Machine Learning HW1 PA Report

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For Problem 6, you will play with the PLA algorithm.

First, we use an artificial data set to study PLA. The data set is in

`http://www.csie.ntu.edu.tw/~htlin/course/mlfound19fall/hw1/hw1_6_train.dat`

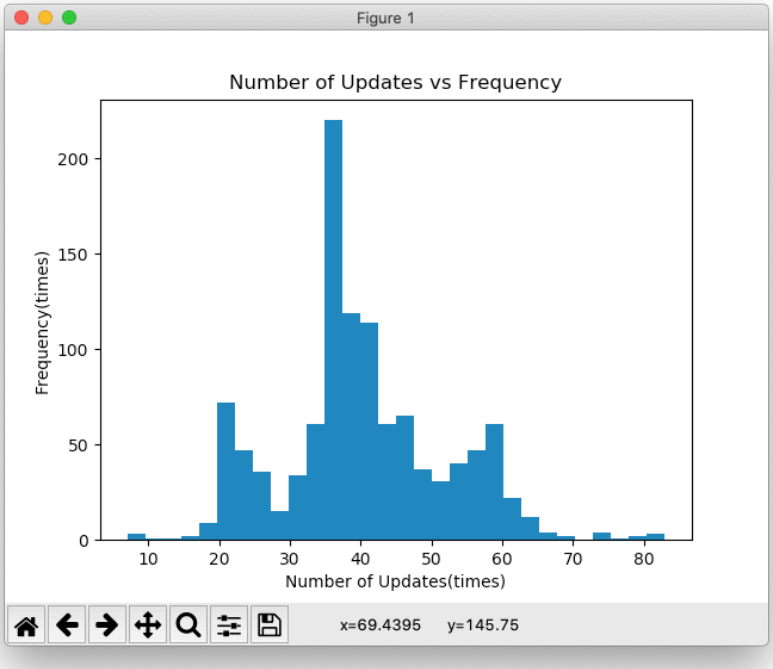
Note that the file is exactly the same as the one for Cousera Homework 1, Problem 15.

`https://www.csie.ntu.edu.tw/~htlin/mooc/datasets/mlfound_math/hw1_15_train.dat`

Each line of the data set contains one $(\mathbf{x}_n, y_n)$ with $\mathbf{x}_n \in \mathbb{R}^4$. The first 4 numbers of the line contains the components of $\mathbf{x}_n$ orderly, the last number is y_n. Please initialize your algorithm with $\mathbf{w} = \mathbf{0}$ and take sign(0) as -1. As a friendly reminder, remember to add $x_0 = 1$ as always!

6. (*, 20 points) Implement a version of PLA by visiting examples in fixed, pre-determined random cycles throughout the algorithm. Run the algorithm on the data set. Please repeat your experiment for 1126 times, each with a different random seed. What is the average number of updates before the algorithm halts? Plot a histogram (`https://en.wikipedia.org/wiki/Histogram`) to show the number of updates versus the frequency of the number.

6.




```
Average number of updates:40.22
```

Next, we play with the pocket algorithm. Modify your PLA in the previous problem by adding the 'pocket' steps to the algorithm. We will use

