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RegNo: 22BCE9651
Slot : **L22+L23**
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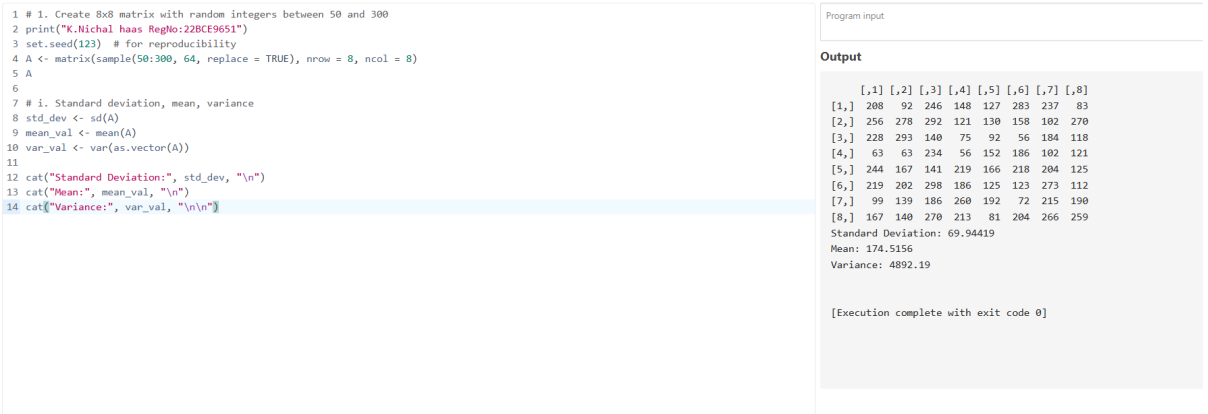
Vellore Institute of Technology
SCOPE
FDA (CSE1006) - Slot - L22+L23

DA - V

1. Create a 8×8 NumPy array with random integers between 50 and 300. Perform the following operations
i. Find the standard deviation, mean and variance of the entire array.



```
# 1. Create 8x8 matrix with random integers between 50 and 300
print("K.Nichal haas RegNo:22BCE9651")
set.seed(123)  # for reproducibility
A <- matrix(sample(50:300, 64, replace = TRUE), nrow = 8, ncol = 8)
A

# i. Standard deviation, mean, variance
std_dev <- sd(A)
mean_val <- mean(A)
var_val <- var(as.vector(A))

cat("Standard Deviation:", std_dev, "\n")
cat("Mean:", mean_val, "\n")
cat("Variance:", var_val, "\n\n")
```

```
Program input

Output

     [,1] [,2] [,3] [,4] [,5] [,6] [,7] [,8]
[1,]  208   92  246  148  127  283  237   83
[2,]  256  278  292  121  130  158  102  270
[3,]  228  293  140   75   92   56  184  118
[4,]   63   63  234   56  152  186  102  121
[5,]  244  167  141  219  166  218  204  125
[6,]  219  202  298  186  125  123  273  112
[7,]   99  139  186  260  192   72  215  190
[8,]  167  140  270  213   81  204  266  259
Standard Deviation: 69.94419
Mean: 174.5156
Variance: 4892.19


[Execution complete with exit code 0]
```

A <- matrix(sample(50:300, 64, replace = TRUE), nrow = 8, ncol = 8)
A

# i. Standard deviation, mean, variance
std_dev <- sd(A)
mean_val <- mean(A)
var_val <- var(as.vector(A))

cat("Standard Deviation:", std_dev, "\n")
cat("Mean:", mean_val, "\n")
cat("Variance:", var_val, "\n\n")

ii. Compute the column sum, row sum and diagonal sum and anti-diagonal sum.

```r
# 1. Create 8x8 matrix with random integers between 50 and 300
print("K.Nichal haas RegNo:22BCE9651")
set.seed(123)  # for reproducibility
A <- matrix(sample(50:300, 64, replace = TRUE), nrow = 8, ncol = 8)
A

# i. Standard deviation, mean, variance
std_dev <- sd(A)
mean_val <- mean(A)
var_val <- var(as.vector(A))

cat("Standard Deviation:", std_dev, "\n")
cat("Mean:", mean_val, "\n")
cat("Variance:", var_val, "\n\n")

# ii. Column sum, row sum, diagonal sum, anti-diagonal sum
col_sum <- colSums(A)
row_sum <- rowSums(A)
diag_sum <- sum(diag(A))
anti_diag_sum <- sum(diag(apply(A, 2, rev)))  # reverse columns for anti-diagonal

cat("Column Sum:", col_sum, "\n")
cat("Row Sum:", row_sum, "\n")
cat("Diagonal Sum:", diag_sum, "\n")
cat("Anti-Diagonal Sum:", anti_diag_sum, "\n\n")
```

