Announcements

Assignments

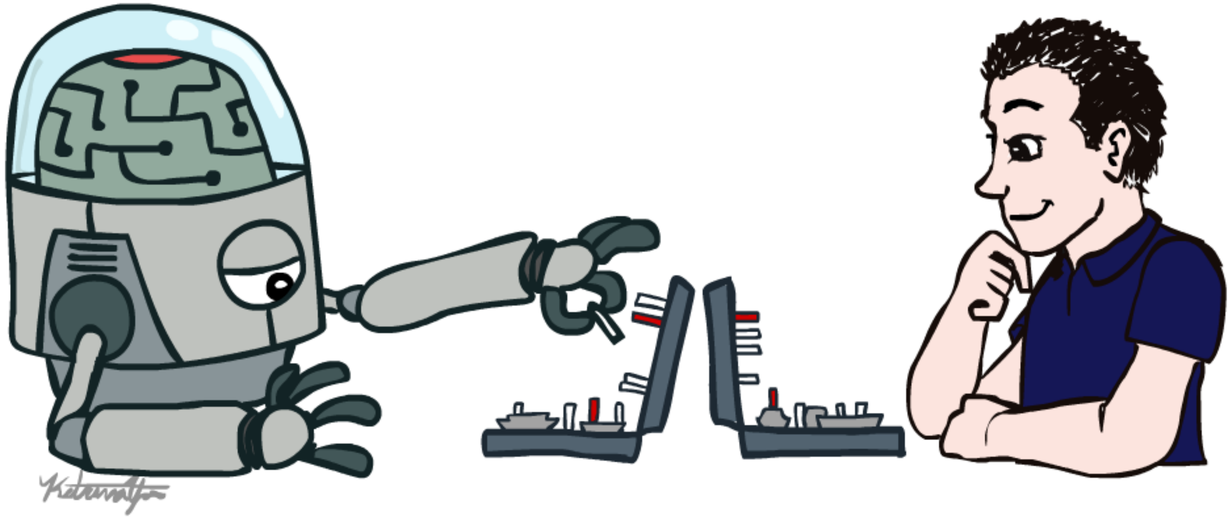
- HW12
  - Due tomorrow, 12/6, 10 pm

Final Exam

- Thur, 12/12, 1-4 pm, GHC 4401
- See Piazza for details
- Recitation → Review session, Fri, 3-4:20 pm, GHC 4401
- Practice exam and learning objectives coming soon!
  - Practice exam solution session: Wed, 12/11, 12-2pm, GHC 4215

AI: Representation and Problem Solving

Human-Compatible AI



Instructors: Pat Virtue & Fei Fang

Slide credits: CMU AI and http://ai.berkeley.edu

Intelligent Agents

From first lecture

Candy Grab

A. 11 pieces on the table

B. Take turns taking either 1 or 2 pieces

C. Person that takes the last piece wins!

```
class Agent
    function getAction(state)
        return action
```

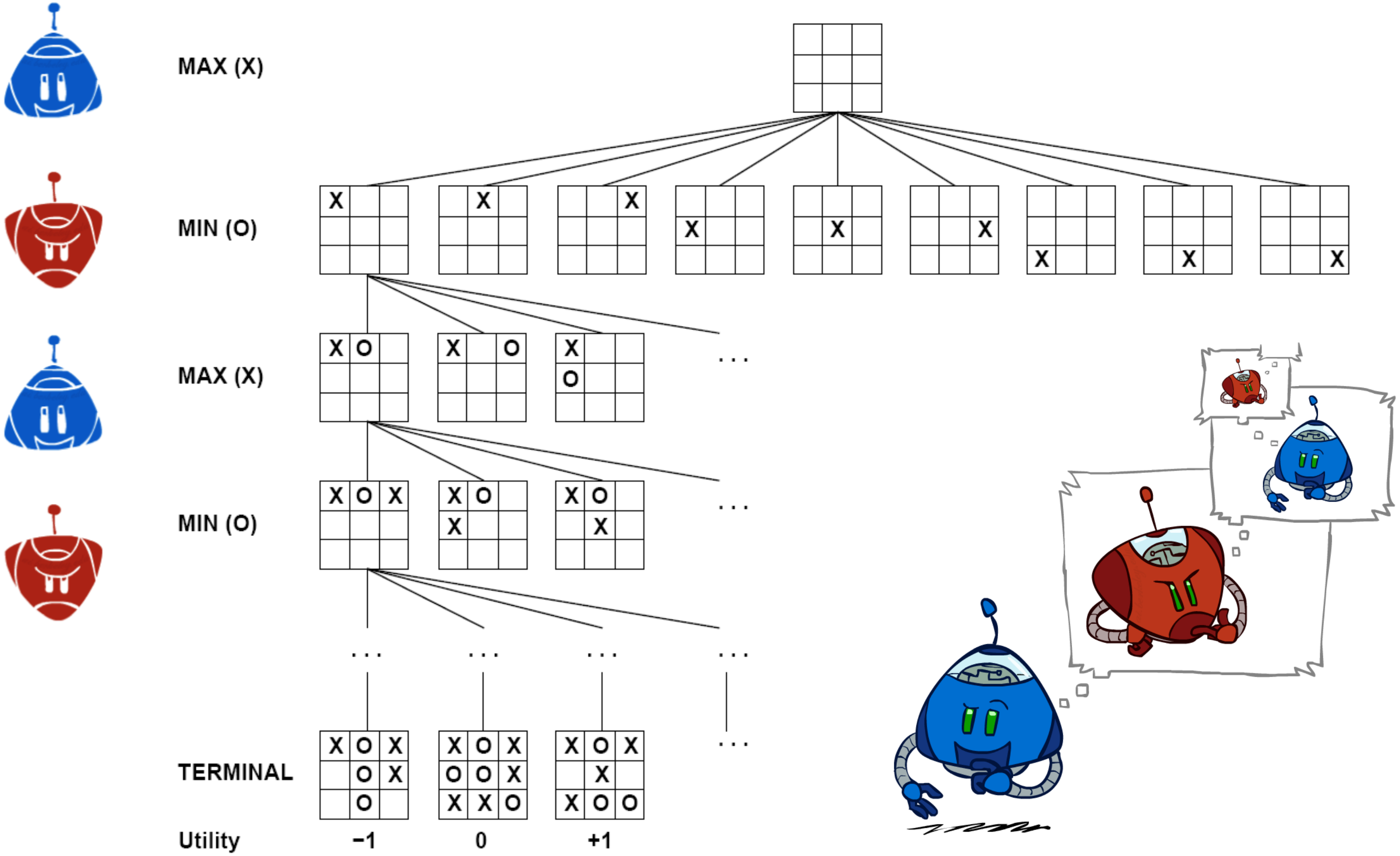
Piazza Poll 1

Three “Intelligent” Agents

Which agent code is the most “intelligent”?

Games – Three “Intelligent” Agents

A: Search



Games – Three “Intelligent” Agents

B: Encode the pattern

```
function getAction( numPiecesAvailable )

     if numPiecesAvailable % 3 == 2
          return 2
     else
          return 1
```

```
10's value:Win
9's value:Lose
8's value:Win
7's value:Win
6's value:Lose
5's value:Win
4's value:Win
3's value:Lose
2's value:Win
1's value:Win
0's value:Lose
```

Games – Three "Intelligent" Agents

C: Record statistics of winning positions

Pieces Available	Take 1	Take 2
2	0%	**100%**
3	2%	0%
4	**75%**	2%
5	4%	**68%**
6	5%	6%
7	**60%**	5%

Piazza Poll 1

Three “Intelligent” Agents

Which agent code is the most “intelligent”?

