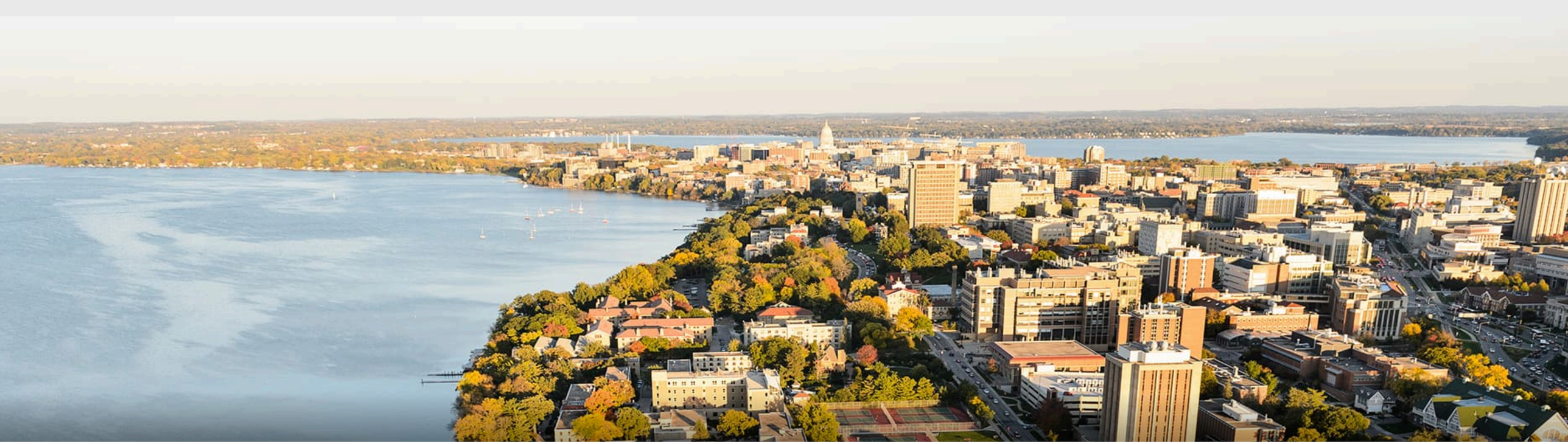


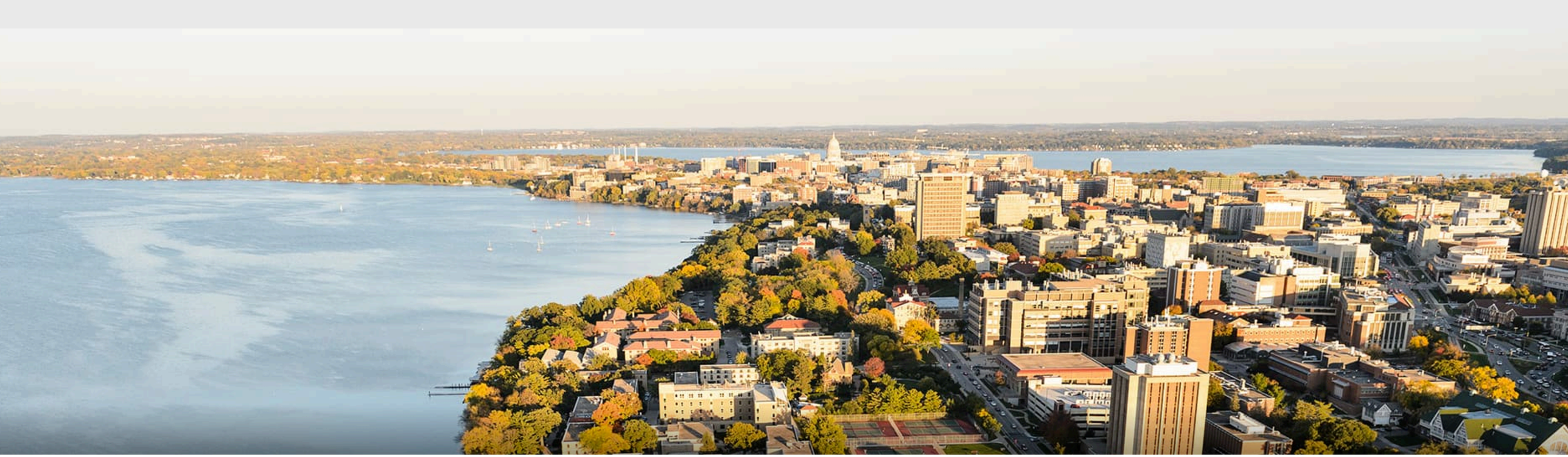
CS 540 Introduction to Artificial Intelligence
Course Overview

