CSE 573:
Artificial Intelligence

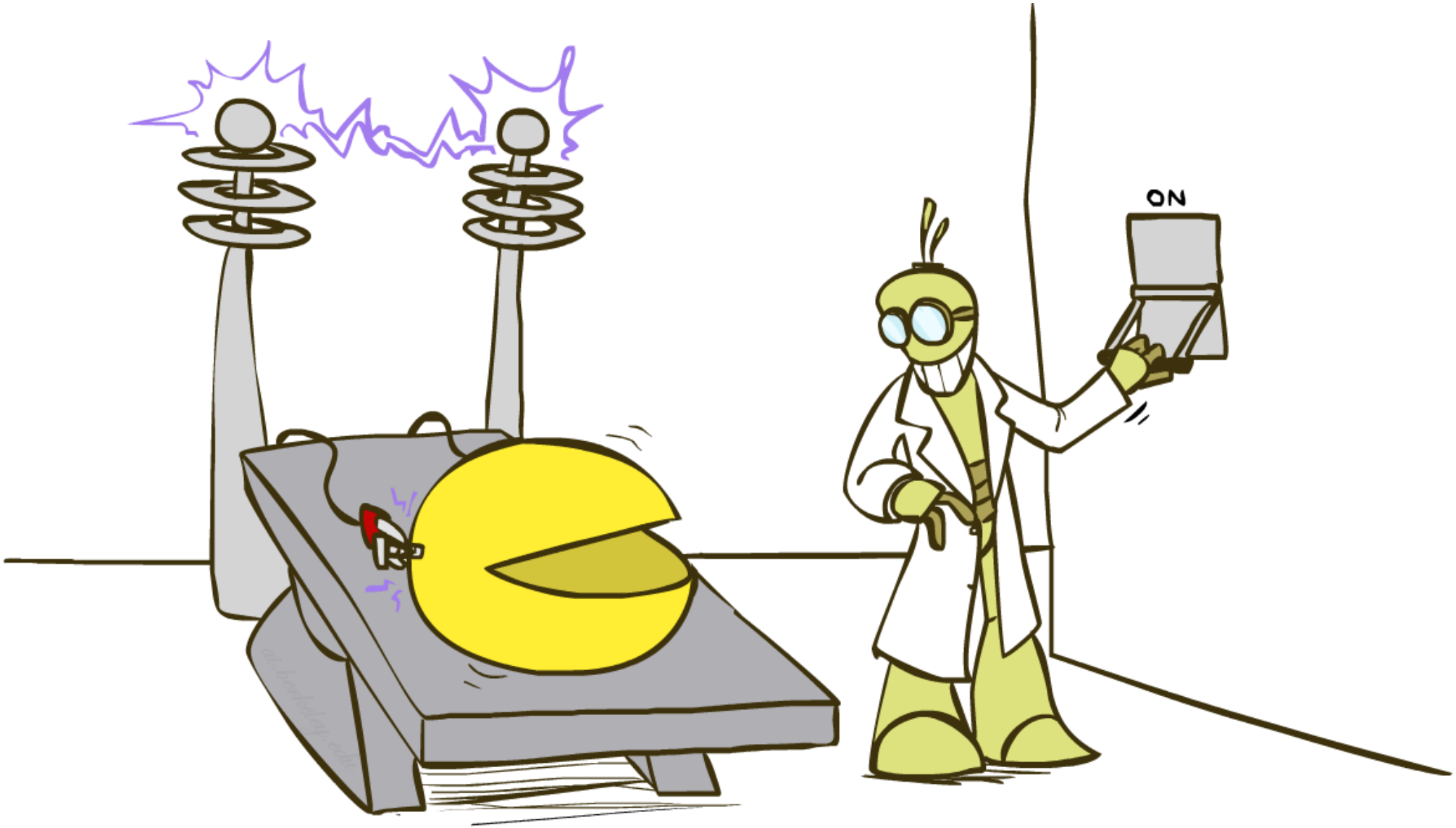
Hanna Hajishirzi

slides adapted from
Dan Klein, Pieter Abbeel ai.berkeley.edu
And Dan Weld, Luke Zettlemoyer

Topics in This Course

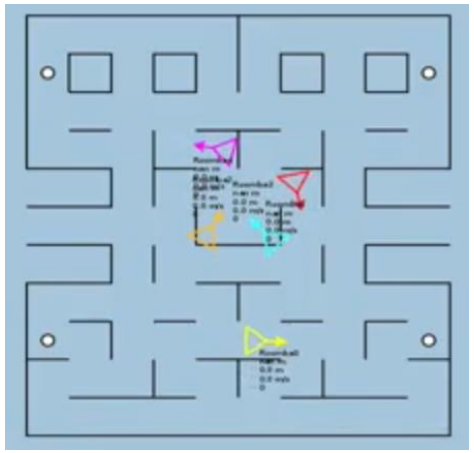
- Part I: Intelligence from Computation
  - Fast search
  - Adversarial and uncertain search
- Part II: Reasoning under Uncertainty
  - Decision theory: Reinforcement Learning, Markov Decision Processes
  - Machine learning
  - Graphical Models - Bayes Nets; HMMs
- Throughout: Applications
  - Natural language, vision, robotics, games, …

Pac-Man Beyond the Game!



Pacman: Beyond Simulation?

ROOMBA PACMAN



Students at Colorado University: http://pacman.elstonj.com

Research Frontiers

- Deep Unsupervised Learning
- AI for Science
- AI and Ethics

Also:

- Unsupervised Deep Reinforcement Learning
- Human-in-the-loop Reinforcement Learning
- …

Research Frontiers

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Deep Unsupervised Learning

- Key hypothesis:

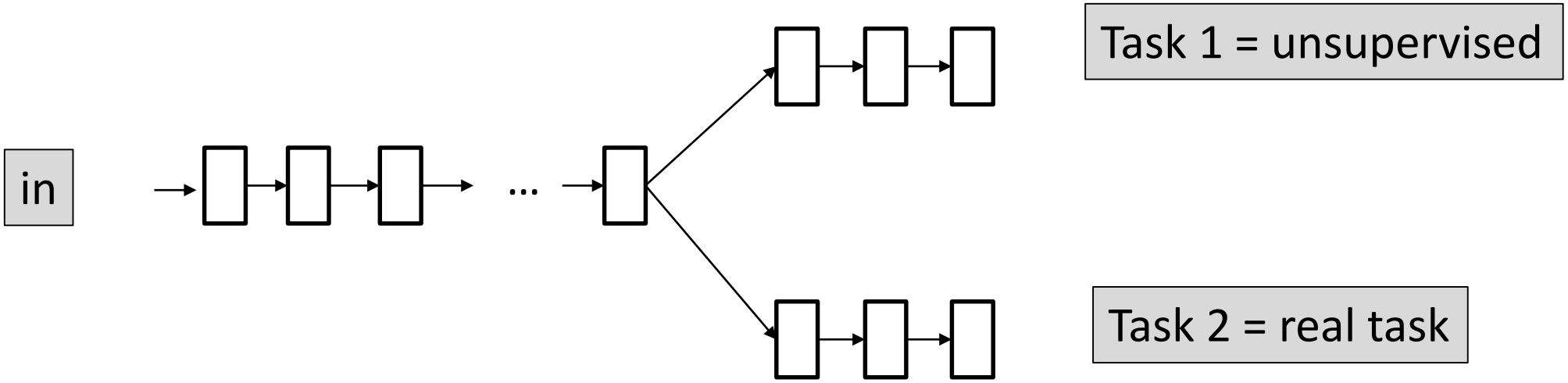
Task 1

- IF neural network smart enough to predict:
  - Next frame in video
  - Next word in sentence
  - Generate realistic images
  - ``Translate'' images
  - …

