Primer to Data Science

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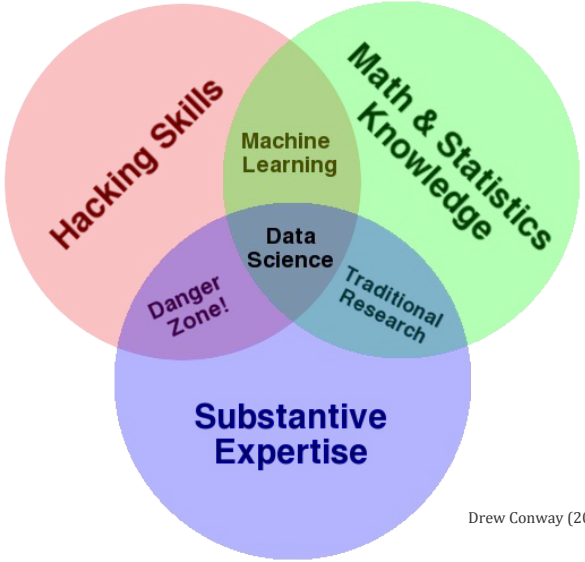
Get started:

https://github.com/StarCYing/open_data_day_dc

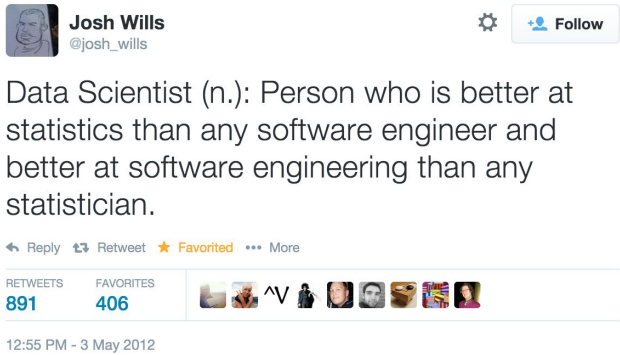
Follow the readme.md instructions to setup for the workshop

COMMERCE DATA SERVICE

The quick definition of data science



Drew Conway (2010)



Josh Wills
@josh_wills

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Data Scientist (n.): Person who is better at statistics than any software engineer and better at software engineering than any statistician.

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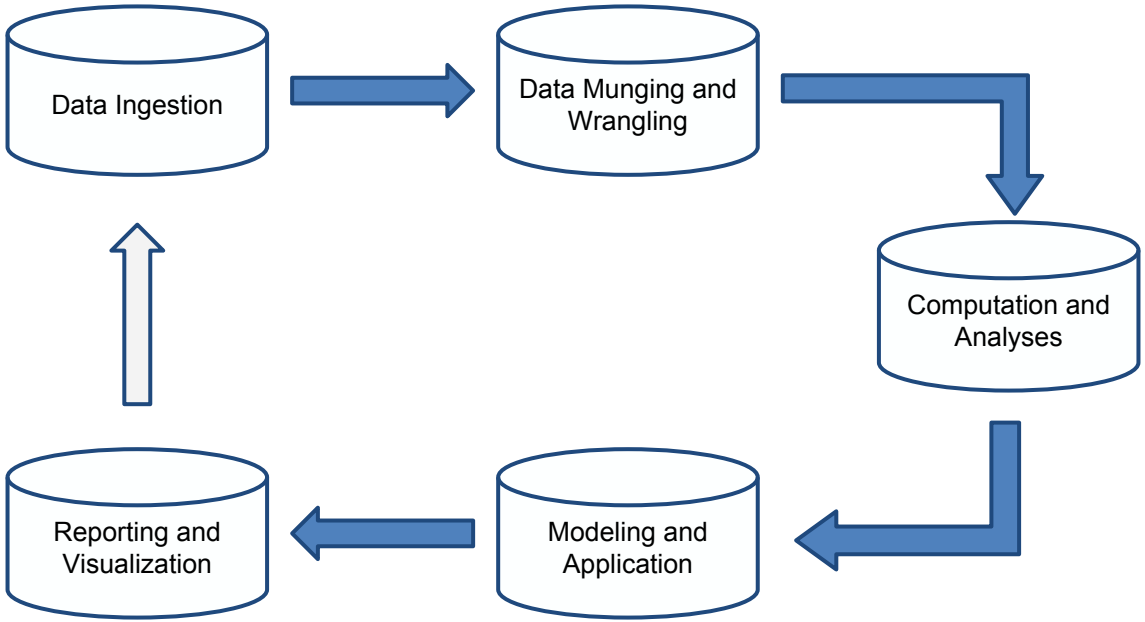
The quick definition of data science



