SRI RAMACHANDRA
INSTITUTE OF HIGHER EDUCATION AND RESEARCH
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SRI RAMACHANDRA ENGINEERING AND TECHNOLOGY

CSE 240 Data Science with R

STUDENT WORK BOOK

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Academic Year	**:**	2020-2021

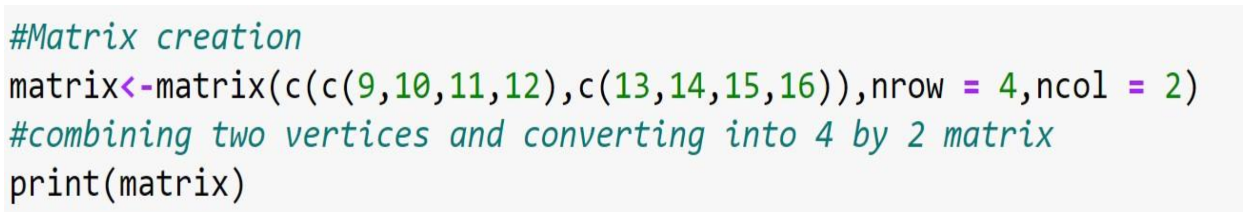
Date:02/11/2020

Q.NO 1: Question

Consider 2 vectors c(9,10,11,12) and c(13,14,15,16).

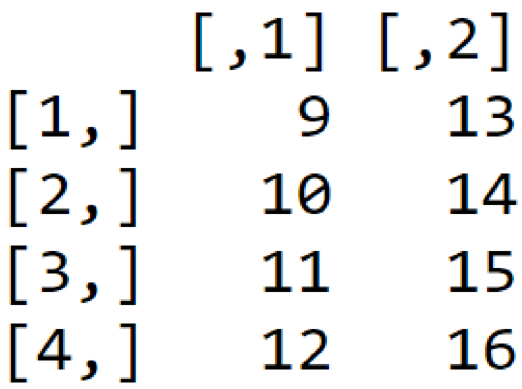
Create a 4 by 2 matrix from these two vectors

Program:



```
#Matrix creation
matrix<-matrix(c(c(9,10,11,12),c(13,14,15,16)),nrow = 4,ncol = 2)
#combining two vertices and converting into 4 by 2 matrix
print(matrix)
```

Output:



```
     [,1] [,2]
[1,]    9   13
[2,]   10   14
[3,]   11   15
[4,]   12   16
```

Explanation:

- ✶ Matrix is a two-dimensional data structure in R programming.
- ✶ Matrix can be created using the matrix () function
- ✶ Dimension of the matrix can be defined by passing appropriate value guments nrow and ncol

Date: 02/11/2020

Q.NO 2: Question

Program:

Write an R program to take input from the user (userID and Group/Branch) and display the values

```
#UserInput
Id = readline("Enter your UserID:")
#Prompts user for input(id)
Branch = readline(prompt="Enter you Branch/Group:")
#Prompts user for input(branch)
cat("Your UserID is",Id,"and you belong to",Branch,"group")
#Displaying Values
```

Output:

```
Enter your UserID:E0119052
Enter you Branch/Group:AI & ML
Your UserID is E0119052 and you belong to AI & ML group
```

Explanation:

- ✶ readline reads a line from the terminal (in interactive use).
- ✶ readline() lets the user enter a one-line string at the terminal.
- ✶ The prompt argument is printed in front of the user input. It usually ends on ": ".

Date: 02/11/2020

Q.NO 3: Question

Create a data frame Write a R program to create a data frame from four given vectors.

a name b. Subject C. Score d. Rank

Program:

```
#Dataframe creation
Name <- c("Jhon", "Lee", "Suzan", "Abhinav", "Brain", "Emma", "David")
#Variables
Subject <- c("Data Science", "Machine Learning", "Deep Learning",
             "Data Structures", "Database Managemnt System",
             "Operating Systems", "Python Programming")

Score <- c(56, 76, 86, 96, 73, 87, 47)

Rank <- c(5,8,6,7,9,2,1)

df = data.frame(Name,Subject,Score,Rank)
print(df)
#Dataframe Created Successfully
```

Output:

```
     Name                  Subject Score Rank
1    Jhon             Data Science    56    5
2     Lee         Machine Learning    76    8
3   Suzan            Deep Learning    86    6
4 Abhinav          Data Structures    96    7
5   Brain Database Managemnt System   73    9
6    Emma        Operating Systems    87    2
7   David       Python Programming    47    1
```

Explanation:

- A **data frame** is used for storing data tables. It is a list of vectors of equal length.
- The top line of the table, called the **header**, contains the column names.
- Each horizontal line afterward denotes a **data row**, which begins with header, and then followed by the actual data.
- Each data member of a row is called a **cell**.

Date: 02/11/2020

Q.NO 4: Question

Write a R program to get the statistical summary and nature of the data of a given data frame. (use 3rd Question dataframe

Program:

```
#Dataframe creation
Name <- c("Jhon", "Lee", "Suzan", "Abhinav", "Brain", "Emma", "David")
#Variables
Subject <- c("Data Science", "Machine Learning", "Deep Learning",
             "Data Structures", "Database Managemnt System",
             "Operating Systems", "Python Programming")
Score <- c(56, 76, 86, 96, 73, 87, 47)
Rank <- c(5,8,6,7,9,2,1)
df = data.frame(Name,Subject,Score,Rank)
print(df)
#Dataframe Created Successfully
print(summary(df))
#Dataframe Stastical summary
```

Output:

```
      Name                         Subject        Score             Rank      
 Abhinav:1   Data Science             :1   Min.   :47.00   Min.   :1.000  
 Brain  :1   Data Structures          :1   1st Qu.:64.50   1st Qu.:3.500  
 David  :1   Database Managemnt System:1   Median :76.00   Median :6.000  
 Emma   :1   Deep Learning            :1   Mean   :74.43   Mean   :5.429  
 Jhon   :1   Machine Learning         :1   3rd Qu.:86.50   3rd Qu.:7.500  
 Lee    :1   Operating Systems        :1   Max.   :96.00   Max.   :9.000  
 Suzan  :1   Python Programming       :1                                  
```

Explanation:

Summary is a generic function used to produce result summaries of the results of various model fitting functions.
The function invokes particular methods which depend on the class of the first argument
The form of the value returned by summary depends on the class of its argument

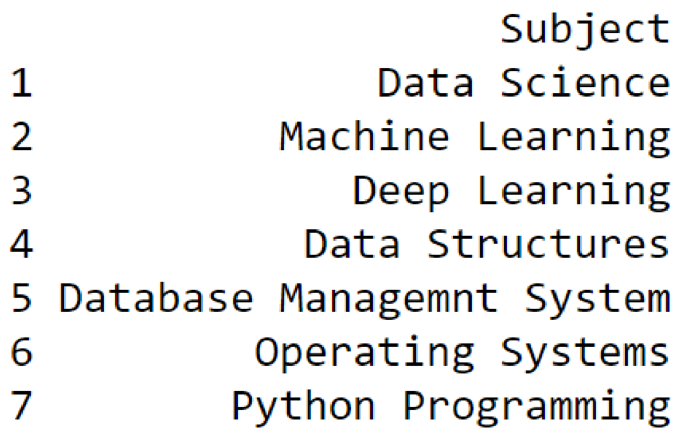
Date: 02/11/2020
Q.NO 5: Question

Write a R program to extract specific column from a data frame using column name

Program:

```r
#Dataframe creation
Name <- c("Jhon", "Lee", "Suzan", "Abhinav", "Brain", "Emma", "David")
#Variables
Subject <- c("Data Science", "Machine Learning", "Deep Learning",
             "Data Structures", "Database Managemnt System",
             "Operating Systems", "Python Programming")
Score <- c(56, 76, 86, 96, 73, 87, 47)
Rank <- c(5,8,6,7,9,2,1)
df = data.frame(Name,Subject,Score,Rank)
print(df)
#Dataframe Created Successfully
print(df["Subject"])
#Sliced column with column name
```

