

SVM Kernels Indepth Intuition And Practical Explanation

```
In [2]: import numpy as np
import matplotlib.pyplot as plt

x = np.linspace(-5.0, 5.0, 100)
y = np.sqrt(10**2 - x**2)
y=np.hstack([y,-y])
```

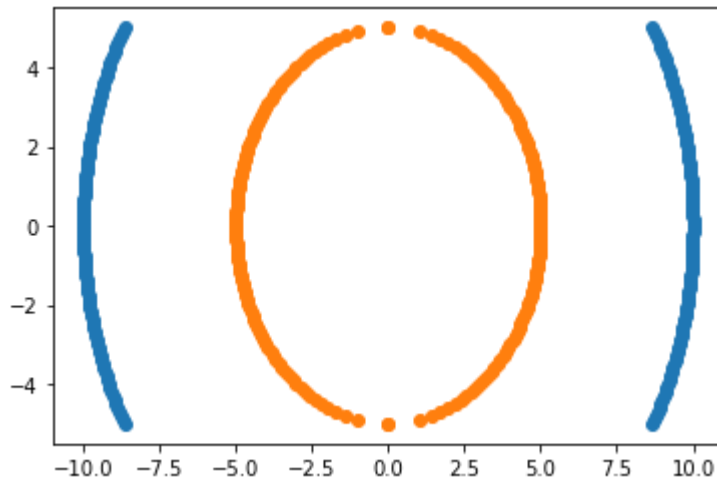
In [39]:

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```

```
In [4]: x1 = np.linspace(-5.0, 5.0, 100)
        y1 = np.sqrt(5**2 - x1**2)
        y1=np.hstack([y1,-y1])
```

```
In [5]: plt.scatter(y,x)
```

```
Out[5]: <matplotlib.collections.PathCollection at 0x229ae0785e0>
```



```
In [6]:
```

```
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               [ -4.54999774, 33.09999999],
               [ -4.60499779, 33.19999999],
               [ -4.65999784, 33.29999999],
               [ -4.71499789, 33.39999999],
               [ -4.76999794, 33.49999999],
               [ -4.82499799, 33.59999999],
               [ -4.87999804, 33.69999999],
               [ -4.93499809, 33.79999999],
               [ -4.98999814, 33.89999999],
               [ -5.04499819, 33.99999999],
               [ -5.09999824, 34.09999999],
               [ -5.15499829, 34.19999999],
               [ -5.20999834, 34.29999999],
               [ -5.26499839, 34.39999999],
               [ -5.31999844, 34.49999999],
               [ -5.37499849, 34.59999999],
               [ -5.42999854, 34.69999999],
               [ -5.48499859, 34.79999999],
               [ -5.53999864, 34.89999999],
               [ -5.59499869, 34.99999999],
               [ -5.64999874, 35.09999999],
               [ -5.70499879, 35.19999999],
               [ -5.75999884, 35.29999999],
               [ -5.81499889, 35.39999999],
               [ -5.86999894, 35.49999999],
               [ -5.92499899, 35.59999999],
               [ -5.97999904, 35.69999999],
               [ -6.03499909, 35.79999999],
               [ -6.08999914, 35.89999999],
               [ -6.14499919, 35.99999999],
               [ -6.19999924, 36.09999999],
               [ -6.25499929, 36.19999999],
               [ -6.30999934, 36.29999999],
               [ -6.36499939, 36.39999999],
               [ -6.41999944, 36.49999999],
               [ -6.47499949, 36.59999999],
               [ -6.52999954, 36.69999999],
               [ -6.58499959, 36.79999999],
               [ -6.63999964, 36.89999999],
               [ -6.69499969, 36.99999999],
               [ -6.74999974, 37.09999999],
               [ -6.80499979, 37.19999999],
               [ -6.85999984, 37.29999999],
               [ -6.91499989, 37.39999999],
               [ -6.96999994, 37.49999999],
               [ -7.02499999, 37.59999999],
               [ -7.07999999, 37.69999999],
               [ -7.13499999, 37.79999999],
               [ -7.18999999, 37.89
```

```
In [7]: import pandas as pd
df1 =pd.DataFrame(np.vstack([y,x]).T,columns=['X1', 'X2'])
df1['Y']=0
df2 =pd.DataFrame(np.vstack([y1,x1]).T,columns=['X1', 'X2'])
df2['Y']=1
df = df1.append(df2)
```

```
Out[7]:
```

	X1	X2	Y
0	8.660254	-5.00000	0
1	8.717792	-4.89899	0
2	8.773790	-4.79798	0
3	8.828277	-4.69697	0
4	8.881281	-4.59596	0

```
In [8]:
```

```
Out[8]:
```

