

IS 605 - Assignment 3

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Problem Set 1:

- (1) What is the rank of the matrix A? **Answer:** matrix A rank = 4

```
matrixA <- matrix(c(1,-1,0,5,2,0,1,4,3,1,-2,-2,4,3,1,-3), nrow=4)
decompA <- qr(matrixA)
matrixA
```

```
##      [,1] [,2] [,3] [,4]
## [1,]    1    2    3    4
## [2,]   -1    0    1    3
## [3,]    0    1   -2    1
## [4,]    5    4   -2   -3
```

```
decompA$rank
```

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

- (2) Given an $m \times n$ matrix where $m > n$, what can be the maximum rank? The minimum rank, assuming that the matrix is non-zero? **Answer:** The maximum rank of an $m \times n$ matrix with $m > n$ is n . The minimum rank of a non-zero matrix is 1
- (3) What is the rank of matrix B? **Answer:** matrix B rank = 1

```
matrixB <- matrix(c(1,3,2,2,6,4,1,3,2), nrow=3)
decompB <- qr(matrixB)
matrixB
```

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

```
decompB$rank
```

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

Problem Set 2:

Compute the eigenvalues and eigenvectors of the matrix A. You'll need to show your work. You'll need to write out the characteristic polynomial and show your solution

(see the following URL for proof of some of these calcs: <http://tinyurl.com/da605hmwk3ps2>)

Also, see attached PDF for manual calculations of this problem.

```
library(pracma)
matrix2 <- matrix(c(1,0,0,2,4,0,3,5,6), nrow=3)
matrix2
```

```
##      [,1] [,2] [,3]
## [1,]    1    2    3
## [2,]    0    4    5
## [3,]    0    0    6
```

```
# charpoly has the eigenvalues as its roots...
charPoly <- charpoly(matrix2, info = TRUE)
```

```
## Error term: 0
```

```
# we expect: X^3-11X^2+34X-24
charPoly$cp
```

```
## [1]    1 -11  34 -24
```

```
# show the roots (ie the eigenvalues)
roots(charPoly$cp)
```

```
## [1] 6 4 1
```

```
charPoly$det
```

```
## [1] 24
```

```
# zapsmall just lets us view really small values as 0
zapsmall(charPoly$inv %*% matrix2)
```

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