Output:



```
                    Subject
1              Data Science
2          Machine Learning
3             Deep Learning
4           Data Structures
5 Database Managemnt System
6         Operating Systems
7        Python Programming
```

Explanation:

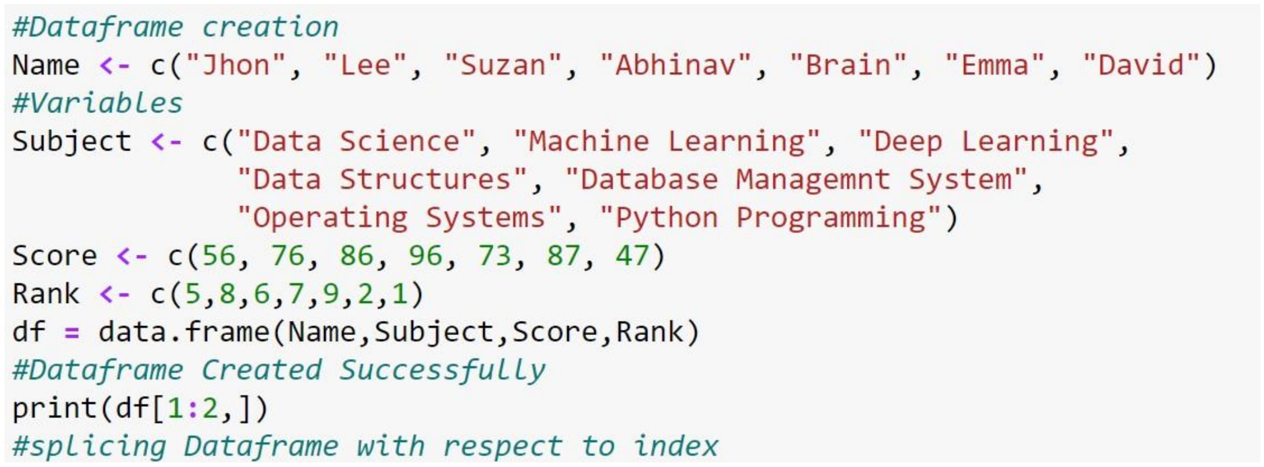
- We retrieve a data frame column slice with the single square bracket "[]" operator.
- Here We can retrieve the same column slice by its name.
- And we can pack the row names in an index vector in order to retrieve multiple rows

Date: 02/11/2020

Q.NO 6: Question

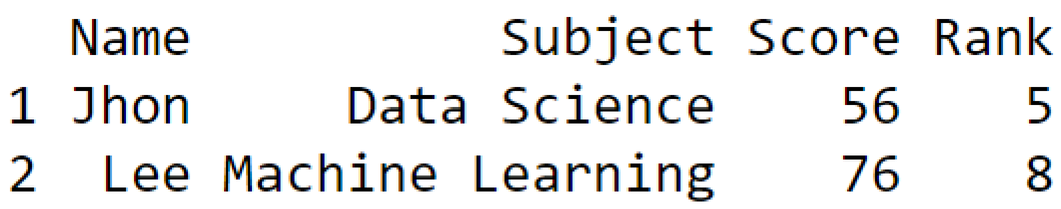
.Write a R program to extract first two rows from a given data frame

Program:



```
#Dataframe creation
Name <- c("Jhon", "Lee", "Suzan", "Abhinav", "Brain", "Emma", "David")
#Variables
Subject <- c("Data Science", "Machine Learning", "Deep Learning",
             "Data Structures", "Database Managemnt System",
             "Operating Systems", "Python Programming")
Score <- c(56, 76, 86, 96, 73, 87, 47)
Rank <- c(5,8,6,7,9,2,1)
df = data.frame(Name,Subject,Score,Rank)
#Dataframe Created Successfully
print(df[1:2,])
#splicing Dataframe with respect to index
```

Output:



```
  Name          Subject Score Rank
1 Jhon     Data Science    56    5
2  Lee Machine Learning    76    8
```

Explanation:

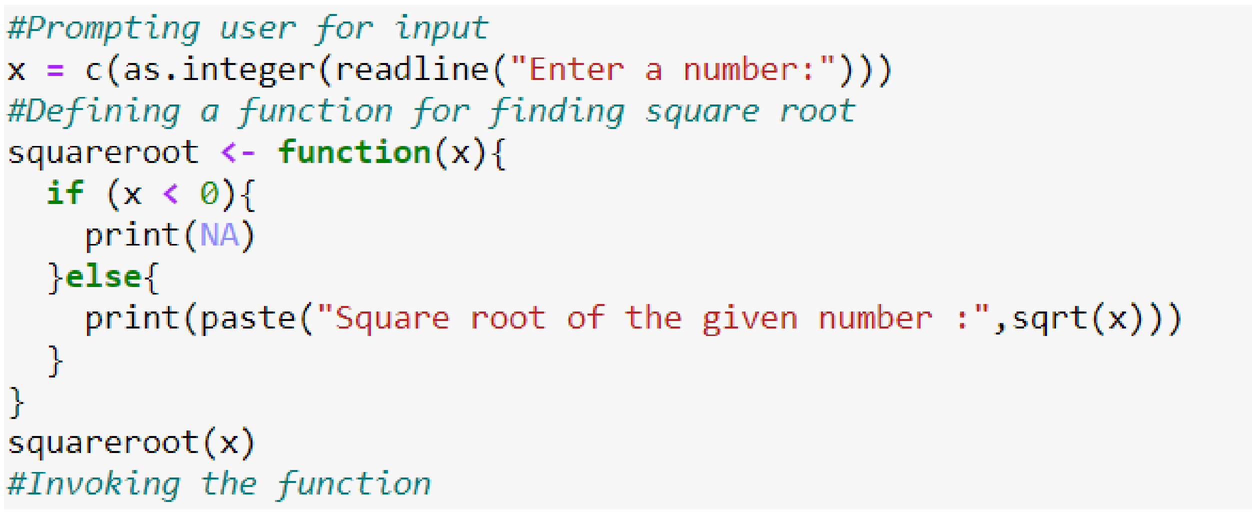
- We retrieve rows from a data frame with the single square bracket operator, just like what we did with columns.
- However, in additional to an index vector of row positions, we append an extra comma character.
- This is important, as the extra comma signals a wildcard match for the second coordinate for column positions.

Date: 03/11/2020

Q.NO 7: Question

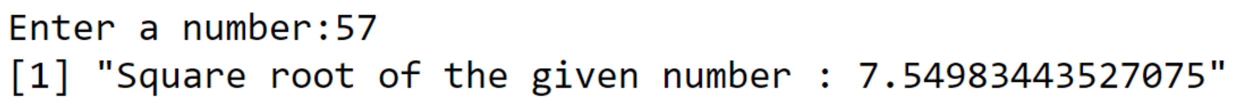
Create an R script that calculates the square root of a given integer vector x of length one, if the value contained in x is negative it should return NA.

Program:

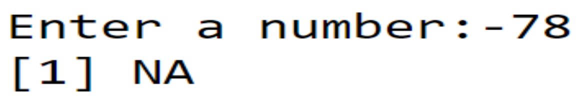


```
#Prompting user for input
x = c(as.integer(readline("Enter a number:")))
#Defining a function for finding square root
squareroot <- function(x){
  if (x < 0){
    print(NA)
  }else{
    print(paste("Square root of the given number :",sqrt(x)))
  }
}
squareroot(x)
#Invoking the function
```

Output:



```
Enter a number:57
[1] "Square root of the given number : 7.54983443527075"
```



```
Enter a number:-78
[1] NA
```

Explanation:

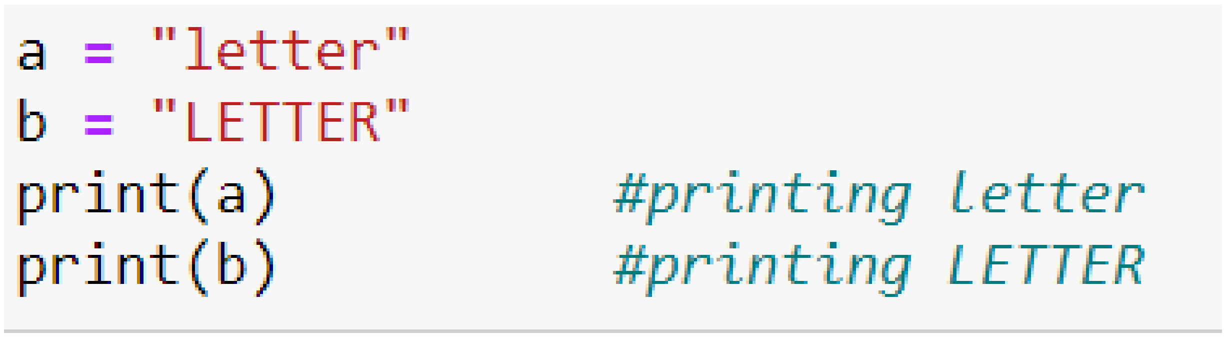
- ✶ Missing values are represented by the symbol **NA** (not available)
- ✶ If the numeric_Expression is a positive value, the sqrt function returns the square root of a given value.
- ✶ If the numeric_Expression is a negative value, the sqrt function return ***NaN***.
- ✶ Numeric_Expression is not a number (**NaN**), or Negative Infinity, then sqrt in R returns ***NaN***.

Date: 03/11/2020

Q.NO 8: Question

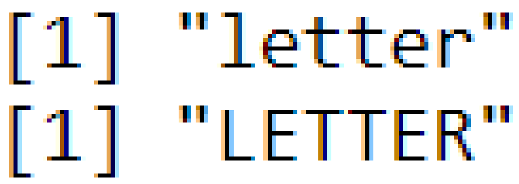
Demonstrate and examine the output of letter and LETTER

Program:



```
a = "letter"
b = "LETTER"
print(a)            #printing letter
print(b)            #printing LETTER
```

Output:



```
[1] "letter"
[1] "LETTER"
```

Explanation:

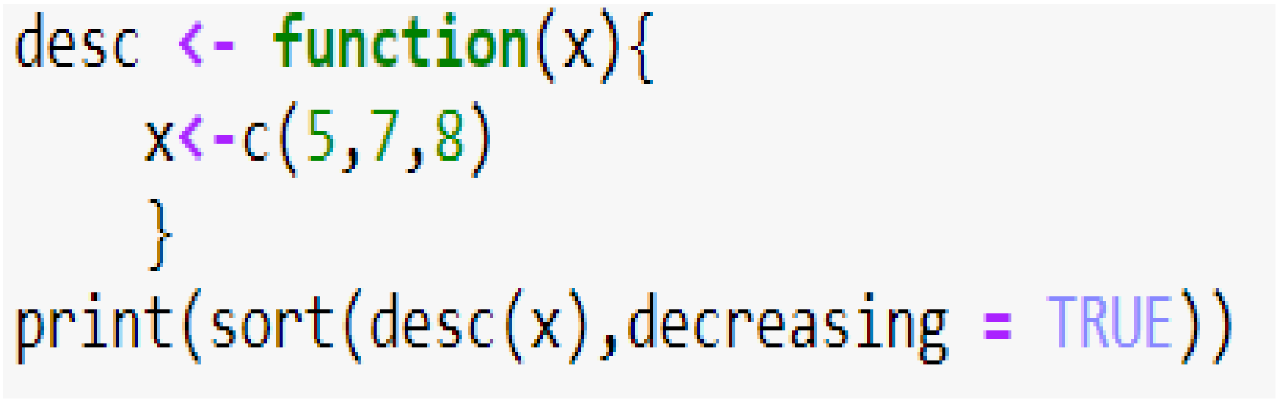
- ✶ This is useful because you can always view your data: just print it.
- ✶ You needn’t write special printing logic, even for complicated data structures.
- ✶ The print function has a significant limitation, it prints only one object at a time.
- ✶ Trying to print multiple items gives this mind-numbing error message

Date: 03/11/2020

Q.NO 9: Question

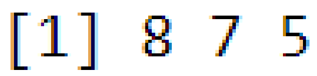
Create an R script that, given a numeric vector x with length 3, will print the elements by order from high to low.

Program:



```
desc <- function(x){
    x<-c(5,7,8)
    }
print(sort(desc(x),decreasing = TRUE))
```

Output:



```
[1] 8 7 5
```

Explanation:

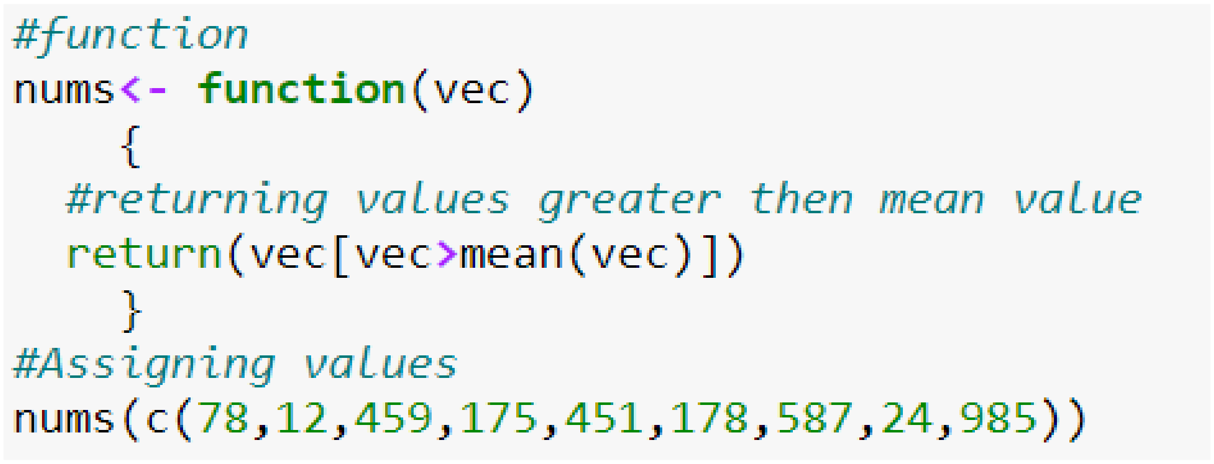
- ✶ Sort (or *order*) a vector or factor (partially) into ascending or descending order. For ordering along more than one variable, e.g., for sorting data frame
- ✶ To sort a data frame in R, use the **sort( )** function. By default, sorting is ASCENDING.
- ✶ Prepend the sorting variable by a minus sign to indicate DESCENDING order

Date: 03/11/2020

Q.NO 10: Question

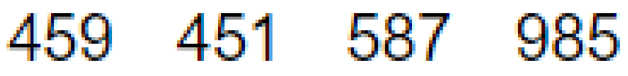
Create an R script that returns the amount of values that are larger than the mean of a vector. You are allowed to use mean(). (Use function)

