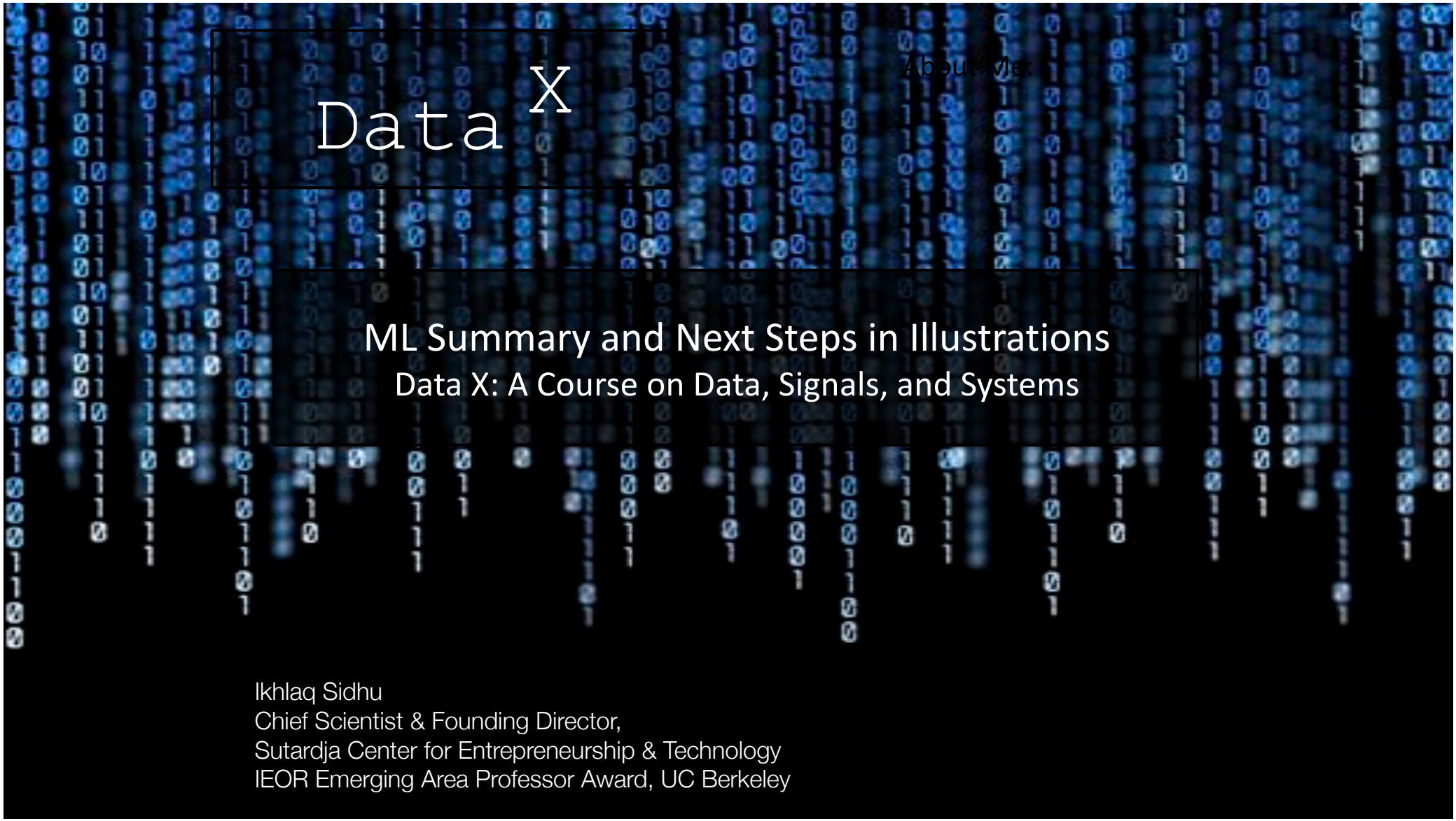
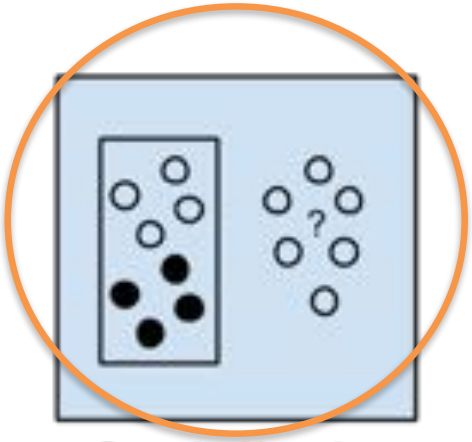