University of Wisconsin-Madison

Spring 2022

Today's outline

- What's in CS540
- Course logistics
- Software



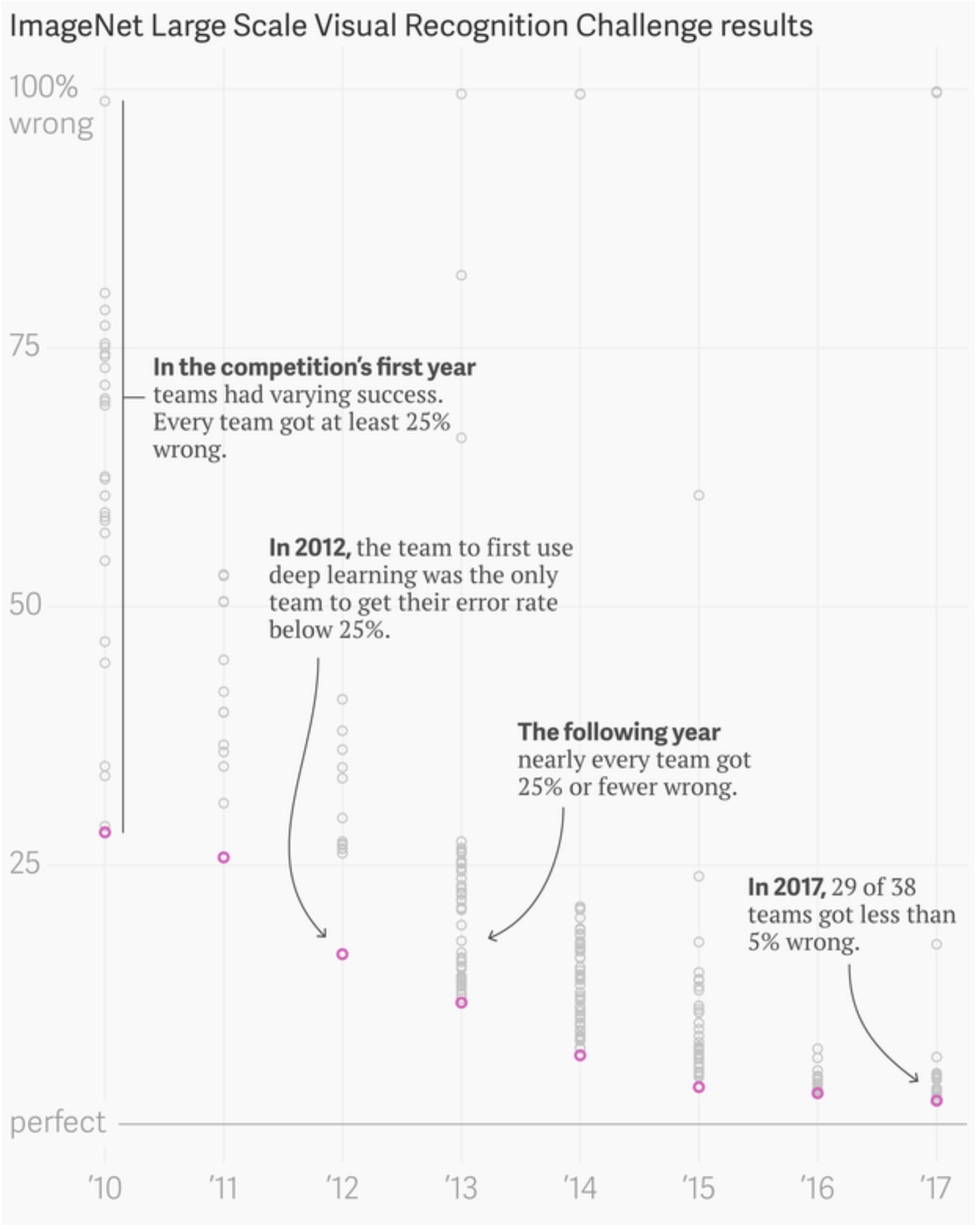
Part I: Course overview

AI

Classify Images

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

Classify Images



https://qz.com/1034972/the-data-that-changed-the-direction-of-ai-research-and-possibly-the-world/

Detect and Segment Objects

https://github.com/matterport/Mask_RCNN

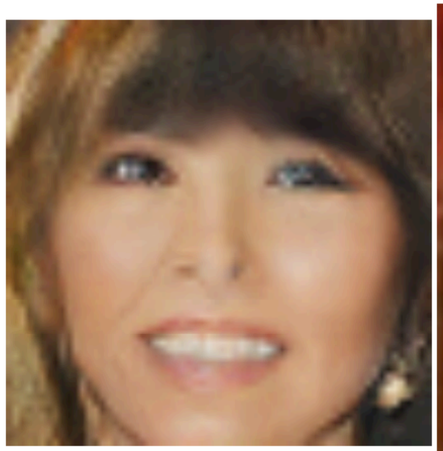
Style Transfer

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

http://www.whichfaceisreal.com/methods.html

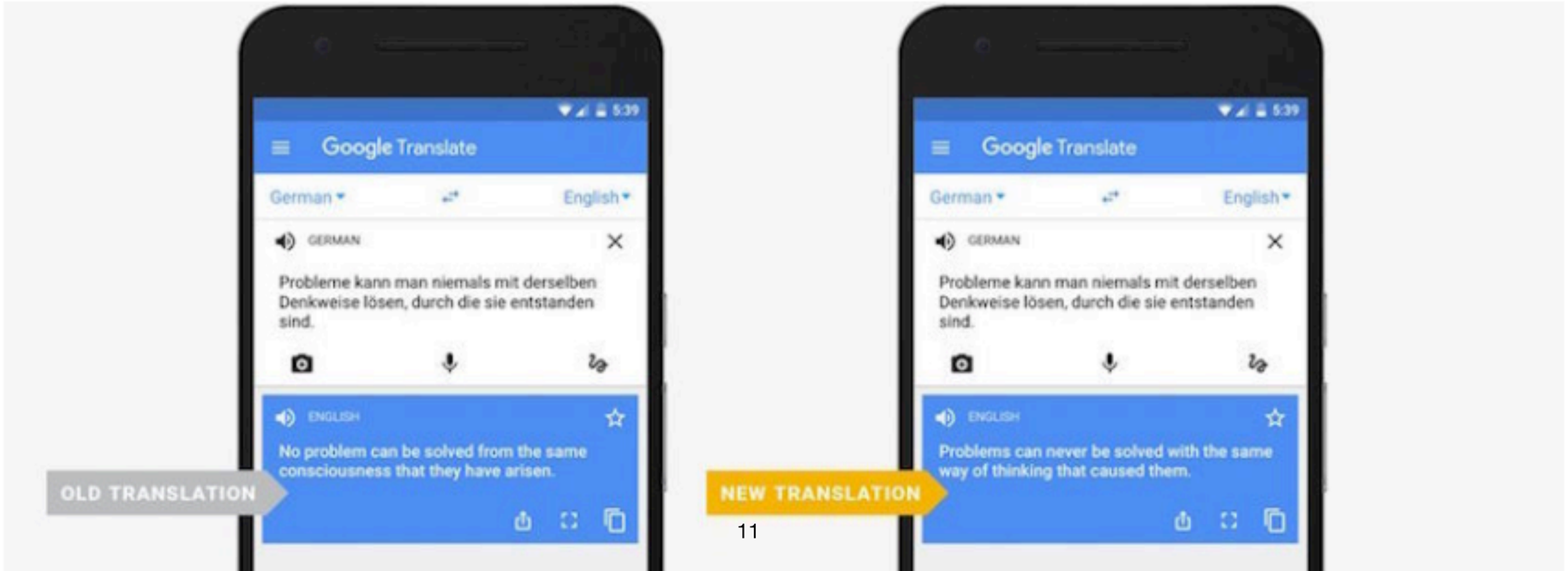
Machine Translation

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

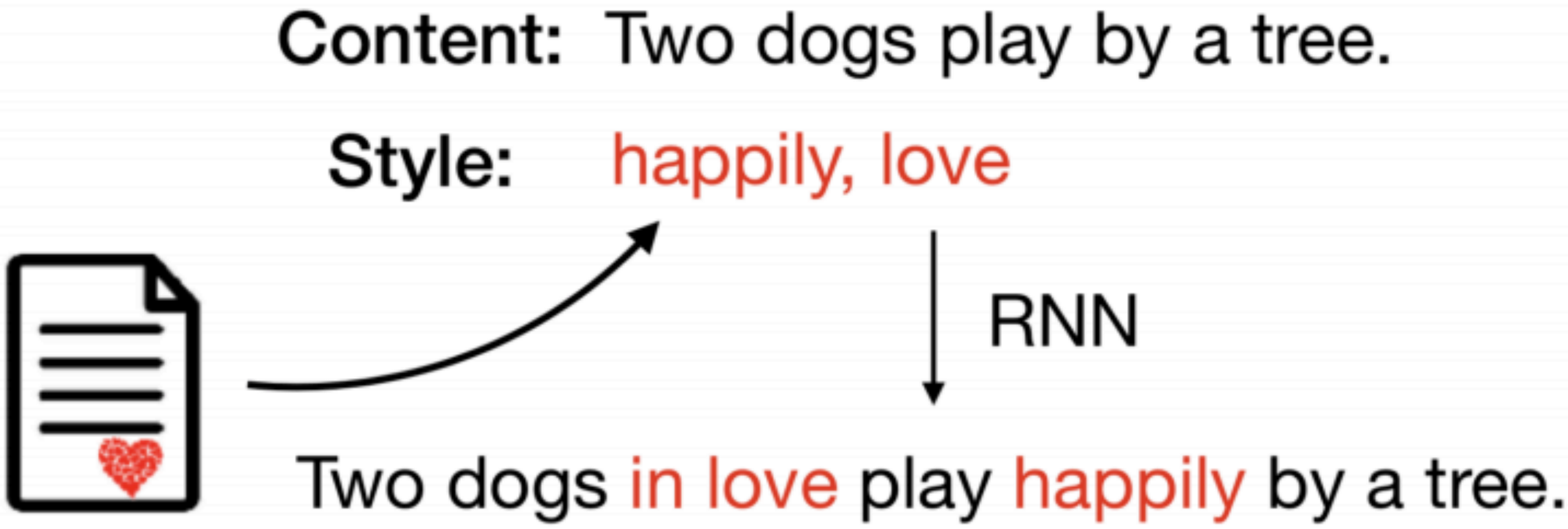
Google Expands Neural Networks for Language Translation

