Loops and Flow Control

Programming in R for Data Science

Anders Stockmarr, Kasper Kristensen, Anders Nielsen

Loops in **R**

- In **R** the **for loop** is used perform a task for each element in a set.
- Example:
  - Given a set of integers:

```
> 1:3

[1] 1 2 3
```

  - Let a variable i run through the set and print $i + i$:

```
> for(i in 1:3) {
+     cat(i, "+", i, "=", i+i, "\n")
+ }

1 + 1 = 2
2 + 2 = 4
3 + 3 = 6
```

- The sequence to loop through is not limited to a vector of integers. For example, we could let a variable run through a **list**, **data.frame** or **matrix**.
- Example:
  - `> d <- data.frame(a = 1:2, b=2:3)`
  - Print column sums of d:

```
> for(x in d) {
+     cat("Column sum:", sum(x), "\n")
+ }

Column sum: 3
Column sum: 5
```

Flow Control: if and if else statements

- if(cond) expr:

```
> for(i in 1:3){
+   if (i==2) cat("This index is even:","\n")
+   cat(i,"\n")
+   }
```

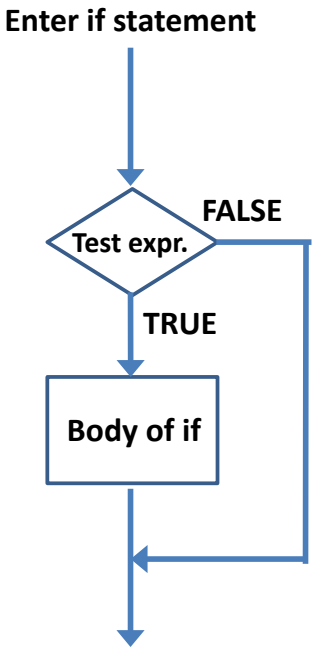
```
1
This index is even:
2
3
```

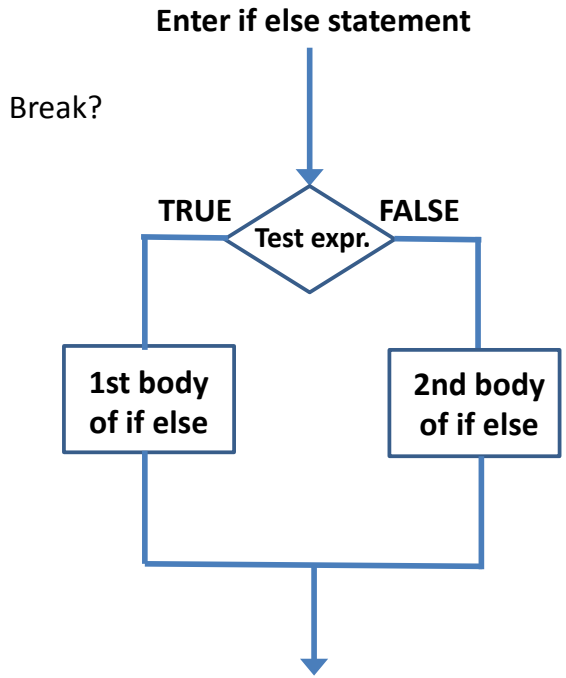
- if(cond) cond.expr else alt.expr:

```
> for(i in 1:3){
+   if (i==2) cat("The index is 2","\n") else
+             cat("The index is not 2","\n")
+   }
```

```
The index is not 2
The index is 2
The index is not 2
```

Flow charts for if and if else statements





While and repeat loops

The **while** loop:

- while(cond) expr

The **repeat** loop:

