BATCH : **B 84** Data Science

LESSON : **Machine Learning**

DATE : 12.09.2022

SUBJECT : **Supervised Learning**

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MACHINE LEARNING - 3

Machine Learning

Makine Öğrenmesi – 3

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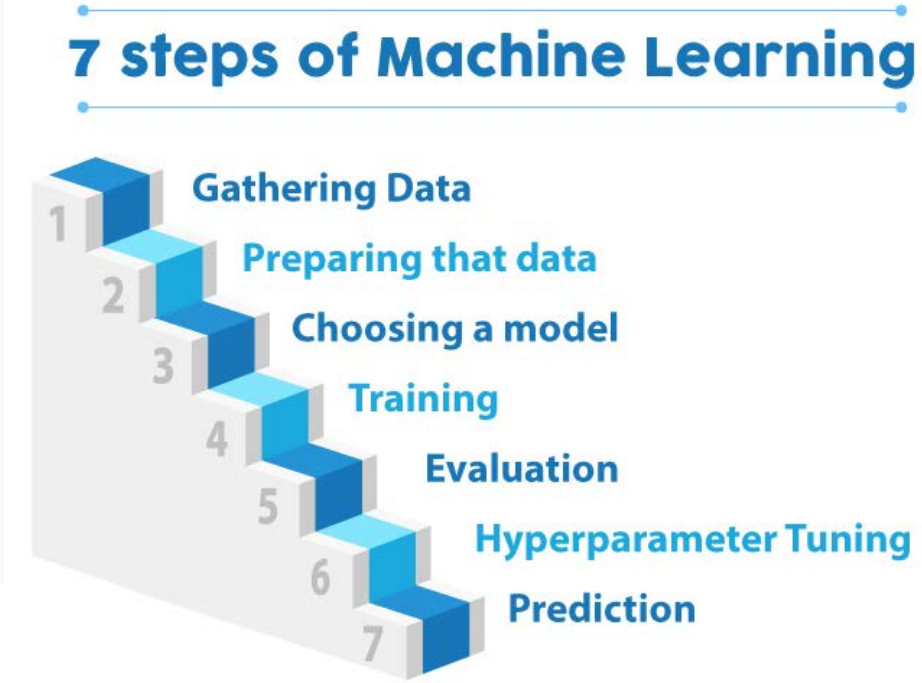
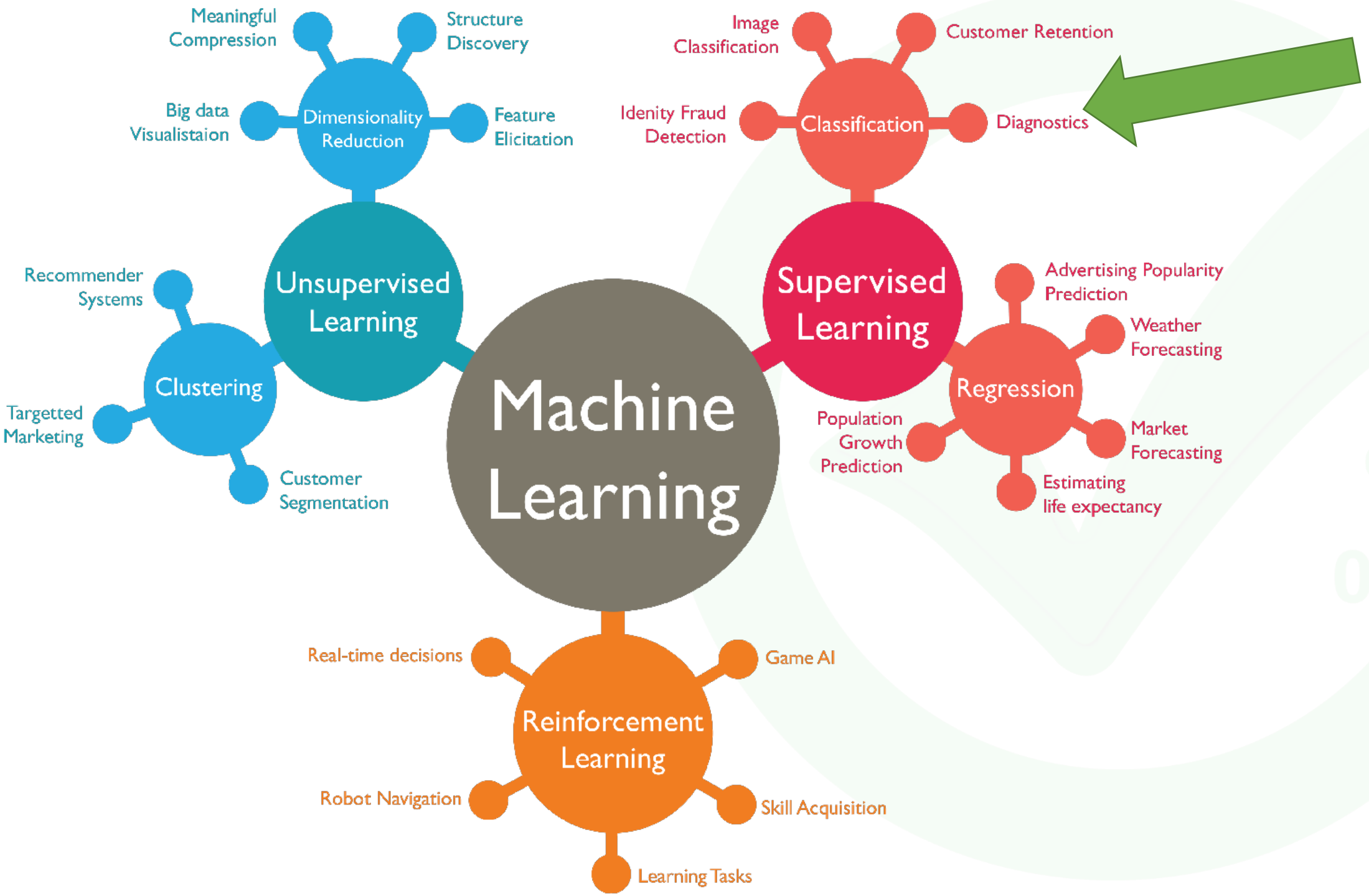
General Content

- Supervised Learnig Algorithm - **Classisfication**
- Supervised Algorithm practices Python application
- Projects Solutions

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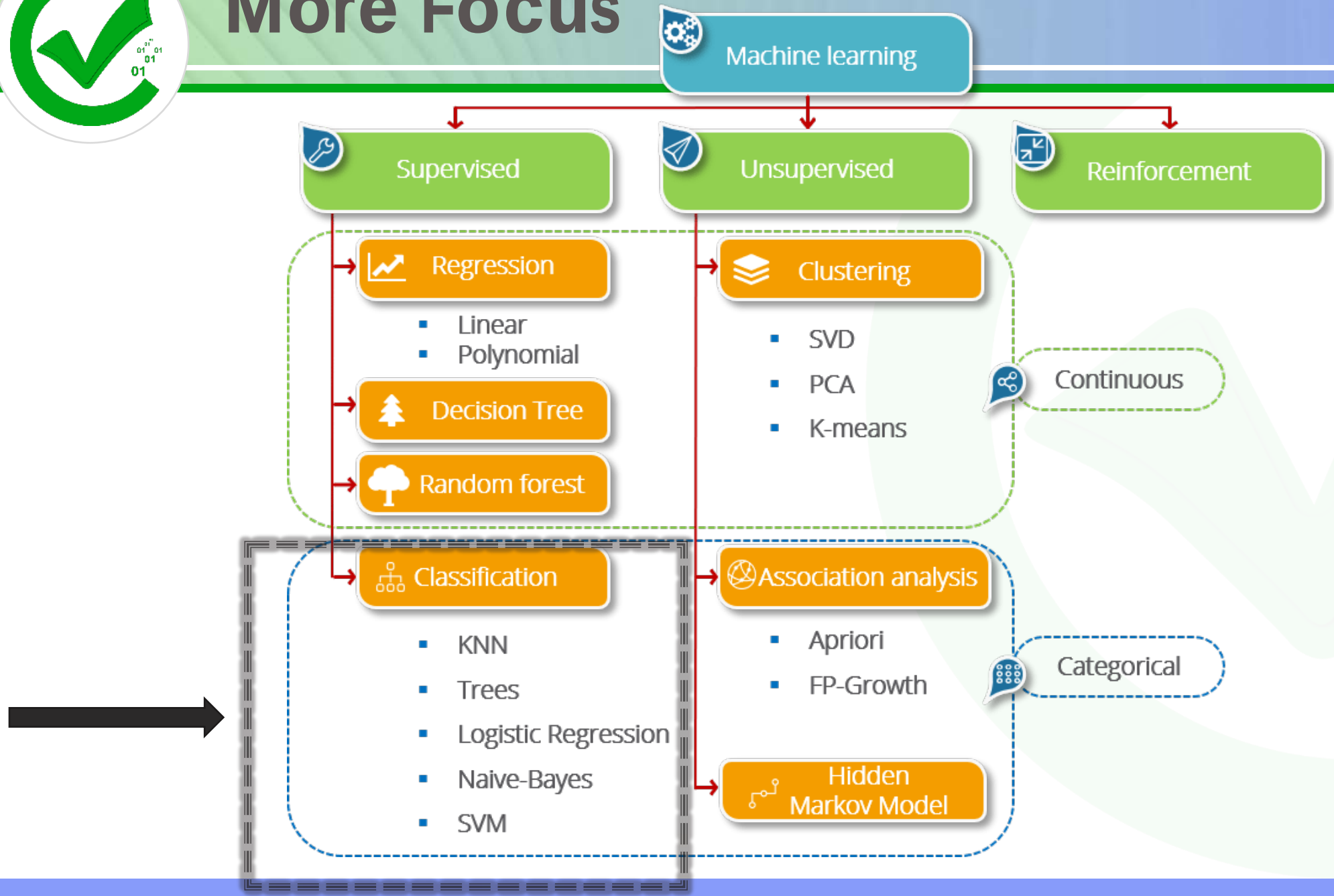
Learning Tasks