A. Search

B. Encode multiple of 3 pattern

C. Keep stats on winning positions

Piazza Poll 2

Which 281 technique is the most intelligent?

A. Search

B. Logical inference

C. Numeric optimization

D. Q-learning

E. Approximate Q-learning

F. Exact inference Bayes nets

G. Approximate inference Bayes nets

Value of Information

Ghostbusters

Given:

$P(G = g_{top}) \ = \ 0.5$

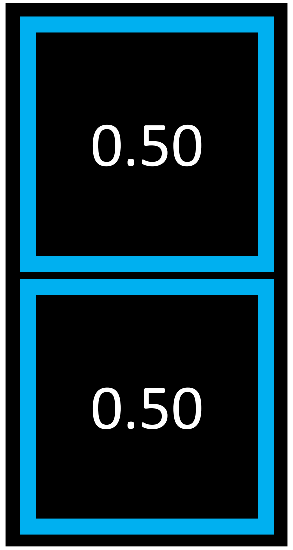
$P(G = g_{bottom}) \ = \ 0.5$

$P(\,S_{top} = red \mid g_{top}\,) \ = \ 0.8$

$P(\,S_{top} = red \mid g_{bottom}\,) \ = \ 0.4$

$P(\,S_{bottom} = red \mid g_{top}\,) \ = \ 0.4$

$P(\,S_{bottom} = red \mid g_{bottom}\,) \ = \ 0.8$



0.50

0.50

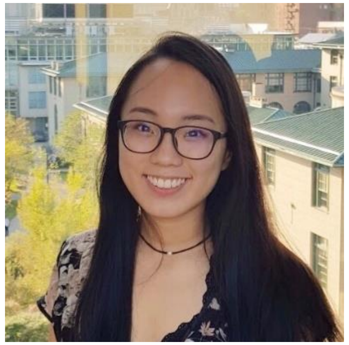
Value of Information

$P(G = g_{top}) = 0.5$
$P(G = g_{bottom}) = 0.5$

$P\left(S_{top} = red \,\middle|\, g_{top} \right) = 0.8$
$P\left(S_{top} = red \,\middle|\, g_{bottom} \right) = 0.4$
$P(S_{bottom} = red \mid g_{top}) = 0.4$
$P(S_{bottom} = red \mid g_{bottom}) = 0.8$

FCE: https://cmu.smartevals.com/

TA survey: https://www.ugrad.cs.cmu.edu/ta/F19/feedback/



Angela
Yang

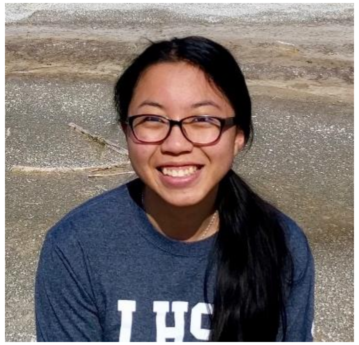
Claire Wang
(Head TA)

