

CS 3244

Machine Learning

Week 1 – Part 1A
Administrivia

Kan Min-Yen

Why should you care about

Machine Learning?

with the leader of Google Brain.

Machine Learning, and

ns that are often used

S.

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Win)

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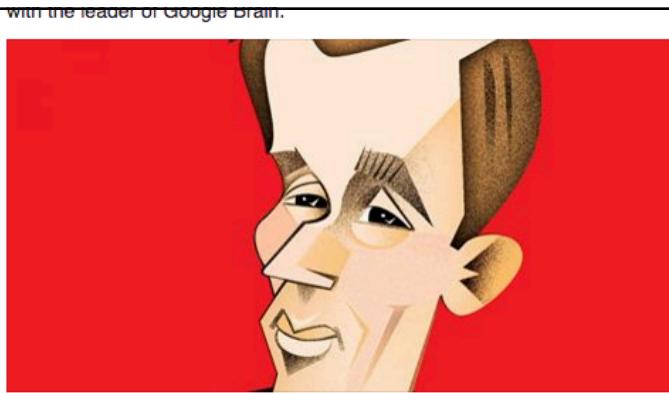
with MATLAB in this video!

The Economist

May 14, 2015 ·

The standard joke about artificial intelligence (AI) is that, like nuclear fusion, it has been the future for more than half a century now. AI is in the news again, for there has been impressive progress in the past few years in a particular subfield of AI called machine learning. But what exactly is that? The Economist explains how machine learning works

<http://econ.st/1IA3T6V>



Machine Learning for Everyone

Recent advances are making machine learning useful outside the tech industry, says the leader of the Google Brain research group.

TECHNOLGYREVIEW.COM

WORLD ECONOMIC FORUM

World Economic Forum June 18 ·

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"You may not know it, but it's all around you."



Why you need to understand machine learning

From picking stocks to finding partners, machine learning plays a part in every stage of our lives - yet most of us know little about these powerful tools.

WEFORUM.ORG

The Economist

May 14, 2015 ·

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The standard joke about artificial intelligence (AI) is that, like nuclear fusion, it has been the future for more than half a century now. AI is in the news again, for there has been impressive progress in the past few years in a particular subfield of AI called machine learning. But what exactly is that? The Economist explains how machine learning works

<http://econ.st/1IA3T6V>

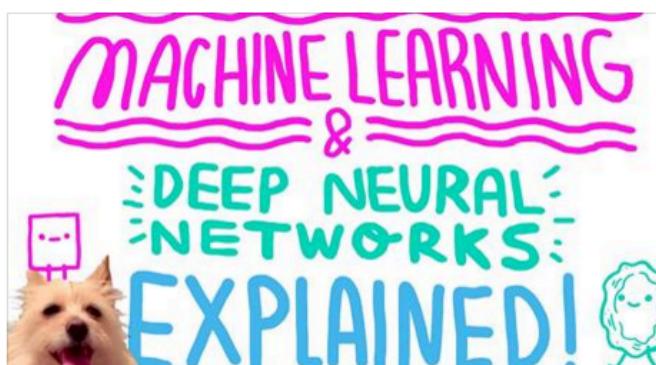


NOW, Everyone needs to understand it.

Discovery News September 28, 2015 ·

[Like Page](#) [Watch Video](#)

WHAT IS MACHINE LEARNING?: Computers are starting to "think" more and more like humans. What does that mean and how scared should we be? Video: <http://dne.ws/1KAduct>



What Is Machine Learning?

Computers are starting to

TESTTUBE.COM

Machine Learning



Futurism

July 20 at 3:30pm ·

Machines can now understand how it works—and



Understanding

FUTURISM.COM | BY

Popular Science July 8 at 3:15am ·

Achieve the impossible by m



Launch Into the Inn

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SHOP.POPSCI.COM

It is far reaching and transformative, disruptive.

F Forbes   October 25, 2015 ·  

Machine learning started as far back as the 1950s, when computer scientists figured out how to teach a computer to play checkers.