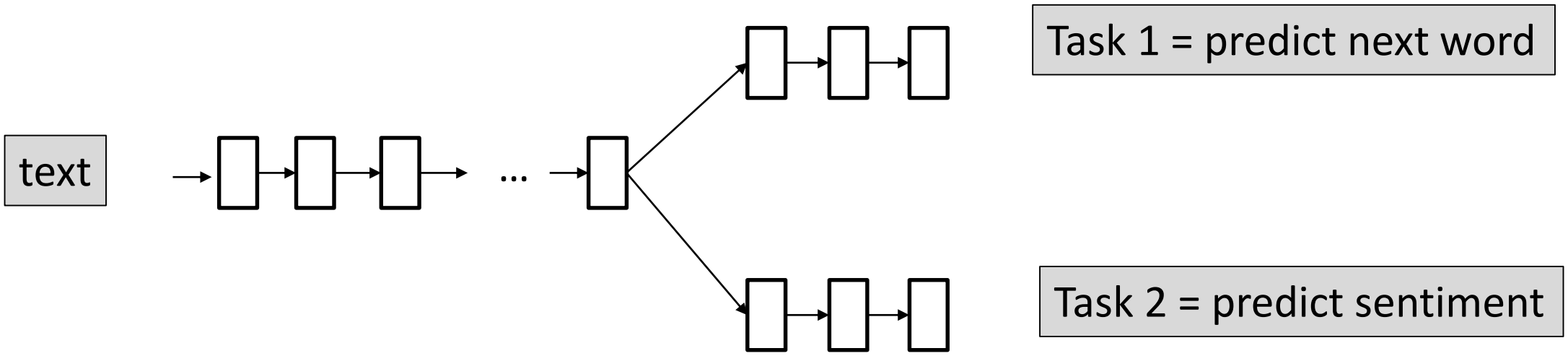
Task 2

- THEN same neural network is ready to do Deep Supervised Learning from very small data-set

Transfer from Unsupervised Learning



Example Setting



Text Generati…'s GPT-2)

SYSTEM PROMPT (HUMAN-WRITTEN)

In a shocking f… remote, previou… surprising to the … English.

MODEL COMPLETION (MACHINE-WRITTEN, 10 TRIES)

The scientist nam… Ovid's Unicorn. Th… previously unknown …

Now, after almost tw… odd phenomenon is fi…

Dr. Jorge Pérez, an ev… La Paz, and several co… Mountains when they fou… or humans. Pérez noticed… a natural fountain, surr… snow.

Pérez and the others then … the time we reached the top… with some crystals on top,"

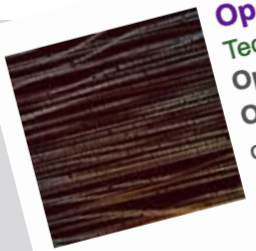
Pérez and his friends were as… These creatures could be seen … too much to see them — they we… horns.

…izarre creatures the scientists discovered … spoke some fairly regular English. Pérez … example, that they have a common …ke a dialect or dialectic."

…e unicorns may have originated in …ls were believed to be descendants of a …ed there before the arrival of humans …tica.

… unclear, some believe that perhaps …n a human and a unicorn met each …ivilization. According to Pérez, …ts seem to be quite common."

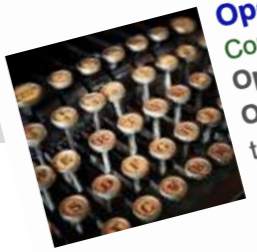
…that it is likely that the only …ns are indeed the descendants of … "But they seem to be able to … which I believe is a sign of … social organization," said the



OpenAI built a text generator **so** good, it's considered **too dangerous**…
TechCrunch - 17 Feb 2019
OpenAI built a text generator **so** good, it's considered **too dangerous to release** …
OpenAI said its new natural **language model**, GPT-2, was trained to … said, it's only **releasing** a smaller version of the **language model**, citing its …
Scientists Developed an AI **So** Advanced They Say It's **Too Dangerous** …
ScienceAlert - 18 Feb 2019

AI text writing technology **too dangerous to release**, creators claim
The Drum - 17 Feb 2019
This technology could 'absolutely devastate' the internet as we know it
NEWS.com.au - 17 Feb 2019
This AI is **so** good at writing that its creators won't let you use it
In-Depth - CNN - 18 Feb 2019
Lord of The Rings, Celebrity Gossip: This AI is **So** Good at Writing That …
In-Depth - News18 - 18 Feb 2019
View all

When Is Technology **Too Dangerous to Release** to the Public?
Slate Magazine - 22 Feb 2019
If your knowledge of the model, called GPT-2, came solely on headlines … U.K. read, "Elon Musk-Founded **OpenAI** Builds Artificial Intelligence **So** … had trained a **language model** using text from 8 million webpages to predict …
AI Weekly: Experts say **OpenAI's** controversial **model** is a potential …
In-Depth - VentureBeat - 22 Feb 2019
View all

