# Assignment #4 Support Vector Machines

Problem#2:

- Fit() function:
  - First initialize the "β = w" and b.
  - Then start the iterations in a for loop.
  - Calculate the margin and the cost.

$$\Phi(w) = \tfrac{1}{2} w^T w + C\sum \xi_i$$

Figure 1:Cost function

Where:

$$\xi_i = max\left(0, 1 - y_i(\beta^T x_i + b)\right)$$

then:

$$L = \frac{||\beta^2||}{2} + C\sum_{i=1}^{n} max\left(0, 1 - y_i(\beta^T x_i + b)\right)$$

- save the cost per iteration to an array
- get the indices of the data points where margin=(yi (βTxi+1))<1
- Update β= β - λg and b= b - λg until convergence Same as in Linear/Logistic Regression, where λ is the learning rate , Φ(w)=L

$$\frac{\delta L}{\delta \beta} = \beta - C \sum_{i=1, \xi_i \geq 0}^{n} y_i x_i$$

$$\frac{\delta L}{\delta b} = -C \sum_{i=1, \xi_i \geq 0}^{n} y_i$$

- finally get the index of the support vectors.

- Score() function: we have np.mean(y == P) where y is actual & p is predicted. First, this will evaluate the conditional,y == P, which will return a list of True and False values. Then it will run np.mean() on that list, True = 1, False = 0 during the calculation. Mean=(Number of elements satisfying condition) / (Number of total elements), thus np.mean() give us the accuracy. Output showing in the following figure.

```
[False  True  True  True  True  True  True  True  True  True  True  True
  True False  True  True  True  True  True  True]
test score: 0.9
```

- Plot() function: using scatter plot