More Focus


Machine learning
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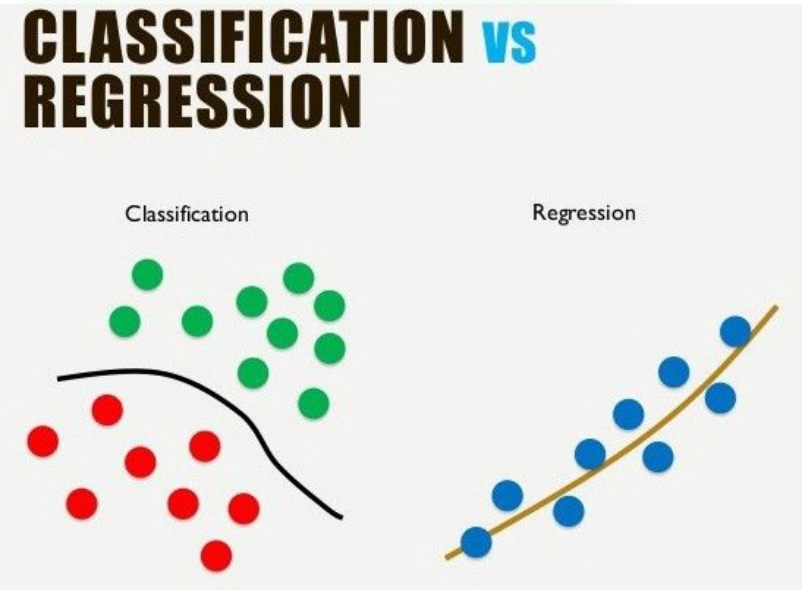
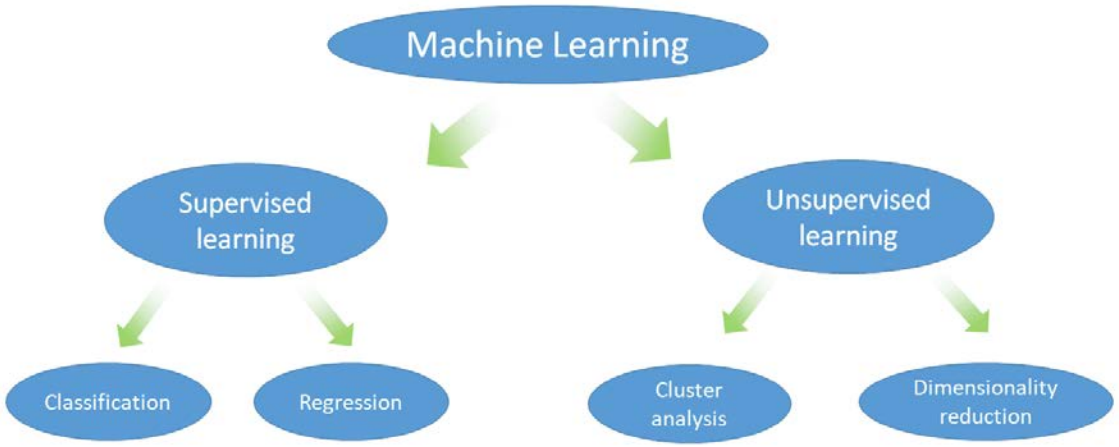
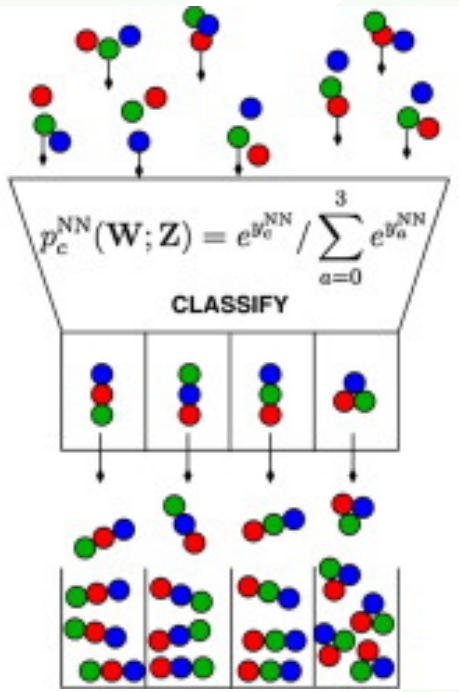
SUPERVISED LEARNING - Classification

Sınıflandırma


PAPER
METAL
PLASTIC
E-WASTE
GLASS
ORGANIC


CLASSIFICATION VS REGRESSION
Classification
Regression

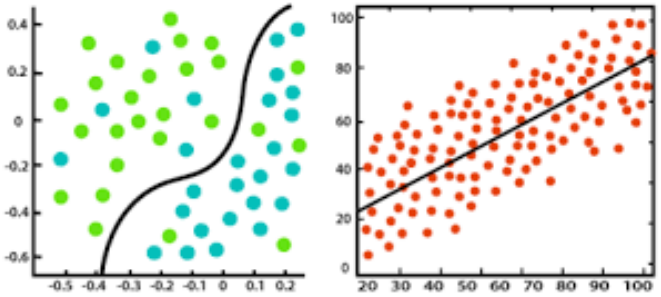

Machine Learning
Supervised learning
Unsupervised learning
Classification
Regression
Cluster analysis
Dimensionality reduction

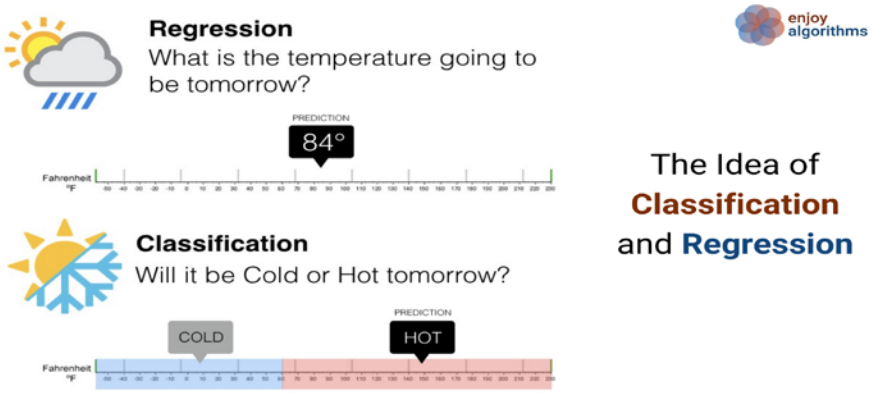

$p_c^{NN}(\mathbf{W};\mathbf{Z}) = e^{y_c^{NN}} / \sum_{a=0}^{3} e^{y_a^{NN}}$
CLASSIFY

Supervised Learning

Classification ‘a Giriş (Sınıflandırma)

- Regresyonda neler gördük
- Supervised Learning in 2. tipi olarak Classification
- Regression vs Classification
- Target için Kategorik Sınıflandırma vardır



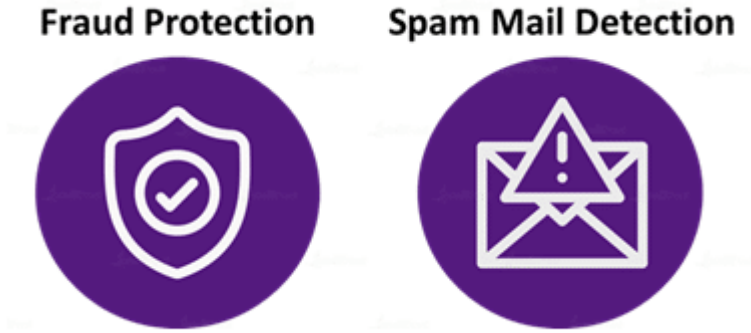


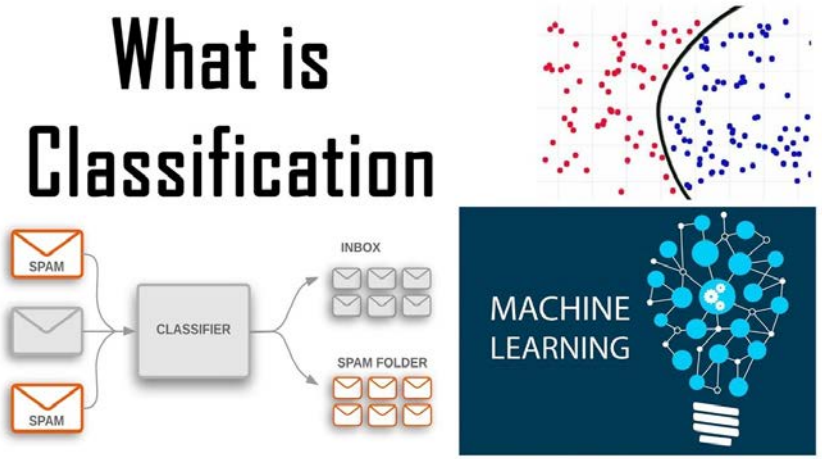
!! **Regresyonda** target hedef değişkenin **sayısal değerlerini**; **sınıflandırmada** ise target değişkenin ait olduğu **sınıfları (ya da "etiketi")** tahmin eden modelleri oluşturmaya çalışırız.

