Multivariate Statistics Week 1 HW1

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Goal : Perform the PCA of ANY photo.

Process : Create different versions of the photo

1. Intro 1 ~ 4
2. Two largest eigenvalues
3. Ten largest eigenvalues
4. 11th through 100th eigenvalues
5. 100 largest eigenvalues
6. First half of the eigenvalues
7. All the eigenvalues
8. Save the Final Result

Intro 1 : Set path of file

```
setwd('/Users/namwoo/Desktop/UNIST/lecture/1-1/Multivaraiate Statistics')
getwd()
```

```
## [1] "/Users/namwoo/Desktop/UNIST/lecture/1-1/Multivaraiate Statistics"
```

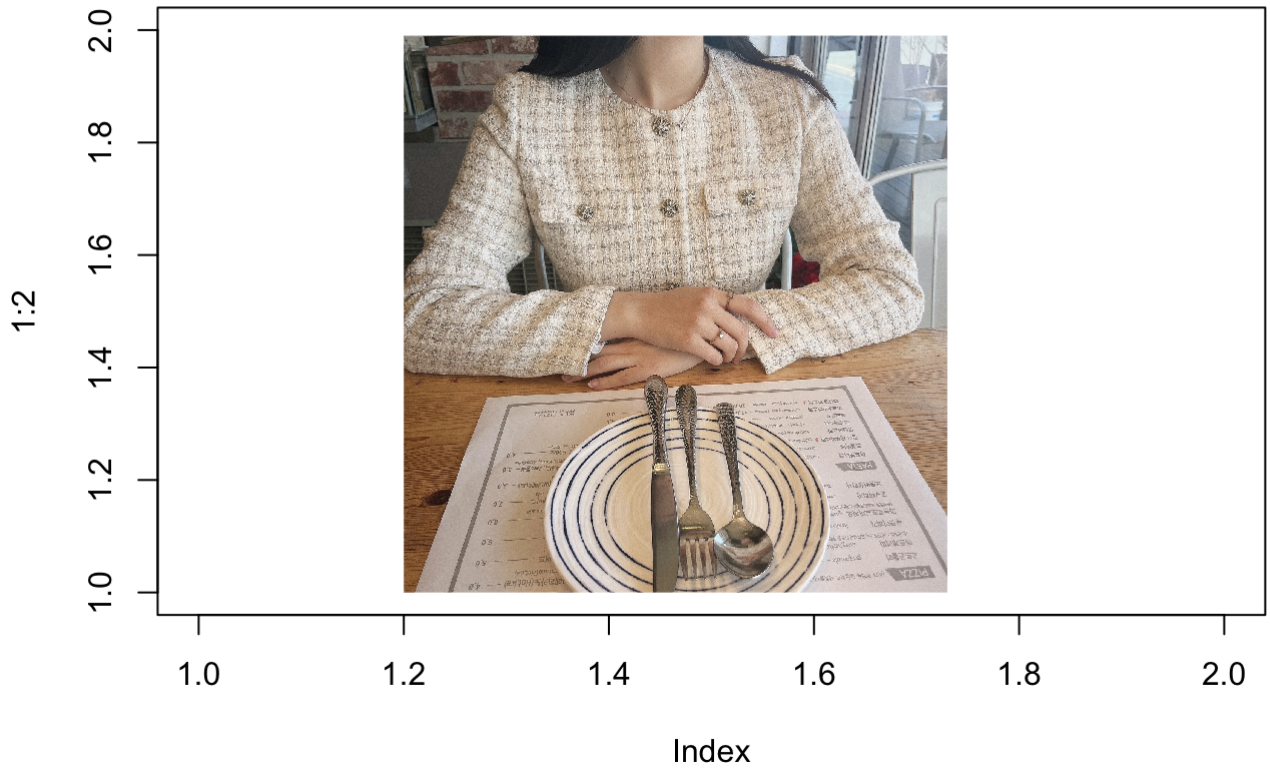
Intro 2 : Load Image File

```
# install.packages('jpeg')
library(jpeg)
img <- readJPEG('Home_Work_1_image.jpeg')
```

```
dim(img) # image size 1440, 1440, 3
```

```
## [1] 1440 1440    3
```

```
plot(1:2, type='n')
rasterImage(as.raster(img[,,1:3]), 1.2, 1.0, 1.73, 1.99, interpolate=FALSE)
```



Intro 3 : Separate Matrix by RGB

```
r <- img[,,1] # Red
g <- img[,,2] # Green
b <- img[,,3] # Blue
```

Intro 4 : Let's PCA

```
# 'center=F' : To reverse the data back to the original without reprocessing the mean
img.r.pca <- prcomp(r, center=F)
img.g.pca <- prcomp(g, center=F)
img.b.pca <- prcomp(b, center=F)

# Check importance of principal component
r_importance <- summary(img.r.pca)$importance
g_importance <- summary(img.g.pca)$importance
b_importance <- summary(img.b.pca)$importance
```

```
# Check 5 of PC
r_importance[, 1:5]
```

```
##                             PC1      PC2      PC3      PC4      PC5
## Standard deviation     27.56183 2.357403 2.260893 1.802444 1.139824
## Proportion of Variance  0.95615 0.006990 0.006430 0.004090 0.001640
## Cumulative Proportion   0.95615 0.963150 0.969580 0.973670 0.975300
```

```
g_importance[, 1:5]
```

```
##                             PC1     PC2      PC3      PC4      PC5
## Standard deviation     25.56004 2.29914 2.214335 1.994816 1.225098
## Proportion of Variance  0.94714 0.00766 0.007110 0.005770 0.002180
## Cumulative Proportion   0.94714 0.95480 0.961910 0.967680 0.969860
```

```
b_importance[, 1:5]
```

```
##                             PC1      PC2      PC3      PC4      PC5
## Standard deviation     23.91446 2.470779 2.254042 2.064386 1.472278
## Proportion of Variance  0.93572 0.009990 0.008310 0.006970 0.003550
## Cumulative Proportion   0.93572 0.945710 0.954030 0.961000 0.964550
```

```
# Save the result of PCA
rgb.pca <- list(img.r.pca, img.g.pca, img.b.pca)
```

Do Home Work 1

```
# Numbers of Principal Component
num = c(2, # Two largest eigenvalues
        10, # Ten largest eigenvalues
        11, # 11th through 100th eigenvalues
        100, # 100 largest eigenvalues
        720, # First half of the eigenvalues
        1440) # All the eigenvalues
```

```
for (i in num) {
  pca.img <- sapply(rgb.pca, function(j) {
    # Restore compressed images based on their principal components
    # If HW1 part 3, Change the parameter
    if (i == 11) { compressed.img <- j$x[, 11:100]%*%t(j$rotation[, 11:100])}
    else {compressed.img <- j$x[, 1:i]%*%t(j$rotation[, 1:i])}

  }, simplify = 'array')
  # Save the Image
  # If HW1 part 3, Change the parameter
  if (i==11){writeJPEG(pca.img, paste('HW_1_PCA_', i, '- 100', '.jpg', sep=''))}
  else {writeJPEG(pca.img, paste('HW_1_PCA_', i, '.jpg', sep=''))}
}
```

View an image of My homework's final product

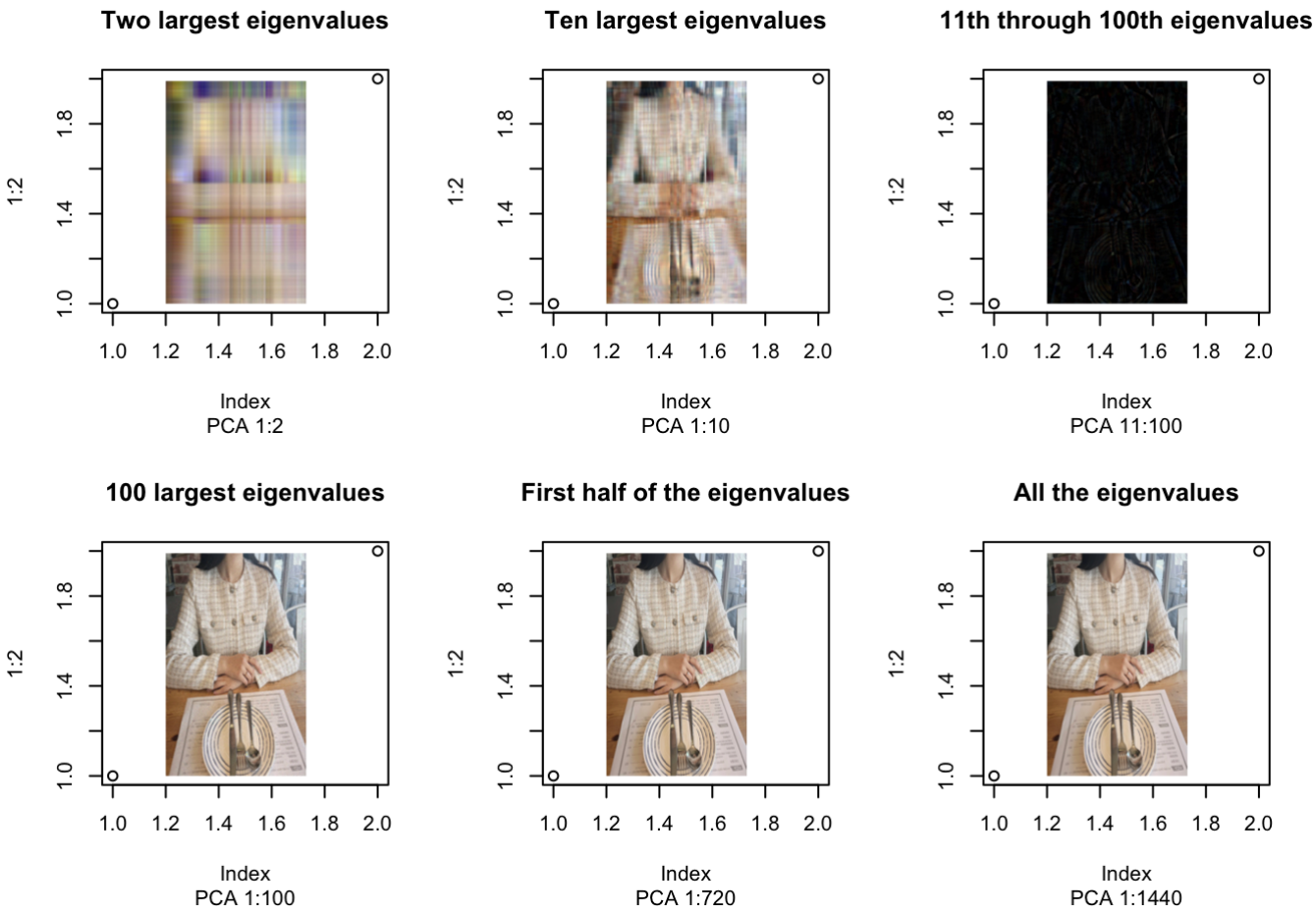
```
# Save the result of PCA
rgb.pca <- list(img.r.pca, img.g.pca, img.b.pca)
```

