DS501: Machine learning, Part 1

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2014

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Learning **objectives** for this machine learning class.

- Overview of machine learning
- Supervised classification.
  - K-nearest neighbors
  - Support vector machines
- Learn some Python packages, including:
  - scikit-learn

Inspired by: http://scikit-learn.org/stable/tutorial/statishttp://scikit-learn.org/stable/tutorial/statistical_inference/supervised_learning.htmltical_inference/supervised_learning.html

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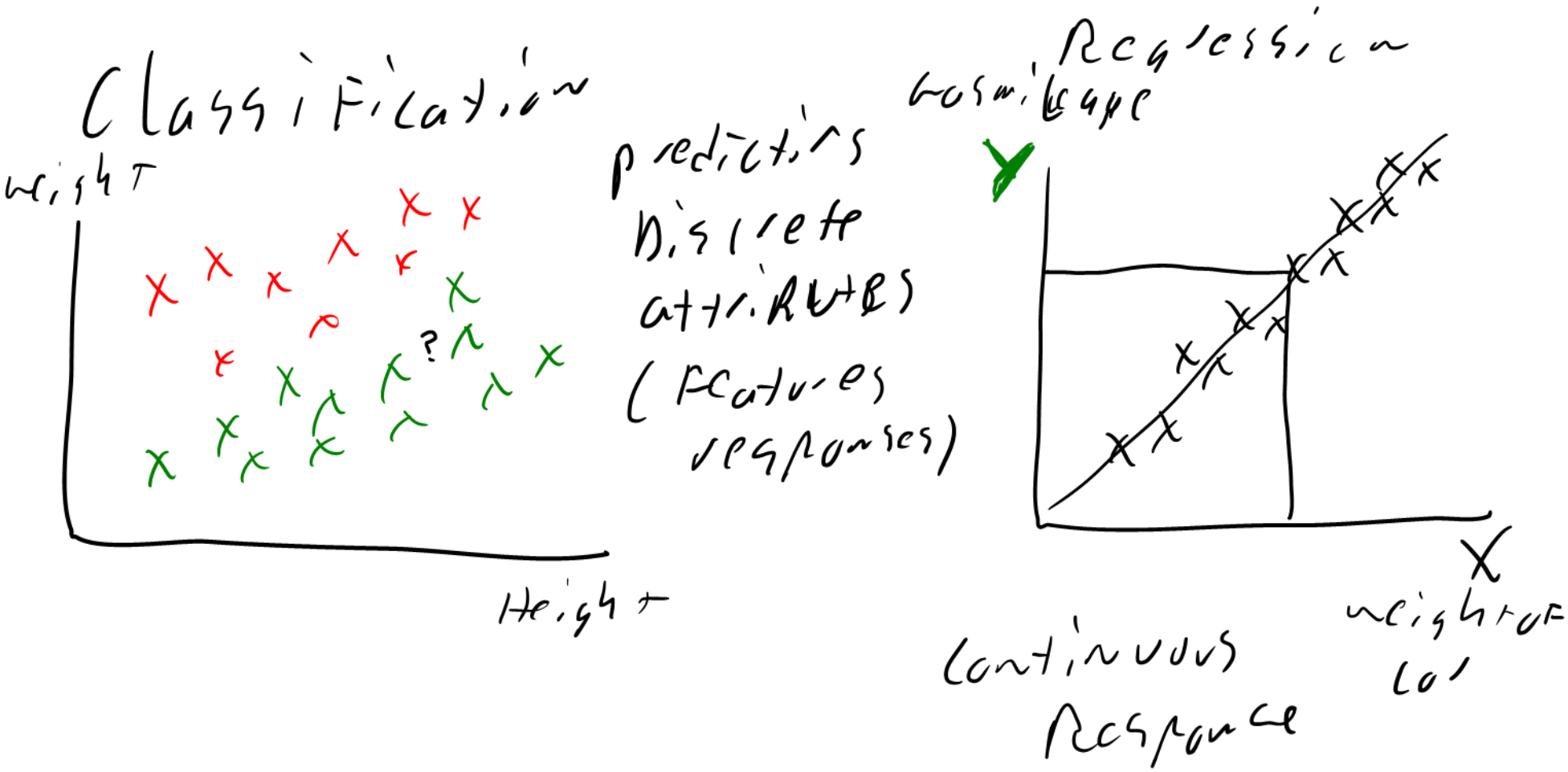
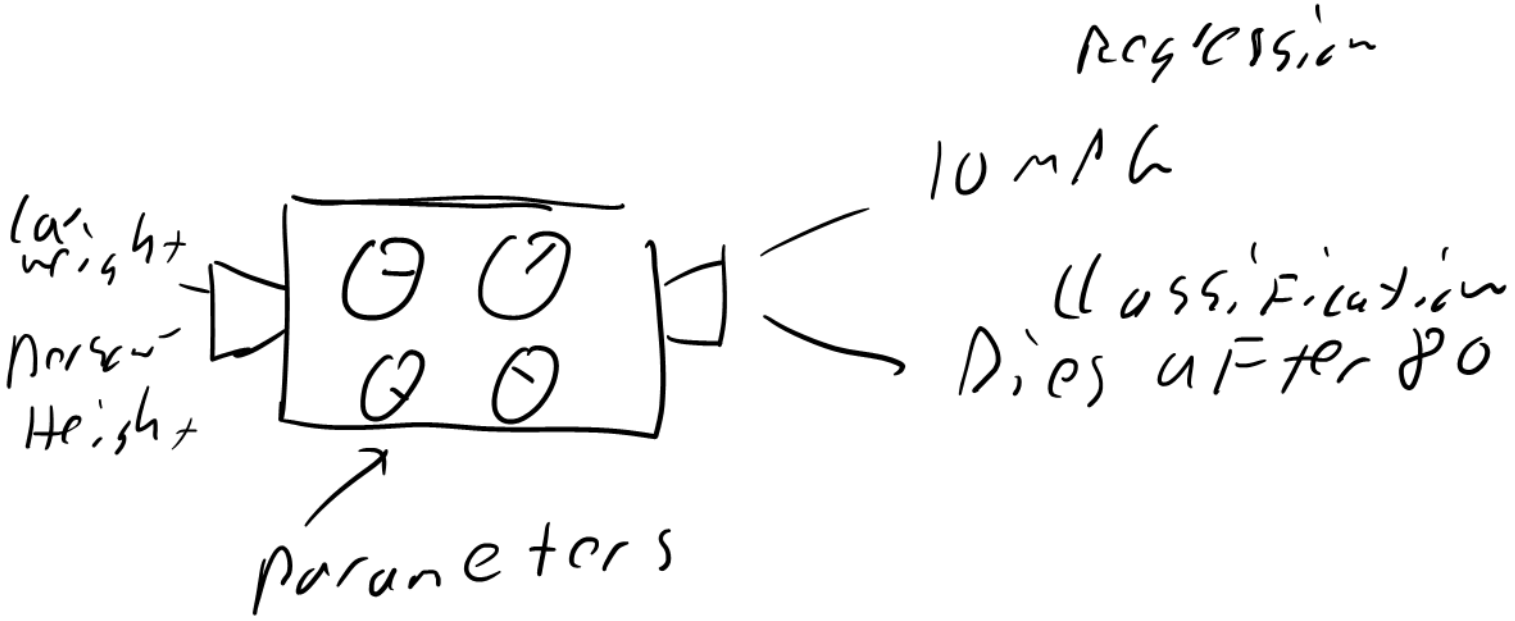
Basic definitions: Classification vs. Regression



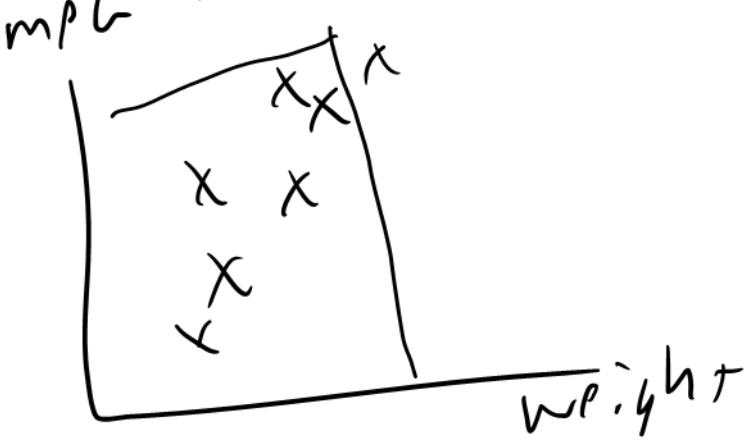


Data is used to set the dials

Basic definitions: Supervised vs. Unsupervised Learning

supervised

You have examples to learn from



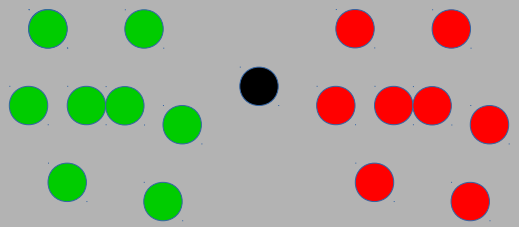
unsupervised

no examples to learn from!