ML Summary and Next Steps in Illustrations

Data X: A Course on Data, Signals, and Systems

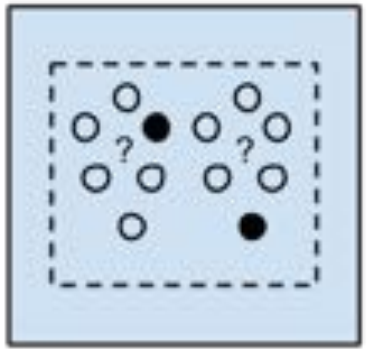
Ikhlaq Sidhu
Chief Scientist & Founding Director,
Sutardja Center for Entrepreneurship & Technology
IEOR Emerging Area Professor Award, UC Berkeley

Overview

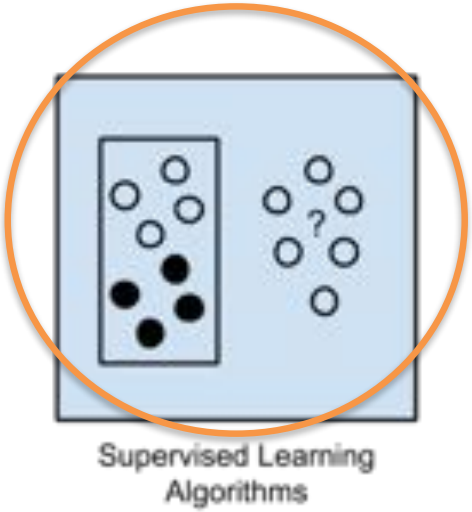


Supervised Learning Algorithms

Unsupervised Learning Algorithms

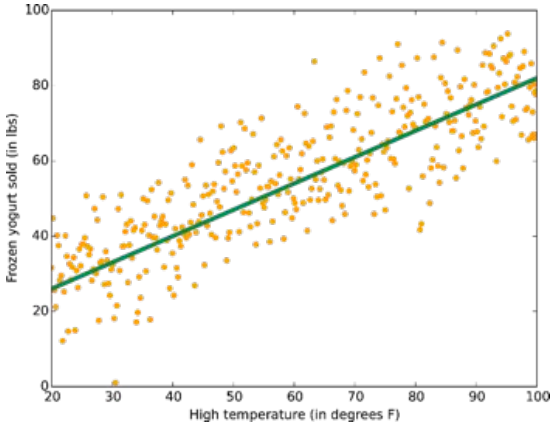


Semi-supervised Learning Algorithms




```
#Setting up for Supervised learning
# First clean: use mapping + buckets

# X = matrix of data – e.g 1000 rows
# Y = In sample responses

# Typically we want to split in to
training data and test data

X_train = X[0:500]
Y_train = Y[0:500]
X_test = X[501:1000]
Y_test = Y[501:1000]
```