`http://www.csie.ntu.edu.tw/~htlin/course/mlfound19fall/hw1/hw1_7_train.dat`

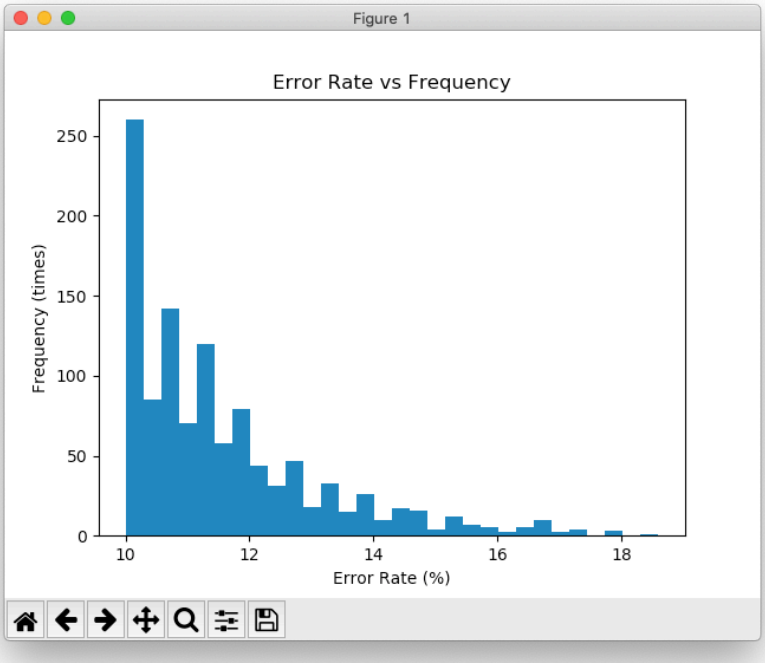
as the training data set $\mathcal{D}$, and

`http://www.csie.ntu.edu.tw/~htlin/course/mlfound19fall/hw1/hw1_7_test.dat`

as the test set for "verifying" the g returned by your algorithm (see lecture 4 about verifying). The sets are of the same format as the previous one.

7. (*, 20 points) Run the pocket algorithm with a total of 100 updates on $\mathcal{D}$, and verify the performance of $\mathbf{w}_{\text{POCKET}}$ using the test set. Please repeat your experiment for 1126 times, each with a different random seed. What is the average error rate on the test set? Plot a histogram to show the error rate versus frequency.

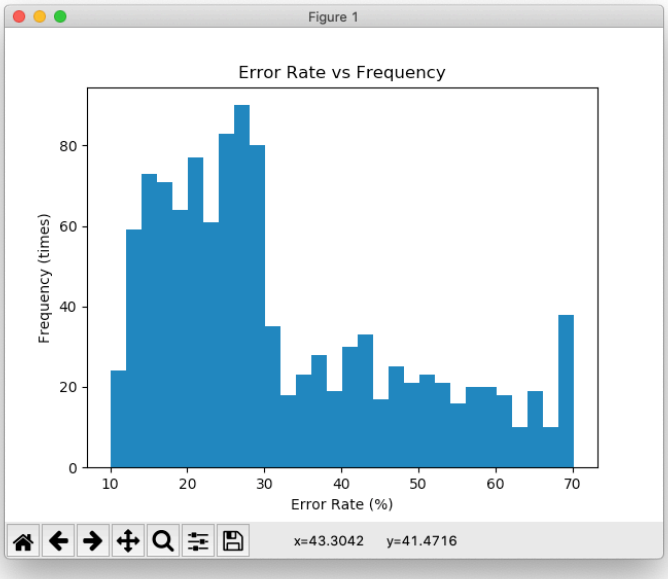
7.




```
Average error rate: 11.6%
```

> **8.** (*, 20 points) Modify your algorithm in the previous problem to return $\mathbf{w}_{100}$ (the PLA vector after 100 updates) instead of $\hat{\mathbf{w}}$ (the pocket vector) after 100 updates. Run the modified algorithm on $\mathcal{D}$, and verify the performance using the test set. Please repeat your experiment for 1126 times, each with a different random seed. What is the average error rate on the test set? Plot a histogram to show the error rate versus frequency. Compare your result to the previous problem and briefly discuss your findings.

8.




```
Average error rate: 32.1%
```

顯然使用[第 100 次 update 後的 weight vector]比[前 100 次 update 中最佳(error 最少)的 weight vector]平均效果要差了不少，而且穩定度變差(變異數變大)很多，average error rate 上升了 176.7%，這也是為什麼我們要記錄最佳的 weight vector 放在 pocket 裡面。