

Programming for Data Science Lab Assignment – 3

Date:31-07-25

Total Marks: 100

Experiment Title:

Optimizing Parking Allocation with VIP Area Using One-Dimensional Vectors in R

Scenario:

At VIT Chennai, the vehicle parking system consists of:

- Five bike parking areas, each with a random capacity between 150 and 500.
- Four car parking areas, each with a random capacity between 150 and 500.
- One exclusive VIP parking area with a fixed capacity of 10, reserved only for VIP vehicles.

Every day, a random number of bikes, cars, and VIP vehicles arrive on campus. Your task is to design an R program that efficiently manages the allocation of these vehicles using:

- Only one-dimensional vectors
- Built-in and user-defined functions
- No use of data frames, matrices, lists, or other multi-dimensional structures

The program should allocate vehicles in an optimized manner, and clearly display the parking status and utilization summary using a user-defined function, making the output

understandable even to a non-technical audience.

Objectives:

- Simulate a real-world parking management system using 1D vectors in R.
- Develop logic for efficient resource allocation.
- Strengthen understanding of built-in and user-defined functions in R.
- Practice modular programming by creating reusable functions.
- Generate human-readable output reflecting real-time parking data.

Requirements & Constraints:

1. Use only one-dimensional vectors (e.g., `c()` in R).
2. Do not use data frames, lists, matrices, or any multi-dimensional data structures.
3. Create at least two user-defined functions:
 - One for optimally allocating vehicles to parking slots.
 - One for displaying the parking status in a clear and readable format.
4. Use built-in functions such as `sum()`, `which.max()`, `length()`, `round()`, etc.
5. VIP vehicles must be parked exclusively in the VIP parking area.
6. Include clear and consistent comments throughout your code.
7. The program output must include:
 - Parking status of each slot (used vs. total capacity)

- Number of vehicles successfully parked
- Parking utilization summary: total capacity, used space, remaining space, and utilization percentage

Expected Output Format (Example):

Only 10 VIPs accommodated out of 11
No more available space in this category.
No more available space in this category.

===== Final Parking Status =====

BikeParking Status:

Slot 1 -> Used: 279 / 279 [FULL]
Slot 2 -> Used: 301 / 301 [FULL]
Slot 3 -> Used: 380 / 380 [FULL]
Slot 4 -> Used: 415 / 415 [FULL]
Slot 5 -> Used: 497 / 497 [FULL]

Bike Parking FULL in slot(s): 1, 2, 3, 4, 5

CarParking Status:

Slot 1 -> Used: 378 / 378 [FULL]
Slot 2 -> Used: 183 / 183 [FULL]
Slot 3 -> Used: 322 / 322 [FULL]
Slot 4 -> Used: 174 / 174 [FULL]

Car Parking FULL in slot(s): 1, 2, 3, 4

VIP Parking Used: 10 / 10 [FULL]

===== Parking Utilization Report =====

Total Capacity: 2939
Used Capacity: 2939
Remaining Capacity: 0
Utilization: 100 %

Sample Output

All 7 VIPs accommodated in VIP parking.
No more available space in this category.

===== Final Parking Status =====

BikeParking Status:

Slot 1 -> Used: 388 / 388 [FULL]
Slot 2 -> Used: 286 / 286 [FULL]
Slot 3 -> Used: 158 / 158 [FULL]
Slot 4 -> Used: 404 / 404 [FULL]
Slot 5 -> Used: 350 / 350 [FULL]

Bike Parking FULL in slot(s): 1, 2, 3, 4, 5

CarParking Status:

Slot 1 -> Used: 331 / 473
Slot 2 -> Used: 339 / 482
Slot 3 -> Used: 256 / 399
Slot 4 -> Used: 165 / 308

VIP Parking Used: 7 / 10

===== Parking Utilization Report =====

Total Capacity: 3258
Used Capacity: 2684
Remaining Capacity: 574
Utilization: 82.38 %

Lab Report Format:

Filename Format:

Experiment_<Number>_<StudentName>_<RegistrationNumber>.docx

Example:

Experiment_02_Ananya_21BCE1234.docx

Lab Report Structure:

1. Title of the Experiment

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2. Objective
3. Problem Statement
4. Logic / Algorithm Used
5. Screenshots of Output (if applicable)
6. R Code (well-commented)
7. Sample Output
8. Conclusion

Evaluation Rubric (100 Marks):

| Criteria | Marks |
|--|-------|
| Initialization of all vectors | 10 |
| Simulation of arriving vehicles | 10 |
| Correct implementation of VIP parking logic | 10 |
| Vehicle allocation using user-defined function | 15 |
| Parking status display function | 15 |
| Effective use of built-in R functions | 10 |
| Optimization and correctness of logic | 10 |
| Code readability and inline comments | 5 |

| | |
|--|----|
| Output formatting and clarity | 5 |
| Lab report structure and correct file naming | 10 |

Important Instructions:

- This is an individual lab assignment.
- Do not use AI tools, ChatGPT, or online code generators.
- Mobile phones or smart devices are strictly not allowed during the lab.
- Maintain silence and avoid discussion or collaboration.
- Any form of plagiarism or copying will result in zero marks and disciplinary action.
- Submit * .docx report as instructed by the lab faculty.