Do Home Work 1

```
# Load Saved Images
img_2 <- readJPEG('HW_1_PCA_2.jpg') # Picture quality is very choppy
img_10 <- readJPEG('HW_1_PCA_10.jpg') # Better than before, but not as good quality
img_11 <- readJPEG('HW_1_PCA_11- 100.jpg') # Fine lines indicate contours
img_100 <- readJPEG('HW_1_PCA_100.jpg') # Shows much better quality images
img_720 <- readJPEG('HW_1_PCA_720.jpg') # Doesn't look much different from the origin
al image
img_1440 <- readJPEG('HW_1_PCA_1440.jpg') # Doesn't look much different from the orig
inal image
```

View Images in Report

```
par(mfrow=c(2:3))
plot(1:2, main="Two largest eigenvalues", sub="PCA 1:2")
rasterImage(img_2, 1.2, 1.0, 1.73, 1.99)
plot(1:2, main="Ten largest eigenvalues", sub="PCA 1:10")
rasterImage(img_10, 1.2, 1.0, 1.73, 1.99)
plot(1:2, main="11th through 100th eigenvalues", sub="PCA 11:100")
rasterImage(img_11, 1.2, 1.0, 1.73, 1.99)
plot(1:2, main="100 largest eigenvalues", sub="PCA 1:100")
rasterImage(img_100, 1.2, 1.0, 1.73, 1.99)
plot(1:2, main="First half of the eigenvalues", sub="PCA 1:720")
rasterImage(img_720,1.2, 1.0, 1.73, 1.99)
plot(1:2, main="All the eigenvalues", sub="PCA 1:1440")
rasterImage(img_1440, 1.2, 1.0, 1.73, 1.99)
```



Save Final Product

```
jpeg(filename="Final Result by HW1.png",
     width=600,
     height=300,
     unit="px",
     bg="transparent")

par(mfrow=c(2:3))
plot(1:2, main="Two largest eigenvalues", sub="PCA 1:2")
rasterImage(img_2, 1.2, 1.0, 1.73, 1.99)
plot(1:2, main="Ten largest eigenvalues", sub="PCA 1:10")
rasterImage(img_10, 1.2, 1.0, 1.73, 1.99)
plot(1:2, main="11th through 100th eigenvalues", sub="PCA 11:100")
rasterImage(img_11, 1.2, 1.0, 1.73, 1.99)
plot(1:2, main="100 largest eigenvalues", sub="PCA 1:100")
rasterImage(img_100, 1.2, 1.0, 1.73, 1.99)
plot(1:2, main="First half of the eigenvalues", sub="PCA 1:720")
rasterImage(img_720,1.2, 1.0, 1.73, 1.99)
plot(1:2, main="All the eigenvalues", sub="PCA 1:1440")
rasterImage(img_1440, 1.2, 1.0, 1.73, 1.99)

dev.off()
```

```
## quartz_off_screen
##                 2
```