Program:



```
#function
nums<- function(vec)
    {
  #returning values greater then mean value
  return(vec[vec>mean(vec)])
    }
#Assigning values
nums(c(78,12,459,175,451,178,587,24,985))
```

Output:



```
459  451  587  985
```

Explanation:

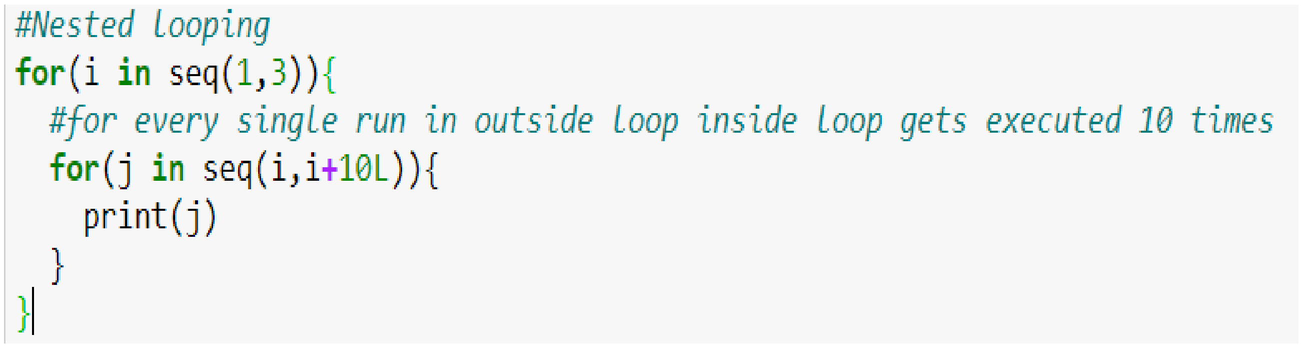
- ✶ It is calculated by taking the sum of the values and dividing with the number of values in a data series.
- ✶ The function **mean()** is used to calculate and decision operator “>” is used to compare the giving condition and take decision

Date: 03/11/2020

Q.NO 11: Question

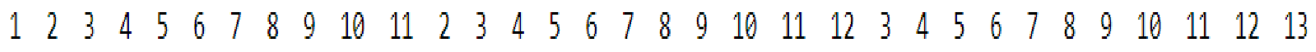
Write a double for loop which prints 30 numbers (1:10, 2:11, 3:12). Those are three clusters of ten numbers each. The first loop determines the number of clusters (3) via its length; the second loop the numbers to be printed (1 to 10 at the beginning). Each cluster starts one number higher than the previous one

Program:



```
#Nested looping
for(i in seq(1,3)){
  #for every single run in outside loop inside loop gets executed 10 times
  for(j in seq(i,i+10L)){
    print(j)
  }
}
```

Output:



```
1  2  3  4  5  6  7  8  9  10  11  2  3  4  5  6  7  8  9  10  11  12  3  4  5  6  7  8  9  10  11  12  13
```

Explanation:

- In Nested for Loop, it makes use of the control structures to manage the execution of the expression, one such control structure is Nested for Loop a similar to basic 'for' loop executes.
- It can be defined as placing one 'for' loop inside the first 'for' loop is called as nesting or loop of loops in some terms, which takes the responsibility of two loops such that the outer loop controls the number of repetition of the whole inner detailed information until it is false,
- in other words, the inner loop executes n-times of every execution of the outer for loop and also, it's a great tool to work with R Programming Language.

Date: 03/11/2020

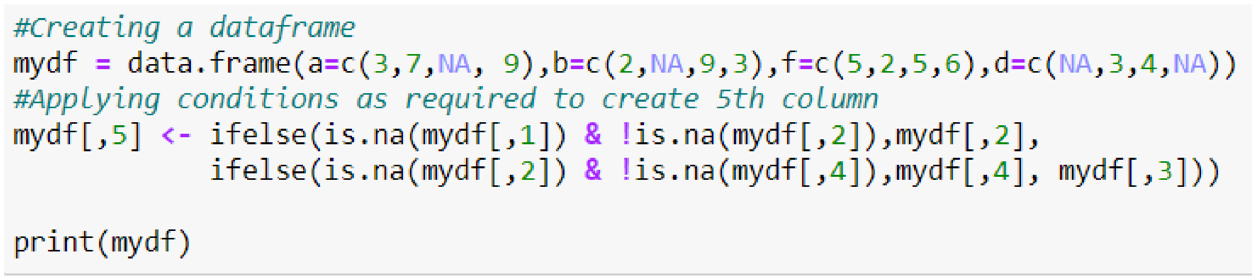
Q.NO 12: Question

a. You have the data.frame ‘mydf’ with four columns like below

a = c(3,7,NA, 9) b = c(2,NA,9,3) f = c(5,2,5,6) d = c(NA,3,4,NA)

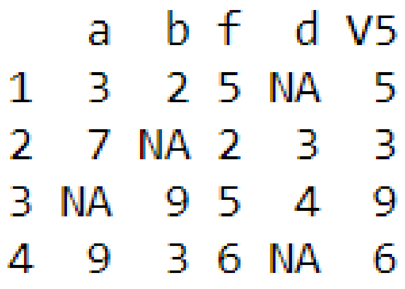
You want to add another column ‘5’: the 5th column contains the value of col 2 if col 1 is NA; the 5th column contains the value of col 4 if col 2 is NA; the 5th column contains the value of col 3 in all other cases.

Program:



```
#Creating a dataframe
mydf = data.frame(a=c(3,7,NA, 9),b=c(2,NA,9,3),f=c(5,2,5,6),d=c(NA,3,4,NA))
#Applying conditions as required to create 5th column
mydf[,5] <- ifelse(is.na(mydf[,1]) & !is.na(mydf[,2]),mydf[,2],
            ifelse(is.na(mydf[,2]) & !is.na(mydf[,4]),mydf[,4], mydf[,3]))

print(mydf)
```

Output:



```
   a  b f  d V5
1  3  2 5 NA  5
2  7 NA 2  3  3
3 NA  9 5  4  9
4  9  3 6 NA  6
```

Explanation:

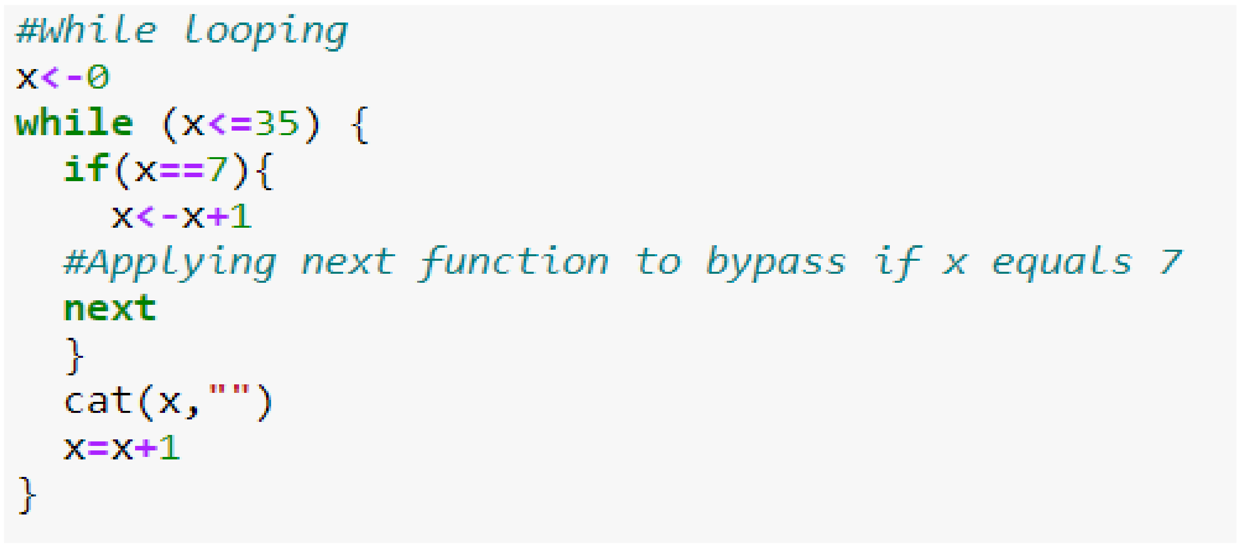
- An if statement can be followed by an optional else statement which executes when the Boolean expression is false.
- An if statement can be followed by an optional else if...else statement, which is very useful to test various conditions using single if...else if statement