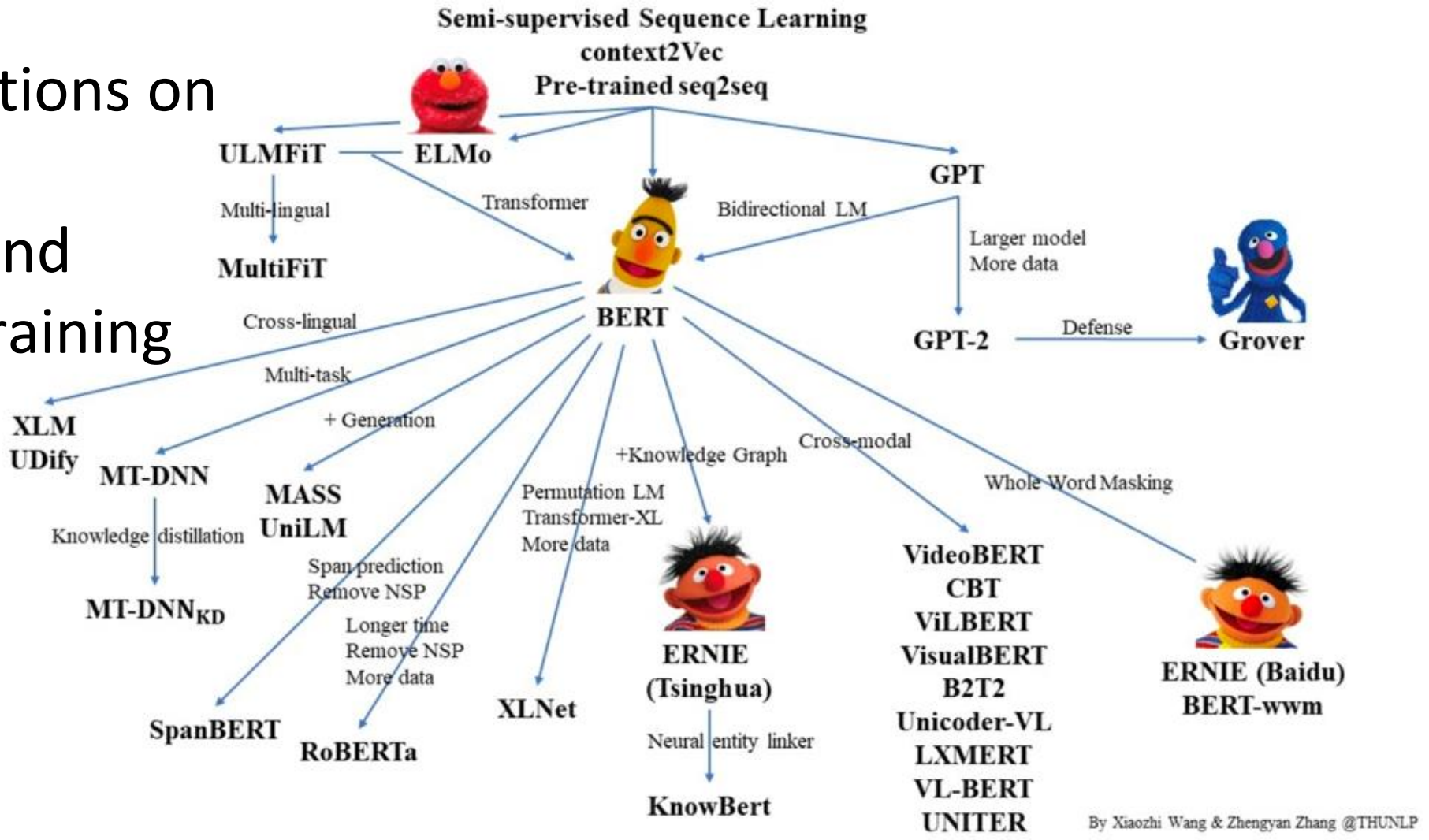


OpenAI's Text **Model so** Disruptive it's Deemed **Too Dangerous To** …
Computer Business Review - 15 Feb 2019
OpenAI's Text Model **so** Disruptive it's Deemed **Too Dangerous To Release** …
OpenAI has declined to **release** the full research due to concerns over … We've trained an unsupervised **language model** that can generate …
New AI fake text generator may be **too dangerous to release**, say …
Highly Cited - The Guardian - 14 Feb 2019
View all

[Radford et al, 2019]

BERT and Family

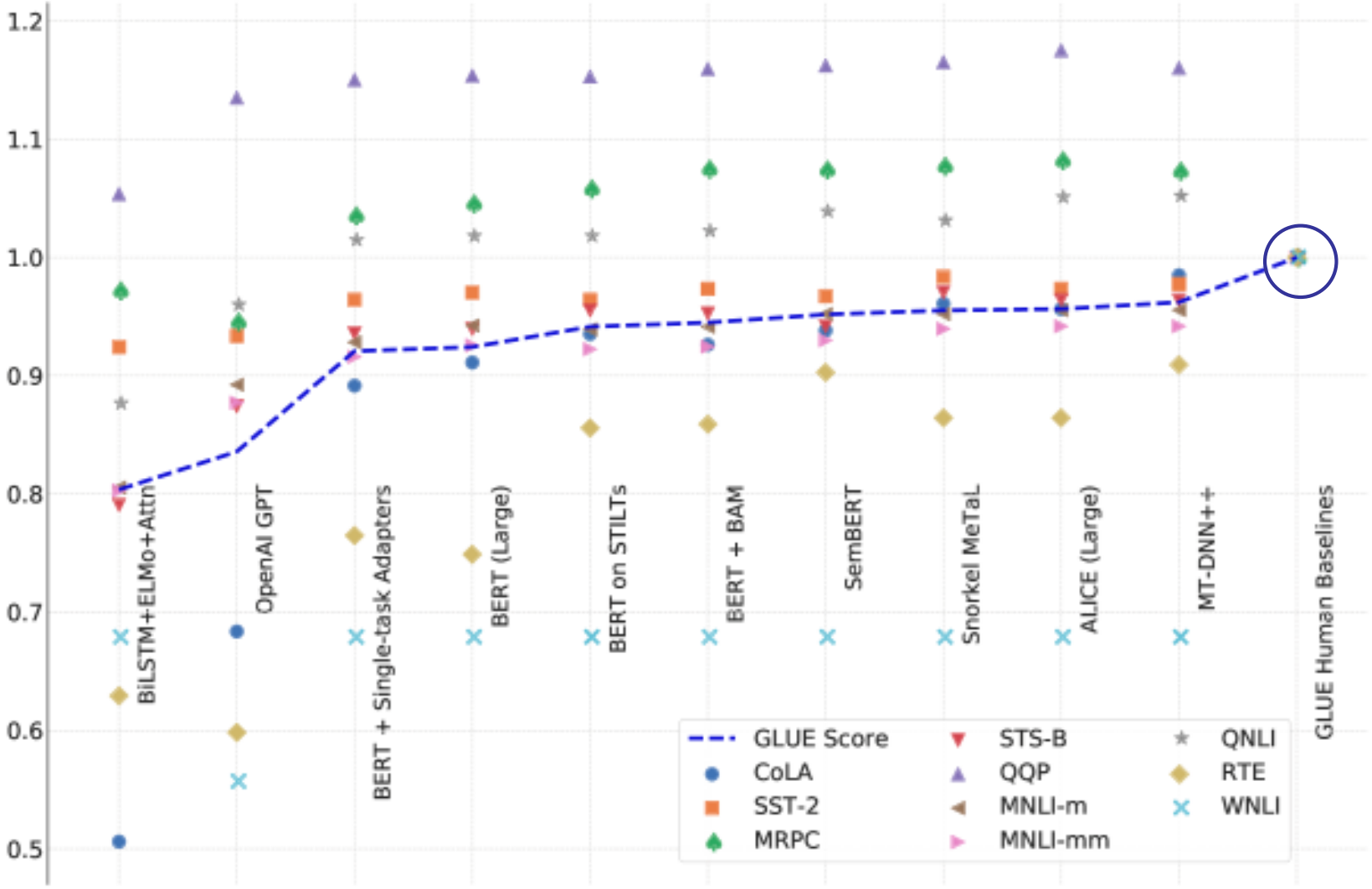
Different Variations on Transformer architectures and different pre-training tasks



Benchmarks

DATASET	METRIC	OUR RESULT	PREVIOUS RECORD	HUMAN
Winograd Schema Challenge	accuracy (+)	**70.70%**	63.7%	92%+
LAMBADA	accuracy (+)	**63.24%**	59.23%	95%+
LAMBADA	perplexity (-)	**8.6**	99	~1-2
Children's Book Test Common Nouns (validation accuracy)	accuracy (+)	**93.30%**	85.7%	96%
Children's Book Test Named Entities (validation accuracy)	accuracy (+)	**89.05%**	82.3%	92%
Penn Tree Bank	perplexity (-)	**35.76**	46.54	unknown
WikiText-2	perplexity (-)	**18.34**	39.14	unknown

Pretrained Models (BERT) on GLUE Benchmarks



Human Performance on GLUE

Massive Pre-trained models are few-shot learners! (GPT-3)

175B GPT-3 can work without fine-tuning, when it is shown sample **demonstrations** for a task:

Few-shot

In addition to the task description, the model sees a few examples of the task. No gradient updates are performed.

```
1  Translate English to French:        ← task description
2  sea otter => loutre de mer          ← examples
3  peppermint => menthe poivrée        ← examples
4  plush girafe => girafe peluche      ← examples
5  cheese =>                           ← prompt
```