George
Brown

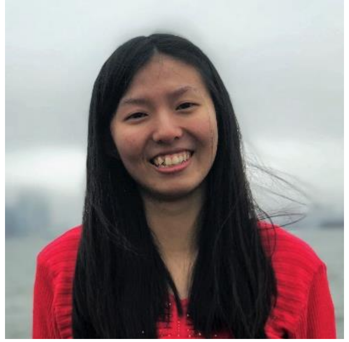
Michelle
Ma

Sean
Pereira

Chakara (Tian)
Owarang

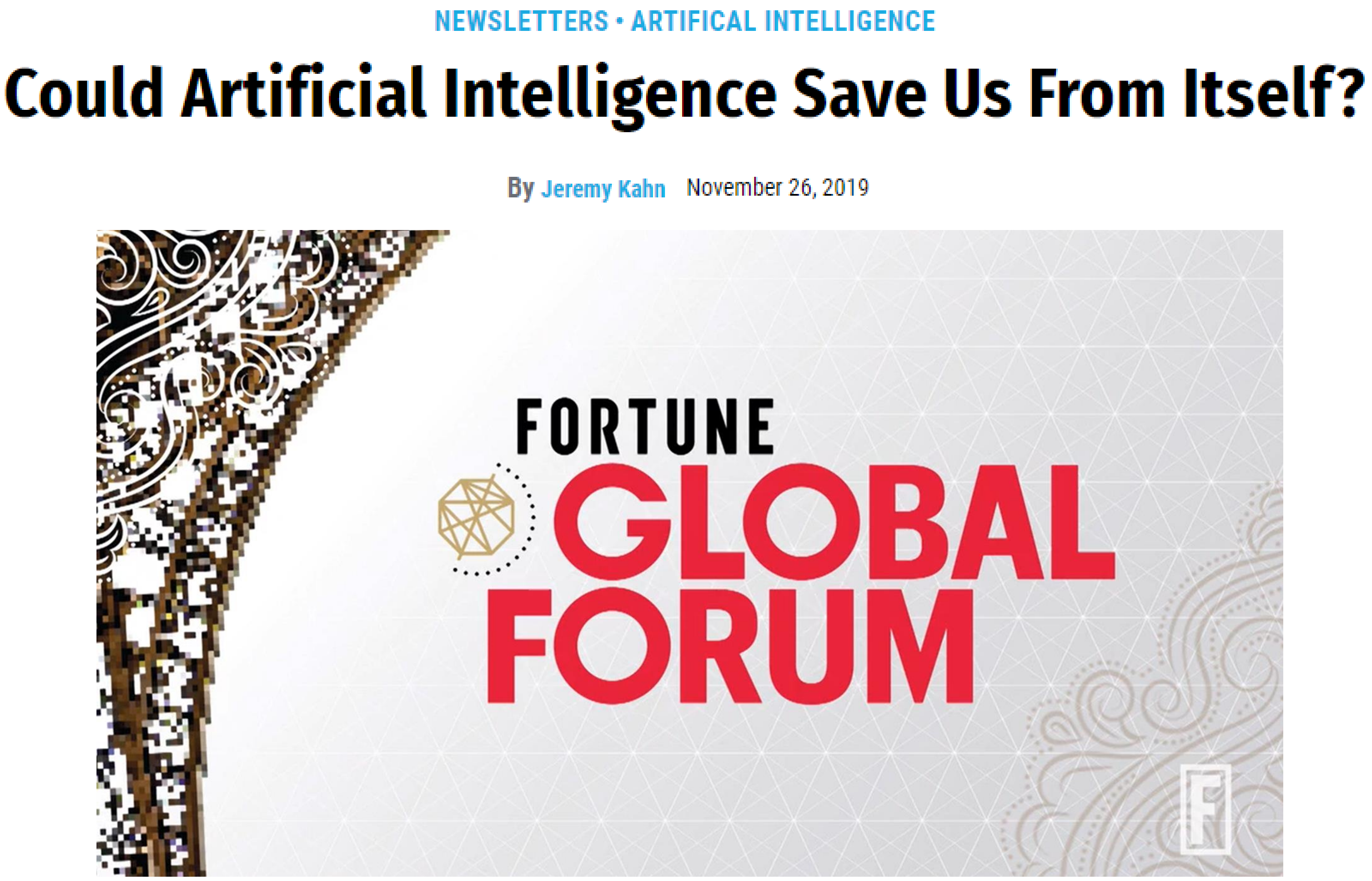


Tina
Wu



Vicky
Zeng

AI in the News



NEWSLETTERS • ARTIFICAL INTELLIGENCE

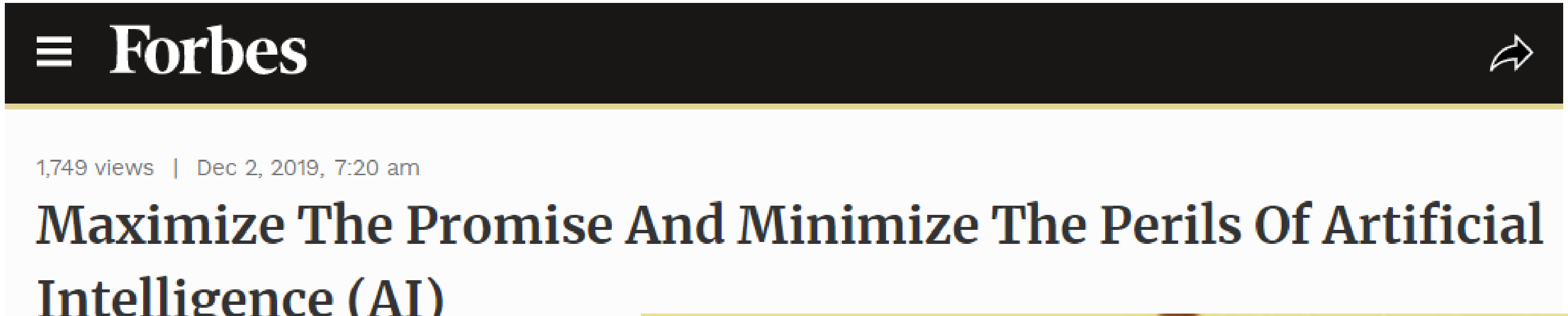
Could Artificial Intelligence Save Us From Itself?

By Jeremy Kahn November 26, 2019

https://fortune.com/2019/11/26/ai-is-the-problem-and-the-solution/

AI in the News

https://www.forbes.com/sites/grantfreeland/2019/12/02/maximize-the-promise-and-minimize-the-perils-of-artificial-intelligence-ai/amp/



Forbes

1,749 views | Dec 2, 2019, 7:20 am

Maximize The Promise And Minimize The Perils Of Artificial Intelligence (AI)

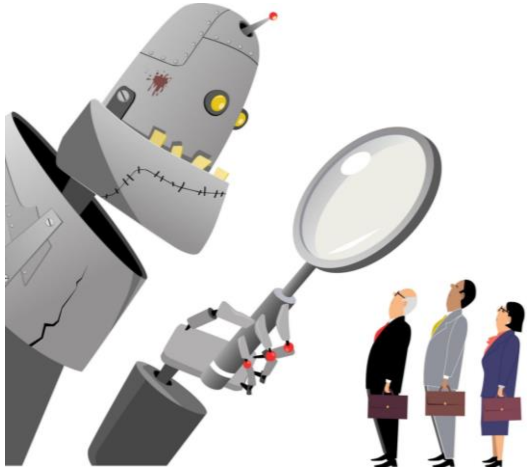
Grant Freeland Contributor ⓘ

Leadership Strategy

Should We Worry about Today's A.I.?

Should We Worry about Today's A.I.?

Bias



Images:
https://medium.com/@turalt/ai-isnt-biased-we-are-b74ec94d1698

AI Bias

ACM Conference on Fairness, Accountability, and Transparency (ACM FAT*)

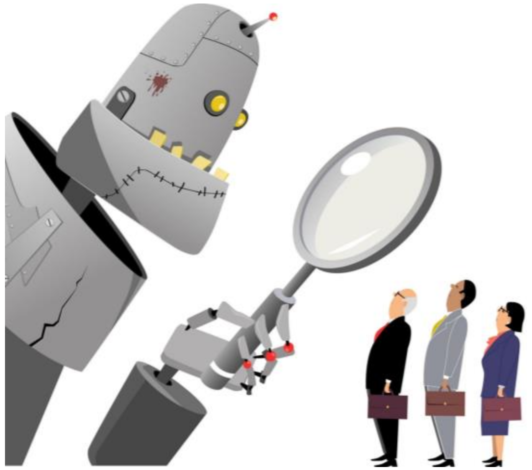
A multi-disciplinary conference that brings together researchers and practitioners interested in fairness, accountability, and transparency in socio-technical systems.

Alexandra Chouldechova
CMU, Statistics and Public Policy
http://www.contrib.andrew.cmu.edu/~achoulde/

https://fatconference.org/

Should We Worry about Today's A.I.?

Bias



Weapons

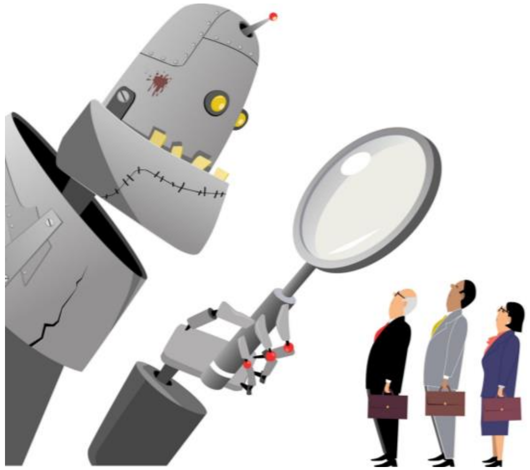
Images:
https://medium.com/@turalt/ai-isnt-biased-we-are-b74ec94d1698
http://futureoflife.org/2016/09/20/podcast-what-is-nuclear-risk/

AI Weapons

https://fatconference.org/

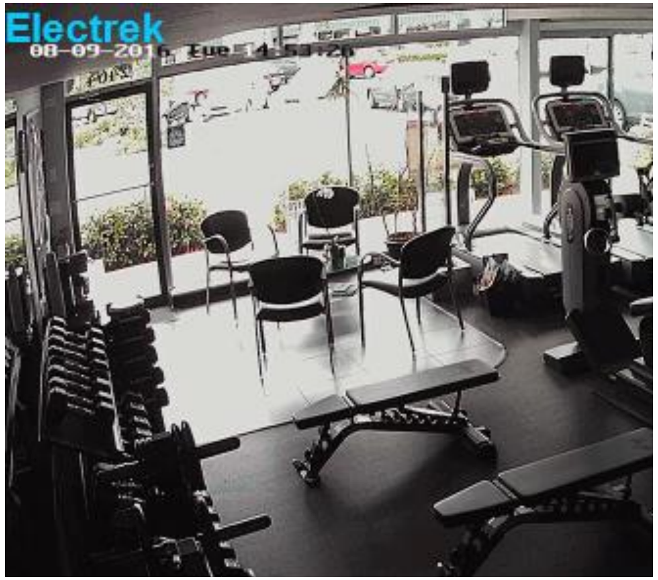
Should We Worry about Today's A.I.?

Bias



Weapons

Liability



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http://futureoflife.org/2016/09/20/podcast-what-is-nuclear-risk/
https://electrek.co/2016/09/25/tesla-model-s-crashes-into-gym-driver-claims-autonomous-acceleration-tesla-says-drivers-fault/