5 Ways Machine Learning Is Reshaping Our World
Machine learning is really just the very advanced application of statistics to learning to identify patterns in data and then make predictions from those patterns.
WWW.FORBES.COM | BY BERNARD MARR

 **Singularity Hub**
May 27 · 

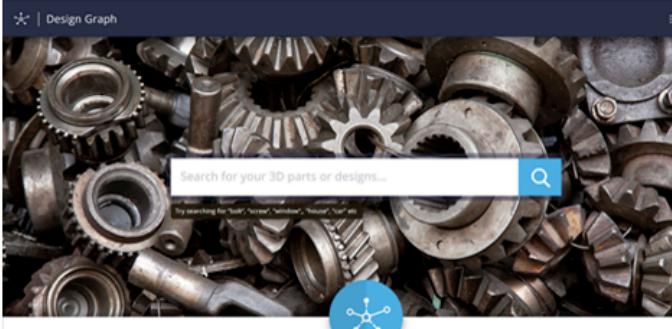
"For overwhelmed researchers navigating the growing literature — the value isn't in having so much new info relevant insights when they need them."



Machine Learning's Next Trick Will Transform Research Is Done
Though research is a slow moving and rigid process, one study of scientific study has exploded in the last 50 years. According to SINGULARITYHUB.COM

 **D3 TECHNOLOGIES**  Yesterday at 9:16am ·  

Design Graph tames data overload with sophisticated machine learning



How machine learning will transform 3D engineering
Imagine having Google search-like functionality for the world of 3D models. Think of the simplicity and the speed at which you could work. This is what we have been working on at Autodesk and it...
IMAGINE. DESIGN. CREATE.

Ad Age   Yesterday at 6:05am · 

Here are five industries where machine learning will shape customer experience and marketing programs. <http://bit.ly/2a7Kosd>



When Machines Get Smarter, So Do CMOs
The proliferation of data and intelligent platforms has become increasingly prevalent and is beginning to shape the way businesses must transform their own organizations, writes Evan Rowe.
ADAGE.COM

 **VentureBeat**  July 20 at 9:15pm · 

How machine learning and A.I. are transforming commerce
Pinterest



Pinterest's commerce head explains how A machine learning will transform shopping
Aunkur Arya, Braintree's mobile general manager, and Michael Pinterest's head of commerce, took the stage at VentureBeat's ONVB.CO

r models and machine learning to cross the city.



I to reduce pollution in

rch group is using AI techniques to predict
er 10 days in advance.

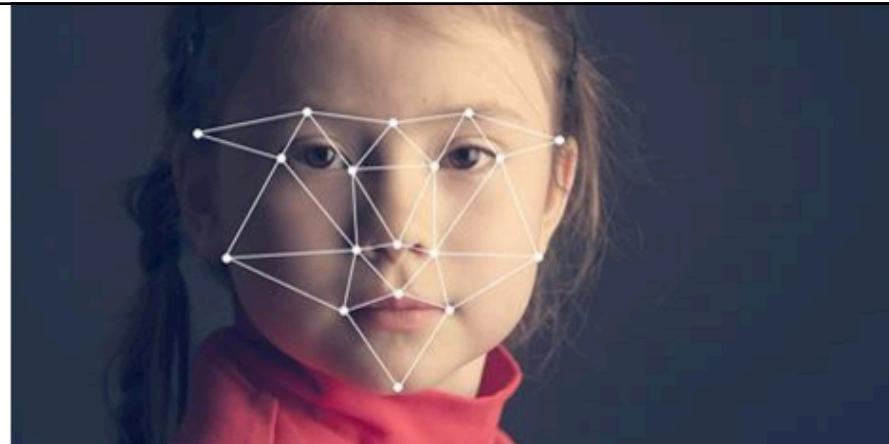
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Using machine learning to
learning to create a "bat map" which may

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ster child for renewable energy, its grids
re of wind and solar power.



How Human-Machine Learning Partnerships Can Reduce Unconscious Bias

ENTREPRENEUR.COM | BY BRIAN UZZI

It can potentially save the world and save us from ourselves



New Scientist

11 hrs ·

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With US policing in the spotlight, the police are turning to AI to predict which officers are at risk of cracking under stress



Machine learning is going to revolutionize the way you use your phone

It'll order you an Uber when you're too drunk, for one.

TECHINSIDER.IO



Futurism

April 5 ·

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As more and more devices vie for precious bandwidth space, DARPA is looking for creative ways to manage the radio spectrum.



Managing Bandwidth Through Machine Learning

FUTURISM.COM



NOVA | PBS

July 23 at 3:51am ·

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The same techniques that inspired AlphaGo could help Google combat climate change.



Corporates are all-in.

Magazine

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uses machine learning to translate 2 billion News Feed



book's Biggest Artificial Intelligence Project

line learning" platform is powering your cat videos and family

er

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in on machine learning and artificial intelligence.



azon Echo is just the 'beginning of a

ezos spoke at a recent tech conference about machine

Kathiravan Srinivasan liked this post

Vinayak Hegde

1 hr ·

<http://www.forbes.com/.../how-microsoft-is-making-big-impac.../>



How Microsoft Is Making Big Impact With Machine Learning

During the last two years, Microsoft has upped the ante on Machine Learning

FORBES.COM | BY JANAKIRAM MSV

WSJ The Wall Street Journal

May 19 ·

Google is betting it can outsmart rivals on new products—from virtual assistants to messaging apps—with advances in artificial intelligence.



Google's New Products Reflect Push Into Machine Learning

Google on Wednesday revealed new products and software that uses machine...



TechCrunch February 20 ·

Salesforce plans to use some of the tech to build out its own machine learning capabilities as part of SalesforceIQ



Salesforce Acquires PredictionIO To Build Up Its Machine Learning Muscle

Salesforce has made another acquisition to build out its technology in machine learning and big data analytics: the company has acquired PredictionIO, a...

TCRN.CH



Business Insider: Tech

July 26 at 5:45am ·

Machine learning is a major priority of tech giants like Google, Facebook and Amazon.



Do not ignore machine learning — Google, Facebook, and Amazon are all betting big on it

This is why we can ignore machine learning. It's not about what it can do, but the effects of its prioritization.

BUSINESSINSIDER.COM

In more ways than one. Series A funding and acquisitions



Greg Brown

June 26 ·

I've written exactly, oh, about five machine learning scripts. Anyone want to create a Machine Learning startup in our virtual garage? I'm kidding, almost, but not 100%. The ML world is starting to feel like a mini dot-com 1990's bubble. It's not as easy as putting ".com" on the end of a domain name and writing an ambiguous business plan, not at all, but it has the faint smell of the dot-com bubble.



Artificial Intelligence Exploses: New Deal Activity Record For AI Startups

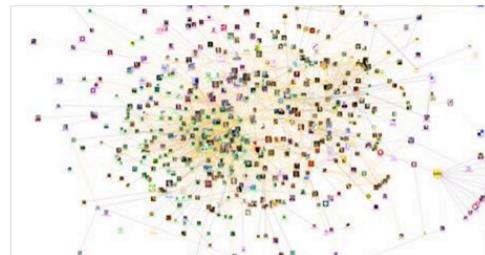
In Q1'16, there were over 140 deals to startups focused on AI. Khosla Ventures emerges as most active VC investor in AI.

CRINSIGHTS.COM

NEA - New Enterprise Associates

January 9, 2015 ·

GraphLab is now Dato!
Oh, and they've raised \$18.5M.
Congratulations!



Machine Learning Startup GraphLab Gets A New Name And An \$18.5M Check

Looking to bring machine learning to the masses -- or at least the masses of businesses that could benefit from embedding artificial intelligence in their.

TECHCRUNCH.COM

VB VentureBeat

July 6 at 6:49pm ·

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Machine vision is advancing, but still early stages.



Google buys machine learning startup Moodstock to help your phone's camera identify objects

Google announced today that it has acquired Paris-based Moodstocks, a startup that has developed machine learning technology to bolster the image recognition...

