W4995 Applied Machine Learning

Introduction

01/23/19

Andreas C. Müller

Logistics

Email

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CAs: Pranjal Bajaj, Ujjwal Peshin, Liyan Nie, Yao Fu, Luv Aggarwal, Sukriti Tiwari

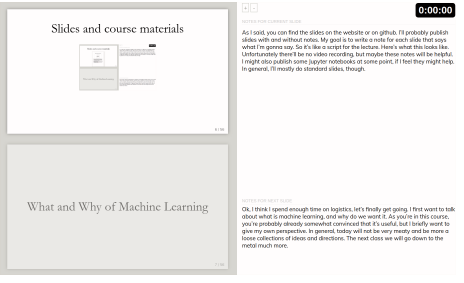
Office Hours

- Andreas Müller Wednesdays 10am-11am, Interchurch 320 K
- CA office hours: TBA

Logistics

- Course website http://www.cs.columbia.edu/~amueller/comsw4995s19/
- Six programming assignments
- Grade: 60% homeworks, 20% first exam, 20% second exam

Slides and course materials



Using markdown with remark. Press "p" for notes.

Lecture Recordings

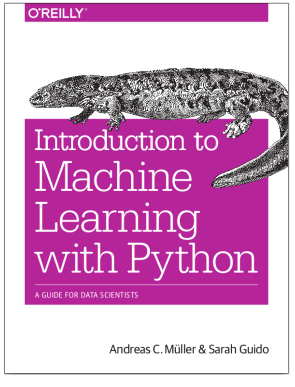
Plagiarism and Code copying

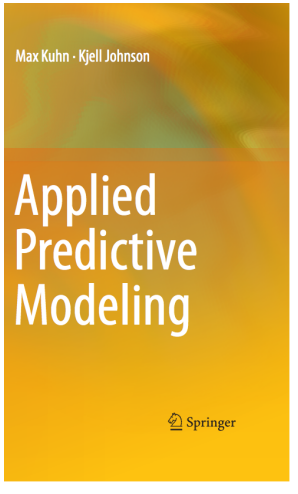
- Homeworks are checked for plagiarism
- Copied code will result in 0 points for all involved
- Copying from my slides or online sources (Stack overflow, tutorials, etc.) is fine.