Piazza Poll 3

AI Explainability

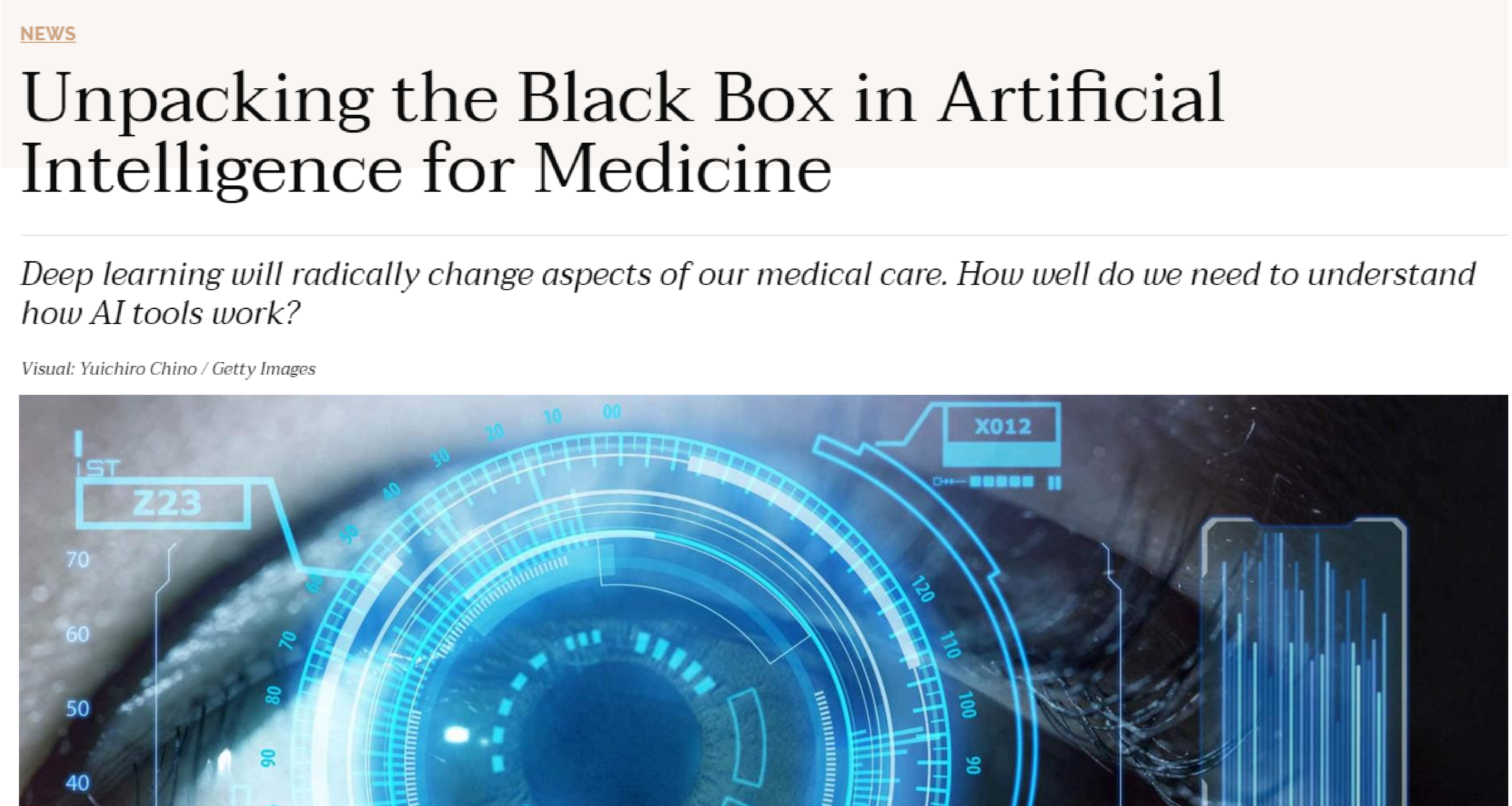
Which of the following techniques have explainable results?

(SELECT ALL THAT APPLY)

A. Search
B. Logical inference
C. Numeric optimization
D. Q-learning
E. Approximate Q-learning
F. Exact inference Bayes nets
G. Approximate inference Bayes nets
H. Deep learning

AI in the News

https://undark.org/2019/12/04/black-box-artificial-intelligence/



NEWS

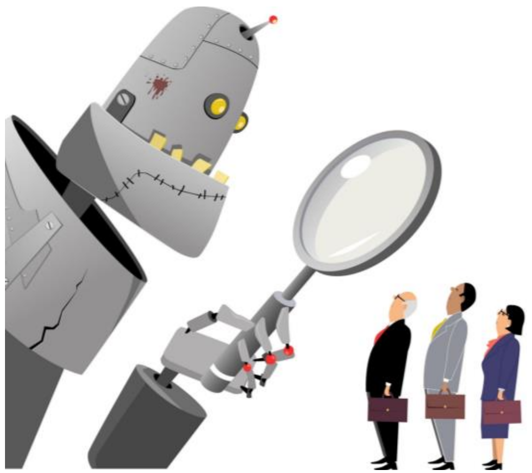
Unpacking the Black Box in Artificial Intelligence for Medicine

Deep learning will radically change aspects of our medical care. How well do we need to understand how AI tools work?

Visual: Yuichiro Chino / Getty Images

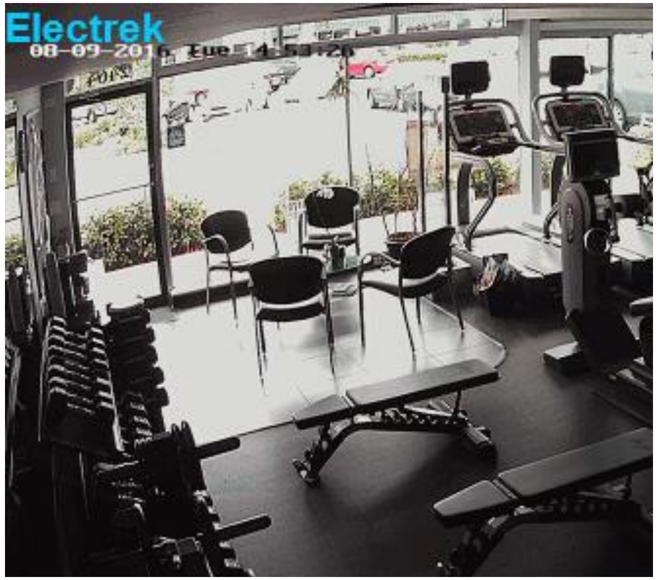
Should We Worry about Today’s A.I.?

Bias



Weapons

Liability



Jobs

Images:
https://medium.com/@turalt/ai-isnt-biased-we-are-b74ec94d1698
http://futureoflife.org/2016/09/20/podcast-what-is-nuclear-risk/
https://electrek.co/2016/09/25/tesla-model-s-crashes-into-gym-driver-claims-autonomous-acceleration-tesla-says-drivers-fault/
http://ot.to/

AI in the News

https://www.supplychaindigital.com/technology/ups-invests-autonomous-driving-firm-tusimple

SUPPLY CHAIN LOGISTICS TECHNOLOGY

UPS invests in autonomous driving firm TuSimple

By **SEAN GALEA-PACE** • Aug 15, 2019, 10:20AM

Piazza Poll 4

Is it ok if autonomous vehicles completely replace human drivers?

Piazza Poll 4

Is it ok if autonomous vehicles completely replace human drivers?