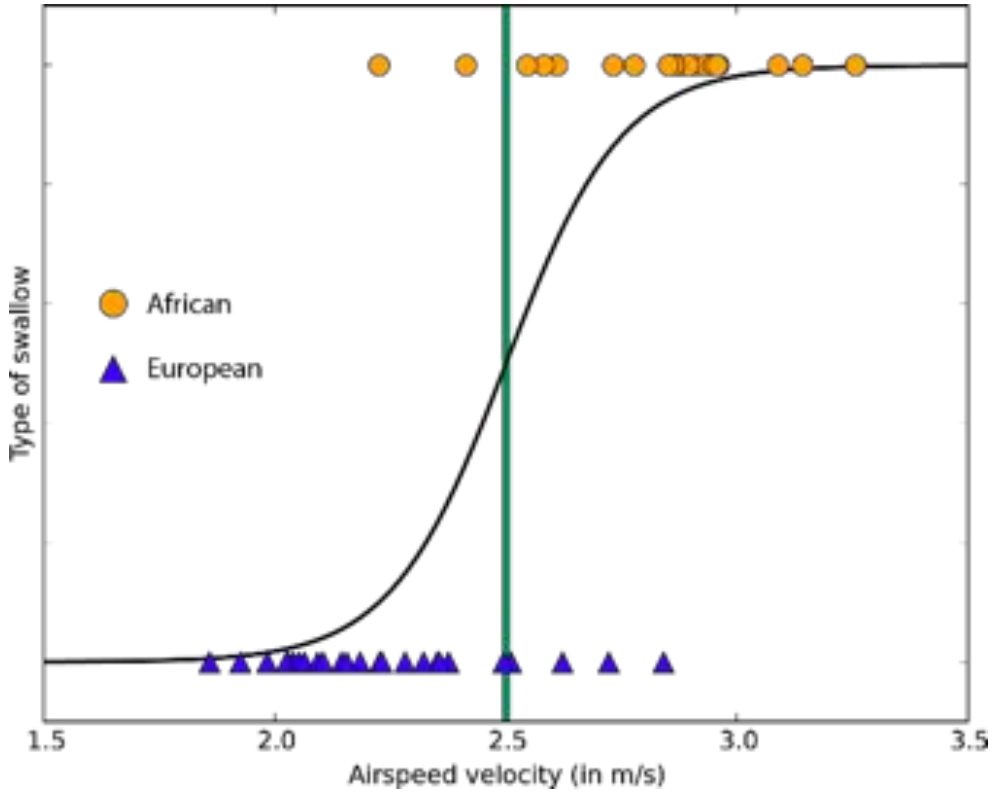
Linear Regression Illustration




```
#Setting Linear Regression in sklearn
from sklearn import linear_model

model= linear_model.LinearRegression()
model.fit(X_train, Y_train)

Y_pred_train =  model.predict(X_train)
Y_pred_test =  model.predict(X_test)


# Compare Y_pred_test with Y_test for
error.
```

Illustration Source: https://docs.microsoft.com/en-us/azure/machine-learning/machine-learning-algorithm-choice

