- Dataset can be found at Pima Indians Diabetes Database (https://www.kaggle.com/uciml/pima-indians-diabetes-database)
- More about K-Means clustering at Pocket Algorithm (https://www.codeproject.com/Articles/1229772/Machine-Learning-Basics-Pocket-Learning-Algorithm)

In [1]:
```
import numpy as np
import pandas as pd

from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler
from sklearn import metrics

from matplotlib import pyplot as plt
```

In [2]:
```
df = pd.read_csv("diabetes.csv")
df.head()
```

Out[2]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
0	6	148	72	35	0	33.6	0.627	50	1
1	1	85	66	29	0	26.6	0.351	31	0
2	8	183	64	0	0	23.3	0.672	32	1
3	1	89	66	23	94	28.1	0.167	21	0
4	0	137	40	35	168	43.1	2.288	33	1

What does the dataset contain ?

The datasets consists of several medical predictor variables and one target variable, Outcome. Predictor variables includes the number of pregnancies the patient has had, their BMI, insulin level, age, and so on.

In [3]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 768 entries, 0 to 767
Data columns (total 9 columns):
 #   Column                    Non-Null Count  Dtype  
---  ------                    --------------  -----  
 0   Pregnancies               768 non-null    int64  
 1   Glucose                   768 non-null    int64  
 2   BloodPressure             768 non-null    int64  
 3   SkinThickness             768 non-null    int64  
 4   Insulin                   768 non-null    int64  
 5   BMI                       768 non-null    float64
 6   DiabetesPedigreeFunction  768 non-null    float64
 7   Age                       768 non-null    int64  
 8   Outcome                   768 non-null    int64  
dtypes: float64(2), int64(7)
memory usage: 54.1 KB
```

What is the algorithm

```
* A perceptron is a neural network unit (an artificial neuron) that does certain computation. During the
learning phase, the network learns by adjusting these weights in order to be able to predict the correct class
for input data.
* It is supervised linear classifier.
```

How does it work

```
1. Initialize the pocket weight vector, W_pocket to 0 to small random numbers and use the weight vector as the
initialized weight vector, W_0 of Perceptron Learning Algorithm
2. For each training iteration, perform the following sub-steps:
    * Run the training step of Perceptron Learning Algorithm to obtain the updated weight vector, W_t where t
indicates the current iteration.
    * Evaluate W_t by comparing the number of misclassification on the entire sample set with the number of
misclassification performed by W_pocket.
    * If W_i is better than W_pocket, replace W_pocket with W_i
3. Return W_pocket when the training iteration terminates.
```

Advantages and Disadvantges of the algorithm

```
Advantages:
* Pocket algorithm can be used only for simple problems.
* It's computation time is very fast.

Disadvantages:
* Pocket algorithm is prune to overfitting
* Number of iterations limits the accuracy. This is not recommended for non-linearly separable data
```

How is it performed on the dataset

In [4]:
```
df.head()
```

Out[4]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
0	6	148	72	35	0	33.6	0.627	50	1
1	1	85	66	29	0	26.6	0.351	31	0
2	8	183	64	0	0	23.3	0.672	32	1
3	1	89	66	23	94	28.1	0.167	21	0
4	0	137	40	35	168	43.1	2.288	33	1

In [5]:
```
df['Outcome'].replace({0: -1}, inplace=True)
```

In [6]:
```
df.head()
```

Out[6]:

	Pregnancies	Glucose	BloodPressure	SkinThickness	Insulin	BMI	DiabetesPedigreeFunction	Age	Outcome
0	6	148	72	35	0	33.6	0.627	50	1
1	1	85	66	29	0	26.6	0.351	31	-1
2	8	183	64	0	0	23.3	0.672	32	1
3	1	89	66	23	94	28.1	0.167	21	-1
4	0	137	40	35	168	43.1	2.288	33	1

In [7]:
```
X = df.iloc[:, :-1].values
y = df.iloc[:, -1].values
```

In [8]:
```
X_train, X_test, y_train, y_test = train_test_split(X, y, random_state=42, test_size=0.3)
```

In [9]:
```
X_train.shape
```

Out[9]:
```
(537, 8)
```

In [10]:
```
learningRate = 0.01
oneVector = np.ones((X_train.shape[0], 1))
print (X_train.shape)
print(y_train.shape)
```

```
(537, 8)
(537,)
```

In [11]:

```
def pocket_algo(X, y, iterations=70):
    plotData = []
    weights = np.random.rand(X.shape[1], 1)
    weights_pocket = None
    misClassifications = 1
    minMisclassifications = X.shape[0]
    iteration = 0
    while (misClassifications != 0 and (iteration < iterations)):
        iteration += 1
        misClassifications = 0
        for i in range(0, len(X)):
            currentX = X[i].reshape(-1, X.shape[1])
            currentY = y[i]
            wTx = np.dot(currentX, weights)[0][0]
            if currentY == 1 and wTx < 0:
                misClassifications += 1
                weights = weights + learningRate * np.transpose(currentX)
            elif currentY == -1 and wTx > 0:
                misClassifications += 1
                weights = weights - learningRate * np.transpose(currentX)
        plotData.append(misClassifications)

        if misClassifications < minMisclassifications:
            minMisclassifications = misClassifications
            weights_pocket = weights
#         print("Iteration {}, Misclassifications {}".format(iteration, misClassifications))
    print ("Minimum Misclassifications : ", minMisclassifications)
    return weights_pocket, plotData, minMisclassifications
```

In [12]:

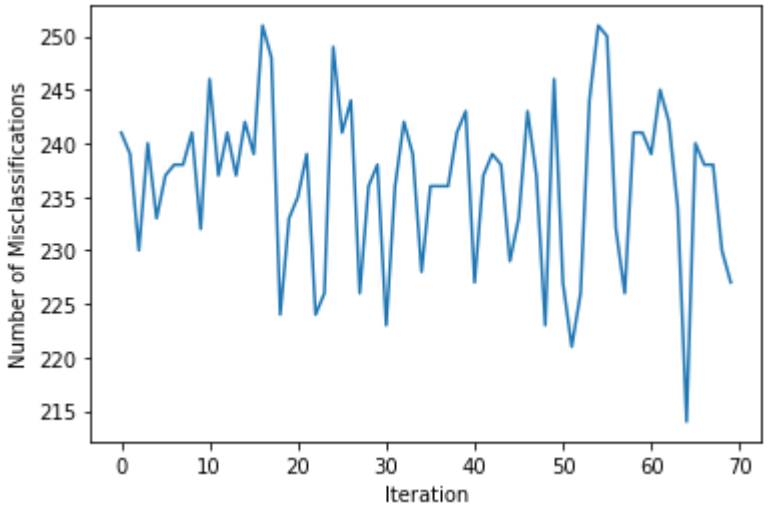
```
num_iterations = 70
weights, plotData, minMisclassifications = pocket_algo(X_train, y_train, iterations=num_iterations)
```

```
Minimum Misclassifications :  214
```

In [13]:

```
print ("Best Case Accuracy of Pocket Learning Algorithm: {:.3f} %".format
       (((X_train.shape[0] - minMisclassifications)/X_train.shape[0])*100))
plt.plot(np.arange(0, num_iterations), plotData)
plt.xlabel("Iteration")
plt.ylabel("Number of Misclassifications")
plt.show()
```

```
Best Case Accuracy of Pocket Learning Algorithm: 60.149 %
```



Summary

- Pocket algorithm is one of the simplest and fastest algorithms
- But the model in itself is not very reliable
- The model can not generalize the data and results in low accuracy
- Pocket algorithm is good for smaller datasets

In [ ]: