LOGO

BigData Engineering

10주차: Supervised Learning

강의 : 신경섭

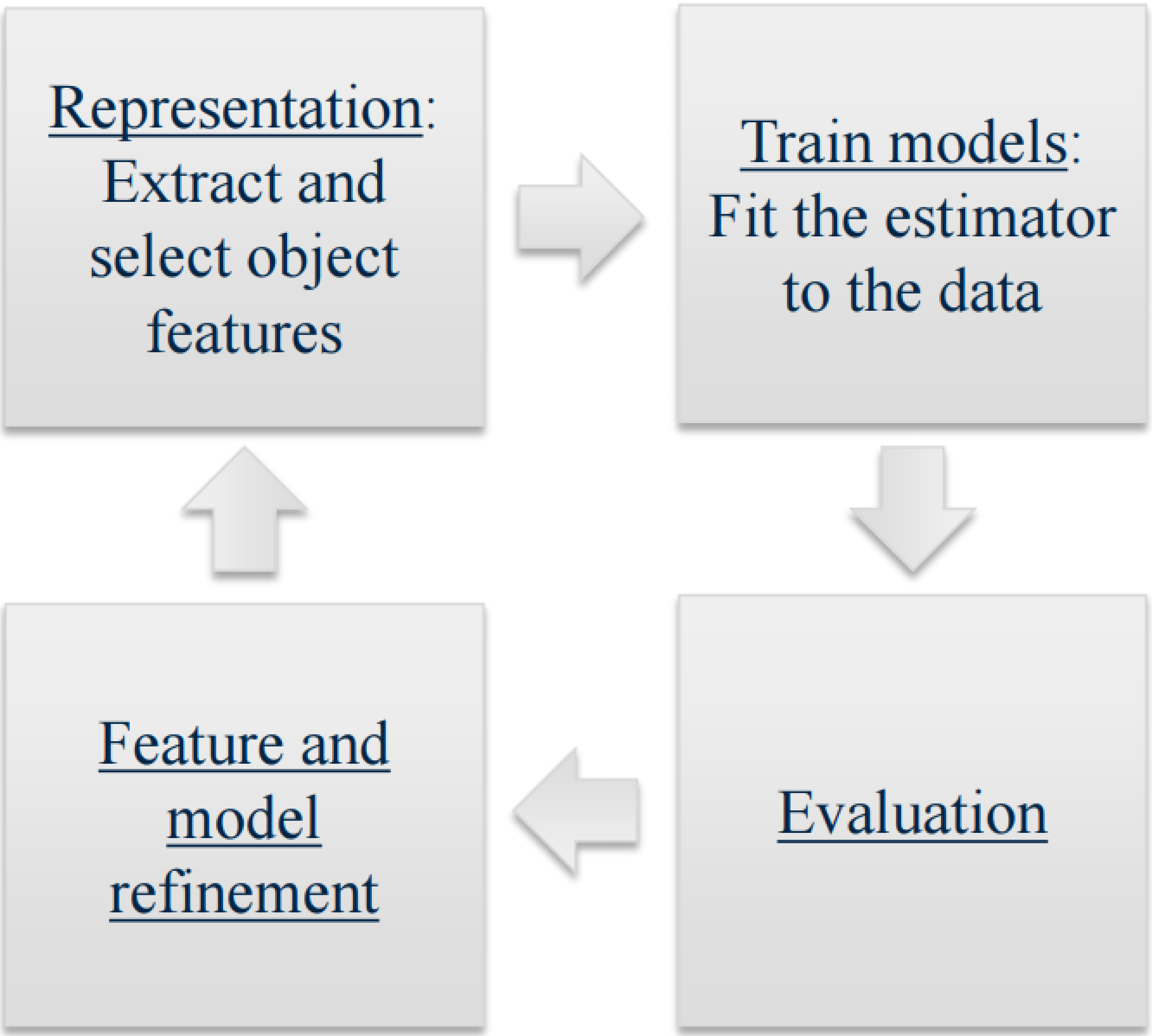
We covered...

