
  - Deep Blue relied on high speed brute force search
  - Raised the question: Is that how people do it?
  - Why not?
  - Does it matter?

# WHAT IS AI?

## A MORE MODERN VIEW

Russell & Norvig: Views of AI fall into four categories:

Thinking Humanly	Thinking Rationally
Acting Human	Acting Rationally

The textbook organized around "acting rationally"

but lets consider the others as well...



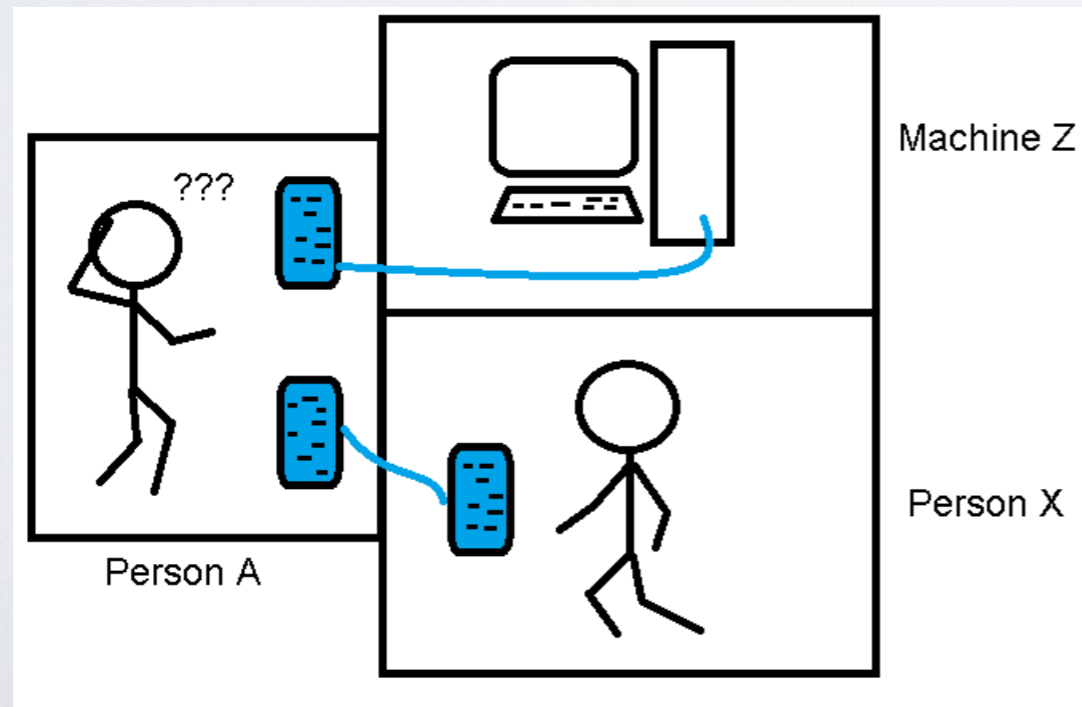
# ARTIFICIAL INTELLIGENCE

- Intelligence
  - Cognitive modeling: behaves like a human
  - Engineering: achieve (or surpass) human performance
  - Rational: behaves perfectly, normative
  - Bounded-rational: behaves as well as possible
  - Aiding humans or completely autonomous



# ACTING HUMANLY: TURING TEST

- Turing (1950) "Computing machinery and intelligence":
- "Can machines think?" or "Can machines behave intelligently?"



WHAT WOULD A COMPUTER NEED  
TO PASS THE TURING TEST?

?

# WHAT WOULD A COMPUTER NEED TO PASS THE TURING TEST?

- **Natural language processing:** to communicate with examiner.
- **Knowledge representation:** to store and retrieve information provided before or during interrogation.
- **Automated reasoning:** to use the stored information to answer questions and to draw new conclusions.
- **Machine learning:** to adapt to new circumstances and to detect and extrapolate patterns.
- And this is only the simple version without perception or action!