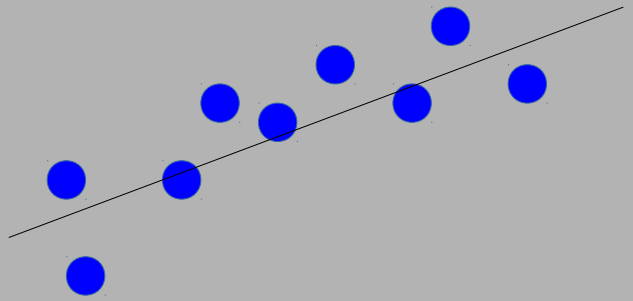
colors make it supervised

We have four days we will cover four topics.

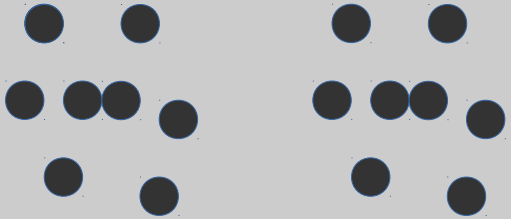
Supervised Classification



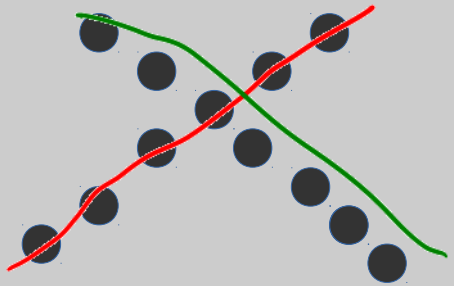
Supervised Regression



Unsupervised Clustering



Dimension Reduction



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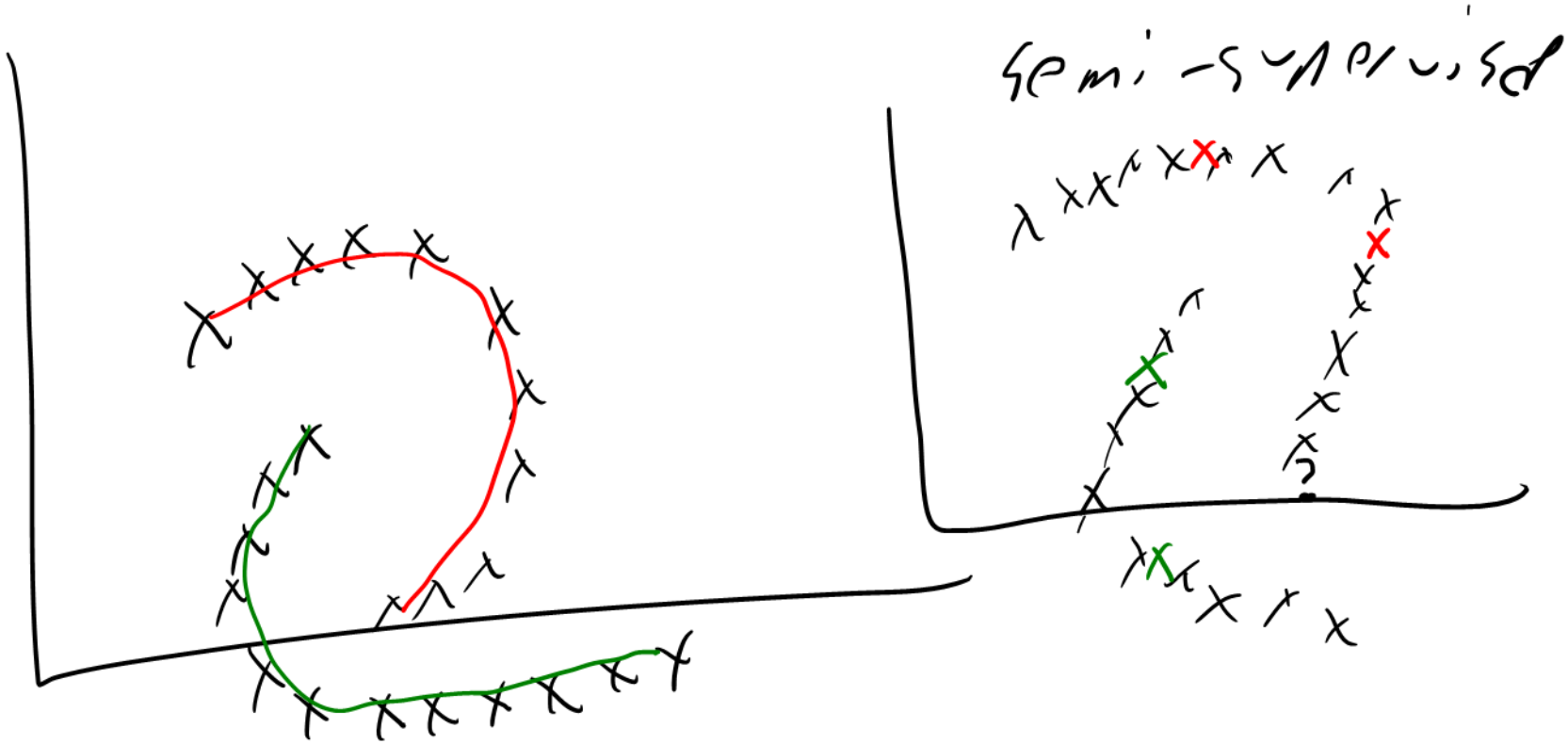
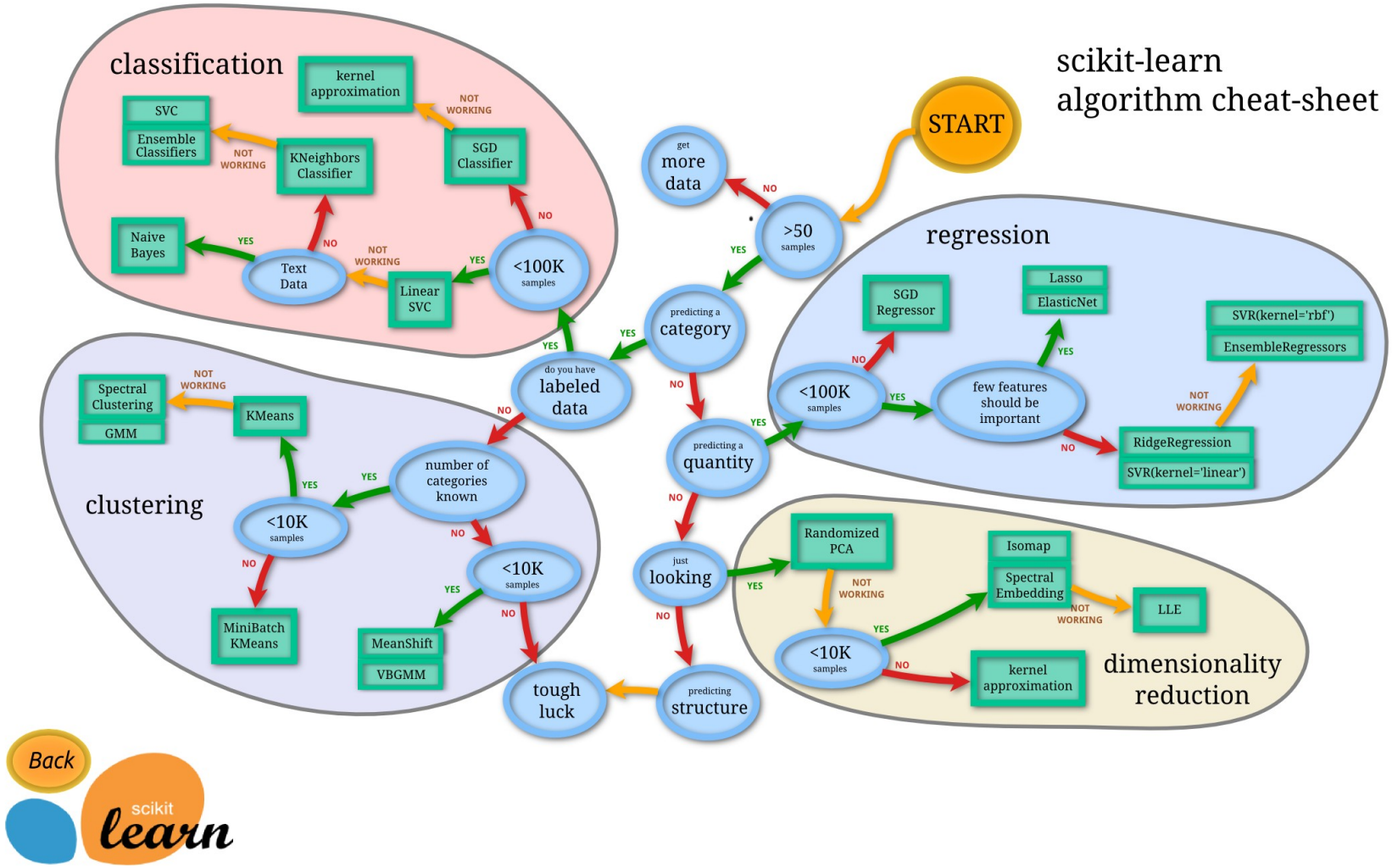
What about Unsupervised Regression?



scikit-learn



http://scikit-learn.org/stable/tutorial/machine_learning_map/index.html

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Iris data set

Features:

sepal length (cm)
sepal width (cm)
petal length (cm)
petal width (cm)

"Iris virginica" by Frank Mayfield - originally posted to Flickr as Iris virginica shrevei BLUE FLAG. Licensed under Creative Commons Attribution-Share Alike 2.0 via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:Iris_virginica.jpg#mediaviewer/File:Iris_virginica.jpg

Catagories:

setosa
versicolor
virginica

"Kosaciec szczecinkowaty Iris setosa". Licensed under Creative Commons Attribution-Share Alike 3.0 via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:Kosaciec_szczecinkowaty_Iris_setosa.jpg#mediaviewer/File:Kosaciec_szczecinkowaty_Iris_setosa.jpg

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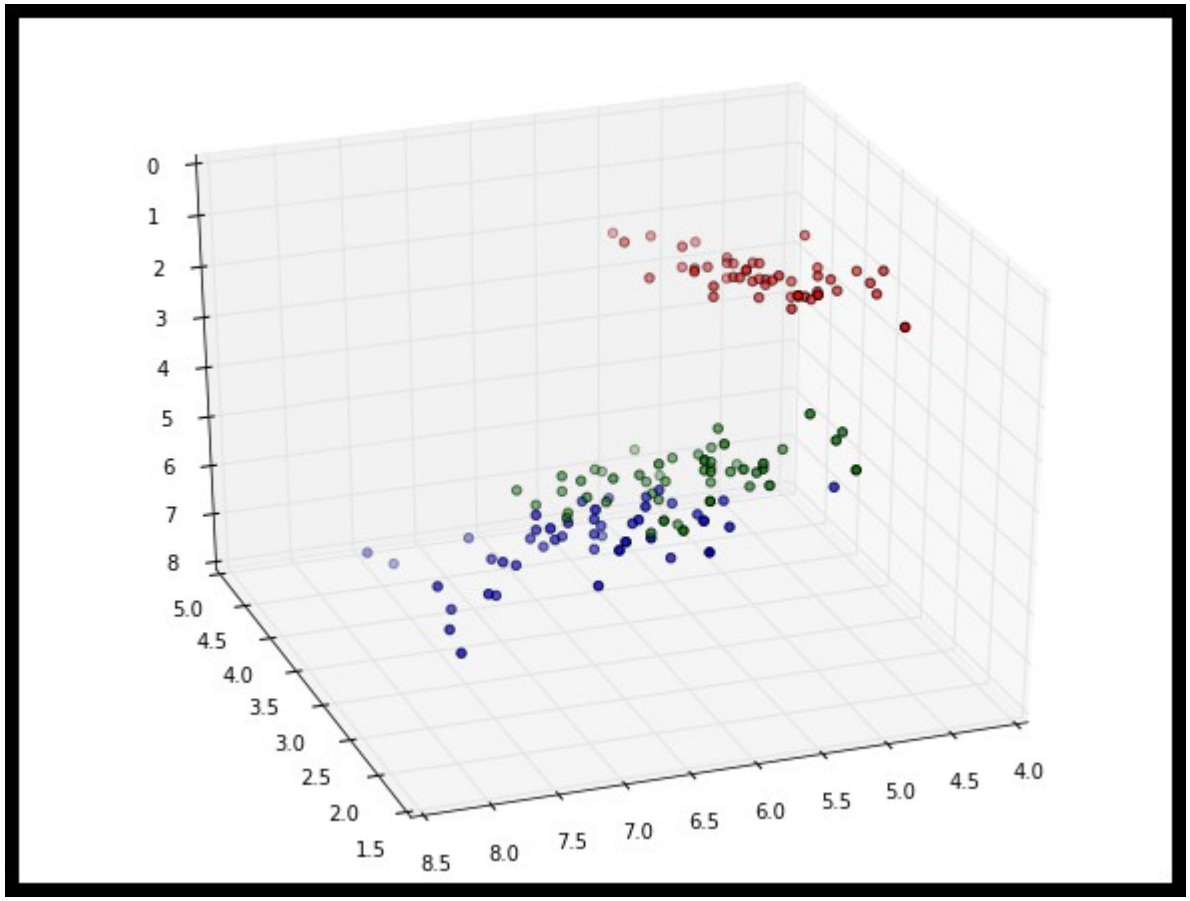
Let's look at it in Python



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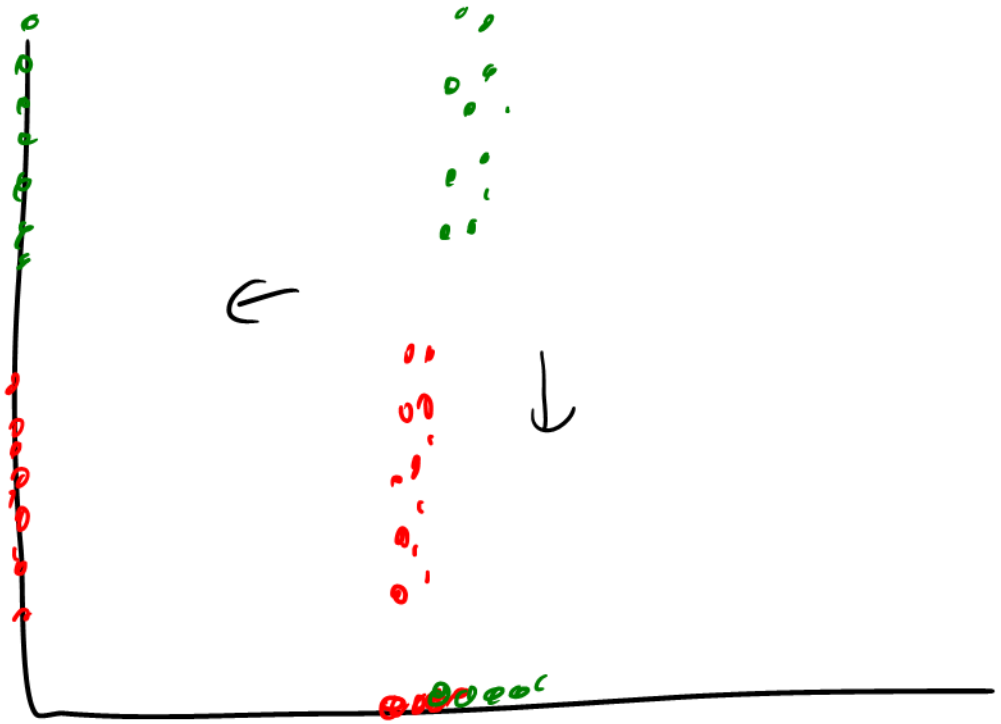
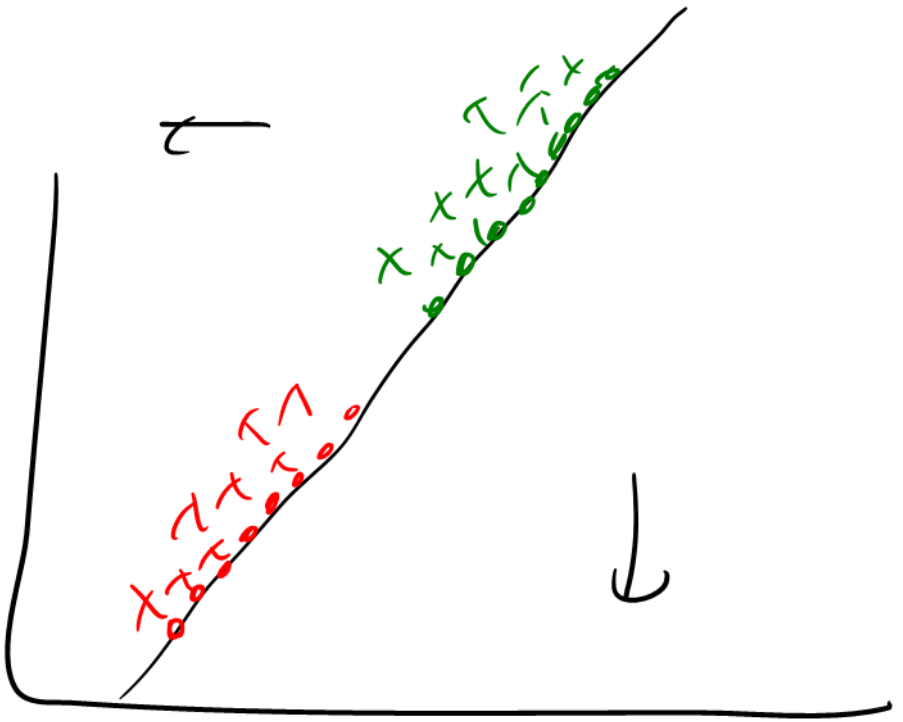
What is PCA?

