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HW #4

1. **PCA by hand**
2. First we write the matrix **X** of our data

X =

1. We calculate the mean of and subtract from each column

\*Both averages are 0 so subtracting them from the columns makes no difference

1. Compute the covariance matrix

The covariance matrix is

1. Find the eigenvalues and eigenvectors

We solve for the eigenvector corresponding to

Now we row reduce the matrix

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Since corresponds to a greater eigenvector than it will be the first principal component .

The variance of

1. If we reconstruct the original points by using the principal component, then we get the following points back:

The reconstruction error is:

Error:

**2 Manual Calculations of one round of EM For a GMM**

**M-Step**

1. The objective function is:
2. Computations for

1. Computations for
2. Computations for

**E-Step**