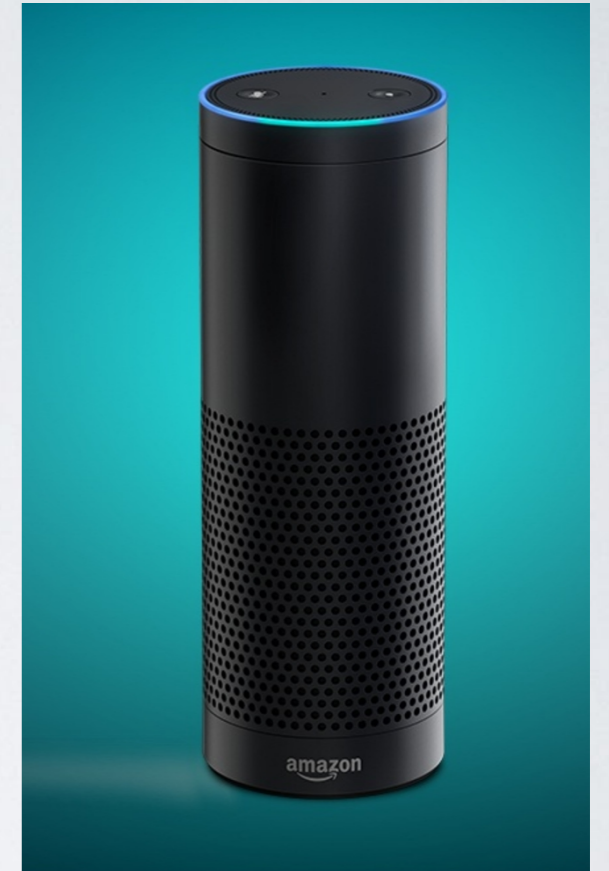
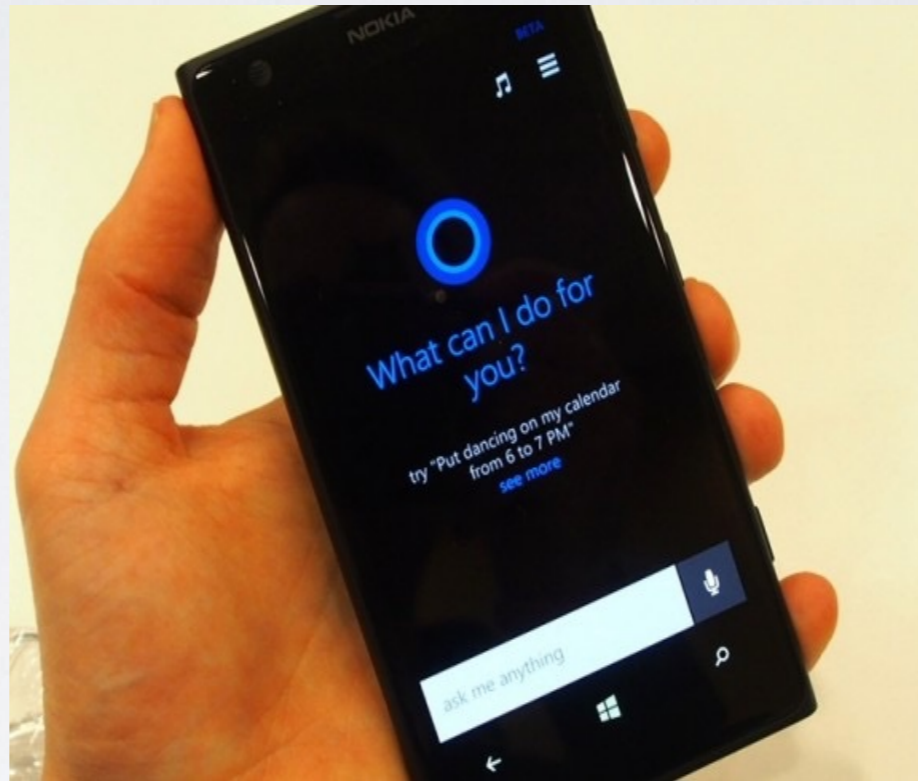
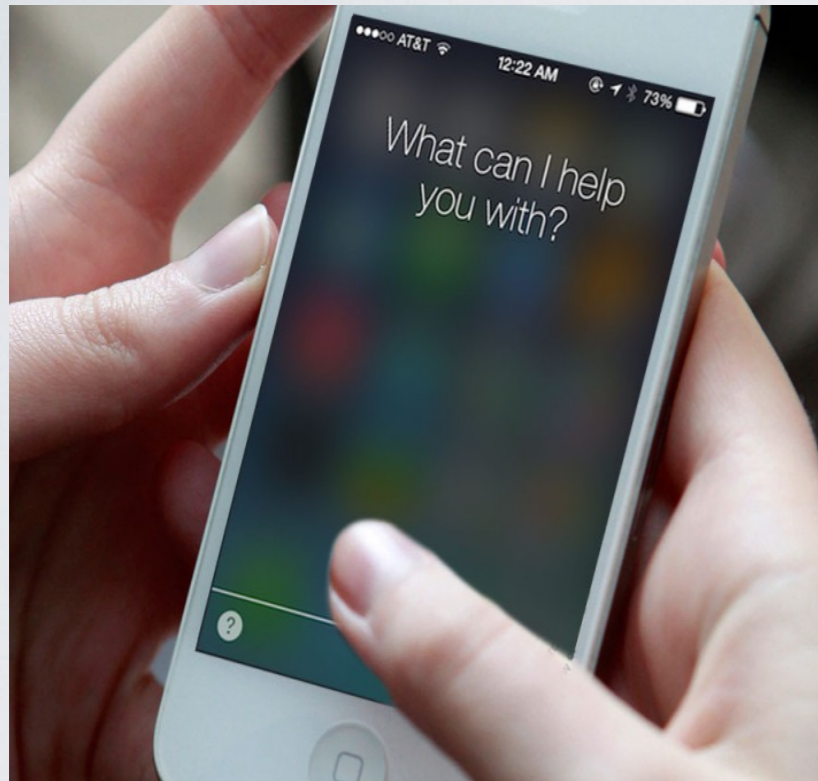
# WHAT WOULD A COMPUTER NEED TO PASS THE TURING TEST?

