CPDA SP18 Assignment #5

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Eigenfaces

(a) Import data into workspace and print dimensions.

```
setwd("/Users/hughj/Development/osu/osu-mach-learn/module-5")
X <- as.matrix(read.csv("my_data_pca.txt", header = FALSE))
dim(X)
```

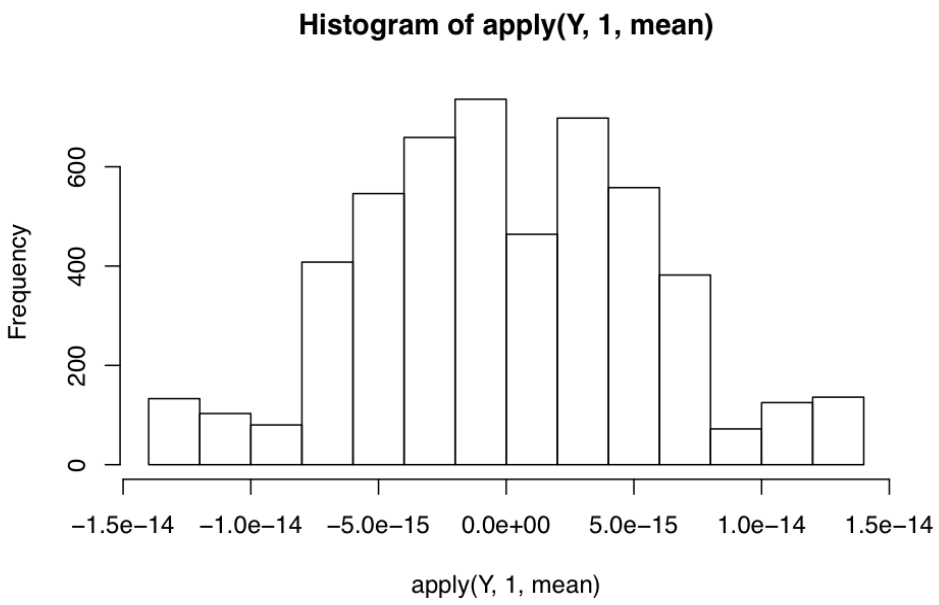
```
## [1] 5100  800
```

(b) Compute the mean of each feature and subtract from each column

```
moef <- as.matrix(apply(X, 1, mean))
Y <- apply(X, 2, function(m){m - t(moef)})
dim(Y)
```

```
## [1] 5100  800
```

```
hist(apply(Y, 1, mean))
```



(c) Calculate the covariance of Y given by C = t(Y)Y

```
C<- t(Y) %*% Y
dim(C)
```

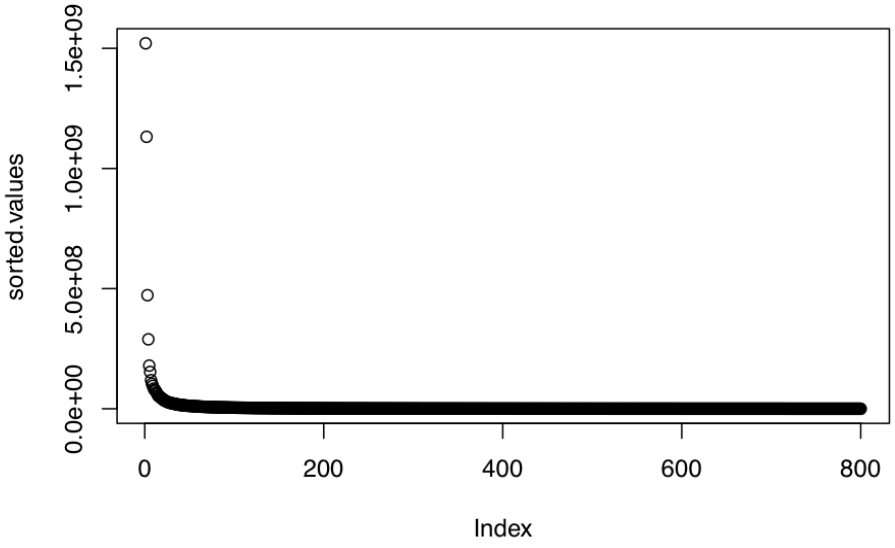
```
## [1] 800 800
```

(d) Find the eigenvalues and eigenvectors of the matrix C.

```
c.eigen <- eigen(C)
```

(e)Order the eigenvalues of the matrix from the largest to smallest, and plot the ordered eigenvalues.

```
sorted.values<-sort(c.eigen$values, decreasing = TRUE)
plot(sorted.values)
```



