Today’s outline

- What’s in CS540
- Course logistics
- Software
Part I: Course overview
Classify Images

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

http://www.whichfaceisreal.com/methods.html
Artificial Image Synthesis

Synthesize the images

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

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

A cute little dog sitting in a heart drawn on a sandy beach.

A dog walking next to a little dog on top of a beach.

A large brown dog next to a small dog looking out a window.

Automatically captioned

A dog is sitting on the beach next to a dog.

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

Machine Learning

Deep Learning

Artificial Intelligence
Any technique which enables computers to mimic behavior.
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**
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.
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TL;DR Lots of useful stuff, theory and practice in AI
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<td>Thursday, Jan 28</td>
<td>Probability</td>
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<td>Linear Algebra and PCA</td>
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- **Deep Learning**
- **ResNet**
- **DenseNet**

*Note: Channel-wise concatenation*
What you can learn from CS540?
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**Food Image Classifier**

**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
  - Slides, schedule, policies

- **Piazza** [piazza.com/wisc/spring2022/cs540](http://piazza.com/wisc/spring2022/cs540)
  - Discussion, questions, announcements
Textbook

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

• 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
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!