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- And this is only the simple version without perception or action!
- Is this a good test of AI?

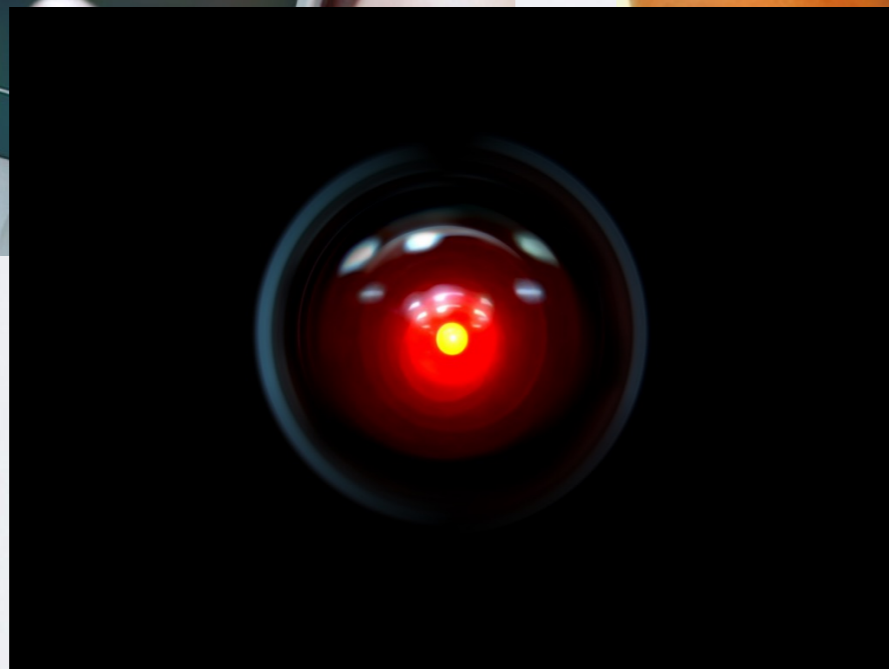
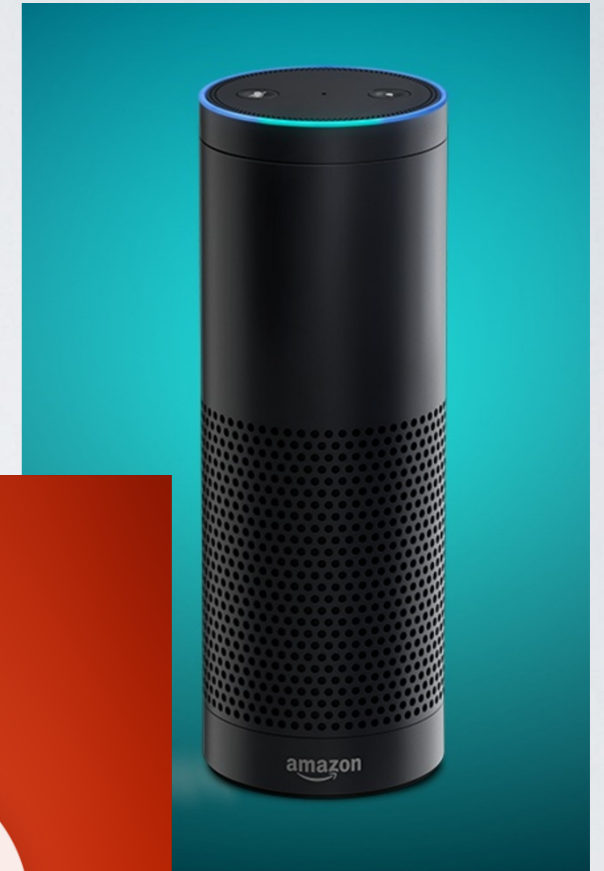
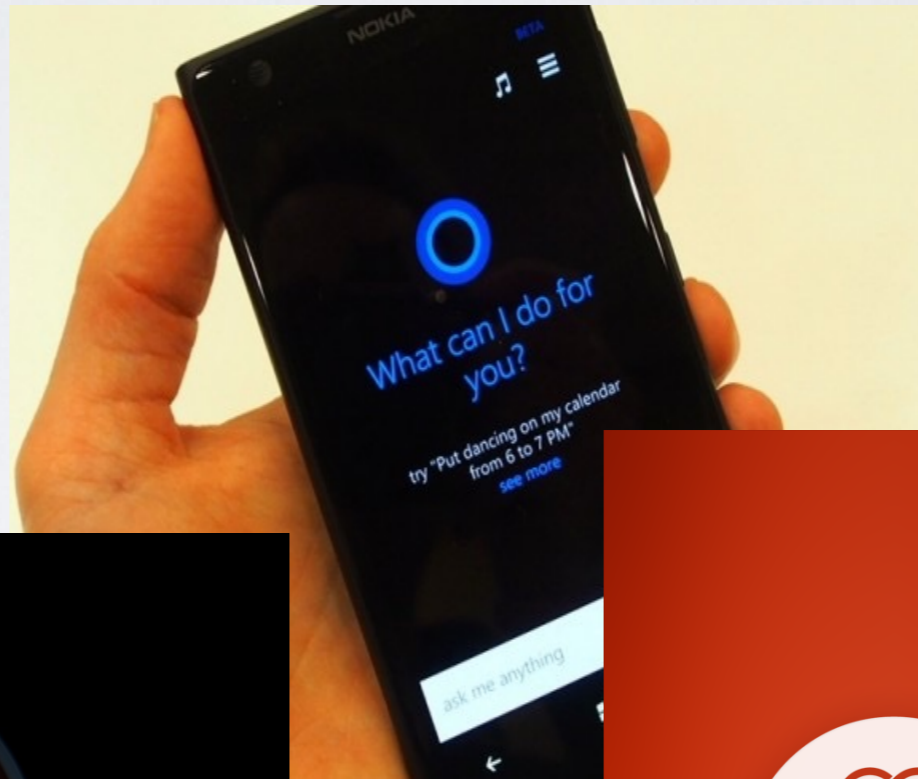
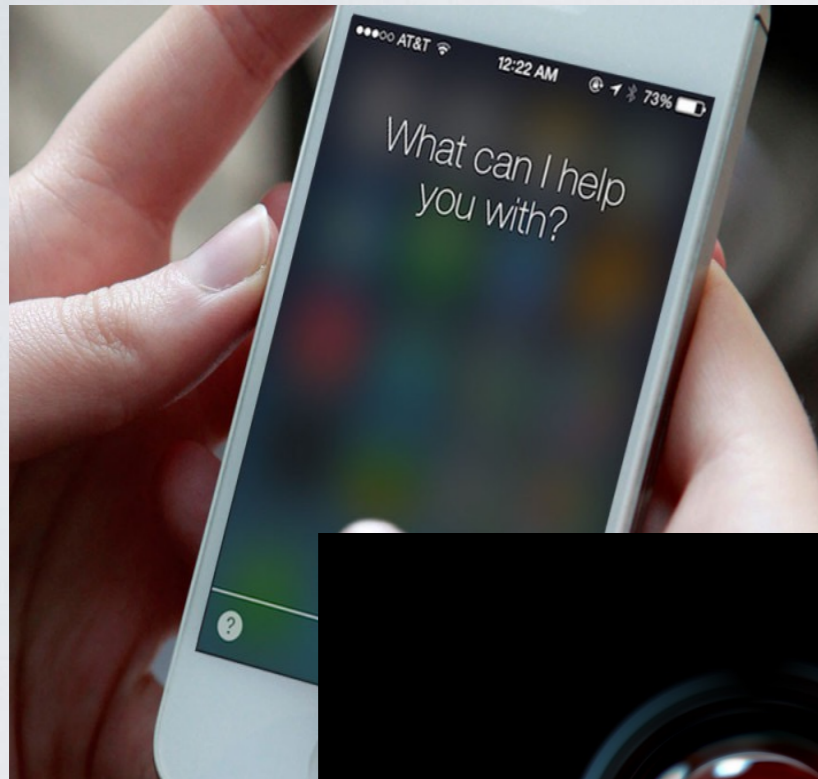
# IBM'S WATSON



