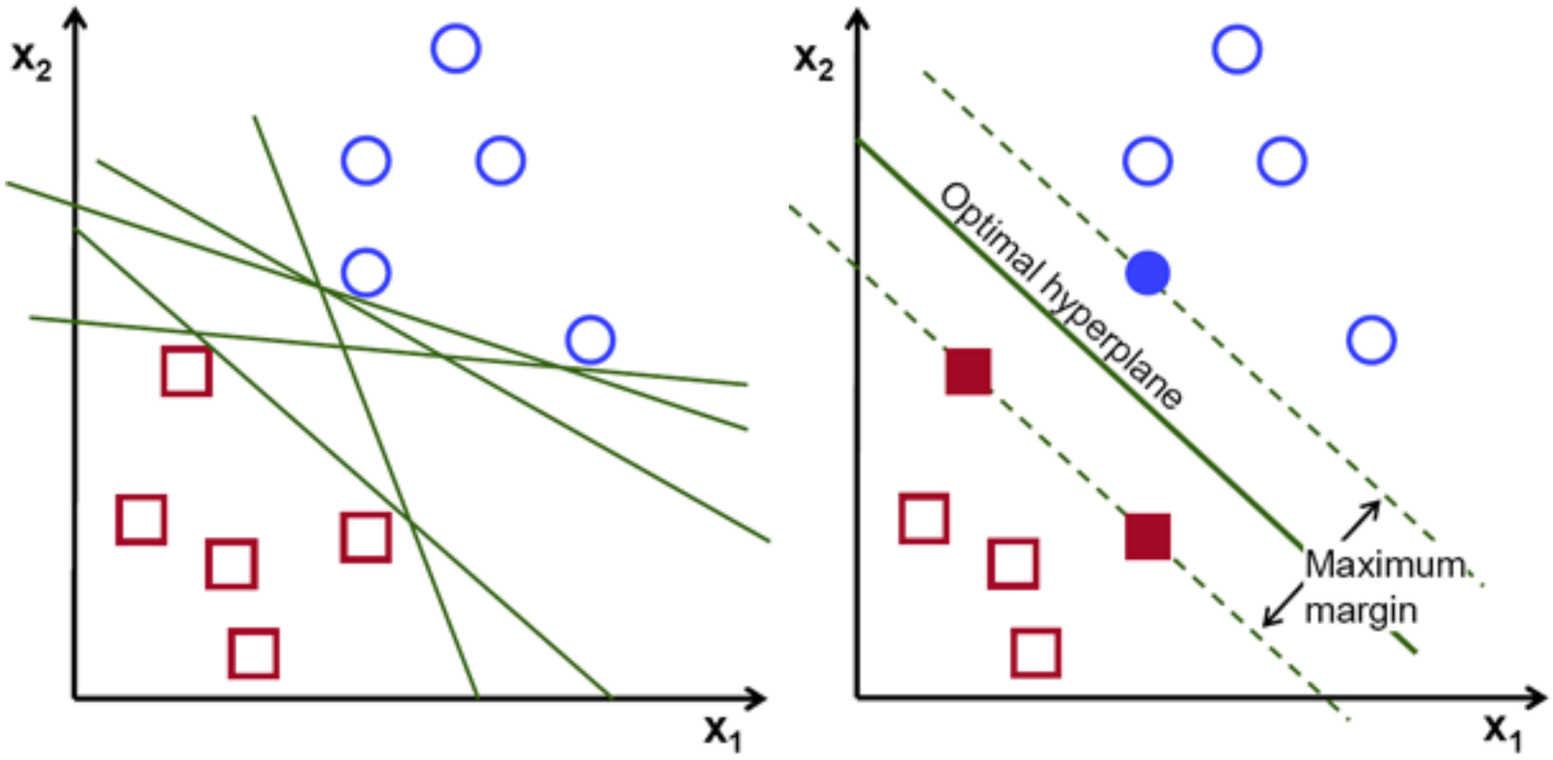
Hiba Talat
Artificial Intelligence
Final Project

What is a Support Vector Machine?

The objective of the support vector machine algorithm is to find a hyperplane in N-dimensional space that distinctly classifies the data points.



Possible hyperplanes

To distinguish between these two classes of data points, there are a lot of possible hyperplanes that could be taken into account. Our goal is to find a plane that has the maximum margin, that is the maximum distance between data points of both classes.