ONVB.CO

TechCrunch

July 6 at 11:53pm ·

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Google is next to acquire a machine learning startup



Google buys France-based Moodstocks, which makes



National University
of Singapore

Damian Eads

March 18, 2014 ·

Two years ago today, I wrote the first lines of code at Starbucks while unemployed and waiting for my UK visa. Happy St Patrick's Day! ☺

WSJ

Inspired by Astrophysics, Machine Learning Startup Wise.io Raises \$2.5M - Venture Capital...

The startup's technology analyzes interactions among businesses and their customers.

BLOGS.WSJ.COM | BY DEBORAH GAGE

VB VentureBeat

July 13 at 3:45pm ·

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Self-driving cars may not need pre-loaded detailed 3D maps of the world's roads. This startup promises to map the world in real time as it goes along.



U.K. machine-learning startup FiveAI raises \$2.7 million to create the smart autonomous cars of tomo

FiveAI, a U.K. startup leveraging artificial intelligence (A.I.) to build the brains for the autonomous cars of the future, has announced a \$2.7 million funding round...

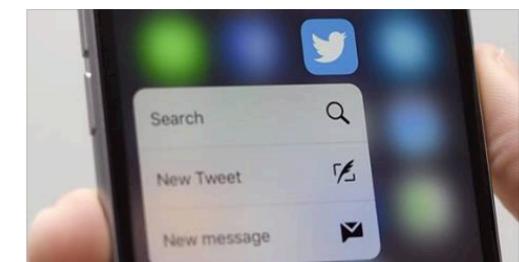
ONVB.CO

WSJ The Wall Street Journal

June 21 ·

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Magic Pony's technology allows for better-quality video compression, essentially allowing for better-looking videos that use less data and are less choppy.



You might be able to use it today...



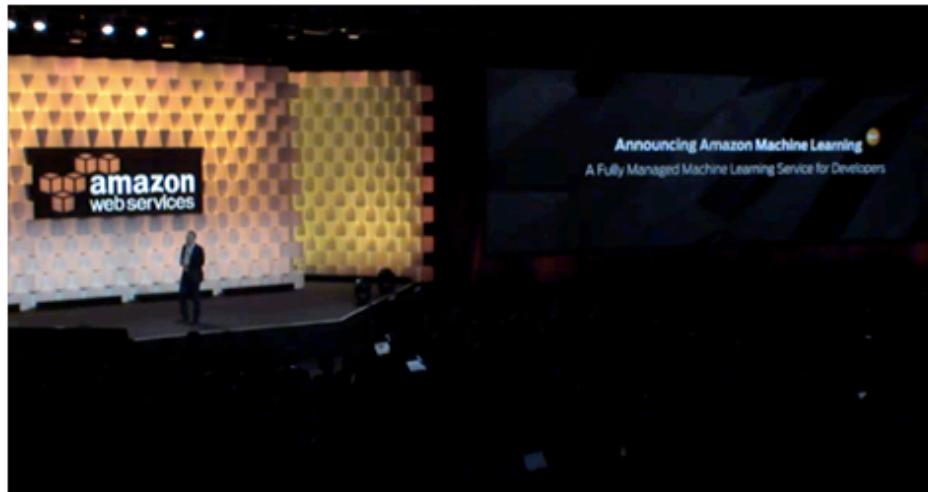
TechCrunch

April 10, 2015

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AWS announced a new Machine Learning platform today that it says puts machine learning into the hands of ordinary developers.



AWS Wants To Put Machine Learning In Reach Of Any Developer

Andy Jassy, senior vice president at Amazon Web Services, announced a new machine learning platform today at the AWS Summit in San Francisco. The...

TCRN.CH



The Verge

April 14

Like Page

Watch Video

Google's TensorFlow is the most popular machine learning framework on code repository GitHub.



TensorFlow

Google has given its open-source machine learning software a big upgrade

Last November, Google opened up its in-house machine learning software TensorFlow, making the program that powers its translation services and photo...

THEVERGE.COM | BY JAMES VINCENT

ongoing big-data revolution is inadequate, at best.