Supervised Learning

Classification ‘a Giriş

- Classification un hayattaki kullanım alanları
- Binary Classification



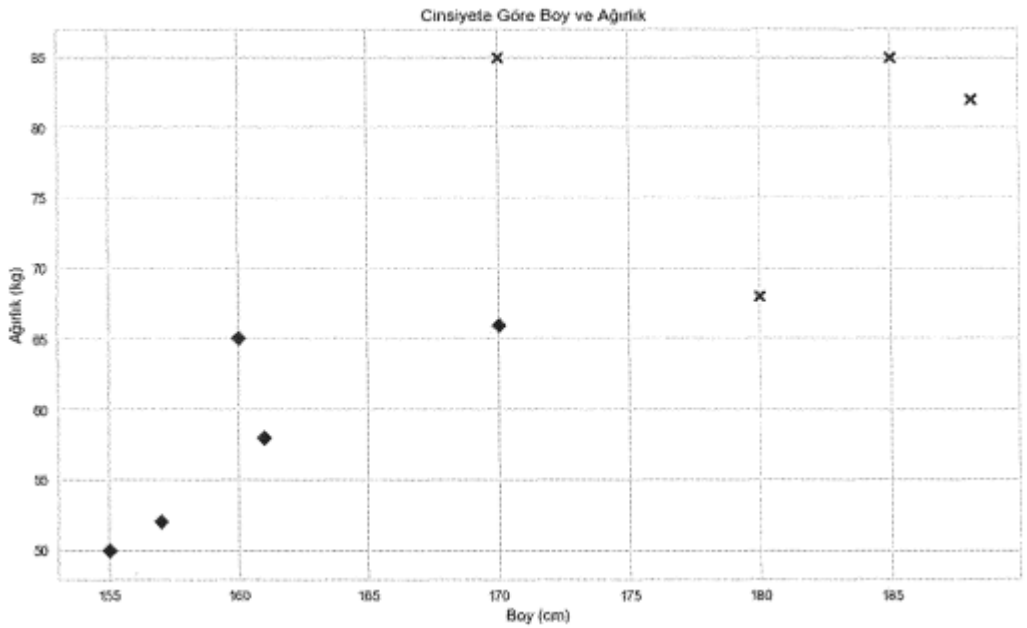


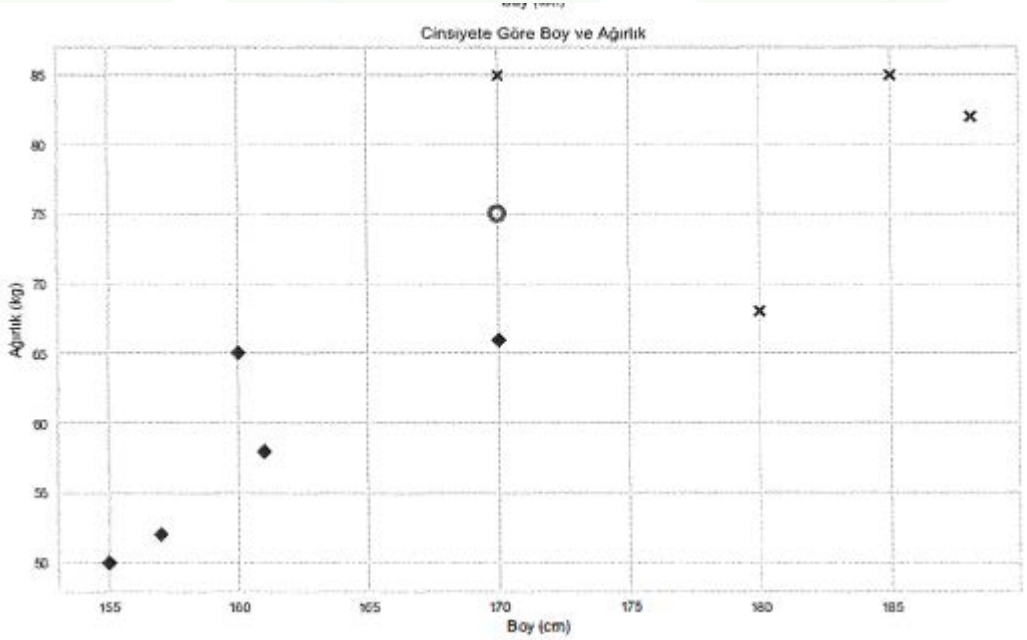
Boy	Kilo	Cinsiyet
160	65	K
170	85	E
185	85	E
188	82	E
155	50	K
161	58	K
180	68	E
157	52	K
170	66	K

Supervised Learning

Classification ‘a Giriş

- Binary Classification
- Kategori tahmini
- «Yakınlık» kavramı - ‘ara mesafe ölçümü’

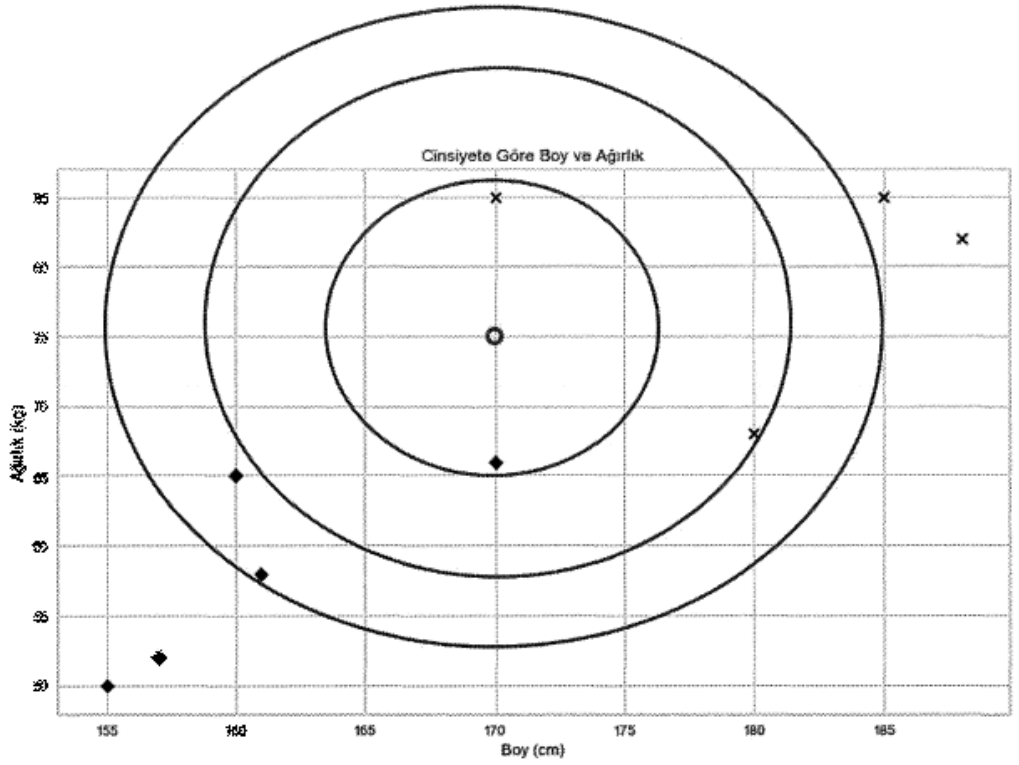


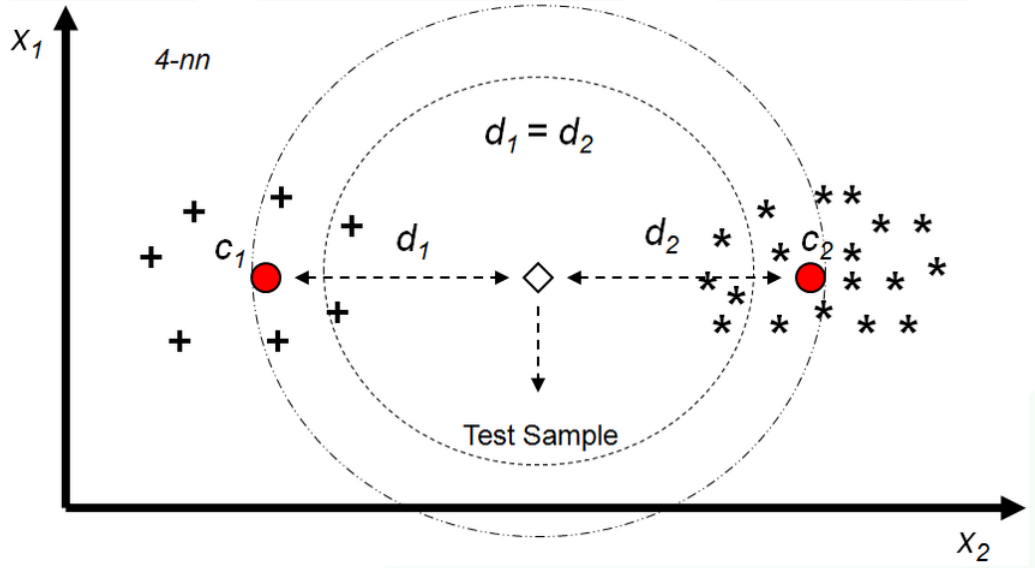


Supervised Learning

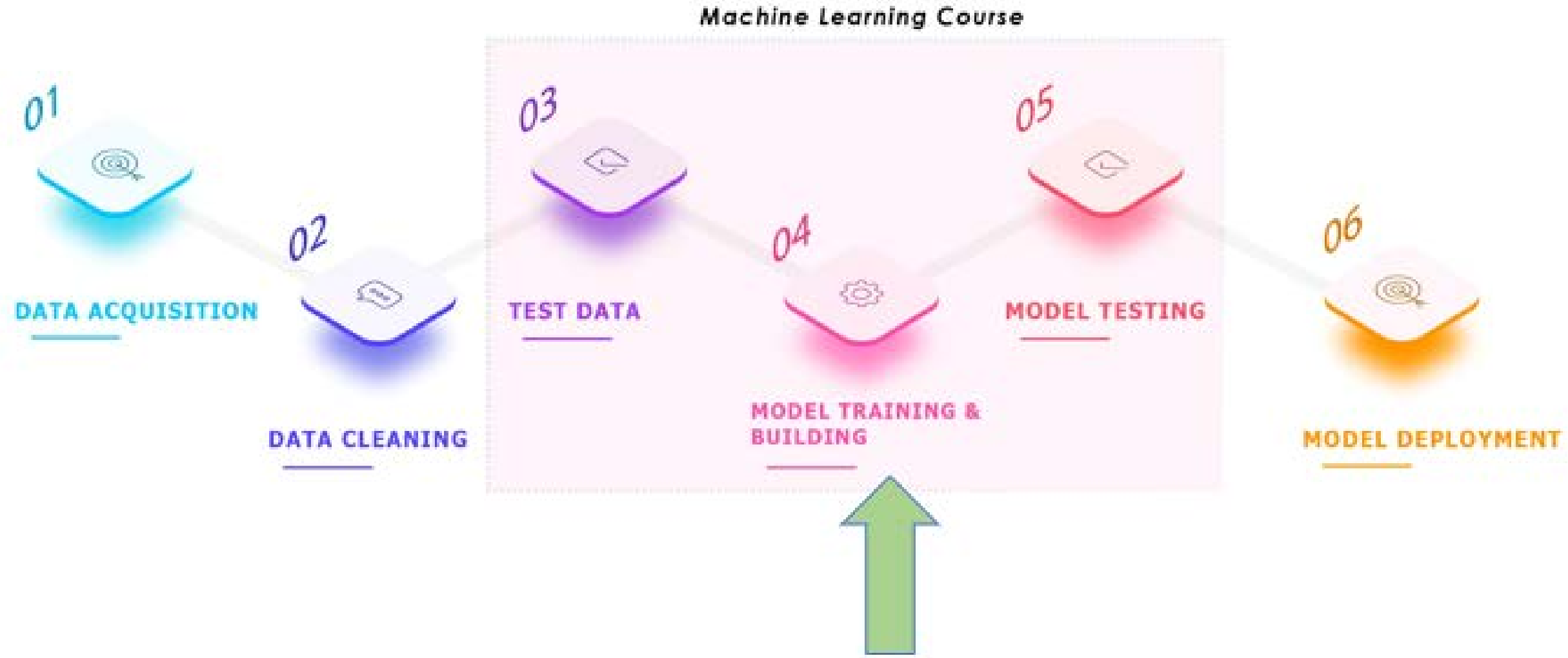
Classification ‘a Giriş

- «**Yakınlık**» kavramı - «**ara mesafe ölçümü**»
- En yakın komşu kavramı





Where are we?