Logistic Regression Illustration



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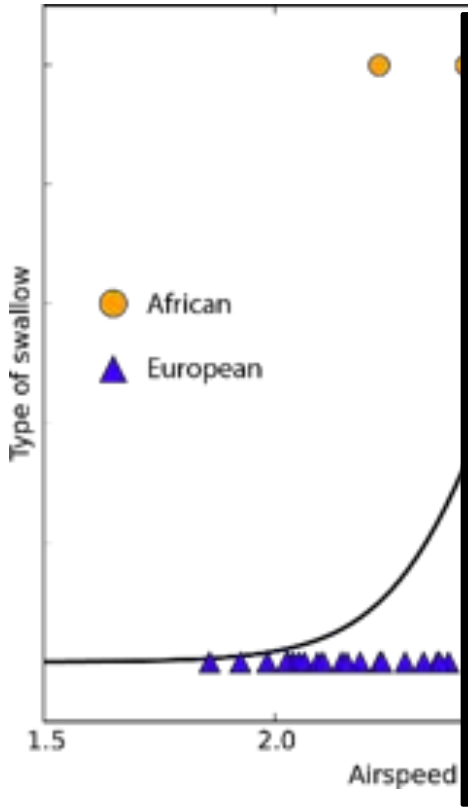
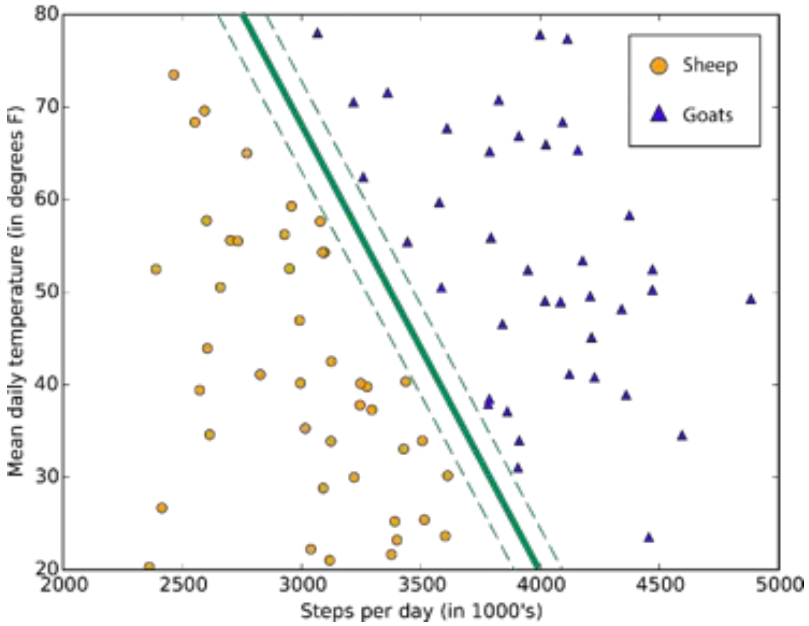
Logistic Regression Illustration




```
from sklearn.linear_model import LogisticRegression

# Logistic Regression
logreg = LogisticRegression()
logreg.fit(X_train, Y_train)
Y_pred = logreg.predict(X_test)

# Error
acc_log = round(logreg.score(X_train, Y_train) * 100, 2)
acc_log

# or compare Y_pred with Y_test
```

Illustration Source: https://docs.microsoft.com/en-us/azure/machine-learning/machine-learning-algorithm-choice

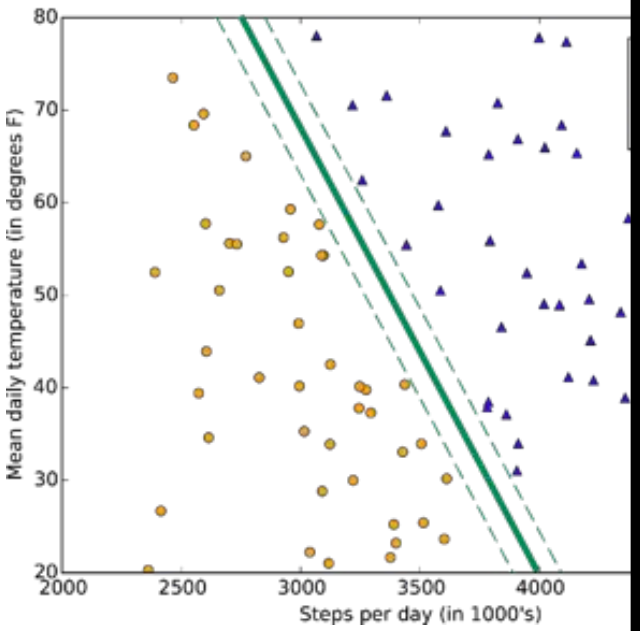
Support Vector Machine (SVM) Illustration



A typical support vector machine class boundary maximizes the margin separating two classes

Illustration Source: https://docs.microsoft.com/en-us/azure/machine-learning/machine-learning-algorithm-choice

