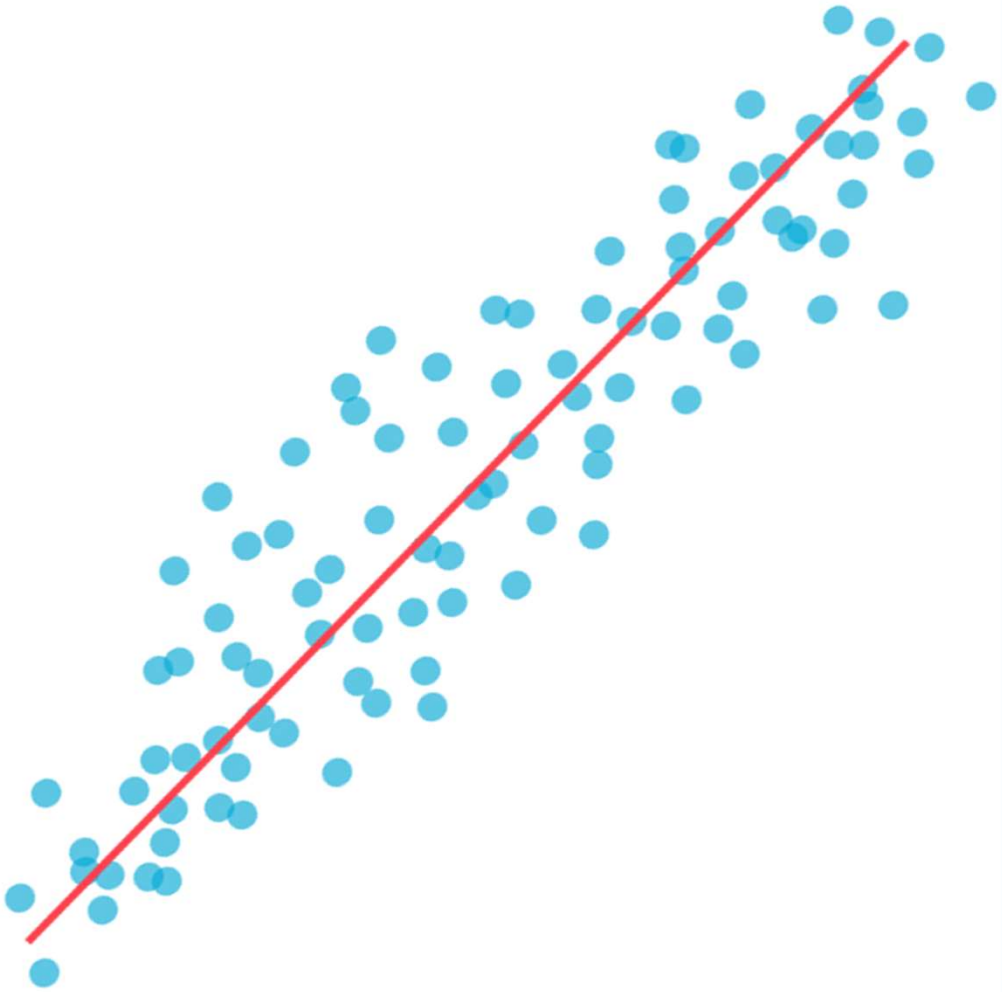

Supervised Machine Learning

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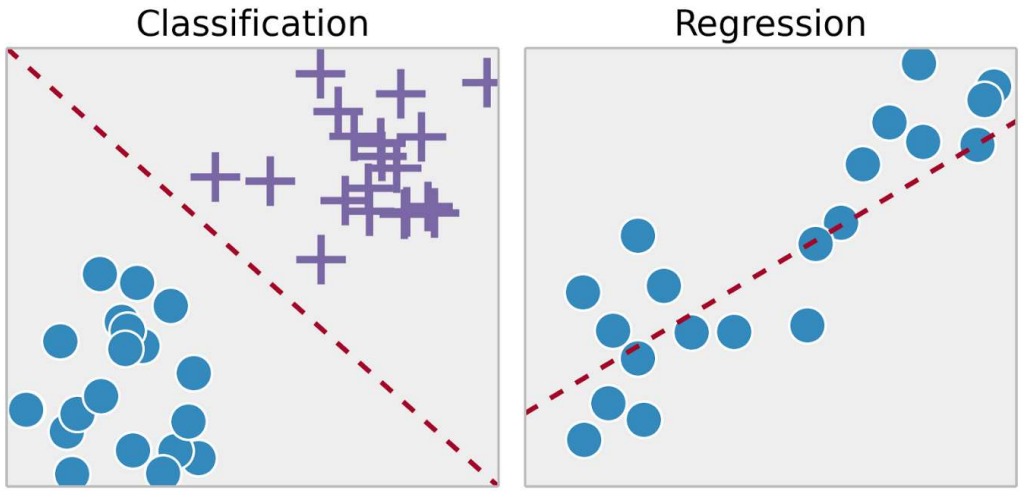
Supervised ML