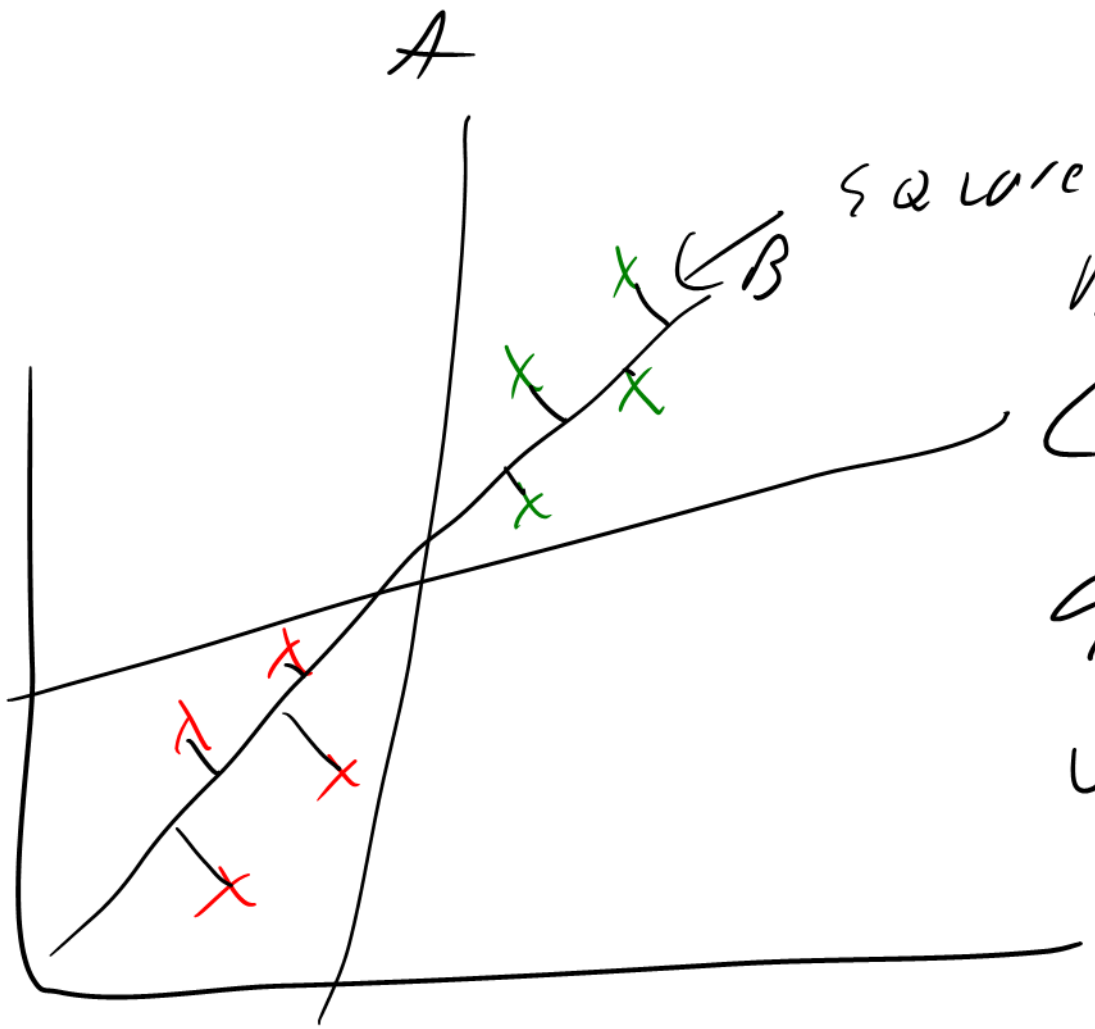
- Principle Component Analysis
  - Commonly used tool for visualization and data pre-processing.

Key idea of PCA

maximize the variance of the projection!