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

By Tom Brant November 15, 2016



Text Synthesis

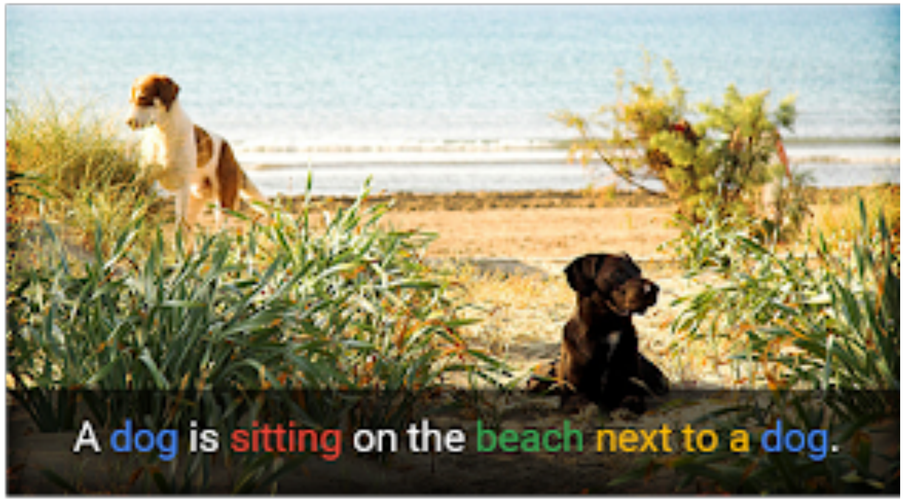


Li et al, NACCL, 2018

Image Captioning

Human captions from the training set

Automatically captioned



https://ai.googleblog.com/2016/09/show-and-tell-image-captioning-open.html

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.

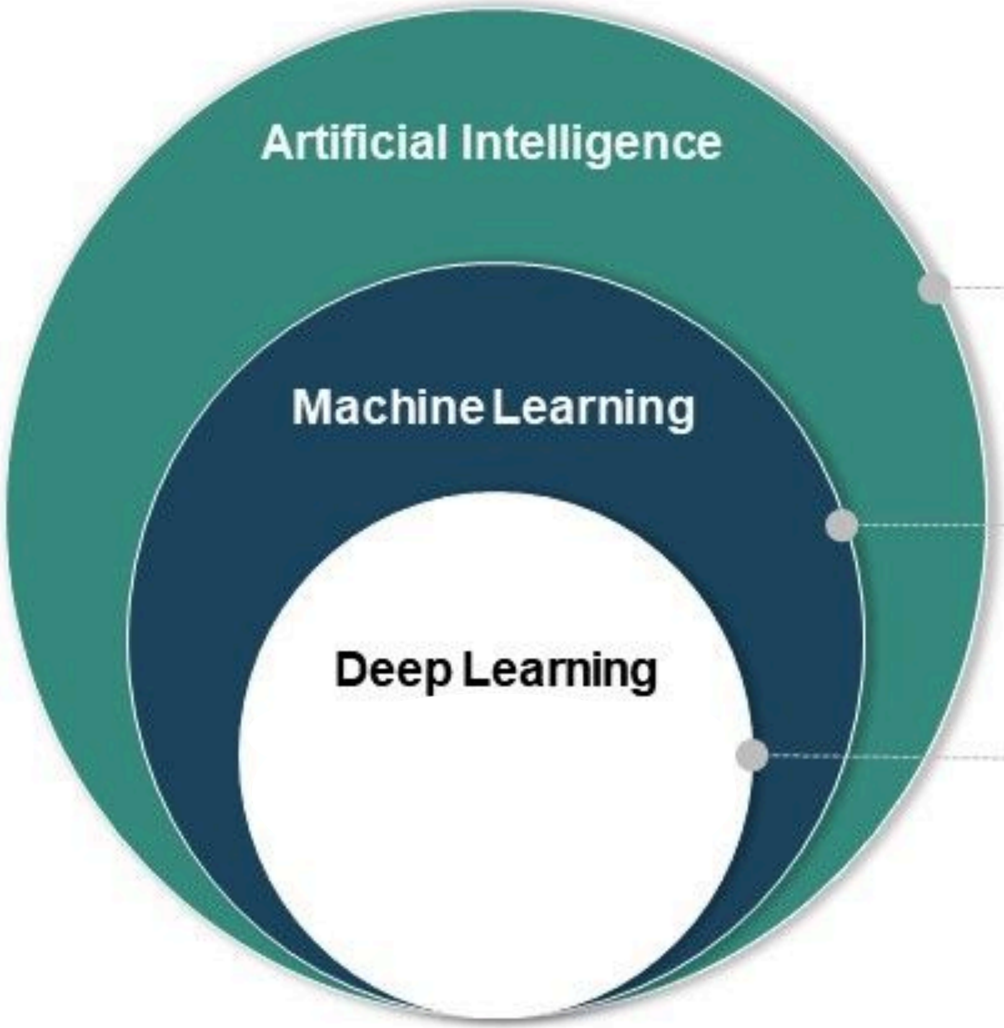
Q: How many eyes does a giraffe have?
A: A giraffe has two eyes.

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.