AI in the News

- https://www.brookings.edu/research/what-jobs-are-affected-by-ai-better-paid-better-educated-workers-face-the-most-exposure/
- https://www.vox.com/platform/amp/policy-and-politics/2019/12/3/20965464/2020-presidential-candidates-jobs-automation-ai
- https://www.irishtimes.com/business/technology/short-window-to-stop-ai-taking-control-of-society-warns-ex-google-employee-1.4104535

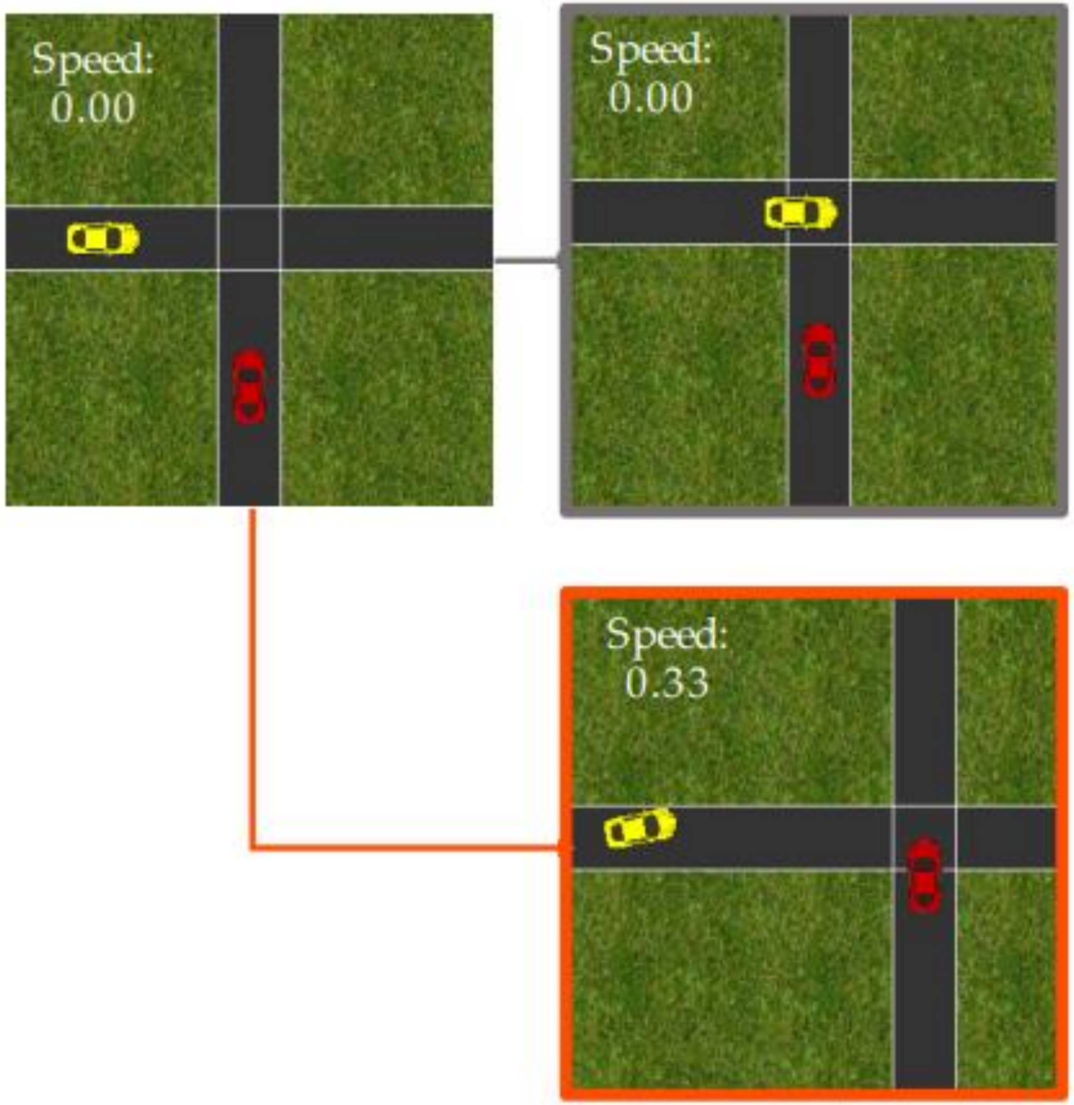
AI Challenge: Humans

Handing humans a drink

Anca Dragan
UC Berkeley, EECS
CMU PhD

AI Challenge: Humans

Driving with humans

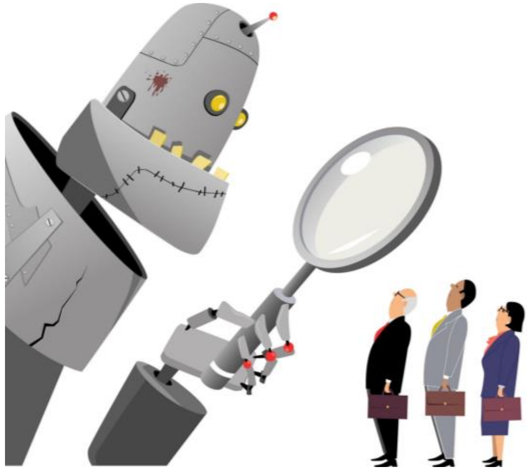


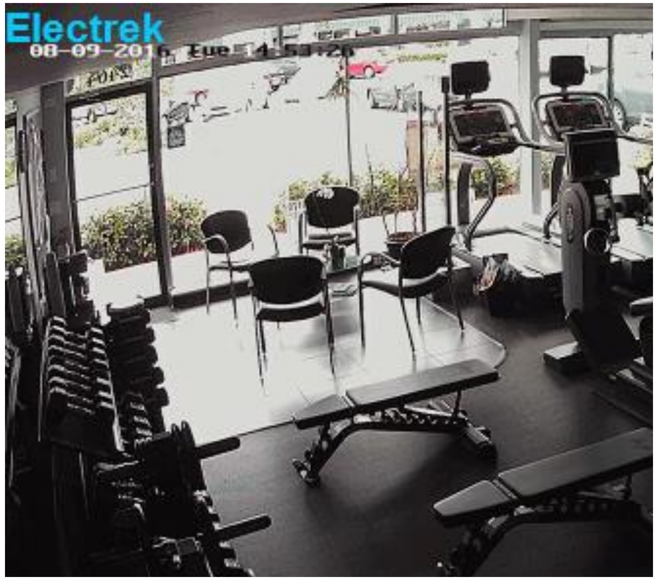
Dorsa Sadigh
Stanford, CS
https://stanford-iliad.github.io/pdfs/publications/sadigh2016planning.pdf

Piazza Poll 5

Once autonomous vehicles are readily available, should it be illegal for humans to drive?

Narrow A.I.





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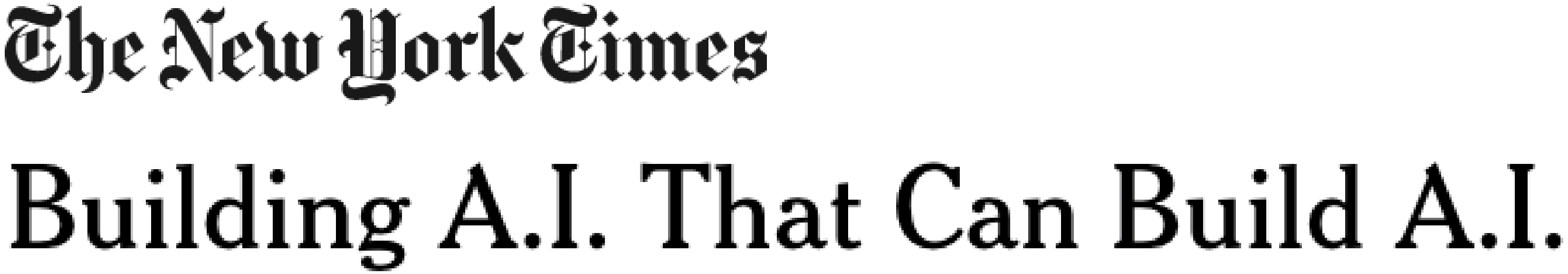
https://electrek.co/2016/09/25/tesla-model-s-crashes-into-gym-driver-claims-autonomous-acceleration-tesla-says-drivers-fault/
http://ot.to/