(f) We wish to keep only 12 eigenvectors corresponding to 12 largest eigenvalues. Stack these 12 eigenvectors as columns of a matrix V.

```
s <- apply(as.matrix(sorted.values), 1, function(n){which(c.eigen$values == n)})[1:12]
V<-c.eigen$vectors[,s]
dim(V)
```

```
## [1] 800  12
```

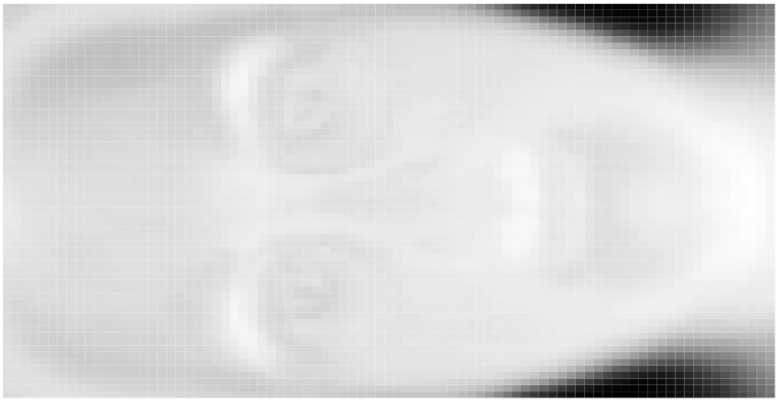
(g) Find E = Y * V. The eigenfaces are given by the resultant matrix E. What is the dimension of E.

```
E <- Y %*% V
dim(E)
```

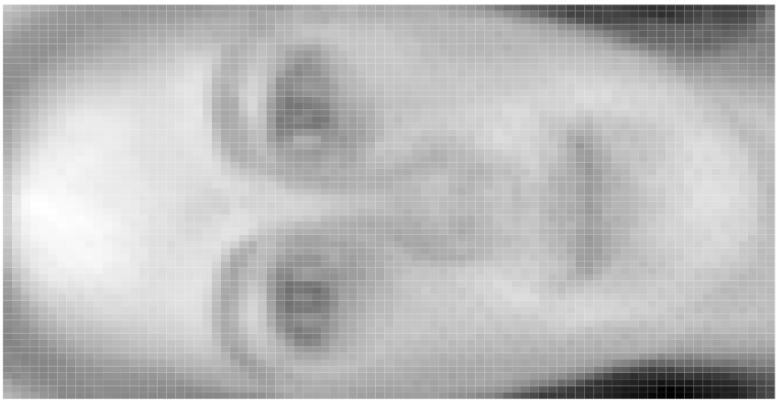
```
## [1] 5100   12
```

(h) Convert E into 12 images where each image is of dimension 85 x 60, and use image(.) function in R to display each of the 12 images.

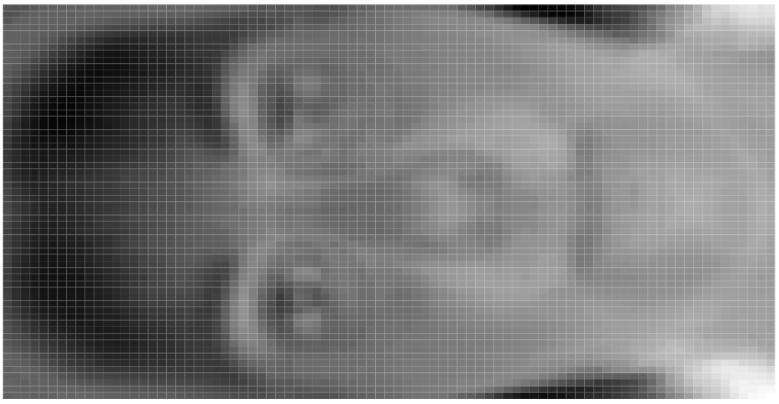
```
for (img in 1:12){
  image(matrix(E[,img], 85, 60), axes=FALSE, col=grey(seq(0,1,length=256)))
  cat("##\n")
}
```