- **Idea**: given a dataset and its corresponding desired output, determine the best algorithm & parameters to predict the output from the data
- **Use cases:**
  - Classification
    «which ad should I show this customer»
  - Regression / Prediction
- **Common Methods**:
  - Decision Trees
  - Support Vector Machines
  - **Neural Networks**



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How does “supervision” work?

- **Intuition:** 1 Algorithm **builds models**, 1 Algorithm **scores the models** and choses the best.
  - ➔ The builder Algorithm tweaks the best model and repeats
- **Building**: Depends on specific method, generally tweaking of model parameters.
- **Scoring**: Calculate a predefined **cost function / score**
  - E.g. Sum of Squared Errors (SSE)
- How Machnes Learn [CGPGrey]

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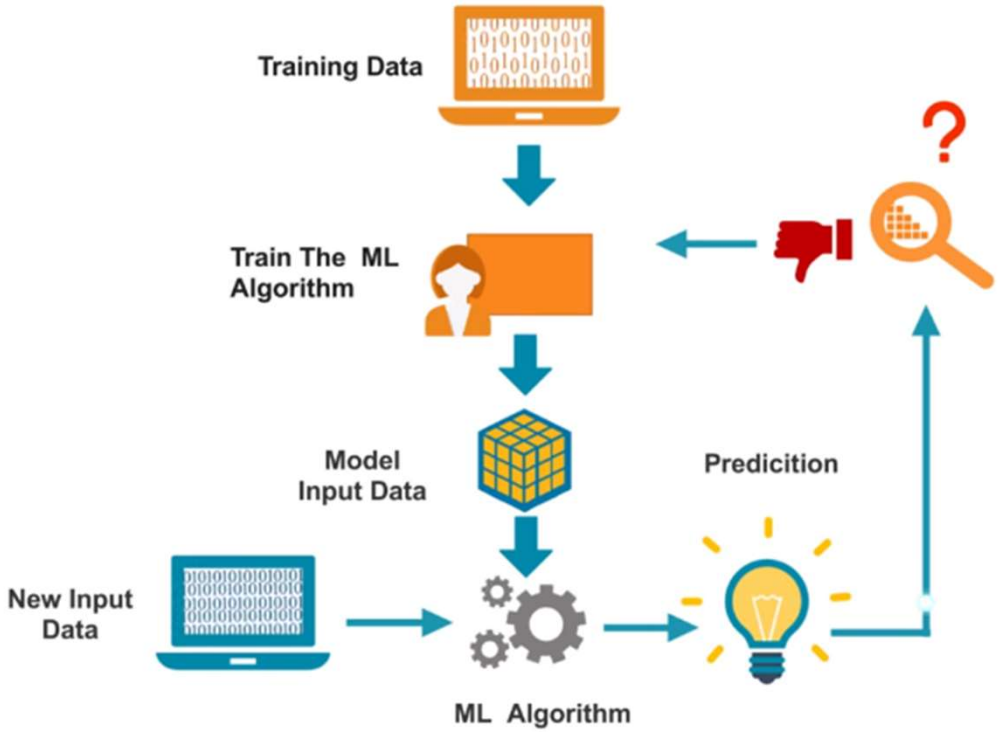
Typical Supervised ML Workflow