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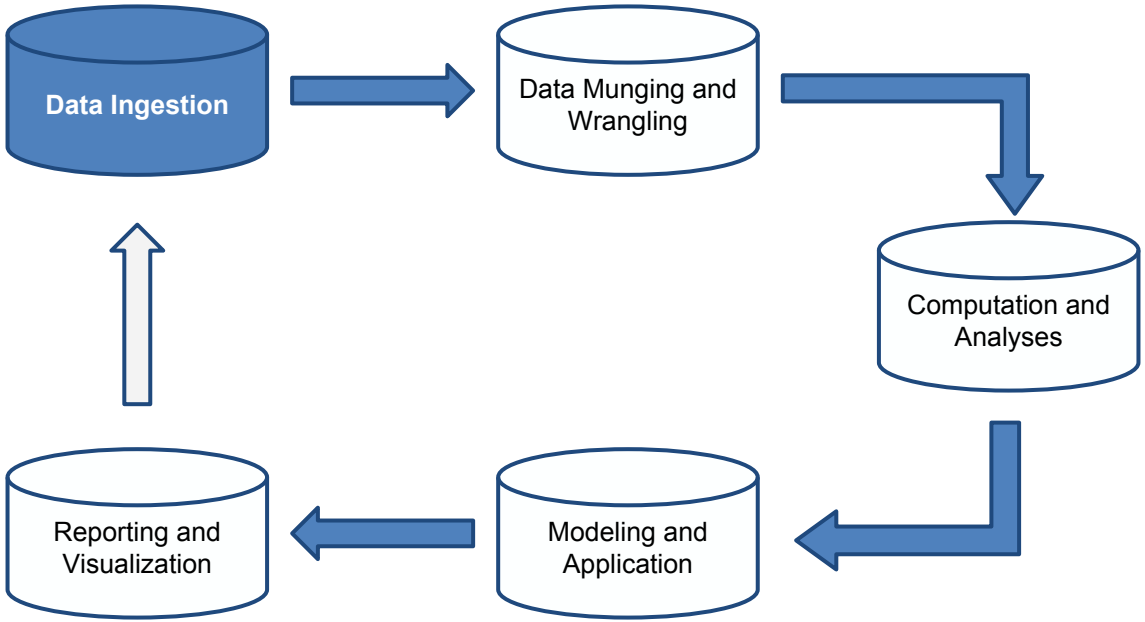
Data Ingestion

Means
Source
Question
Size
Velocity



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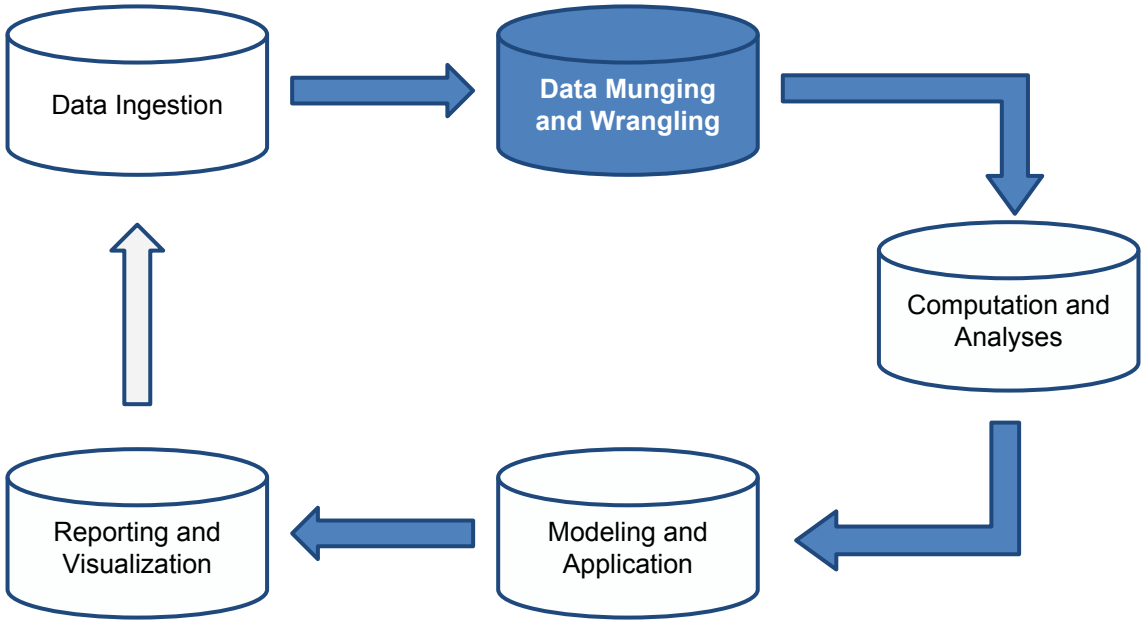
Data Munging and Wrangling

Warehouse
Extract
Transform
Filter
Aggregation
Training



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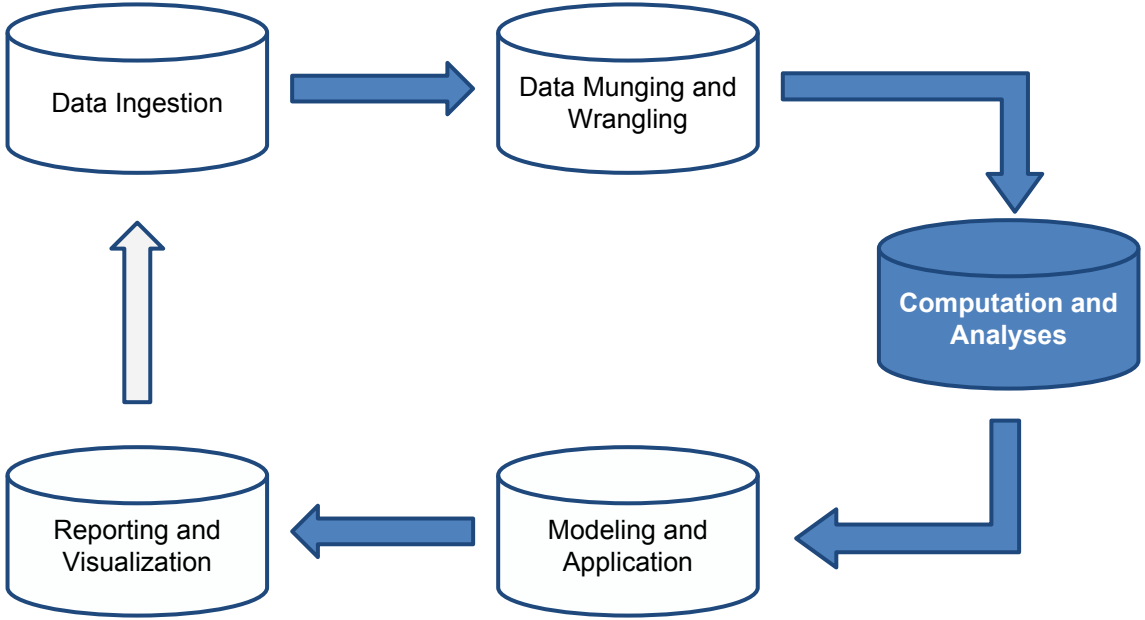
Computation and Analyses