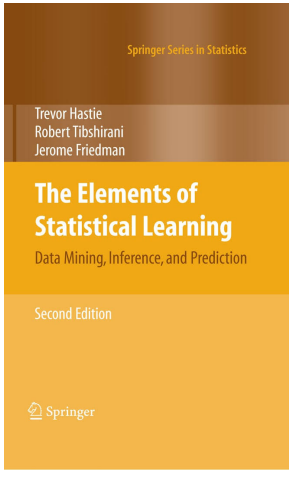
Scikit-learn Development

http://scikit-learn.org/dev/developers/contributing.html

Books



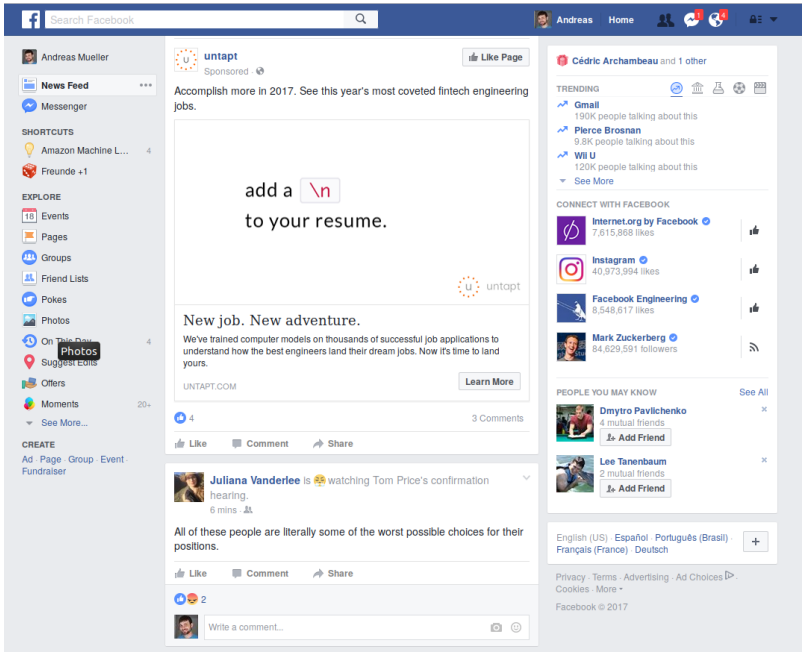




http://ciml.info/

What and Why of Machine Learning

What is machine learning?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6 mins
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2
Write a comment...
Cédric Archambeau and 1 other
TRENDING
Gmail
190K people talking about this
Pierce Brosnan
9.8K people talking about this
Wii U
120K people talking about this
See More
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Instagram
40,973,994 likes
Facebook Engineering
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84,629,591 followers
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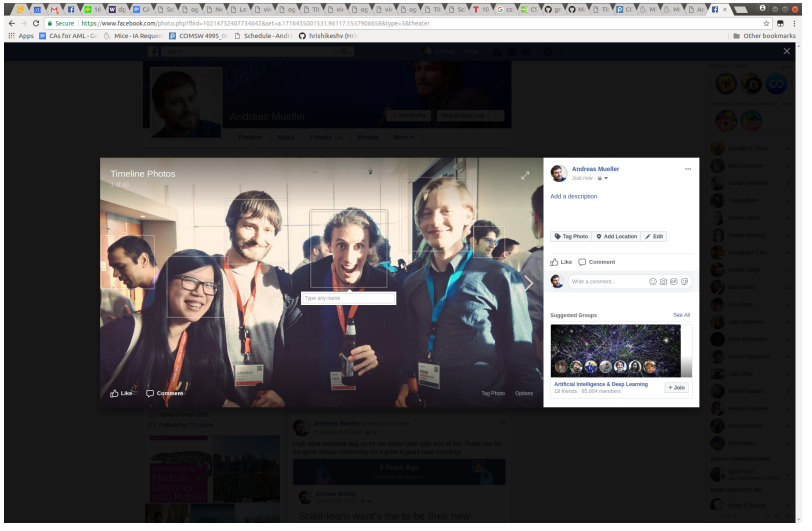
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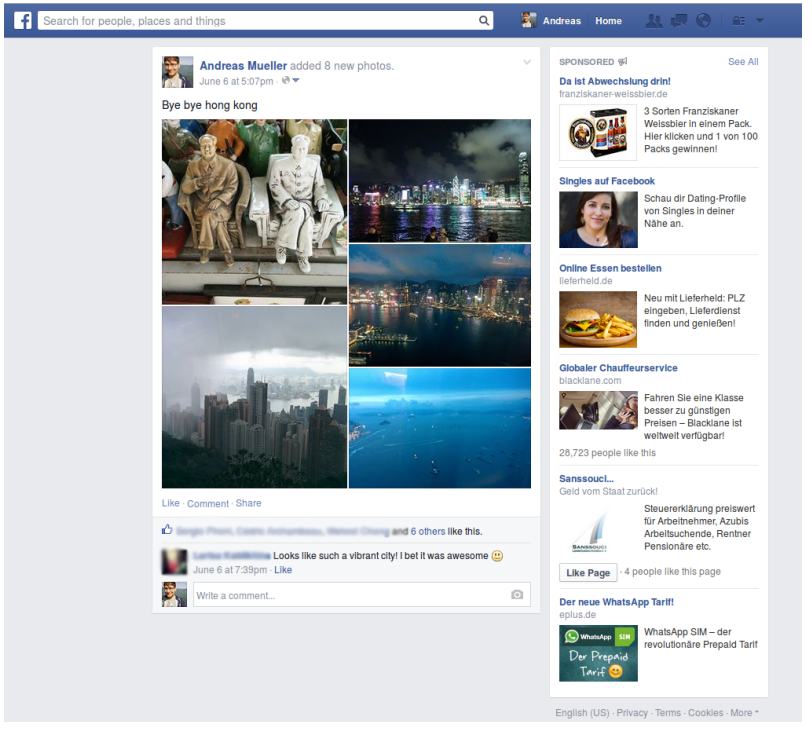
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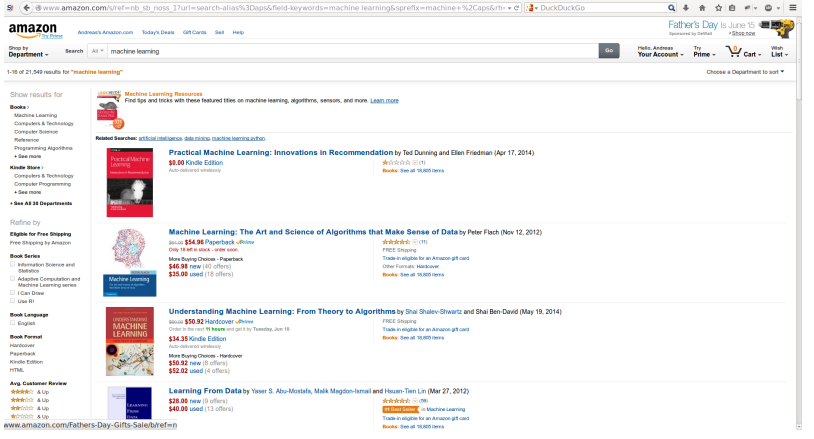
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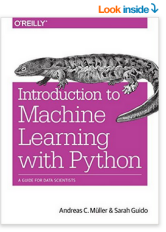
Introduction to Machine Learning with Python: A Guide for Data Scientists 1st Edition

by Andreas C. Müller (Author), Sarah Guido (Author)

9 customer reviews



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Machine learning has become an integral part of many commercial applications and research projects, but this field is not exclusive to large companies with extensive research teams. If you use Python, even as a beginner, this book will teach you practical ways to build your own machine learning solutions. With all the data available today, machine learning applications are limited only by your imagination.

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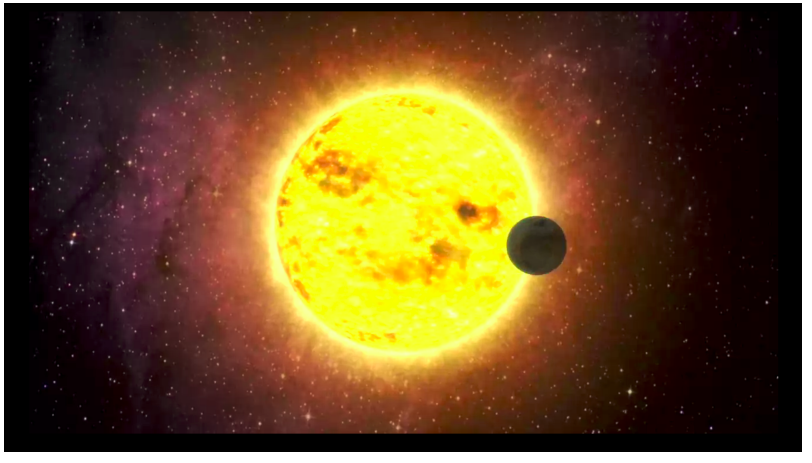
Science!



Types of Machine Learning

Types of Machine Learning

- Supervised
- Unsupervised
- Reinforcement

Supervised Learning

$$(x_i, y_i) \propto p(x, y) \text{ i.i.d.}$$

$$x_i \in \mathbb{R}^p$$

$$y_i \in \mathbb{R}$$

$$f(x_i) \approx y_i$$

Generalization

Not only $f(x_i) \approx y_i,$

also for new data: $f(x) \approx y$

Examples of Supervised Learning

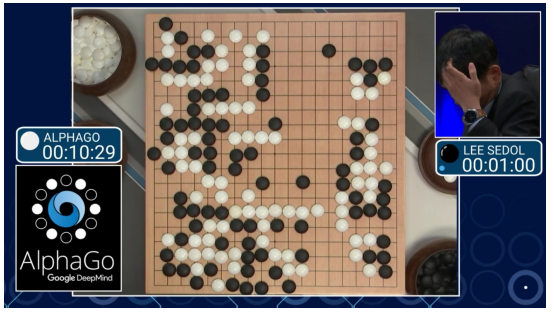
- spam detection
- medical diagnosis
- add click prediction

Unsupervised Learning

$x_i \propto p(x)$ i.i.d.

Learn about p.

Reinforcement Learning



Explore & Learn

Other kinds of learning

- Semi-supervised
- Active Learning
- Forecasting
- ...


THE REVOLUTION
WILL NOT BE
SUPERVISED

Classification and Regression

Classification

- target y discrete
- Will you pass?

Regression

- target y continuous
- How many points will you get in the exam?

Relationship to Statistics

Statistics

- model first
- inference emphasis

Machine learning

- data first
- prediction emphasis

Relationship to Statistics

Statistics

- model first
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Machine learning

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Guiding Principles in Machine Learning

Goal considerations

The Cost of Complex Systems

Data driven first? yes! (or maybe)

Machine Learning first: No!

Thinking in Context!
What is the baseline?
What is the benefit?

Good and Bad Substitutes

Communicating Results

Explainable Results

These recommendations are based on items you own and more.

view: **All** | New Releases | Coming Soon

1. 

R for Data Science: Import, Tidy, Transform, Visualize, and Model Data
by Hadley Wickham (January 5, 2017)
Average Customer Review: (4)
In Stock

List Price: ~~$39.99~~
Price: $32.91
28 used & new from $28.91

Add to Cart | Add to Wish List

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Recommended because you purchased **Data Science from Scratch: First Principles with Python** and more (Fix this)

2. 

Storytelling with Data: A Data Visualization Guide for Business Professionals
by Cole Nussbaumer Knaflic (November 2, 2015)
Average Customer Review: (137)
In Stock

List Price: ~~$39.95~~
Price: $29.71
94 used & new from $20.00

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Recommended because you purchased **Mindset: The New Psychology of Success** and more (Fix this)

3. 

Deep Learning (Adaptive Computation and Machine Learning series)
by Ian Goodfellow (November 18, 2016)
Average Customer Review: (20)
In Stock

List Price: ~~$80.00~~
Price: $68.34
18 used & new from $68.34

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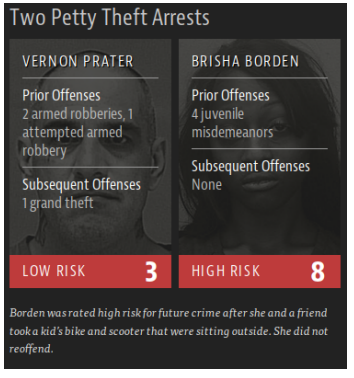
Sidebar: Ethical Considerations



https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing

Ethics: It's in the application!