WIRED.COM | BY INGRID DAUBECHIES



Eric Ries

July 26 at 1:32am

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"Machine learning will likely advance in a punctuated equilibrium fashion: in a few, hard-won, big leaps. The reason for this is deep learning software is nearly impossible to debug because we don't fully understand how it works."



Slate.com

September 28, 2015

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"Machine learning" is starting to reshape how we live. It's time we understood it.



NUS

... but perhaps only a few understand it.



Eric Ries

July 26 at 1:32am ·

Like Page

"Machine learning will likely advance in a punctuated equilibrium fashion: in a few, hard-won, big leaps. The reason for this is deep learning software is nearly impossible to debug because we don't fully understand how it works."



The Business Implications of Machine Learning

It's not about what it can do, but the effects of its prioritization

MEDIUM.COM I BY DREW BREUNIG



WIRED

December 13, 2015 ·

Learn More

It is the guiding principle of many applied mathematicians that if something mathematical works really well, there must be a good underlying mathematical reason for it, and we ought to be able to understand it.



Machine Learning Works Great—Mathematicians Just Don't Know Why

Our current mathematical understanding of many techniques that are central to the ongoing big-data revolution is inadequate, at best.

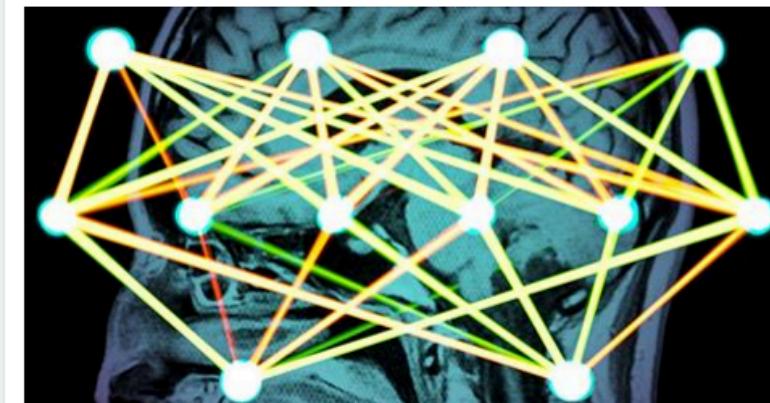
WIRED.COM I BY INGRID DAUBECHIES

Slate

Slate.com

September 28, 2015 ·

"Machine learning" is starting to reshape how we live. It's time we understood it.



This Big New Trend in Programming Could Change Everything—but Almost No One Understands It

Computers and the algorithms they run are precise, perfect, meticulously programmed, and austere. That's the idea, anyway. But there's a burgeoning,...



What about you?

Machine Learning



what society thinks I
do



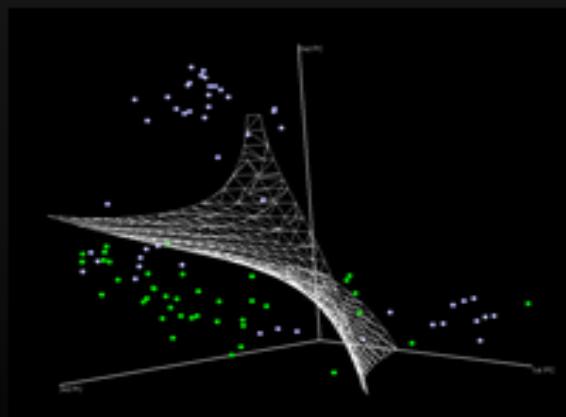
what my friends think
I do



what my parents think
I do

$$L_p = \frac{1}{2} \|\mathbf{w}\|^2 - \sum_{i=1}^l \alpha_i y_i (\mathbf{x}_i \cdot \mathbf{w} + b) + \sum_{i=1}^l \alpha_i$$
$$\alpha_i \geq 0, \forall i$$
$$\mathbf{w} = \sum_{i=1}^l \alpha_i y_i \mathbf{x}_i, \sum_{i=1}^l \alpha_i y_i = 0$$
$$\nabla \hat{g}(\theta_t) = \frac{1}{n} \sum_{i=1}^n \nabla \ell(x_i, y_i; \theta_t) + \nabla r(\theta_t).$$
$$\theta_{t+1} = \theta_t - \eta_t \nabla \ell(x_{i(t)}, y_{i(t)}; \theta_t) - \eta_t \cdot \nabla r(\theta_t)$$
$$\mathbb{E}_{i(t)} [\ell(x_{i(t)}, y_{i(t)}; \theta_t)] = \frac{1}{n} \sum_i \ell(x_i, y_i; \theta_t).$$

