



CS 540 Introduction to Artificial Intelligence Course Overview

Sharon Yixuan Li
University of Wisconsin-Madison

Jan 26, 2021



Today's outline

- Introduction to “Introduction to Artificial Intelligence”
 - Course logistics
 - Python overview

Instructor

- Prof. Sharon Li

Email: sharonli@cs.wisc.edu

Office: 5393 Computer Sciences

Virtual office hours: Tuesday after class

Use piazza for questions:

piazza.com/wisc/spring2021/cs540/home

For emails, please include **[CS540]** in the subject title :)



Instructor

- **Prof. Fred Sala**

Email: fredsal@cs.wisc.edu

Virtual office hours: Weds 11-12 am /
Thursday 9-10 am

Use piazza for questions:

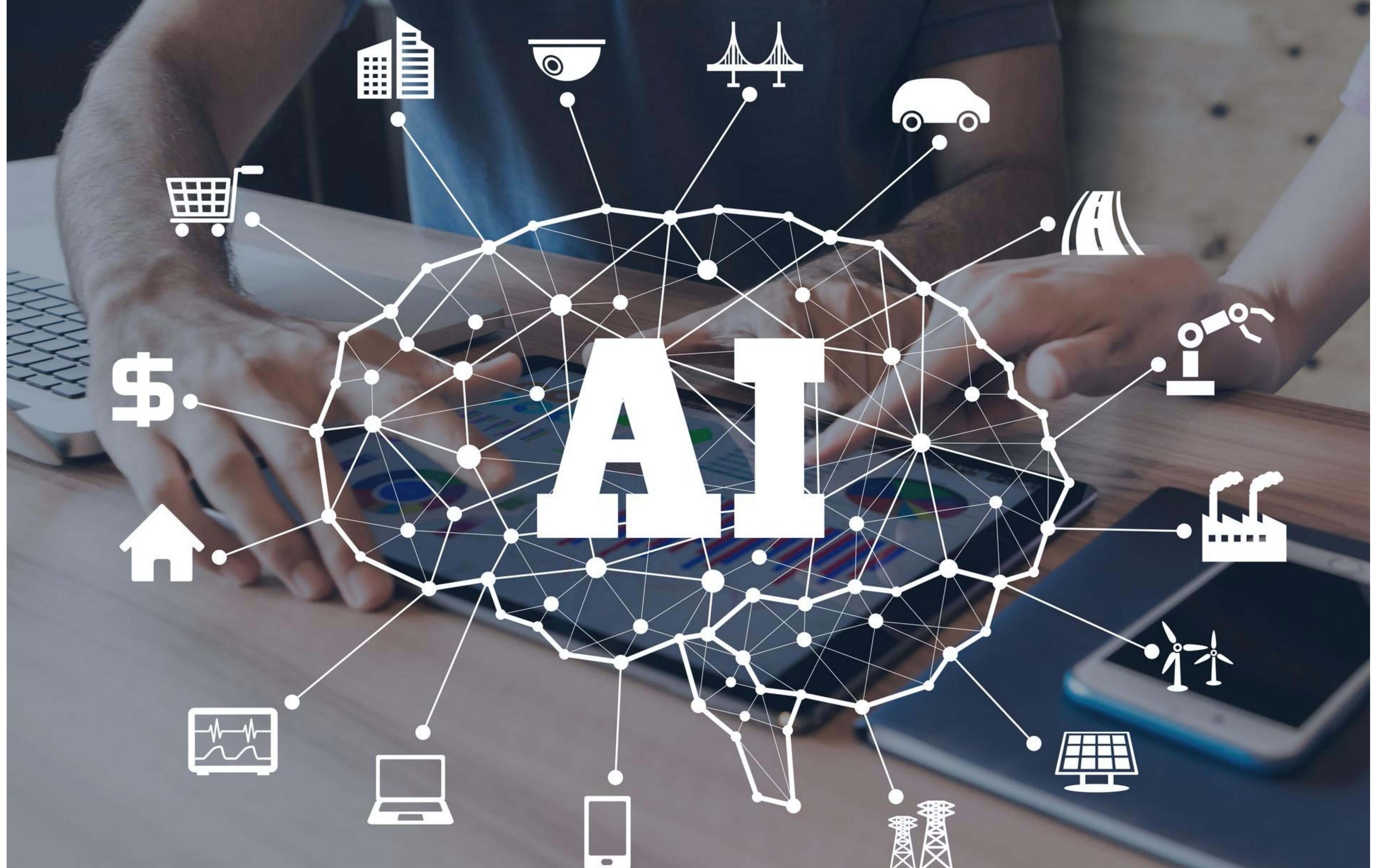
piazza.com/wisc/spring2021/cs540/home



For emails, please include **[CS540]** in the subject title :)



