

# LU Decomposition in R

Rahul Goswami

2022-01-28

LU decomposition is a factorization method matrix A into two matrices L and U such that  $A = LU$ . L represents the lower triangular matrix and U represents the upper triangular matrix.

Now we will write same code in R

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

Example:

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

```
##      [,1] [,2] [,3]
## [1,] 1.000 0.000000 0
## [2,] 0.375 1.000000 0
## [3,] 0.500 1.837838 1
```

```
print(DECOMPO$U)
```

```
##      [,1] [,2] [,3]
## [1,] 8 1.000 6.00000
## [2,] 0 4.625 4.75000
## [3,] 0 0.000 -9.72973
```

Checking

DECOMPO\$L %\*% DECOMPO\$U

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