Coding and Mathematical Definitions

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Definitions of R Code

R script: the lines of code and comments that you are writing (filename.R).

R project: your R script, any variables you have created, and your current R environment (filename.Rproj).

R package: a set of functions/code that you can load into your script (examples - dplyr, sp).

R Comment: does not run as code, starts with #. You use comments to explain what your code is doing in plain langauge.

Object or Variable: a unit of information that is stored in the workspace (computer memory) and can be recalled or manipulated. ‘a’ is an object. Specifically, a vector of length 3.

```r
a = c(3, 2, 1)
```

Element: a piece of information within an object. The 1st element of a is...

```r
a[1]
```

[1] 3

Function: a command to take inputs (objects or elements) and manipulates it to provide an output, which can be saved as a new object.

```r
fun.text = function(x) {
    paste("Your input variable is ", x, sep = "")
}

fun.text(4)
```

[1] "Your input variable is 4"

```r
fun.text("INPUT")
```

[1] "Your input variable is INPUT"

Argument: a specific command within a function. Many functional arguments are preset and do not need to be explitly stated.

```r
x = c(1, 2, 3, NA)
mean(x)
```

[1] NA

```r
# na.rm is an argument of the function mean to ignore the missing value. Its
# preset is FALSE. If you have na's you need to change the argument to 'TRUE'.
mean(x, na.rm = TRUE)
```

[1] 2

Types of R Objects and Mathematical Notation

Vector: 1 row, many columns OR 1 column many rows. Can be numbers of characters.

```r
v = c(4, 1, 3)
is.vector(v)
```

[1] TRUE

```r
length(v)
```

[1] 3

Math notation (capitalized & lower case): $\vec{v}$ or $\mathbf{v}$

$$\mathbf{v} = \begin{bmatrix} 4 & 1 & 3 \end{bmatrix} \tag{1}$$

Matrix: Generalization of vectors. Can have 1 or more rows and columns. Only numbers.

```r
M = matrix(1:10, nrow = 2)
M
```

```
##      [,1] [,2] [,3] [,4] [,5]
## [1,]    1    3    5    7    9
## [2,]    2    4    6    8   10
```

```r
dim(M)
```

```
## [1] 2 5
```

```r
is.vector(M)
```

```
## [1] FALSE
```

```r
is.matrix(M)
```

```
## [1] TRUE
```

Math notation (capitalized & upper case): $\mathbf{M}$

$$\mathbf{M} = \begin{bmatrix} 1 & 3 & 5 & 7 & 9 \\ 2 & 4 & 6 & 8 & 10 \end{bmatrix} \tag{2}$$

Array: Generalization of matrices. Can be n dimensional. Only numbers.

```r
arr = array(1:100, dim = c(3, 4, 3))
arr
```

```
## , , 1
##
##      [,1] [,2] [,3] [,4]
## [1,]    1    4    7   10
## [2,]    2    5    8   11
## [3,]    3    6    9   12
##
## , , 2
##
##      [,1] [,2] [,3] [,4]
## [1,]   13   16   19   22
## [2,]   14   17   20   23
## [3,]   15   18   21   24
##
## , , 3
##
##      [,1] [,2] [,3] [,4]
## [1,]   25   28   31   34
## [2,]   26   29   32   35
## [3,]   27   30   33   36
```

```r
dim(arr)
```

```
## [1] 3 4 3
```

```r
is.vector(arr)
```

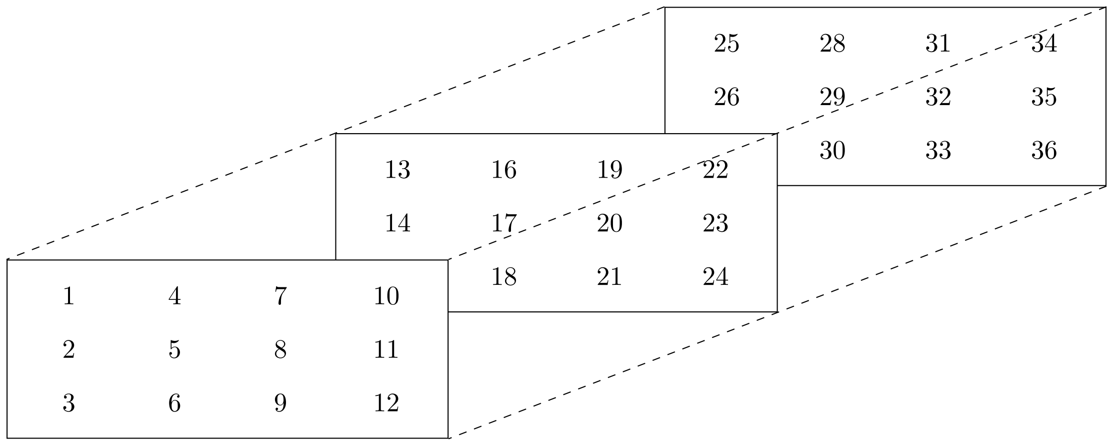
```
## [1] FALSE
```

```r
is.matrix(arr)
```

```
## [1] FALSE
```

```r
is.array(arr)
```

```
## [1] TRUE
```



List: Can store any type of objects together.

```r
list1 = vector("list", 2)
list1[[1]] = v
list1[[2]] = M
list1[[3]] = arr

is.list(list1)
```

```
## [1] TRUE
```

```r
length(list1)
```

```
## [1] 3
```

```r
list1[[1]]
```

```
## [1] 4 1 3
```

Important Functions

For Loop: To do a task many times. Simple, but inefficient

```r
#First, create a large matrix

x <- matrix(rnorm(400*4000), ncol=400)

#Second, create a vector to store results
mx <- rep(NA, nrow(x))

#Third, for each row of the matrix, find the maximum value and store it in mx using
#a loop. We will do this from index 1 to the max number of rows (nrow(x)). We will
#iterate using index i.

for(i in 1:nrow(x)){
  mx[i] <- max(x[i,])
}
```

Apply: To do a task many times using vectorization. Much faster then a for loop.

```r
# The 1 indicates to the function 'max' on the rows of the object 'x'. A 2 would
#that this function should be applied to each column of the object 'x'.
mx2 <- apply(x, 1, max)
```