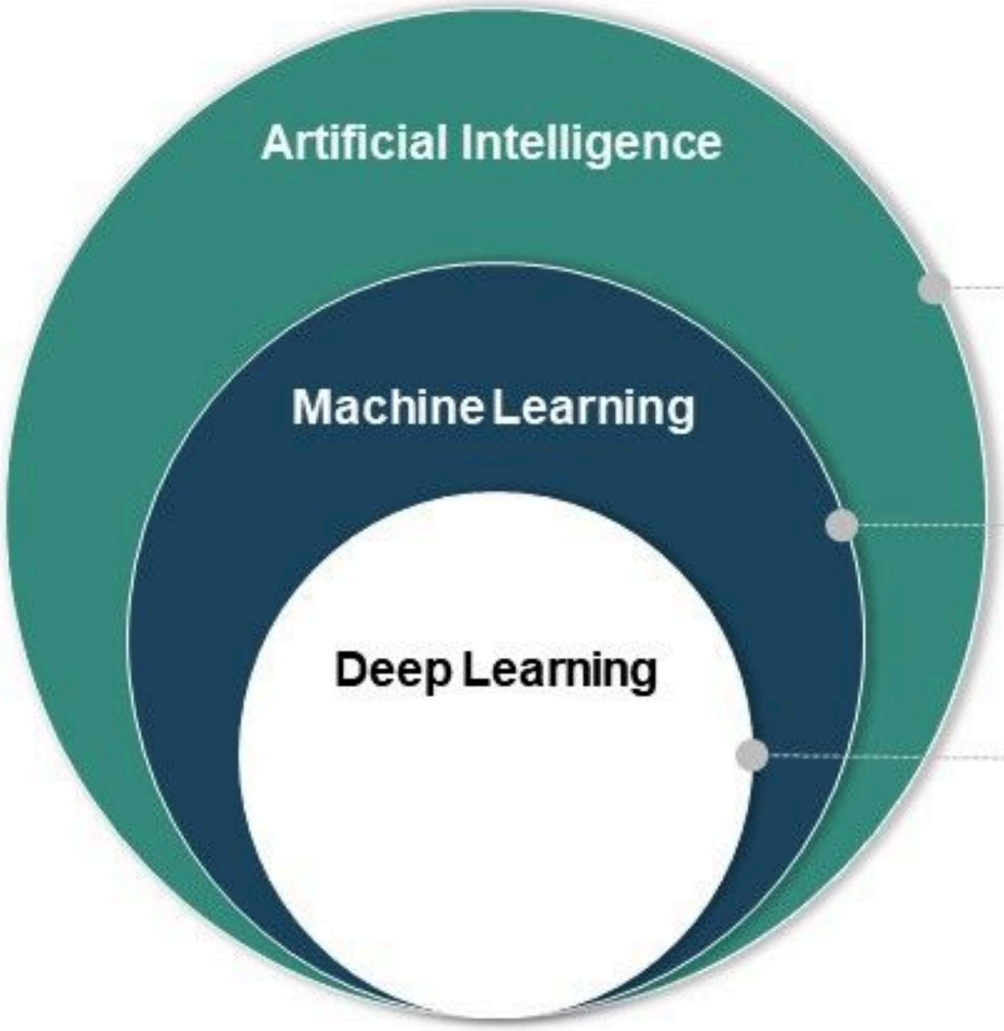
Q: Why don't animals have three legs?
A: Animals don't have three legs because they would fall over.

What is Artificial Intelligence (AI)?



Artificial Intelligence
Any technique which enables computers to mimic behavior.

What is Artificial Intelligence (AI)?



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

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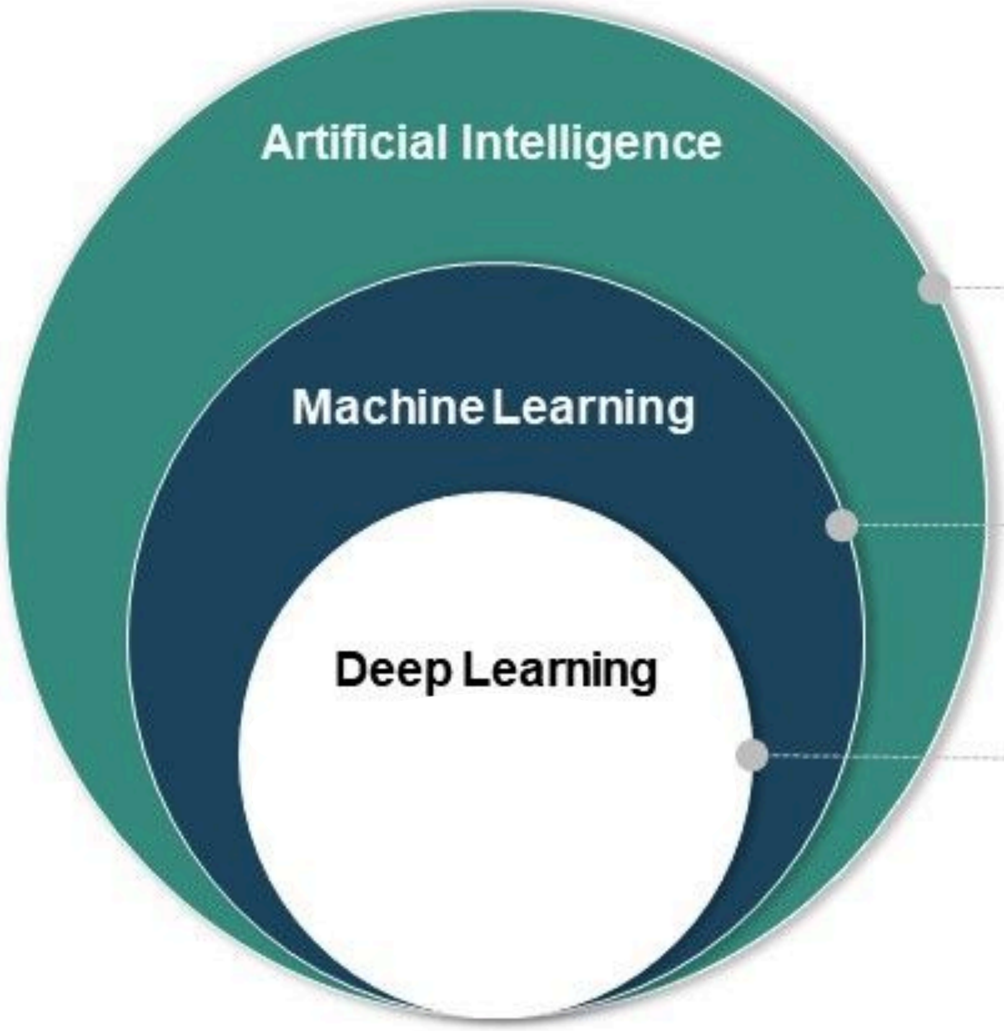

Artificial Intelligence
Any technique which enables computers to mimic behavior.

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.

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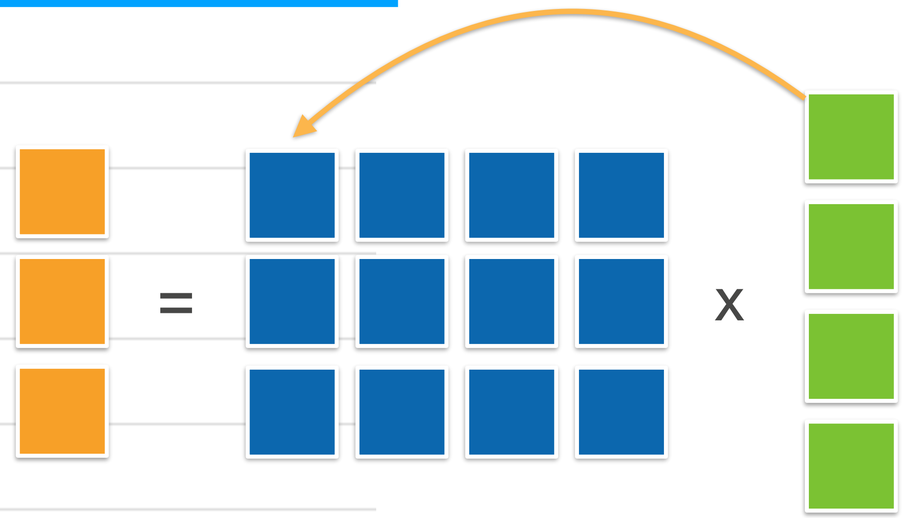
TL;DR **Lots of useful stuff, theory and practice in AI**

What you can learn from CS540?

https://pages.cs.wisc.edu/~sharonli/courses/cs540_spring2022/index.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



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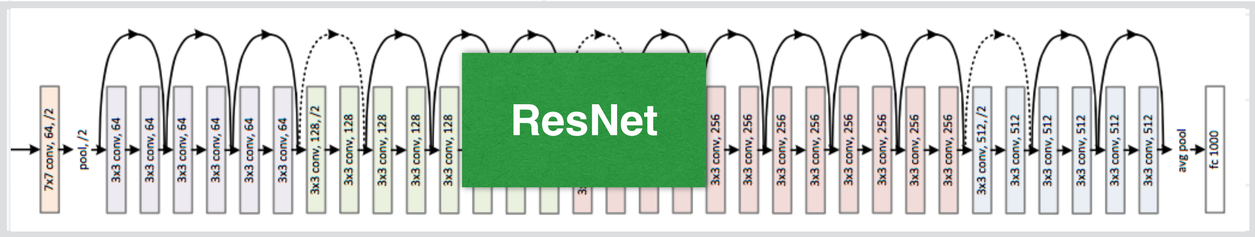
Tuesday, March 9	Machine Learning: Neural Network I

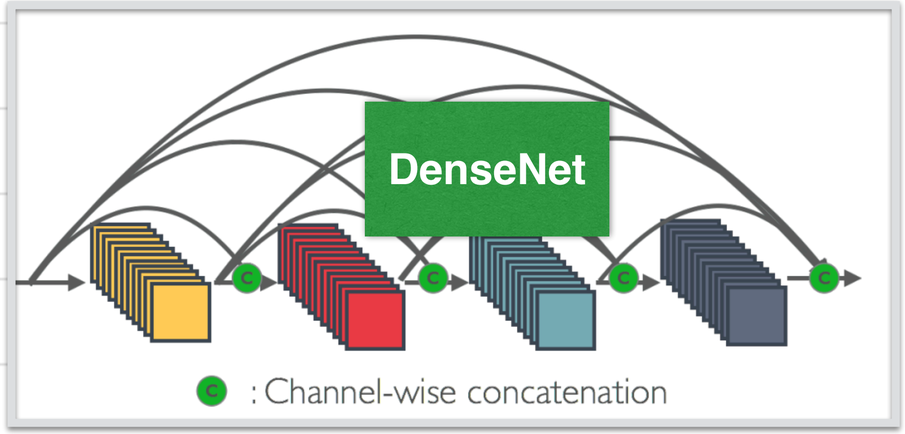
Machine learning

What you can learn from CS540?

Tuesday, March 9	Machine Learning: Neural Network I
	Machine Learning: Neural Network II
	Machine Learning: Neural Network III
	Machine Learning: Deep Learning I
	Machine Learning: Deep Learning II
	Machine Learning: Deep Learning III
	Machine Learning: Deep Learning and Neural Network's Summary
	Game - Part I
	Game - Part II
Tuesday, April 20	Introduction to Reinforcement Learning

Deep Learning





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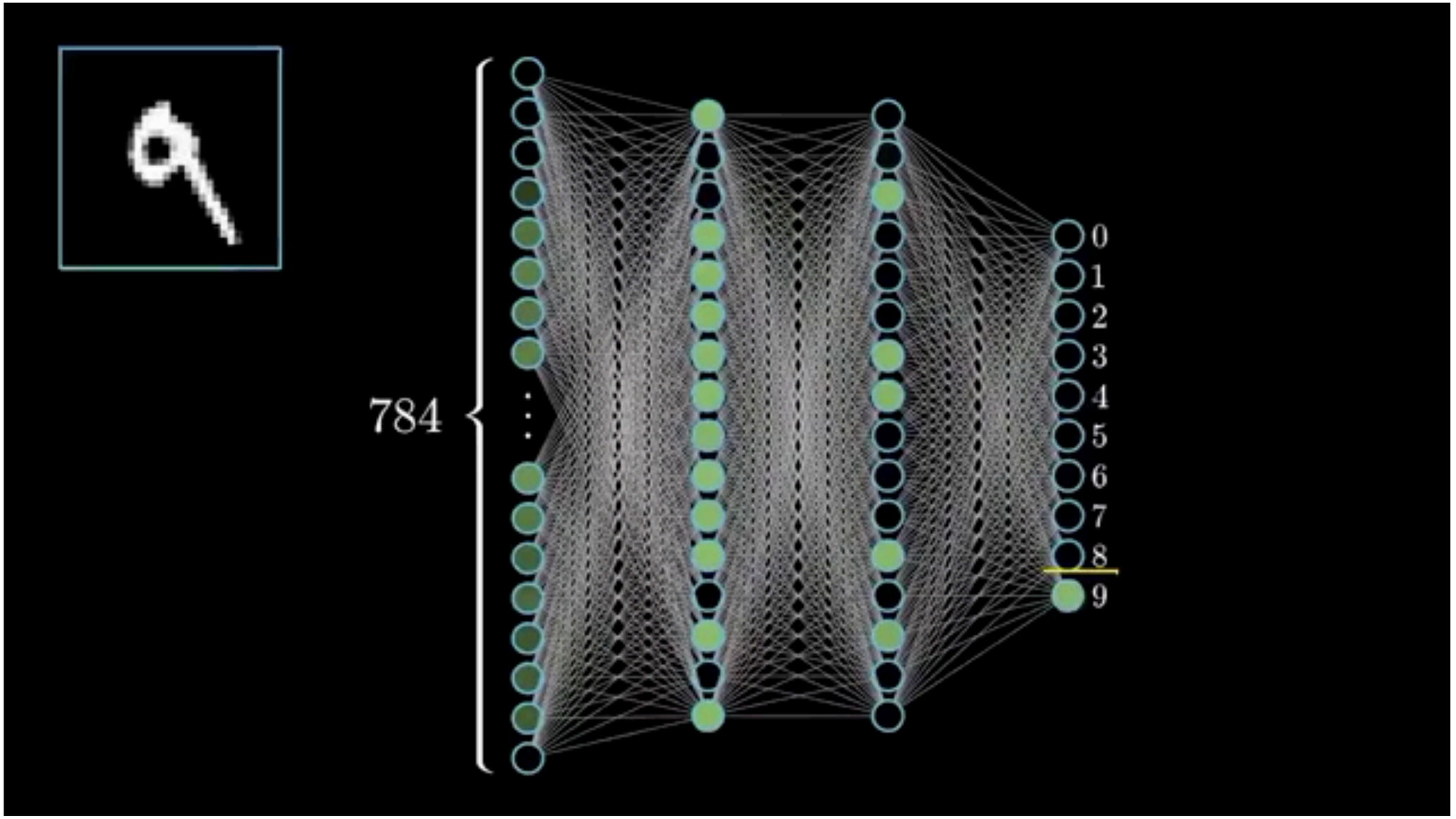
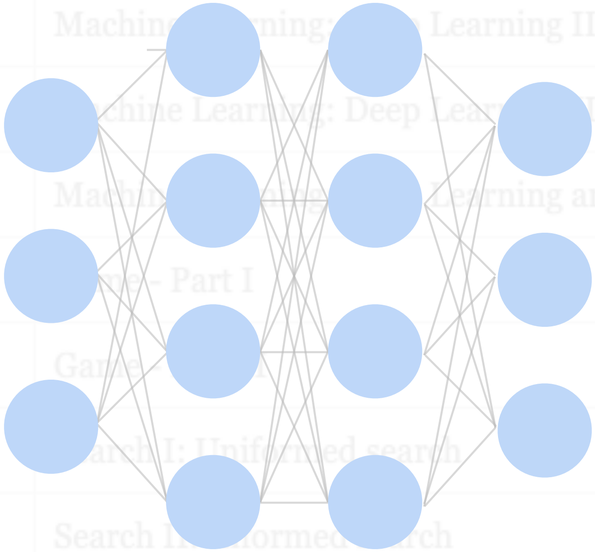


What you can learn from CS540?