# AI ASSISTANTS



# AI ASSISTANTS





# AUTONOMOUS CARS

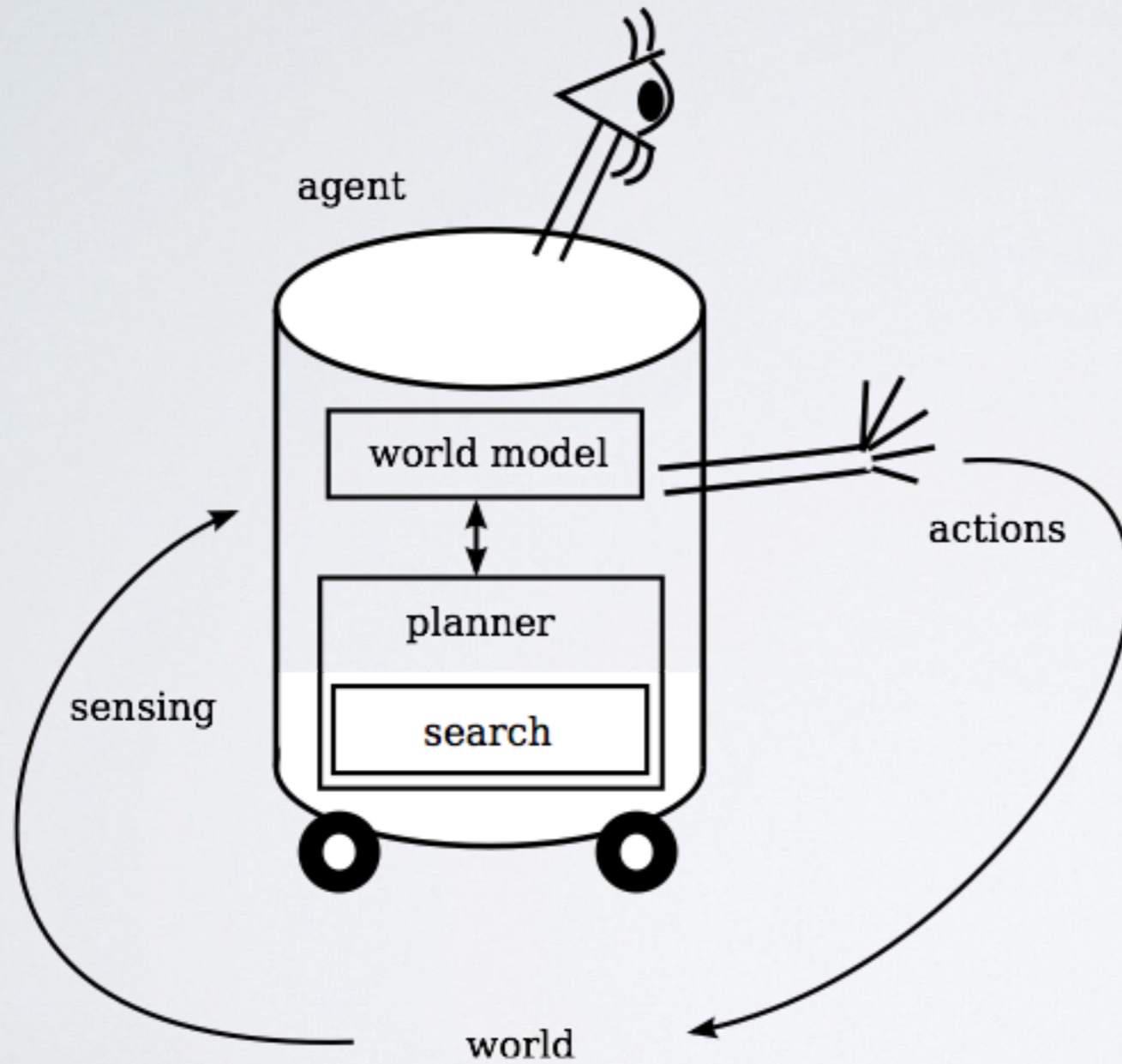


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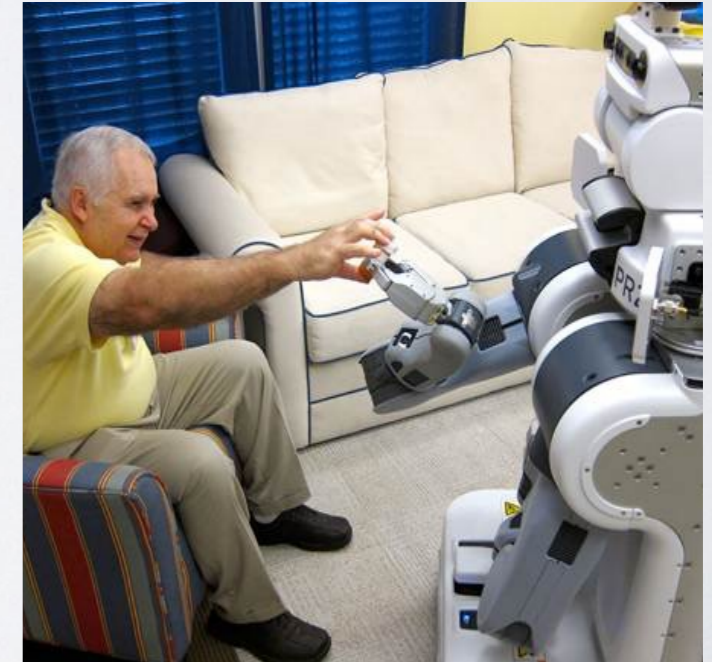


- Google, Tesla, Audi, BMW, GM, Ford, Uber, Lyft, Apple, nuTonomy...

# ROBOTICS



# SOME ROBOTS



# AI'S CYCLE OF FAILED EXPECTATIONS

- 1958, Simon and Newell: "within ten years a digital computer will be the world's chess champion"
- 1965, Simon: "machines will be capable, within twenty years, of doing any work a man can do."
- 1967, Minsky: "Within a generation ... the problem of creating 'artificial intelligence' will substantially be solved."
- 1970, Minsky: "In from three to eight years we will have a machine with the general intelligence of an average human being."
- Such optimism lead to AI winters as AI failed to meet expectations
  - Reduced attendance at conferences, reduced federal funding

# WHAT WERE THE ROADBLOCKS?

- Limited computer power: There was not enough memory or processing speed to accomplish anything truly useful
- Intractability and the combinatorial explosion. Karp: *many problems can probably only be solved in exponential time (in the size of the inputs)*
- Commonsense knowledge and reasoning. Many important artificial intelligence applications like vision or natural language require enormous amounts of information about the world
- Moravec's paradox: Proving theorems and solving geometry problems is comparatively easy for computers, but a supposedly simple task like recognizing a face or crossing a room without bumping into anything is extremely difficult.