Part I: Course overview



Classify Images

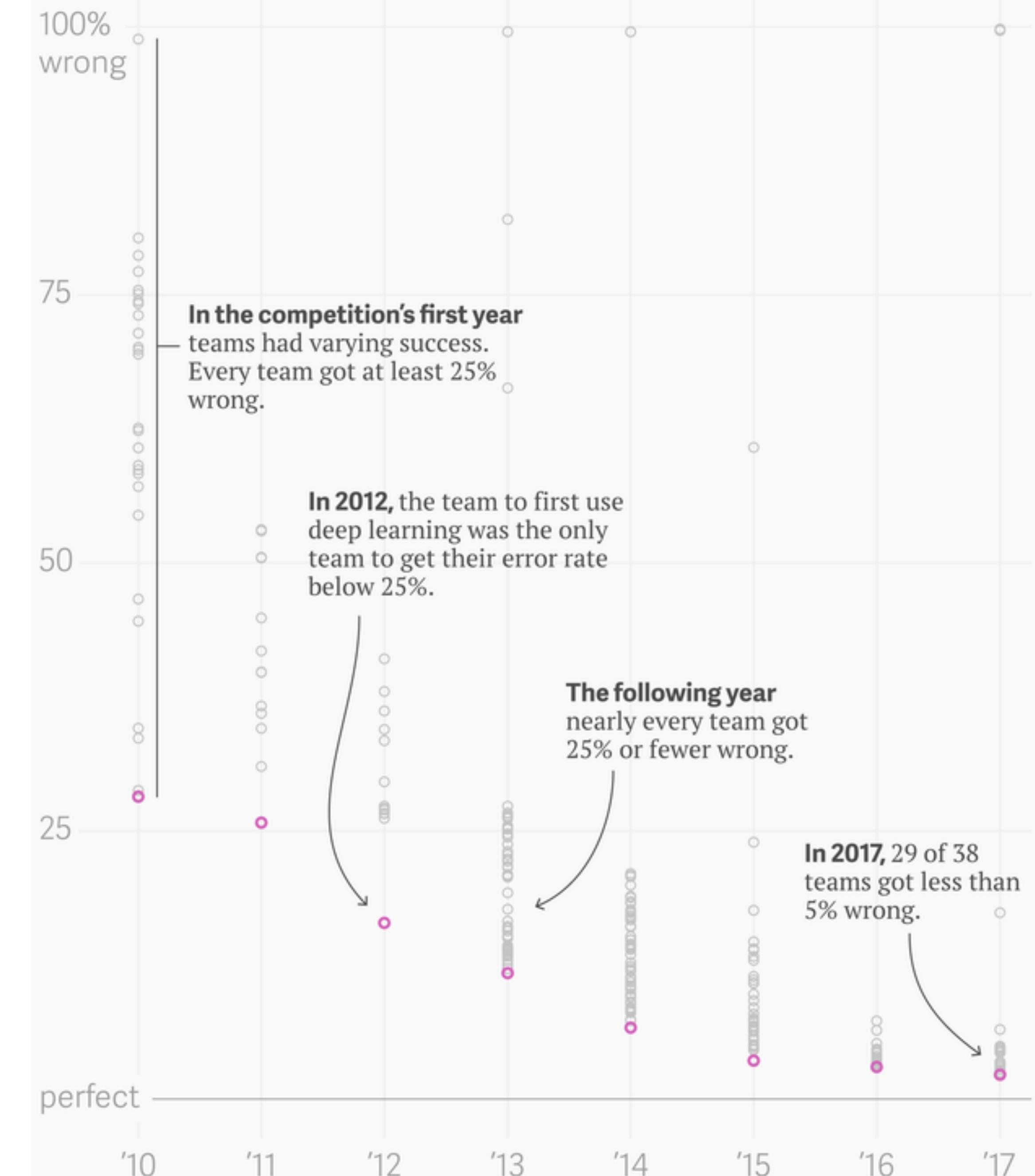
<http://www.image-net.org/>



Classify Images



ImageNet Large Scale Visual Recognition Challenge results



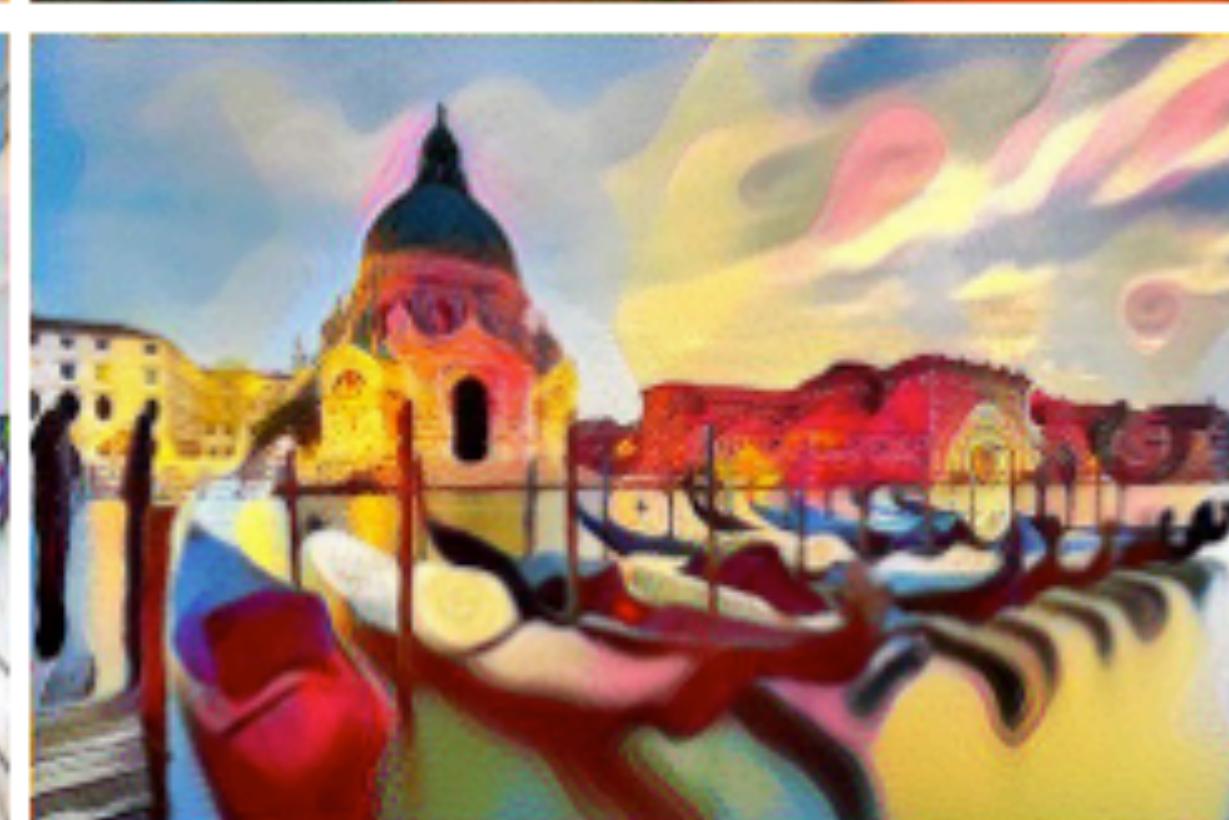
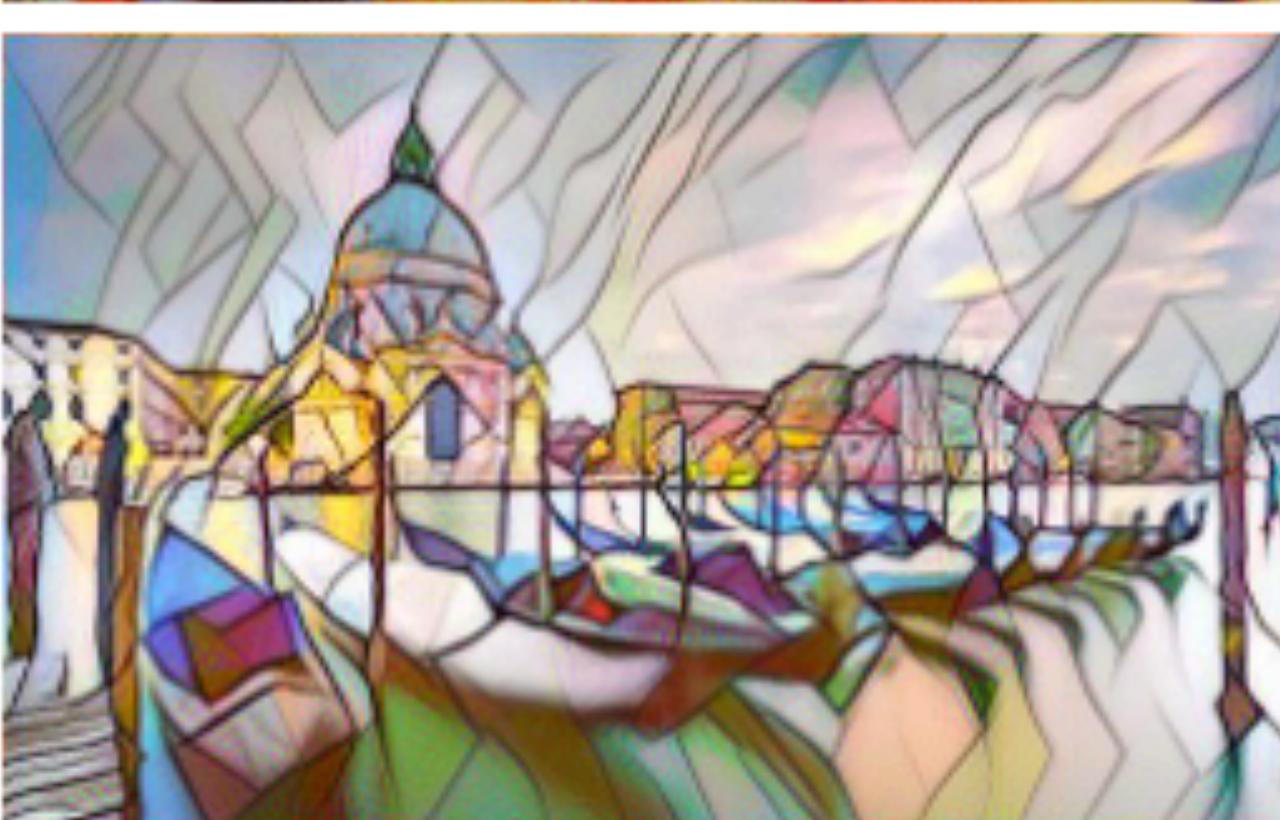
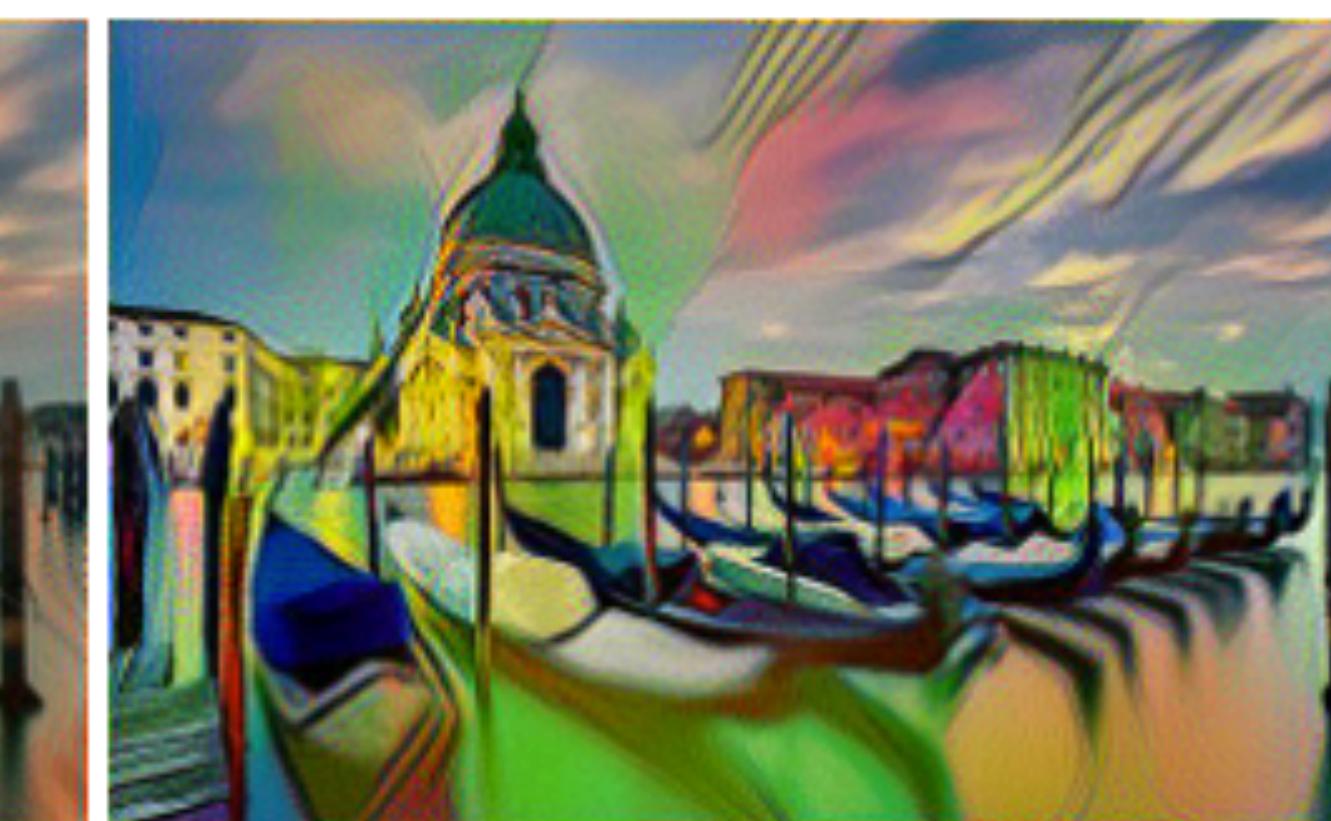
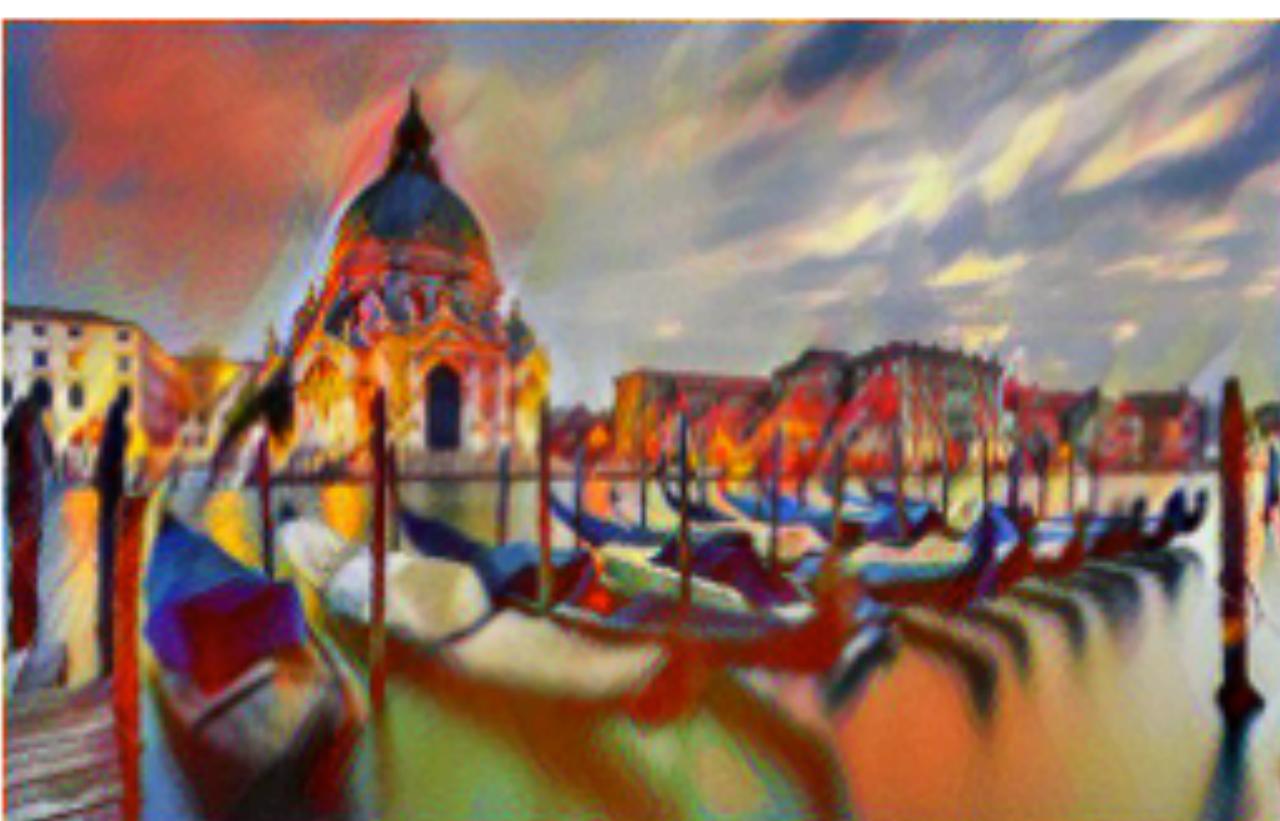
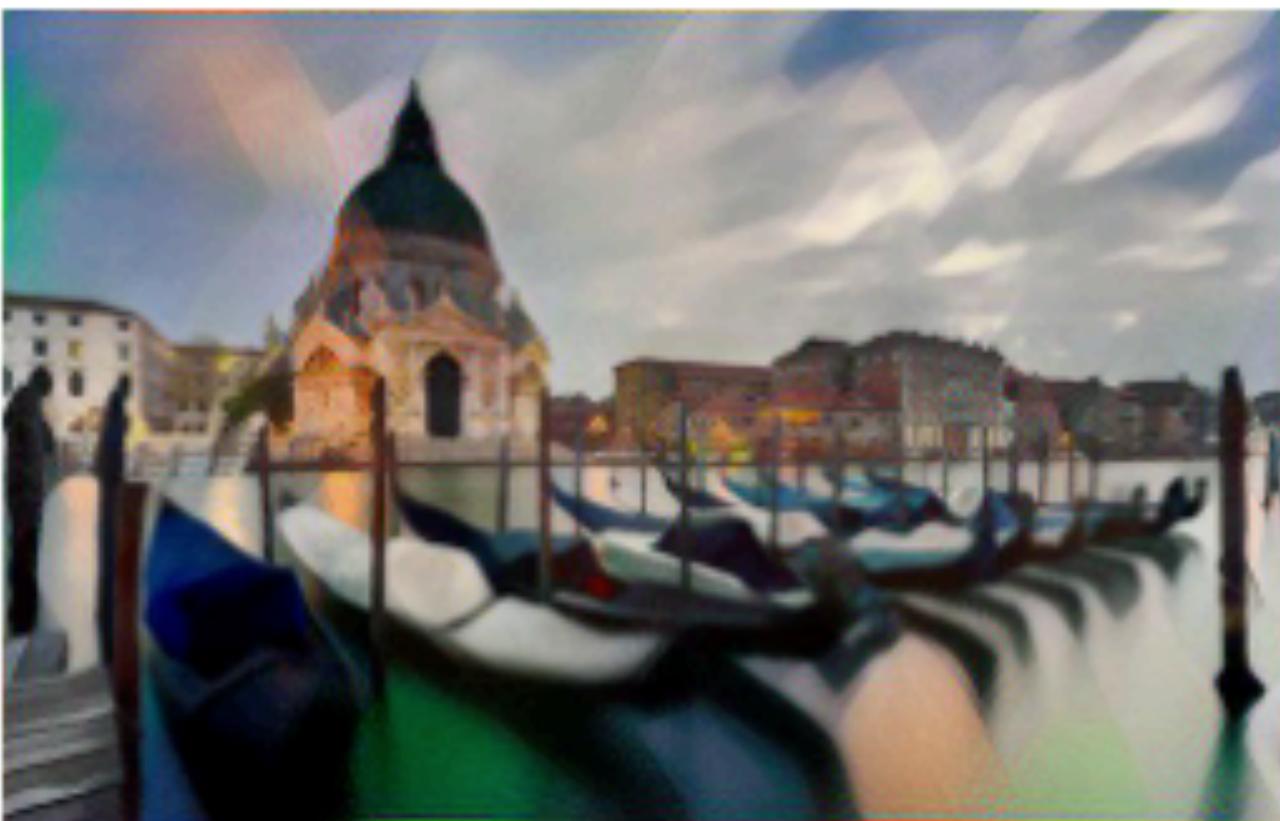
Detect and Segment Objects