- Data management by python
  - Numpy, pandas, data acquisition
- Machine learning workflow with data

Today's Subjects

- EDA (Exploratory Data Analysis)
- Supervised learning
  - Examples – k-NN classifier
  - Regression : linear regression
  - Classification : logistic regression based binary classification

Represent / Train / Evaluate / Refine Cycle



Before feature representation.....

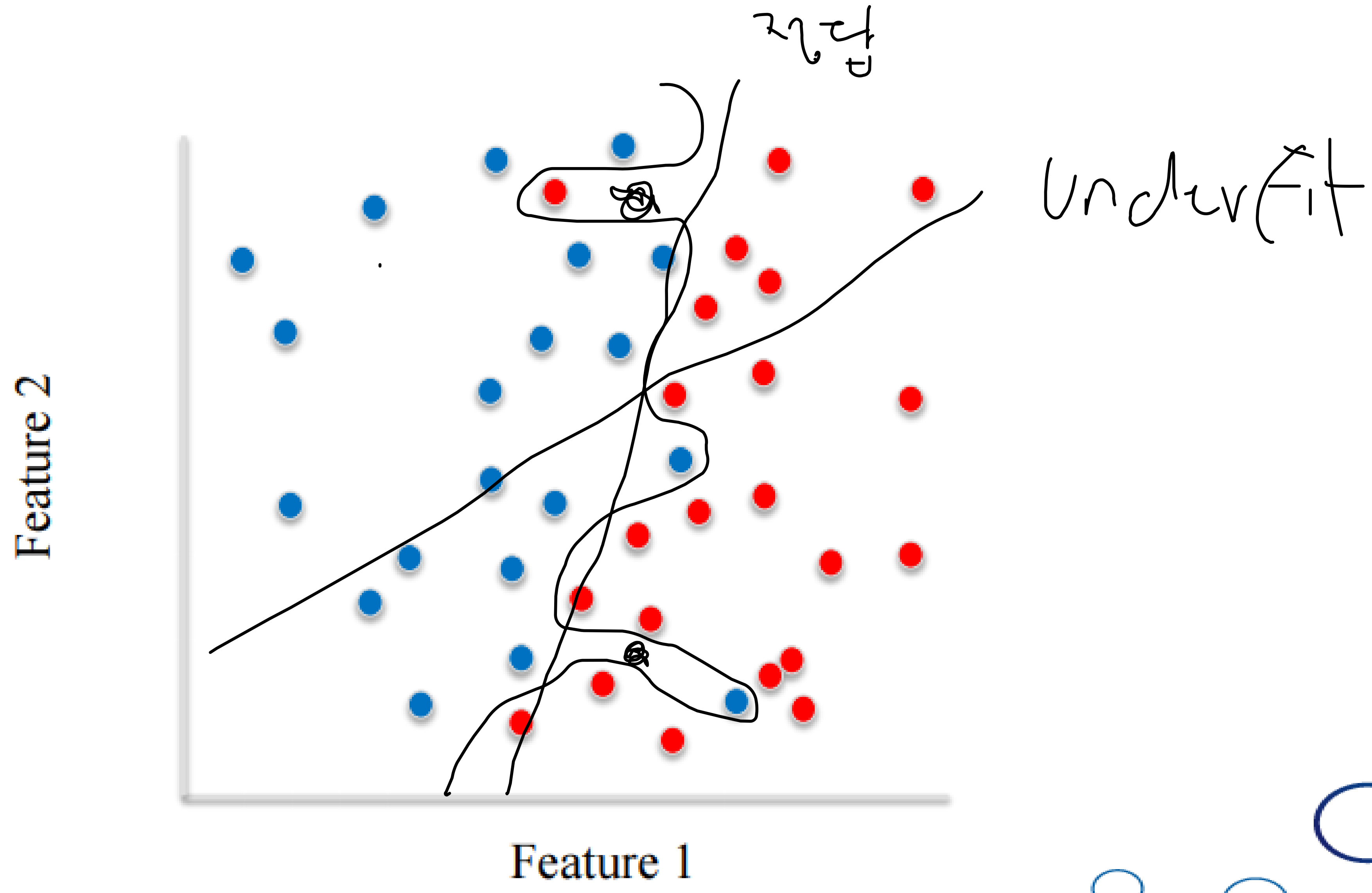
- EDA (Exploratory Data Analysis)
  - Understanding your variables
  - Cleaning your dataset
  - Analyzing relationship between variables