1. Define Goal
2. Get Data
3. Prepare Data
4. Create & Train A Model
5. Evaluate & Improve
6. Make Predictions



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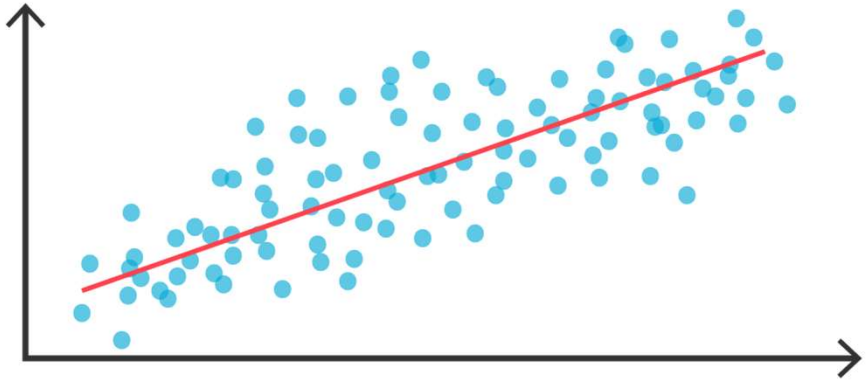
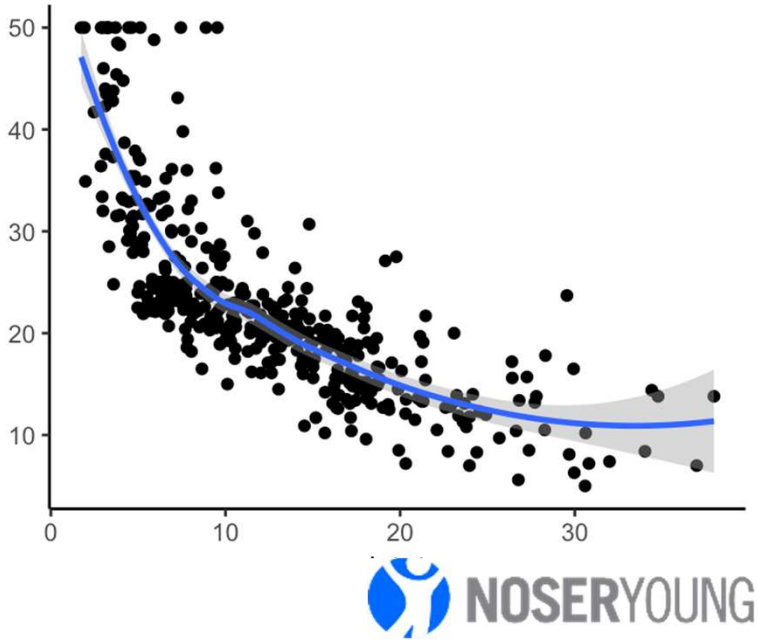
Regression

- **Idea:** Given a set of input variables, predict a numerical output variable
- **Use cases:**
  - Prediction in Marketing, Medicine, Finance etc.
- **Method:**
  - Find line that minimizes error between prediction and real values





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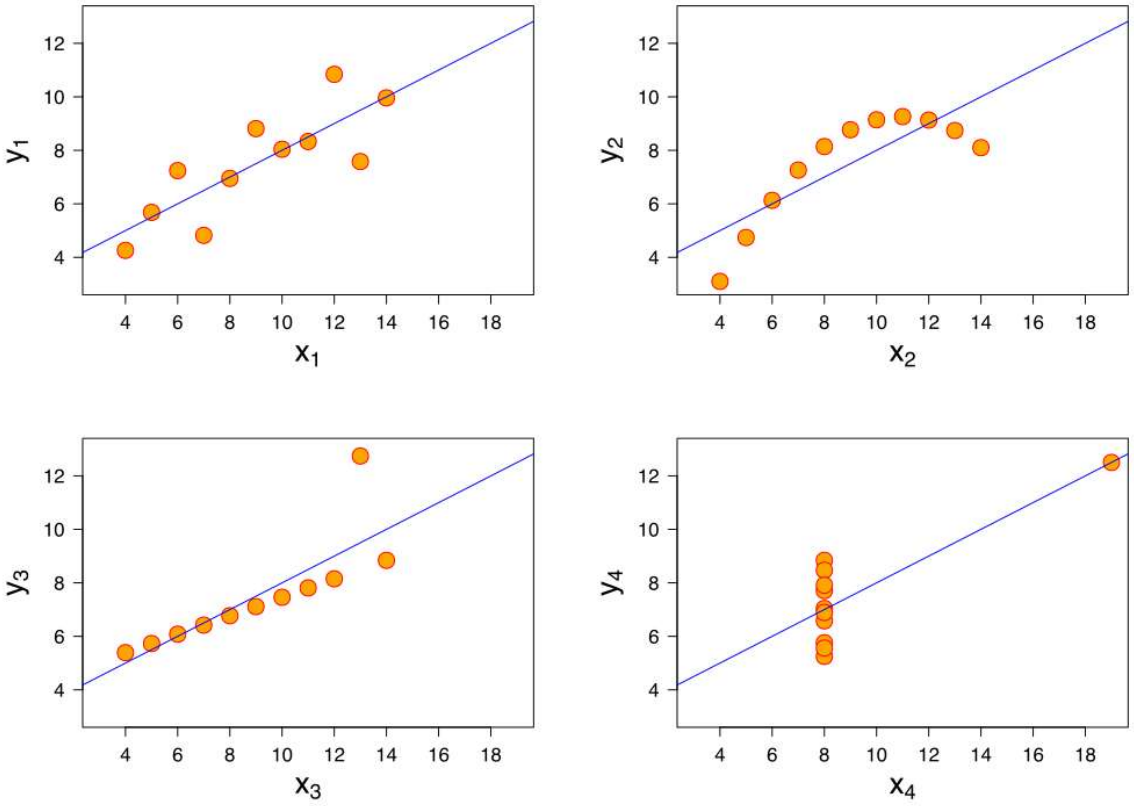
Regression

Problems

- Can be susceptible to outliers (this can be overcome)
- Can be susceptible to over- / underfitting



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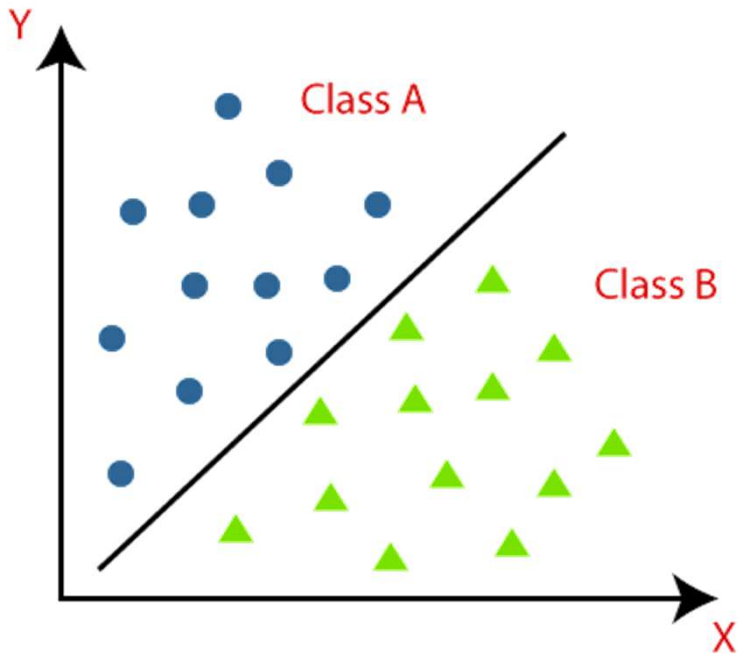
Classification

- **Idea:** given a set of input variables, predict a class for each datapoint
- **Use cases:**
  - Image-/ Speech-recognition
  - Medical prognosis
  - Customer Segmentation
  - Spam detection



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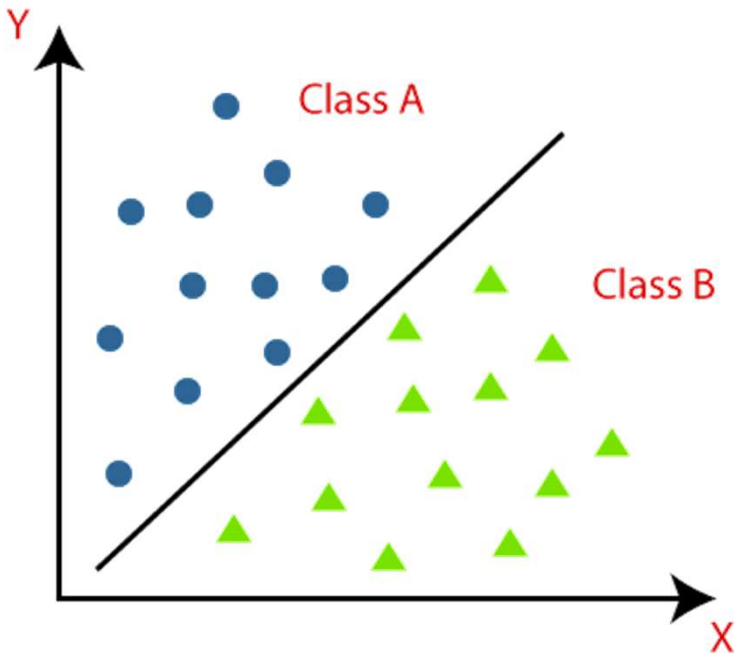
Classification

