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Subject: Computing Lab - III | Experiment No - 02 (3rd YEAR CSE-AIML 2023-2024)

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Aim: R program to Implement Vector, Dataframe, Matrix, List and Array operations.

Theory:

Vector:

R Vectors are the same as the arrays in R language which are used to hold multiple data values of the same type. One major key point is that in R Programming Language the indexing of the vector will start from '1' and not from '0'. We can create numeric vectors and character vectors as well.

```
numeric_vector <- c(1, 2, 3, 4, 5)
char_vector <- c("apple", "banana", "orange", "grape", "kiwi")

# Basic operations
result_addition <- numeric_vector + 2
result_multiplication <- numeric_vector * 3

# Display results
print(result_addition)
```

```
## [1] 3 4 5 6 7
```

```
print(result_multiplication)
```

```
## [1]  3  6  9 12 15
```

Matrix:

A matrix is a two-dimensional data structure where data are arranged into rows and columns.

```
# Create a matrix
my_matrix <- matrix(c(1, 2, 3, 4, 5, 6, 7, 8, 9), nrow = 3, ncol = 3, byrow = TRUE)

# Matrix operations
matrix_product <- my_matrix %*% my_matrix
determinant_value <- det(my_matrix)

# Display results
print(matrix_product)
```

```
##      [,1] [,2] [,3]
## [1,]   30   36   42
## [2,]   66   81   96
## [3,]  102  126  150
```

```
print(determinant_value)
```

```
## [1] 6.661338e-16
```

Dataframe:

A data frame is a two-dimensional data structure which can store data in tabular format.

Data frames have rows and columns and each column can be a different vector. And different vectors can be of different data types.

```
# Create a dataframe
my_dataframe <- data.frame(Name = c("John", "Alice", "Bob"),
                           Age = c(25, 30, 28),
                           Grade = c("A", "B", "C"))

# Add a new row
new_row <- c("Eva", 22, "A")
my_dataframe <- rbind(my_dataframe, new_row)

# Subset and filter
subset_dataframe <- my_dataframe[my_dataframe$Age > 25, ]

# Display results
print(my_dataframe)
```

```
##    Name Age Grade
## 1  John  25     A
## 2 Alice  30     B
## 3   Bob  28     C
## 4   Eva  22     A
```

```
print(subset_dataframe)
```

```
##    Name Age Grade
## 2 Alice  30     B
## 3   Bob  28     C
```

List:

A List is a collection of similar or different types of data.

In R, we use the `list()` function to create a list.

```
# Create a list
my_list <- list(numbers = c(1, 2, 3), characters = c("apple", "banana", "orange"), logicals =
c(TRUE, FALSE, TRUE))

# Access and modify elements
my_list$numbers[2] <- 5

# Display results
print(my_list)
```

```
## $numbers
## [1] 1 5 3
##
## $characters
## [1] "apple"  "banana" "orange"
##
## $logicals
## [1]  TRUE FALSE  TRUE
```

```
print(length(my_list))
```

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

```
str(my_list)
```

```
## List of 3
##  $ numbers   : num [1:3] 1 5 3
##  $ characters: chr [1:3] "apple" "banana" "orange"
##  $ logicals  : logi [1:3] TRUE FALSE TRUE
```

Array:

An Array is a data structure which can store data of the same type in more than two dimensions.

The only difference between vectors, matrices, and arrays are

- Vectors are uni-dimensional arrays
- Matrices are two-dimensional arrays
- Arrays can have more than two dimensions

```
# Create a 2D array for temperature data
temperature_data <- array(data = c(23, 28, 24, 29, 26, 30, 21, 25, 22, 27, 29, 31),
                          dim = c(3, 4),
                          dimnames = list(c("City_A", "City_B", "City_C"), c("Jan", "Feb", "M
ar", "Apr")))

# Calculate average temperature for each city
average_city_temperature <- apply(temperature_data, 1, mean)

# Calculate overall average temperature
overall_average_temperature <- mean(temperature_data)

# Display results
print(temperature_data)
```

```
##        Jan Feb Mar Apr
## City_A  23  29  21  27
## City_B  28  26  25  29
## City_C  24  30  22  31
```

```
print(average_city_temperature)
```

```
## City_A City_B City_C
##  25.00  27.00  26.75
```

```
print(overall_average_temperature)
```

```
## [1] 26.25
```

Conclusion:

Through this experiment we have studied about implementation of Vector, Matrix, Dataframe, List and Array in R programming.