Machine Learning Course
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DATA CLEANING
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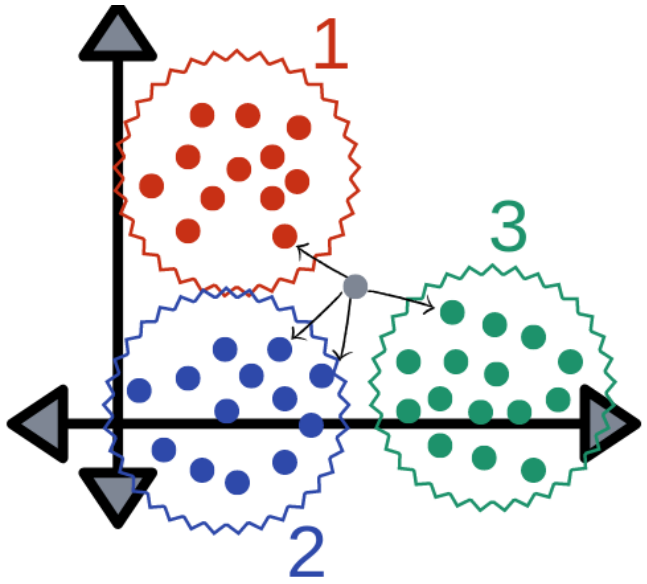
TEST DATA
04
MODEL TRAINING & BUILDING
05
MODEL TESTING
06
MODEL DEPLOYMENT

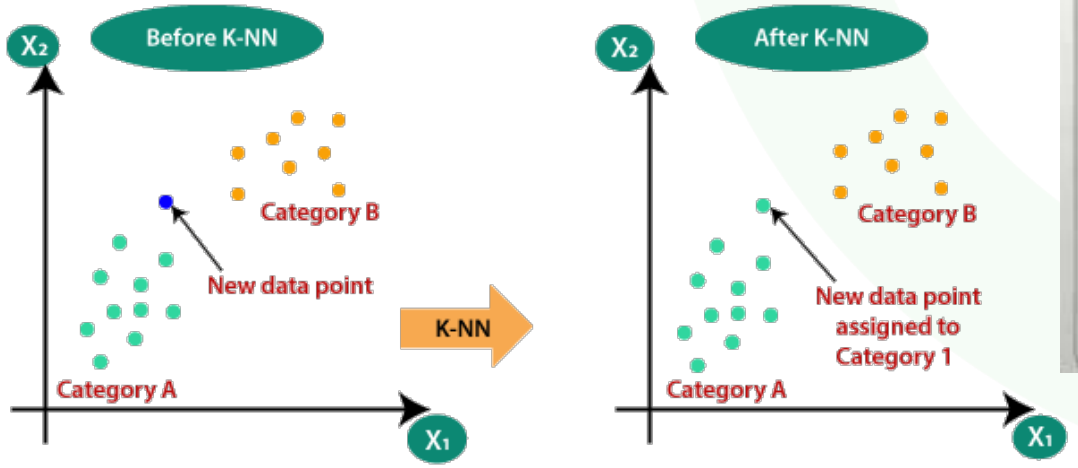
Supervised Learning

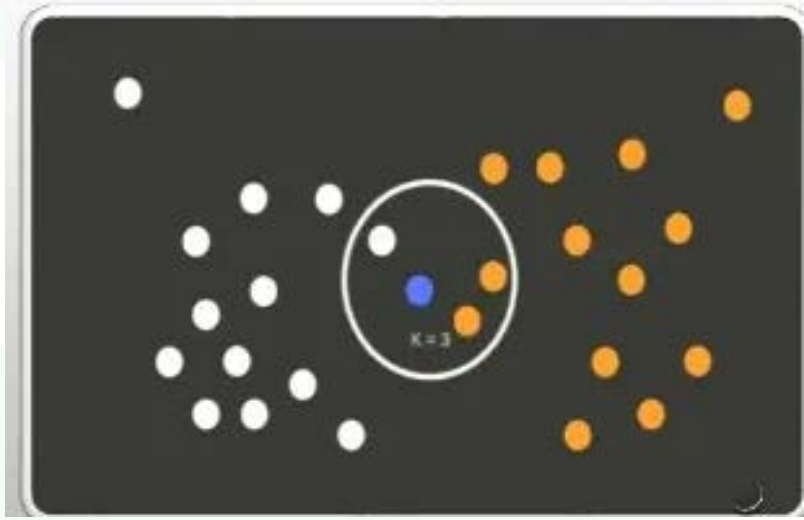
K Nearest Neighbour-KNN Algoritması

K-EN YAKIN KOMŞU Algoritması

- Logistic Regression ‘ dan bir adım öncesinde
- Classification için en basit yol olarak KNN
- En yakın komşu sayısı