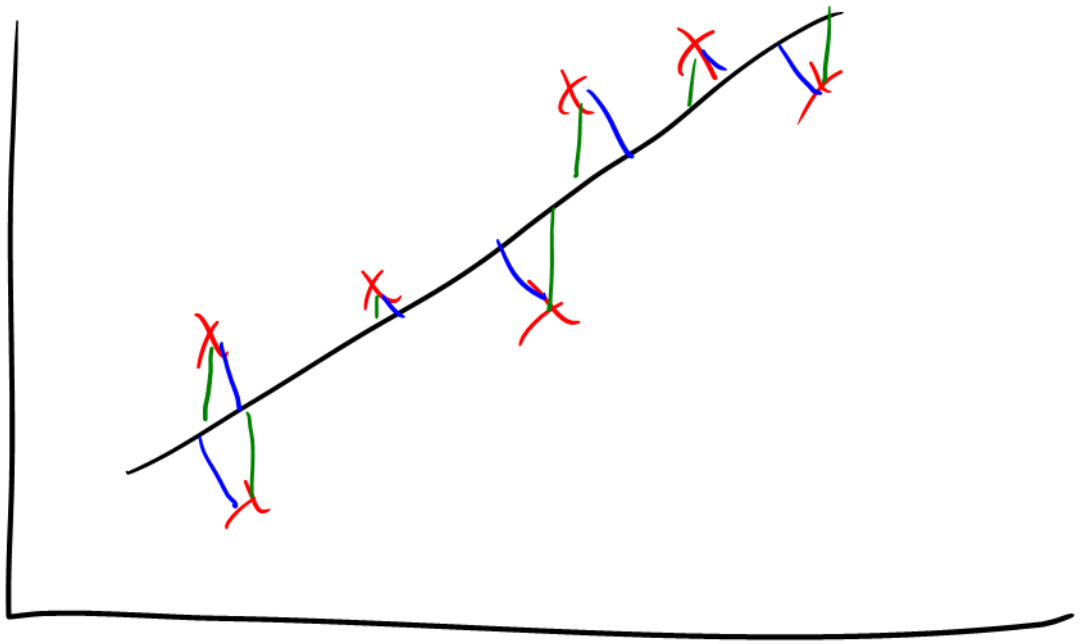




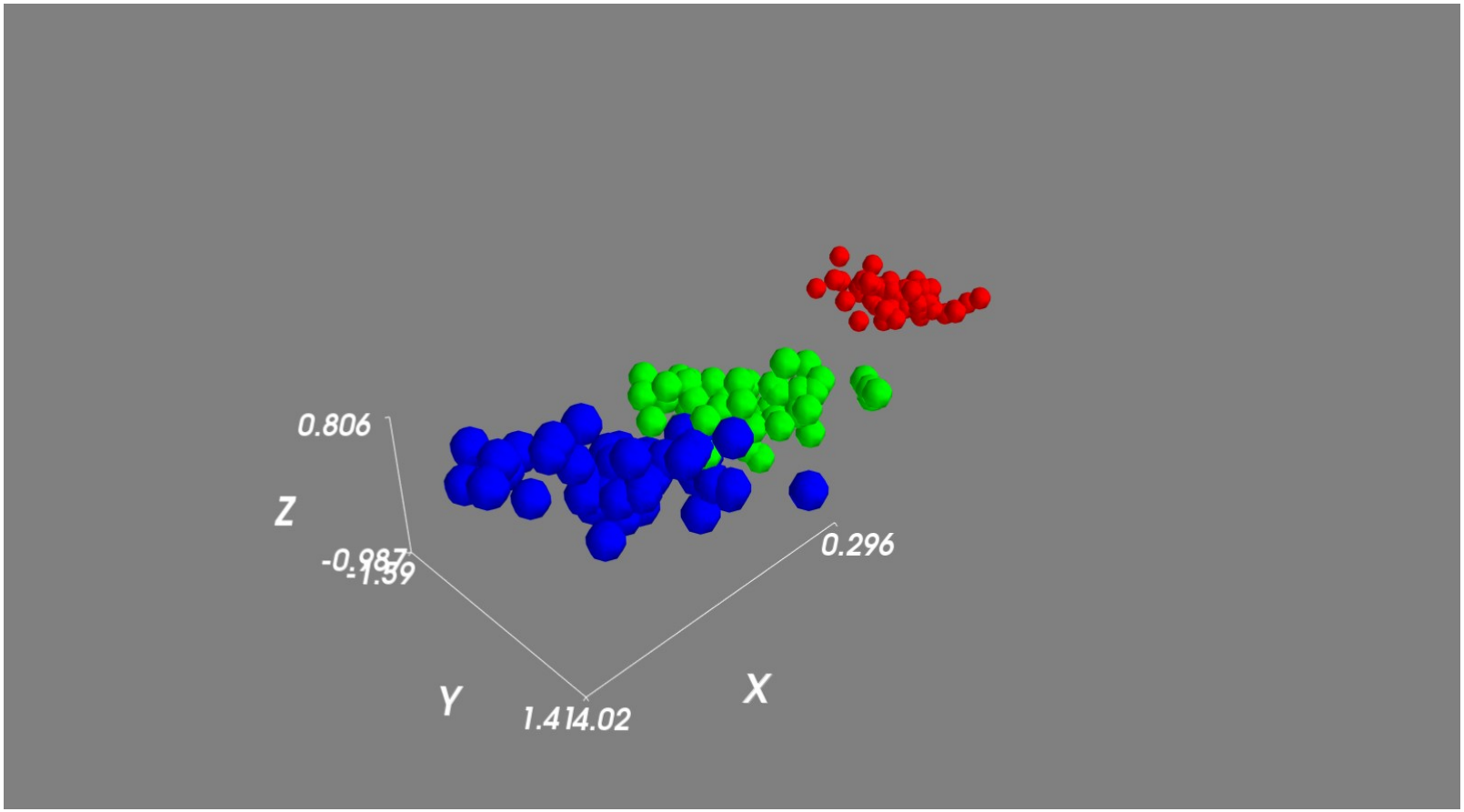


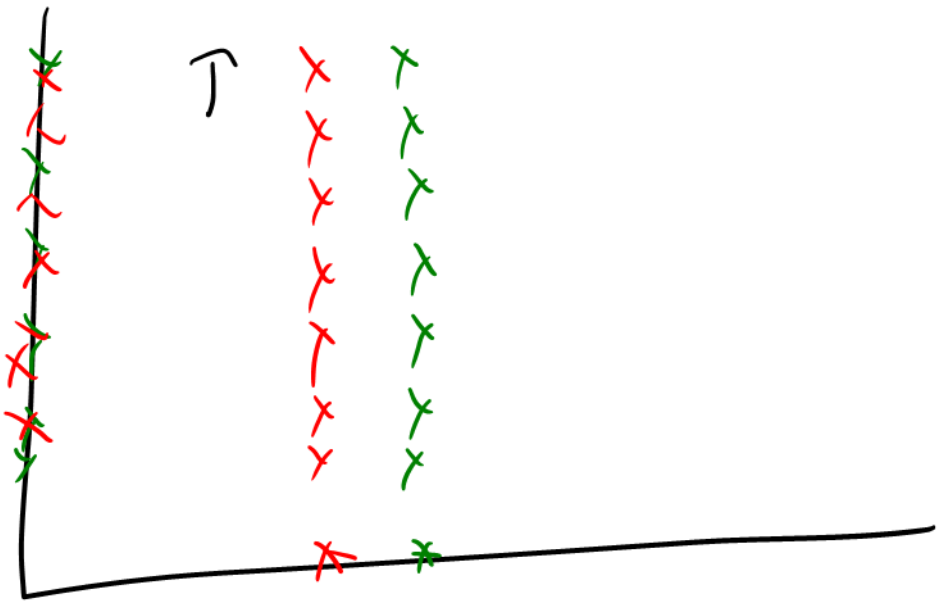
squares with the
Distance
C

Singular
value
Decomposition
SVD

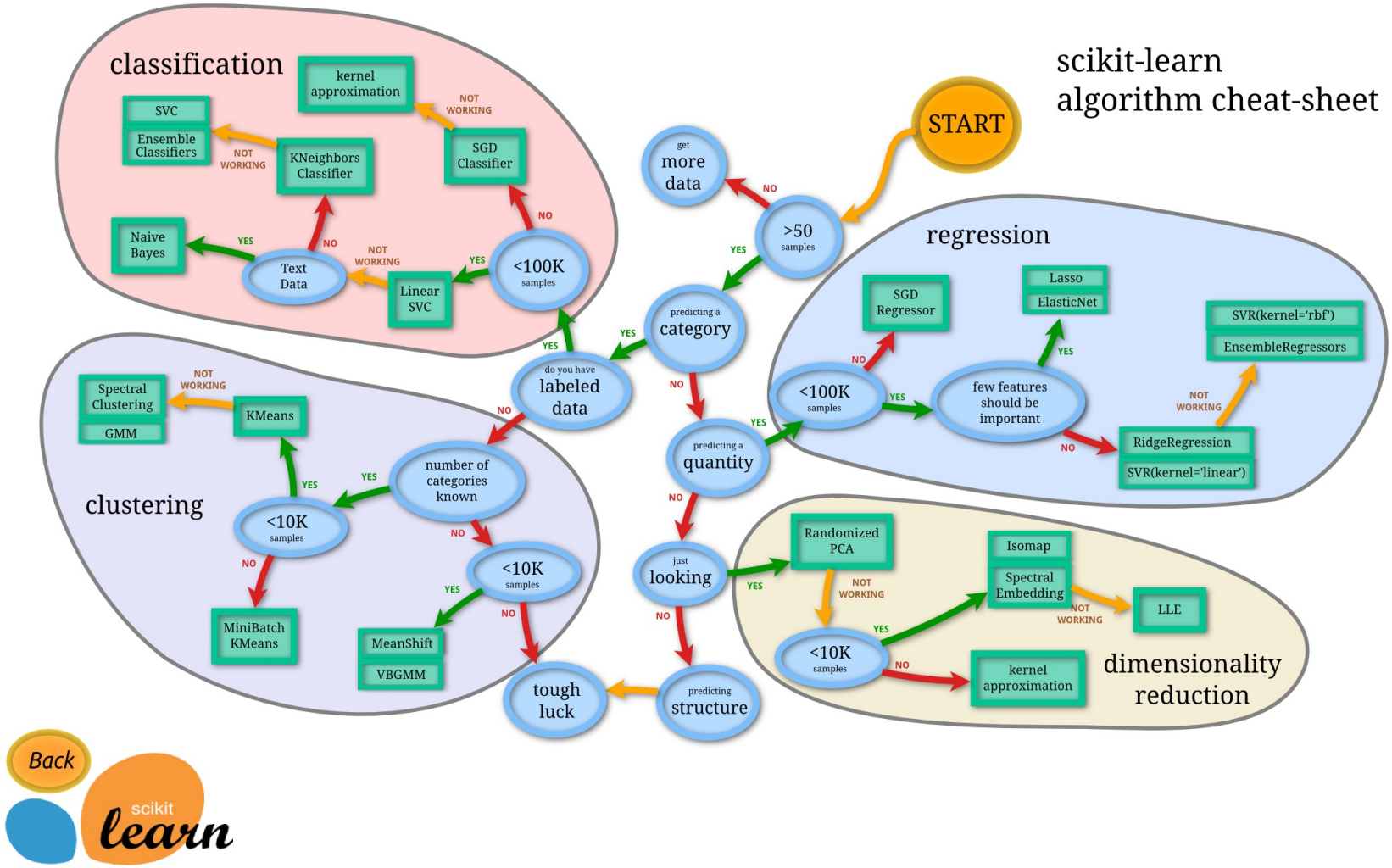


Lets take a look at it in Python





scikit-learn



http://scikit-learn.org/stable/tutorial/machine_learning_map/index.html