Hypothesis
Design
Method
Time



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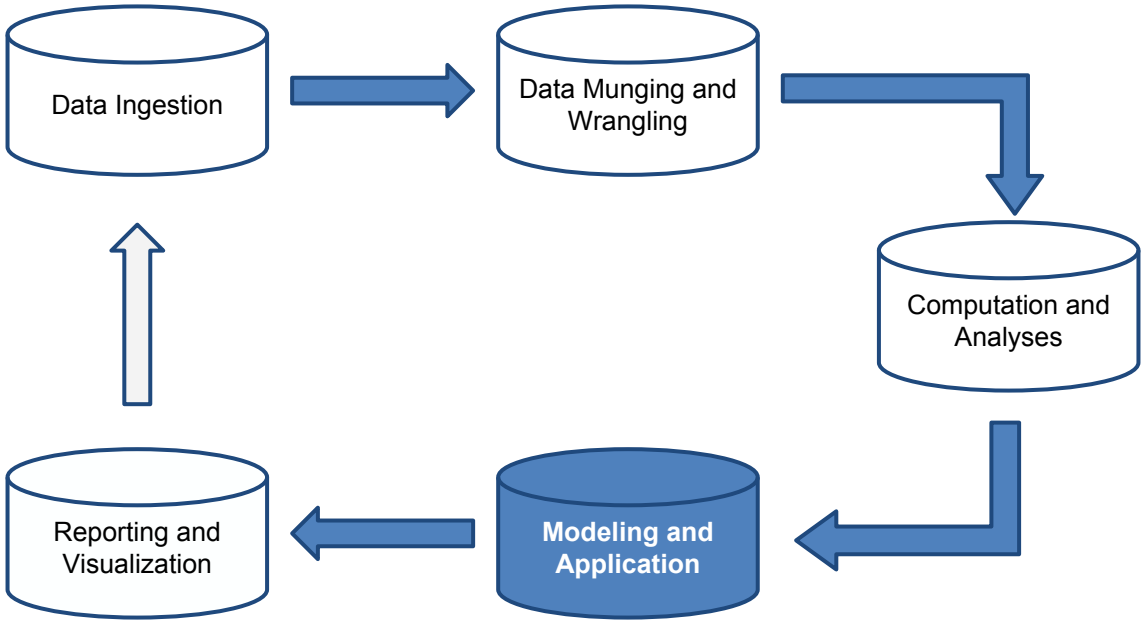
Modeling and Application

Supervised
Unsupervised
Regression
Classification
Clustering
Etc...



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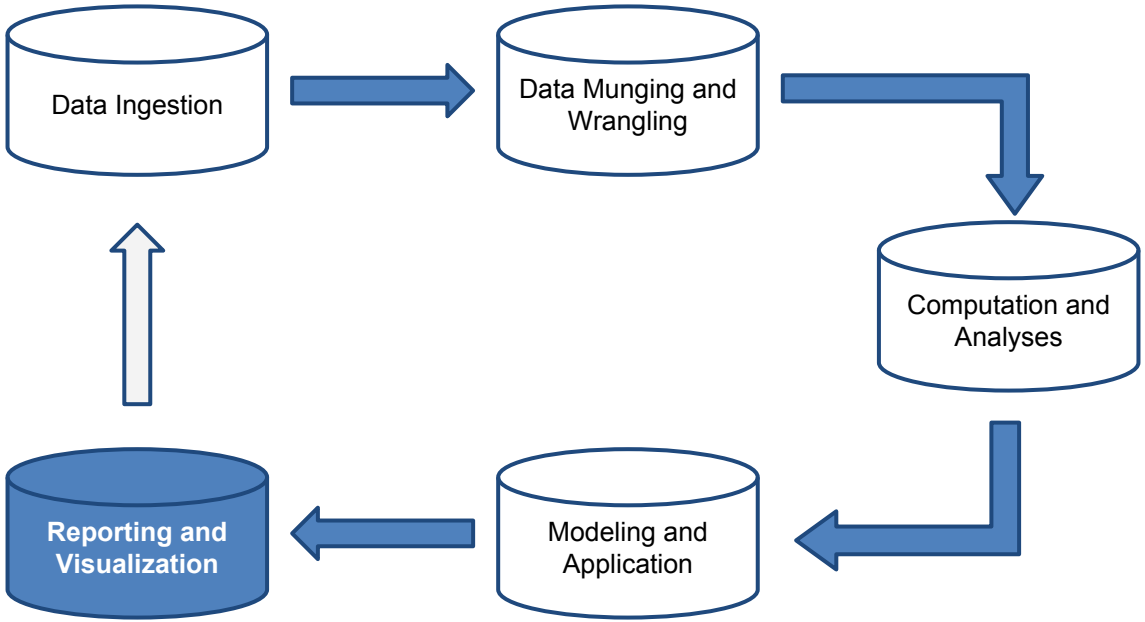
Reporting and Visualization

Crucial
Active Learning
Error Detection
Mashups
Value



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Modeling and Application

- Scope
  - What is the question/problem statement?
  - What data is available to answer this question?
- Explore
  - ‘Initial data touch’
  - Summary statistics
  - Simple visualizations
- Clean
- Model
  - choose a machine learning model (more on that in a minute)
- Evaluate
  - figure out if your model is any good