Data and Data Collection

Free vs Expensive Data

Free

Expensive

Free vs Expensive Data

Free

Predict observable events

- Stock market
- Clicks
- House numbers

Expensive

Automate complex process

- Dignosis
- Drug Trial
- Chip Design

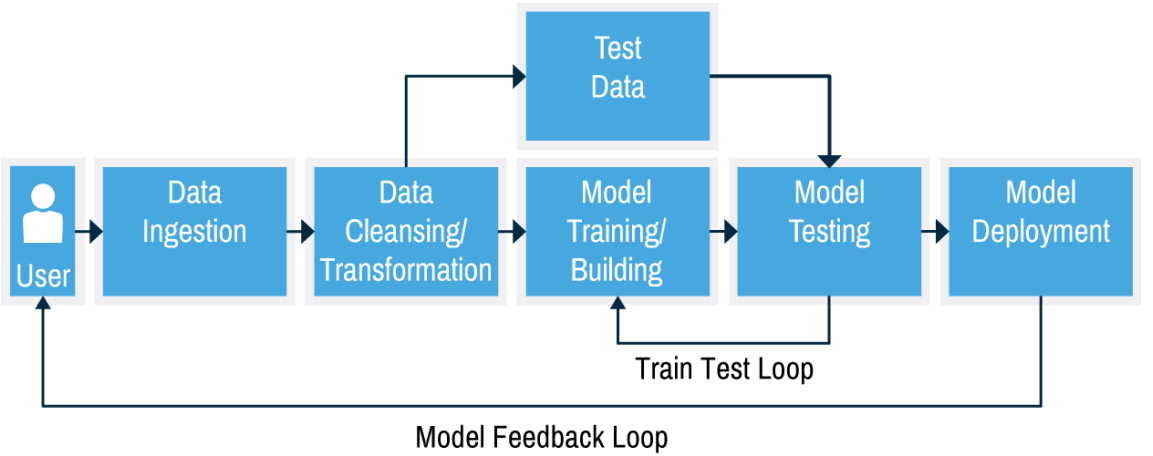
The cost (and benefit?) of BigData

Subsample to RAM (which can be 512gb)

Cornerstones of this Course

- Good software engineering practices
- Problem definition and success measures
- Feature engineering and data cleaning
- Strength and weaknesses of different algorithms
- Model selection best practices

The Machine Learning Work-Flow



Taken from MAPR https://www.mapr.com/ebooks/spark/08-recommendation-engine-spark.html

General coding guidelines

Programs must be written for people to read, and only incidentally for machines to execute.

Harold Abelson (wizard book)

Everyone knows that debugging is twice as hard as writing a program in the first place. So if you're as clever as you can be when you write it, how will you ever debug it?

Brian Kernighan

- Don’t be clever!
- Make it readable!
- Future you is the most likely person to try to understand your code.

- Don’t be clever!
- Make it readable!
- Future you is the most likely person to try to understand your code.
- Avoid writing code.

Python basics

Why Python?

- General purpose language
- Great libraries
- Easy to learn / use
- Contenders: R (Scala? Julia?)

The two language problem

Python is slooooow...

- Numpy: C
- Scipy: C, fortran
- Pandas: Cython, Python
- Scikit-learn: Cython, Python
- CPython: C

Python 2 vs Python 3

- “current” : (2.7), 3.6, 3.7
- Don't use Python 2

Python ...

Package management:

- don't use system python!
- use Virtual environments
- understand pip (and wheels)
- probably use Conda (and anaconda or conda-forge)

Python ...

Package management:

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Pip and conda and upgrades

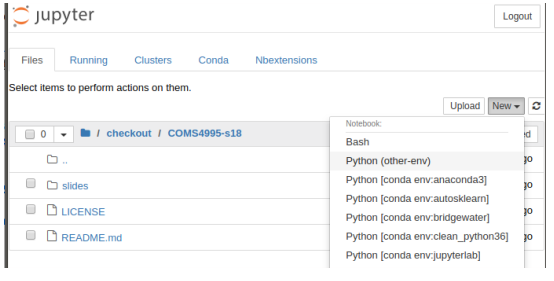
- Pip upgrade works on dependencies (unless you do -no-dep)
- pip has no dependency resolution!
- conda has dependency resolution
- Use conda environments!
- upgrading a conda package with pip (or vice versa) will break stuff!

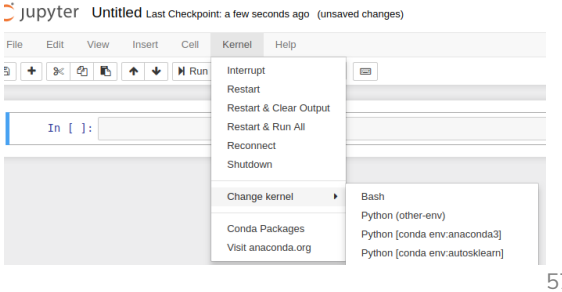
Environments and Jupyter Kernels

- Environment != kernels
- Use nb_conda_kernels or add environment kernels manually:

```
source activate myenv
python -m ipykernel install --user --name myenv --display-name "Python (myenv)"
source activate other-env
python -m ipykernel install --user --name other-env --display-name "Python (other-env)"
```

- https://jakevdp.github.io/blog/2017/12/05/installing-python-packages-from-jupyter/





Dynamically typed, interpreted

- Invalid syntax lying around
- Code is less self-documenting

Editors

- Flake8 / pyflake
- Scripted / weak typing: Have a syntax checker!
- write pep8 (according to the standard, not the tool)
- use autopep8 if you have code lying around

Questions ?