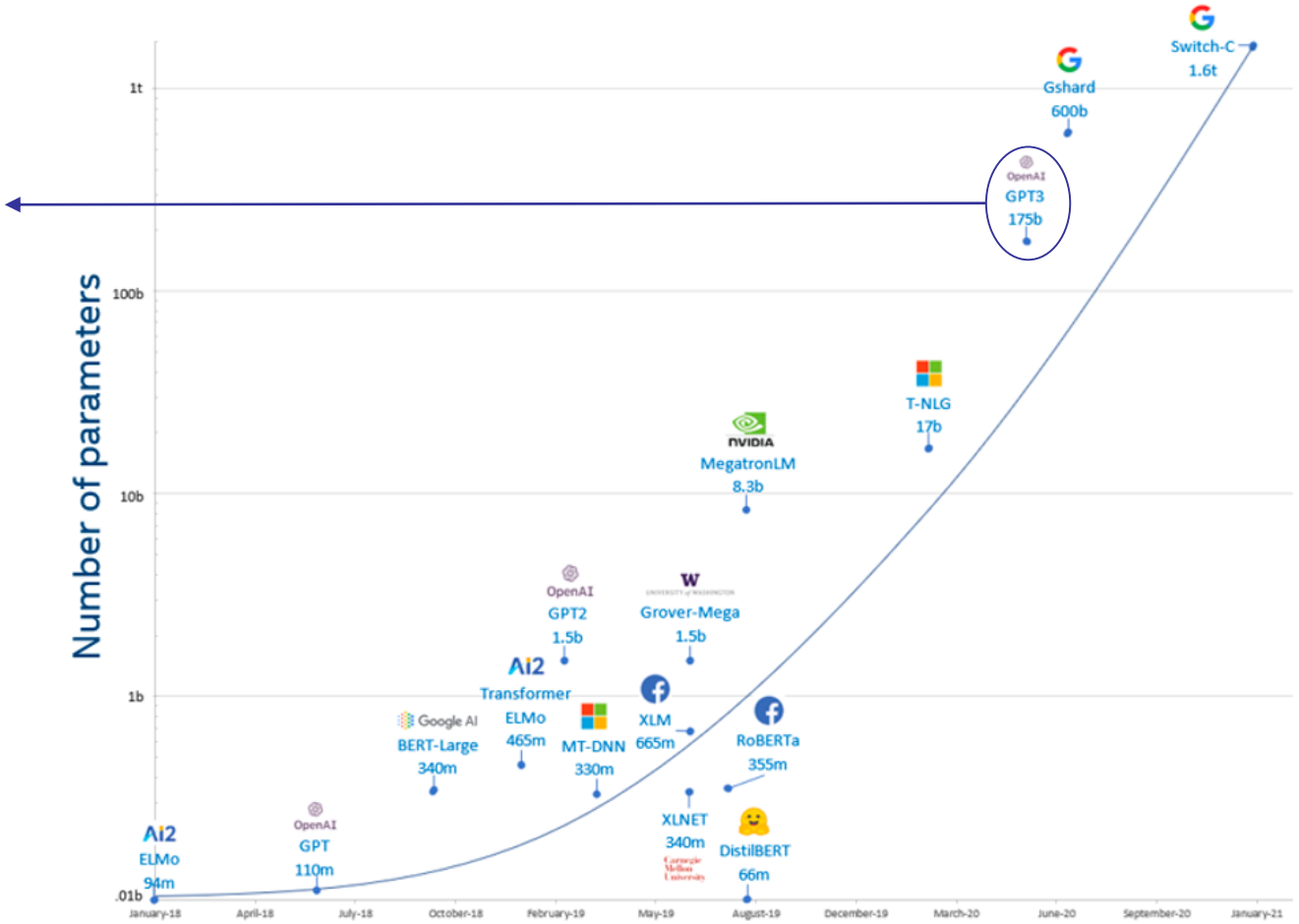
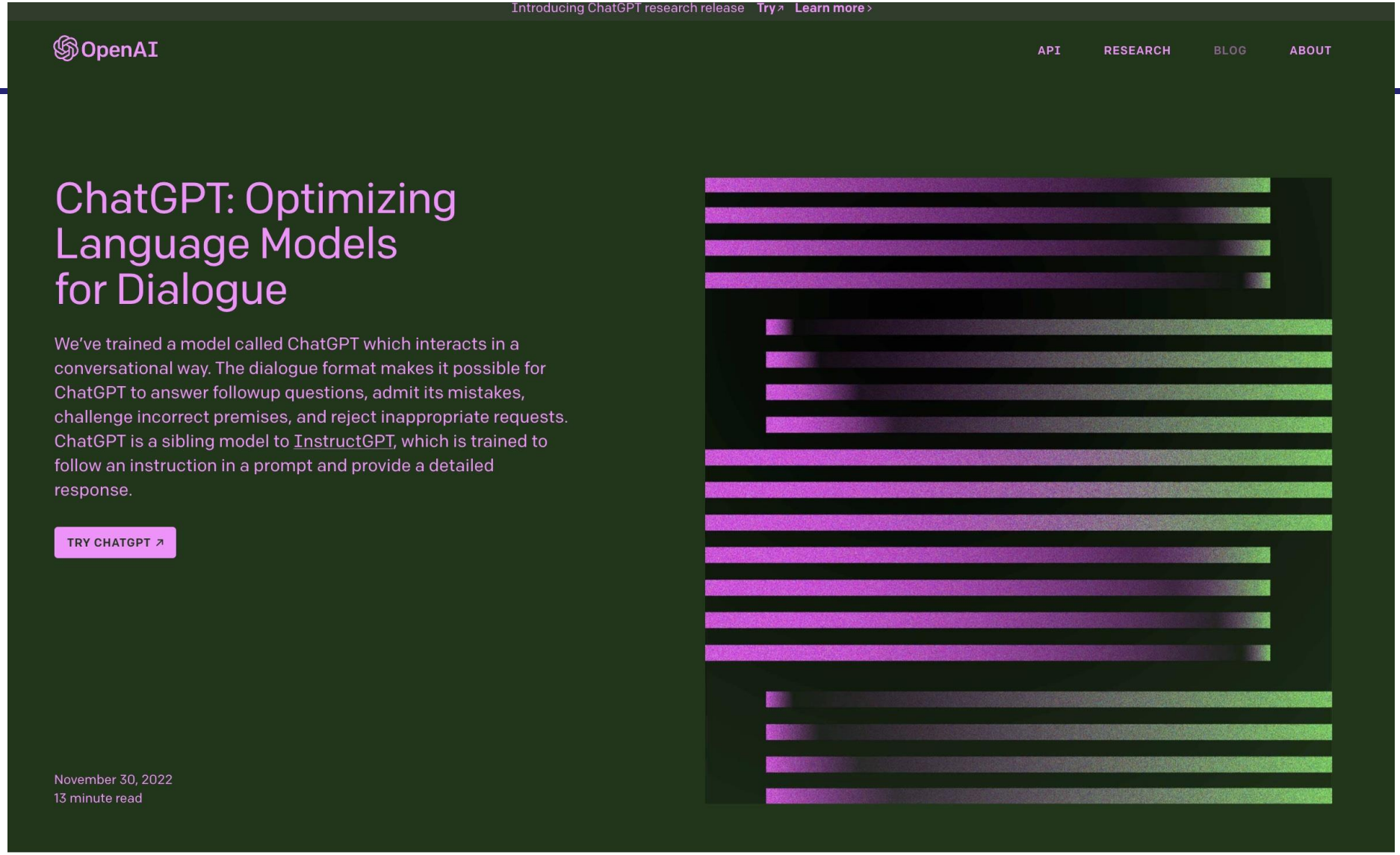


Figure 1: Exponential growth of number of parameters in DL models

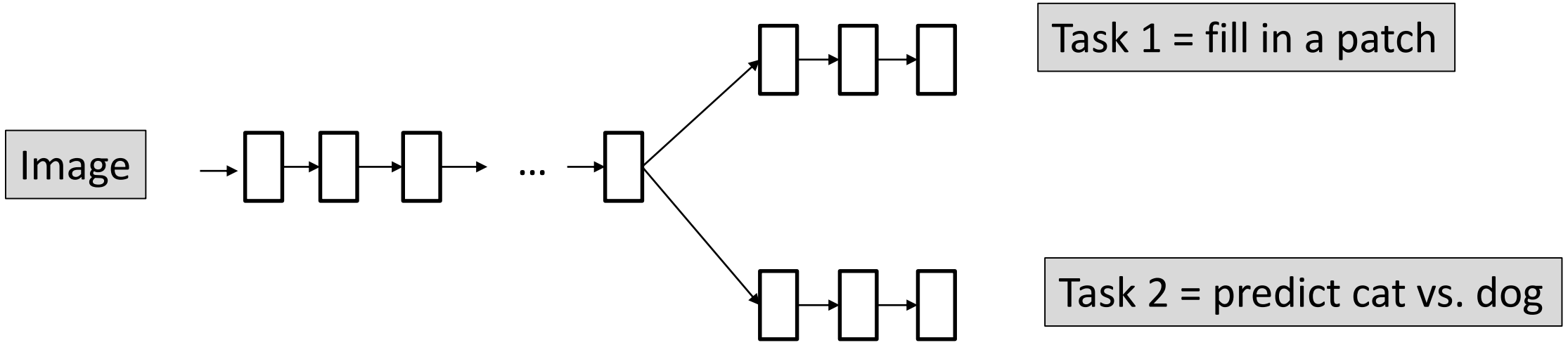


We are excited to introduce ChatGPT to get users' feedback and learn about its strengths and weaknesses. During the research preview, usage of ChatGPT is free. Try it now at chat.openai.com.