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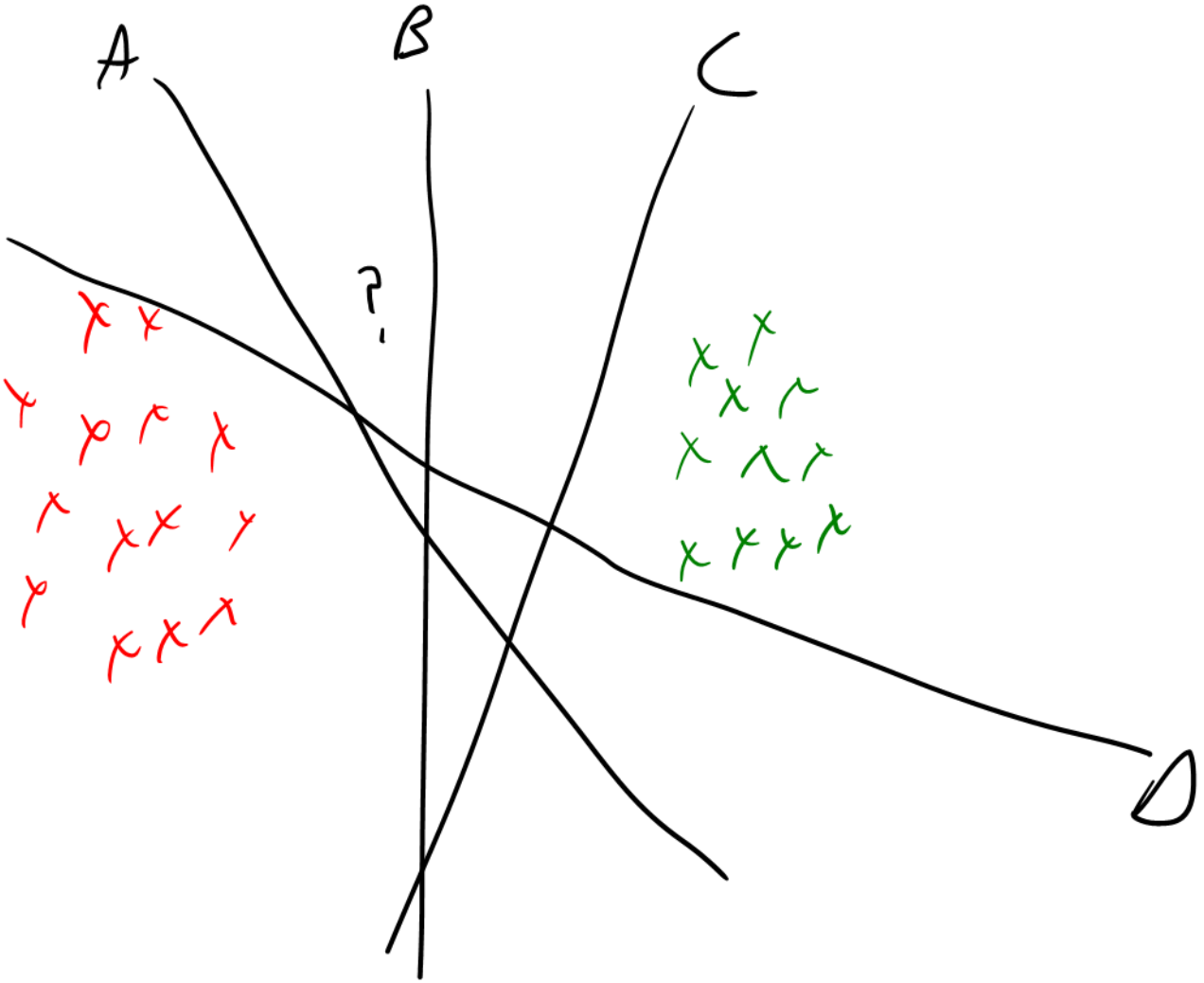
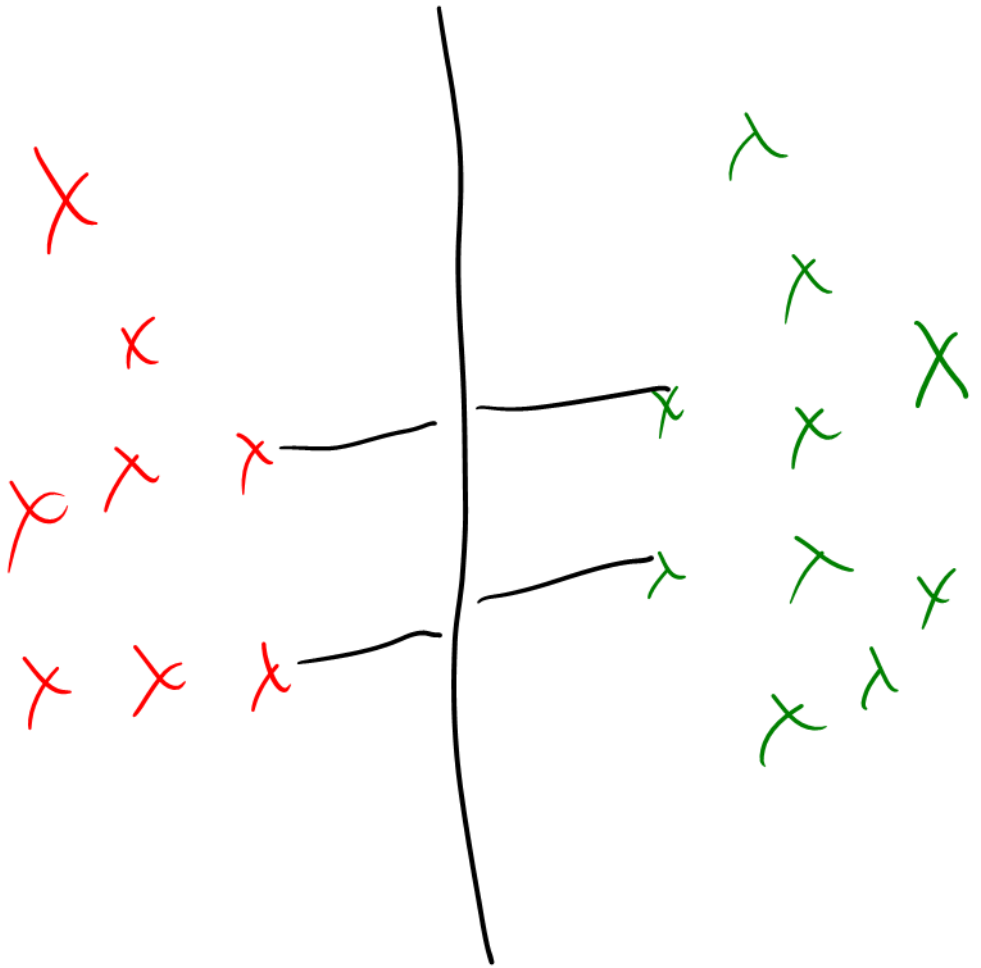
What is Linear Support Vector Machine (SVM)?

- Maximum margin classifier
  - Computes a linear “decision boundary” that splits the data into two regions.
  - Allows one to predict a classification of a point based upon which side of the decision boundary it lay on.

