Practice Problems: Control Structures and Functions

STAT 450, Fall 2021

Exercise 1

Write the following mathematical functions as functions in R.

a

$$f(x) = x^3$$

b

$$g(x) = a \cdot e^{-ax}$$

with $a = 1$ as a default argument. The R function `exp()` computes the exponential function.

c

$$h(x, p) = \begin{cases} log(x), & \text{if } p = 0 \\ x^p, & \text{if } p \neq 0 \end{cases}$$

The R function `log()` computes the logarithmic function (base e).

Exercise 2

Consider the following code that removes missing values from a vector:

```
x <- c(6, 21, NA, NA, 12, NA, 23, 15)
is.na(x)
```

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

```
x[!is.na(x)] # removes NA values
```

```
## [1]  6 21 12 23 15
```

Generalize this code by writing a function called `remove_na()` that removes the `NA` values from a vector. This is what the output of your function should look like:

```
x <- c(6, 21, NA, NA, 12, NA, 23, 15)
remove_na(x)
```

```
## [1]  6 21 12 23 15
```

```
airquality$Ozone
```

```
##   [1]  41  36  12  18  NA  28  23  19   8  NA   7  16  11  14  18  14  34   6
##  [19]  30  11   1  11   4  32  NA  NA  NA  23  45 115  37  NA  NA  NA  NA  NA
##  [37]  NA  29  NA  71  39  NA  NA  23  NA  NA  21  37  20  12  13  NA  NA  NA
##  [55]  NA  NA  NA  NA  NA  NA  NA 135  49  32  NA  64  40  77  97  97  85  NA
##  [73]  10  27  NA   7  48  35  61  79  63  16  NA  NA  80 108  20  52  82  50
##  [91]  64  59  39   9  16  78  35  66 122  89 110  NA  NA  44  28  65  NA  22
## [109]  59  23  31  44  21   9  NA  45 168  73  NA  76 118  84  85  96  78  73
## [127]  91  47  32  20  23  21  24  44  21  28   9  13  46  18  13  24  16  13
## [145]  23  36   7  14  30  NA  14  18  20
```

```
remove_na(airquality$Ozone)
```

```
##   [1]  41  36  12  18  28  23  19   8   7  16  11  14  18  14  34   6  30  11
##  [19]   1  11   4  32  23  45 115  37  29  71  39  23  21  37  20  12  13 135
##  [37]  49  32  64  40  77  97  97  85  10  27   7  48  35  61  79  63  16  80
##  [55] 108  20  52  82  50  64  59  39   9  16  78  35  66 122  89 110  44  28
##  [73]  65  22  59  23  31  44  21   9  45 168  73  76 118  84  85  96  78  73
##  [91]  91  47  32  20  23  21  24  44  21  28   9  13  46  18  13  24  16  13
## [109]  23  36   7  14  30  14  18  20
```

Exercise 3

The formula for the variance of a data set $x_1, x_2, \cdots, x_n$ is given by:

$$\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}$$

Write an R function called `compute_var()` that computes the variance of a numeric vector. The function should have two arguments:

- `x`, a numeric vector
- `na.rm`, a logical value (`TRUE` / `FALSE`) indicating whether `NA` values should be removed. Set the default to `na.rm = FALSE`

This is what the output of your function should look like:

```
compute_var(x = 1:10)
```

```
## [1] 9.166667
```

```
compute_var(mtcars$mpg)
```

```
## [1] 36.3241
```

```
compute_var(airquality$Ozone, na.rm = TRUE)
```

```
## [1] 1088.201
```

Exercise 4

Try to predict the output of the following R code. Then run the code in R to verify.

a

```
temp <- 82
if(temp < 70) {
  print("cold")
} else if(temp < 80) {
  print("warm")
} else {
  print("hot")
}
```

b

```
f <- function(x) {
  if(x < 0) {
    print("undefined")
  } else {
    sqrt(x)
  }
}
f(-1)
f(9)
```

c

```
x <- 47
g <- function(x, y) {
  x^2 + y^2
}
g(x = 2, y = 2)
x
```

d

```
for(i in 1:10) {
  y <- 2 * i - 1
  print(y)
}
```