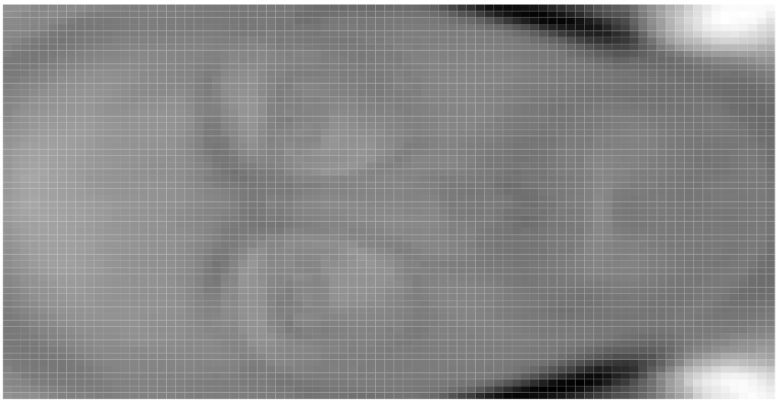
```
## ##
```



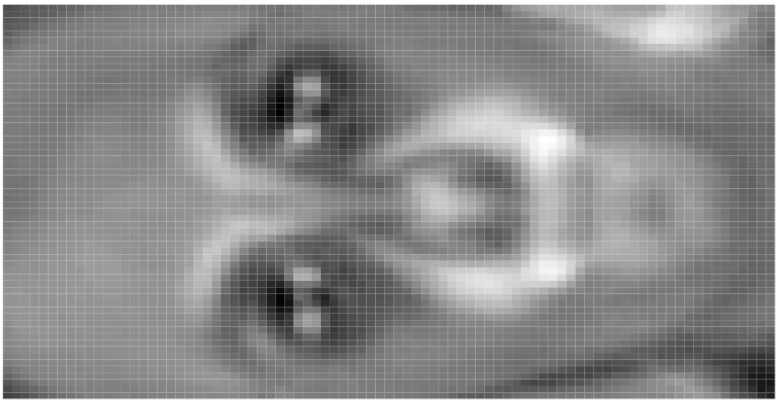
```
## ##
```



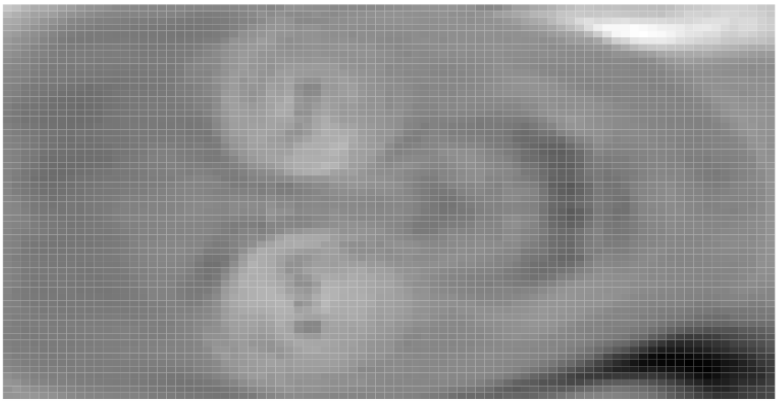
##



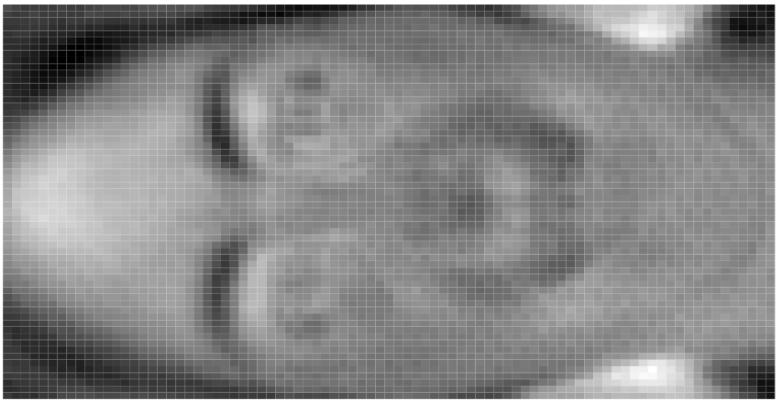
##



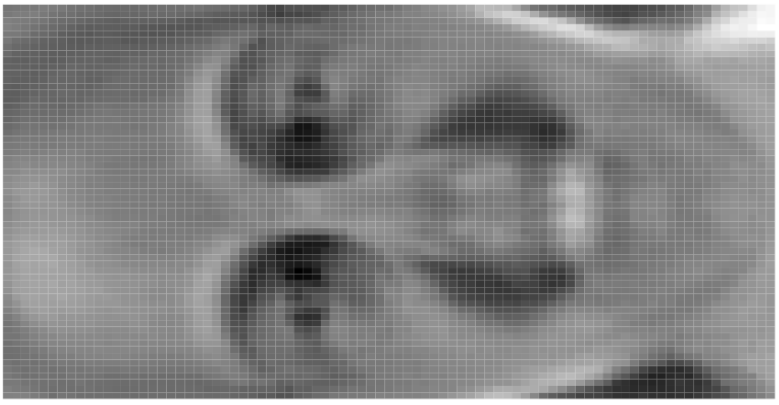