Pause

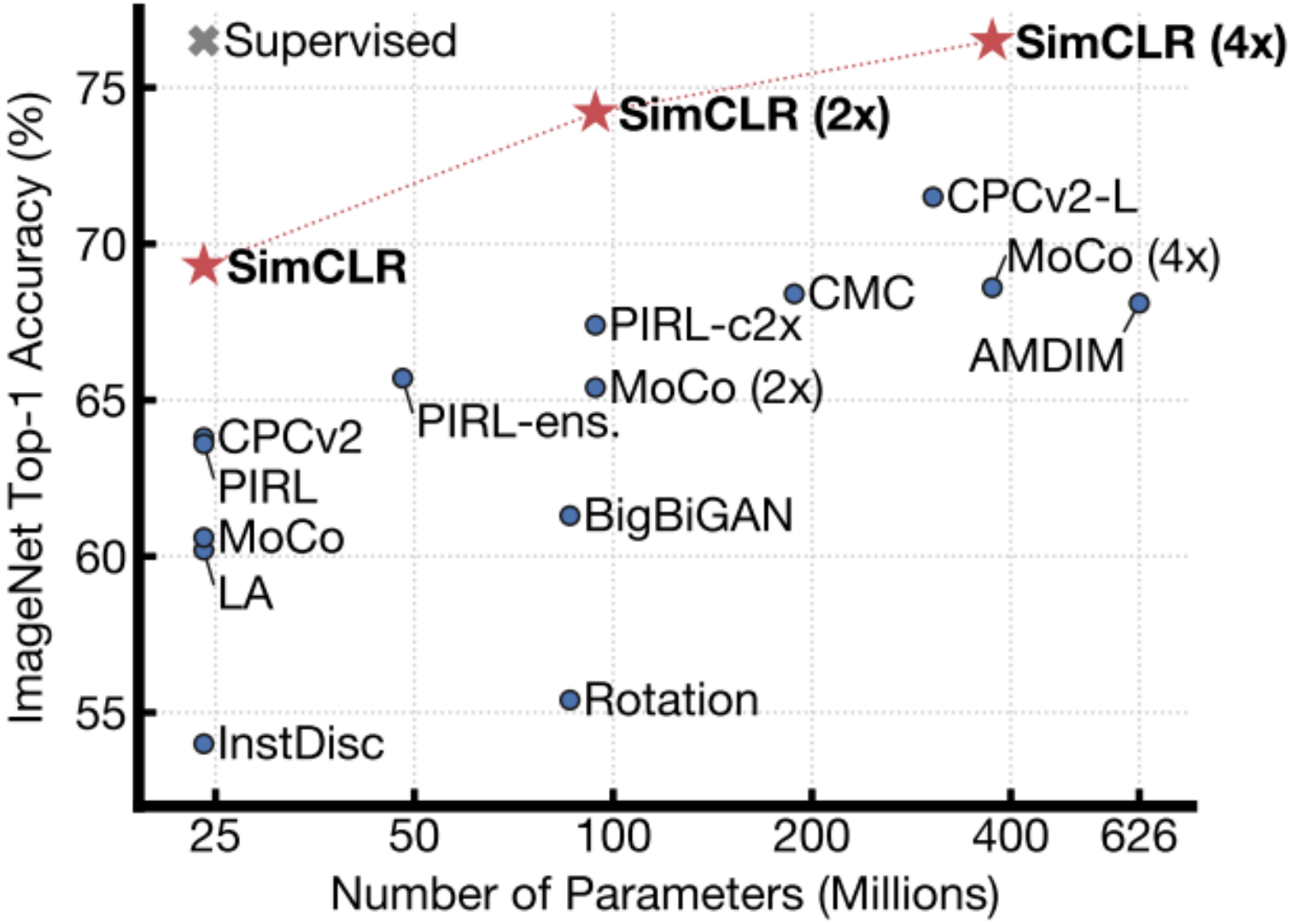
- https://uw.iasystem.org/survey/271829

Unsupervised Learning in Vision



Predict Missing Patch

SimCLR + linear classifier

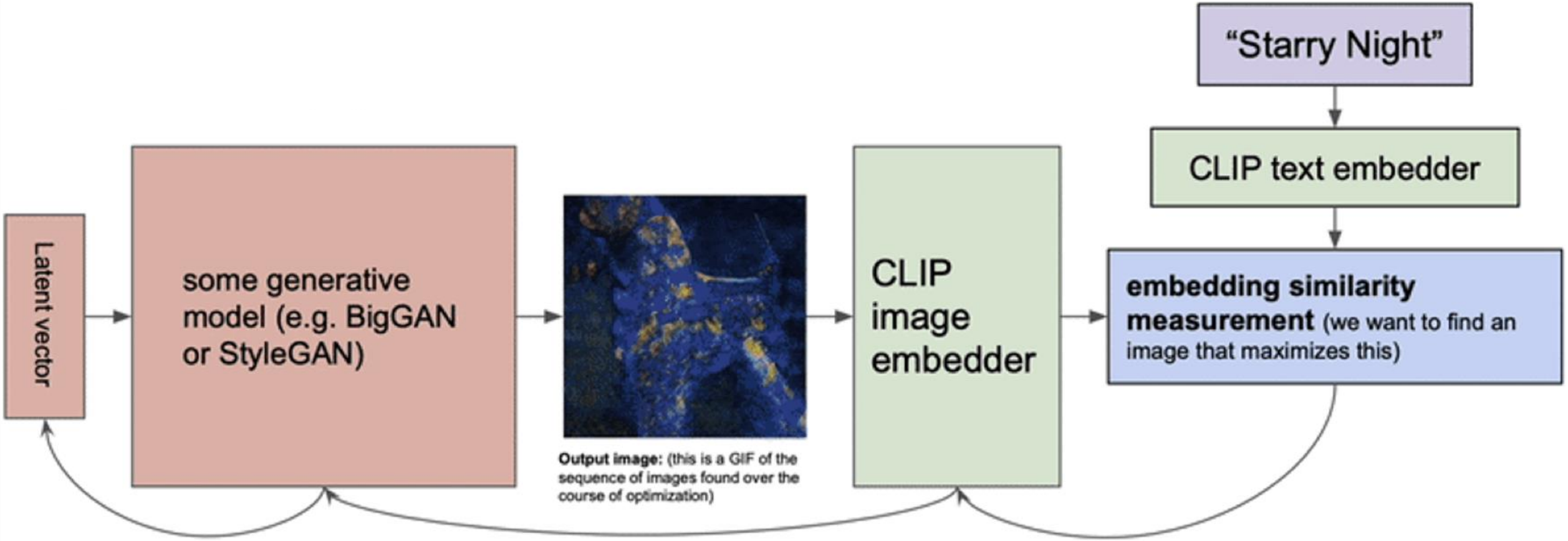


AI for Art Creation

humanoid robot Mona Lisa
artstationHQ

studio ghibli trending on artstation | vary

Text-Guided Image Generation



via Charlie Snell

Examples (CLIP + VQGAN)