Program input

Output

```
 [1,]  208   92  246  148  127  283  237   83
 [2,]  256  278  292  121  130  158  102  270
 [3,]  228  293  140   75   92   56  184  118
 [4,]   63   63  234   56  152  186  102  121
 [5,]  244  167  141  219  166  218  204  125
 [6,]  219  202  298  186  125  123  273  112
 [7,]   99  139  186  260  192   72  215  190
 [8,]  167  140  270  213   81  204  266  259
Standard Deviation: 69.94419
Mean: 174.5156
Variance: 4892.19

Column Sum: 1484 1374 1807 1278 1065 1300 1583 1278
Row Sum: 1424 1607 1186 977 1484 1538 1353 1600
Diagonal Sum: 1445
Anti-Diagonal Sum: 1216


[Execution complete with exit code 0]
```

```r
# ii. Column sum, row sum, diagonal sum, anti-diagonal sum
col_sum <- colSums(A)
row_sum <- rowSums(A)
diag_sum <- sum(diag(A))
anti_diag_sum <- sum(diag(apply(A, 2, rev)))  # reverse columns for anti-diagonal

cat("Column Sum:", col_sum, "\n")
cat("Row Sum:", row_sum, "\n")
cat("Diagonal Sum:", diag_sum, "\n")
cat("Anti-Diagonal Sum:", anti_diag_sum, "\n\n")
```

iii. Extract a sub-matrix of size 3×3 from the center of the array.

```r
print("K.Nichal haas RegNo:22BCE9651")
set.seed(123)  # for reproducibility
A <- matrix(sample(50:300, 64, replace = TRUE), nrow = 8, ncol = 8)
A

# i. Standard deviation, mean, variance
std_dev <- sd(A)
mean_val <- mean(A)
var_val <- var(as.vector(A))

cat("Standard Deviation:", std_dev, "\n")
cat("Mean:", mean_val, "\n")
cat("Variance:", var_val, "\n\n")

# ii. Column sum, row sum, diagonal sum, anti-diagonal sum
col_sum <- colSums(A)
row_sum <- rowSums(A)
diag_sum <- sum(diag(A))
anti_diag_sum <- sum(diag(apply(A, 2, rev)))  # reverse columns for anti-diagonal

cat("Column Sum:", col_sum, "\n")
cat("Row Sum:", row_sum, "\n")
cat("Diagonal Sum:", diag_sum, "\n")
cat("Anti-Diagonal Sum:", anti_diag_sum, "\n\n")

# iii. Extract 3×3 submatrix from center
sub_matrix <- A[3:5, 3:5]
cat("3x3 Sub-matrix from center:\n")
print(sub_matrix)
```

Output

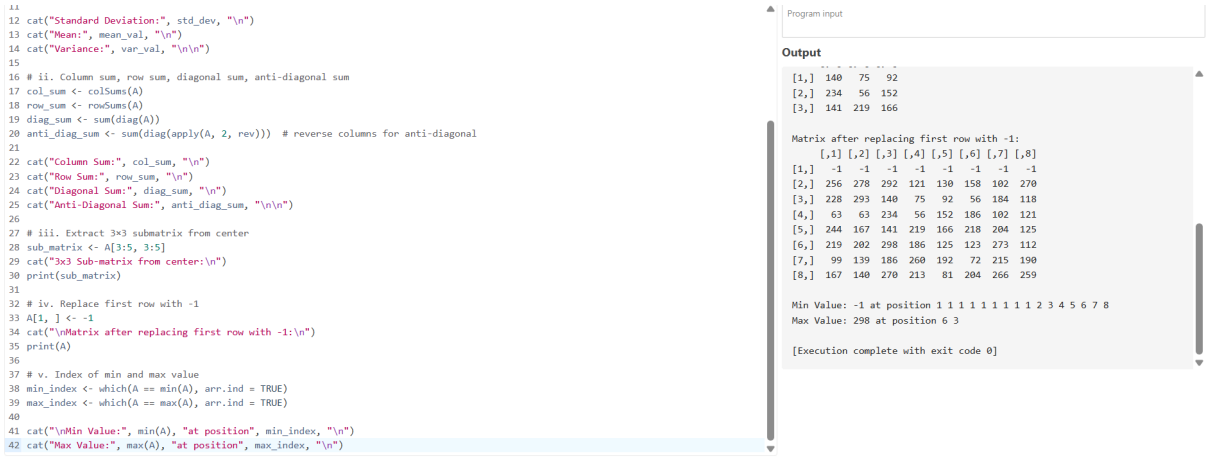
```
 [6,]  219  202  298  186  125  123  273  112
 [7,]   99  139  186  260  192   72  215  190
 [8,]  167  140  270  213   81  204  266  259
Standard Deviation: 69.94419
Mean: 174.5156
Variance: 4892.19

Column Sum: 1484 1374 1807 1278 1065 1300 1583 1278
Row Sum: 1424 1607 1186 977 1484 1538 1353 1600
Diagonal Sum: 1445
Anti-Diagonal Sum: 1216

3x3 Sub-matrix from center:
     [,1] [,2] [,3]
[1,]  140   75   92
[2,]  234   56  152
[3,]  141  219  166

[Execution complete with exit code 0]
```

```r
# iii. Extract 3×3 submatrix from center
sub_matrix <- A[3:5, 3:5]
cat("3x3 Sub-matrix from center:\n")
print(sub_matrix)
```