	X1	X2	Y
195	-1.969049	-4.59596	1
196	-1.714198	-4.69697	1
197	-1.406908	-4.79798	1
198	-0.999949	-4.89899	1
199	-0.000000	-5.00000	1

```
In [9]: ### Independent and Dependent features
X = df.iloc[:, :2]
```

```
In [10]:
```

```
Out[10]:
```

0	0
1	0
2	0
3	0
4	0
..	
195	1
196	1
197	1
198	1
199	1

Name: Y, Length: 400, dtype: int64

```
In [11]: ## Split the dataset into train and test
from sklearn.model_selection import train_test_split
```

In [12]:

Out[12]:

	X1	X2
50	4.999745	0.050505
63	9.906589	1.363636
112	-3.263736	3.787879
159	-9.953852	-0.959596
83	3.680983	3.383838
...
123	-4.223140	2.676768
192	-9.031653	-4.292929
117	-9.445795	3.282828
47	9.996811	-0.252525
172	-9.738311	-2.272727

300 rows × 2 columns

Polynomial Kernel

$$K(x, y) = (x^T y + c)^d$$

In [14]:

```
# We need to find components for the Polynomical Kernel
#X1,X2,X1_square,X2_square,X1*X2

df['X1_Square'] = df['X1']**2
df['X2_Square'] = df['X2']**2
df['X1*X2'] = (df['X1'] * df['X2'])
```

Out[14]:

	X1	X2	Y	X1_Square	X2_Square	X1*X2
0	8.660254	-5.000000	0	75.000000	25.000000	-43.301270
1	8.717792	-4.89899	0	75.999898	24.000102	-42.708375
2	8.773790	-4.79798	0	76.979390	23.020610	-42.096467
3	8.828277	-4.69697	0	77.938476	22.061524	-41.466150
4	8.881281	-4.59596	0	78.877155	21.122845	-40.818009

In [15]:

```
### Independent and Dependent features
X = df[['X1', 'X2', 'X1_Square', 'X2_Square', 'X1*X2']]
```

In [16]:

```
Out[16]: 0      0
         1      0
         2      0
         3      0
         4      0
         ..
        195     1
        196     1
        197     1
        198     1
        199     1
        Name: Y, Length: 400, dtype: int64
```

In []:

In [17]:

```
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size = 0.25, r
```

In [18]:

```
Out[18]:
```

	X1	X2	X1_Square	X2_Square	X1*X2
50	4.999745	0.050505	24.997449	0.002551	0.252512
63	9.906589	1.363636	98.140496	1.859504	13.508984
112	-3.263736	3.787879	10.651974	14.348026	-12.362637
159	-9.953852	-0.959596	99.079176	0.920824	9.551676
83	3.680983	3.383838	13.549638	11.450362	12.455852
...
123	-4.223140	2.676768	17.834915	7.165085	-11.304366
192	-9.031653	-4.292929	81.570758	18.429242	38.772248
117	-9.445795	3.282828	89.223038	10.776962	-31.008922
47	9.996811	-0.252525	99.936231	0.063769	-2.524447
172	-9.738311	-2.272727	94.834711	5.165289	22.132526

300 rows × 5 columns

In []:

```
In [19]: import plotly.express as px

fig = px.scatter_3d(df, x='X1', y='X2', z='X1*X2',
                    color='Y')
```

In [20]:

```
fig = px.scatter_3d(df, x='X1_Square', y='X1_Square', z='X1*X2',  
                    color='Y')
```

In []:

In []:

In []:

In []:

In []:

In []:

```
In [51]: from sklearn.svm import SVC
from sklearn.metrics import accuracy_score
classifier = SVC(kernel="linear")
classifier.fit(X_train, y_train)
y_pred = classifier.predict(X_test)
```

Out[51]: 0.45

```
In [52]: from sklearn.svm import SVC
from sklearn.metrics import accuracy_score
classifier = SVC(kernel="poly")
classifier.fit(X_train, y_train)
y_pred = classifier.predict(X_test)
```

Out[52]: 0.59

```
In [53]: from sklearn.svm import SVC
from sklearn.metrics import accuracy_score
classifier = SVC(kernel="rbf")
classifier.fit(X_train, y_train)
y_pred = classifier.predict(X_test)
```

Out[53]: 1.0

```
In [54]: from sklearn.svm import SVC
from sklearn.metrics import accuracy_score
classifier = SVC(kernel="sigmoid")
classifier.fit(X_train, y_train)
y_pred = classifier.predict(X_test)
```

Out[54]: 0.51

In []: