About the Course

Predictive Modeling & Statistical Learning

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Official Title

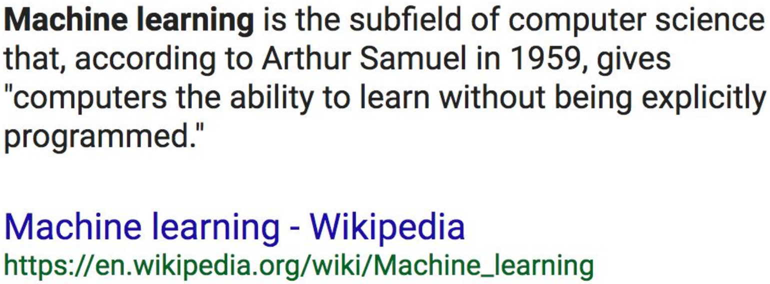
Stat 154:
Modern Statistical Prediction and Machine Learning

I prefer something like ...

An introduction to
Predictive Modeling
and Statistical Learning

What is this course about?

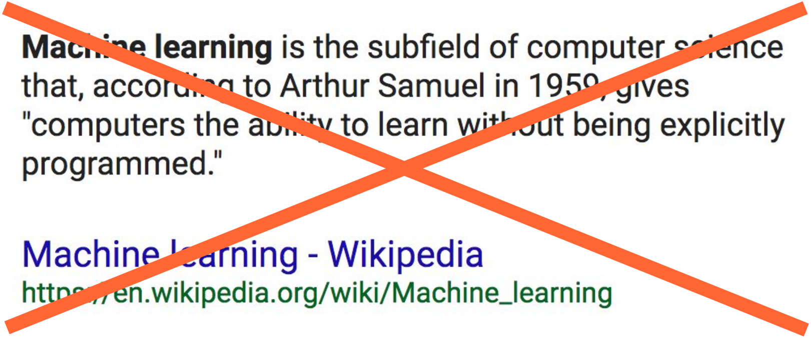
Machine Learning (ML)?



Machine learning is the subfield of computer science that, according to Arthur Samuel in 1959, gives "computers the ability to learn without being explicitly programmed."

Machine learning - Wikipedia
https://en.wikipedia.org/wiki/Machine_learning

Not this type of ML



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Machine learning - Wikipedia

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Simply put

- focus on Predictive Models
- from Statistical Learning standpoint
- and a pinch of descriptive methods

How I think of Statistical Learning

Data analysis and model-building techniques from cross-pollination between Statistics, Applied Math, and Computer Science, with contributions and applications from all scientific corners (Life sciences + Social sciences + other)

Two big areas

Learning approaches:

Supervised -vs- Unsupervised

Statistics	**Machine Learning**
Predictive methods	Supervised learning
Descriptive methods	Unsupervised learning

Two big areas

Unsupervised or Descriptive

Search data sets and discover the locations of unexpected structures or relationships, patterns, trends, clusters, and outliers in the data.

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Supervised or Predictive

Build models and procedures for regression and classification tasks, and assess the predictive accuracy of those models and procedures when applied to new data.

Supervised Learning

Problems in which the learning algorithm receives a set of continuous or categorical input variables and a correct output variable (which is observed or provided by an explicit "teacher") and tries to find a function of the input variables to approximate the known output variable: a continuous output variable yields a regression problem, whereas a categorical output variable yields a classification problem.
Izenman, 2008

Unsupervised Learning

Problems in which there is no information available (i.e. no explicit "teacher") to define an appropriate output variable.
Izenman, 2008

A word of caution

Sometimes there might not be a clear distinction between supervised and unsupervised learning. Often, a given method mixes both types of approaches.

Supervised Methods

Two flavors

- Regression: quantitative target variable
- Classification: qualitative target variable

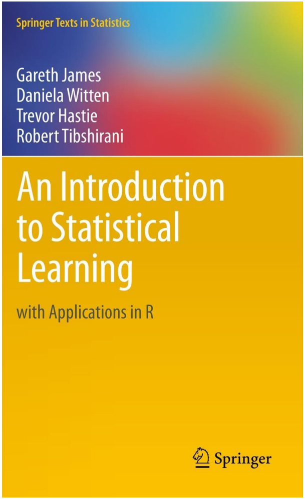
Unsupervised Methods

Structural Methods

- Ordering: finding systematic patterns of variation
- Clustering: finding groups in data

Course Content

Primary Textbooks



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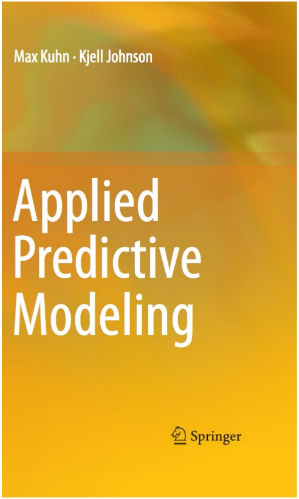

APM

Course in a nutshell

Not necessarily in this order

- Matrix algebra housekeeping
- Data Preprocessing
- Principal Components Analysis
- Regression
  - Linear (and related) Models
  - Regression Trees and extensions
- Classification
  - Linear (and related) Models
  - Classification Trees and extensions
- Process of predictive model building
- Clustering

Github repo

- username: **ucb-stat154**
- repository: **stat154-fall-2017**

`https://github.com/ucb-stat154/stat154-fall-2017`

I'll be uploading/updating the repo's content as we move on with the course

Prereqs

Prereqs

- Math 53: multivariate calculus
- Math 54: linear algebra
- Stat 134: statistical inference
- Stat 133: computing with data

Two Assumptions

I'm assuming 2 things about you:

Matrix Algebra & R basics

Matrix Algebra

You should have been exposed to concepts such as:

- Vector Spaces
- Inner Products
- Matrix Multiplication
- Linear Dependency
- Rank
- Trace, Determinant
- Inverse
- *etc*

R Basics

You should have been exposed to:

- R `vector`'s, `list`'s, `data.frame`'s
- Subscripting and indexing (i.e. bracket notation)
- Writing functions: `function() {...}`
- Conditionals: `if {...} else {...}`
- Loops: `for`, `while`, `repeat`
- Graphics: base, ggplot2, etc
- RStudio familiarity

Matrix Algebra

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- *etc*

Expectations

At the end of the course

- Understand theory and concepts
- Being able to interpret results
- Being able to implement algorithms in R (scripting, programming)
- Implement Full pipeline (with prepacked tools)
- Move on to more specialized techniques