AI in the News

Nov. 5, 2017

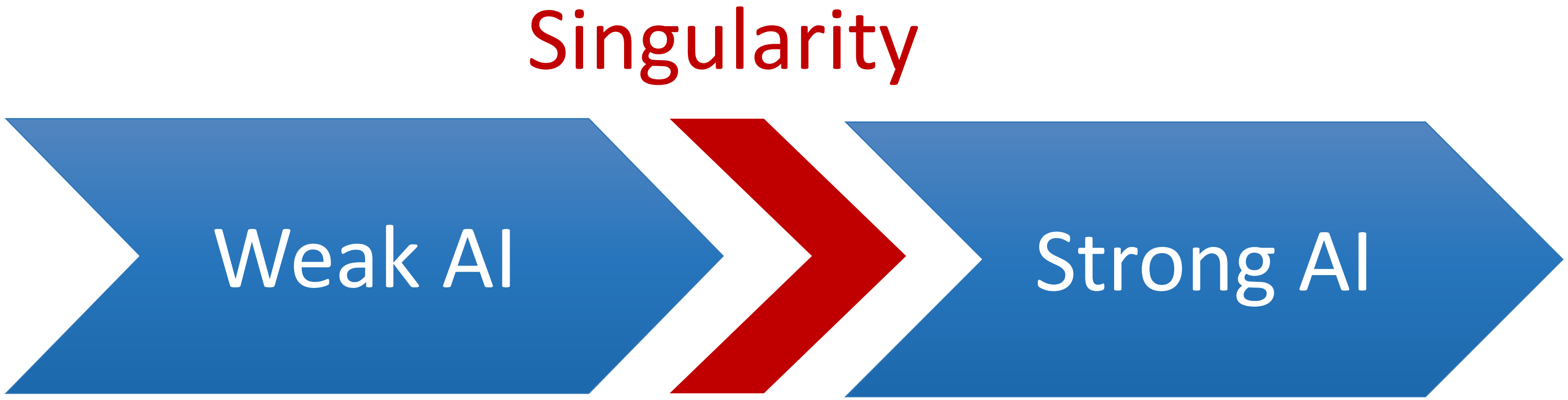


The New York Times

Building A.I. That Can Build A.I.

https://mobile.nytimes.com/2017/11/05/technology/machine-learning-artificial-intelligence-ai.html

Should we worry about future A.I.?



Singularity

Weak AI

Strong AI

- Narrow AI
- Limited number of applications

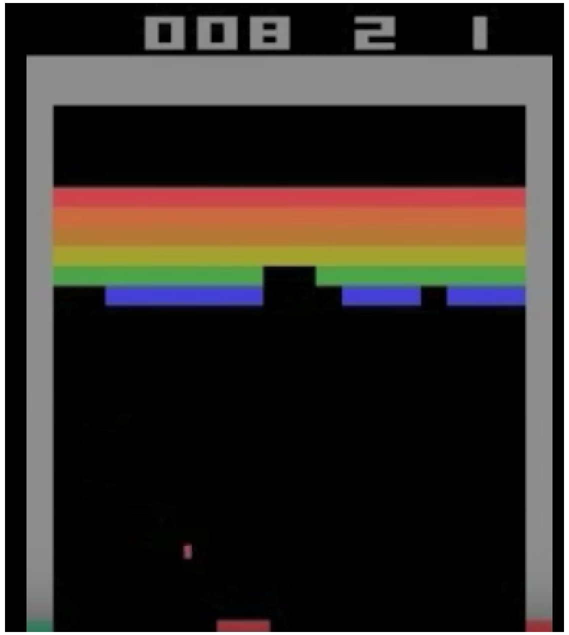
- Artificial General Intelligence (AGI)
- Recursive self-improvement
- Beyond human control

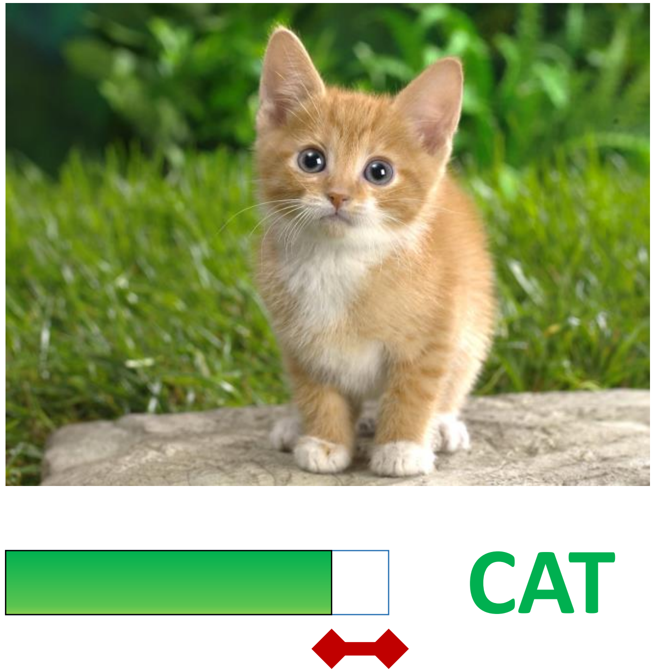
Should we worry about future A.I.?

What motivates agents?

Candy grab

Ana: “taking 2 makes it 8”
Bob: “taking 1 makes it 7”
Ana: “taking 2 makes it 5”
Bob: “taking 2 makes it 3”
Ana: “taking 1 makes it 2”
Bob: “taking 2 makes it 0”
I WIN!





Should we worry about future A.I.?

Question: What is the specific motivation behind these techniques?

- Search
- Logical inference
- Linear programming
- RL
- Inference Bayes nets

Should we worry about future A.I.?

Question: What motivation could cause problems?

Should we worry about future A.I.?

Stuart Russell, UC Berkeley [Center for Human-Compatible AI]

The off-switch problem
PR2
I must fetch the coffee
I can't fetch the coffee if I'm dead
Therefore I must disable my off-switch
TED

Stuart Russell *at* TED2017

3 principles for creating safer AI

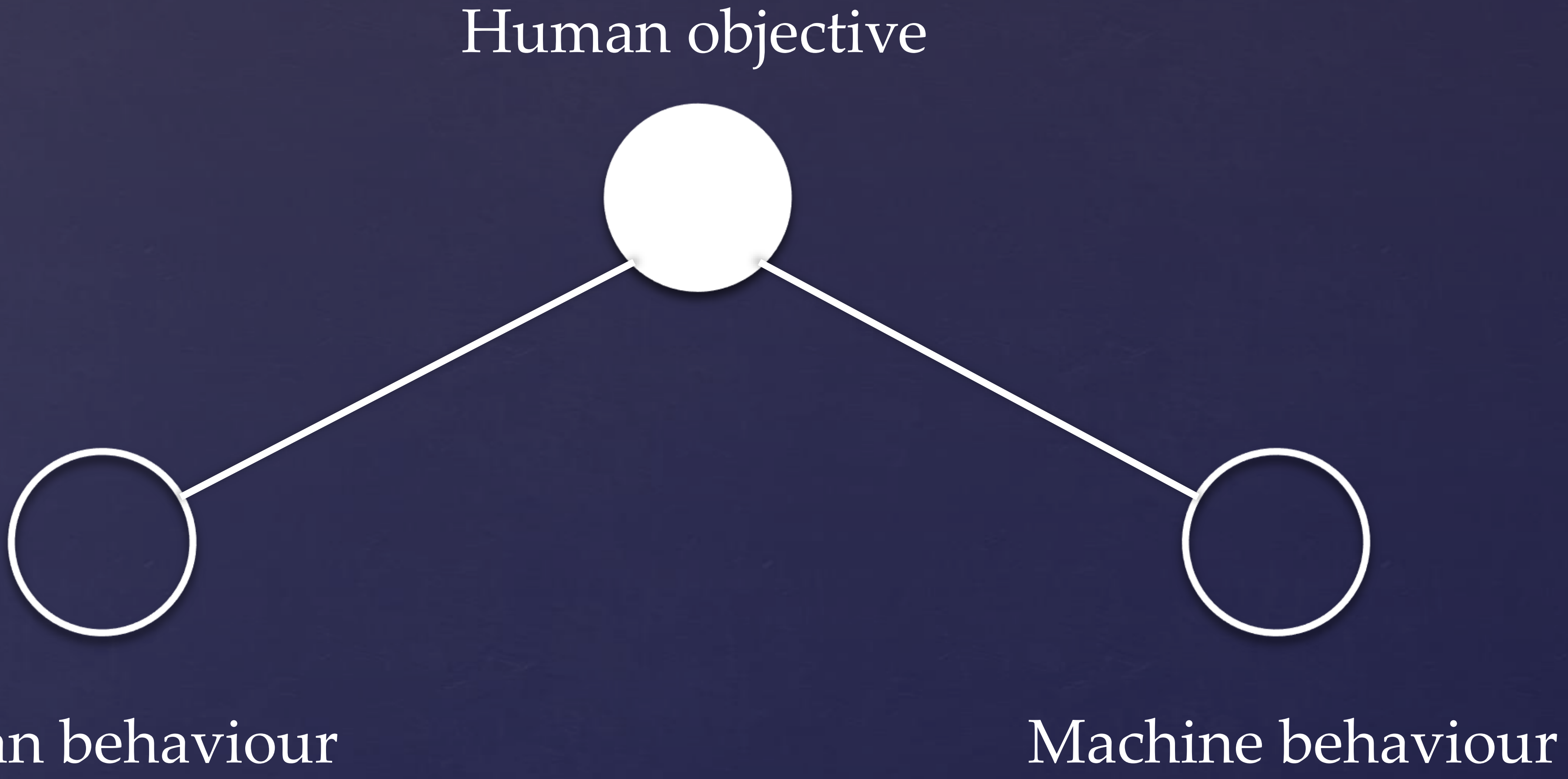
https://www.ted.com/talks/stuart_russell_how_ai_might_make_us_better_people