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 Reinforcement Learning

What you can learn from CS540?

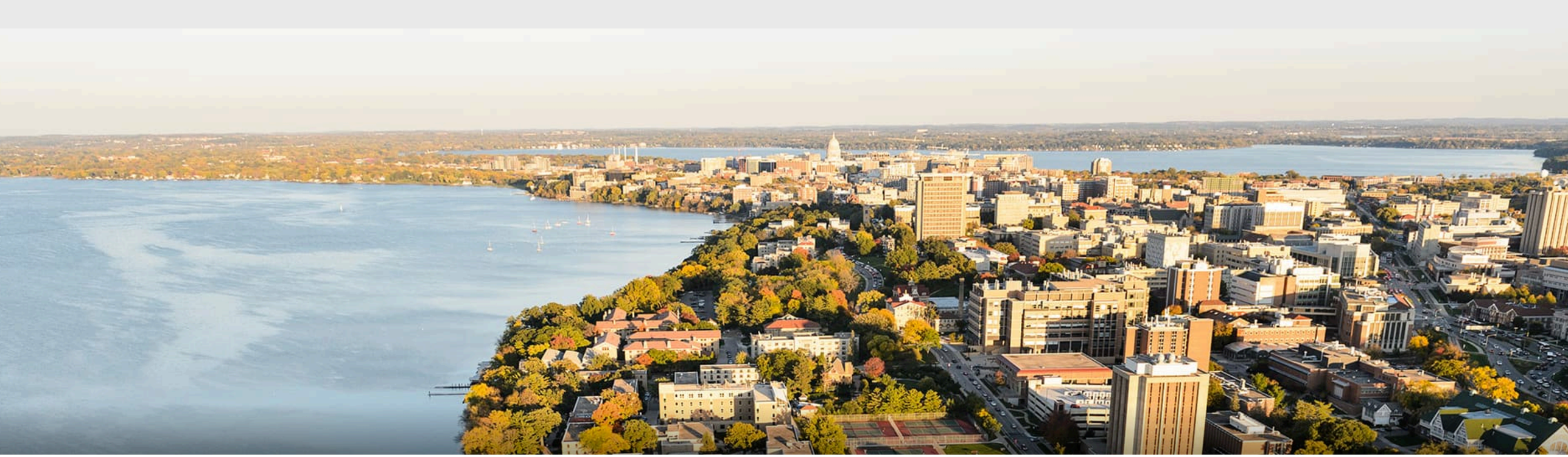


Food Image Classifier

Artificial Intelligence in the Real World

Ethics of Artificial Intelligence

Real-world AI (new!)



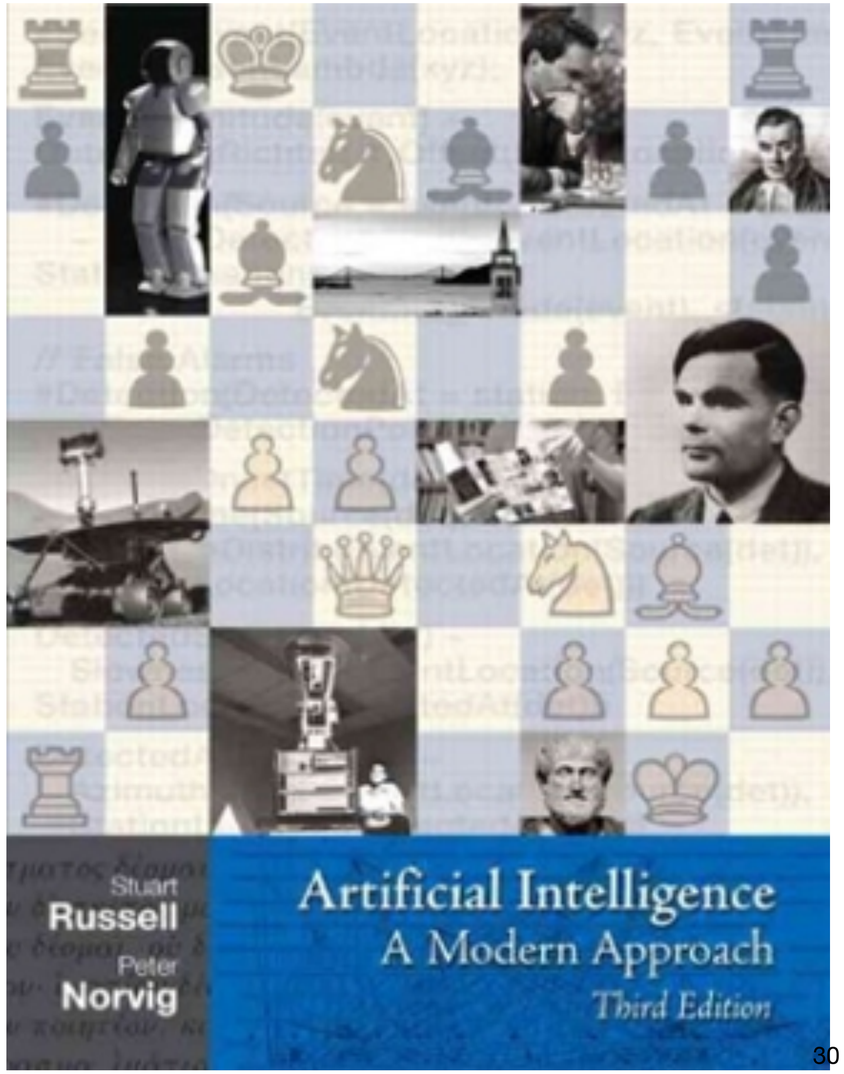
Part II: Course Logistics

Where to find everything?

- **Canvas** - *Pointer to everything*
  - Assignments, submissions, grades (private materials *that should not be shared)*
- **Course website** - public materials
  - https://pages.cs.wisc.edu/~sharonli/courses/cs540_spring2022/index.html
  - Slides, schedule, policies
- **Piazza piazza.com/wisc/spring2022/cs540**
  - Discussion, questions, announcements

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)**



Instruction Team

(See course webpage)

Merged across sections:

- Teaching Assistants (TAs): hold office hours, grade your homework
- Peer Mentors: hold office hours
- Graders: grade your homework

Office Hours

- Available on the course website
- All office hours are **merged** across sections, you can go to anyone
- Use TA and Peer Mentor hours for detailed-level questions (e.g. coding related), and use professor office hours for conceptual level questions

Grading scheme

- **Midterm Exam**: 15% (around March 10, evening)
- **Final Exam**: 15% (TBA)
- **Homework Assignments**: 70% (10 HWs)

  TWO lowest homework scores are dropped from the final homework average calculation. This is for emergency, sickness, etc.

  Homework is always due 9am on the specified date (mostly Tuesday).
  (Late submissions will not be accepted.)

  Homework will be posted and submitted via Canvas.

Regrade Request

Use Google Form (will be announced) for regrade request

Raised with the TAs within 72 hours after homework / exam is returned.

Integrity

Just don’t cheat at all. You’ll be caught. It’s not worth it.

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)

Quiz

1. Where can I find all the 540 stuff, if I didn’t write down the URL?
2. I feel sick, should I still show up to class?
3. I can’t finish my homework because I was traveling, I was sick, my dog ate it, etc. Can I ask for an extension?
4. Can I do homework with a group?