what other programmers
think I do



what I think I do

```
>>> from sklearn import svm
```

what I really do

Barriers to success in this course



- **Serious Math (at least to SoC folk)**

- Calculus
- Linear Algebra
- Matrix Operations

(You have been warned)

- Your instructor.
- Programming competence.
- Partially flipped course implementation.



Will need your support and understanding as we revamp the course this semester.



And now a word from our sponsors

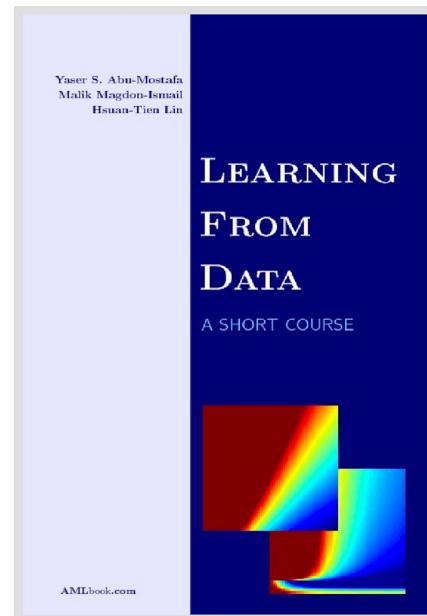
Course Organization

From the introduction of our primary text *LFD*:

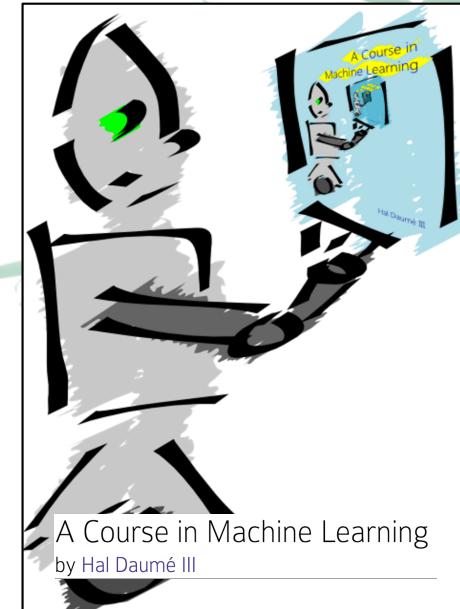
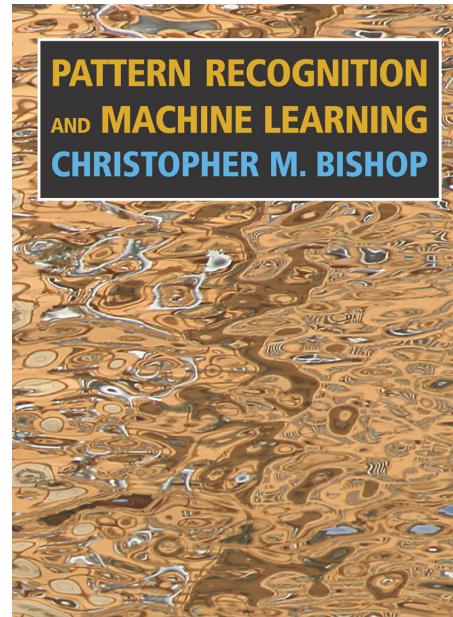
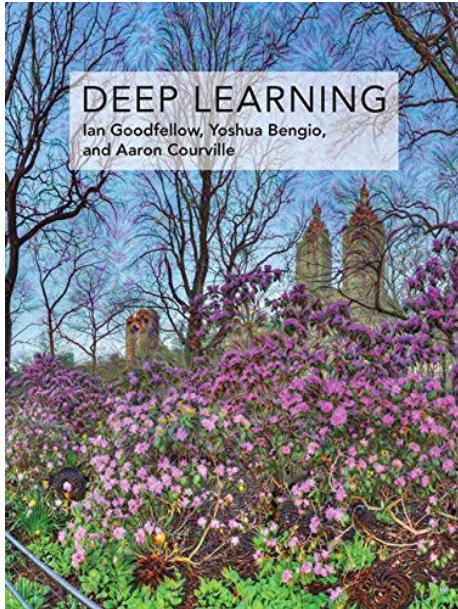
“ Learning from data has distinct theoretical and practical tracks. If you read two books that focus on one track or the other, you may feel that you are reading about two different subjects altogether. ”

