DA410\_Assignment1\_GRAHN

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# Q 2.1

A <- matrix(c(4,2,3,7,5,8),   
 nrow = 2,   
 ncol = 3,  
 byrow = TRUE)  
  
B <- matrix(c(3,-2,4,6,9,-5),   
 nrow = 2,   
 ncol = 3,  
 byrow = TRUE)  
  
is.matrix(A)

## [1] TRUE

is.matrix(B)

## [1] TRUE

# find A + B   
A + B

## [,1] [,2] [,3]  
## [1,] 7 0 7  
## [2,] 13 14 3

# and A - B  
A - B

## [,1] [,2] [,3]  
## [1,] 1 4 -1  
## [2,] 1 -4 13

# find A'A   
t(A) %\*% A

## [,1] [,2] [,3]  
## [1,] 65 43 68  
## [2,] 43 29 46  
## [3,] 68 46 73

# and AA'  
A %\*% t(A)

## [,1] [,2]  
## [1,] 29 62  
## [2,] 62 138

# Q 2.2

# Find (A + B)'   
t(A + B)

## [,1] [,2]  
## [1,] 7 13  
## [2,] 0 14  
## [3,] 7 3

# and A' + B'   
t(A) + t(B)

## [,1] [,2]  
## [1,] 7 13  
## [2,] 0 14  
## [3,] 7 3

# and compare them, thus illustrating (2.15).  
(t(A + B)) - (t(A) + t(B))

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

# Show that (A')' = A, thus illustrating (2.6).  
A

## [,1] [,2] [,3]  
## [1,] 4 2 3  
## [2,] 7 5 8

t(t(A))

## [,1] [,2] [,3]  
## [1,] 4 2 3  
## [2,] 7 5 8

A - t(t(A))

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

# Q 2.3(a)

A <- matrix(c(1, 3, 2, -1),   
 nrow = 2,   
 ncol = 2,   
 byrow = 2)  
B <- matrix(c(2,0,1,5),   
 nrow = 2,   
 ncol = 2,   
 byrow = TRUE)  
  
#Find AB   
A\*B

## [,1] [,2]  
## [1,] 2 0  
## [2,] 2 -5

#and BA.  
B\*A

## [,1] [,2]  
## [1,] 2 0  
## [2,] 2 -5

# Q 2.14

A <- matrix(c(1,3,2,2,0,-1),  
 nrow = 2,  
 ncol = 3,  
 byrow = TRUE)  
  
B <- matrix(c(1,2,0,1,1,0),  
 nrow = 3,  
 ncol = 2,  
 byrow = TRUE)  
  
C <- matrix(c(2,1,1,5,-6,-4),  
 nrow = 2,  
 ncol = 3,  
 byrow = TRUE)  
A

## [,1] [,2] [,3]  
## [1,] 1 3 2  
## [2,] 2 0 -1

B

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

C

## [,1] [,2] [,3]  
## [1,] 2 1 1  
## [2,] 5 -6 -4

# Find AB   
A %\*% B

## [,1] [,2]  
## [1,] 3 5  
## [2,] 1 4

# and CB.   
C %\*% B

## [,1] [,2]  
## [1,] 3 5  
## [2,] 1 4

# Are they equal?   
A %\*% B - C %\*% B

## [,1] [,2]  
## [1,] 0 0  
## [2,] 0 0

# subtracting one from the other shows that they are equal.  
  
# What is the rank of A, B, and C?  
Matrix::rankMatrix(A)[1]

## [1] 2

Matrix::rankMatrix(B)[1]

## [1] 2

Matrix::rankMatrix(C)[1]

## [1] 2

#The rank of each matrix A, B, and C is 2.

# Q 2.18

A <- matrix(c(1,-1,1,2,1,0,1,-1,-1),  
 nrow = 3,  
 ncol = 3,  
 byrow = TRUE)  
A

## [,1] [,2] [,3]  
## [1,] 1 -1 1  
## [2,] 2 1 0  
## [3,] 1 -1 -1

#Normalize the columns of A by dividing each column by its length; denote the resulting matrix by C.  
vec1 <- A[,1]  
vec2 <- A[,2]  
vec3 <- A[,3]  
  
len1 <- sqrt(1^2 + 2^2 + 1^2)  
len2 <- sqrt((-1)^2 + 1^2 + (-1)^2)  
len3 <- sqrt(1^2 + 0^2 + (-1)^2)  
  
C <- matrix(c(vec1/len1, vec2/len2, vec3/len3),  
 nrow = 3,  
 ncol = 3,  
 byrow = FALSE)  
  
#Show that C is an orthogonal matrix, that is, C'C = C C = I.  
round(crossprod(C),   
 digits = 1)

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