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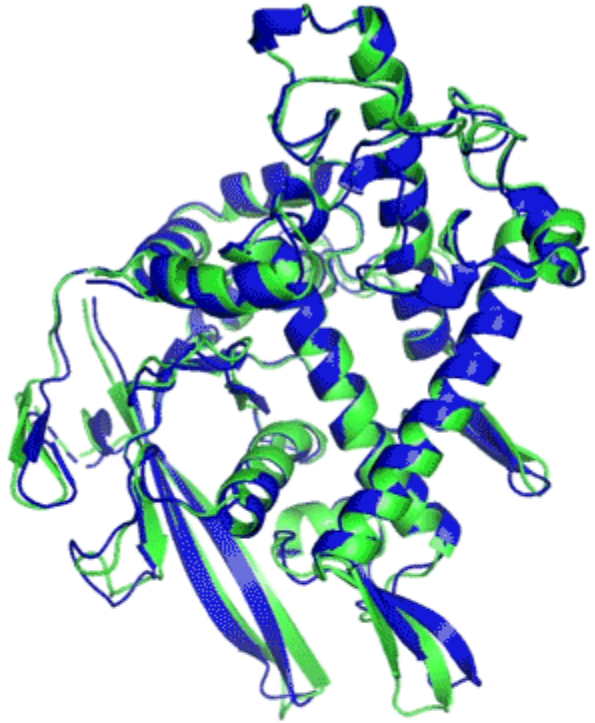
NEWS · 30 NOVEMBER 2020

‘It will change everything’: DeepMind’s AI makes gigantic leap in solving protein structures

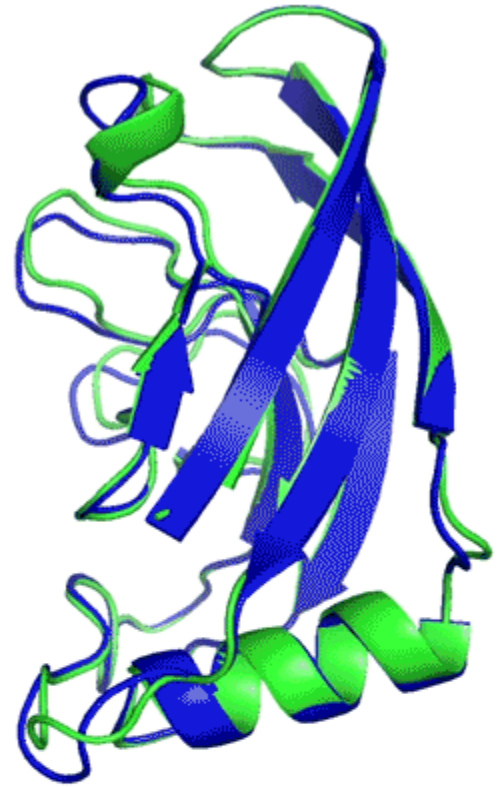
Google’s deep-learning program for determining the 3D shapes of proteins stands to transform biology, say scientists.

Ewen Callaway

A protein’s function is determined by its 3D shape. Credit: DeepMind



T1037 / 6vr4
90.7 GDT
(RNA polymerase domain)

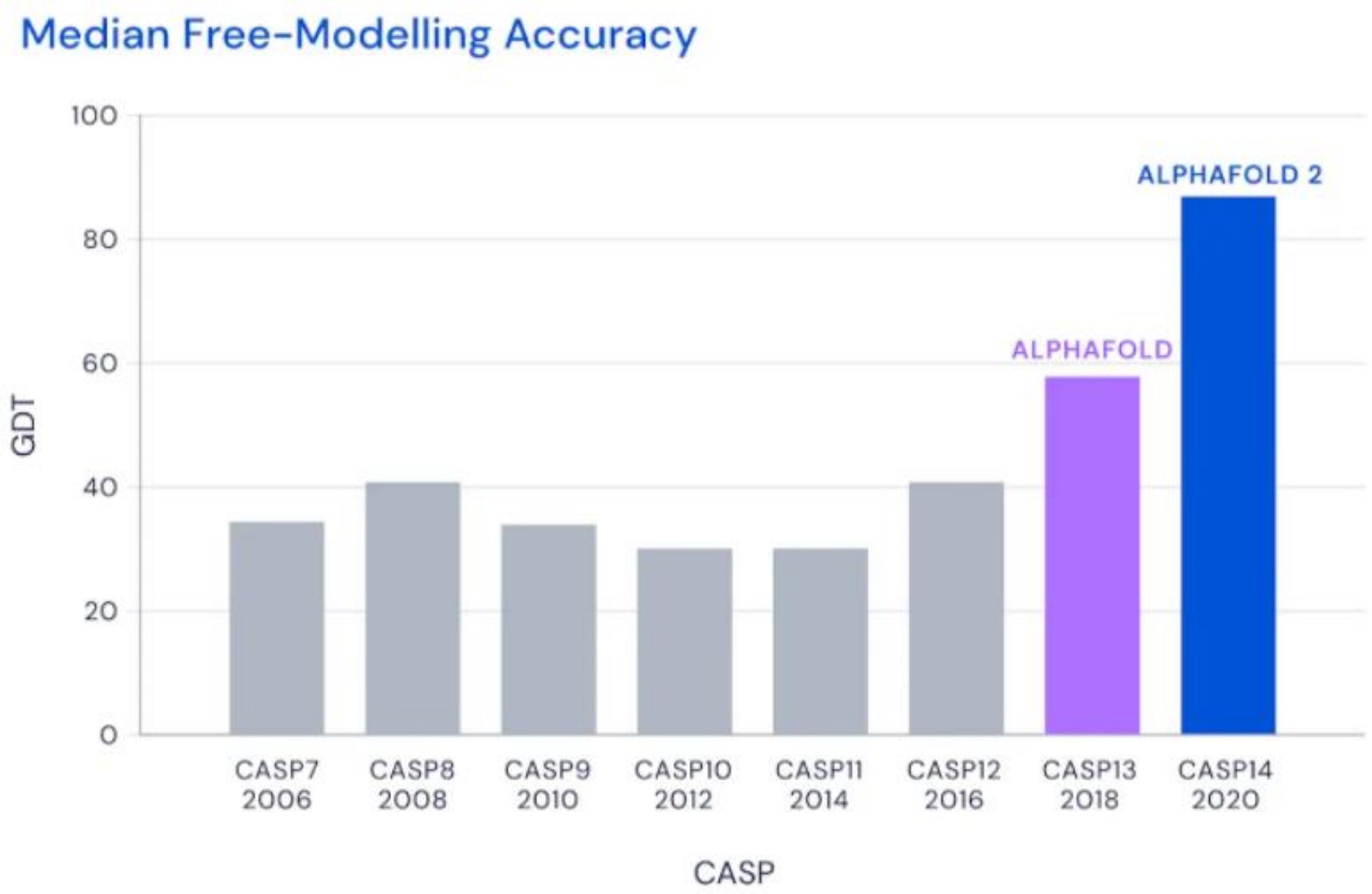


T1049 / 6y4f
93.3 GDT
(adhesin tip)

Experimental result

Computational prediction

CASP 2020 Competition



Symbolic Math: Integrals and ODEs

Equation	Solution
$y' = \frac{16x^3 - 42x^2 + 2x}{(-16x^8 + 112x^7 - 204x^6 + 28x^5 - x^4 + 1)^{1/2}}$	$y = \sin^{-1}(4x^4 - 14x^3 + x^2)$
$3xy\cos(x) - \sqrt{9x^2\sin(x)^2 + 1}y' + 3y\sin(x) = 0$	$y = c\exp\left(\sinh^{-1}(3x\sin(x))\right)$
$4x^4yy'' - 8x^4y'^2 - 8x^3yy' - 3x^3y'' - 8x^2y^2 - 6x^2y' - 3x^2y'' - 9xy' - 3y = 0$	$y = \frac{c_1 + 3x + 3\log(x)}{x(c_2 + 4x)}$

Table 4: Examples of problems that our model is able to solve, on which Mathematica and Matlab were not able to find a solution. For each equation, our model finds a valid solution with greedy decoding.