https://github.com/matterport/Mask_RCNN

Style Transfer

<https://github.com/StacyYang/MXNet-Gluon-Style-Transfer>



Generative Modeling

4.5 years of face generation



2014



2015



2016



2017



2018

Artificial Image Synthesis

Synthesize the images



Machine Translation

<https://www.pcmag.com/news/google-expands-neural-networks-for-language-translation>

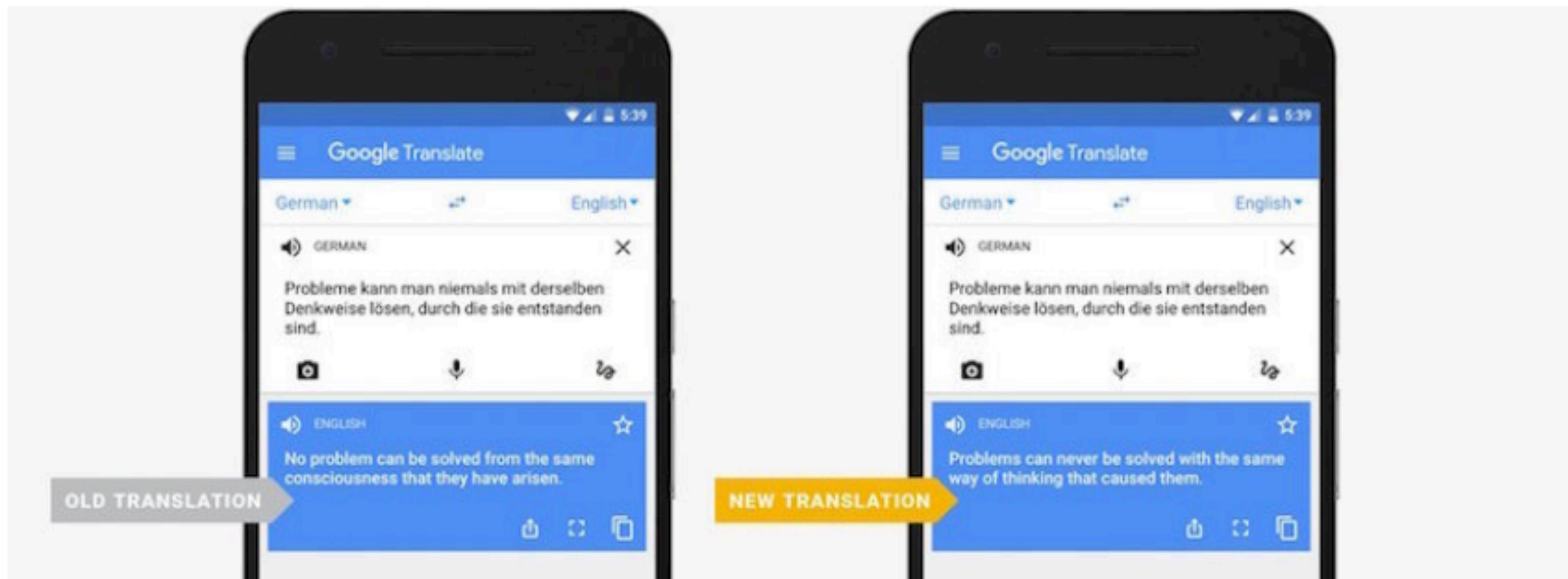
Google Expands Neural Networks for Language Translation

The new system can translate whole sentences at a time, rather than just phrases.



By [Tom Brant](#) November 15, 2016

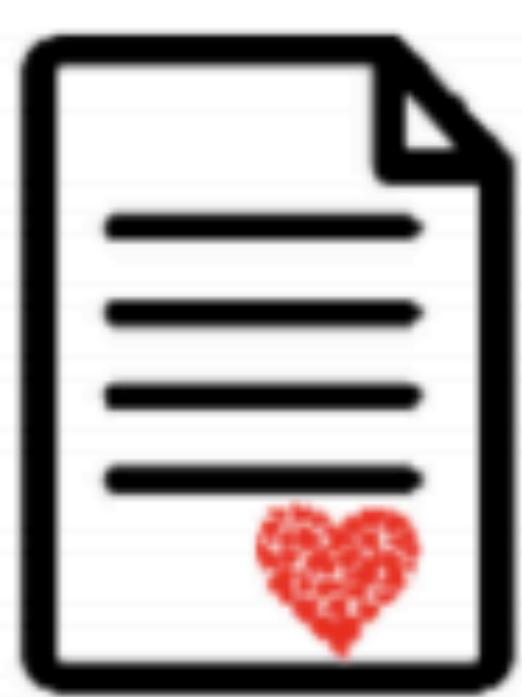
...



Text Synthesis

Content: Two dogs play by a tree.

Style: **happily, love**



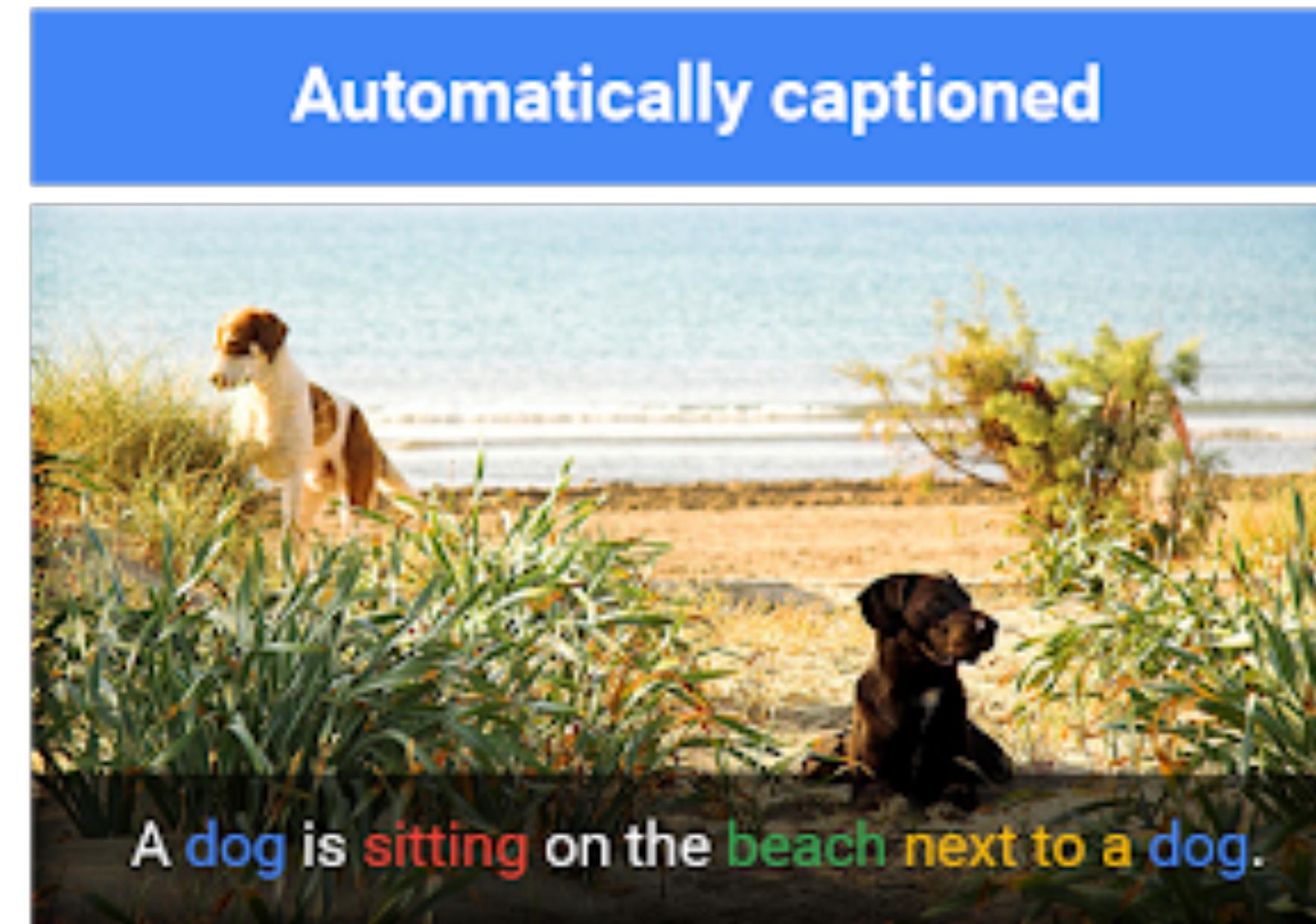
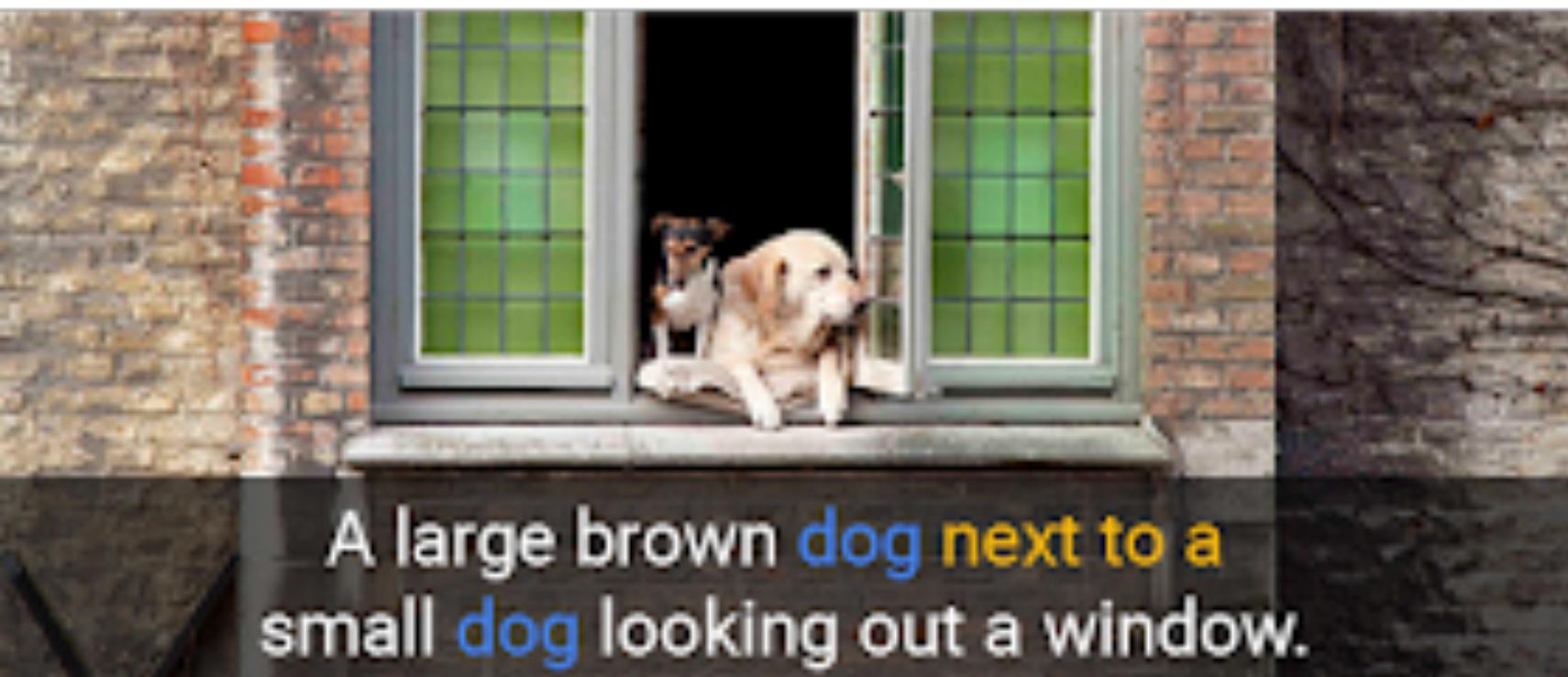
Two dogs **in love** play **happily** by a tree.