- Read: https://towardsdatascience.com/an-extensive-guide-to-exploratory-data-analysis-ddd99a03199e

Generalization, overfitting, and underfitting

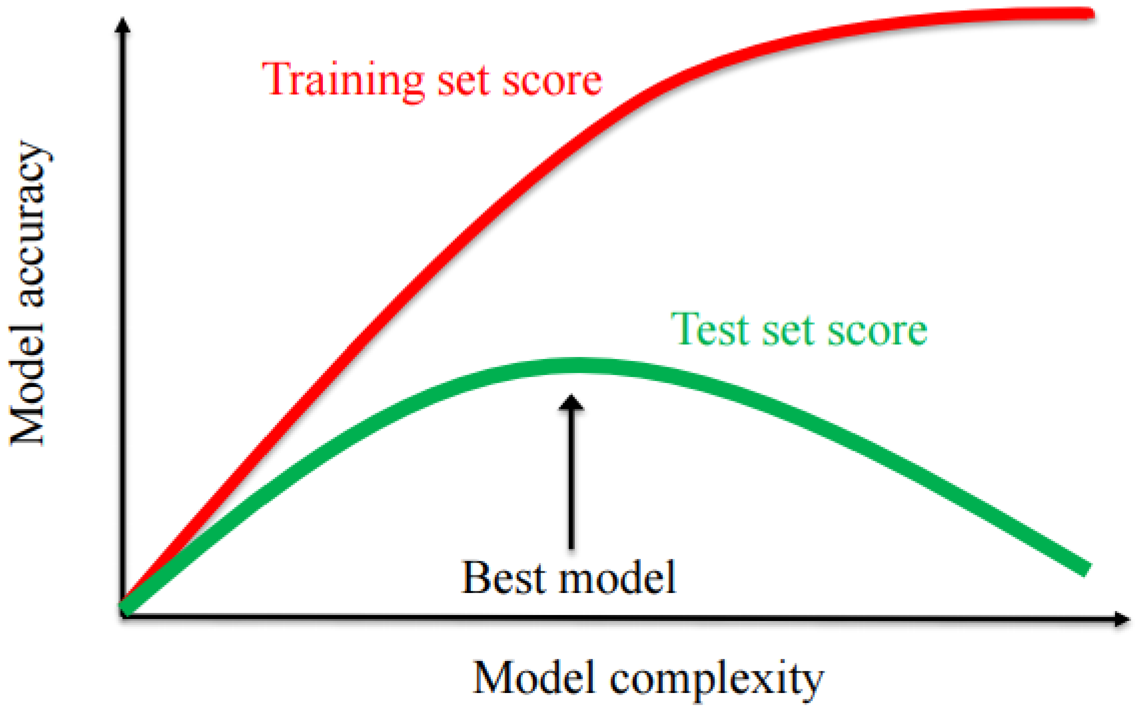
- Generalization ability refers to an algorithm's ability to give accurate predictions for new, previously unseen data.
- Assumptions:
  - Future unseen data (test set) will have the same properties as the current training sets.
  - Thus, models that are accurate on the training set are expected to be accurate on the test set.
  - But that may not happen if the trained model is tuned too specifically to the training set.
- Models that are too complex for the amount of training data available are said to overfit and are not likely to generalize well to new examples.
- Models that are too simple, that don't even do well on the training data, are said to underfit and also not likely to generalize well.