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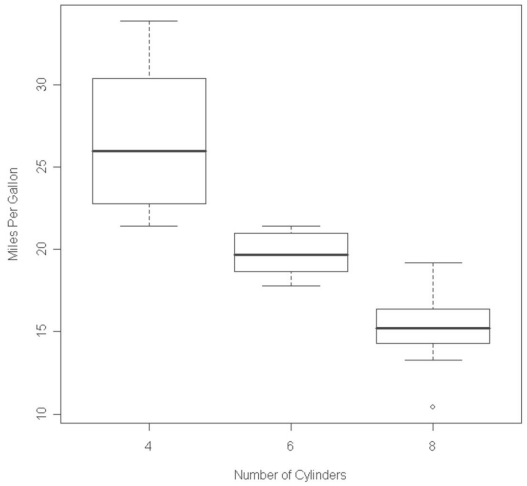
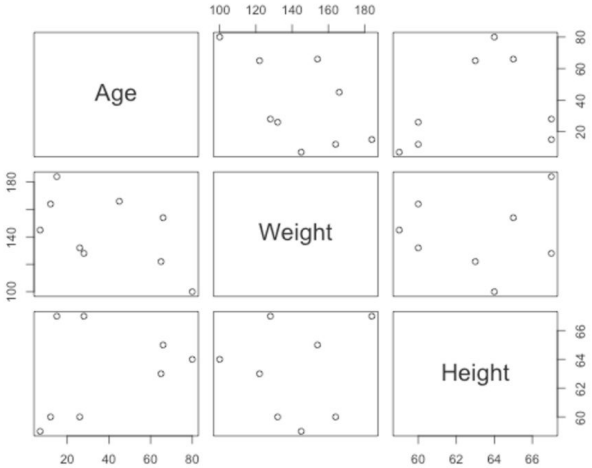
Visualize

- Types
  - Boxplots
  - Scatter Plots
  - Tables
  - etc...
- Tools
  - R
  - Matplotlib





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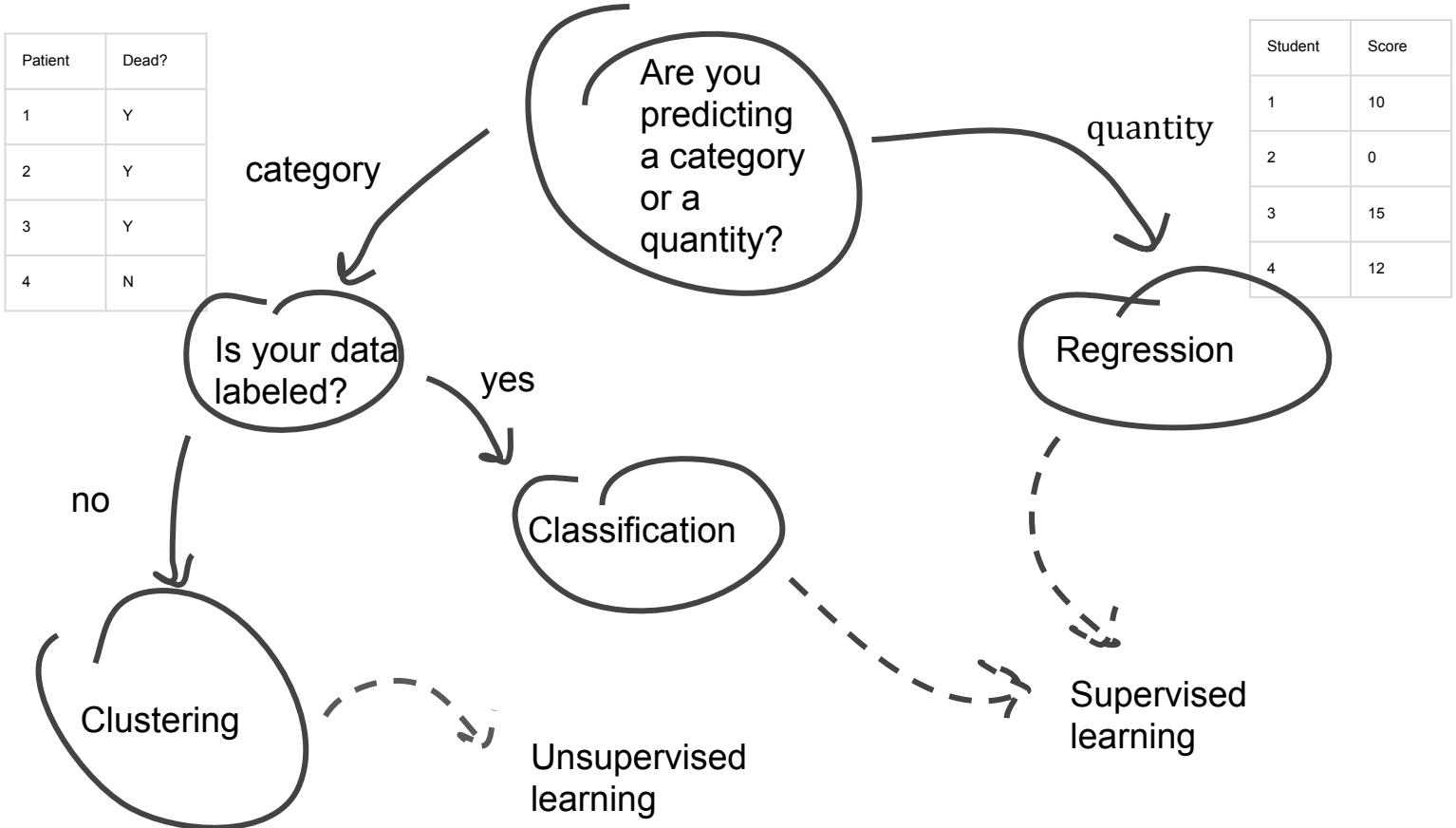
Choose a machine learning method