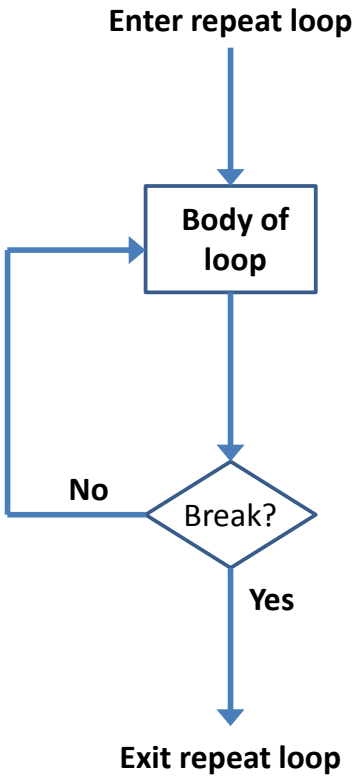
- repeat expr

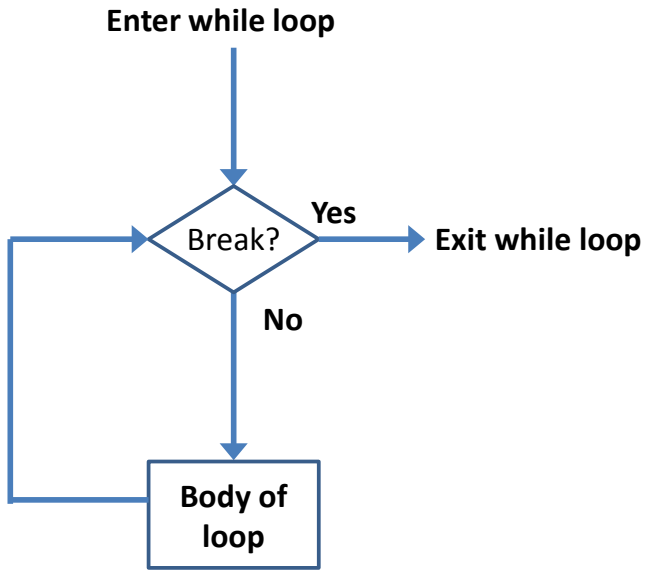
The repeat loop has to be exited manually.

Flow controllers:

- **next**: Halts the execution of the current iteration of the loop and advances to the next
- **break**: Exits the loop

Flow charts for repeat and while loops





Storing of machine parts

```
> k<-0 # number of big parts (>2)
> y<-abs(rnorm(1000)) # simulated part size
> i<-0 # index of parts
> # loop:
> while(k<3 & i<1000){
+  i<-i+1
+  temp<-y[i]
+  k<-k+(temp>2)
+   }
> rm(temp)
> i
```

```
[1] 42
```

Selection of persons without blue or yellow eyes

```
> eye.colors<-c("brown","blue","green","yellow","grey")
> eyecolor<-data.frame(personId=1:100,color=
+                        sample(eye.colors,100,rep=T))
> i<-0
> list.of.ids<-numeric(0) # patient ID list
> #loop:
> repeat {
+   i<-i+1
+   if(eyecolor$color[i]=="yellow" |
+      eyecolor$color[i]=="blue") next
+   list.of.ids<-c(list.of.ids,eyecolor$personId[i])
+   if(i==100 | length(list.of.ids)==20) break
+   }
> list.of.ids
 [1]  5  6  7  9 10 11 12 14 15 18 19 20 21 22 23 24 25 28
[19] 29 30
```

Loops and run times

When the amount of data is large, loops can significantly increase run time:

```
> y<-matrix(rnorm(1000000),nrow=1000)
> z<-0*y
> time1<-as.numeric(Sys.time())
> #loop:
> for(i in 1:1000){
+   for(j in 1:1000){
+     z[i,j]<-y[i,j]^2
+     }
+   }
> time2<-as.numeric(Sys.time())
> # using object form in R:
> z<-y^2
> time3<-as.numeric(Sys.time())
> # run time increase factor:
> (time2-time1)/(time3-time2)
```

```
[1] Inf
```

lapply() and sapply()

- Functions which apply functions are to vectors, matrices, arrays or lists.
- The lapply() and sapply() function apply functions to the input.
- The lapply() and sapply() are similar, except that:
- The output from lapply() is a list;
- The output from sapply() is a vector or a matrix.

lapply() and sapply examples

A simple example: Sum the colums of a data frame.

```
> my.data<-data.frame(data1=rnorm(10),data2=rnorm(10),data3=rnorm(10))
> lapply(my.data,sum)

$data1
[1] 3.189681

$data2
[1] 2.711566

$data3
[1] -3.247268

> sapply(my.data,sum)

    data1     data2     data3
 3.189681  2.711566 -3.247268
```

lapply() and sapply() examples

A less simple example: Applying lapply() and sapply() to lists.

```
> A<-matrix(1:9,nrow=3);B<-matrix(1:16,nrow=4);C=matrix(1:8,nrow=4)
> my.list<-list(A=A,B=B,C=C); my.list
```

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

$B
     [,1] [,2] [,3] [,4]
[1,]    1    5    9   13
[2,]    2    6   10   14
[3,]    3    7   11   15
[4,]    4    8   12   16

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

lapply() and sapply() examples

Now let's suppose that we want to extract the second column of each of these matrices. We can do this with the square bracket function:

```
> lapply(my.list,"[",,2)
$A
[1] 4 5 6

$B
[1] 5 6 7 8

$C
[1] 5 6 7 8
```

sapply() cannot do this job!