Overfitting in classification

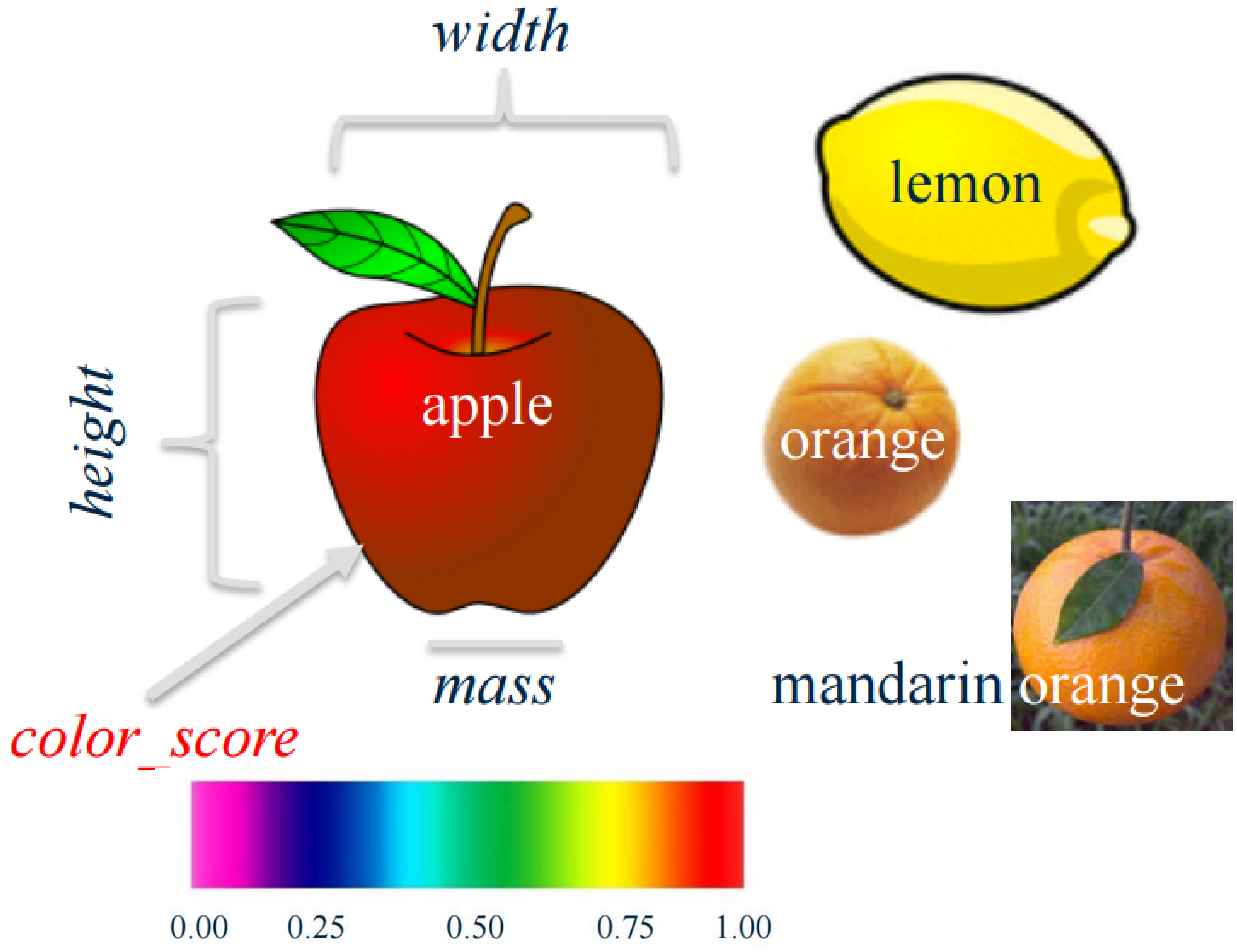


Overfitting

- The relationship between model complexity and training/test performance



Fruit Dataset

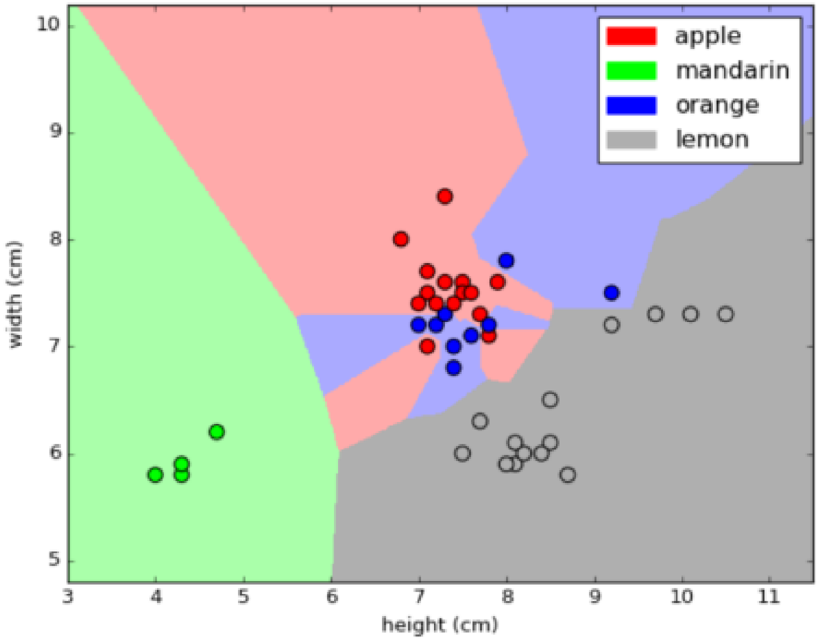


	fruit_label	fruit_name	fruit_subtype	mass	width	height	color_score
0	1	apple	granny_smith	192	8.4	7.3	0.55
1	1	apple	granny_smith	180	8.0	6.8	0.59
2	1	apple	granny_smith	176	7.4	7.2	0.60
3	2	mandarin	mandarin	86	6.2	4.7	0.80
4	2	mandarin	mandarin	84	6.0	4.6	0.79
5	2	mandarin	mandarin	80	5.8	4.3	0.77
6	2	mandarin	mandarin	80	5.9	4.3	0.81
7	2	mandarin	mandarin	76	5.8	4.0	0.81
8	1	apple	braeburn	178	7.1	7.8	0.92
9	1	apple	braeburn	172	7.4	7.0	0.89
10	1	apple	braeburn	166	6.9	7.3	0.93
11	1	apple	braeburn	172	7.1	7.6	0.92
12	1	apple	braeburn	154	7.0	7.1	0.88
13	1	apple	golden_delicious	164	7.3	7.7	0.70
14	1	apple	golden_delicious	152	7.6	7.3	0.69
15	1	apple	golden_delicious	156	7.7	7.1	0.69
16	1	apple	golden_delicious	156	7.6	7.5	0.67