Method

- In general, the aim is to minimize the number and severity of wrong assignments
- **Selection of classification Algorithms:**
  - K-nearest neighbours
  - Decision Trees
  - Support Vector Machines
  - Neural Networks



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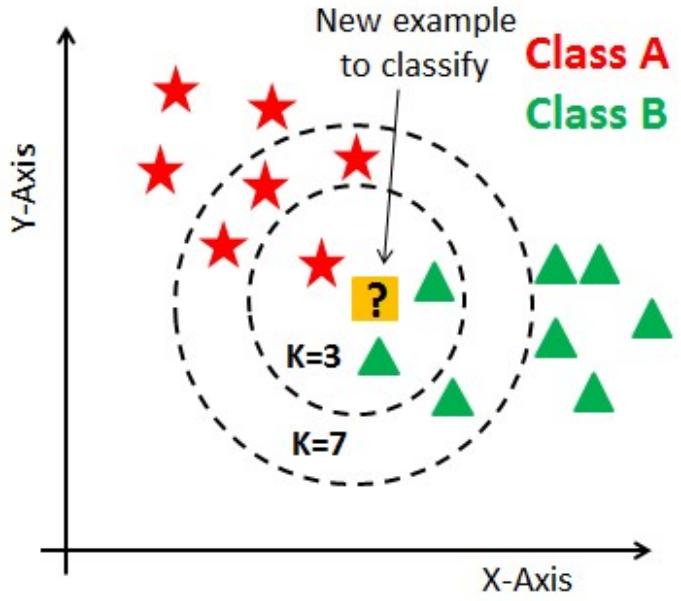
K-nearest-neighbour

- **Idea**: classify a point as the majority class of its k nearest neighbours.
- **Pros**: no training, simple, easy to incorporate more data
- **Con**: cannot handle very large, very high dimensional or imbalanced datasets. Sensitive to outliers



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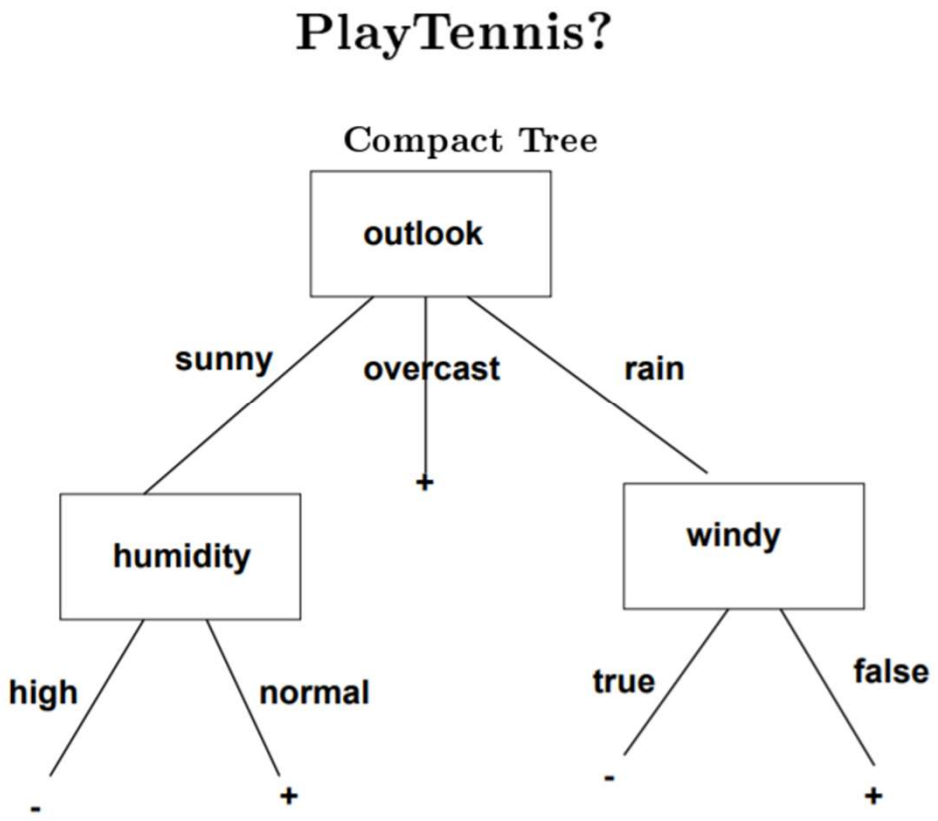
Decision Trees

