

Machine Learning for Natural Language Processing

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Information

- In my research, I deal with tons of data and (lots of) text data. That's why this course.
- Introduce yourself. What are your expectations? Why are you here? What kind of text/data you are currently using or plan to use?

Plan for this course

- Supervised Learning
- Unsupervised Learning
- Applications on Text Data
- Implementation of algorithms with Python

Final assessment will consist of the following:

- **In classroom** (20% of final grade). We'll measure this from answers in Slack.
 - ▶ Participation 10 %
 - ▶ Quizzes 10 %
- **2 Problem Sets** (40% of final grade)
- **Individual Project** (40% of final grade)
- **Online teaching eventuality.** Everything remains the same, but I expect most cameras on. If less than 60 percent of the class has their cameras off in a class, all participants will be deducted 1 point. Experiment with virtual backgrounds.

Meet your TA – Gergely Attila Kiss



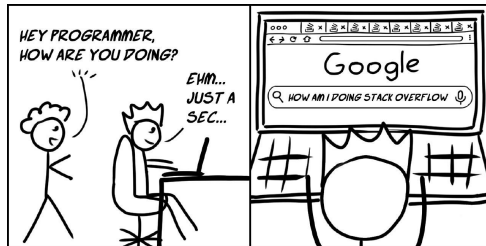
Deadlines

- Past deadline submissions do not get graded
- Email for meetings, questions, etc
- Emails/Questions: You will get a reply. However, questions about homework should be received by us 24 hours before a deadline (no response otherwise)
- Slack will be our communication tool for this course
 - ▶ Post questions and answers in respective channels
 - ▶ Keep a close eye on channels on quizzes and assignments
 - ▶ Make sure you reply in thread when needed
- I strongly encourage peer learning. Feel free to post in the Slack channel if you think some information is of common interest

Rules

- In each class, I will assign readings for the next class. Make sure you do the readings (you will be quizzed on those).
- Try to type code along with me – share screen.
- Ask questions and feel free to google
 - ▶ Don't feel bad about this especially for the programming part of the course. (Even software developers spend a lot of their coding time googling programming related questions)
 - ▶ Important to know how to read error messages
 - ★ or google them
 - ▶ Stack Overflow is a programmer's best friend

Stack Overflow



Recommended Material

- Python
 - ▶ [Codecademy](#) is the place to start
 - ▶ [Automate the Boring Stuff with Python](#) and [The Real Python](#) are great sources
- Machine Learning
 - ▶ An Introduction to Statistical Learning (ISL) by Gareth, Witten, Hastie and Tibshirani
 - ▶ The Elements of Statistical Learning (ESL) by Hastie, Tibshirani, Friedman
 - ▶ Statistical Learning with Sparsity (SLS) by Hastie, Tibshirani, Wainwright
 - ▶ Introduction to Machine Learning with Python: A Guide for Data Scientists (IMLP) by Sarah Guido, and Andreas Muller
- Text Analysis
 - ▶ [Introduction to Information Retrieval](#) by Christopher D. Manning, Prabhakar Raghavan and Hinrich Schutze
 - ▶ Speech and Language Processing by Dan Jurafsky and James H. Martin

Academic Papers in Economics

TABLE 4
PERCENT DISTRIBUTIONS OF METHODOLOGY OF PUBLISHED ARTICLES, 1963–2011*

Year	Type of study				
	Theory	Theory with simulation	Empirical: borrowed data	Empirical: own data	Experiment
1963	50.7	1.5	39.1	8.7	0
1973	54.6	4.2	37.0	4.2	0
1983	57.6	4.0	35.2	2.4	0.8
1993	32.4	7.3	47.8	8.8	3.7
2003	28.9	11.1	38.5	17.8	3.7
2011	19.1	8.8	29.9	34.0	8.2

* A type could not be assigned to seventeen of the articles published in 1963.

Hammermesh (2013)

Background

- Old data, structured and small: (gdp, population, investment)
- New data, less structure and larger (scraped data, consumer search patterns, social networks, texts, ?)
- New methods needed: data collection/management, workflow/collaboration, description/analysis

Causal Inference and Machine Learning

- Causal Inference
 - ▶ Focus on one/few coefficients of interest (causal effect)
 - ▶ Use one main specification, show robustness to alternative specification and placebo tests
 - ▶ Model rarely evaluated (when pure inference we focus on in-sample-properties, mostly R^2)
- Machine Learning (ML)
 - ▶ Focus on prediction (and description)
 - ▶ Use data-driven model selection to have best prediction (treated as a black box)
 - ▶ Model is evaluated out-of-sample (e.g. cross-validation)

Use ML to identify the most meaningful predictive variables (i.e Lasso and Ridge), dimensionality reduction, generate outcome of interest Y , or/and main variable of interest X

Linguistic differences

	Econometrics	Machine Learning
Y	Outcome	Target
X	Independent Variables	Features

Note that Scikit-learn and IMLP refer to observations as "Samples". Don't be confused!

Supervised vs Unsupervised Learning

- Supervised Learning: Y , the target, is available. Labeled data
 - ▶ Regression: Y is continuous
 - ▶ Classification: Y is categorical (binary or multi-class – ordered or not ordered)
- Unsupervised Learning: Y is not available
 - ▶ Exploratory data analysis and can be useful as a pre-processing step for supervised learning

Other types of learning

- Deep Learning
- Semi-Supervised
- Active Learning
- Forecasting

Know Your Task

- Each algorithm is different in terms of what kind of data and what problem setting it works best for. When building an algorithm ask:
 - ▶ What question(s) am I trying to answer? Do I think the data collected can answer that question?
 - ▶ What is the best way to phrase my question(s) as a machine learning problem?
 - ▶ Have I collected enough data to represent the problem I want to solve?
 - ▶ What features of the data did I extract, and will these enable the right predictions?
 - ▶ How will I measure success in my application?
 - ▶ How will the machine learning solution will help my project?

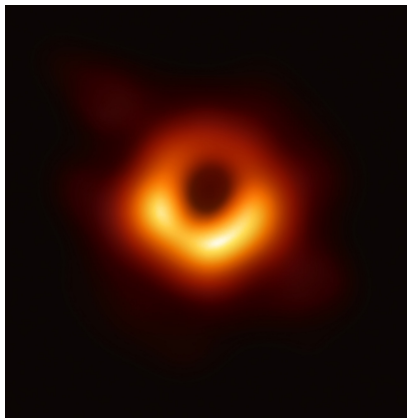
Know Your Data

- The most important task when working with data is knowing your data
 - ▶ All data related work
 - ▶ Extract features only if you know your data well enough.
We are going to talk about best practices throughout this course

A bit about Python

- Programming language intended for general-purpose high-level language
- Web development, scientific and numeric education, desktop graphical user interface, software development
- Free and open source
- You can do everything that you can do in a programming language
- Big community (Google, Youtube, Nasa...)
- High readability (more than R or C)
- Python was first released in early 1980
 - ▶ Python 2 in 2000 and Python 3 in 2008

Black Holes and Python



Purpose of the course

- Machine Learning and Text Analysis, as well as programming in Python, are (mildly put) very broad topics, and we will not be able to cover many(!) things
- Build foundations such that in the future you get confidence in starting to dig deeper into these topics
- Strong focus towards applications and real-life problems