iv. Replace all elements in the first row with -1.


```
# iv. Replace first row with -1
A[1, ] <- -1
cat("\nMatrix after replacing first row with -1:\n")
print(A)
```

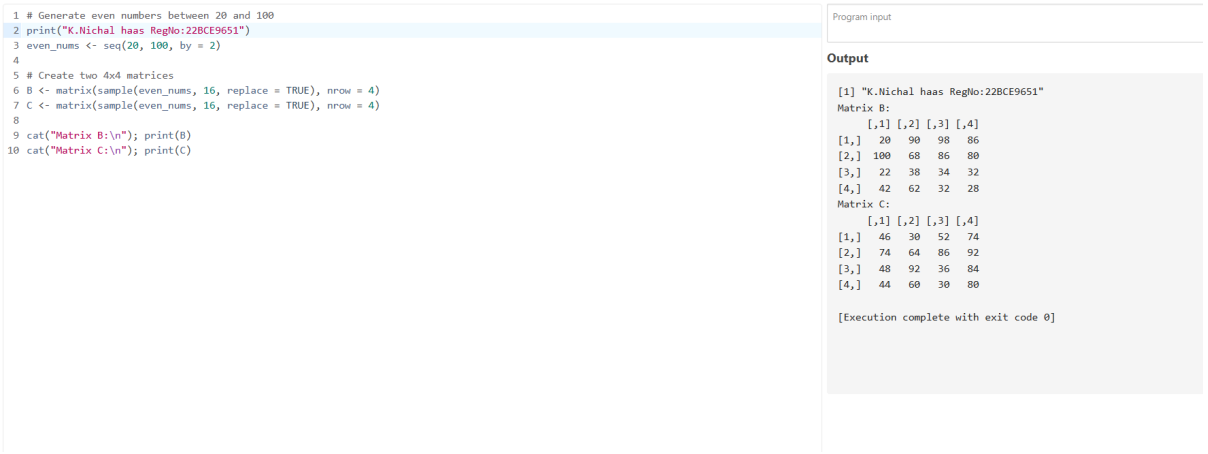
v. Find the index position of the minimum value and maximum value in the array.




```
# v. Index of min and max value
min_index <- which(A == min(A), arr.ind = TRUE)
max_index <- which(A == max(A), arr.ind = TRUE)

cat("\nMin Value:", min(A), "at position", min_index, "\n")
cat("Max Value:", max(A), "at position", max_index, "\n")
```

2. Generate two 4×4 NumPy arrays with random even values between 20 and 100. Perform the following

.



```
# Generate even numbers between 20 and 100
print("K.Nichal haas RegNo:22BCE9651")
even_nums <- seq(20, 100, by = 2)

# Create two 4x4 matrices
B <- matrix(sample(even_nums, 16, replace = TRUE), nrow = 4)
C <- matrix(sample(even_nums, 16, replace = TRUE), nrow = 4)

cat("Matrix B:\n"); print(B)
cat("Matrix C:\n"); print(C)
```