Support Vector Machine (SVM) Illustration

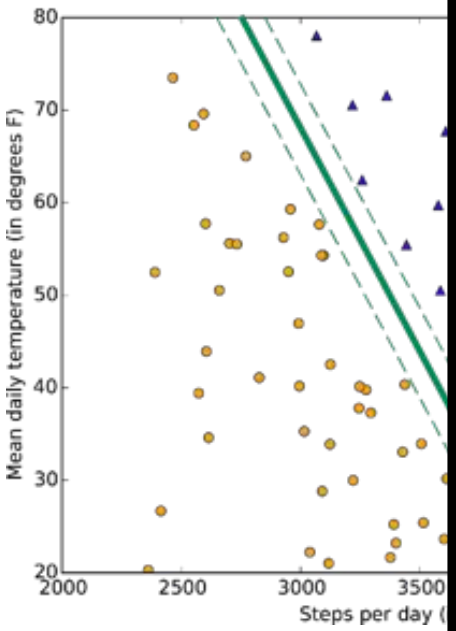


A typical support vector machine class boundary maximizes the margin s
classes

```
from sklearn.svm import SVC, LinearSVC

svc = SVC()
svc.fit(X_train, Y_train)
Y_pred = svc.predict(X_test)

# Error
acc_svc = round(svc.score(X_train, Y_train) * 100, 2)
acc_svc

# or compare Y_pred with Y_test
```

Illustration Source: https://docs.microsoft.com/en-us/azure/machine-learning/machine-learning-algorithm-choice

Support Vector Machine (SVM) Illustration



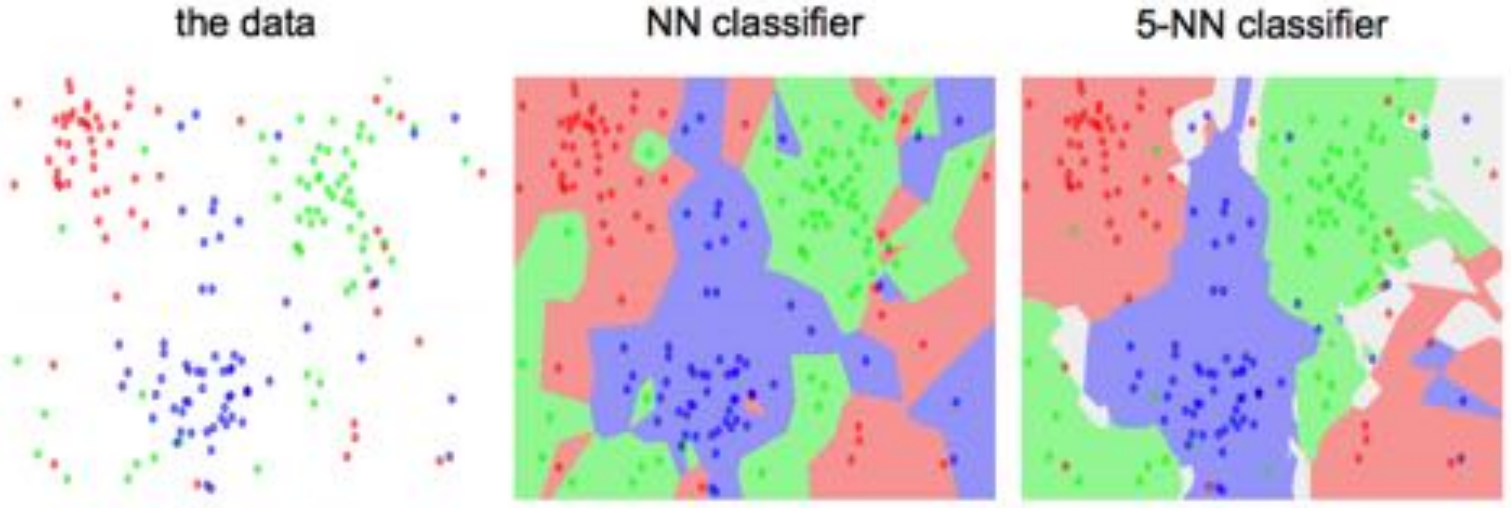
A typical support vector machine class boundary ma
classes

```
from sklearn.svm import SVC, LinearSVC

# Linear SVC
linear_svc = LinearSVC()
linear_svc.fit(X_train, Y_train)

Y_pred = linear_svc.predict(X_test)

# Error:
acc_linear_svc = round(linear_svc.score(X_train, Y_train) * 100, 2)
acc_linear_svc

# or compare Y_pred with Y_test
```