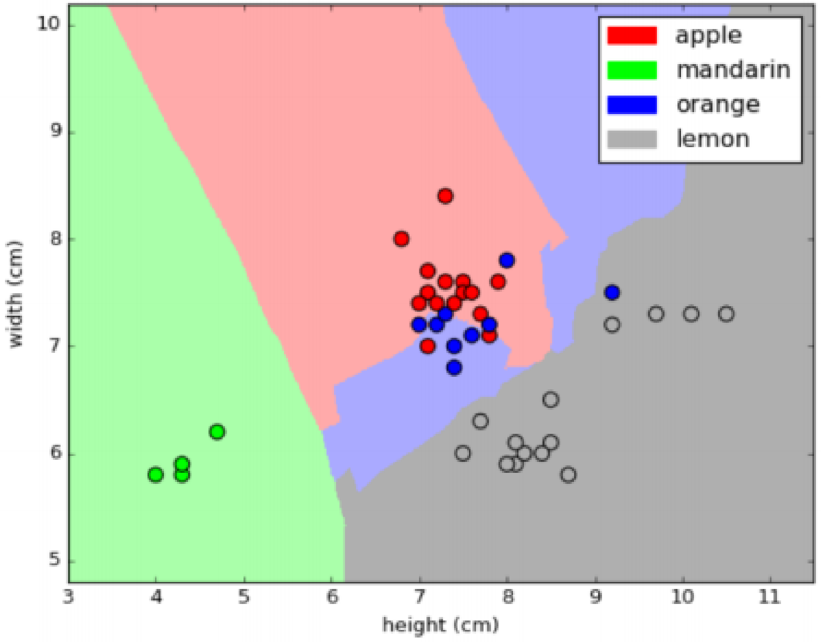
fruit_data_with_colors.txt

The k-Nearest Neighbor(k-NN) Algorithm

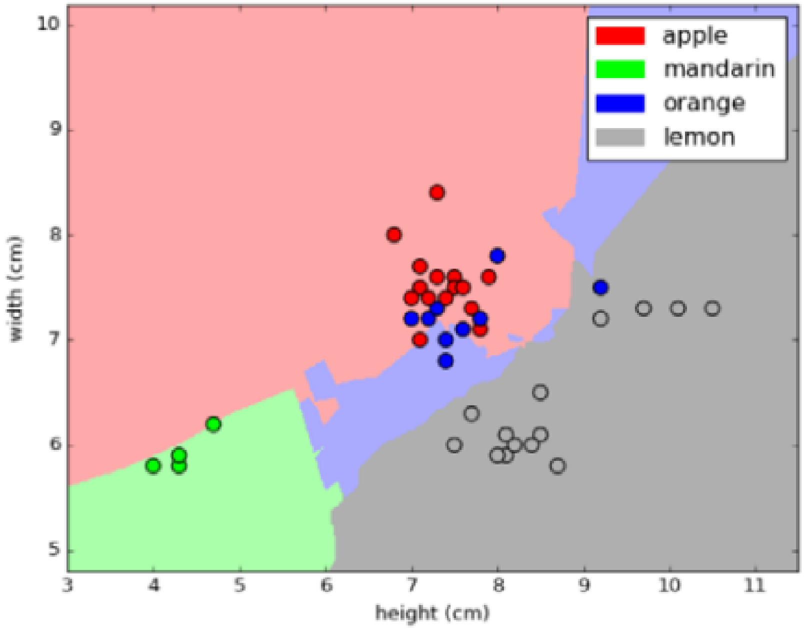
- **Find k nearest neighbor data to classification**