- **Idea**: find a combination of binary decisions that best classify all datapoints into output classes
- **Pros**: less preporocessing required Easy to interpret and may give additional insights
- **Con**: unstable results ➔ ensamble methods (random forest)



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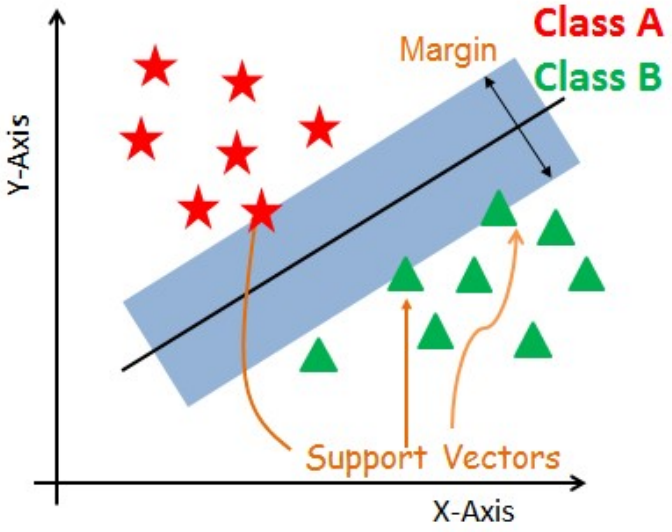
Support Vector Machines

- **Idea**: find the hyperplane (Line in 2D) that best separates the classes (largest margin)

- **Pros**: handles high dimensional data well
- **Cons**: problems with noisy / overlapping data.



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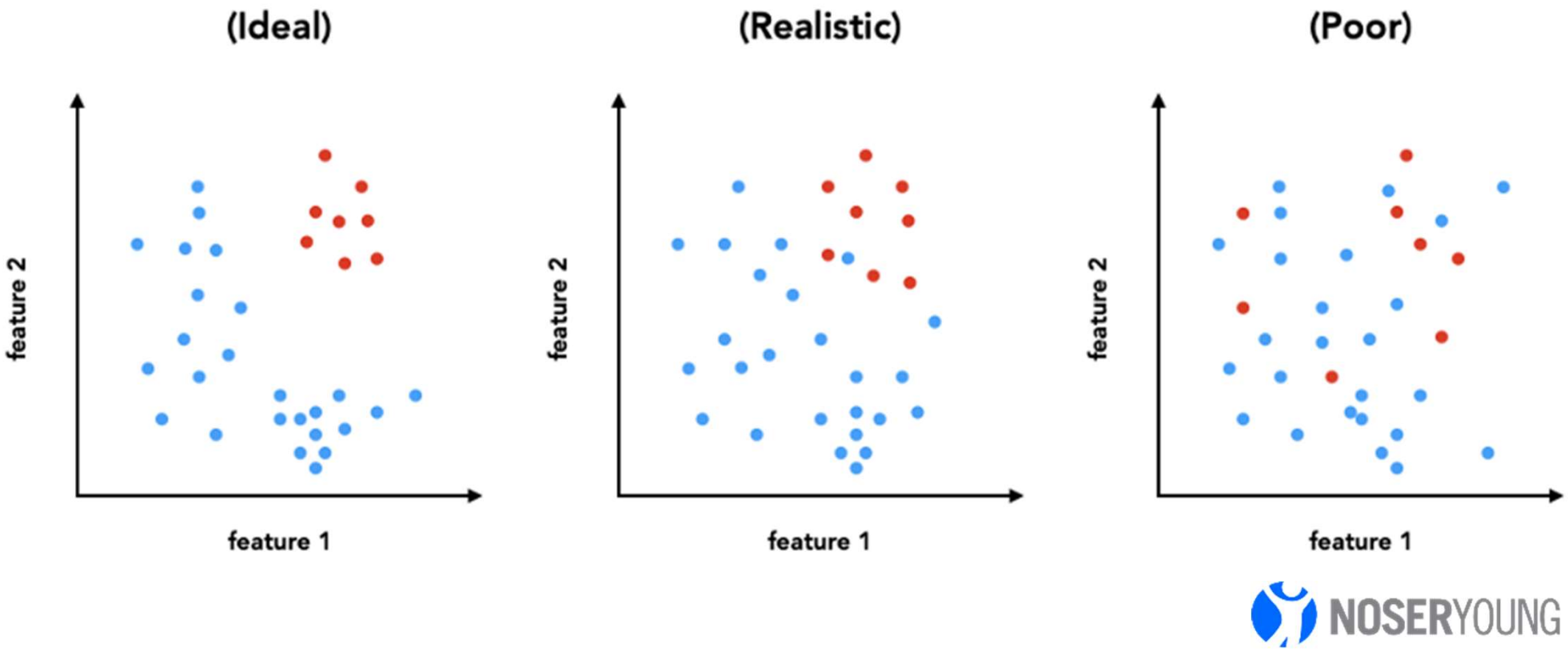
Problems