We'll be using the most of the textbook and augmenting the lectures with other material as warranted.

Stuck? Watch Prof. Abu-Mostafa's Caltech lectures on YouTube.



Supplemental Texts



Free online textbook at deeplearningbook.org. We'll refer to it later in the second half of the semester. It has good prefatory material for the background lectures.

Good for a more thorough treatment of Bayesian styled learning, not the central focus of our course.

Free textbook, modern and current. Written by a noted ML / NLP scholar.
<http://ciml.info>

Lecturer

Min-Yen KAN (as in $\min(x)$)

kanmy@comp.nus.edu.sg

<http://www.comp.nus.edu.sg/~kanmy>

Office: AS6 05-12 / COM1 02-19F

6516-1885

Hours: 13:00-14:00 Fri,
or by appointment

Hobbies:

Taking care of two little ones

Sleeping (-:



Teaching Assistants



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Course web sites



<http://www.comp.nus.edu.sg/~cs3244>

- Homework
- Other supplementary content

When using a search engine to find our course materials, make sure you find our site for 2017/18 Sem I.

The background this year is
BLUE.

<http://ivle.nus.edu.sg/>

- Lecture notes (via workbin)
- Discussion forum (participation counts!)
 - Any questions related to the course should be raised on this forum
 - Emails to me are considered public unless otherwise specified
- Announcements
- Homework submissions (via workbin)

<http://archipelago.comp.nus.edu.sg/>

- In class participation



Deep Learning for Vision

NUS SoC, 2017/2018, Semester I

CS 6101 - Exploration of Computer Science Research

Last updated: July 5, 2017 - Initial port of last year's home page.

This is a section of the CS 6101 Exploration of Computer Science Research at NUS. CS 6101 is a 4 modular credit pass/fail module for new incoming graduate programme students to obtain background in an area with an instructor's support. It is designed as a "lab rotation" to familiarize students with the methods and ways of research in a particular research area.

Our section will be conducted as a group seminar, with class participants nominating themselves and presenting the materials and leading the discussion. It is not a lecture-oriented course and not as in-depth as [Fei-Fei Li et al.](#)'s original course at Stanford, and hence is not a replacement, but rather a class to spur local interest in Deep Learning for Vision. Unlike the original course, we do not require you to do projects, assignments or homework, although those that attempt this will be encouraged to present in the project showcase at the end of the course to the general public.

This "course" is offered twice, for Session I (Weeks 3-7) and Session II (Weeks 8-13), although it is clear that the course is logically a single course that builds on the first half. Nevertheless, the material should be introductory and should be understandable given some prior study.

A discussion group will be on [Slack](#). Students and guests, please login when you are free. If you have a [@comp.nus.edu.sg](#), [@u.nus.edu](#), [@nus.edu.sg](#), [@a-star.edu.sg](#) or [@i2r.a-star.edu.sg](#) email address you can create your Slack account for the group discussion without needing an invite.

Meeting Venue and Time

For directions to NUS School of Computing (SoC) and COM1: please read the directions [here](#), to park in CP13 or take the shuttle bus to SoC.

Please eat before the course or during (we don't mind -- like a brown-bag seminar series), and if you're parked, you will be able to leave after 7:30pm without paying carpark charges.

