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## Homework 3

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2017-11-28

### 1 PCA EIGENVECTOR ORTHOGONALITY

According to the first equation:

$$\begin{aligned} A\vec{x} &= \lambda_1 \vec{x} \\ \vec{x}^T A^T &= \lambda_1 \vec{x}^T \end{aligned}$$

We know that A is a symmetric matrix

$$\begin{aligned} \vec{x}^T A &= \lambda_1 \vec{x}^T \\ \vec{x}^T A \vec{y} &= \lambda_1 \vec{x}^T \vec{y} \end{aligned}$$

According to the second equation, we can do the following substitution:

$$\begin{aligned} \vec{x}^T \lambda_2 \vec{y} &= \lambda_1 \vec{x}^T \vec{y} \\ (\lambda_1 - \lambda_2) * \vec{x}^T \vec{y} &= 0 \end{aligned}$$

As eigenvalues are different

$$\vec{x}^T \vec{y} = 0$$

Therefore, the two eigenvectors are orthogonal