Instruction to run the code:

> python3 project.py

Output of code:
Output file output.txt is generated.

Contents of output.txt:

1. Whether the classification of test samples is correct or not.
2. Accuracy of the classifier

Report:
Non-kernalized binary classifer

```
S, features = X.shape[0], X.shape[1]
lamb = 0.1
w = np.zeros(features)
choice = np.arange(1,S+1)
for t in range(0,T):
    i = np.random.choice(choice)
    eta = 1/(lamb*(t+1))
    x_val, y_val = X[i], y[i]
    value = w.dot(x_val)
    if y_val*value < 1:
        w = (1 - eta*lamb)*w + eta * y_val * x_val
    else:
        w = (1 - eta * lamb) * w
```

Function used to learn the weights (function obtained from paper given as reading material)
T is chosen to be 1000.
A random training sample is chosen and is repeated T times.
The value of the weights are learnt 1000 times and the last iteration of w is chosen for further steps.
A learning rate is chosen according to the iteration number.
The training sample and its corresponding label is chosen and w value is calculated for that particular i.
This w is used in the next step.
The w is next used in the test samples.
If the product of w^Tx (w^T being w transpose) and the test labels have the same sign, then the sample has been correctly classified, else wrong classification.
Accuracy is measures as correct classification upon total samples to be classified.

Loss functions:

In the paper, in the SVM the weight vector $\boldsymbol{w}$ is defined as the vector that minimizes the following *objective function*:

$$f(\boldsymbol{w}, \boldsymbol{X}, Y) = \sum_i \text{Loss}(\boldsymbol{w}, \boldsymbol{x}_i, y_i) + \lambda \cdot \|\boldsymbol{w}\|^2$$

For the SVM, Loss is the *hinge loss function*:

$$\text{Loss}(\boldsymbol{w}, \boldsymbol{x}_i, y_i) = \max(0, 1 - y_i \cdot (\boldsymbol{w} \cdot \boldsymbol{x}_i))$$

The hinge loss function can be written more explicitly in this way:

$$\text{Loss}(\boldsymbol{w}, \boldsymbol{x}_i, y_i) = \begin{cases} 1 - y_i \cdot (\boldsymbol{w} \cdot \boldsymbol{x}_i) & \text{if } y_i \cdot (\boldsymbol{w} \cdot \boldsymbol{x}_i) < 1 \\ 0 & \text{otherwise} \end{cases}$$

Link to screencast