People

ARCHIPELAGO

LEARNING FOR STUDENTS ...
... LEARNING FOR TEACHERS

GET STARTED

LOGIN

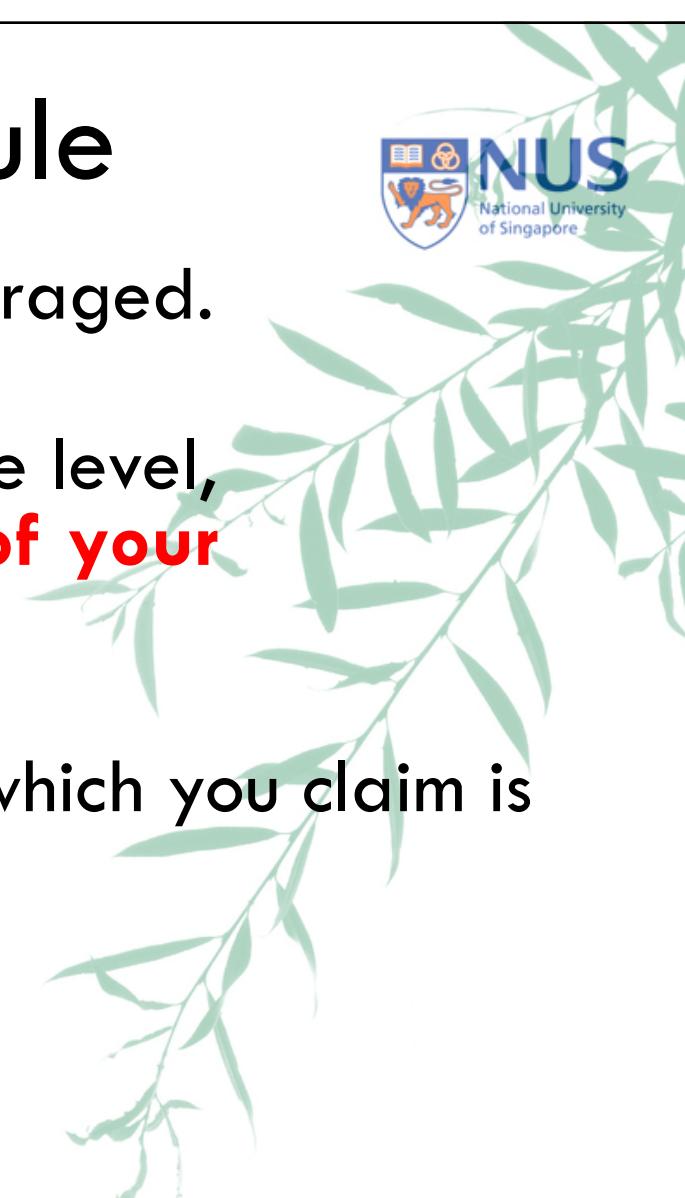
REGISTER



Freedom of information rule



- Collaboration is acceptable and encouraged.
- To assure that all collaboration is on the level,
**you must always fill in the name(s) of your
collaborators on your assignment.**
- You will be assessed for the parts for which you claim is
your own contribution.



Facebook rule



- You are free to meet with fellow students(s) and discuss assignments with them.
- Writing on a board or shared piece of paper is acceptable during the meeting; however, you **may not take any written (electronic or otherwise) record away from the meeting.**
- After the meeting, do something else for at least a half-hour (Facebook, or doing an assignment for a different class), before working on the assignment.
 - This will assure that you are able to reconstruct what you learned from the meeting, **by yourself, using your own brain.**
 - You will be asked to certify that you meet this requirement per assignment.

Python and Jupyter



- We'll be using the Python programming language for our entire class homework assignments, in particular the **3.5.x version**.
- You are expected to learn Python and use it for the assignments.
- We'll also be using Jupyter / iPython Notebooks to show and simulate experiments (hopefully).
- Python is an easy language to transition to for most programmers and it has numerous libraries that work well with machine learning as well as data analysis.