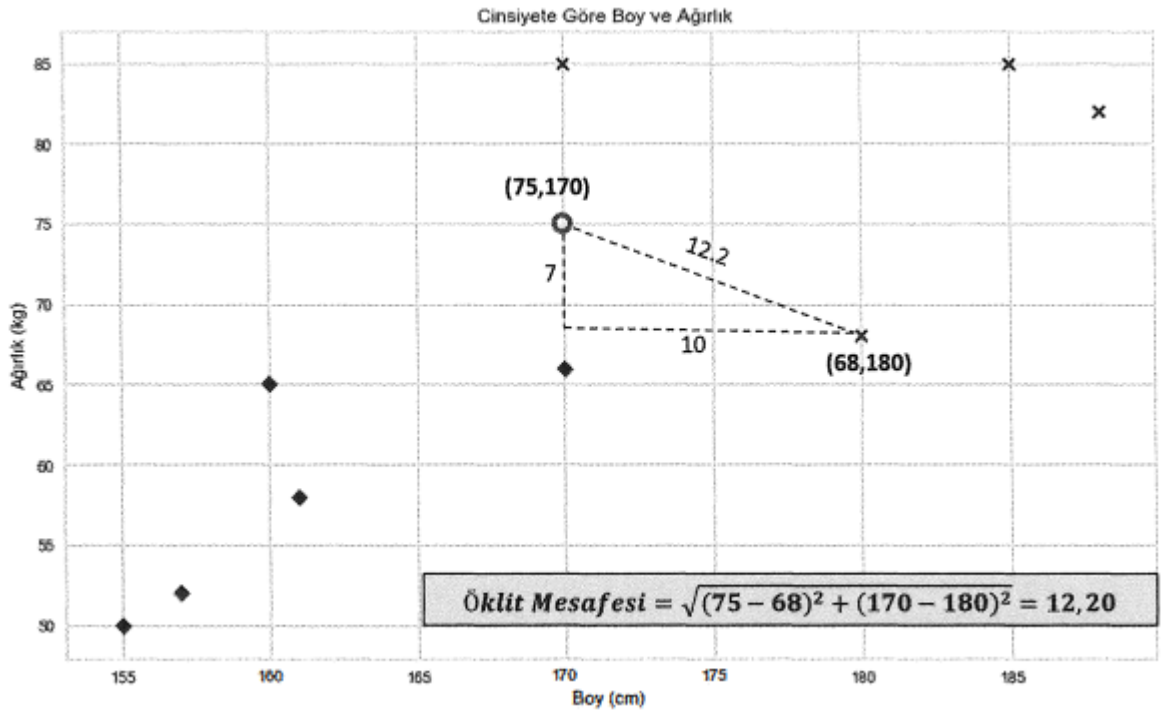


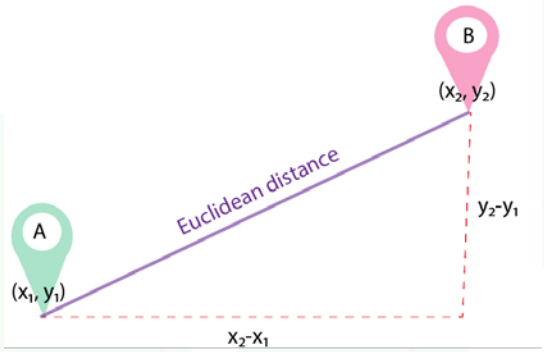


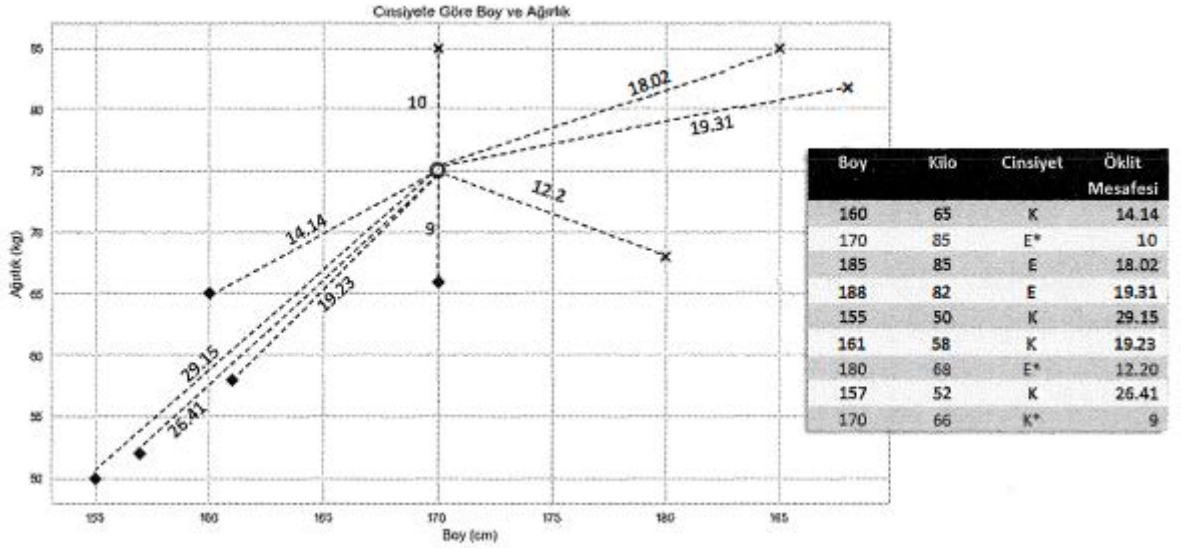
Supervised Learning

K Nearest Neighbour-KNN Algoritması

- Öklid mesafesi





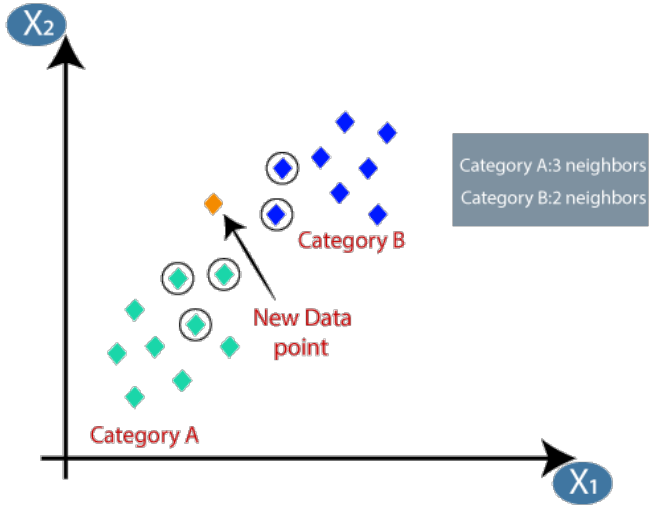


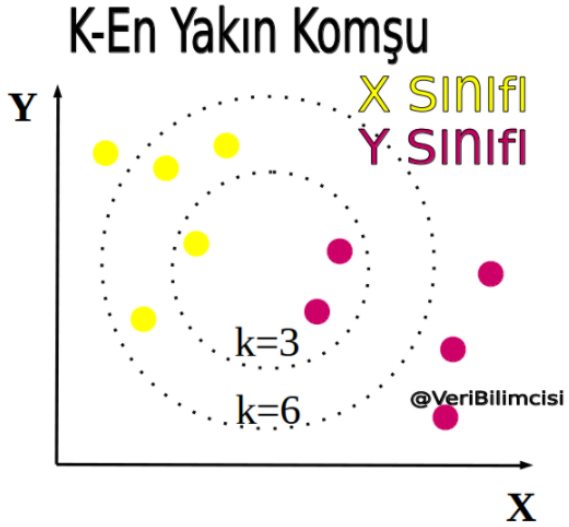
Boy	Kilo	Cinsiyet	Öklit Mesafesi
160	65	K	14.14
170	85	E*	10
185	85	E	18.02
188	82	E	19.31
155	50	K	29.15
161	58	K	19.23
180	68	E*	12.20
157	52	K	26.41
170	66	K*	9