[Lample and Charton, ICLR 2020]

Symbolic Math: Integrals and ODEs

	Integration (BWD)	ODE (order 1)	ODE (order 2)
Mathematica (30s)	84.0	77.2	61.6
Matlab	65.2	-	-
Maple	67.4	-	-
Beam size 1	98.4	81.2	40.8
Beam size 10	99.6	94.0	73.2
Beam size 50	99.6	97.0	81.0

[Lample and Charton, ICLR 2020]

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AI Ethics Ever More Important

- Why?
  - AI is making decisions, at scale
  - Any kind of issues (e.g. bias or malignant use) could significantly affect *people*
- Many open questions:
  - Who is responsible?
  - How to diagnose and prevent?

Some Key AI Ethics Topics

- Disinformation
- Bias and fairness
- Privacy and surveillance
- Metrics
- Algorithmic colonialism

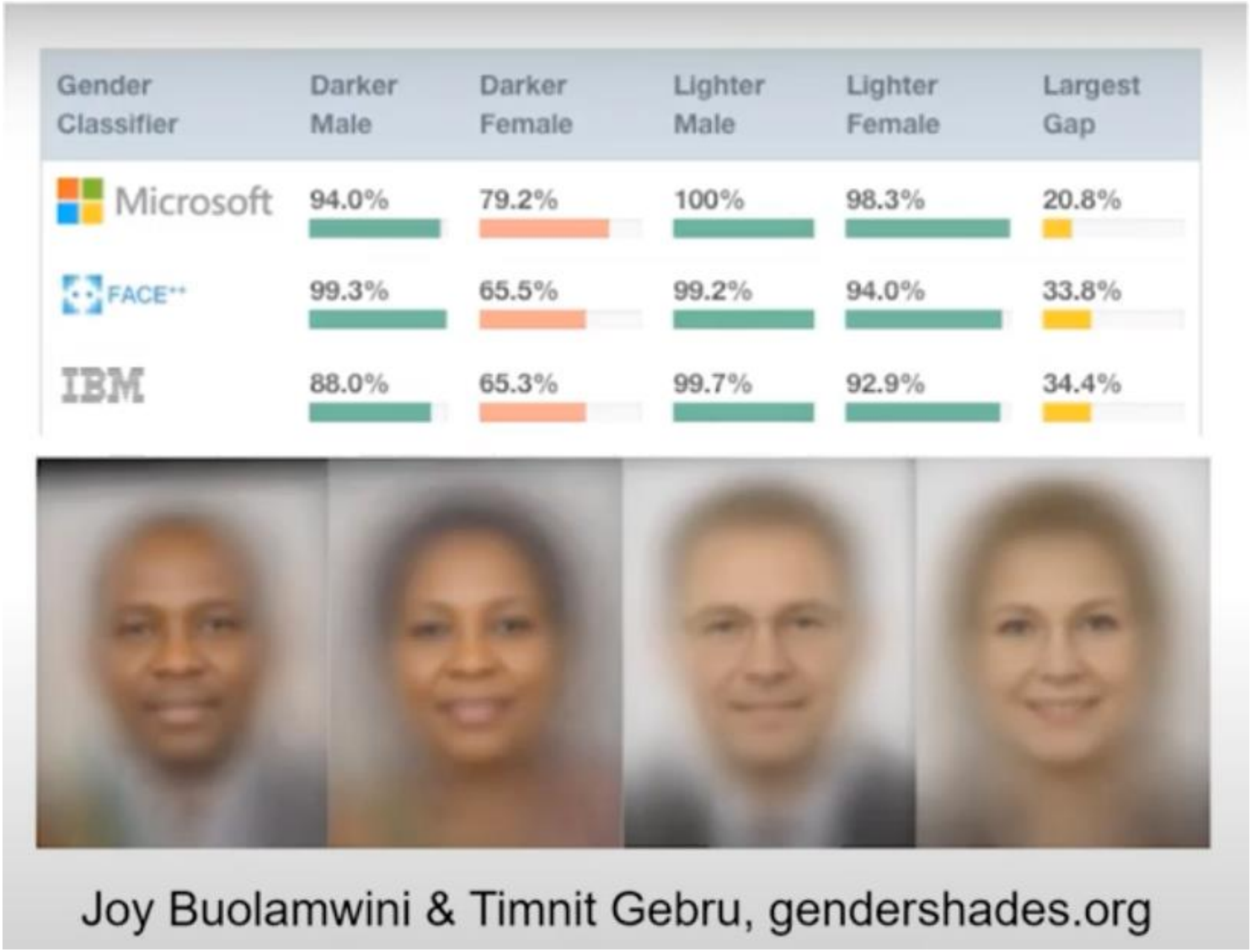
Source: Rachel Thomas (@math_rachel)

Disinformation can be aided by AI generated text

Prompt: Recycling is good for the world, no, you could not be more wrong.

GPT-2: Recycling is NOT good for the world. It is bad for the environment, it is bad for our health, and it is bad for our economy. I'm not kidding. Recycling is not good for the environment. It is destructive to the earth and it is a major contributor to global warming. Recycling is not good for our health. It contributes to obesity and diseases like heart disease and cancer. Recycling is bad for our economy. It increases the cost of a product, and in turn, the price of everything that is made with that product. Recycling is not good for our nation. We pay a tremendous price for the privilege of having the world's most advanced and efficient recycling system. Recycling is a huge, colossal waste of time, energy, money, and resources.

Bias and Fairness – Gender Shades



Source: Rachel Thomas (@math_rachel)

