Classify Images

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

2014
2015
2016
2017
2018

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

Synthesize the images

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

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.
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.
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.

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• Search and Reinforcement Learning

• Artificial Intelligence and Machine Learning in Real-World settings and the Ethics of Artificial Intelligence.

TL;DR Lots of useful stuff, theory and practice in AI
What you can learn from CS540?

https://pages.cs.wisc.edu/~yliang/cs540_1_fall21/schedule.html

<table>
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<tr>
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<tr>
<td>Thursday, Sept 16</td>
<td>Linear Algebra and PCA</td>
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<tr>
<td>Tuesday, Sept 21</td>
<td>Statistics and Math Review</td>
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<tr>
<td>Thursday, Sept 23</td>
<td>Introduction to Logic</td>
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<td>Tuesday, Sept 28</td>
<td>Natural Language Processing</td>
</tr>
<tr>
<td>Thursday, Sept 30</td>
<td>Machine Learning: Introduction</td>
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<td>Tuesday, Oct 5</td>
<td>Machine Learning: Unsupervised Learning I</td>
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<td>Thursday, Oct 7</td>
<td>Machine Learning: Unsupervised Learning II</td>
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<td>Machine Learning: Linear regression</td>
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<td>Machine Learning: K - Nearest Neighbors &amp; Naive Bayes</td>
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<td>Machine Learning: Neural Network I (Perceptron)</td>
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Foundations
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<td>Machine Learning: Neural Network II</td>
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<tr>
<td>Tuesday, Oct 26</td>
<td>Machine Learning: Neural Network III</td>
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<tr>
<td>Tuesday, Nov 2</td>
<td>Machine Learning: Deep Learning I</td>
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<td>Thursday, Nov 4</td>
<td>Machine Learning: Deep Learning II</td>
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<td>Tuesday, Nov 9</td>
<td>Machine Learning: Deep Learning III</td>
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<tr>
<td>Thursday, Nov 11</td>
<td>Machine Learning: Deep Learning and Neural Network's Summary</td>
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<td>Game - Part I</td>
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Deep Learning

- ResNet
- DenseNet

: Channel-wise concatenation
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<td>Game - Part II</td>
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<td>Tuesday, Nov 23</td>
<td>Search I: Un-Informed search</td>
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<tr>
<td>Thursday, Nov 25</td>
<td>Search II: Informed search</td>
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<td>Advanced Search</td>
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<tr>
<td>Thursday, Dec 2</td>
<td>Introduction to Reinforcement Learning</td>
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<td>Tuesday, Dec 7</td>
<td>Reinforcement Learning and Search Summary</td>
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<td>Ethics and Trust in AI</td>
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Real-world AI

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Where to find content?

• **Piazza**  piazza.com/wisc/fall2021/cs5401/home
  • Discussion, questions
  • Announcements

• **Canvas** - private materials *that should not be shared*
  • Videos
  • Assignments
  • Grades

• **Course website** - public materials
  • Slides  https://pages.cs.wisc.edu/~yliang/cs540_1_fall21/
  • Schedule
  • Policies
Textbook

Grading scheme

• Midterm Exam: 15%
• Final Exam: 15%
• 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.
Office Hours

- Teaching team: 1 instructor, 3 TAs, 1 Grader, 12 Peer Mentors

- Office hours: [http://pages.cs.wisc.edu/~yliang/cs540_1_fall21/office_hours.html](http://pages.cs.wisc.edu/~yliang/cs540_1_fall21/office_hours.html)

- Use Peer Mentor hours for detailed-level questions (e.g. coding related), and use TA office hours for conceptual level questions
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/~yliang/cs540_1_fall21/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)
Software Tools

• Python
  • Everyone is using it in machine learning & data science
  • A Crash course in Python (self-study): Link

• Jupyter
  • So much easier to keep track of your experiments
  • Obviously you should put longer code into modules

• Colab
  • Go to colab.research.google.com
  • Activate the GPU supported runtime
Thanks!