BHao_Assign4

Problem Set 1

```
A = matrix(c(1,2,3,-1,0,4), 2, 3, byrow = TRUE)  # create matrix A
X = A %*% t(A)  # matrix X = AAt
Y = t(A) %*% A  # matrix Y = AtA
U = eigen(X)$vectors  # matrix U = eigenvectors of X
V = eigen(Y)$vectors  # matrix V = eigenvectors of Y
D = eigen(X)$values  # D = eigenvalues of X and Y

d = svd(A)$d  # squareroots of eigenvalues of X and Y
u = svd(A)$u  # eigenvectors of X as per svd function
v = svd(A)$v  # eigenvectors of Y as per svd function

# The left singular vectors of A (u) are indeed equal to the eigenvectors
# of X (U) (with the signs of the # left column reversed)
u
```

```
##            [,1]       [,2]
## [1,] -0.6576043 -0.7533635
## [2,] -0.7533635  0.6576043
```

```
U
```

```
##           [,1]       [,2]
## [1,] 0.6576043 -0.7533635
## [2,] 0.7533635  0.6576043
```

```
# The right singular vectors of A (v) are indeed qual to the eigenvectors
# of Y (V) (with the signs of the # left column reversed). Addtionally, the
# 3rd column of V is not relevant as there are only 2 eigenvalues.
v
```

```
##             [,1]       [,2]
## [1,]  0.01856629 -0.6727903
## [2,] -0.25499937 -0.7184510
## [3,] -0.96676296  0.1765824
```

```
V
```

```
##             [,1]       [,2]       [,3]
## [1,] -0.01856629 -0.6727903  0.7396003
## [2,]  0.25499937 -0.7184510 -0.6471502
## [3,]  0.96676296  0.1765824  0.1849001
```

```
# The squares of the singular values of A (d) are indeed equal to the
# eigenvalues of X and Y (D)
d^2
```

```
## [1] 26.601802  4.398198
```

```
D
```

```
## [1] 26.601802  4.398198
```

Problem Set 2

```
A = matrix(c(1,3,5,8,2,3,5,2,6,2,4,5,1,3,7,8), nrow = 4)

myinverse = function(A) {
  C = matrix(rep(0, length(A)), nrow(A), ncol(A))
  for (j in 1:ncol(A)) {
    for (i in 1:nrow(A)) {
      C[i, j] = (-1)^(i+j) * det(A[-i, -j])
    }
  }
  return(t(C) / det(A))
}
B = myinverse(A)
A %*% B
```

```
##               [,1]         [,2] [,3]         [,4]
## [1,]  1.000000e+00 4.440892e-16    0 2.706169e-16
## [2,] -2.775558e-16 1.000000e+00    0 4.926615e-16
## [3,] -4.996004e-16 3.552714e-15    1 9.436896e-16
## [4,] -7.771561e-16 2.664535e-15    0 1.000000e+00
```

```
round(A %*% B, 6)
```

```
##      [,1] [,2] [,3] [,4]
## [1,]    1    0    0    0
## [2,]    0    1    0    0
## [3,]    0    0    1    0
## [4,]    0    0    0    1
```