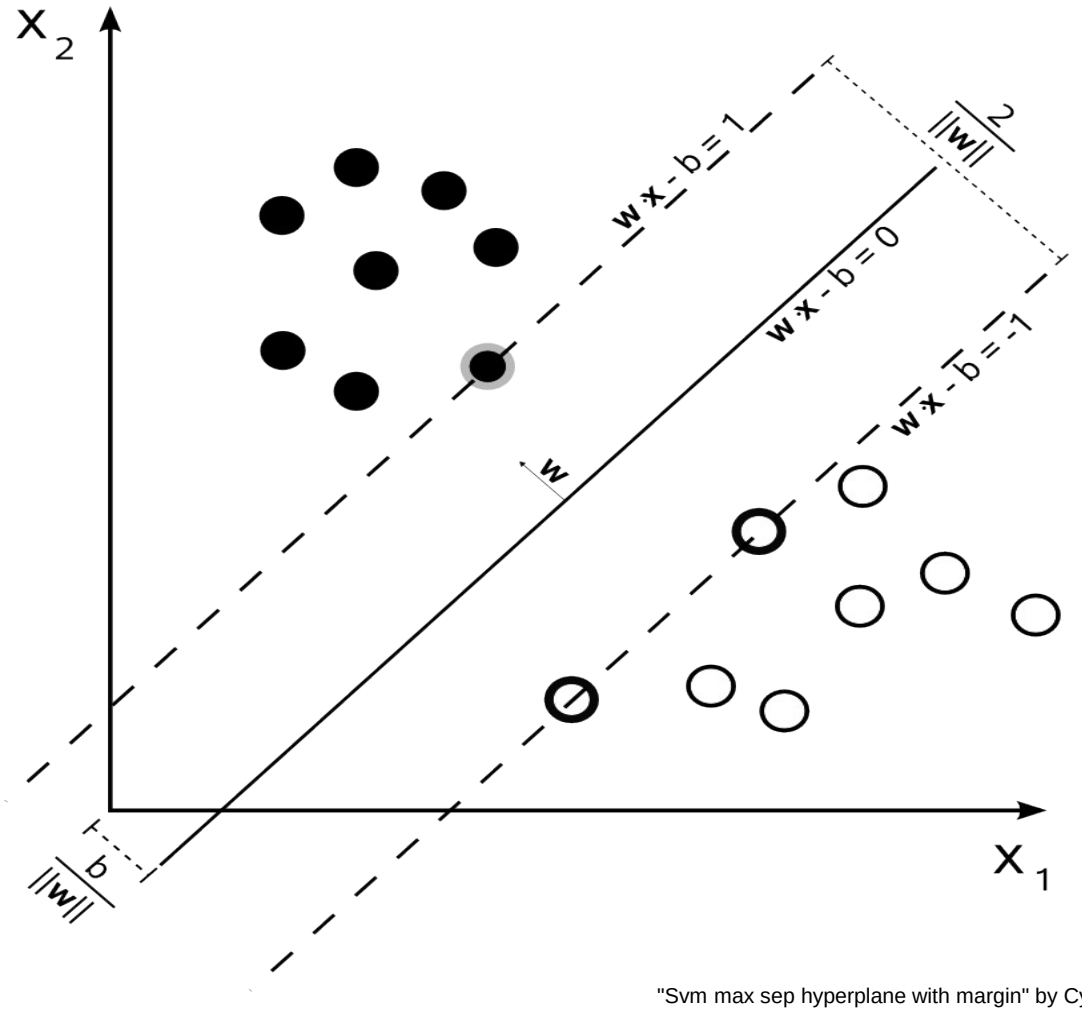
Let's derive SVM



maximize the minimum distance



SVM



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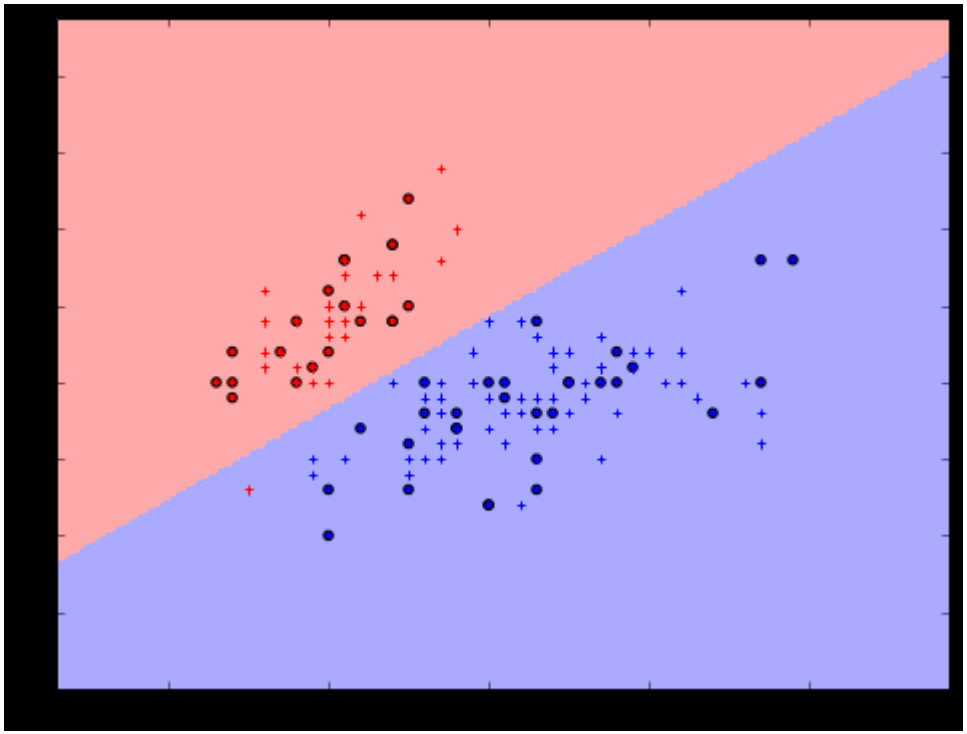
Let's look at SVM in Python



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But wait! Training vs. testing!