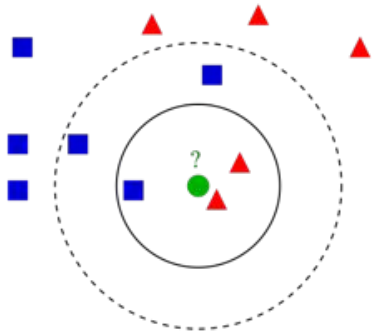
Illustration Source: https://docs.microsoft.com/en-us/azure/machine-learning/machine-learning-algorithm-choice

KNN / K Means Illustration

KNN Method: Find the k nearest images and have them vote on the label (i.e. take the mode)



Example of *k*-NN classification. The test sample (green circle) should be classified either to the first class of blue squares or to the second class of red triangles. If *k = 3* (solid line circle) it is assigned to the second class because there are 2 triangles and only 1 square inside the inner circle. If *k = 5* (dashed line circle) it is assigned to the first class (3 squares vs. 2 triangles inside the outer circle). - Wikipedia



K-means
(data is not labeled)

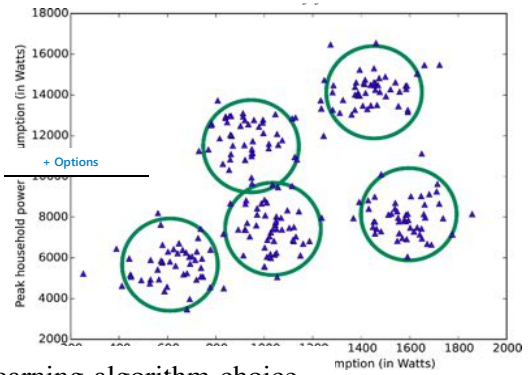
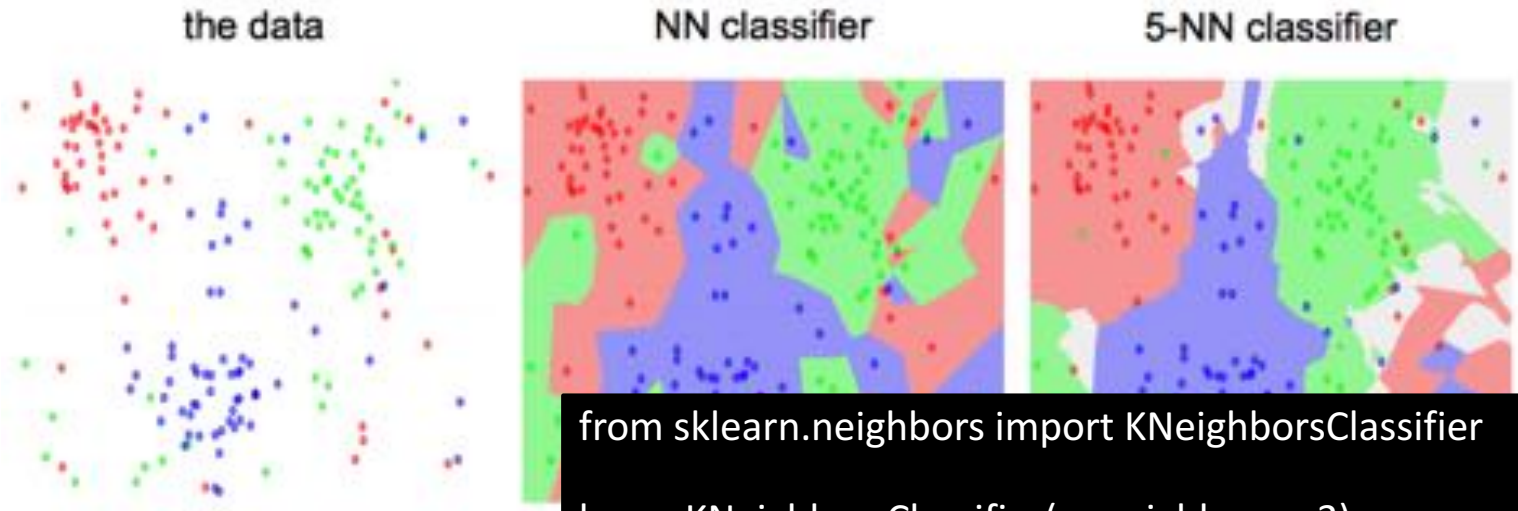