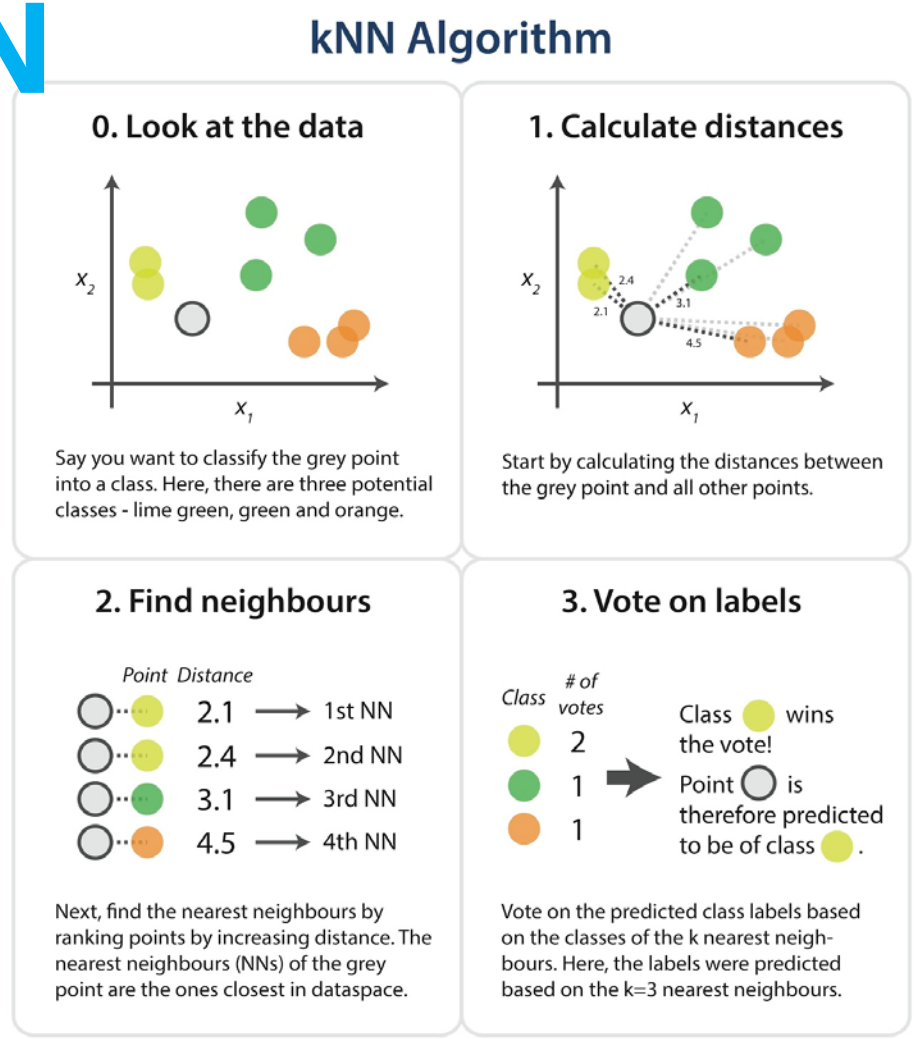
Supervised Learning

K Nearest Neighbour-KNN Algoritması

- KNN avantajları
- KNN dezavantajları

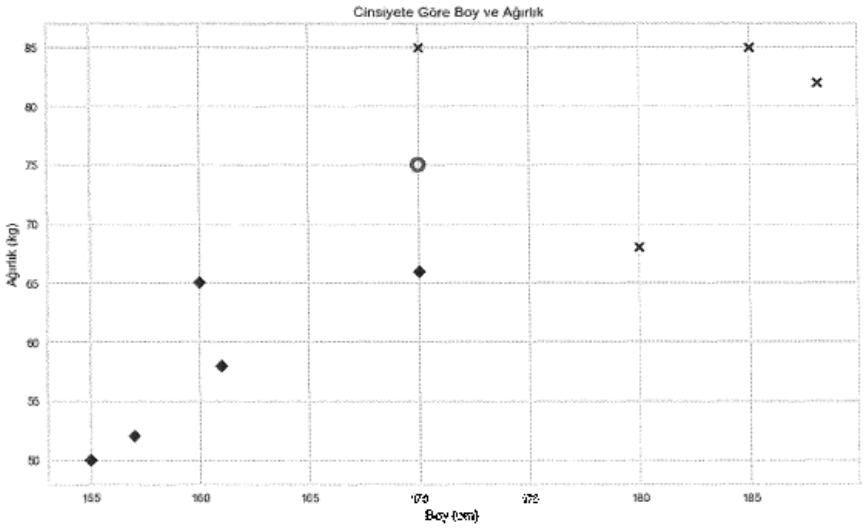


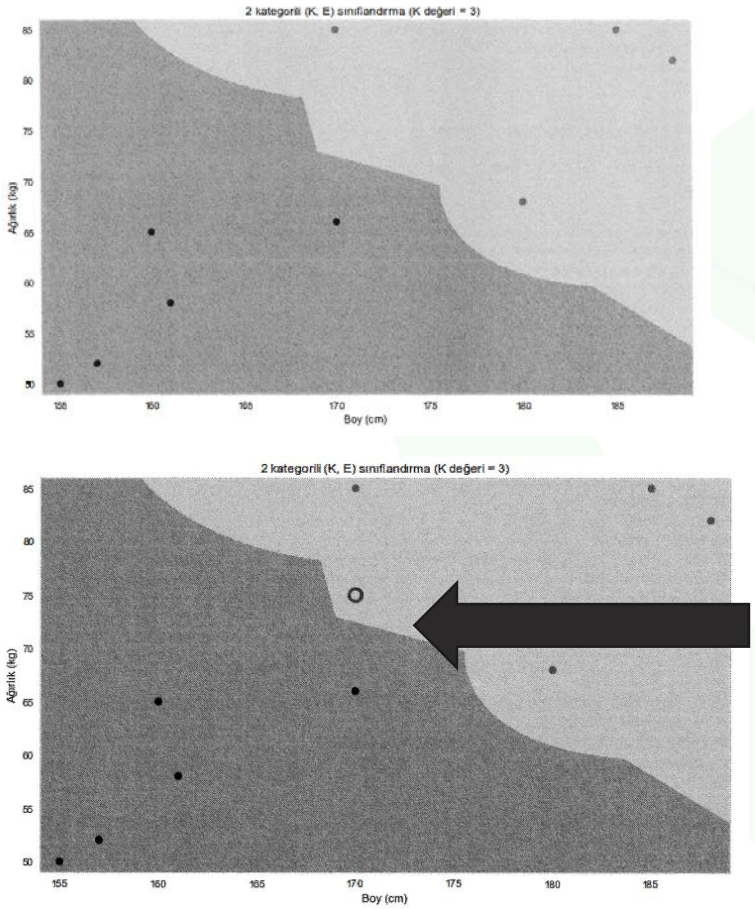


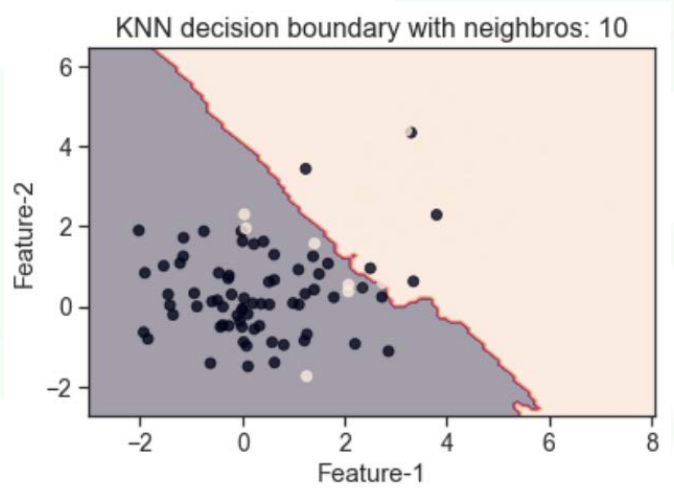


K Nearest Neighbour-KNN Algoritması

Decision boundary kavramı

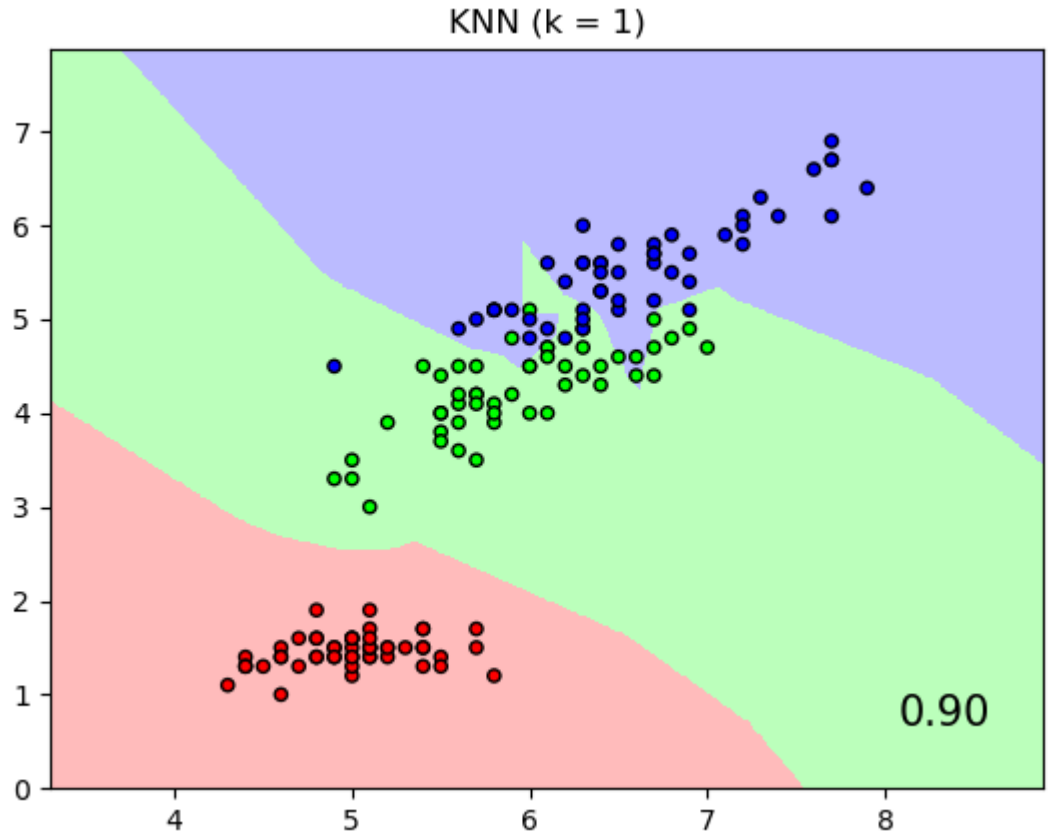


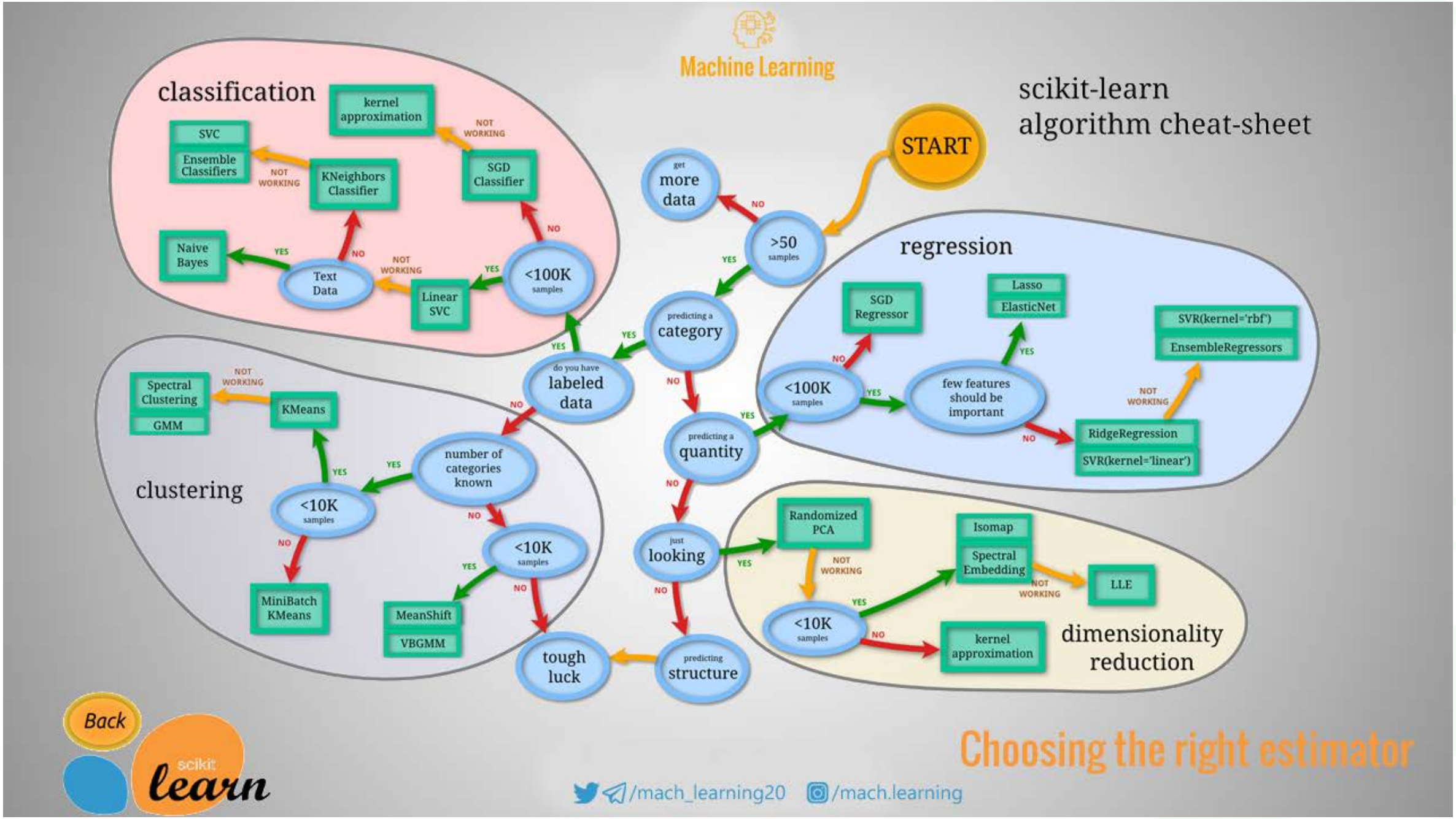




Supervised Learning

Multi Label KNN (Çok sınıflı KNN)




Machine Learning
scikit-learn
algorithm cheat-sheet
START
classification
kernel approximation
NOT WORKING
SVC
Ensemble Classifiers
NOT WORKING
KNeighbors Classifier
SGD Classifier
NO
Naive Bayes
YES
NO
Text Data
NOT WORKING
Linear SVC
YES
<100K samples
NO
YES
get more data
NO
>50 samples
YES
regression
SGD Regressor
Lasso
ElasticNet
SVR(kernel='rbf')
EnsembleRegressors
predicting a category
YES
NO
<100K samples
NO
YES
few features should be important
YES
NOT WORKING
RidgeRegression
NO
SVR(kernel='linear')
do you have labeled data
YES
NO
predicting a quantity
YES
NO
Spectral Clustering
GMM
NOT WORKING
KMeans
YES
clustering
number of categories known
YES
NO
<10K samples
NO
MiniBatch KMeans
<10K samples
YES
NO
MeanShift
VBGMM
just looking
YES
NO
Randomized PCA
NOT WORKING
Isomap
Spectral Embedding
NOT WORKING
LLE
YES
<10K samples
NO
kernel approximation
dimensionality reduction
tough luck
predicting structure
Back
scikit learn
Choosing the right estimator
/mach_learning20
/mach.learning

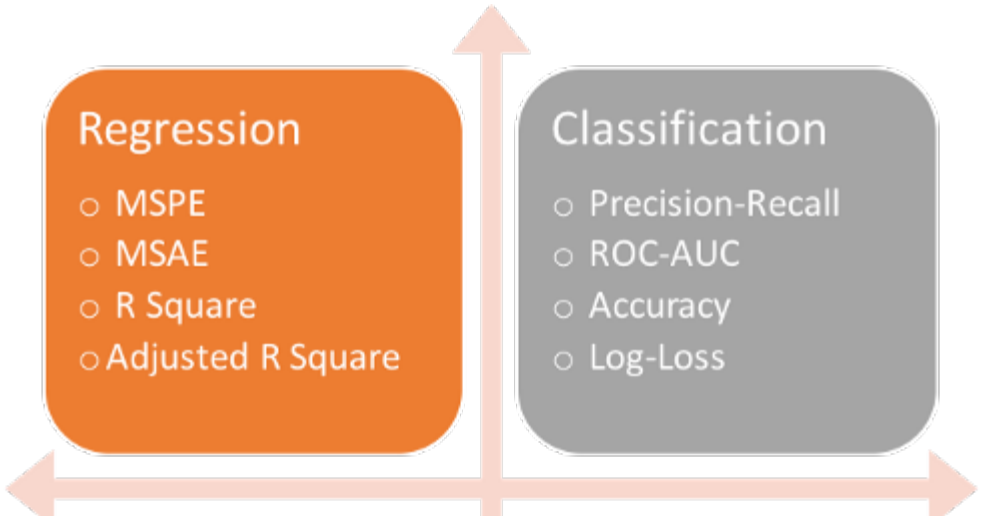
Supervised Learning

Evaluation Metrics for Classification Problems

(Performans Ölçütleri)

very Important

- Regresyon kriterleri nasıl olurdu burada?
- Confusion metrics kavramı



		Predicted Class: Positive	Predicted Class: Negative	
Actual Class	Positive	True Positive (TP)	False Negative (FN) **Type II Error**	**Sensitivity** $\frac{TP}{(TP+FN)}$
	Negative	False Positive (FP) **Type I Error**	True Negative (TN)	**Specificity** $\frac{TN}{(TN+FP)}$
		Precision $\frac{TP}{(TP+FP)}$	**Negative Predictive Value** $\frac{TN}{(TN+FN)}$	**Accuracy** $\frac{TP+TN}{(TP+TN+FP+FN)}$