##



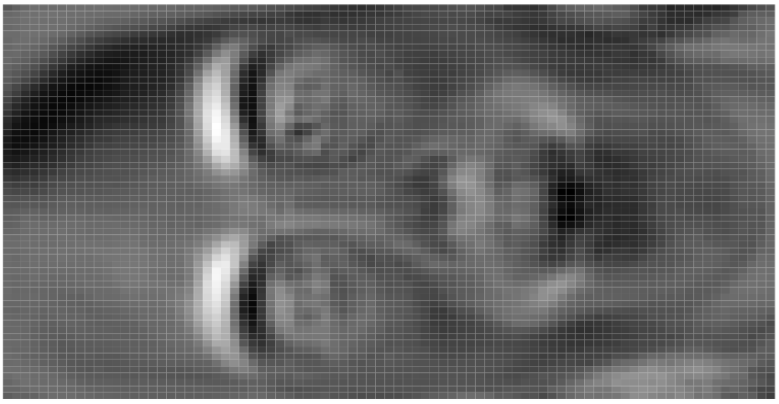
##



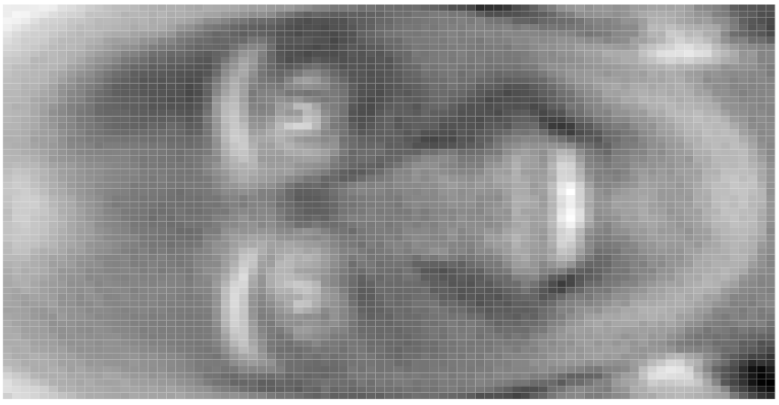
##



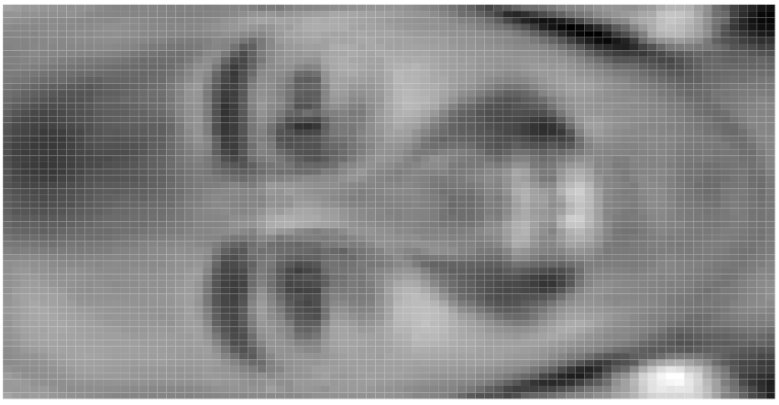
##



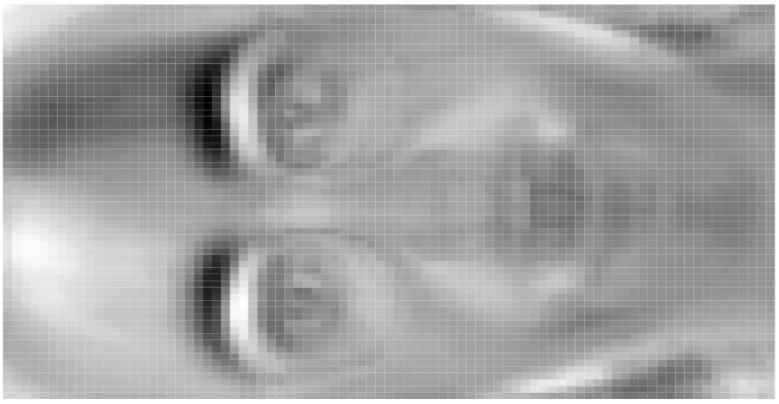
##



##



##



##