Date: 03/11/2020

Q.NO 13: Question

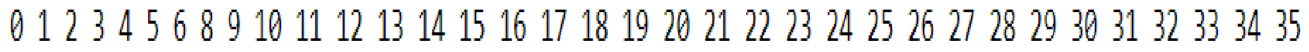
Write a while loop starting with x = 0. The loop prints all numbers up to 35 but it skips number 7.
Condition: If x== 7 next

Program:



```
#While looping
x<-0
while (x<=35) {
  if(x==7){
    x<-x+1
  #Applying next function to bypass if x equals 7
  next
  }
  cat(x,"")
  x=x+1
}
```

Output:



```
0 1 2 3 4 5 6 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
```

Explanation:

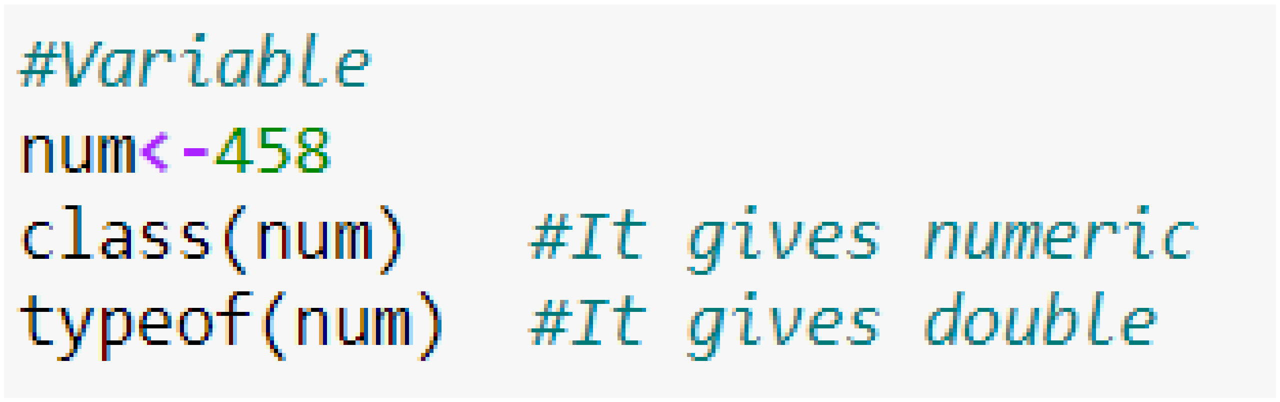
- ✶ The **next** statement in is useful when we want to skip the current iteration of a loop without terminating it.
- ✶ On encountering next, the R parser skips further evaluation and starts next iteration of the loop.in other words, the inner loop executes n-times of every execution of the outer for loop.

Date: 03/11/2020

Q.NO 14: Question

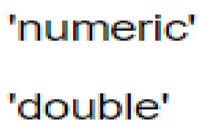
Examine the difference between typeof and class () method using R program

Program:



```
#Variable
num<-458
class(num)   #It gives numeric
typeof(num)  #It gives double
```

Output:



```
'numeric'

'double'
```

Explanation:

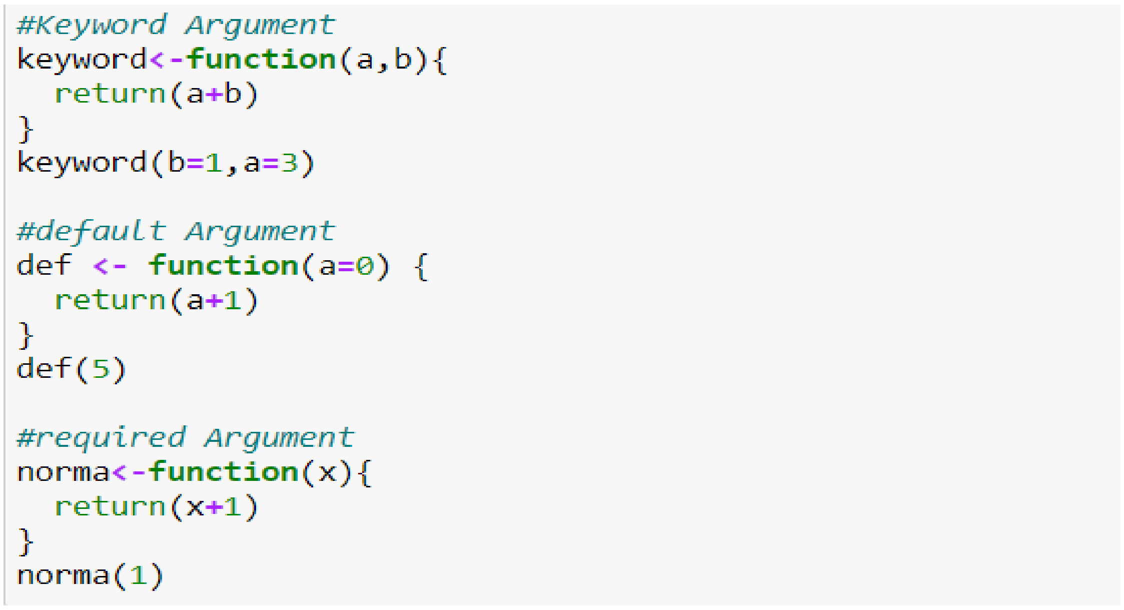
- 'class' is a property assigned to an object that determines how generic functions operate with it. It is not a mutually exclusive classification. If an object has no specific class assigned to it, such as a simple numeric vector, its class is usually the same as its mode, by convention.
- Typeof determines the (R internal) type or storage mode of any object

Date: 03/11/2020

Q.NO 15: Question

Create a function and demonstrate their features like required, keyword, default.

Program:



```
#Keyword Argument
keyword<-function(a,b){
  return(a+b)
}
keyword(b=1,a=3)

#default Argument
def <- function(a=0) {
  return(a+1)
}
def(5)

#required Argument
norma<-function(x){
  return(x+1)
}
norma(1)
```

Output:

```
4

6

2
```

Explanation:

- ✶ *Arguments are always named when you define a function*. When you call a function, you do not have to specify the name of the argument.
- ✶ Arguments are optional; you do not have to specify a value for them. They can have a default value, which is used if you do not specify a value for that argument yourself.
- ✶ You can use as many arguments as you like, there is no limit to the number of arguments. An argument list comprises of comma-separated values that contain the various formal arguments.