Supervised Learning

Evaluation Metrics for Classification Problems

- Confusion metrics kavramı: TN-FN-FP-TP

2-SINIFLI (CLASS) SINIFLANDIRMA MODELİ İÇİN HATA MATRİSİ

Veri setindeki hedef değişkenin gerçek sınıfları

Negatif — Pozitif

Hedef değişkenin tahmin edilen sınıfları

Negatif — Pozitif

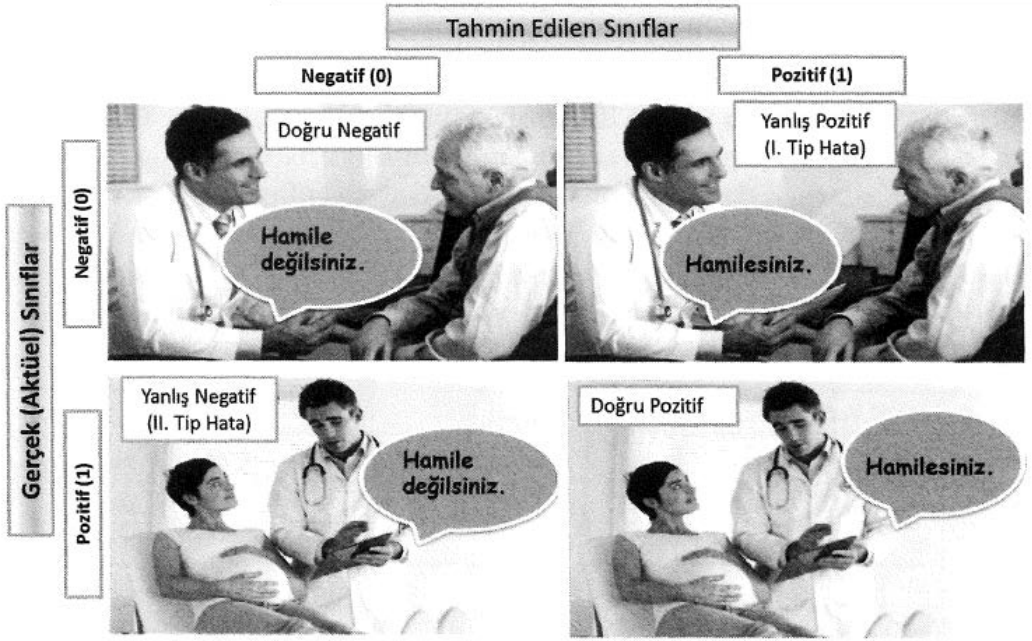
2-SINIFLI (CLASS) SINIFLANDIRMA MODELİ İÇİN HATA MATRİSİ

Gerçek Sınıflar	Tahmin Edilen Sınıflar: Negatif (0)	Tahmin Edilen Sınıflar: Pozitif (1)
Negatif (0)	DN	YP
Pozitif (1)	YN	DP

Supervised Learning

Evaluation Metrics for Classification Problems

Confusion metrics kavramı: TN-FN-FP-TP



Predicted

Actual	0	1
0	30	12
1	8	56

SINIFLANDIRMA MODELLERİ İÇİN PERFORMANS DEĞERLENDİRME ÖLÇÜTLERİ

Gerçek Sınıflar	Tahmin Edilen Sınıflar: Negatif (0)	Tahmin Edilen Sınıflar: Pozitif (1)
Negatif (0)	DN	YP
Pozitif (1)	YN	DP

Doğruluk (Accuracy): Doğru tahmin edilen hedef değişkenlerin tüm hedef değişkenlerine oranıdır. Model hedef değişkenleri ne kadar doğrulukla tahmin ediyor?

$$Doğruluk\,(Accuracy) = \frac{DP + DN}{DP + DN + YP + YN}$$

Kesinlik (Precision): Doğru pozitif olarak tahmin edilen gözlemlerin tüm pozitif gözlemlere oranıdır. Doğru bir şekilde pozitif tahmin edilen gözlemlerin gerçekte ne kadarı doğrudur?

$$Kesinlik\,(Precision) = \frac{DP}{DP + YP}$$

Duyarlılık (Recall): Doğru bir şekilde pozitif olarak tahmin edilen gözlemlerin ne kadar başarılı tahmin edildiğini gösterir.

$$Duyarlılık\,(Recall) = \frac{DP}{DP + YN}$$

F1 Skoru: Kesinlik (precission) ve Duyarlılığın (Recall) harmonik ortalamasıdır.

$$F1 = 2 * \frac{(Kesinlik * Duyarlılık)}{(Kesinlik * Duyarlılık)}$$

Performance metrics associated with Class 1

Predicted Labels \ Actual Labels	1	0
1	True Positive	False Positive
0	False Negative	True Negative

(Is your prediction correct?) (What did you predict)

True Negative

(Your prediction is correct) (You predicted 0)

$$\text{Precision} = \frac{TP}{TP + FP}$$

$$\text{F1 score} = 2x \frac{(\text{Prec x Rec})}{(\text{Prec} + \text{Rec})}$$

$$\text{Specificity} = \frac{TN}{TN + FP}$$

$$\text{False +ve rate} = \frac{FP}{TN + FP}$$

$$\text{Accuracy} = \frac{TP + TN}{TP + FN + FP + TN}$$

$$\text{Recall, Sensitivity} = \text{True +ve rate} = \frac{TP}{TP + FN}$$

Actual class \ Predicted class	+	-
+	TP True Positives	FN False Negatives Type II error
-	FP False Positives Type I error	TN True Negatives

In Python

```
15]: confusion_matrix(y, y_pred)

15]: array([[448,  52],
            [121, 147]], dtype=int64)
```

Actual Cancer:	1	1	0	0	1	0	0	0	0	1 ....
Predicted Cancer:	0	1	1	0	1	0	0	0	0	0 ....
	✗	✓	✗	✓	✓	✓	✓	✓	✓	✗
	FN	TP	FP	TN	TP	TN	TN	TN	TN	FN...

Actual Labels:	1	1	0	1	0	0	0	1	1	0
Predicted Labels:	0	1	1	1	0	0	0	1	1	1
	✗	✓	✗	✓	✓	✓	✓	✓	✓	✗

$$\frac{\text{All correctly predicted values (7)}}{\text{All predicted values (10)}} \times 100 \Rightarrow \text{Accuracy = 70 \%}$$

Why is Accuracy not a good metric?

Cancer Detection Example:

Actual Cancer:	1	1	0	0	1	0	0	0	0	1 ....
Predicted Cancer:	0	1	1	0	1	0	0	0	0	0 ....
	✗	✓	✗	✓	✓	✓	✓	✓	✓	✗

$$\frac{\text{All correctly predicted values (60)}}{\text{All predicted values (63)}} \times 100 \Rightarrow \text{Accuracy = 95 \% (PERFECT ????)}$$

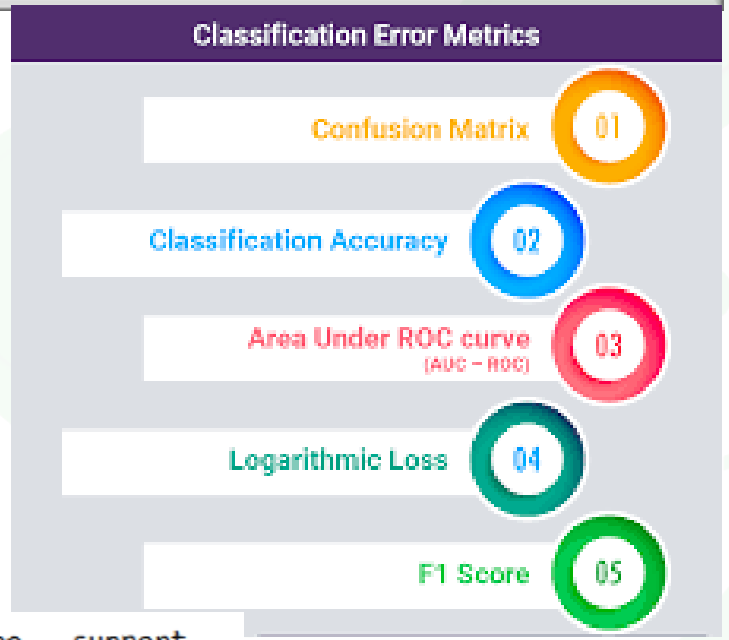
Accuracy is very high, but missed 2 actual patient.

Supervised Learning

Evaluation Metrics for Classification Problems

- Confusion metrics kavramı: TN-FN-FP-TP

Gerçek/Actual Veri				Tahmin		
Boy	Kilo	Cinsiyet	Etiket	Tahmin Edilen Cinsiyet	Etiket	Hata Türü
170	75	E	0	E	0	DN
180	95	E	0	E	0	DN
160	50	K	1	K	1	DP
165	62	K	1	K	1	DP
167	88	K	1	E	0	YN



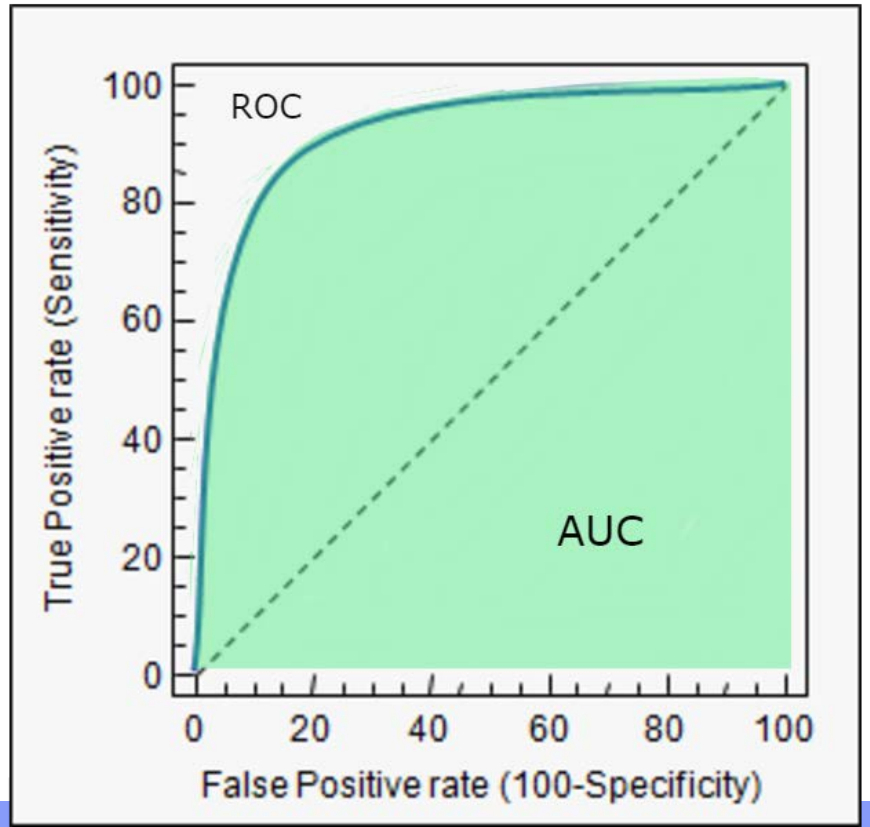
Hata Matrisi		Tahmin Edilen Etiketler	
Negatif (0)		Pozitif (1)	
Gerçek/Aktüel Veri	Negatif (0)	DN=2	YP=0
	Pozitif (1)	YN=1	DP=2

	precision	recall	f1-score	support
E	0.67	1.00	0.80	2
K	1.00	0.67	0.80	3
micro avg	0.80	0.80	0.80	5
macro avg	0.83	0.83	0.80	5
weighted avg	0.87	0.80	0.80	5

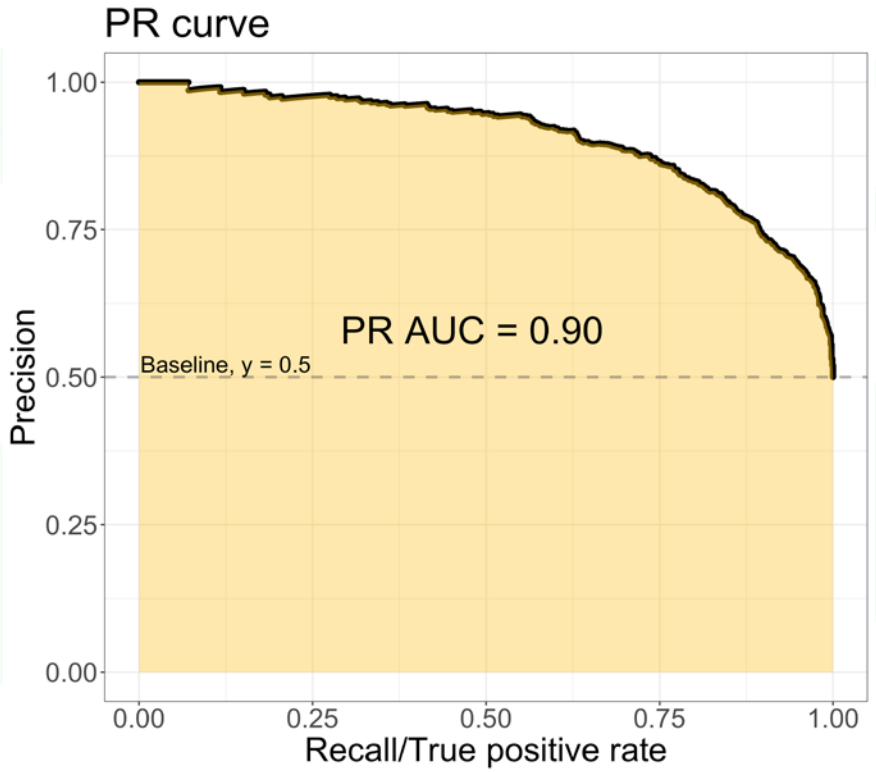
Supervised Learning

Evaluation Metrics for Classification Problems

- ROC Curve (Receiver Operating Characteristics)
- AUC Area (Area Under the Curve)
- (ROC Eğrisi ve AUC Alanı)



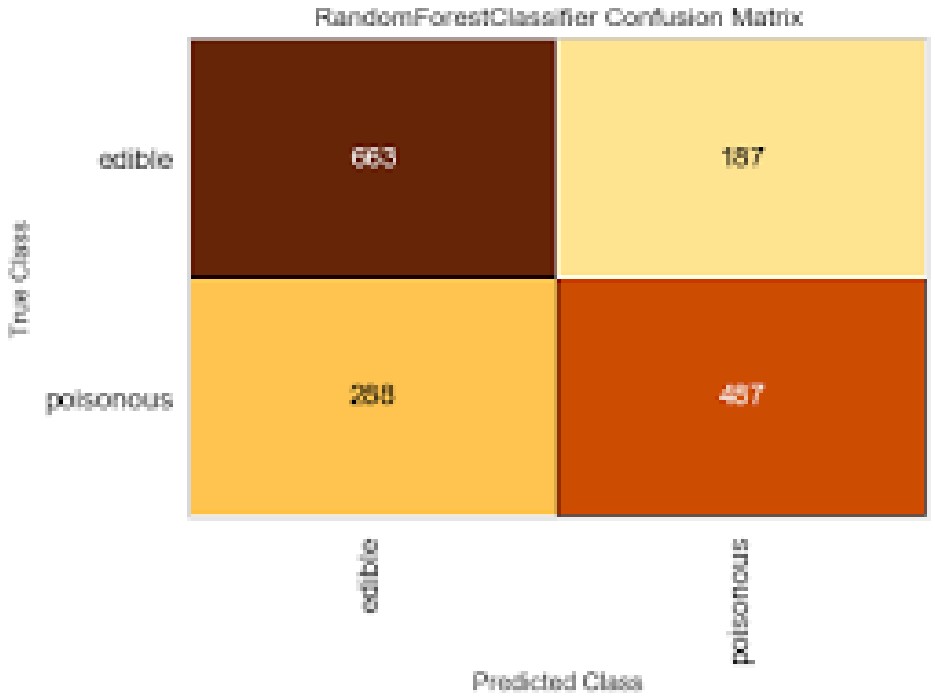
AUC'un olabildiğinde yüksek olması (1 'e yakın olmasını) istiyoruz
AUC ne kadar yüksekse model o kadar negatif (0) durumları negatif; pozitif (1) durumları da pozitif öngörüyor demektir.

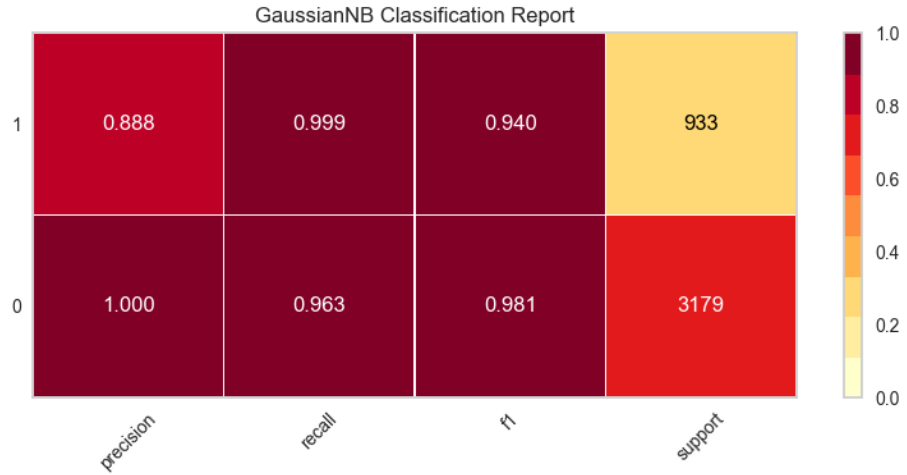


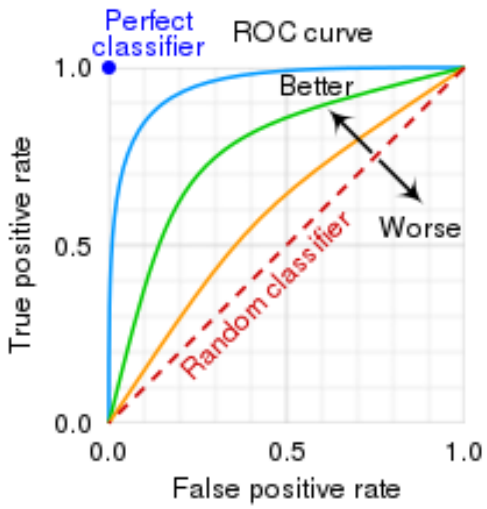
Supervised Learning

Evaluation Metrics for Classification Problems

- Yellowbrick ile confusion matrics

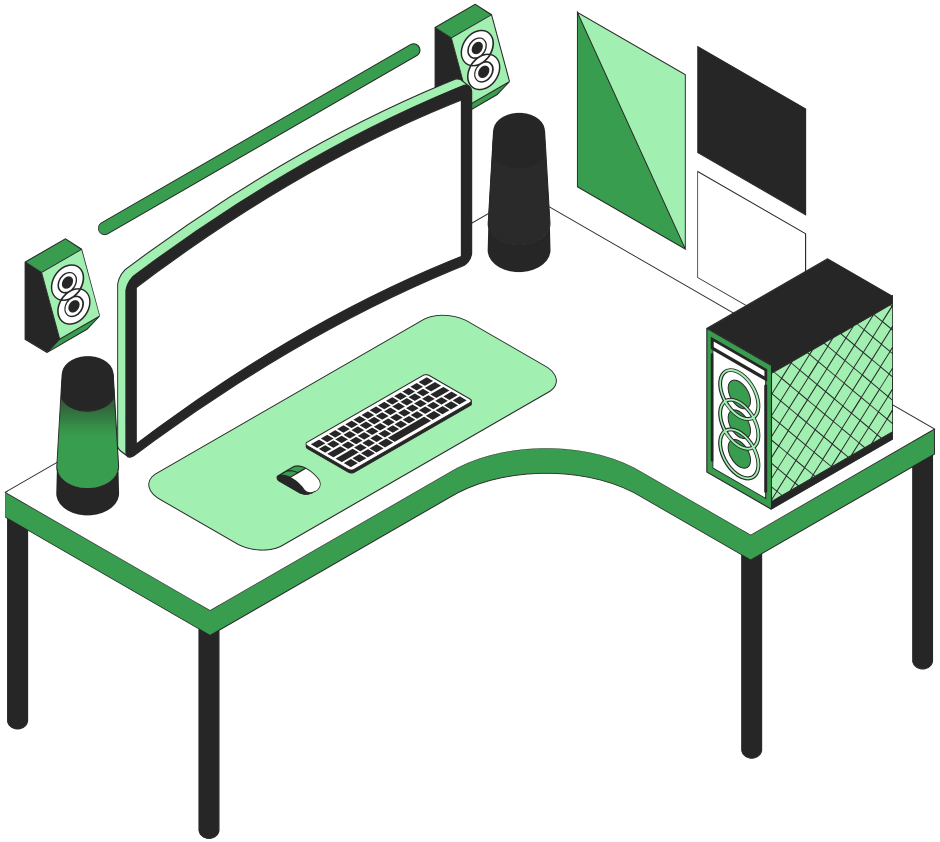






Bu dersi anladım..

Everythig is clear ?



Do you have any questions?

Send it to us! We hope you learned something new.