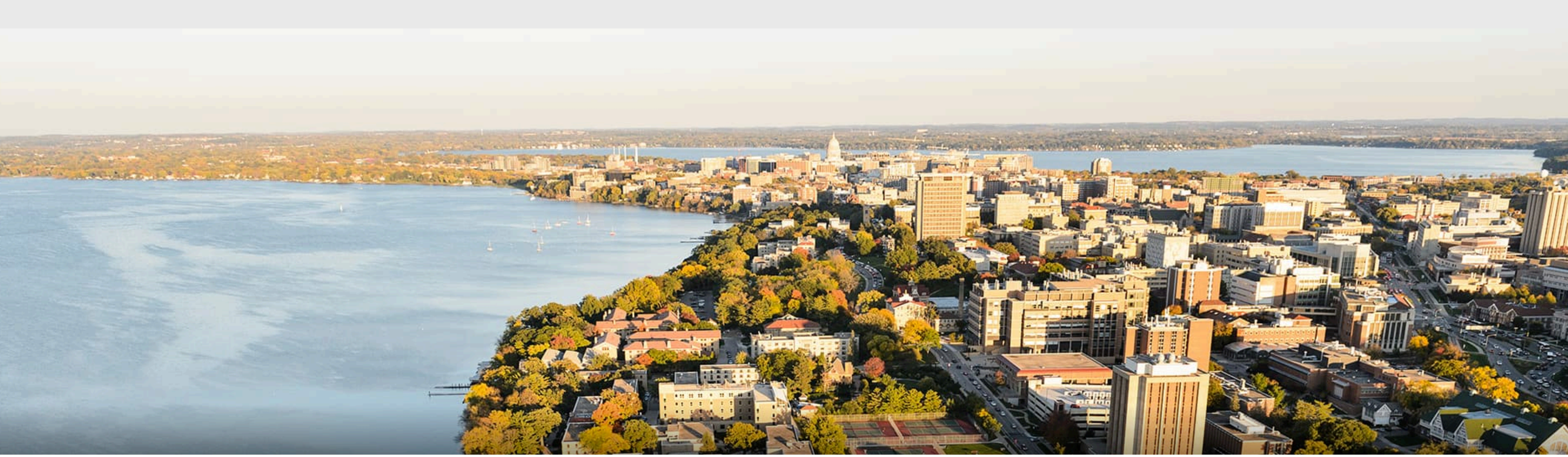
Answers

1. Where can I find all the 540 stuff, if I didn't write down the URL? Your Canvas has the main link.

2. I feel sick, should I still show up to class? NO. Study materials online.

3. I can't finish my homework because I was traveling, I was sick, my dog ate it, etc. Can I ask for an extension? No. But we discard 2 lowest hw scores.

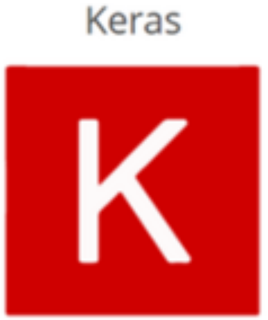
4. Can I do homework with a group? Yes (and encouraged) for high level discussions. No for exact solutions.



Part III: Software

Tools

Keras TensorFlow PyTorch



- **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

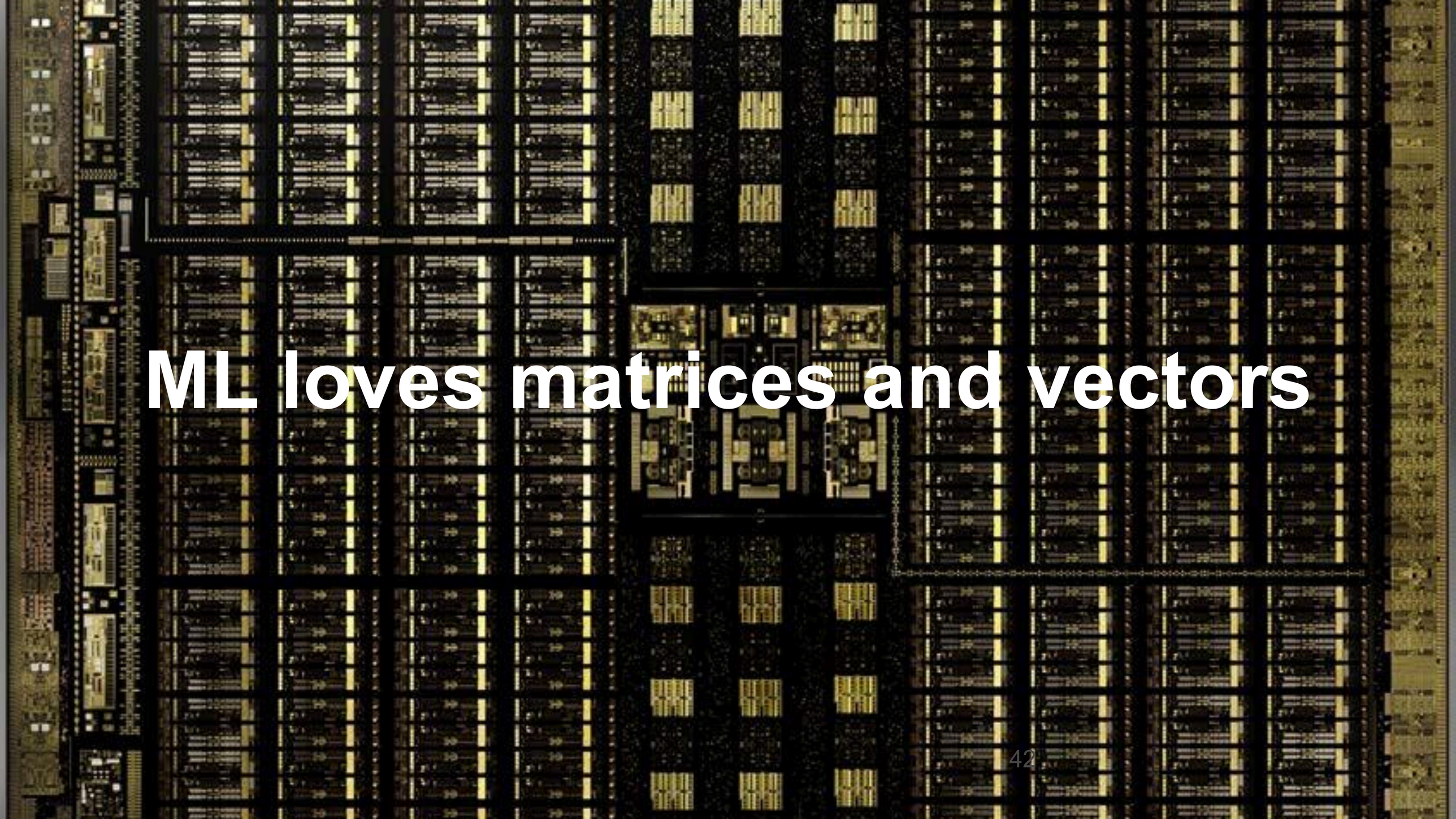
Python for Java Pros (slides available on website)