Date: 03/11/2020

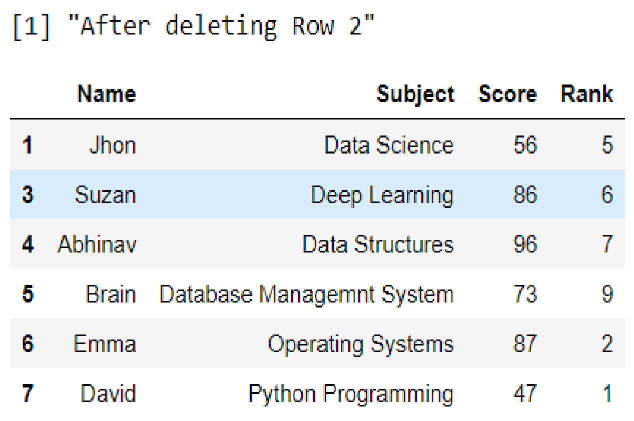
Q.NO 16: Question

Create a dataframe and delete the row and column. (Use the own data values to create frame)

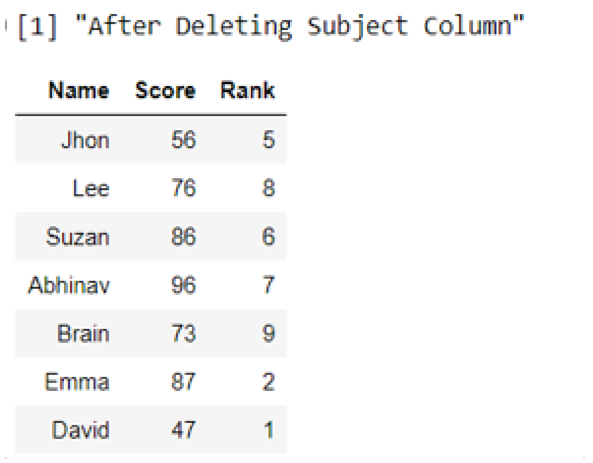
Program:

```r
#Dataframe creation
Name <- c("Jhon", "Lee", "Suzan", "Abhinav", "Brain", "Emma", "David")
#Variables
Subject <- c("Data Science", "Machine Learning", "Deep Learning", "Data Structures",
            "Database Managemnt System", "Operating Systems", "Python Programming")

Score <- c(56, 76, 86, 96, 73, 87, 47)

Rank <- c(5,8,6,7,9,2,1)

df = data.frame(Name,Subject,Score,Rank)
del_row_df<-df[-c(2),] # row deletion
del_col_df<-within(df, rm("Subject")) #Colmn deletion
print("After deleting Row 2")
del_row_df
print("After Deleting Subject Column")
del_col_df
```

Output:



```
[1] "After deleting Row 2"

     Name                   Subject  Score  Rank
1    Jhon              Data Science     56     5
3   Suzan             Deep Learning     86     6
4 Abhinav           Data Structures     96     7
5   Brain  Database Managemnt System    73     9
6    Emma         Operating Systems     87     2
7   David        Python Programming     47     1
```



```
[1] "After Deleting Subject Column"

   Name  Score  Rank
   Jhon     56     5
    Lee     76     8
  Suzan     86     6
Abhinav     96     7
  Brain     73     9
   Emma     87     2
  David     47     1
```

Explanation:

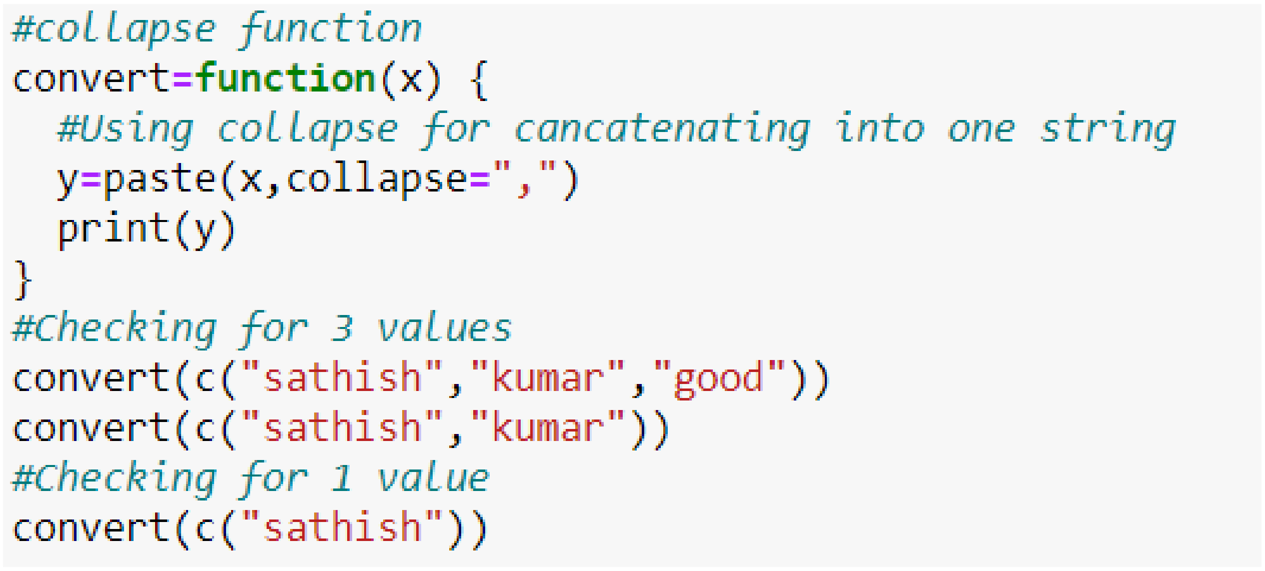
- ✶ -c(rowNum) is used to return a slice of a dataframe without the mentioned row i.e. row deletion
- ✶ The within function returns a subset of a dataframe with the second argument ad a function to apply to all the column rm function removes the “Subject” column out of the data frameTypeof determines the (R internal) type or storage mode of any object.

Date: 04/11/2020

Q.NO 15: Question

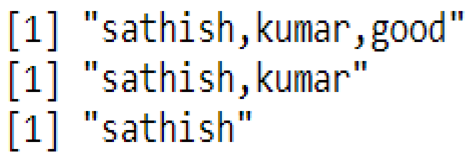
Write a function that turns (e.g.) a vector c("a", "b", "c") into the string "a, b, and c". Think carefully about what it should do if given a vector of length 0, 1, or 2.

Program:



```
#collapse function
convert=function(x) {
  #Using collapse for cancatenating into one string
  y=paste(x,collapse=",")
  print(y)
}
#Checking for 3 values
convert(c("sathish","kumar","good"))
convert(c("sathish","kumar"))
#Checking for 1 value
convert(c("sathish"))
```

Output:



```
[1] "sathish,kumar,good"
[1] "sathish,kumar"
[1] "sathish"
```

Explanation:

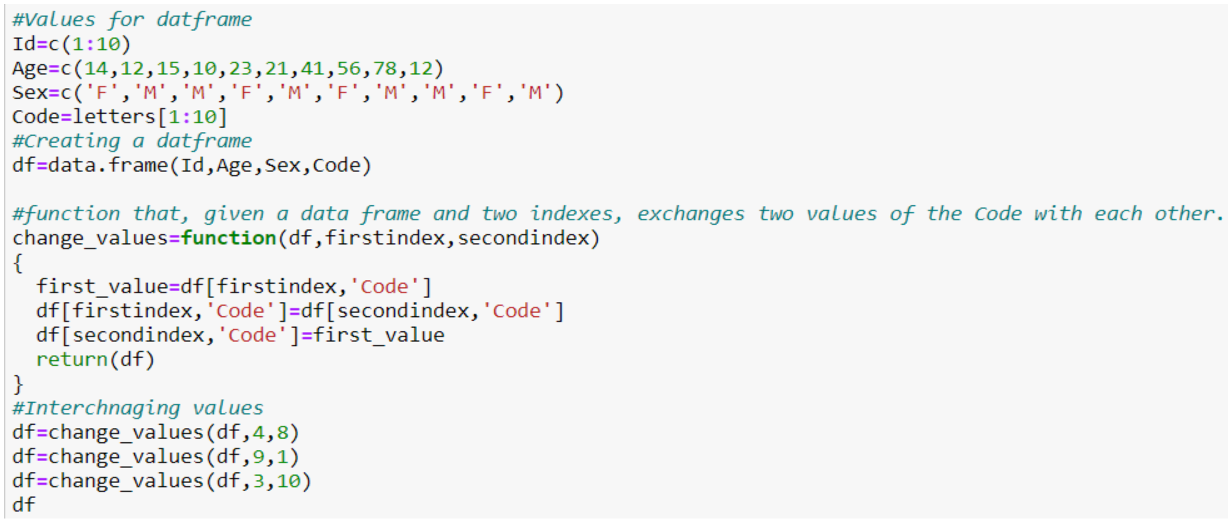
- ✶ **'collapse'** is a property Collapses a character vector of any length into a length 1 vector.
- ✶ Syntax - collapse(x, sep = "", width = Inf, last = "")
- ✶ **'paste'** Concatenate vectors after converting to character.

