Practical Problem Set 3 (DB)

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```
library(matlib)
```

Question 1

For the matrix $M = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 2 & 3 & 4 \\ 1 & 3 & 6 & 10 \\ 1 & 4 & 10 & 20 \end{bmatrix}$, find the following.

- Trace of M.
- Rank of M.
- Inverse of M.
- Determinant of M using the functions `Det(A)` and `cofactor(A, i, j)`.

```
M = matrix(c(1,1,1,1,1,2,3,4,1,3,6,10,1,4,10,20), nrow = 4, byrow = TRUE)
M
```

```
##      [,1] [,2] [,3] [,4]
## [1,]    1    1    1    1
## [2,]    1    2    3    4
## [3,]    1    3    6   10
## [4,]    1    4   10   20
```

```
tr(M)
```

```
## [1] 29
```

```
R(M)
```

```
## [1] 4
```

```
inv(M)
```

```
##      [,1] [,2] [,3] [,4]
## [1,]    4   -6    4   -1
## [2,]   -6   14  -11    3
## [3,]    4  -11   10   -3
## [4,]   -1    3   -3    1
```

```
Det(M)
```

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

```
d = 0
for (i in 1:4)
{
```

```
  d = d + M[1, i]*cofactor(M, 1, i)
}
d
```

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

```
#M[1, 1]*cofactor(M, 1, 1) + M[1, 2]*cofactor(M, 1, 2) + M[1, 3]*cofactor(M, 1, 3) + M[1, 4]*cofactor(M
```

Question 2

Apply Gram-Schmidt orthogonalization to the following sequence of vectors: $(1, 2, 0)$, $(8, 1, -6)$, $(0, 0, 1)$

```
X = matrix(c(1,2,0,8,1,-6,0,0,1), nrow = 3, byrow = FALSE)
X
```

```
##      [,1] [,2] [,3]
## [1,]    1    8    0
## [2,]    2    1    0
## [3,]    0   -6    1
```

```
GramSchmidt(X, normalize = TRUE, verbose = TRUE, tol = sqrt(.Machine$double.eps))
```

```
##
## Initial matrix:
##      [,1] [,2] [,3]
## [1,]    1    8    0
## [2,]    2    1    0
## [3,]    0   -6    1
##
## Column 1: z1 = x1
##      [,1] [,2] [,3]
## [1,]    1    0    0
## [2,]    2    0    0
## [3,]    0    0    0
##
## Column 2: z2 = x2 - Proj(x2, z1)
##      [,1] [,2] [,3]
## [1,]    1    6    0
## [2,]    2   -3    0
## [3,]    0   -6    0
##
## Column 3: z3 = x3 - Proj(x3, z1) - Proj(x3, z2)
##      [,1] [,2]       [,3]
## [1,]    1    6  0.4444444
## [2,]    2   -3 -0.2222222
## [3,]    0   -6  0.5555556
##
## Normalized matrix: Z * inv(L)
##           [,1]       [,2]       [,3]
## [1,] 0.4472136  0.6666667  0.5962848
## [2,] 0.8944272 -0.3333333 -0.2981424
## [3,] 0.0000000 -0.6666667  0.7453560
```