Patient	Dead?
1	Y
2	Y
3	Y
4	N



Student	Score
1	10
2	0
3	15
4	12

COMMERCE DATA SERVICE

Choose a machine learning method

Patient	Dead?
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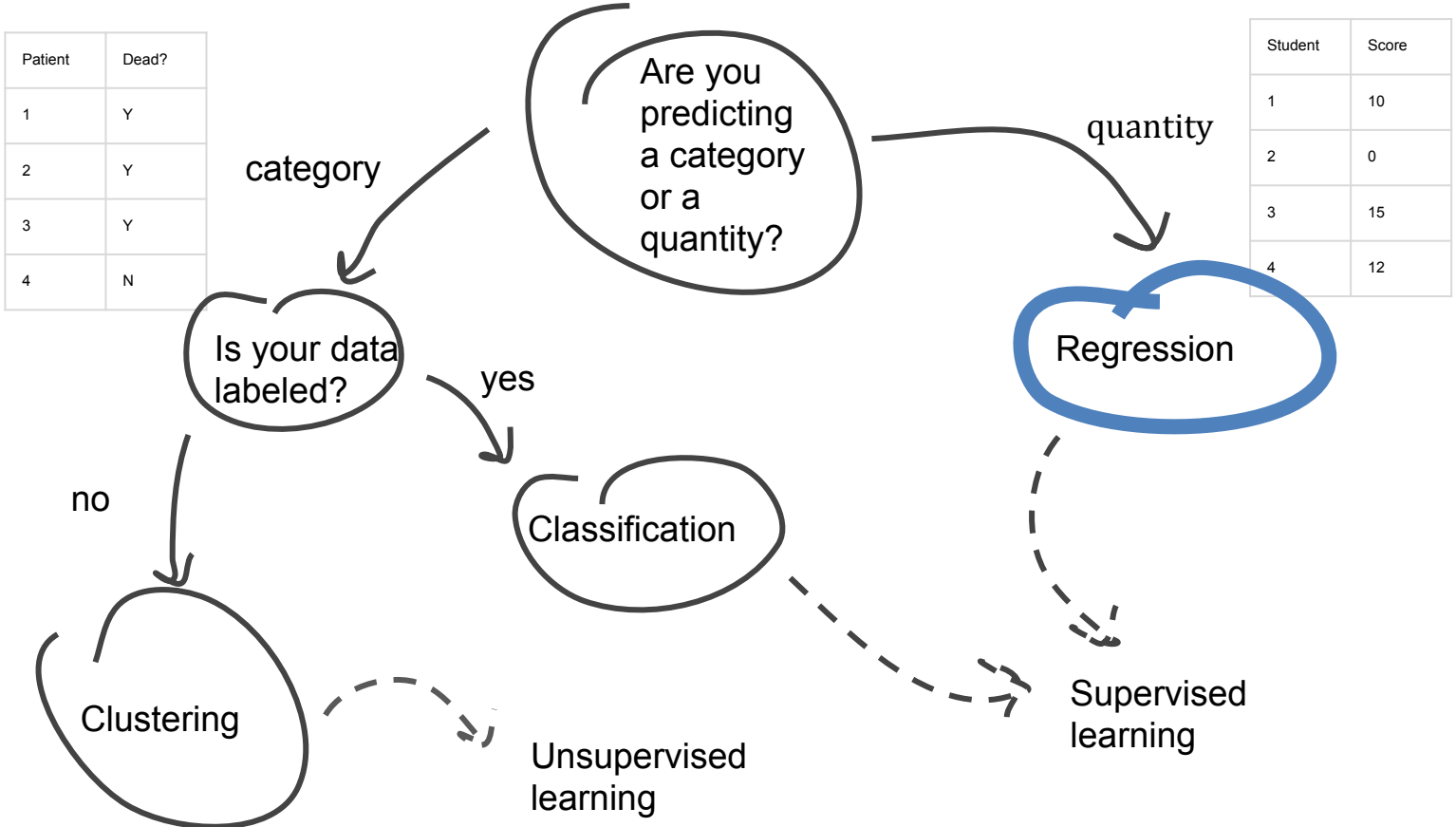

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Regression

Predict a numerical target using predictors (which can be numerical and categorical)

Example dataset: patient age, diagnosis, surgery date, discharge date, number of months survival post-discharge, where we are trying to predict how long a patient survives post-discharge.

- Simple Linear Regression
- Multiple Linear Regression
- K-Nearest Neighbors Regression