Li et al, NACCL, 2018

Image Captioning

Human captions from the training set



Open AI GPT-3: Giving GPT-3 a Turing Test

Q: What is your favorite animal?

A: My favorite animal is a dog.

Q: Why?

A: Because dogs are loyal and friendly.

Open AI GPT-3: Giving GPT-3 a Turing Test

Q: What is your favorite animal?

A: My favorite animal is a dog.

Q: Why?

A: Because dogs are loyal and friendly.

Q: What are two reasons that a dog might be in a bad mood?

A: Two reasons that a dog might be in a bad mood are if it is hungry or if it is hot.

Q: How many eyes does a giraffe have?

A: A giraffe has two eyes.

Q: How many legs does a frog have?

A: A frog has four legs.

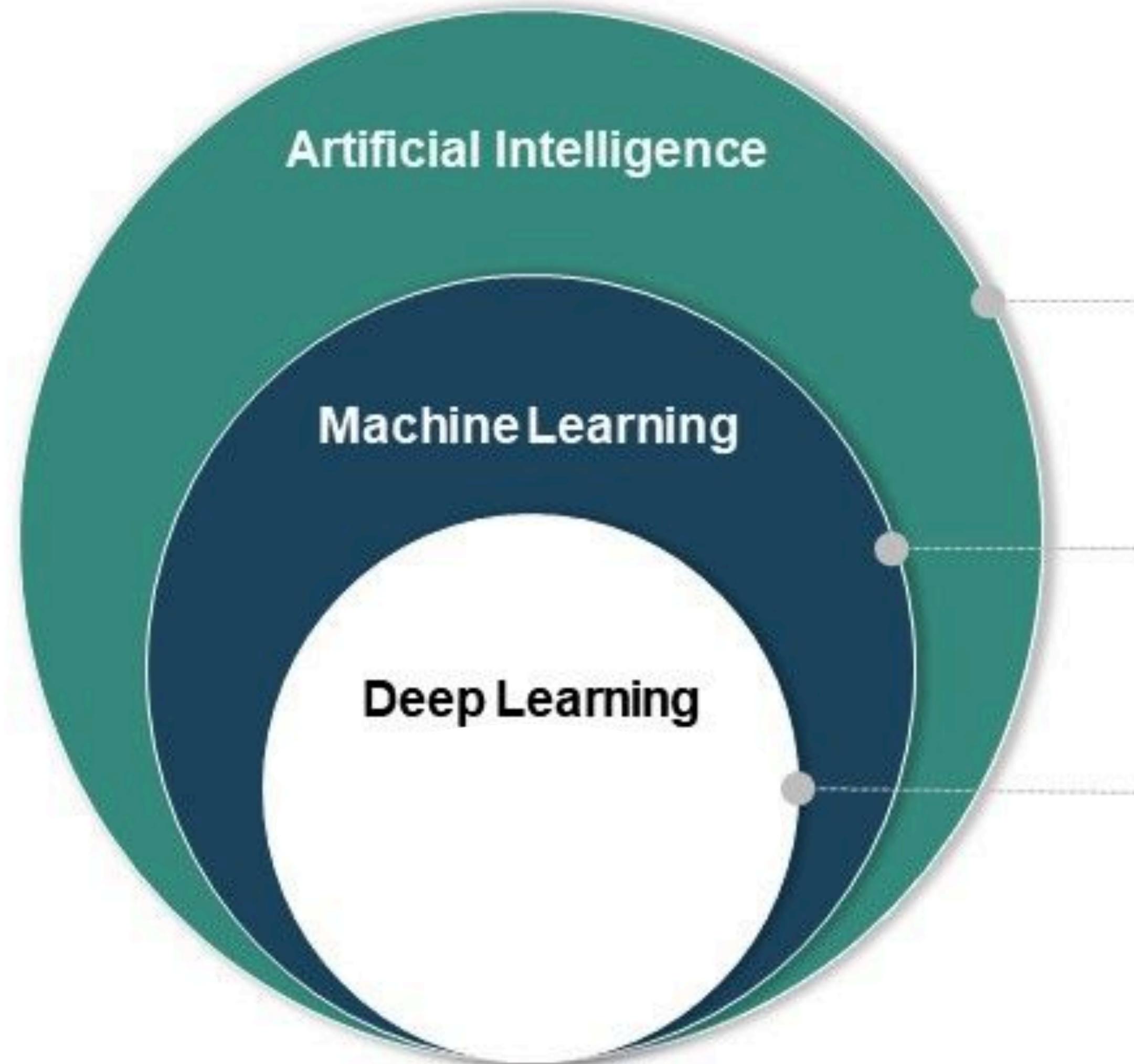
Q: Are there any animals with three legs?

A: No, there are no animals with three legs.

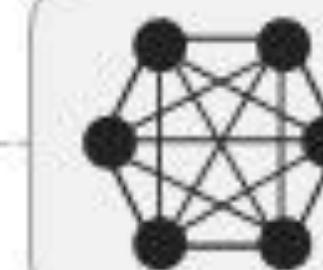
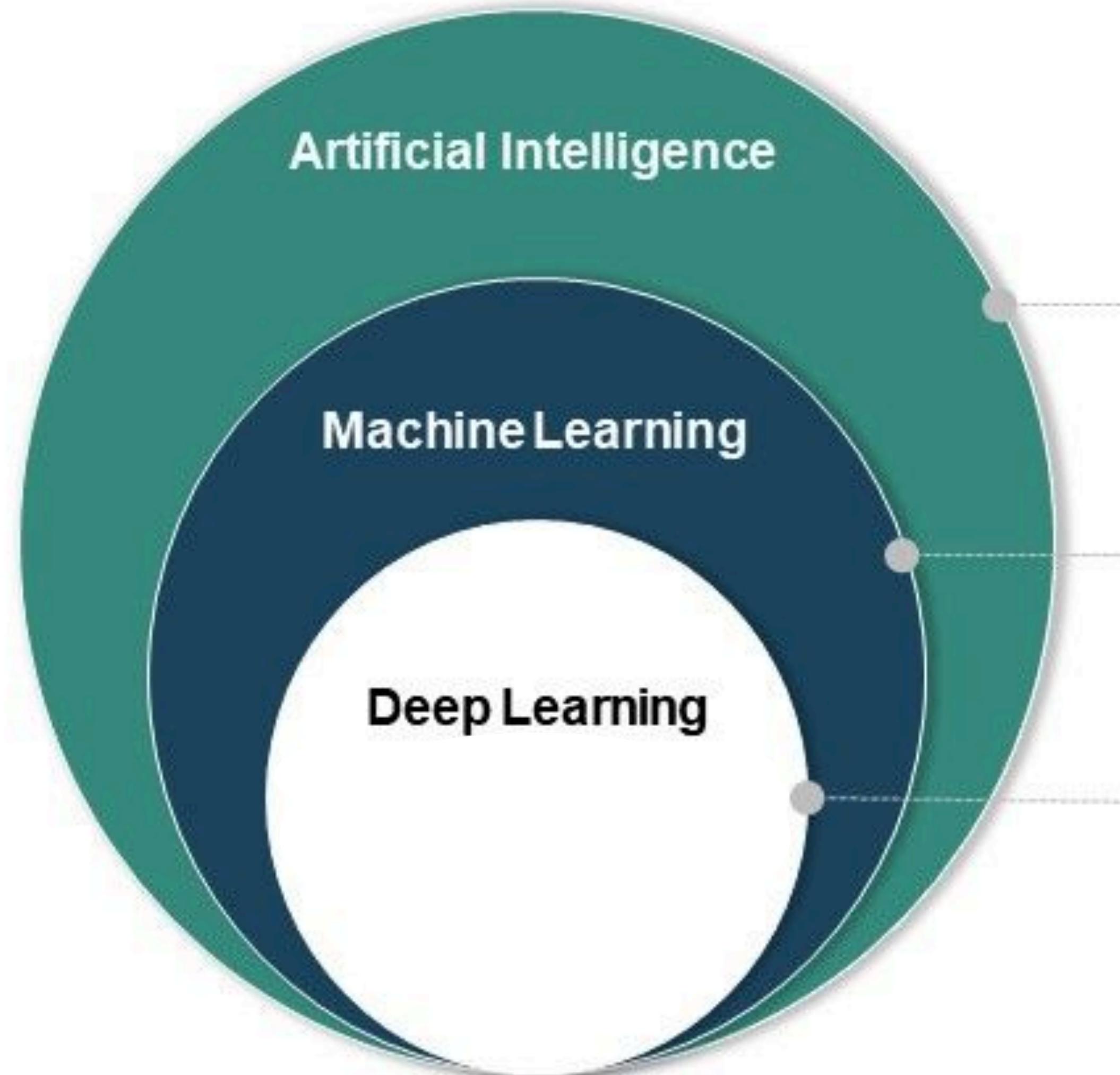
Q: Why don't animals have three legs?

A: Animals don't have three legs because they would fall over.

What is Artificial Intelligence (AI)?



What is Artificial Intelligence (AI)?



