

Objective: To examine the program structure in a functional programming language.

Submission: Submit your R code along with the produced output [hard copy].

Deadline: March 24, 2019 (before the class).

Problem 1. [10 Marks]

Assume that, $n = 100 + \text{lastTwoDigitsOfYourCellNo} + (10 - \text{lastDigitOfYourCellNo})$, Create the following vectors in R :

$a = (5, 10, 15, 20, \dots, n)$

$b = (87, 86, 85, \dots, (88 - \text{length}(a)))$

Use vector arithmetic to multiply these vectors and call the result **d**. Select subsets of **d** to identify the following.

- What are the 19th, 20th, and 21st elements of **d**?
- What are all of the elements of **d** which are less than 2000?
- How many elements of **d** are greater than 6000?
- Using R functions compute the following statistics of **d** : sum, median, standard deviation.
- Assume that, $\mathbf{w} = \text{rev}(a)$ and $\mathbf{r} = \text{rev}(b)$, Use R to create the following two matrices; do the indicated matrix multiplication and display the resulting matrix.

$$M = \begin{pmatrix} r[1] & r[2] & r[3] \\ r[4] & r[5] & r[6] \end{pmatrix} \times \begin{pmatrix} w[1] & w[4] & w[7] & w[10] \\ w[2] & w[5] & w[8] & w[11] \\ w[3] & w[6] & w[9] & w[12] \end{pmatrix}$$

Problem 2. [10 marks] Download the temperature.csv file (from the course website) in your local machine and use the R code: `tempData ← read.csv("temperature.csv")` to import the temperature data into your RStudio environment. The temperature.csv file contains the monthly temperature of 13 different cities [starting from Jan, 2016].

- From these data, collect the temperatures of two cities only and choose those two cities using an index [where $\text{index} = \text{lastDigitOfYourCellNo}$]. For example, if your index is 5 then you will collect the temperature information of City5 and City6 [so, $\text{firstCityTemp} = \text{City}\{\text{index}\}$'s temperatures and $\text{secondCityTemp} = \text{City}\{\text{index}+1\}$'s temperatures]. Finally, collect the temperature of City12 into `thirdCityTemp` vector.

- (b) Plot a line graph with the tempData of firstCityTemp, secondCityTemp, and thirdCityTemp; Comment on which two cities have very close temperature pattern.
- (c) Find out $\text{cov}(\text{firstCityTemp}, \text{secondCityTemp})=?$, $\text{cov}(\text{secondCityTemp}, \text{thirdCityTemp})=?$, $\text{cov}(\text{thirdCityTemp}, \text{firstCityTemp})=?$. And relate them with your comment (regarding the temperature pattern) in the previous question.
- (d) Using `ts()` function, create two time series `firstCityTemp.ts` & `secondCityTemp.ts` from corresponding `firstCityTemp` & `secondCityTemp` data, and then use `predict()` function to know about the temperature of May, 2019 for those two cities.
- (e) Assume that after your graduation, you will be visiting two different tourist places (not in Asia). Create two individual lists (in R) for each place to record some information including `nameOfPlace`, `attractions`, `spokenLanguages`, `nameOfSeasons`, `threeClosebyAirports`, `tempData`. You may find all required information from any source on the Internet but assign the tempData information from the `firstCityTemp` and `secondCityTemp` vector respectively.

Problem 3. [20 marks]

The `mtcars` is a built-in dataset in R that contains various information related to car –

- `mpg`: Miles/gallon, `cyl`: Number of cylinders,
 - `disp`: Displacement (cu.in.),
 - `hp`: Gross horsepower,
 - `drat`: Rear axle ratio,
 - `wt`: Weight (1000 lbs),
 - `qsec`: 1/4 mile time, `vs`: V/S,
 - `am`: Transmission (0 = automatic, 1 = manual),
 - `gear`: Number of forward gears,
 - `carb`: Number of carburetors.
- (a) Attach `mtcars` dataset in your R environment using: `attach(mtcars)` and create a new data frame **carData.df** with only the `mpg`, `cyl`, `hp`, `wt`, `gear` information of `mtcars`.

- (b) Create a random number using the following R code
set.seed(lastdigitOfYourCellNo)
offset←rnorm(length(mpg),mean= lastTwodigitsOfYourCellNo, sd=2)
Add the offset values with the values of mpg in carData.df
- (c) Create a new vector, carType←paste(“Car”,1:length(mpg)), and use cbind() function to include (as a new column) the carType vector in carData.df data frame.
- (d) Use subset() function to display the information of those cars having the gear equals 5.

Bonus Marks

- (e) Use R help page (or internet) to find out a difference between tapply() and lapply() functions.
- (f) Use tapply() function to find out the average mpg for each type of gear.
- (g) Use tapply() function to find out the average wt for each type of cyl.
- (h) Use tapply() function to find out the maximum hp for each type of cyl.
- (i) Create a bar chart to show the mpg for each carType.
- (j) Create a histogram for wt.