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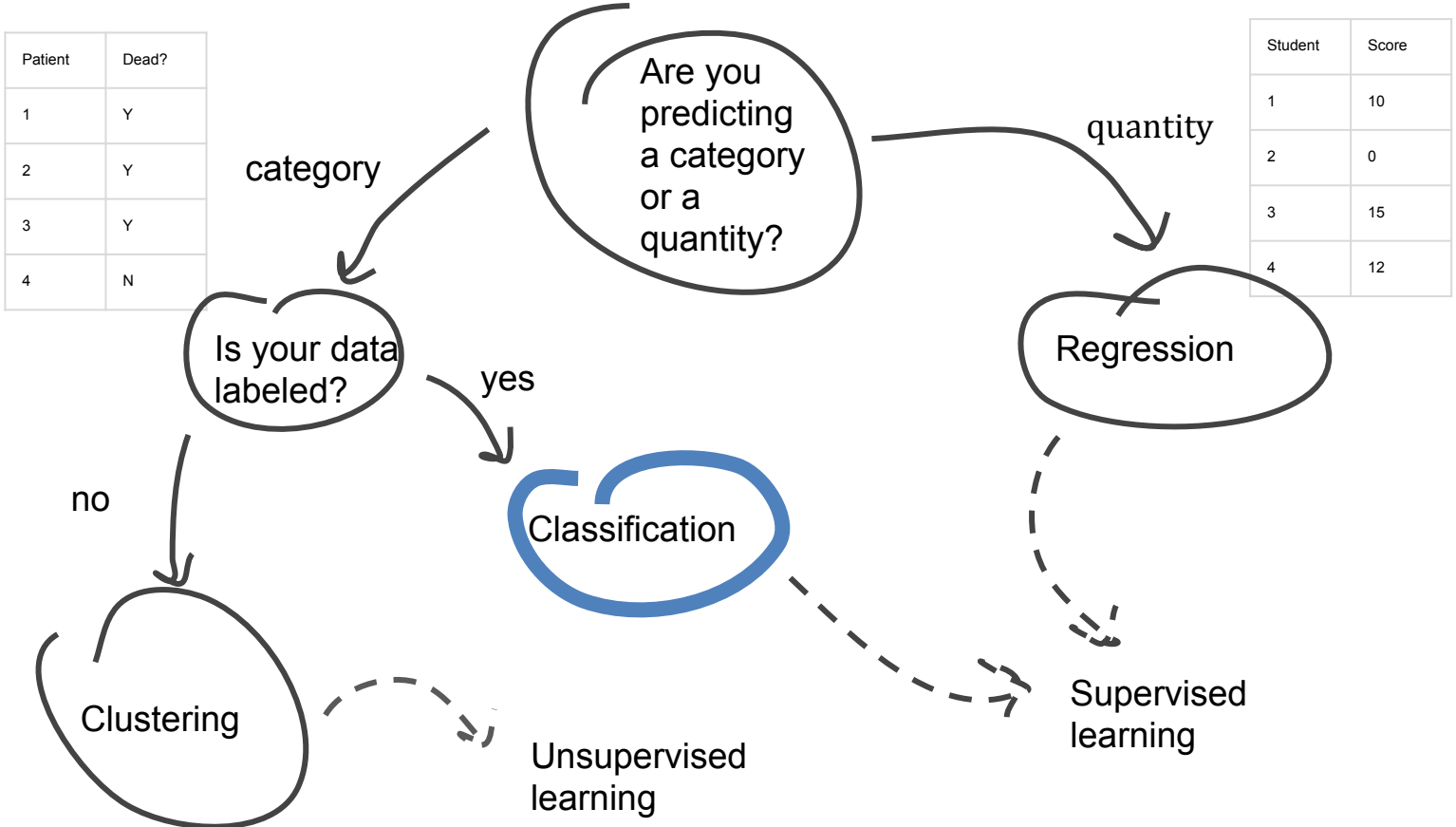

Classification

Identifying which category an object belongs to

Example dataset: patient age, diagnosis, surgery date, discharge date, label of whether the patient died, where we are trying to predict whether a patient will survive

- Logistic Regression
- Multiple Logistic Regression
- Linear Discriminant Analysis
- K-Nearest Neighbors Classifier

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Choose a machine learning method

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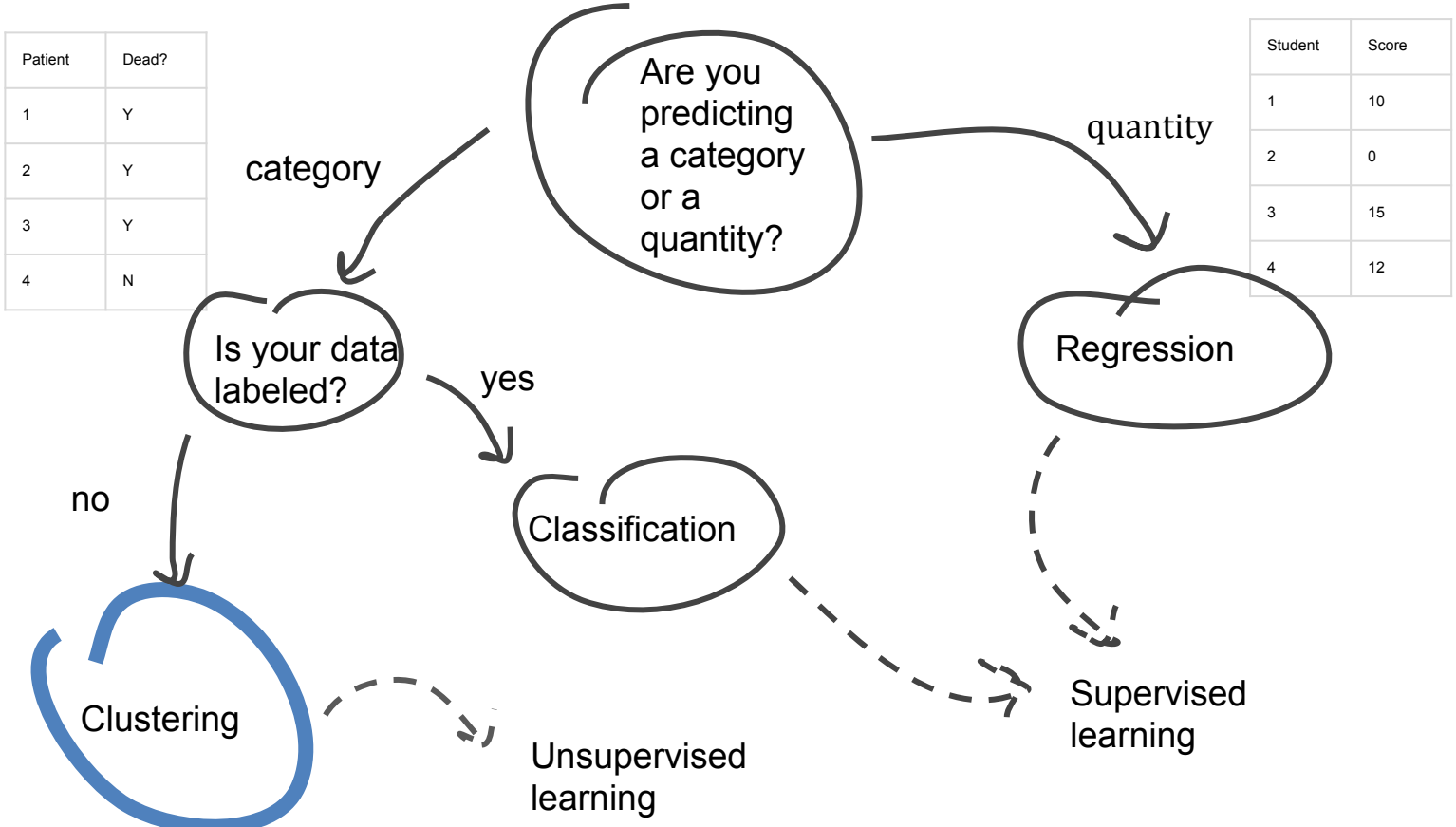

