Reduced Row Echloen form using Gauss Elimination in R

Rahul Goswami

2022-01-27

A matrix is in Reduced Row Echloen form if its satisfy following three conditions :
1. Any row containing non-zero entries preceeds any row containing only zeros.
2. The first non-zero entry in each row is the only non-zero entries in its column
3. The first non-zero entries in each row is 1 and it occurs to the column to the right of the first non-zero entry in the preceeding row
Definition Taken from Friedberg's Linear Algebra Program to calculate the row echelon form of a matrix
A function L to make the Lower Triangular Matrix

```
L <- function(M){
    if(is.matrix(M)){
    n <- ncol(M) # Number of columns
    m <- nrow(M) # Number of rows
    s <- min(n,m)
    pivot <- M[1,1] # Pivot element
    if(pivot == 0){
        stop("Pivot element is zero,Permutate the matrix")
    }
    for(i in 2:s){
        M[i,] <- M[i,] - (M[i,1]/pivot) * M[1,]
    }
    M[-1,-1] <- L(M[-1,-1])
    }
    M
}
```

A function U to make the Upper Triangular Matrix

```
U <- function(M){
    if(is.matrix(M)){
    n <- ncol(M) # Number of columns
    m <- nrow(M) # Number of rows
    s <- min(n,m)
    pivot <- M[s,s] # Pivot element
    for(i in (s-1):1){
        M[i,] <- M[i,] - (M[i,s]/pivot) * M[s,]
    }
    M[-s,-s] <- U(M[-s,-s])
    }
    M
}
```

A function to compute RREF

```
RREF <- function(M){
    M <- U(L(M))
    n <- ncol(M) # Number of columns
    m <- nrow(M) # Number of rows
    s <- min(n,m)
    for(i in 1:s){
        M[i,] <- M[i,]/M[i,i]
    }
    M

}
```

Example of a matrix

```
M <- matrix(c(8,1,6,1,3,5,7,1,4,9,2,1),nrow = 3,byrow = TRUE)
```

Printing the matrix

```
print(M)
```

```
##      [,1] [,2] [,3] [,4]
## [1,]    8    1    6    1
## [2,]    3    5    7    1
## [3,]    4    9    2    1
```

Printing the RREF

```
print(RREF(M))
```

```
##      [,1] [,2] [,3]       [,4]
## [1,]    1    0    0 0.06666667
## [2,]    0    1    0 0.06666667
## [3,]    0    0    1 0.06666667
```