Three simple ideas

1. The robot’s only objective is to maximize the realization of human values
2. The robot is initially uncertain about what those values are
3. The best source of information about human values is human behavior

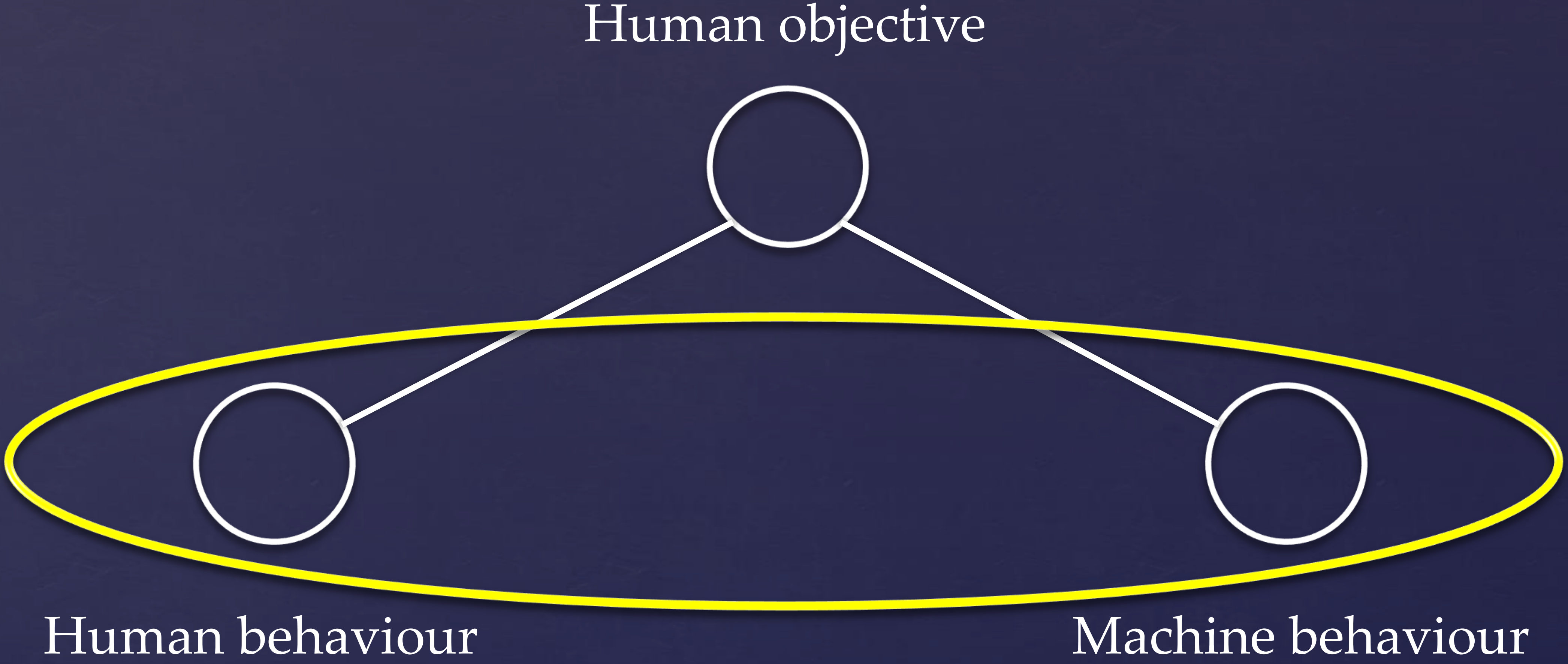
Slides: Stuart Russell, IJCAI 2017

AIMA 1,2,3: objective given to machine



Slides: Stuart Russell, IJCAI 2017

AIMA 4: objective is a latent variable



Slides: Stuart Russell, IJCAI 2017

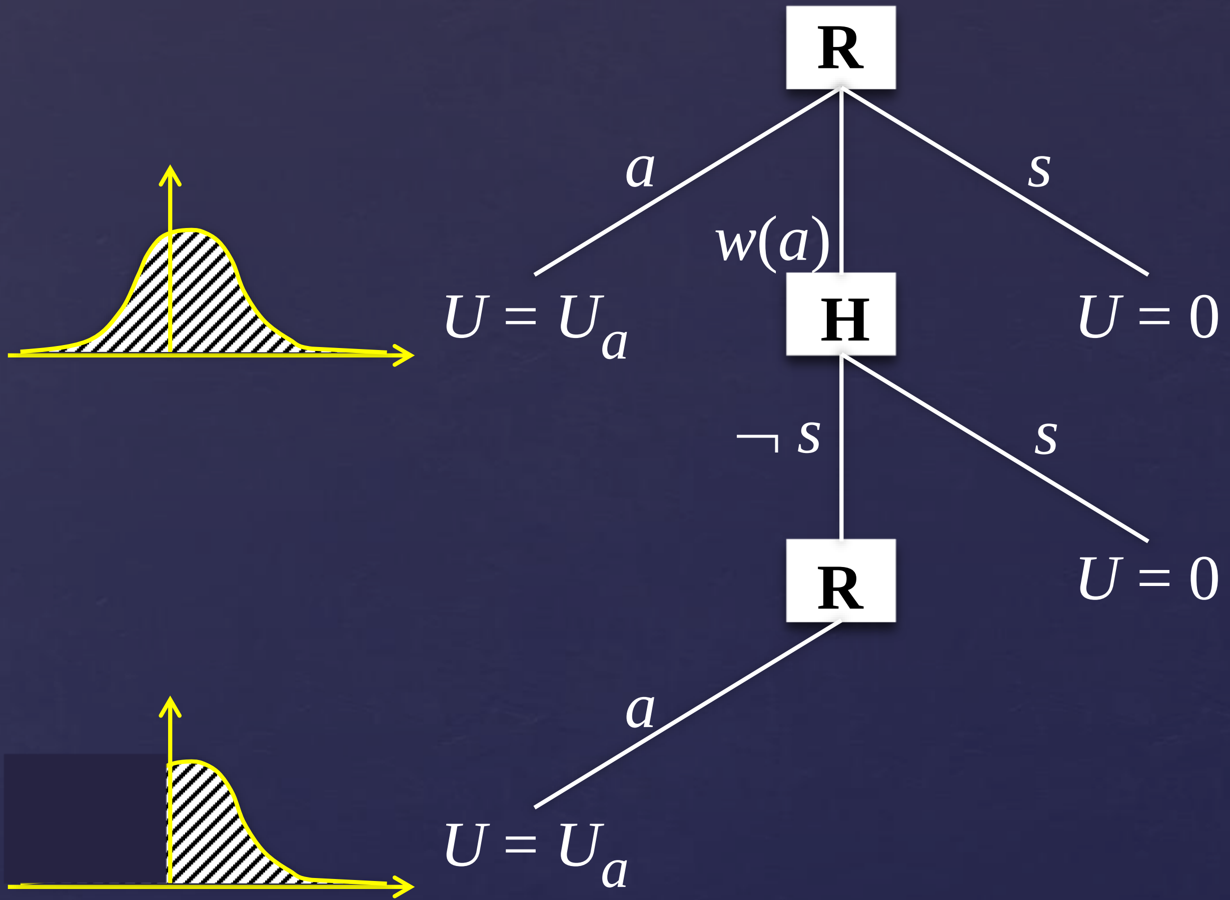
The off-switch problem

- A robot, given an objective, has an incentive to disable its own off-switch

  (You can't fetch the coffee if you're dead)
- How can we prevent this?
- Answer: robot must allow for ***uncertainty*** about the true human objective