Illustration Source: https://docs.microsoft.com/en-us/azure/machine-learning/machine-learning-algorithm-choice

K Means / KNN Illustration

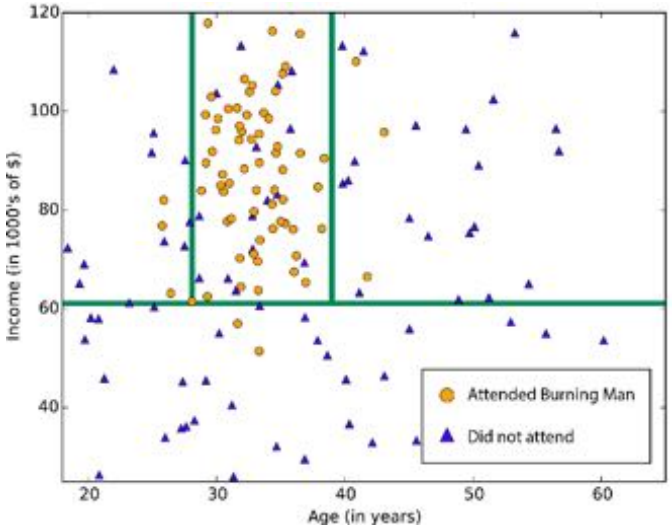


KNN Method: Find the k nearest images and have them vote on the label (i.e. take the mode)

```
from sklearn.neighbors import KNeighborsClassifier

knn = KNeighborsClassifier(n_neighbors = 3)
knn.fit(X_train, Y_train)
Y_pred = knn.predict(X_test)

acc_knn = round(knn.score(X_train, Y_train) * 100, 2)
acc_knn

# or compare Y_pred with Y_test
```

Illustration Source: https://docs.mic

Decision Tree Illustration



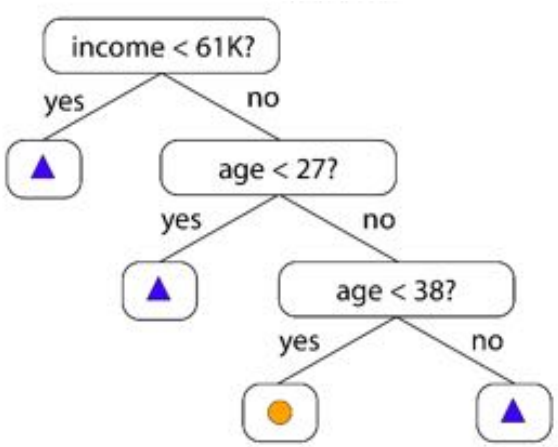
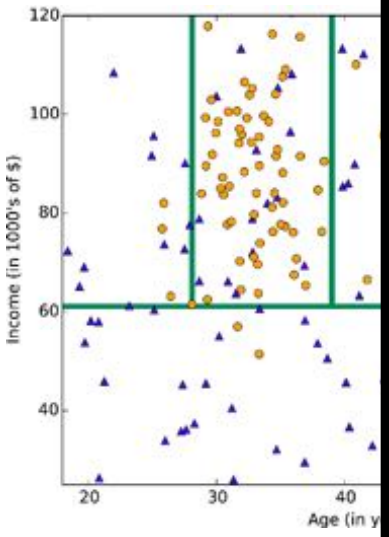