Date: 04/11/2020

Q.NO 16: Question

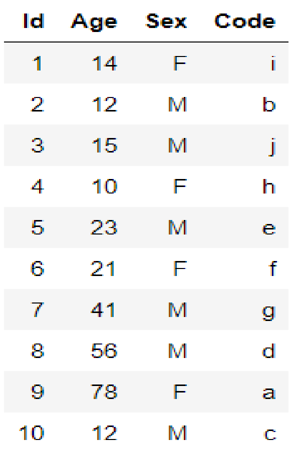
Consider a data frame
Create a function that, given a data frame and two indexes, exchanges two values of the Code variable with each other.
For example, if the index is 1 and 3, you assign: df[1,'Code']=df[3,'Code'] df[3,'Code']=df[1,'Code']

Program:



```
#Values for datframe
Id=c(1:10)
Age=c(14,12,15,10,23,21,41,56,78,12)
Sex=c('F','M','M','F','M','F','M','M','F','M')
Code=letters[1:10]
#Creating a datframe
df=data.frame(Id,Age,Sex,Code)

#function that, given a data frame and two indexes, exchanges two values of the Code with each other.
change_values=function(df,firstindex,secondindex)
{
  first_value=df[firstindex,'Code']
  df[firstindex,'Code']=df[secondindex,'Code']
  df[secondindex,'Code']=first_value
  return(df)
}
#Interchnaging values
df=change_values(df,4,8)
df=change_values(df,9,1)
df=change_values(df,3,10)
df
```

Output:



Id	Age	Sex	Code
1	14	F	i
2	12	M	b
3	15	M	j
4	10	F	h
5	23	M	e
6	21	F	f
7	41	M	g
8	56	M	d
9	78	F	a
10	12	M	c

Explanation:

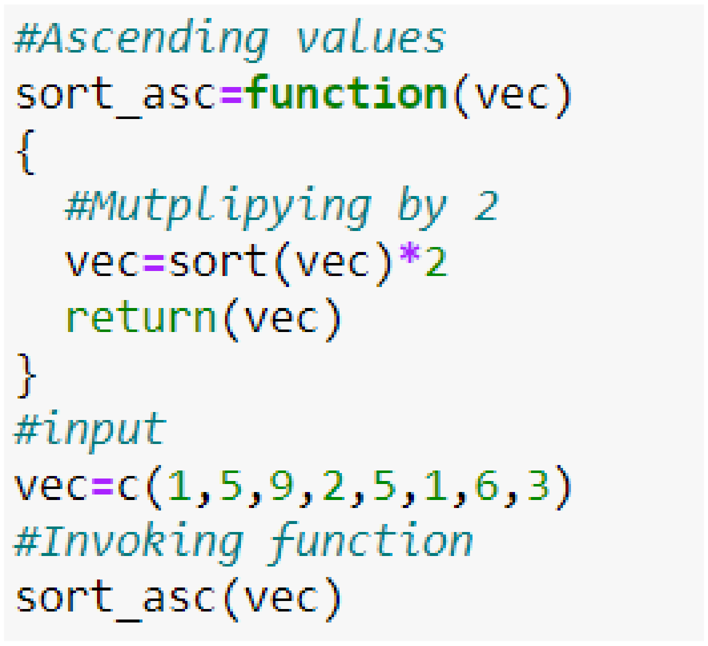
- ✶ A data frame is a table or a two-dimensional array-like structure in which each column contains values of one variable and each row contains one set of values from each column.

Date: 03/11/2020

Q.NO 17: Question

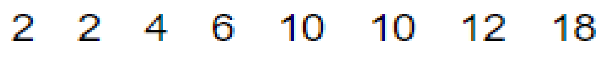
Create a function that given a numeric vector, sort this in ascending order and duplicate it by two.

Program:



```
#Ascending values
sort_asc=function(vec)
{
  #Mutplipying by 2
  vec=sort(vec)*2
  return(vec)
}
#input
vec=c(1,5,9,2,5,1,6,3)
#Invoking function
sort_asc(vec)
```

Output:



```
2   2   4   6   10   10   12   18
```

Explanation:

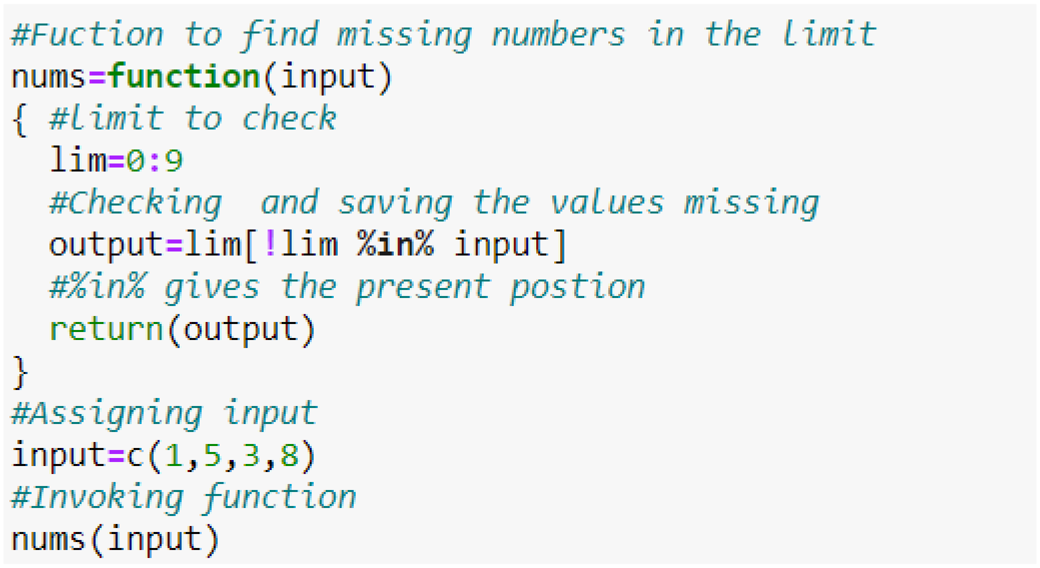
- ✶ Sort (or *order*) a vector or factor (partially) into ascending or descending order. For ordering along more than one variable
- ✶ By default, sorting is ASCENDING. Prepend the sorting variable by a minus sign to indicate DESCENDING order

Date: 04/11/2020

Q.NO 18: Question

Create a function that given a numeric vector X returns the digits 0 to 9 that are not in X. If X=0 2 4 8 the function return 1 3 5 6 7 9