Hyperplane
Hyperplanes are decision boundaries that help classify the data points.
If the input feature is 2, then the hyperplane is just a line. If the number of input is 3, then the hyperplane becomes a two-dimensional plane. It results into difficult to imagine when the number of inputs is more than 3.
Support Vector
Support vectors are data points that are near to the hyperplane and influence the position/orientation of the hyperplane

Data Collected

This is the South African Lottery results from year 2000 when it started to 2015. I was interested in predicting whether there will be winners or not given the following publicly available information prior to betting:

1. Prize Payable
2. Rollover
3. Rollover Count
4. Next Estimated Jackpot

The above-mentioned features attract quite a lot of consumers and with an increase in the betters increase the chances of winning. The winner is 1 and the no-winner is 0.

```
import numpy as np # linear algebra
import pandas as pd # data processing, CSV file I/O (e.g. pd.read_csv)
import pandas_profiling as pp
%matplotlib inline
%reload_ext autoreload
%autoreload 2
```

Data Loading

```
#Loading Data

df= pd.read_csv("../input/south-african-powerball-results-lottery/POWERBALL.csv")

#View Datafram
df.head()
```

Out[12]:

	Draw No	Draw Date	Ball 1	Ball 2	Ball 3	Ball 4	Ball 5	Powerball	Div1	Div2	...	Powerbal Ball Set	Gauteng Winners	Western Cape Winners	Northern Cape Winners	Eastern Cape Winners	Mpumalanga Winners	Limpopo Winners	Freestate Winners	K Winr
0	577	29/05/2015	4	12	17	25	29	5	0	138020	...	PB5	0	0	0	0	0	0	0	
1	576	26/05/2015	12	13	20	31	36	19	0	203470	...	PB4	0	0	0	0	0	0	0	
2	575	22/05/2015	9	31	32	40	41	10	0	397954	...	PB2	0	0	0	0	0	0	0	
3	574	19/05/2015	3	21	25	26	36	1	0	236728	...	PB5	0	0	0	0	0	0	0	
4	573	15/05/2015	8	26	40	44	45	7	0	273026	...	PB4	0	0	0	0	0	0	0	

5 rows × 43 columns

Data Description

[13]:
```
df.describe()
```

Out[13]:

	Draw No	Ball 1	Ball 2	Ball 3	Ball 4	Ball 5	Powerball	Div1	Div2	Div3	...	Total Sales	Gauteng Winners	
count	577.000000	577.000000	577.000000	577.000000	577.000000	577.000000	577.000000	5.770000e+02	5.770000e+02	577.000000	...	5.770000e+02	577.000000	57
mean	289.000000	7.828423	15.448873	22.785095	30.882149	38.173310	10.637782	2.875913e+06	3.465407e+05	20861.507799	...	1.572875e+07	0.065858	
std	166.709828	6.155679	7.510495	8.207313	7.795786	6.135149	5.788413	1.029682e+07	2.402304e+05	9135.985327	...	5.274231e+06	0.261862	
min	1.000000	1.000000	2.000000	4.000000	5.000000	13.000000	1.000000	0.000000e+00	0.000000e+00	6310.000000	...	7.404194e+06	0.000000	
25%	145.000000	3.000000	9.000000	17.000000	26.000000	35.000000	6.000000	0.000000e+00	1.818430e+05	15761.000000	...	1.295400e+07	0.000000	
50%	289.000000	7.000000	15.000000	23.000000	32.000000	40.000000	11.000000	0.000000e+00	2.680130e+05	19351.000000	...	1.431372e+07	0.000000	
75%	433.000000	12.000000	20.000000	28.000000	37.000000	43.000000	16.000000	0.000000e+00	4.375070e+05	23369.000000	...	1.653288e+07	0.000000	
max	577.000000	33.000000	39.000000	43.000000	44.000000	45.000000	20.000000	1.020166e+08	1.121916e+06	97278.000000	...	6.034506e+07	2.000000	

8 rows × 38 columns

[15]:
```
#Number of rows and columns
df.shape
```

Out[15]:
```
(577, 43)
```

+ Code + Markdown

Null Values

[17]:
```
df.isnull().sum()
```

Out[17]
```
Draw No                    0
Draw Date                  0
Ball 1                     0
Ball 2                     0
Ball 3                     0
Ball 4                     0
Ball 5                     0
Powerball                  0
Div1                       0
Div2                       0
Div3                       0
Div4                       0
Div5                       0
Div6                       0
Div7                       0
Div8                       0
Div1 No Win                0
Div2 No Win                0
Div3 No Win                0
Div4 No Win                0
Div5 No Win                0
Div6 No Win                0
Div7 No Win                0
Div8 No Win                0
Prize Payable              0
Rollover                   0
Rollover Count             0
Next Estimated Jackpot     0
Next Guaranteed Jackpot    0
Total Sales                0
Draw Machine               0
Ball Set                   0
```

Question to solve

We will use SVM to predict if Division 1 winner or not.