Clustering

Grouping of similar objects into sets

Example datasets: clustering protein structures using amino acid sequence and secondary structures cluster structurally similar proteins together

- K-means
- Spectral Clustering
- Gaussian mixtures

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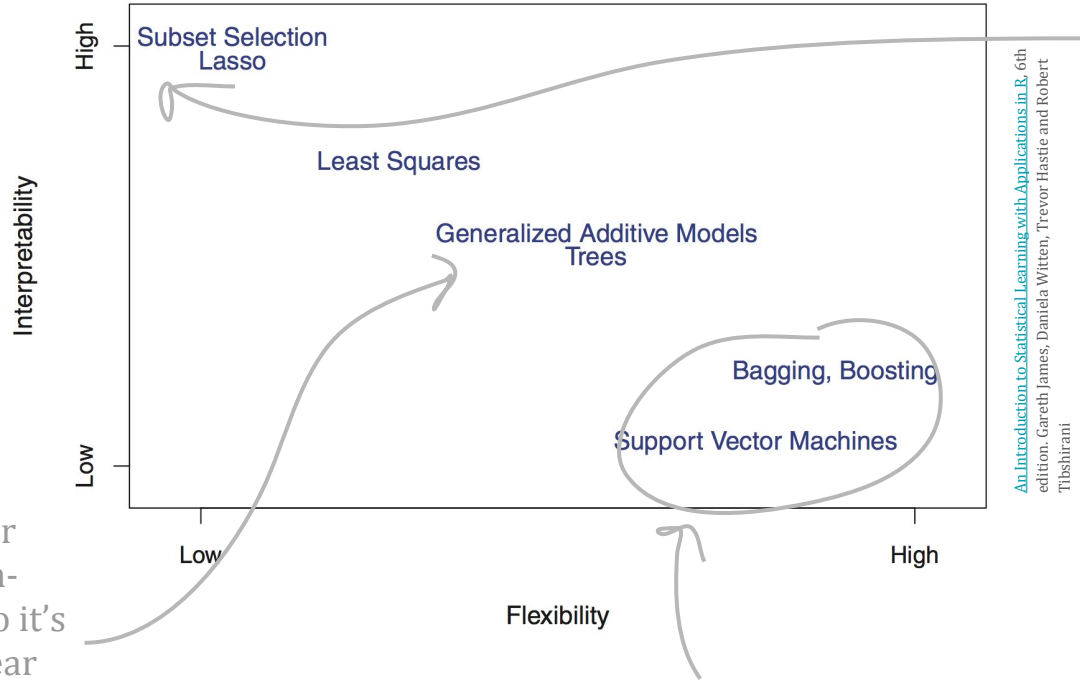
Prediction Accuracy versus Model Interpretability



Linear regression assumes a linear shape, which is pretty straightforward

GAMs extend the linear model to allow for non-linear relationships. So it's more flexible than linear relationships but also less interpretable.

fully non-linear methods that are very flexible, but hard to interpret

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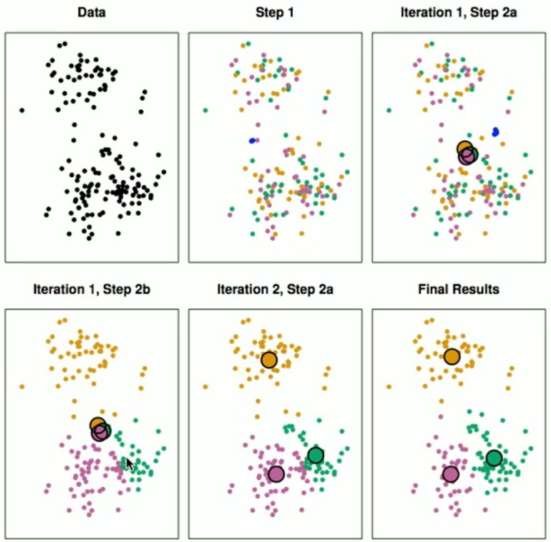
What news topics get published by NIST?