Artificial Intelligence

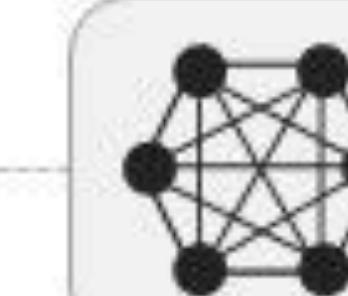
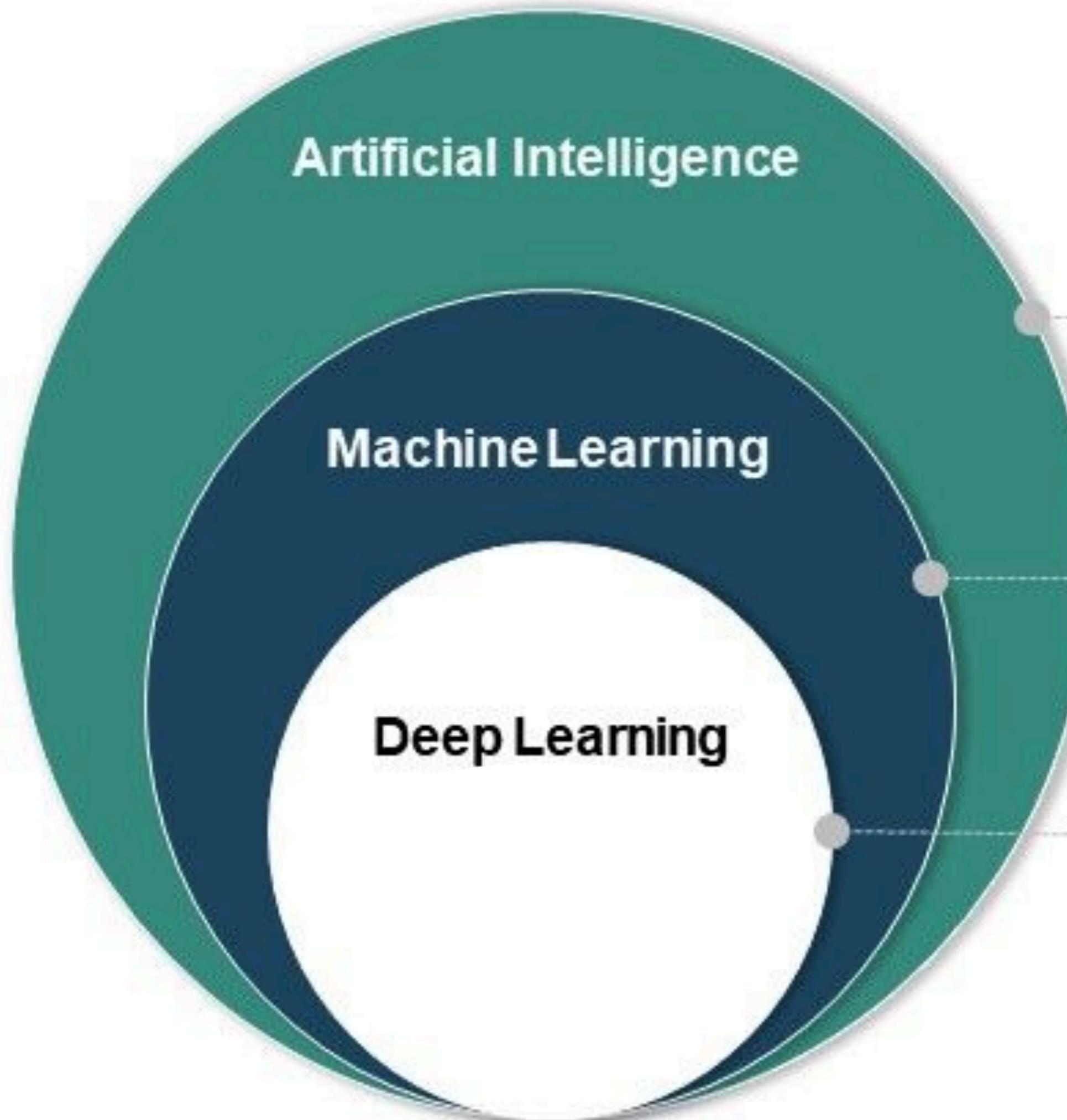
Any technique which enables computers to mimic behavior.



Machine Learning

Subset of AI techniques which use statistical methods to enable machines to improve with experiences.

What is Artificial Intelligence (AI)?



Artificial Intelligence

Any technique which enables computers to mimic behavior.



Machine Learning

Subset of AI techniques which use statistical methods to enable machines to improve with experiences.



Deep Learning

Subset of ML which make the computation of multi-layer neural networks feasible.

Artificial Intelligence is not Magic

They rely on **fundamental** techniques in:

- Algorithms
- Mathematics
- Logic
- Probability and Statistics
- Optimization

What you can learn from CS540?

- Foundational tools in **Machine Learning and Artificial Intelligence**: Linear algebra, Probability, Logic, and elements of Statistics.
- Core techniques in **Natural Language Processing (NLP)**, including bag-of-words, tf-idf, n-Gram Models, and Smoothing.
- Basics of **Machine Learning**. supervised learning vs. unsupervised learning
- **Neural Networks and Deep Learning**: Network Architecture, Training, Backpropagation, Stochastic Gradient Descent.
- Fundamentals of **Game Theory**.
- **Search and Reinforcement Learning**
- **Artificial Intelligence and Machine Learning** in Real-World settings and the Ethics of Artificial Intelligence.

What you can learn from CS540?

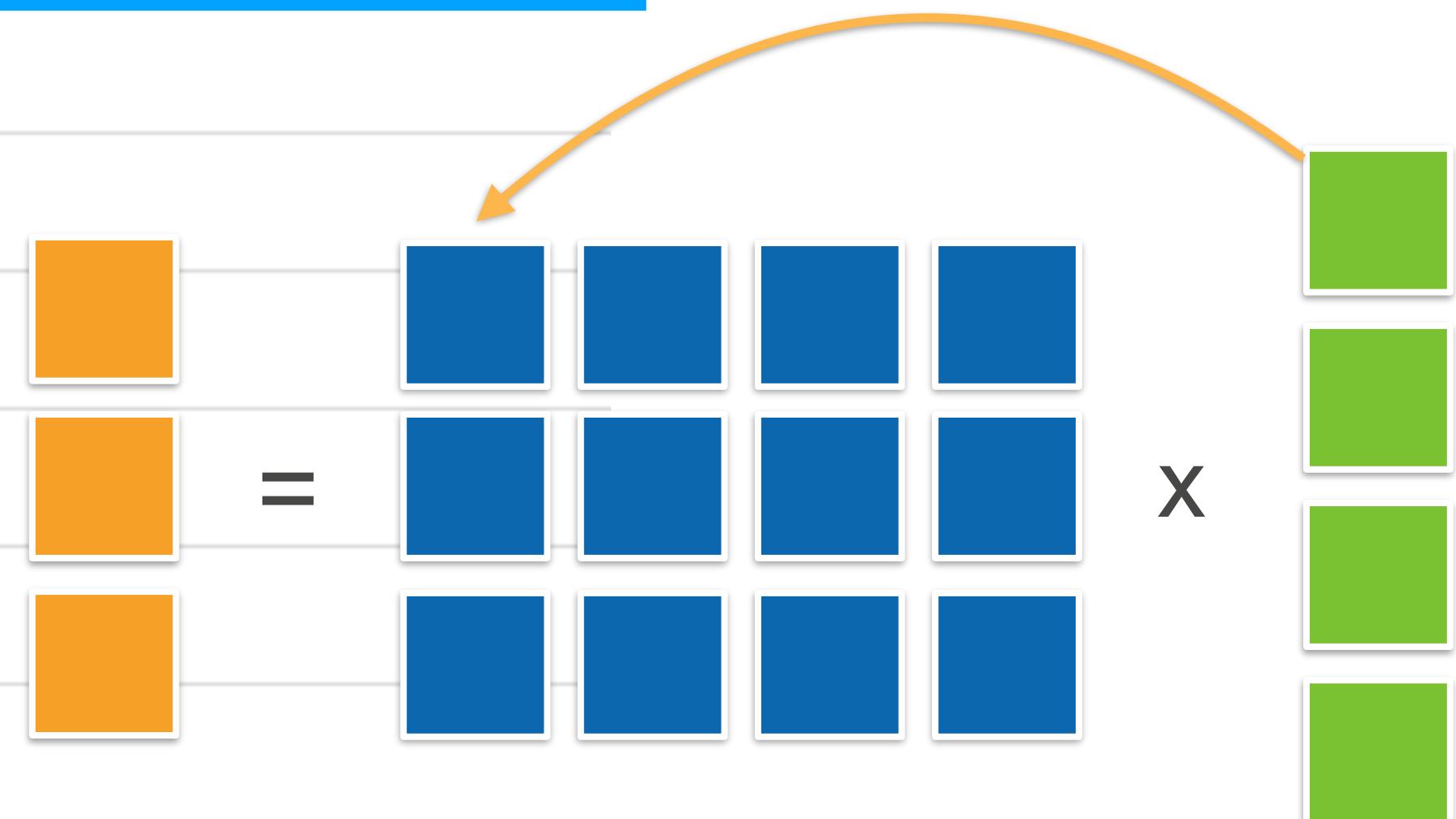
- Foundational tools in **Machine Learning and Artificial Intelligence**: Linear algebra, Probability, Logic, and elements of Statistics.
- Core techniques in **Natural Language Processing (NLP)**, including bag-of-words, tf-idf, n-Gram Models, and Smoothing.
- **TL;DR Lots of useful stuff, theory and practice in AI**
- **Basics of Machine Learning**: supervised learning vs. unsupervised learning
- **Neural Networks and Deep Learning**: Network Architecture, Training, Backpropagation, Stochastic Gradient Descent.
- **Fundamentals of Game Theory**.
- **Search and Reinforcement Learning**
- **Artificial Intelligence and Machine Learning** in Real-World settings and the Ethics of Artificial Intelligence.

What you can learn from CS540?

http://pages.cs.wisc.edu/~sharonli/courses/cs540_spring2021/schedule.html

Date	Topic
Tuesday, Jan 26	Welcome and Introduction to Python
Thursday, Jan 28	Probability
Tuesday, Feb 2	Linear Algebra and PCA
Thursday, Feb 4	Statistics and Math Review
Tuesday, Feb 9	Introduction to Logic
Thursday, Feb 11	Natural Language Processing
Tuesday, Feb 16	Machine Learning: Introduction
Thursday, Feb 18	Machine Learning: Unsupervised Learning I
Tuesday, Feb 23	Machine Learning: Unsupervised Learning II
Thursday, Feb 25	Machine Learning: Linear regression
Tuesday, March 2	Machine Learning: K - Nearest Neighbors
Thursday, March 4	Machine Learning: Perceptron
Tuesday, March 9	Machine Learning: Neural Network I

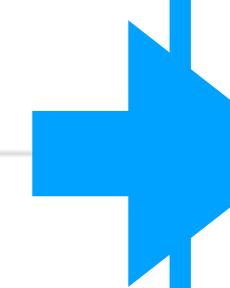
Foundations



What you can learn from CS540?

http://pages.cs.wisc.edu/~sharonli/courses/cs540_spring2021/schedule.html

Date	Topic
Tuesday, Jan 26	Welcome and Introduction to Python
Thursday, Jan 28	Probability
Tuesday, Feb 2	Linear Algebra and PCA
Thursday, Feb 4	Statistics and Math Review
Tuesday, Feb 9	Introduction to Logic
Thursday, Feb 11	Natural Language Processing
Tuesday, Feb 16	Machine Learning: Introduction
Thursday, Feb 18	Machine Learning: Unsupervised Learning I
Tuesday, Feb 23	Machine Learning: Unsupervised Learning II
Thursday, Feb 25	Machine Learning: Linear regression
Tuesday, March 2	Machine Learning: K - Nearest Neighbors
Thursday, March 4	Machine Learning: Perceptron
Tuesday, March 9	Machine Learning: Neural Network I