Columns used to predict are Prize Payable, Rollover, Rollover count, and Next Estimated Jackpot

```
# Division 1 winner or not
#Columns used to predict are Prize Payable, Rollover, Rollover count and Next Estimated Jackpot

y = df.iloc[:, 16:17].values
X = df.iloc[:, 24:28].values
y1 = np.where(y>=1, 1, 0)
```

Apply Support Vector Machine

[54]:
```
# Splitting the dataset into the Training set and Test set
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y1, test_size = 0.25, random_state = 0)
```

[55]:
```
# Feature Scaling
#Standardize features by removing the mean and scaling to unit variance

from sklearn.preprocessing import StandardScaler
sc = StandardScaler()
X_train = sc.fit_transform(X_train)
X_test = sc.transform(X_test)
```

```
# Fitting Kernel SVM to the Training set
from sklearn.svm import SVC
classifier = SVC(kernel = 'linear', C = 8, random_state = 0)
classifier.fit(X_train, y_train.ravel())
```

Out[56]
```
SVC(C=8, kernel='linear', random_state=0)
```

[57]:
```
# Predicting the Test set results
y_pred = classifier.predict(X_test)
```

```
#Comparing the Test Data to the predicted data. This is a 100% Match.
#Turn both arrays to pandas DataFrames and concantenate
y_test = pd.DataFrame(y_test)
y_pred = pd.DataFrame(y_pred)
result_df = pd.concat([y_test, y_pred], axis = 1, sort = False)
result_df
```

Out[58]:

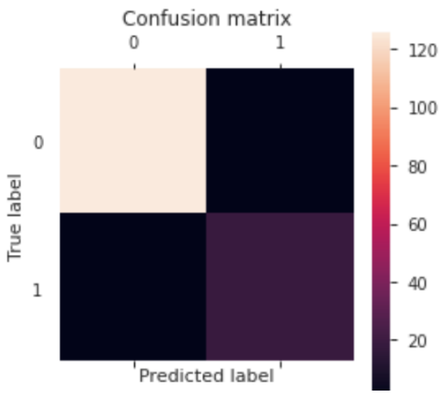
	0	0
0	0	0
1	0	0
2	0	0
3	0	0
4	0	0
...	...	...
140	0	0
141	0	0
142	0	0
143	0	0
144	0	0

145 rows × 2 columns

[59]:
```
# Making the Confusion Matrix for Visualization of the data
from sklearn.metrics import confusion_matrix
cm = confusion_matrix(y_test, y_pred)
score = classifier.score(X_test, y_test)
score
```

Out[59]
```
1.0
```

```
#Plotting the Confusion Matrix
import matplotlib.pyplot as plt
plt.matshow(cm)
plt.title('Confusion matrix')
plt.colorbar()
plt.ylabel('True label')
plt.xlabel('Predicted label')
plt.show()
```



[61]:
```
from sklearn.metrics import accuracy_score
rf_acc_score = accuracy_score(y_test,  y_pred)
print("Accuracy of SVM :",rf_acc_score*100,'\n')
```

```
Accuracy of SVM : 100.0
```

```
# Applying k-Fold Cross Validation to check for mean and Variance
from sklearn.model_selection import cross_val_score
accuracies = cross_val_score(estimator = classifier, X = X_train, y = y_train.ravel(), cv = 10)
Mean = accuracies.mean()#Mean close to 1
Variance = accuracies.std()#Low Variance
print("Variance and Mean is {0} and {1} ".format(Variance, Mean))
```

```
Variance and Mean is 0.0 and 1.0
```

Comparing with Logistic Regression

[20]:
```
# Splitting the dataset into the Training set and Test set
from sklearn.model_selection import train_test_split
X_train, X_test, y_train, y_test = train_test_split(X, y1, test_size = 0.25, random_state = 0)
```

[21]:
```
from sklearn.linear_model import LogisticRegression
from sklearn.metrics import accuracy_score
model = LogisticRegression()
model.fit(X, y)
predicted_classes = model.predict(X)
accuracy = accuracy_score(y.flatten(),predicted_classes)
parameters = model.coef_
accuracy*100
```

```
/opt/conda/lib/python3.7/site-packages/sklearn/utils/validation.py:63: DataConversionWarning: A column-vector y was pass
ed when a 1d array was expected. Please change the shape of y to (n_samples, ), for example using ravel().
  return f(*args, **kwargs)
```

Out[21]
```
98.44020797227037
```

Conclusion

- SVM gives 100 % result vs Logistic regression 98%
- Data has zero null values
- SVM is better where variance variance is 0 and mean is 1

References

Lotto Historical Result. (n.d.). Lotto Historical Result. https://www.nationallottery.co.za/lotto-history/?game=Lotto

Contributor, T. (2017, November 29). *support vector machine (SVM)*. WhatIs.Com. https://whatis.techtarget.com/definition/support-vector-machine-SVM