Program:



```r
#Fuction to find missing numbers in the limit
nums=function(input)
{ #limit to check
  lim=0:9
  #Checking  and saving the values missing
  output=lim[!lim %in% input]
  #%in% gives the present postion
  return(output)
}
#Assigning input
input=c(1,5,3,8)
#Invoking function
nums(input)
```

Output:

```
0 2 4 6 7 9
```

Explanation:

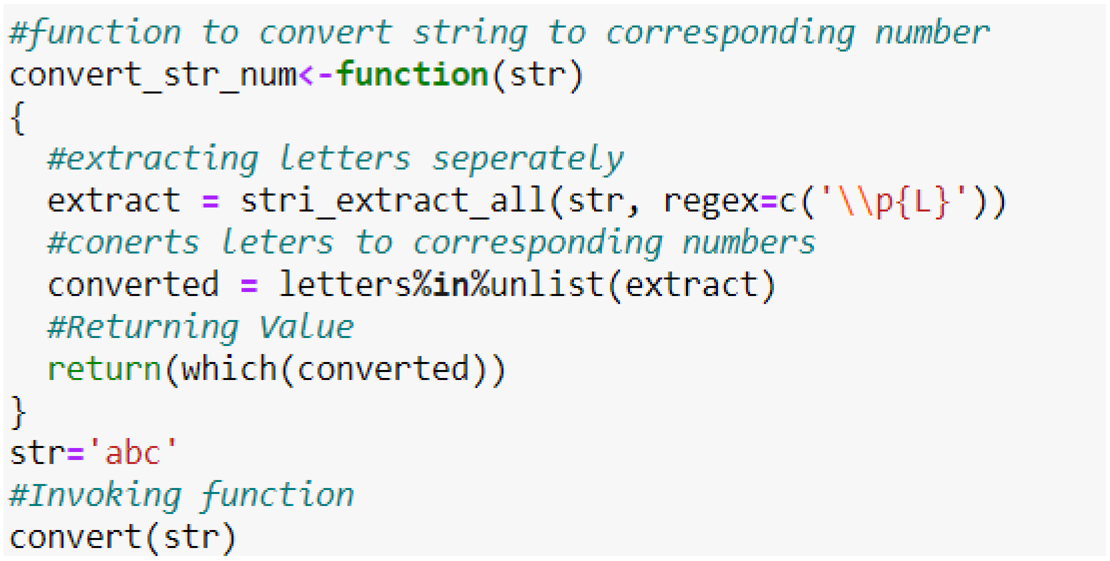
- ✶ %in% operator is used to identify if an element belongs to a vector or Dataframe.
- ✶ We can
    - ○ select column of a dataframe in R using %in% operator.
    - ○ create new variable of a column using %in% operator
    - ○ drop column of a dataframe in R using %in% operator.

Date: 04/11/2020

Q.NO 19: Question

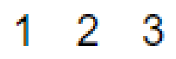
Create a function that given one word, return the position of word's letters on letters vector. For example, if the word is 'abc', the function will return 1 2 3.

Program:



```
#function to convert string to corresponding number
convert_str_num<-function(str)
{
  #extracting letters seperately
  extract = stri_extract_all(str, regex=c('\\p{L}'))
  #conerts leters to corresponding numbers
  converted = letters%in%unlist(extract)
  #Returning Value
  return(which(converted))
}
str='abc'
#Invoking function
convert(str)
```

Output:



```
1  2  3
```

Explanation:

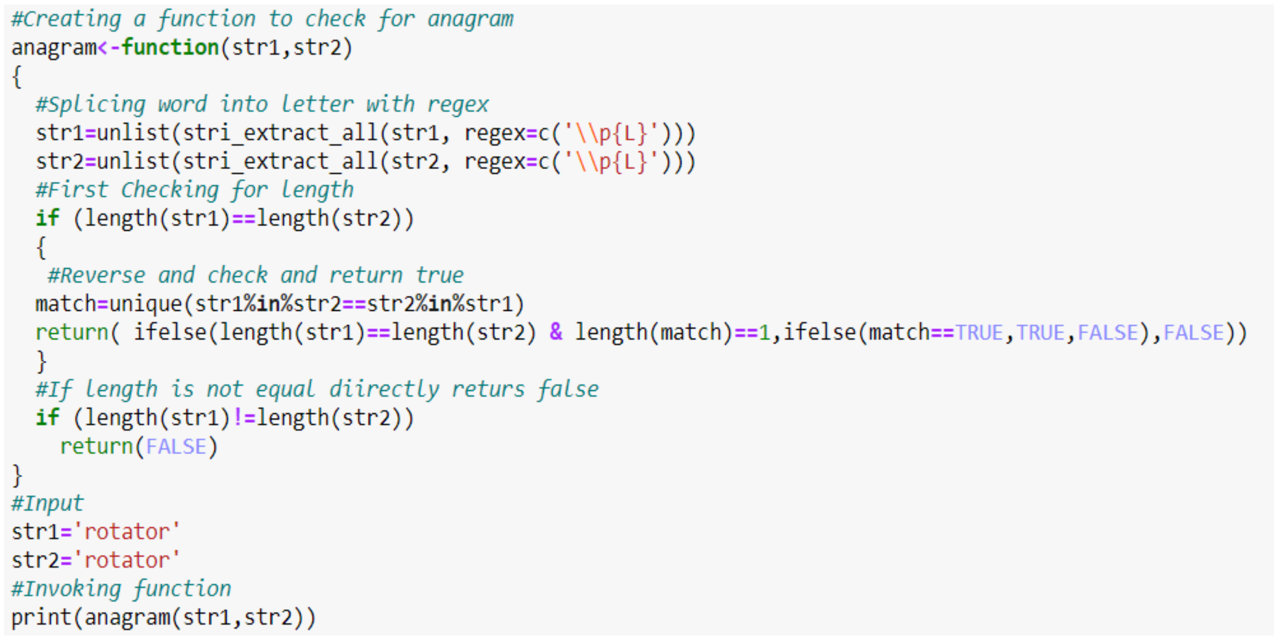
- ✶ Regular expressions are the default pattern engine in stringr. That means when you use a pattern matching function with a bare string, it's equivalent to wrapping it in a call to REGEX()
- ✶ Regular expressions are a concise and flexible tool for describing patterns in strings.

Date: 04/11/2020

Q.NO 20: Question

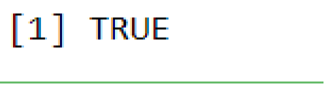
Write a code to check the given string is anagram or not

Program:



```
#Creating a function to check for anagram
anagram<-function(str1,str2)
{
  #Splicing word into letter with regex
  str1=unlist(stri_extract_all(str1, regex=c('\\p{L}')))
  str2=unlist(stri_extract_all(str2, regex=c('\\p{L}')))
  #First Checking for length
  if (length(str1)==length(str2))
  {
   #Reverse and check and return true
  match=unique(str1%in%str2==str2%in%str1)
  return( ifelse(length(str1)==length(str2) & length(match)==1,ifelse(match==TRUE,TRUE,FALSE),FALSE))
  }
  #If length is not equal diirectly returs false
  if (length(str1)!=length(str2))
    return(FALSE)
}
#Input
str1='rotator'
str2='rotator'
#Invoking function
print(anagram(str1,str2))
```

Output:



```
[1] TRUE
```

Explanation:

- ✶ Regular expressions are the default pattern engine in stringr. That means when you use a pattern matching function with a bare string, it's equivalent to wrapping it in a call to REGEX()
- ✶ Regular expressions are a concise and flexible tool for describing patterns in strings.
- ✶ Basically, we're splitting the word up into letters. Then using the unlist function to convert this into a vector. Then sorting the vector into alphabetical order.