Exam 1 (Take Home)

You may use your class notes, Matlab files and the text, but you are expected to do your own work.

1. On the class website, there is a Matlab data file called `Exam01Prob01`. It contains a one set of 100 data triples, (x_i, y_i, z_i) in the array `X`. It also contains one set of 10 ordered pairs, (x_i, y_i), in the array `Xtest`.

   Find parameters a, b, c, d, e so that

   $$z_i \approx ax_i^2 + bx_iy_i + cy_i + d\sin(y_i) + e$$

   Where the parameters minimize the squared error between the actual output and the z_i.

   Then use these parameters to predict the output for the data in `Xtest`, and your script file should print these 10 values to the screen.

2. Suppose the actual payouts for a 7-armed bandit have means:

   $$Q = [-0.4, -0.2, -0.1, 0, 0.1, 0.2, 0.4]$$

   Change the code in `banditS.m` and `banditW.m` so that we play a total of 100 times (you can leave τ, β as they are). Run each and report the estimated Q values that you get in each. (You may publish the script files to get the plots, but you'll have to change the plot command a bit).

3. On the class website, there is a Matlab data file called `FaceClass01`. The file consists of two arrays,

   - Array X is 10304×40, and we should interpret that as 40 points in $\mathbb{R}^{10,304}$.
   - Array T is 40×4, and we should interpret that as 40 points in $\mathbb{R}^4$.

   Find a mapping $f(\mathbf{x}_i) = W\mathbf{x}_i + \mathbf{b} \approx \mathbf{t}_i$, for each $i = 1, 2, \ldots, 40$.

   (a) Find the mapping using Widrow-Hoff. Careful- this is set up like the Iris classification problem (all the data is ordered), and the learning rate should be extremely small- On the order of 10^{-10}. Try several parameters and get the best confusion matrix you can- Report these results (the confusion matrix).

   (b) In the same script, write the classification problem as a linear algebra problem and solve it directly (batch). Look at the confusion matrix again and comment. (NOTE: Recall that to do the batch learning, we have to construct $\hat{W}$ and $\hat{X}$, then we'll may have to change back to re-do the confusion matrix).

Side Remark: This is not needed to solve the problem, but each column vector of X is actually a 112×92 pixel image. To see the first one for example, you could type:

```
A=reshape(X(:,1),112,92);
imagesc(A); axis square; axis off; colormap(gray)
```

There are four sets of 10 photos, each set is for a particular person- Therefore, we are building a classification algorithm to "recognize" the person by classifying the photo as class 1, 2, 3, or 4.