K=1



K=5



K=10

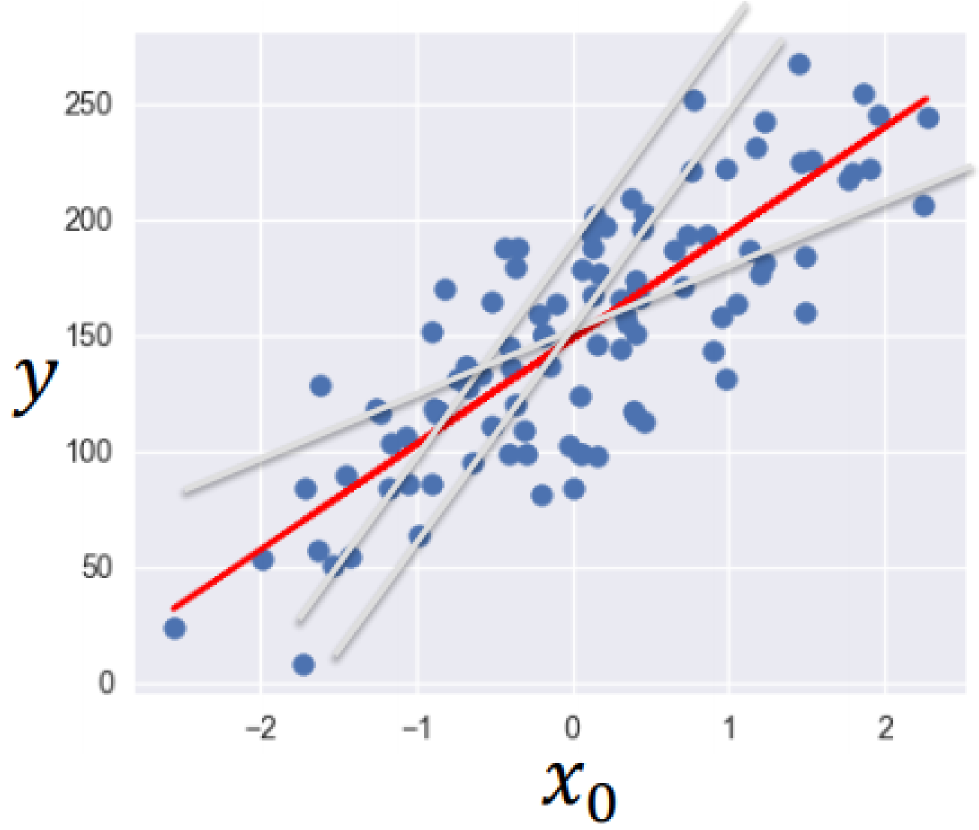
Linear regression

- Example : linear regression model with one variable

Input instance: $\boldsymbol{x} = (x_0)$

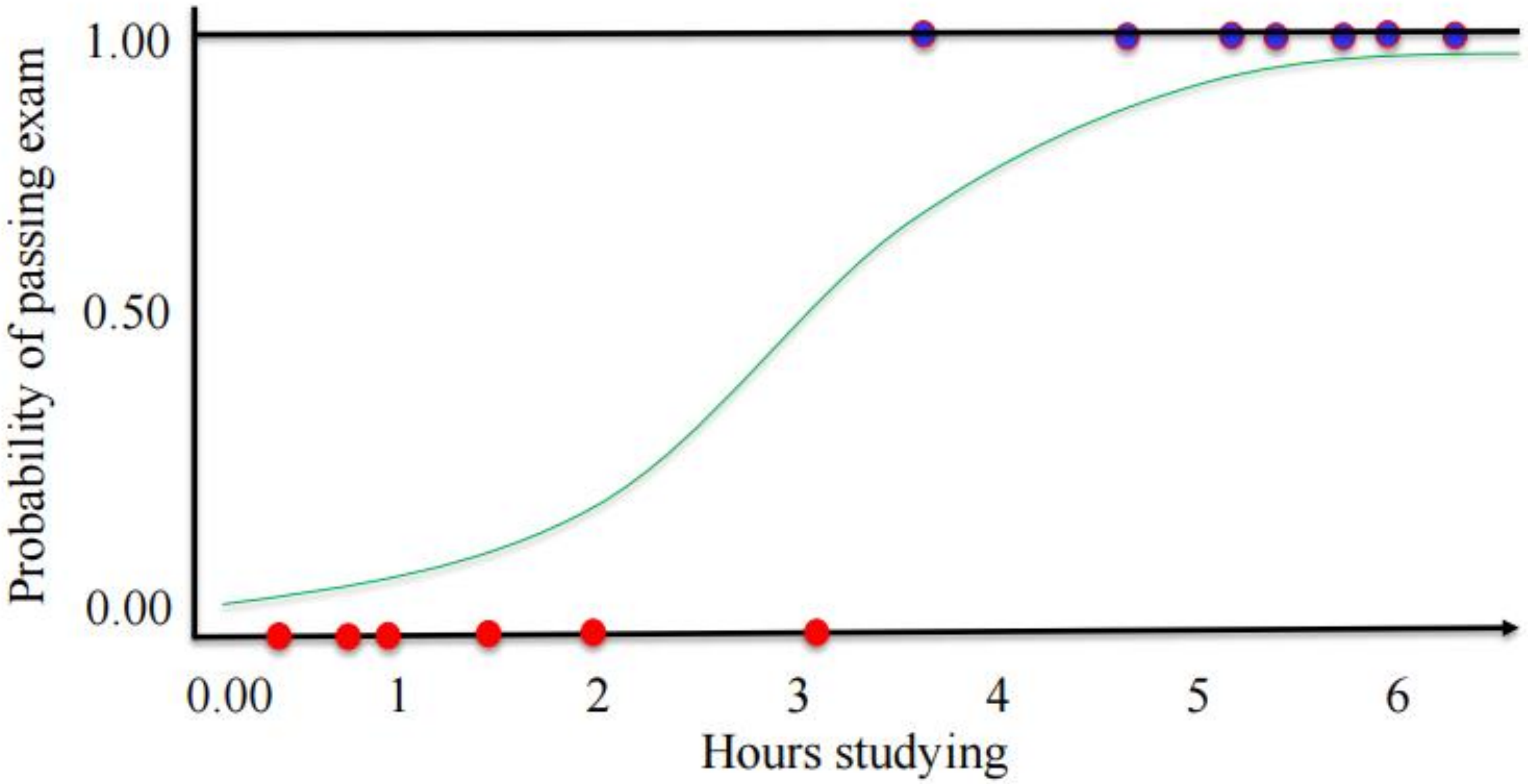
Predicted output: $\hat{y} = \widehat{w_0} x_0 + \hat{b}$

Parameters to estimate: $\widehat{w_0}$ (slope) $\hat{b}$ (y-intercept)

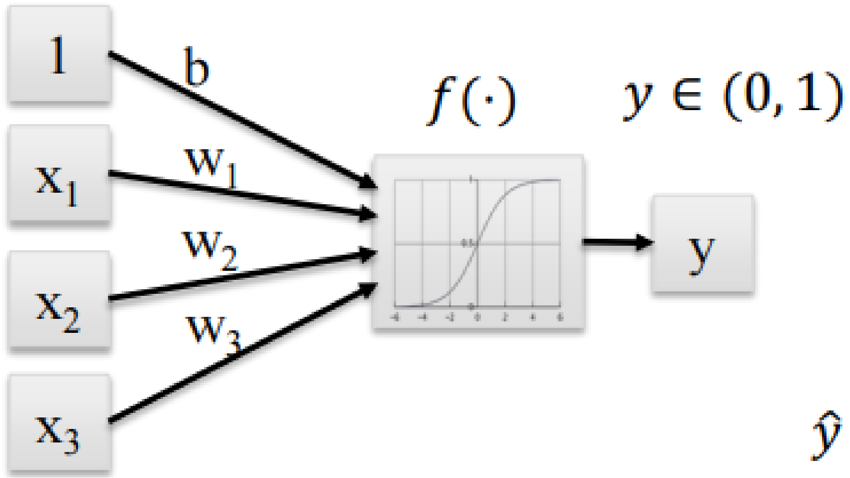


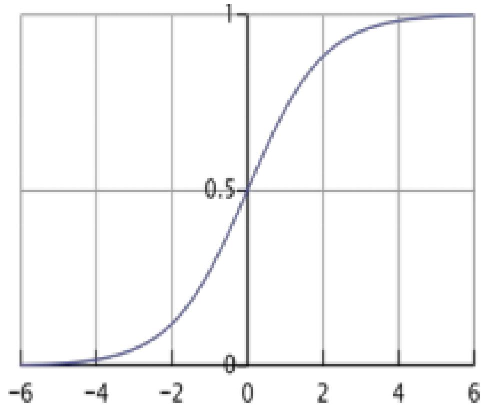
- Objective: minimize $RSS(\mathbf{w}, b) = \sum_{\{i=1\}}^{N} (\mathbf{y}_i - (\mathbf{w} \cdot \mathbf{x}_i + b))^2$

Linear Regression to Logistic Regression



Linear models for classification: Logistic Regression





$$\hat{y} = \text{logistic}(\hat{b} + \hat{w}_1 \cdot x_1 + \cdots \hat{w}_n \cdot x_n)$$

$$= \frac{1}{1 + \exp\left[-\left(\hat{b} + \hat{w}_1 \cdot x_1 + \cdots \hat{w}_n \cdot x_n\right)\right]}$$

Multi-class classification with linear models

```
clf = LinearSVC(C=5, random_state = 67)
clf.fit(X_train, y_train)

print(clf.coef_)

[[-0.23401135  0.72246132]
 [-1.63231901  1.15222281]
 [ 0.0849835   0.31186707]
 [ 1.26189663 -1.68097    ]]

print(clf.intercept_)
[-3.31753728  1.19645936 -2.7468353   1.16107418]
```