# CYCLES OF OPTIMISM, FAILURE ACTUALLY GOOD FOR AI

Forced AI to Explore new ideas

- Statistical techniques revitalized Machine Learning

Old ideas reinvigorated using new approaches and technologies as well as new applications

- Neural Networks
  - Early 1950s work on neural networks falls out of favor after Minsky and Papert book on Perceptrons identifies representational issues
  - Deep Learning: Now back in a wide range of applications involving large data sets that are now available
- Work on Emotion
  - Initially argued as critical for AI by Simon and Minsky
  - Fell out of favor during rational period
  - Now a key new area Affective Computing: as man and machine increasingly interact
- Earlier ideas about knowledge representation re-entering ML
  - May transform purely statistical techniques

# BUT SUCCESS BRINGS FEARS AND ETHICAL CONCERNS

- Real issues
  - Privacy
  - Jobs
- Elon Musk
  - If I were to guess at what our biggest existential threat is, it's probably that... With artificial intelligence, we are summoning the demon
  - AI is "potentially more dangerous than nukes."
- Stephen Hawking
  - "I think the development of full artificial intelligence could spell the end of the human race"



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# THE SOCIAL DILEMMA OF AUTONOMOUS VEHICLES

- Raises fundamental Issues in moral psychology
  - How to balance self-interest and the public good?
- Bonnefon *et al.*'s study (*Science* 24 Jun 2016) found that participants would
  - Approve of autonomous vehicles that might sacrifice passenger to save others
  - Not want to buy or even ride in such vehicles
  - Not approve regulations mandating self-sacrifice

