Exp. 3: Demonstrate Matrix operations in R

Aim: To create a matrix, access and manipulate the elements of matrix, perform operations on matrices

Matrix

- A matrix is a vector with two additional attributes: the number of rows and the number of columns.
- Matrix row and column subscripts begin with 1.
- For example, the upper-left corner of the matrix a is denoted a[1,1]. The internal storage of a matrix is in column-major order, meaning that first all of column 1 is stored, then all of column 2, and so on

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Creating Matrices

The basic syntax for creating a matrix in R is −

> **matrix(data, nrow, ncol, byrow, dimnames)**

where

- **data** is the input vector which becomes the data elements of the matrix.
- **nrow** is the number of rows to be created.
- **ncol** is the number of columns to be created.
- **byrow** is a logical value. If T (TRUE) then the input vector elements are arranged by row. By default byrow=F
- **dimnames** is the names assigned to the rows and columns.

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```
> y <- matrix(c(1,2,3,4), nrow=2, ncol=2)
> y
     [,1] [,2]
[1,]    1    3
[2,]    2    4

>y <- matrix(c(1,2,3,4), nrow=2, ncol=2, byrow=F)
> y
     [,1] [,2]
[1,]    1    3
[2,]    2    4
```

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```
> y <- matrix(c(1,2,3,4), nrow=2, ncol=2, byrow=TRUE)

> y
     [,1] [,2]
[1,]    1    2
[2,]    3    4

> nrow(y)

[1] 2

> ncol(y)

[1] 2
```

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Another way to build a matrix is to specify elements individually:

```
> y <- matrix(nrow=2,ncol=2)
> y[1,1] <- 1
> y[2,1] <- 2
> y[1,2] <- 3
> y[2,2] <- 4
> y
     [,1] [,2]
[1,]    1    3
[2,]    2    4
```

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```
> y <- matrix(1:4, nrow=2, ncol=2, byrow=T, dimnames = list(c("R1","R2"),c("C1","C2")))
> y
   C1 C2
R1  1  2
R2  3  4
```

Another way

```
> rownames=c("R1","R2")
> colnames=c("C1","C2")
> y <- matrix(1:4, nrow=2, ncol=2, byrow=T, dimnames =list(rownames,colnames))
> y
```

```
   C1 C2
R1  1  2
R2  3  4
```

```
>y["R1", ]
```

```
C1 C2
 1  2
```

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```
> x=1:5
> y=11:15
> z=16:20
> m <- cbind(x, y, z)
> m
     x  y  z
[1,] 1 11 16
[2,] 2 12 17
[3,] 3 13 18
[4,] 4 14 19
[5,] 5 15 20
```

```
> n <- rbind(x, y, z)
> n
  [,1] [,2] [,3] [,4] [,5]
x    1    2    3    4    5
y   11   12   13   14   15
z   16   17   18   19   20
```

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Accessing Elements of a Matrix

```
> y <- matrix(1:9, nrow=3)
> y
     [,1] [,2] [,3]
[1,]    1    4    7
[2,]    2    5    8
[3,]    3    6    9

> y[1,1]
     [1] 1
> y[1,3]
      [1] 7

>y[,3]
[1] 7 8 9

> y[3]
[1] 3

> y[3,]
[1] 3 6 9

> y[,2:3]
     [,1] [,2]
[1,]    4    7
[2,]    5    8
[3,]    6    9

> y[c(1,3),]
     [,1] [,2] [,3]
[1,]    1    4    7
[2,]    3    6    9

> y[1,2:3]
[1] 4 7
```

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Matrix operations

To obtain the transpose of a matrix:

```
> y
     [,1] [,2] [,3]
[1,]    1    4    7
[2,]    2    5    8
[3,]    3    6    9
> t(y)
     [,1] [,2] [,3]
[1,]    1    2    3
[2,]    4    5    6
[3,]    7    8    9
```

To add two matrices:

```
> z=matrix(rep(1,9),nrow=3)
> z
     [,1] [,2] [,3]
[1,]    1    1    1
[2,]    1    1    1
[3,]    1    1    1
> y+z                    #Addition
     [,1] [,2] [,3]
[1,]    2    5    8
[2,]    3    6    9
[3,]    4    7   10
> y == z                 #Check for equality of two matrices
      [,1]  [,2]  [,3]
[1,]  TRUE FALSE FALSE
[2,] FALSE FALSE FALSE
[3,] FALSE FALSE FALSE
```

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Matrix operations

Substract two matrices:

> y-z

```
     [,1] [,2] [,3]
[1,]    0    3    6
[2,]    1    4    7
[3,]    2    5    8
```

Multiply two matrices

> y*z

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

> y%*%z

```
     [,1] [,2] [,3]
[1,]   12   12   12
[2,]   15   15   15
[3,]   18   18   18
```

To create an identity matrix

> p=diag(3)

>p

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

Dimensions of a matrix:

> dim(y)

```
[1] 3 3
```

To find the determinant of a square matrix

>det(p)

```
[1] 1
```

To find inverse of a matrix:

>solve(p)

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

TEXT BOOKS:

1. R for Everyone, Jared P Lander, Pearson
2. R in Action, Rob I Kabacoff, Manning (http://www.cs.uni.edu/~jacobson/4772/week11/R_in_Action.pdf)

REFERENCE BOOK:

The Art of R Programming, Norman Matloff, No Starch Press
(https://diytranscriptomics.com/Reading/files/The%20Art%20of%20R%20Programming.pdf)