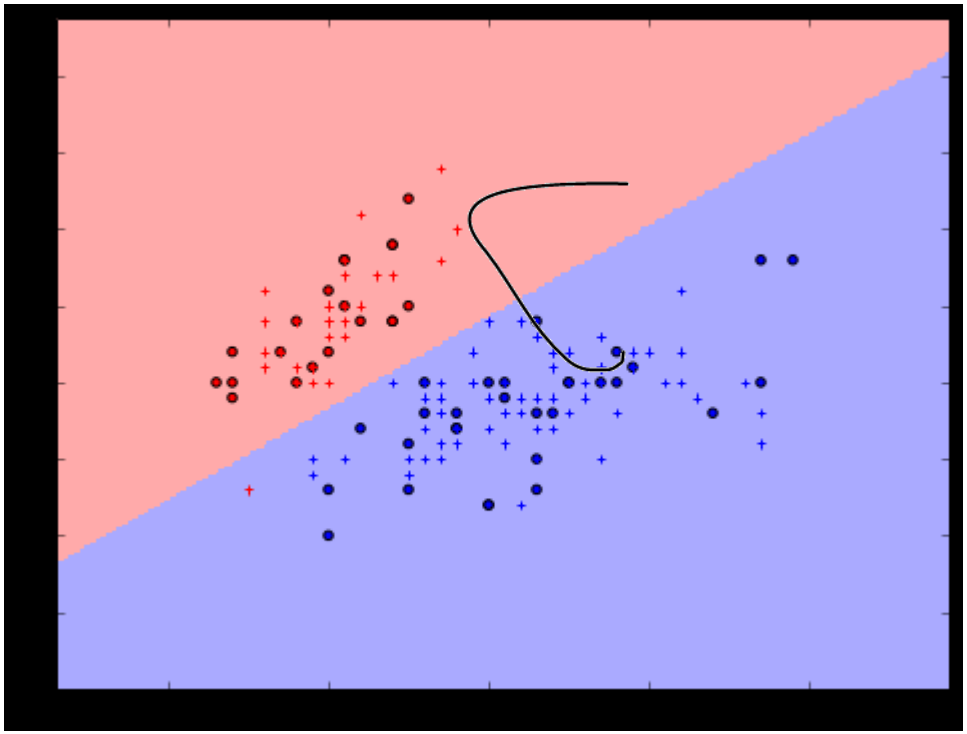
Some data For your algorithm

some data For testing your Algorithm

Fundamental

avoid over Fittings

Back to Python



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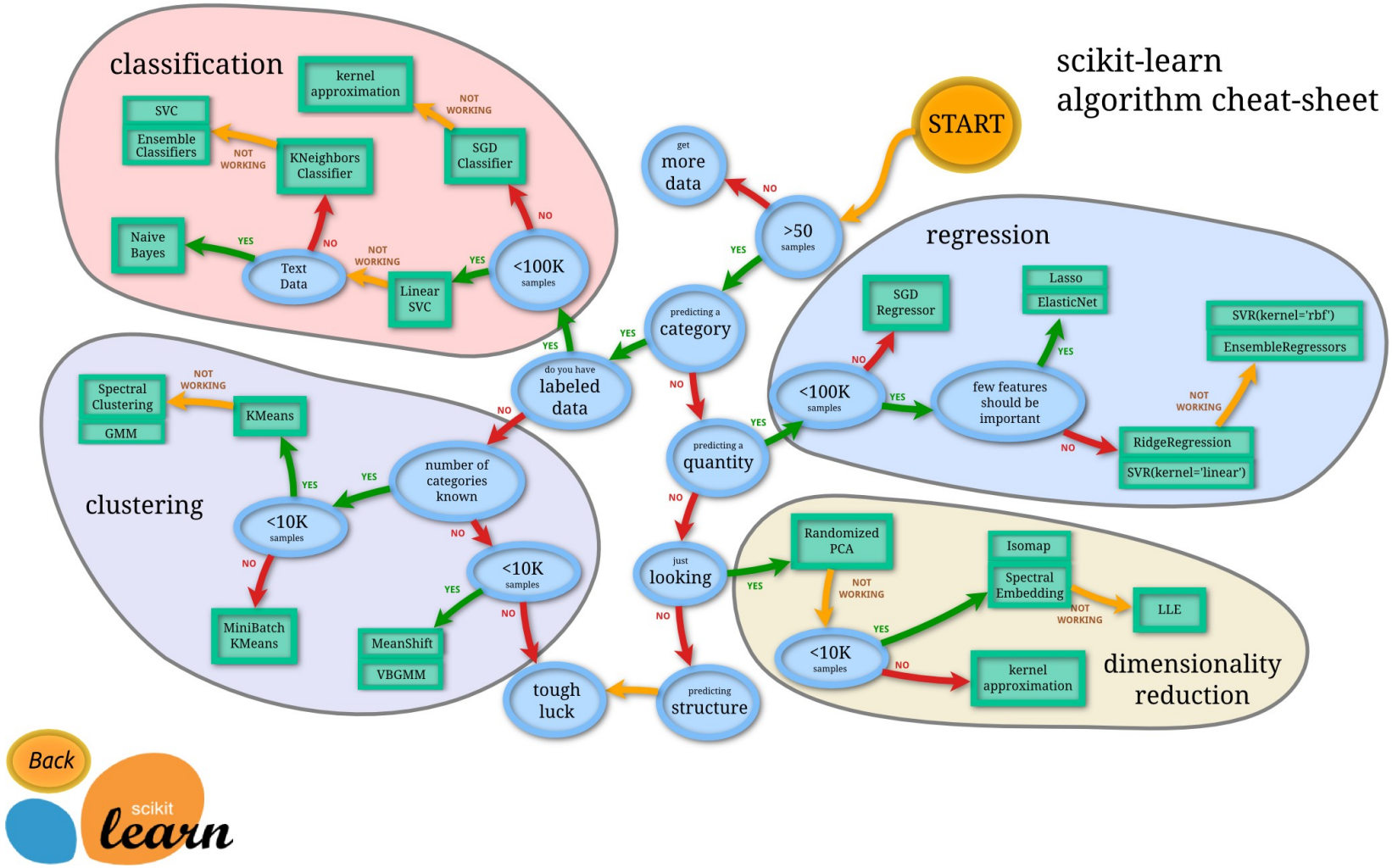

http://scikit-learn.org/stable/tutorial/machine_learning_map/index.html

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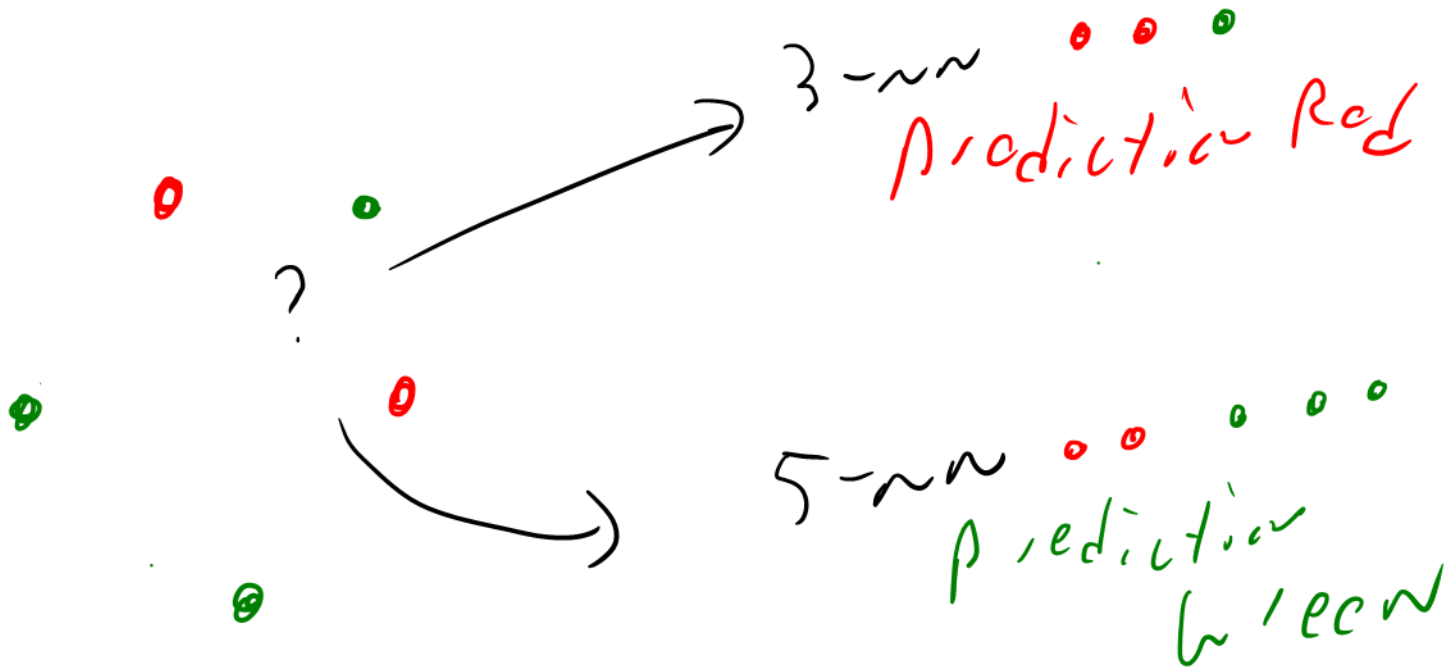
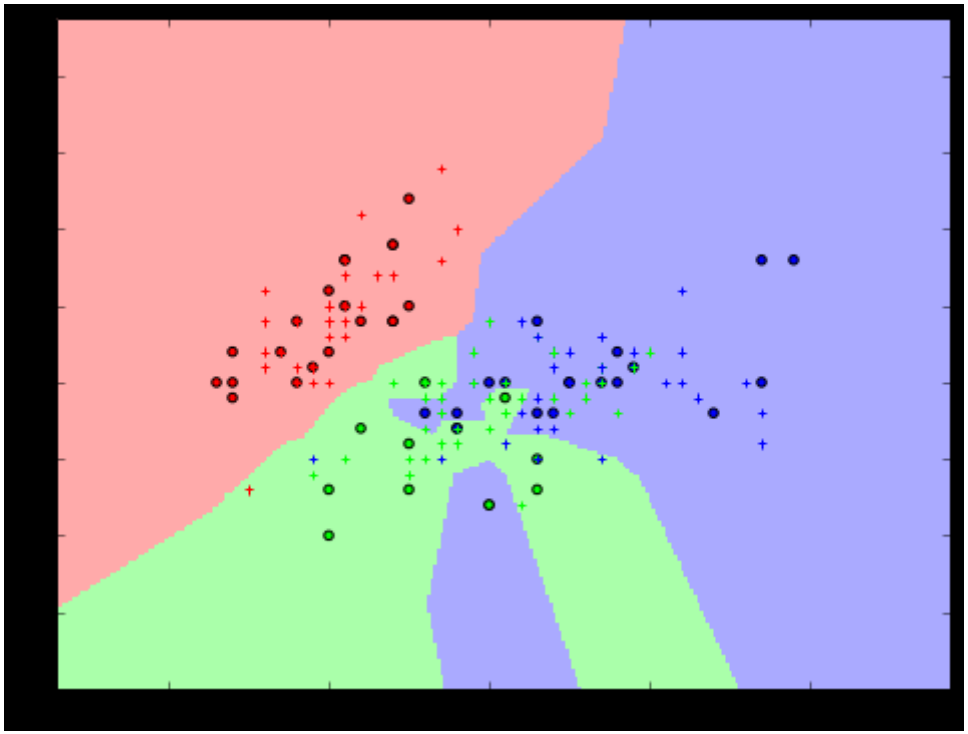
What is K-NN?

- K-nearest neighbors
- Another common classification algorithm
  - Perhaps the most common

Let's try an example



Let's try K-NN in Python



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