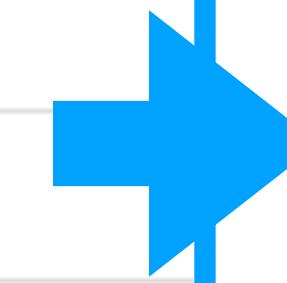


Machine learning

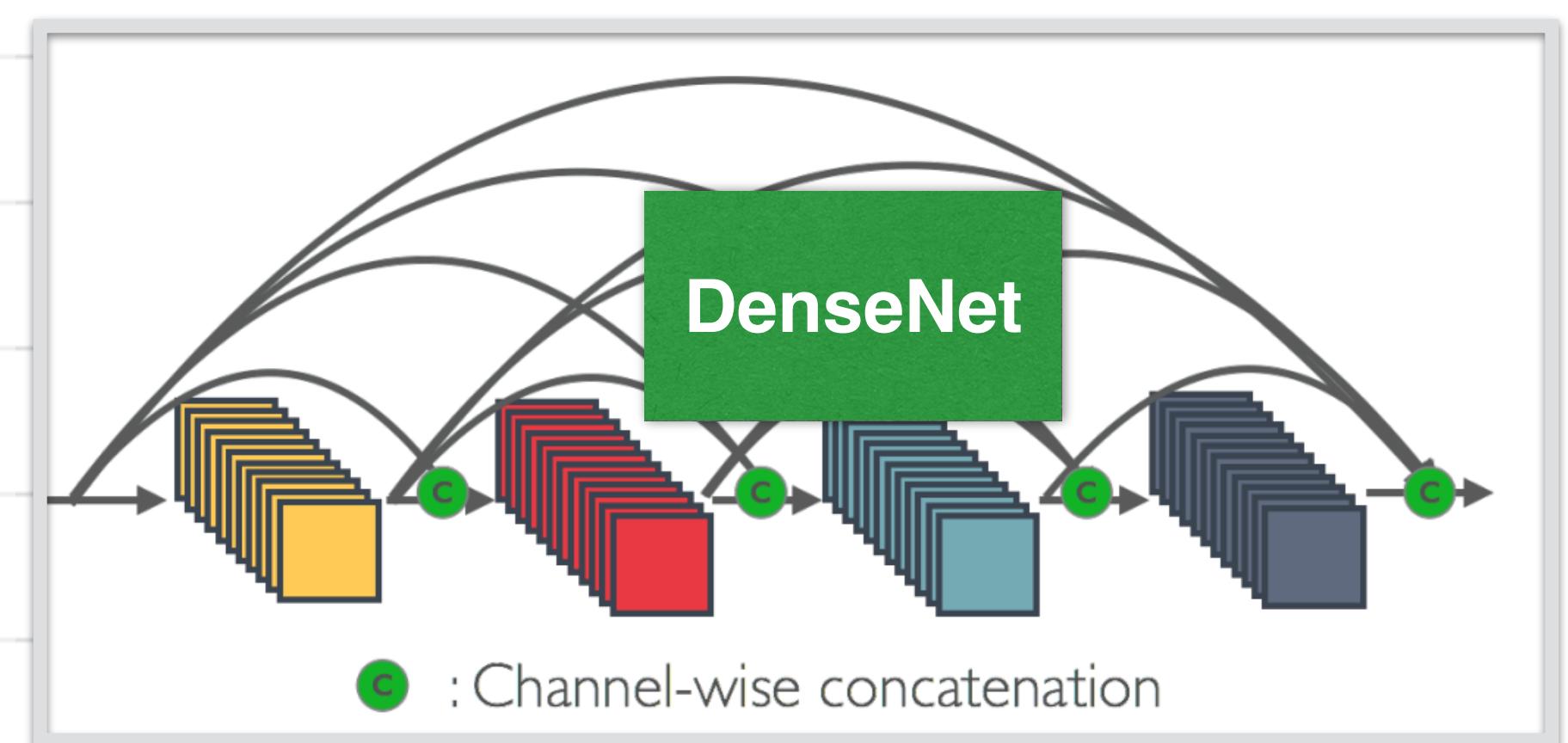
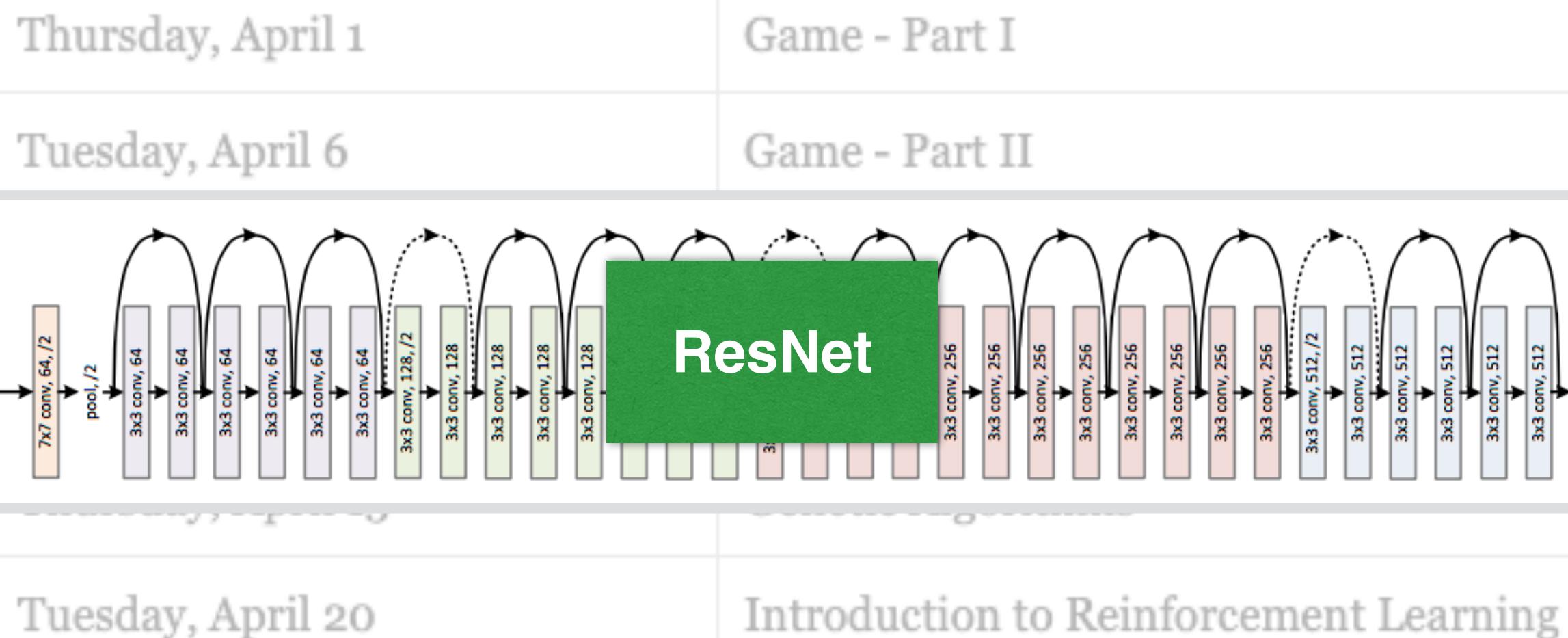
What you can learn from CS540?

http://pages.cs.wisc.edu/~sharonli/courses/cs540_spring2021/schedule.html

Tuesday, March 9	Machine Learning: Neural Network I
Thursday, March 11	Machine Learning: Neural Network II
Tuesday, March 16	Machine Learning: Neural Network III
Thursday, March 18	Machine Learning: Deep Learning I
Tuesday, March 23	Machine Learning: Deep Learning II
Thursday, March 25	Machine Learning: Deep Learning III
Tuesday, March 30	Machine Learning: Deep Learning and Neural Network's Summary

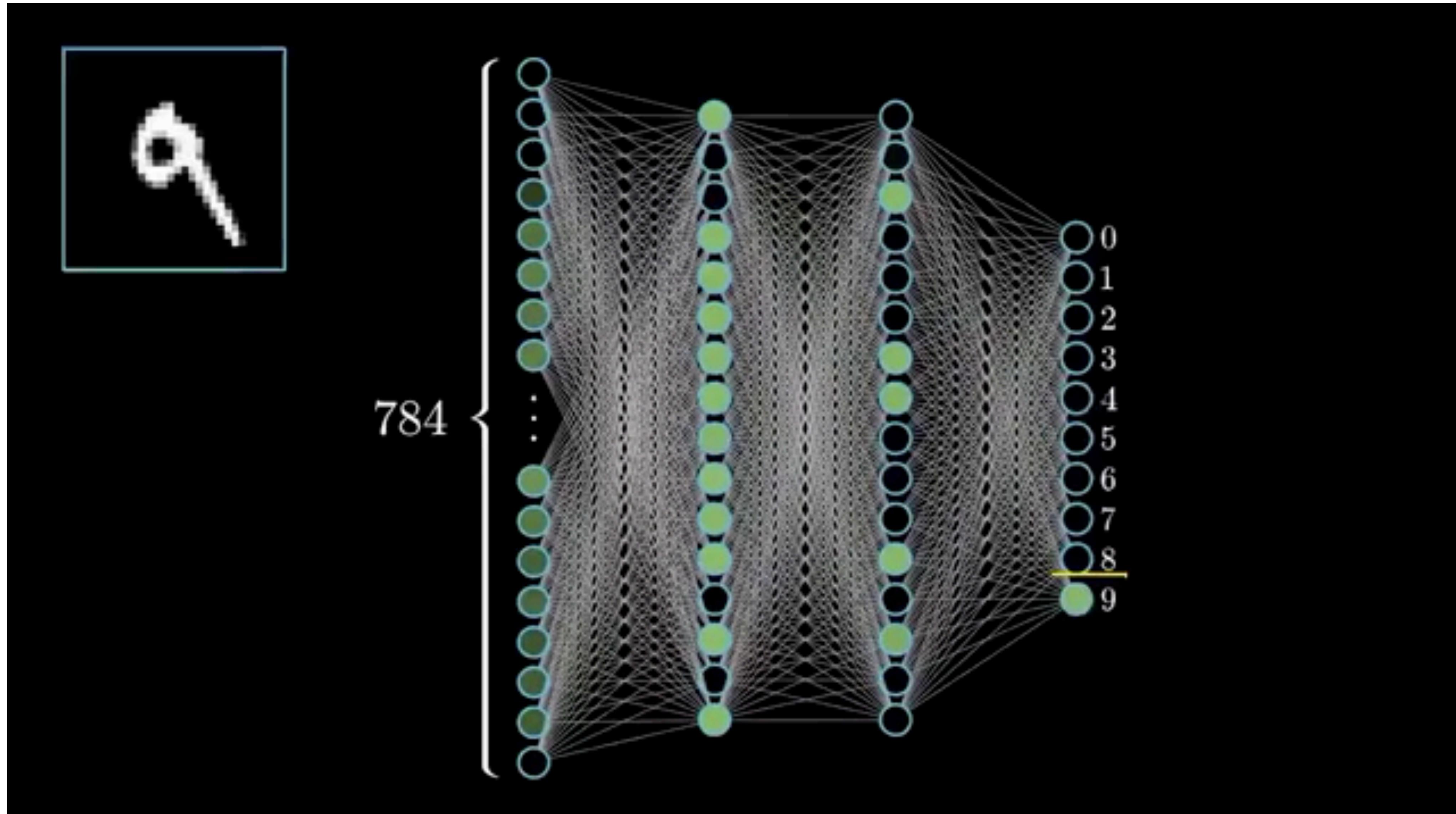


Deep Learning



What you can learn from CS540?

