CS636 R Assignment 2

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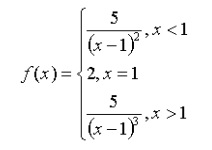
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## CS636 Homework 2

Due on Feb 23 2019 Submit hardcopy in class Submit electronic copy in moodle

Please submit the code together with the running results of the testing commands. Please do not use existing R packages and functions like sort(), order() and so on.

#### 1，Write a function, F(x), which takes x asthe input parameter.It calculates and prints the value of the following mathematical function.



#### Testing commands: F(1); F(10); F(0.3);

F <- function(x) {  
   
 # if x < 1 then formula  
 if(x<1){  
   
 y <- 5/((x-1)^2)  
   
 }else if(x==1){ # if x == 1 then 2  
   
 y <- 2  
   
 }else if(x>1){ # if x > 1 then formula  
   
 y <-5/((x-1)^3)  
   
 }  
   
 return(y)  
}  
  
F(1)

## [1] 2

F(10)

## [1] 0.006858711

F(0.3)

## [1] 10.20408

#### 2， The Fibonacci sequence 1, 1, 2, 3, 5, 8, 13, 21…… starts with two 1s, and each term afterwards is the sum of its two predecessors. Please write a function, Fib(n), which takes n as the input parameter. It will return the n-th number in the Fibonacci sequence.

#### Testing commands: Fib(1); Fib(2); Fib(100);

# Using List mehtod to calculate  
Fib <- function(n){  
   
 fiblist <- c()  
   
 if (n==1){  
   
 fiblist[1] <- 1  
   
 }else if(n==2){  
   
 fiblist[1] <- 1  
 fiblist[2] <- 1  
   
 }else{  
   
 fiblist[1] <- 1  
 fiblist[2] <- 1  
   
 for (i in 3:n){  
  
 fiblist[i] <- fiblist[i-2]+fiblist[i-1]  
  
 }  
 }  
  
 # Turn Scientific Notation Off  
 return(format(fiblist[n],scientific = FALSE))  
   
}  
  
Fib(1)

## [1] "1"

Fib(2)

## [1] "1"

Fib(100)

## [1] "354224848179261997066"

# Using recursive methods to calculate the same.  
# Using memoise library to improve CPU efficiency  
library(memoise)  
Fib <- memoise(function(n){  
   
   
   
 if (n==1){  
   
 return(1)  
   
 }else if(n==2){  
   
 return(1)  
   
 }else{  
   
 return(Fib(n-1)+Fib(n-2))  
  
 }  
  
   
})  
  
Fib(1)

## [1] 1

Fib(2)

## [1] 1

Fib(100)

## [1] 3.542248e+20

#### 3， The merge operation plays an important role in merge sort algorithm. Suppose you have two sorted sequences S1 and S2, merge operation will combine these two sequences into a single ordered sequence. Please write a function, Merge(S1, S2), which accepts two ordered vectors S1 and S2 as parameters. It will return a single ordered sequence. For example, S1 = c(1,3,5,7); S2=c(2,4,6,10); Merge(S1, S2) will return c(1,2,3,4,5,6,7,10)

#### Testing commands: Merge(seq(1, 50, by=3), seq(2, 30, by=2))

# Merge Sort  
Merge <- function (S1, S2){  
   
 print("S1 contains:")  
 print(S1)  
 print("S2 contains:")  
 print(S2)  
   
 len1 <- length(S1)  
 len2 <- length(S2)  
 len <- len1 + len2  
   
 S <- c()  
   
 k1 <- 1  
 k2 <- 1  
   
 for (x in 1:len){  
   
 if(k1>len1){  
 S[x:len] <- S2[k2:len2]  
 break  
 }else if (k2>len2){  
 S[x:len] <- S1[k1:len1]   
 break  
 }else if(S1[k1]<S2[k2]){  
 S[x] <- S1[k1]  
 k1 <- k1+1  
 }else{  
 S[x] <- S2[k2]  
 k2 <- k2+1  
 }  
 }  
   
 print("After Merge:")  
 return(S)  
}  
  
Merge(seq(1, 50, by=3), seq(2, 30, by=2))

## [1] "S1 contains:"  
## [1] 1 4 7 10 13 16 19 22 25 28 31 34 37 40 43 46 49  
## [1] "S2 contains:"  
## [1] 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30  
## [1] "After Merge:"

## [1] 1 2 4 4 6 7 8 10 10 12 13 14 16 16 18 19 20 22 22 24 25 26 28  
## [24] 28 30 31 34 37 40 43 46 49

#### 4， One of the most important algorithms is the quick sort, which is based on the quick sort partition. Here we implement a simple version of the partition function. Please write a function, Partition(pivot, vect), which takes two parameters. The function partitions the sequence, vect, into two parts (part1 <= pivot; part2 > pivot) based on the pivot. For example, Pivot = 6; Vect = c(1, 5, 3, 7, 9, 6, 4, 2, 10, 8); List = Partition(Pivot, Vect); List[[1]] is c(1,5,3,4,2, 6) and List[[2]] is c(7, 9, 10, 8). Note that Partition returns a list.

#### Testing commands: Partition(50, sample(1:100, 100, replace=F))

# Partition list  
Partition <- function(Pivot, vect){  
   
 len = length(vect)  
 list1 <- c()  
 list2 <- c()  
 k1 <- 1  
 k2 <- 1  
   
 for(x in 1:len){  
 if (vect[x]<=Pivot){  
 list1[k1] <- vect[x]  
 k1 <- k1+1  
 }else{  
 list2[k2] <- vect[x]  
 k2 <- k2+1  
 }  
   
 }  
   
 listt = list(list1,list2)  
   
 return(listt)  
   
}  
  
Partition(50, sample(1:100, 100, replace=FALSE))

## [[1]]  
## [1] 5 34 2 50 4 13 46 27 10 8 12 18 30 33 47 36 25 7 9 49 41 23 22  
## [24] 28 48 3 40 19 43 42 45 14 16 38 6 37 24 20 1 17 11 26 39 29 44 35  
## [47] 31 32 15 21  
##   
## [[2]]  
## [1] 78 67 90 51 91 92 82 57 64 81 77 61 76 60 95 96 80  
## [18] 54 69 62 58 98 75 83 53 84 87 100 66 94 65 71 79 86  
## [35] 89 55 52 72 70 74 56 85 93 63 88 73 99 68 59 97

# Quick Sort  
Quick <- function(vect){  
   
   
 vavg <- mean(vect)  
   
 list <- Partition(vavg,vect)  
   
 len1 = length(list[[1]])  
 len2 = length(list[[2]])  
  
 if(len1>1){  
 list1 <- Quick(list[[1]])  
 }else{  
 list1 <- list[[1]]  
 }  
   
 if(len2>1){  
 list2 <- Quick(list[[2]])  
 }else{  
 list2 <- list[[2]]  
 }  
   
   
 listt = c(list1,list2)  
   
 return(listt)  
}  
  
Quick(sample(1:100, 100, replace=FALSE))

## [1] 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17  
## [18] 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34  
## [35] 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51  
## [52] 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68  
## [69] 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85  
## [86] 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100