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

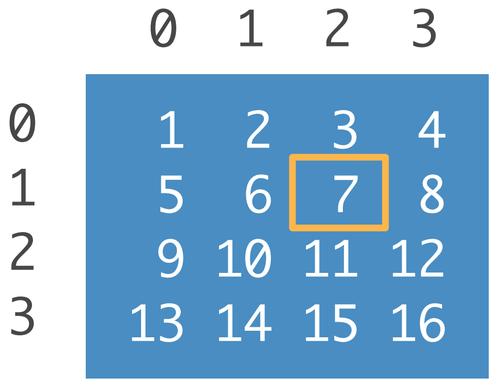
Colab

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

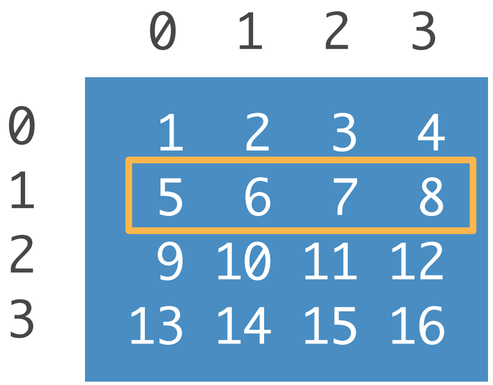

ML loves matrices and vectors

Access Elements

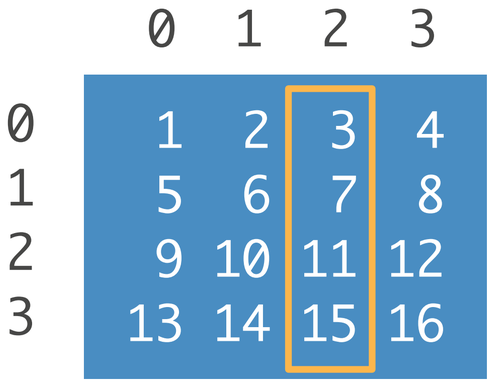
An element: [1, 2]

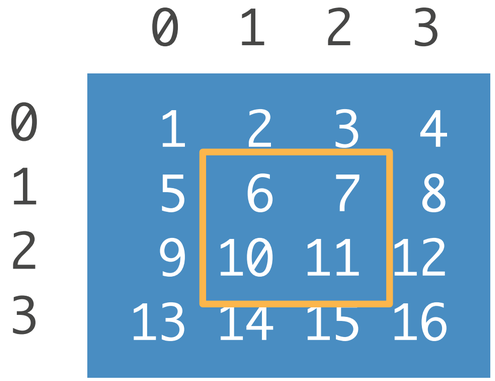


A row: [1, :]



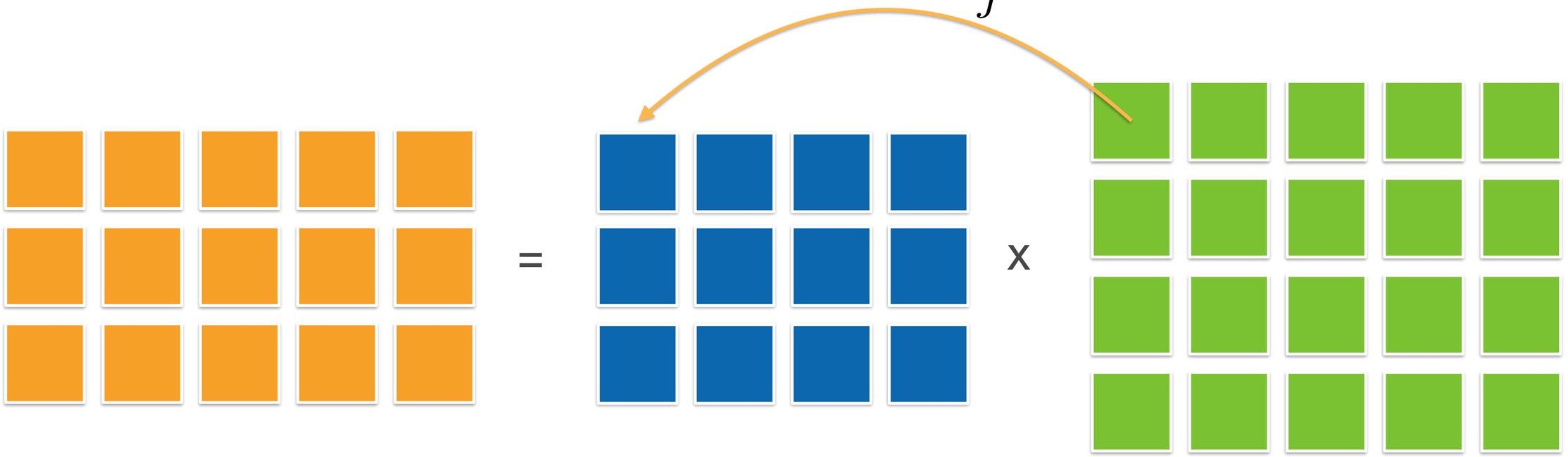
A column: [:, 2]





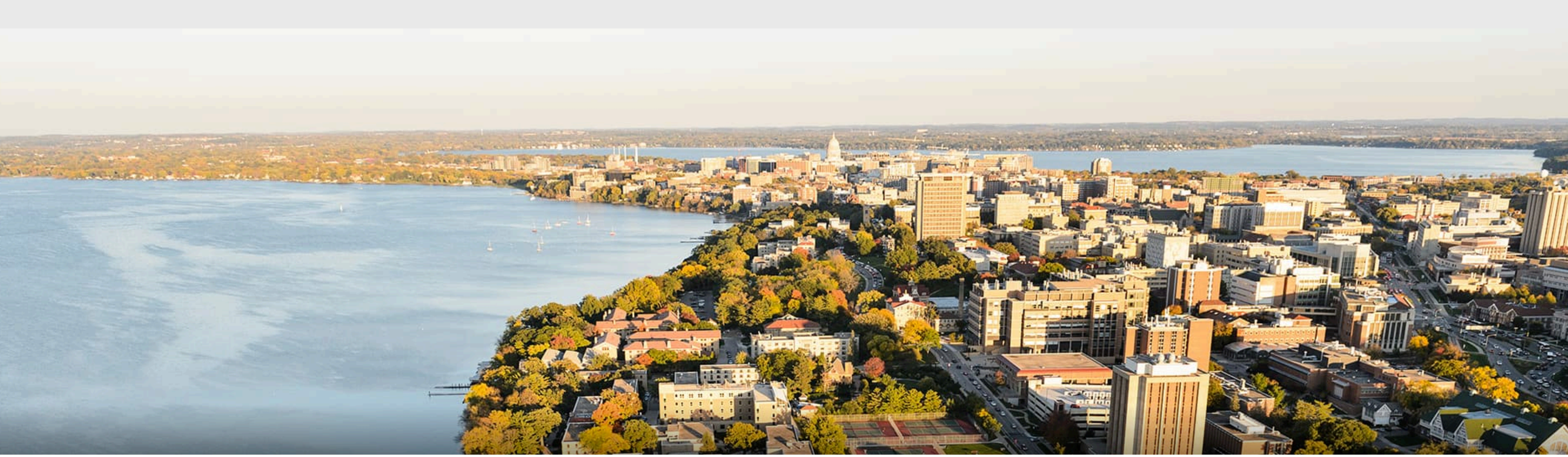
Coming up: Probability and Linear Algebra Review

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



Recap

- What's in CS540
- Course logistics
- Software



Thanks!