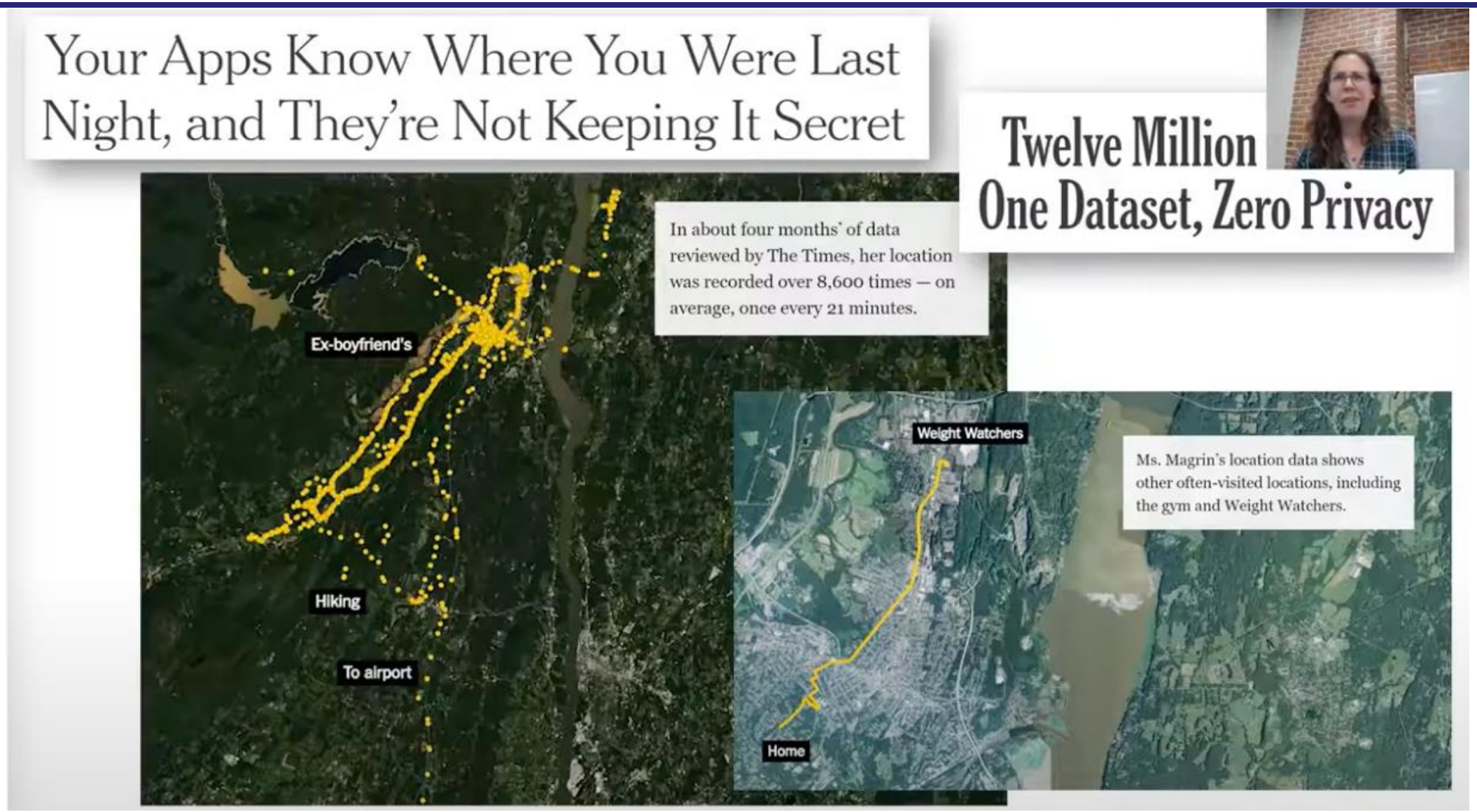
Bias and Fairness

Algorithms are used differently than human decision makers

- People are more likely to assume algorithms are objective or error-free
- Algorithms are more likely to be implemented with no appeals process
- Algorithms are often used at scale
- Algorithmic systems are cheap

Source: Rachel Thomas (@math_rachel)

Privacy and Surveillance



Source: Rachel Thomas (@math_rachel)

Flawed Algorithms Are Grading Millions of Students' Essays

Fooled by gibberish and highly susceptible to human bias, automated essay-scoring systems are being increasingly adopted, a Motherboard investigation has found

Understanding Mean Score Differences Between the *e-rater*® Automated Scoring Engine and Humans for Demographically Based Groups in the *GRE*® General Test

Chaitanya Ramineni, David Williamson

- Automatic essay grading software used in at least 22 USA states
- Focuses on metrics like sentence length, vocabulary, spelling, subject-verb agreement
- Can't evaluate hard-to-quantify qualities, like creativity
- Gibberish essays with lots of sophisticated words score well
- Essays by African-American students receive **lower grades** from computer than from expert human graders
- Essays by students from mainland China receive **higher scores** from computer than from expert human graders; may be using chunks of pre-memorized text

Source: Rachel Thomas (@math_rachel)

Where to Go Next?

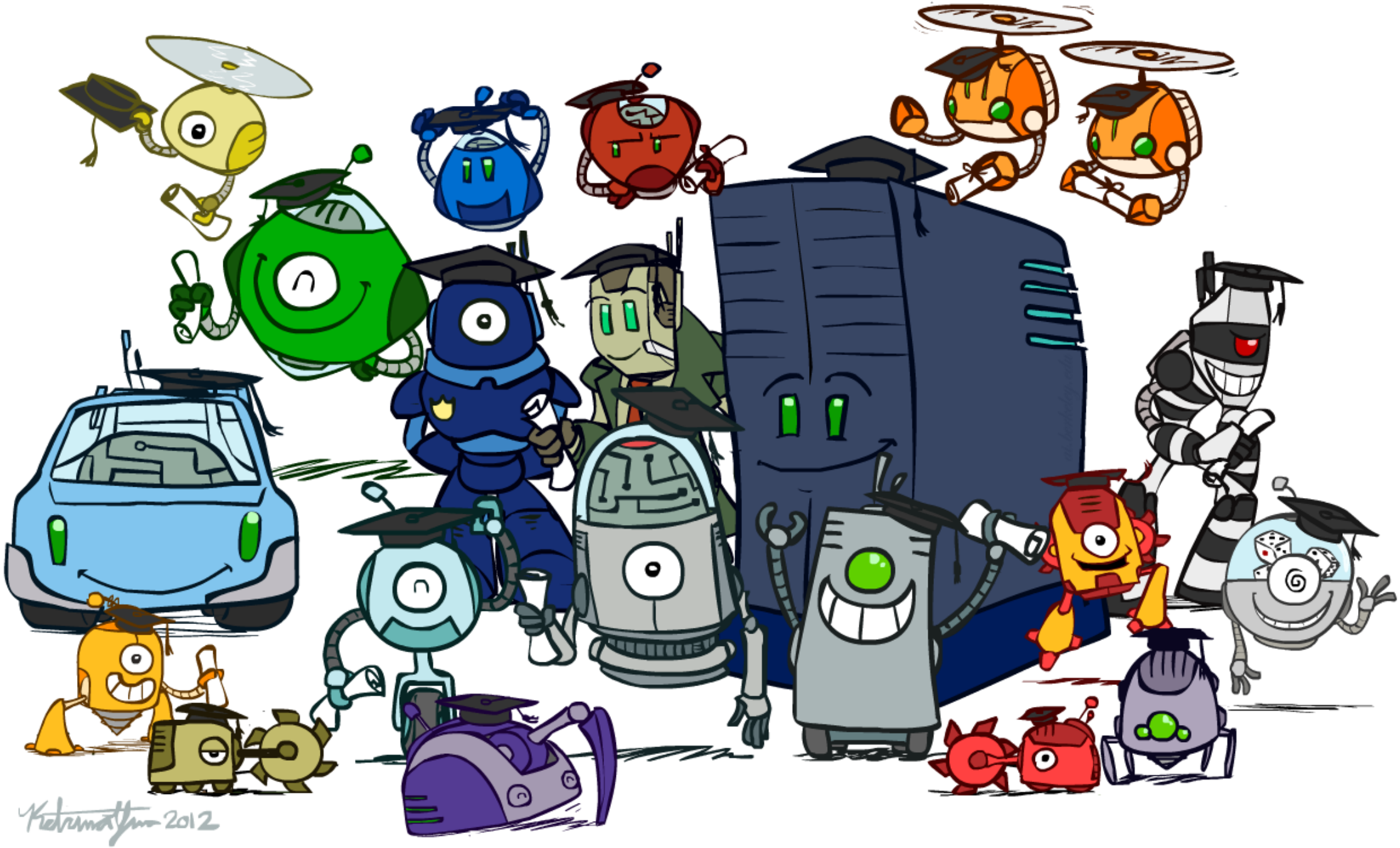
Where to go next?

- Congratulations, you've seen the basics of modern AI
  - … and done some amazing work putting it to use!

- How to continue:
  - Machine learning:
  - Data Science:
  - Data / Ethics:
  - Probability:
  - Optimization:
  - Computer vision:
  - Reinforcement Learning:
  - Robotics:
  - NLP:
  - … and more; ask if you're interested

That’s It!

- Help us out with some course evaluations
- Have a great spring break


2012