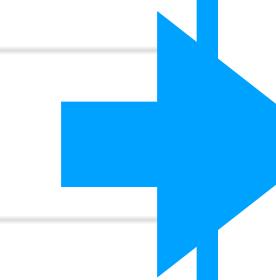
http://pages.cs.wisc.edu/~sharonli/courses/cs540_spring2021/schedule.html



What you can learn from CS540?

http://pages.cs.wisc.edu/~sharonli/courses/cs540_spring2021/schedule.html

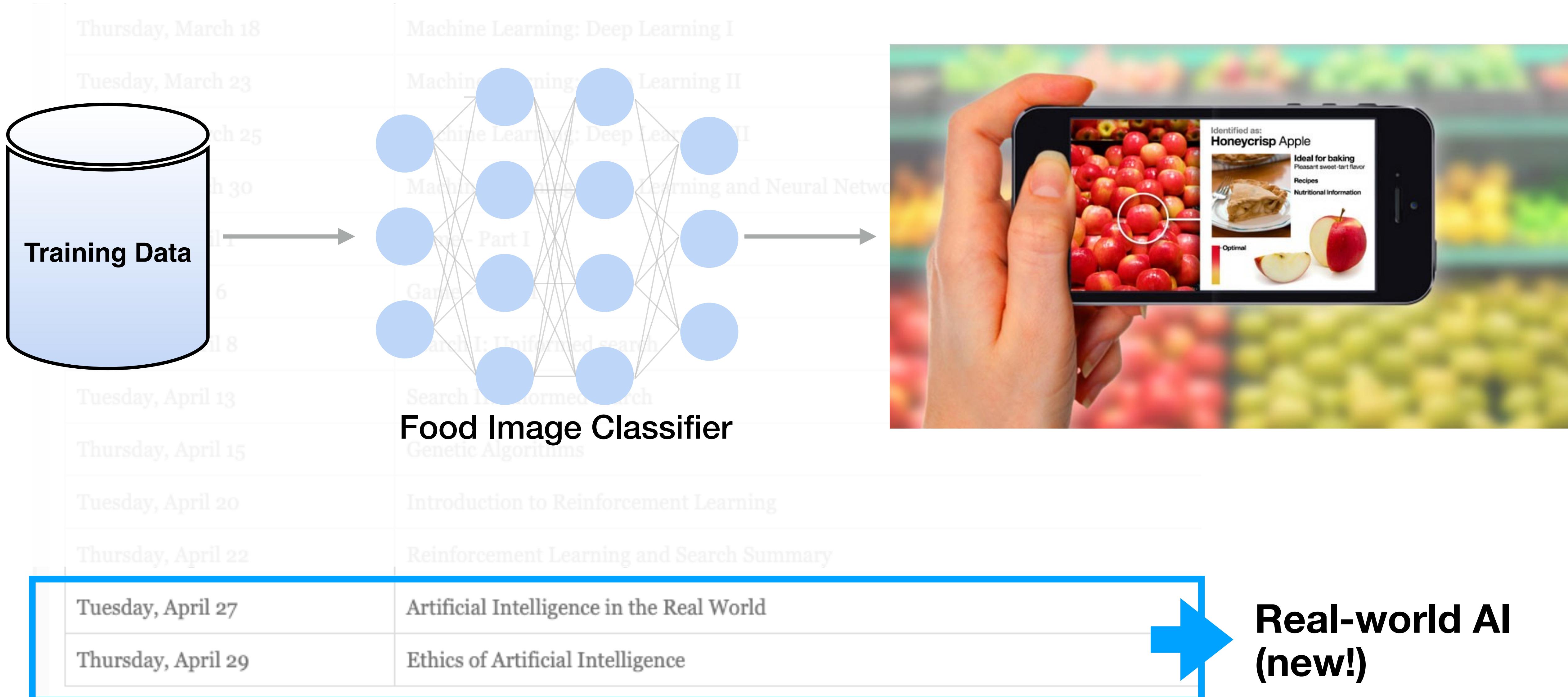
Thursday, March 18	Machine Learning: Deep Learning I
Tuesday, March 23	Machine Learning: Deep Learning II
Thursday, March 25	Machine Learning: Deep Learning III
Tuesday, March 30	Machine Learning: Deep Learning and Neural Network's Summary
Thursday, April 1	Game - Part I
Tuesday, April 6	Game - Part II
Thursday, April 8	Search I: Uniformed search
Tuesday, April 13	Search II: Informed search
Thursday, April 15	Genetic Algorithms
Tuesday, April 20	Introduction to Reinforcement Learning
Thursday, April 22	Reinforcement Learning and Search Summary
Tuesday, April 27	Artificial Intelligence in the Real World
Thursday, April 29	Ethics of Artificial Intelligence



**Game, search
and RL**

What you can learn from CS540?

http://pages.cs.wisc.edu/~sharonli/courses/cs540_spring2021/schedule.html





Part II: Course Logistics

Course Schedule

- Time: **Tuesday and Thursday 2:30-3:45pm CT**
- Location: **BlackBoard Collaborate**
- Schedule is available on the course website:

http://pages.cs.wisc.edu/~sharonli/courses/cs540_spring2021/index.html

- Slides online on website

Attending lecture synchronously

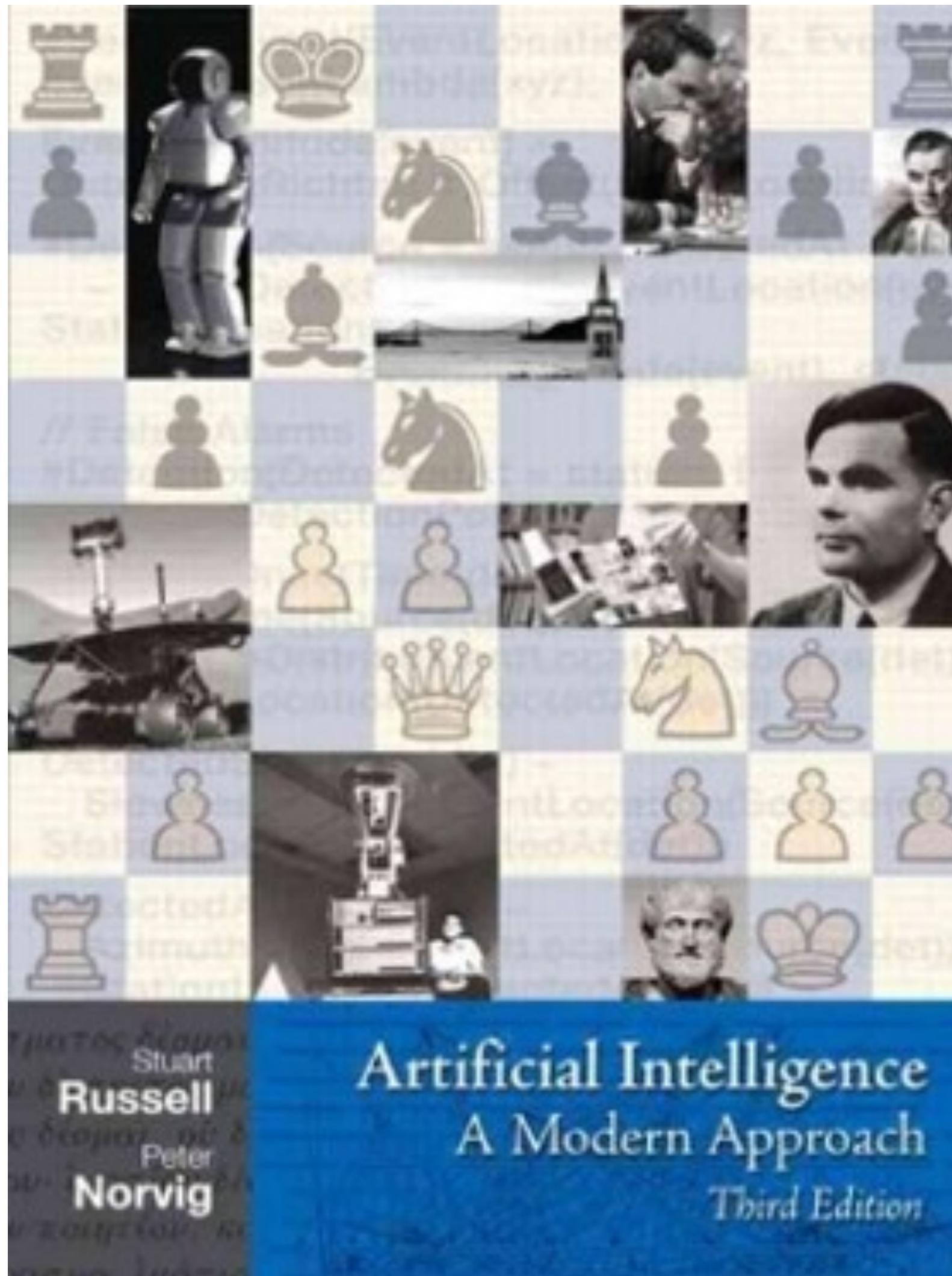
- Each lecture will be a series of **3** short mini-lectures.
- In each block, we will
 - The instructor will lecture using BBCollaborate Ultra
 - Pause for interactive Q&A
 - Deliver short quiz questions to clear up any confusion before proceeding to the next block.
- For asynchronous mode, instructors' approval needed.

Where to find content?

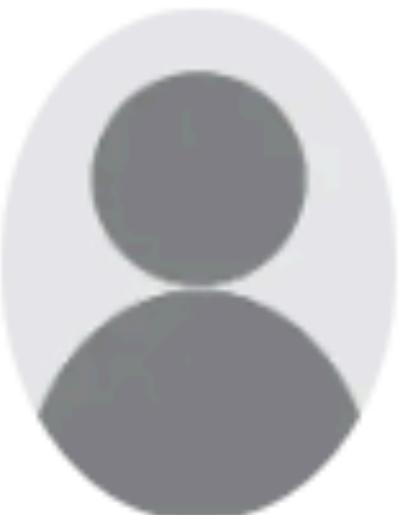
- **Piazza** piazza.com/wisc/spring2021/cs540/home
 - Discussion, questions
 - Announcements
- **Canvas** - private materials *that should not be shared*
 - Videos
 - Assignments
 - Grades
- **Course website** - public materials
 - Slides http://pages.cs.wisc.edu/~sharonli/courses/cs540_spring2021/index.html
 - Schedule
 - Policies

Textbook

Artificial Intelligence: A Modern Approach (4th edition). Stuart Russell and Peter Norvig. Pearson, 2020.
ISBN 978-0134610993. (textbook is optional, but may be useful)



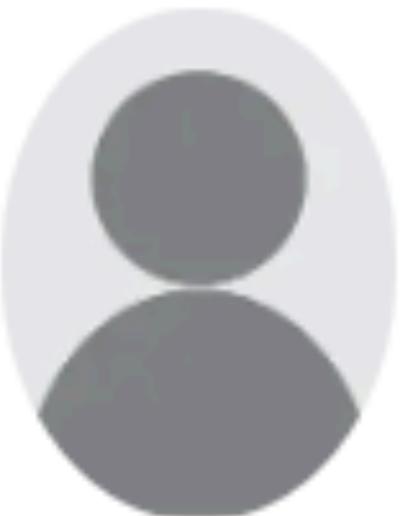
Teaching Assistants



Jeremy McMahan

jmcmaham@wisc.edu

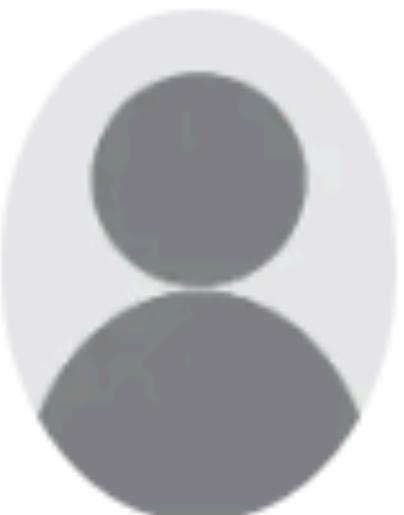
Office Hours: Thursday 11am-12pm



Yifei Ming

ming5@wisc.edu

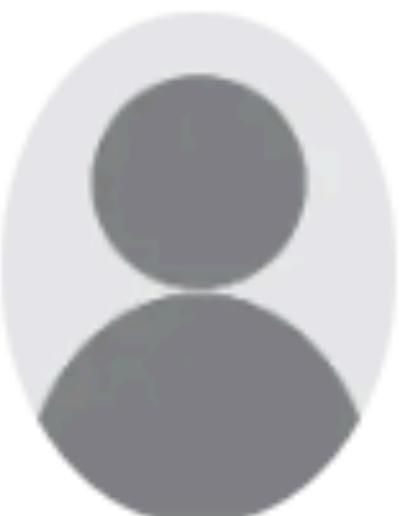
Office Hours: Friday 6pm-7pm



Ziqian Lin

zlin284@wisc.edu

Office Hours: Monday 3pm-4pm



Yien Xu

yien@cs.wisc.edu

Office Hours: Friday 2pm-3pm



John Balis

balis@wisc.edu

Office Hours: Wednesday 3pm-4pm



Apurbaa Bhattacharjee

bhattachar26@wisc.edu

Office Hours: Monday 12pm-1pm



Hemant Chinchore

chinchore@wisc.edu

Office Hours: Friday 5pm-6pm



Xuefeng Du

xdu66@wisc.edu

Office Hours: Friday 10am-11am

Peer Mentors

(5*15 PM hours per week)

