# Exercises for Lecture 11

## 1. Principal components analysis

Assume you are given a dataset of N samples (with each sample having D features), $X_{N \times D}$. You want to project this data down to 1D such that the variance of the projected data is maximized. Denoting the projection parameters (i.e., loading vector) with $w$, this problem can be written as

$$\max_{w} \mathrm{Var}(Xw)$$
$$s.t. \, w^T w = 1$$

Show that the unit vector $w$ that maximizes the variance is the eigenvector of the covariance matrix $X^T X$ with the largest eigenvalue.

You can assume that each column of $X$ has zero mean.

## 2. Principal components analysis lab

Do the labs in Section 10.4 in ISLR.