Illustration Source: https://docs.microsoft.com/en-us/azure/machine-learning/machine-learning-algorithm-choice

Decision Tree Illustration




```
from sklearn import tree

decision_tree = DecisionTreeClassifier()
decision_tree.fit(X_train, Y_train)
Y_pred = decision_tree.predict(X_test)

# Error
acc_decision_tree = round(decision_tree.score(X_train, Y_train) * 100, 2)
acc_decision_tree

# or compare Y_pred with Y_test
```

Illustration Source: http

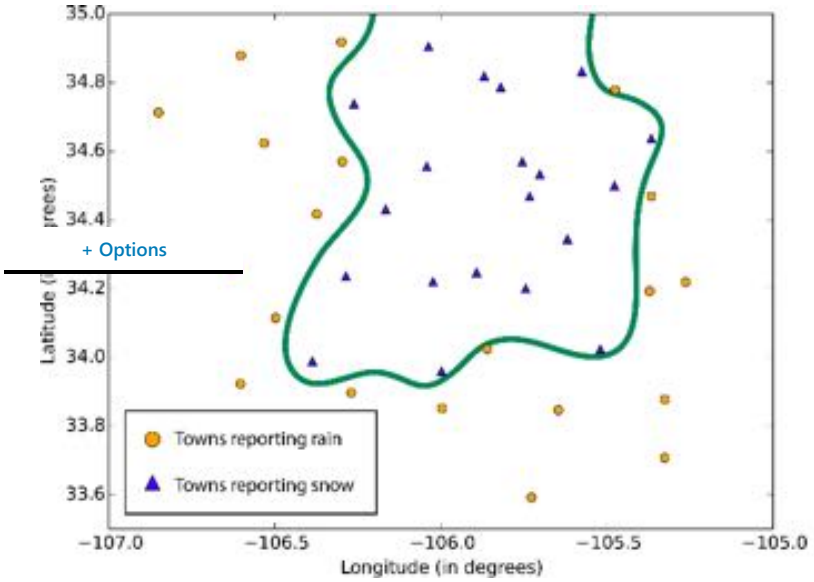
Our experiment with the Titanic Data Set

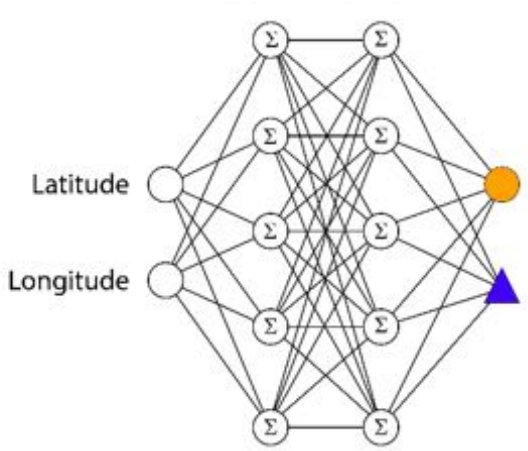
	Model	Score
	Random Forest	86.76
	Decision Tree	86.76
	KNN	84.74
	Support Vector Machines	83.84
	Logistic Regression	80.36
	Linear SVC	79.01
	Perceptron	78.00
	Naive Bayes	72.28
	Stochastic Gradient Decent	72.28

More Accuracy
Generally more training time
More risk of overfitting

Less Accuracy
Generally less computation

Neural Network Illustration





The boundaries learned by neural networks can be complex and irregular

Illustration Source: https://docs.microsoft.com/en-us/azure/machine-learning/machine-learning-algorithm-choice

End of Section