- K-Means Clustering on news published on NIST's newsfeed in 2014
- Their website doesn't indicate which subject area the article is about, so our data is unlabeled
- We know NIST publishes news on 15 subject areas, so we know k=15
- The goal is to find homogeneous clusters in your data, where we try to minimize the amount of variation within the cluster (Euclidean distance)
- Each iteration slightly improves the clustering



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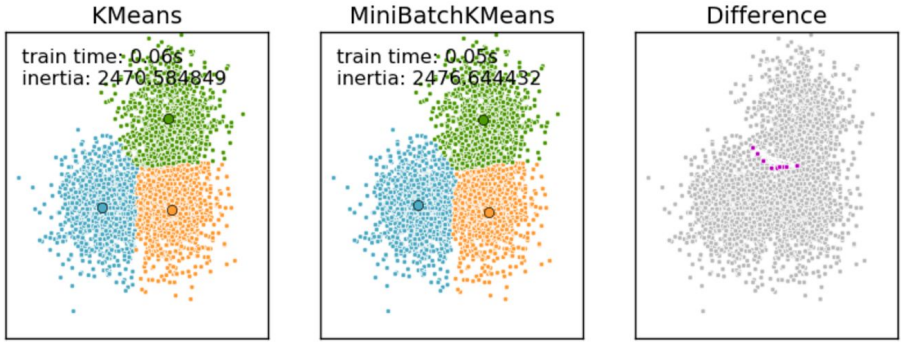
Optimizing

- Change the number of clusters (k)
- Change the stop_words to include words common in your dataset (for example, National Institute of Standards and Technology)
- Mess with the init parameters sklearn.cluster.KMeans
- If you have a lot more data and the computing time is getting ridiculous, try MiniBatchKMeans.



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Resources

- MIT OpenCourseware
  - Machine Learning
  - Statistics
  - Probability
  - Linear Algebra
  - Algorithms
  - Optimization
- An Introduction to Machine Learning with Python (Rebecca Bilbro)
- Machine Learning map for scikit learn and in general
- Binge watch machine learning
- Introduction to Statistical Learning in R

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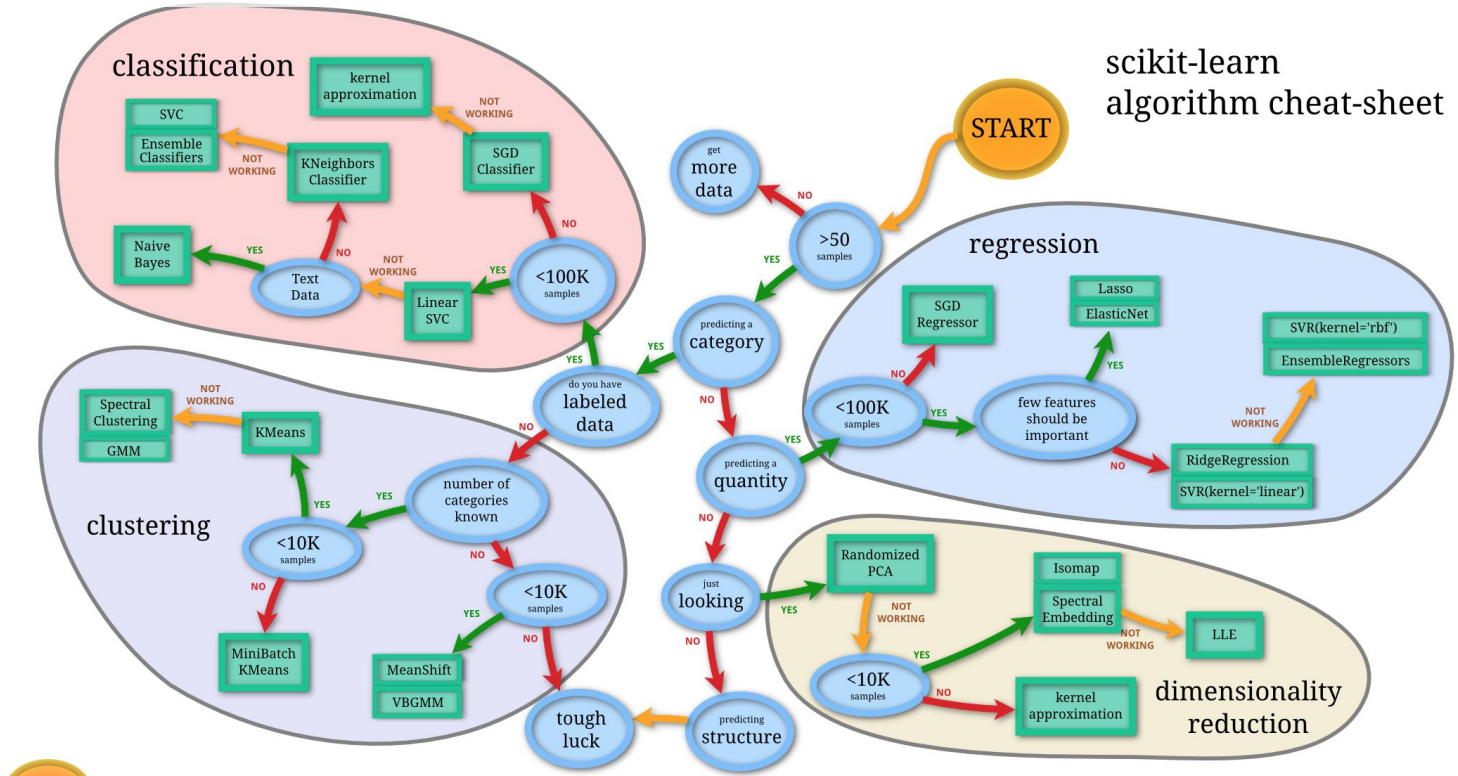
scikit-learn algorithm cheat-sheet



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scikit learn

Question, Comments, Contact

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