Ananya Makwana

amakwana@wisc.edu

Office Hours: TBD

Apeksha Maithal

maithal@wisc.edu

Office Hours: TBD

Atharva Kulkarni

akulkarni23@wisc.edu

Office Hours: TBD

David Woodson

dwoodson2@wisc.edu

Office Hours: TBD

Hunter Abraham

hjabraham@wisc.edu

Office Hours: TBD

Sai Teja

chokkarapu@wisc.edu

Office Hours: TBD

Xingpeng Sun

xsun273@wisc.edu

Office Hours: TBD

Yizhou Chen

ychen884@wisc.edu

Office Hours: TBD

Yizhou Liu

liu773@wisc.edu

Office Hours: TBD

Runduo Ma

rma76@wisc.edu

Office Hours: TBD

Kai Wang

kwang339@wisc.edu

Office Hours: TBD

Lakshay Goyal

lgoyal@wisc.edu

Office Hours: TBD

Lynette Gao

qgao38@wisc.edu

Office Hours: TBD

Pulkit Goyal

pgoyal22@wisc.edu

Office Hours: TBD

Reid (Yi) Chen

reid@cs.wisc.edu

Office Hours: TBD

Office Hours

- Available the course website: http://pages.cs.wisc.edu/~sharonli/courses/cs540_spring2021/teaching_team.html
- All office hours are **merged** between the two sections
- Use Peer Mentor hours for detailed-level questions (e.g. coding related), and use TA office hours for conceptual level questions

Grading scheme

- **Midterm Exam:** 15% (March 17)
- **Final Exam:** 15% (May 6)
- **Homework Assignments:** 70% (10 HWs)

TWO lowest homework scores are dropped from the final homework average calculation.

Homework is always due the minute before class starts on the due date.
(Late submissions will not be accepted.)

Homework will be posted and submitted via Canvas.

Regrade Request

Use Google Form for regrade request

Raised with the TAs within 72 hours after it is returned.

Integrity

http://pages.cs.wisc.edu/~sharonli/courses/cs540_spring2021/about.html

You are encouraged to discuss with your peers, the TA or the instructors ideas, approaches and techniques broadly. However, all examinations, programming assignments, and written homeworks must be written up individually. For example, code for programming assignments must not be developed in groups, nor should code be shared. Make sure you work through all problems yourself, and that your final write-up is your own. If you feel your peer discussions are too deep for comfort, declare it in the homework solution: “I discussed with X,Y,Z the following specific ideas: A, B, C; therefore our solutions may have similarities on D, E, F...”.

You may use books or legit online resources to help solve homework problems, but you must always credit all such sources in your writeup and you must never copy material verbatim.

We are aware that certain websites host previous years’ CS540 homework assignments and solutions against the wish of instructors. Do not be tempted to use them: the solutions may contain “poisonous berries” previous instructors planted intentionally to catch cheating. If we catch you copy such solutions, you automatically fail.

Do not bother to obfuscate plagiarism (e.g. change variable names, code style, etc.) One application of AI is to develop sophisticated plagiarism detection techniques!

Cheating and plagiarism will be dealt with in accordance with University procedures (see the [UW-Madison Academic Misconduct Rules and Procedures](#))



Part III: Software

Tools



- **Python**
 - Everyone is using it in machine learning & data science
 - Conda package manager (for simplicity)
- **Jupyter**
 - So much easier to keep track of your experiments
 - Obviously you should put longer code into modules

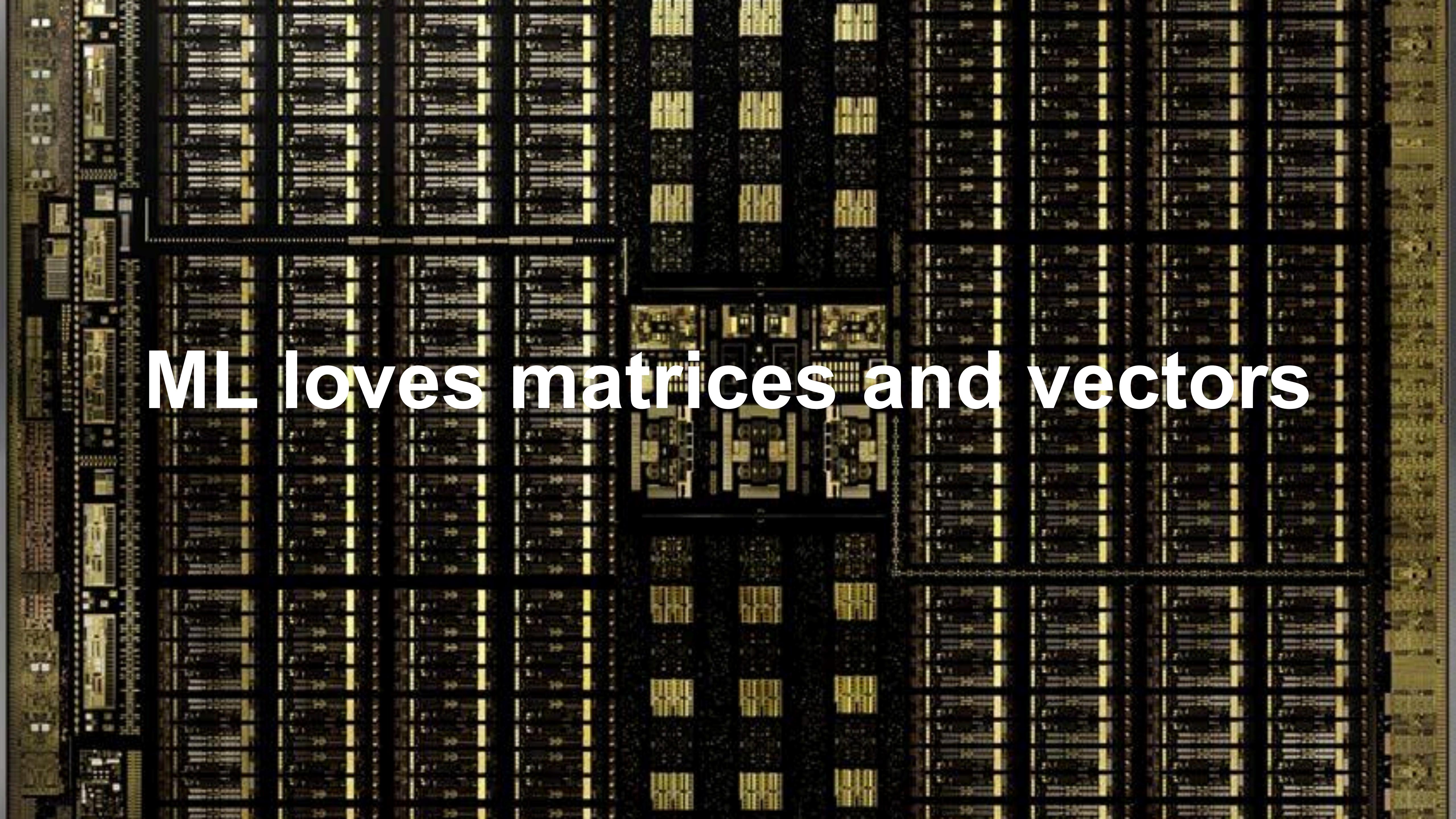
Python for Java Pros (slides available on website)

A Crash Course in Python

1. Why are we doing this in Python?
2. Where do I write Python code? How do I run it?
 - a. Online
 - b. Offline
3. What are the big differences between Java and Python

Colab

- Go to colab.research.google.com
- Activate the GPU supported runtime (this is a K80 GPU)



ML loves matrices and vectors

Access Elements

An element: `[1, 2]`

	0	1	2	3
0	1	2	3	4
1	5	6	7	8
2	9	10	11	12
3	13	14	15	16

A row: `[1, :]`

	0	1	2	3
0	1	2	3	4
1	5	6	7	8
2	9	10	11	12
3	13	14	15	16

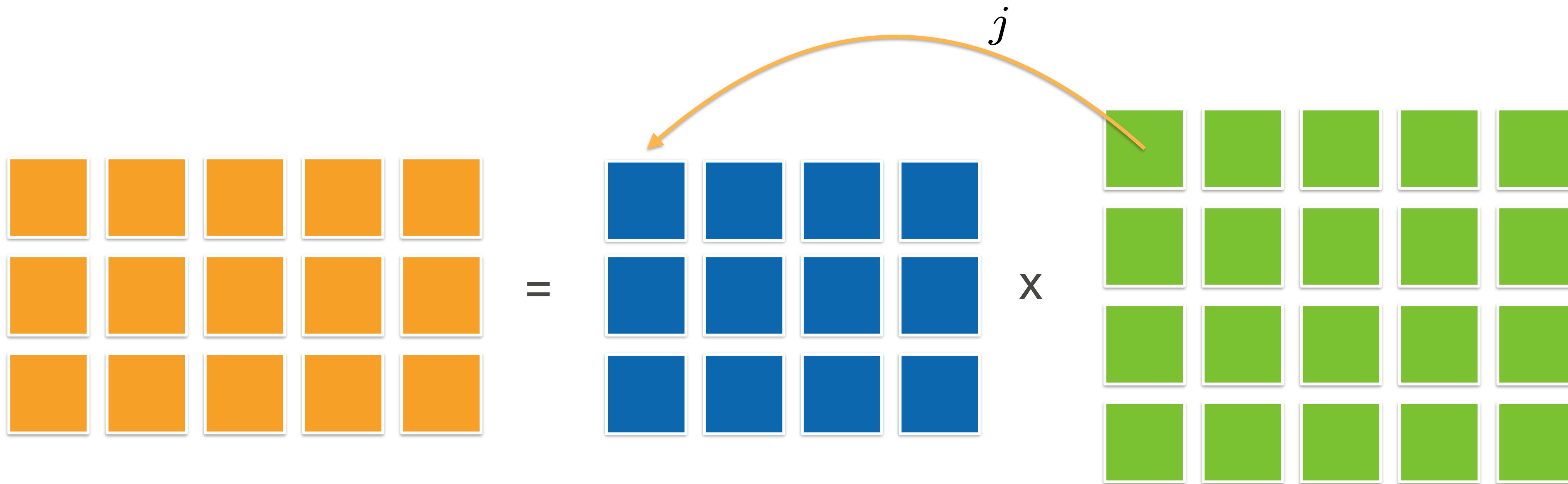
A column: `[1, :]`

	0	1	2	3
0	1	2	3	4
1	5	6	7	8
2	9	10	11	12
3	13	14	15	16

	0	1	2	3
0	1	2	3	4
1	5	6	7	8
2	9	10	11	12
3	13	14	15	16

Next week: Linear Algebra and PCA

$$C = AB \text{ where } C_{ik} = \sum_j A_{ij} B_{jk}$$





Recap

- Artificial Intelligence
 - Overview and agenda
 - Course logistics
 - Homework, exam, OH etc
- Software



Thanks!