Poor class separation



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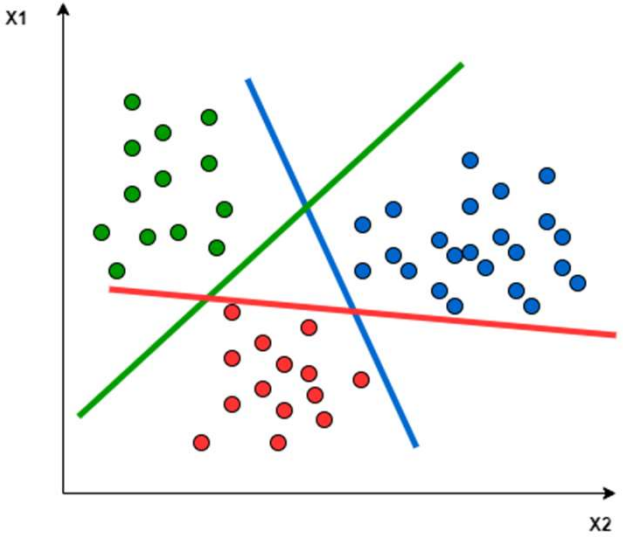
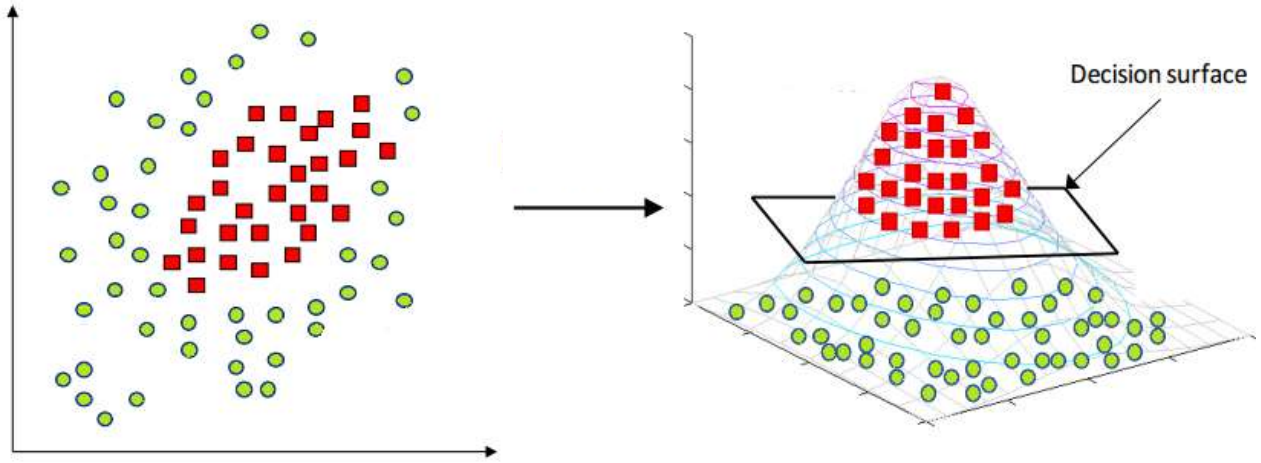
Problems

Advanced

Multi-Class Classification



Feature Transformation



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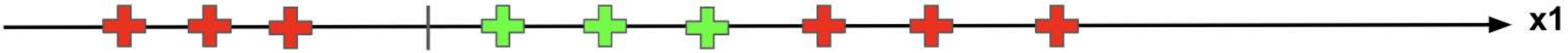
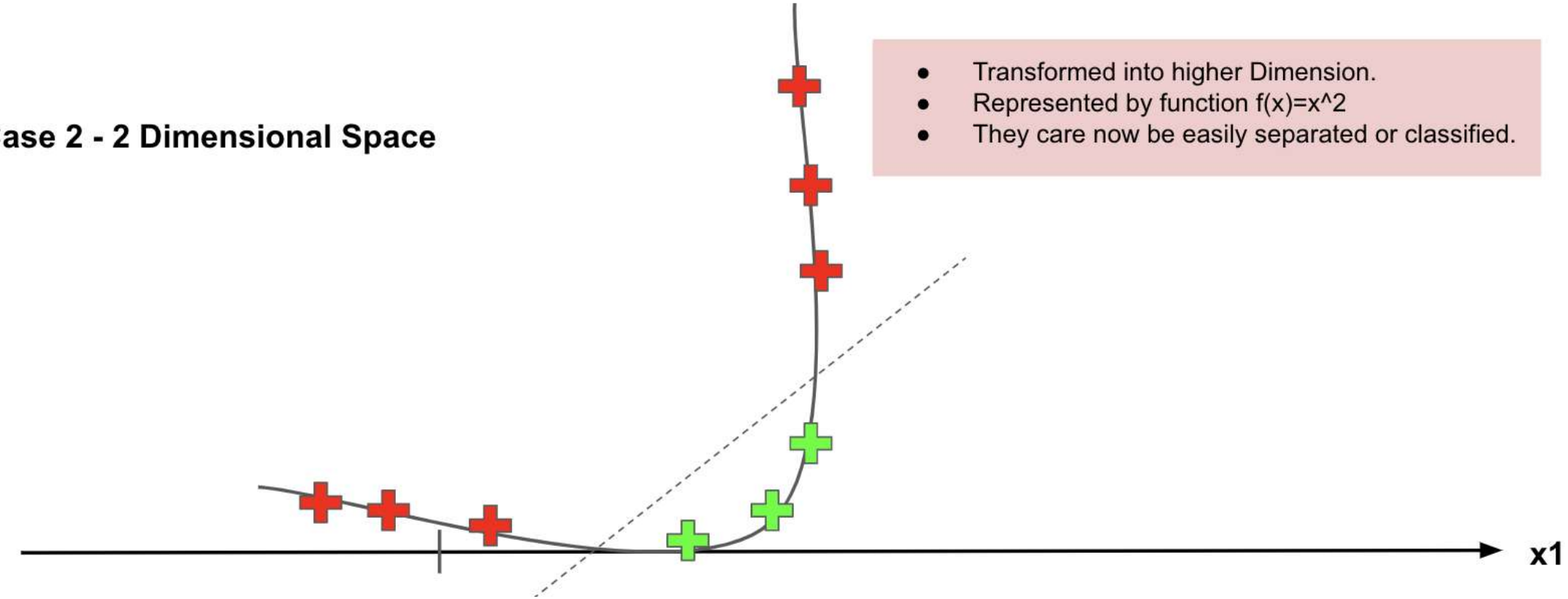
Case 1 - 1 Dimensional Space

- Points in 1 Dimension Plan.
- Represented by function f(x)=x
- They cannot be separated or classified.



Case 2 - 2 Dimensional Space

- Transformed into higher Dimension.
- Represented by function f(x)=x^2
- They care now be easily separated or classified.



Hands-On

Part 4

1. Implement the KNN Algorithm for a set of 2D datapoints (use the ‘`sklearn make_blobs`’ function to get a random dataset with underlying clusters)
2. Use seaborn.lmplot to perform a linear regression on the tips dataset
   - `tips = sns.load_dataset("tips")`
3. Use sklearn.svm.SVC to **train** a SVM classifier and plot the data with your trained classifier.
   - cancer = datasets.load_breast_cancer()
   - Use your trained classifier to predict the classes of new datapoints.

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