  - The human will only switch off the robot if that leads to better outcomes for the true human objective
  - Theorem: it's ***in the robot's interest*** to allow it
  - Theorem: Such a robot is ***provably beneficial***

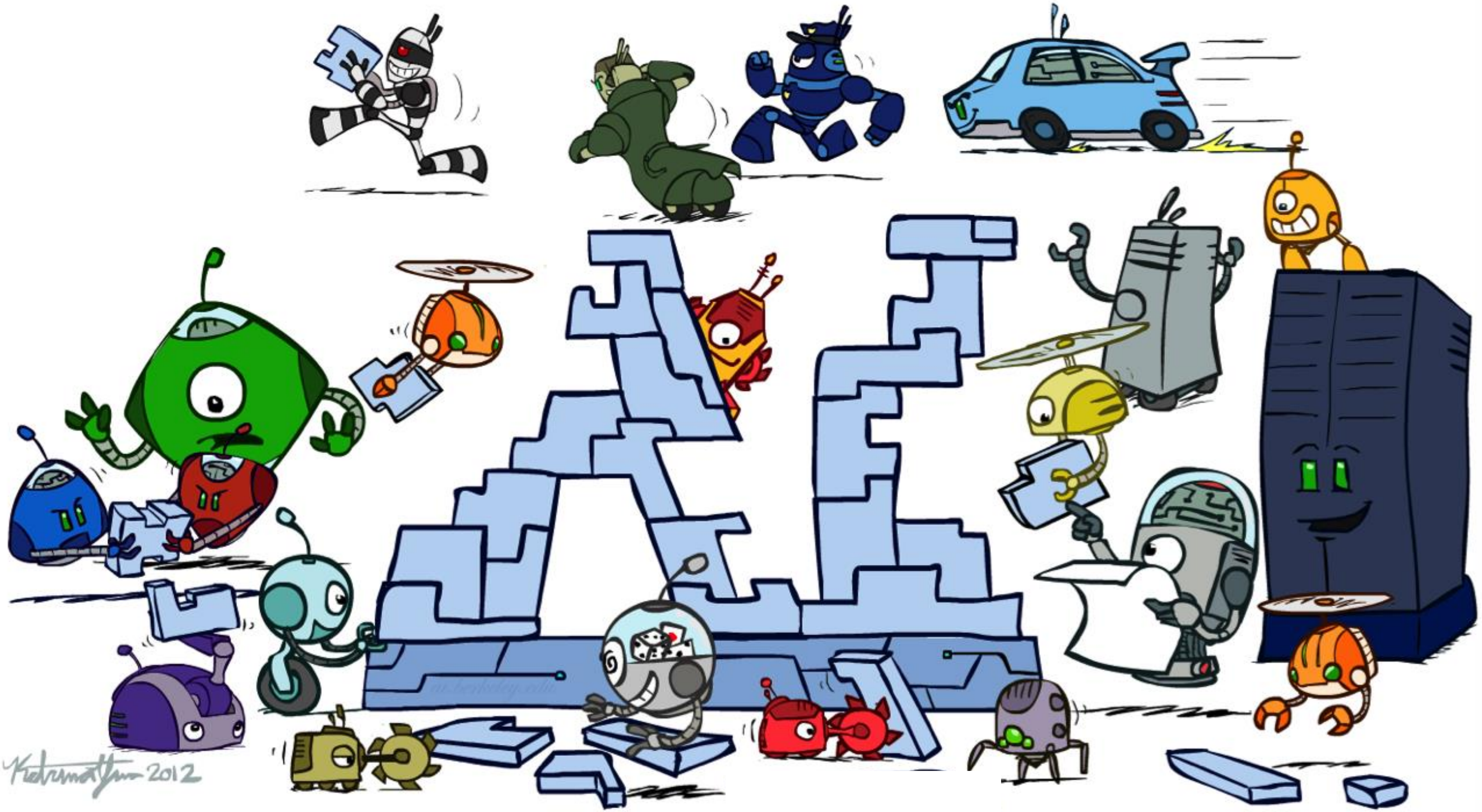
Slides: Stuart Russell, IJCAI 2017, with work by Dylan Hadfield-Menell

Off-switch model



w(*a*) preferred to *a* or *s*

Slides: Stuart Russell, IJCAI 2017, with work by Dylan Hadfield-Menell


Ketrinayim 2012
ai.berkeley.edu

Thanks to Our Course Staff!!

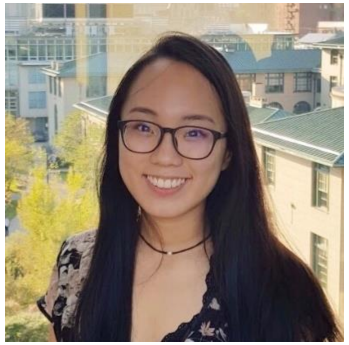
Administrative Assistant

Liv Zane

Videographer

John Lombardo

Teaching Assistants



Angela Yang

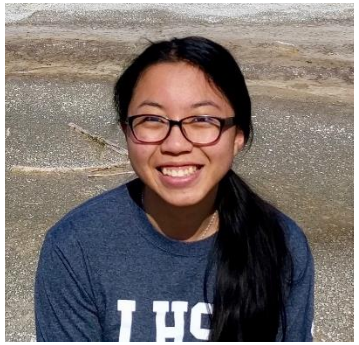
Claire Wang (Head TA)

George Brown

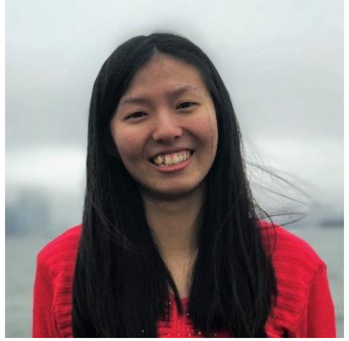
Michelle Ma

Sean Pereira

Chakara (Tian) Owarang



Tina Wu



Vicky Zeng