Program input

Output

```
[1] "K.Nichal haas RegNo:22BCE9651"
Matrix B:
     [,1] [,2] [,3] [,4]
[1,]   20   90   98   86
[2,]  100   68   86   80
[3,]   22   38   34   32
[4,]   42   62   32   28
Matrix C:
     [,1] [,2] [,3] [,4]
[1,]   46   30   52   74
[2,]   74   64   86   92
[3,]   48   92   36   84
[4,]   44   60   30   80

[Execution complete with exit code 0]
```

# Generate even numbers between 20 and 100
print("K.Nichal haas RegNo:22BCE9651")
even_nums <- seq(20, 100, by = 2)

# Create two 4x4 matrices
B <- matrix(sample(even_nums, 16, replace = TRUE), nrow = 4)
C <- matrix(sample(even_nums, 16, replace = TRUE), nrow = 4)

cat("Matrix B:\n"); print(B)
cat("Matrix C:\n"); print(C)

i. Perform element-wise multiplication of both arrays

```
# Generate even numbers between 20 and 100
print("K.Nichal haas RegNo:22BCE9651")
even_nums <- seq(20, 100, by = 2)

# Create two 4x4 matrices
B <- matrix(sample(even_nums, 16, replace = TRUE), nrow = 4)
C <- matrix(sample(even_nums, 16, replace = TRUE), nrow = 4)

cat("Matrix B:\n"); print(B)
cat("Matrix C:\n"); print(C)

# i. Element-wise multiplication
elem_mult <- B * C
cat("\nElement-wise multiplication:\n"); print(elem_mult)
```

Program input

Output

```
[1,]   56   68   28   64
[2,]   58   72   78   86
[3,]   26   52   76   24
[4,]   90   42   40   24
Matrix C:
     [,1] [,2] [,3] [,4]
[1,]   30   82   26   36
[2,]   58   34   44   30
[3,]   64   64   78   48
[4,]   28   20   66   34

Element-wise multiplication:
     [,1] [,2] [,3] [,4]
[1,] 1680 5576  728 2304
[2,] 3364 2448 3432 2580
[3,] 1664 3328 5928 1152
[4,] 2520  840 2640  816

[Execution complete with exit code 0]
```

# i. Element-wise multiplication
elem_mult <- B * C
cat("\nElement-wise multiplication:\n"); print(elem_mult)

ii. Find the dot product of the two matrices.

```r
# Generate even numbers between 20 and 100
print("K.Nichal haas RegNo:22BCE9651")
even_nums <- seq(20, 100, by = 2)

# Create two 4x4 matrices
B <- matrix(sample(even_nums, 16, replace = TRUE), nrow = 4)
C <- matrix(sample(even_nums, 16, replace = TRUE), nrow = 4)

cat("Matrix B:\n"); print(B)
cat("Matrix C:\n"); print(C)

# i. Element-wise multiplication
elem_mult <- B * C
cat("\nElement-wise multiplication:\n"); print(elem_mult)

# ii. Dot product (matrix multiplication)
dot_product <- B %*% C
cat("\nDot product (B %*% C):\n"); print(dot_product)
```

Program input

Output

```
[2,]   46   36   50   76
[3,]   54   84   72   24
[4,]   78   36   48   92

Element-wise multiplication:
     [,1] [,2] [,3] [,4]
[1,] 1344 2088 3520 2376
[2,] 2576 3168 1700 7448
[3,] 4212 8064 4464 2016
[4,] 4524 2232 3936 9200

Dot product (B %*% C):
      [,1]  [,2]  [,3]  [,4]
[1,] 11964 12024 11688 10872
[2,] 16664 12800 13792 18984
[3,] 18684 16212 16416 19944
[4,] 18328 16084 16124 18432

[Execution complete with exit code 0]
```

# ii. Dot product (matrix multiplication)
dot_product <- B %*% C
cat("\nDot product (B %*% C):\n"); print(dot_product)

iii. Replace all values greater than 50 in the second array with 99.

```r
# Generate even numbers between 20 and 100
print("K.Nichal haas RegNo:22BCE9651")
even_nums <- seq(20, 100, by = 2)

# Create two 4x4 matrices
B <- matrix(sample(even_nums, 16, replace = TRUE), nrow = 4)
C <- matrix(sample(even_nums, 16, replace = TRUE), nrow = 4)

cat("Matrix B:\n"); print(B)
cat("Matrix C:\n"); print(C)

# i. Element-wise multiplication
elem_mult <- B * C
cat("\nElement-wise multiplication:\n"); print(elem_mult)

# ii. Dot product (matrix multiplication)
dot_product <- B %*% C
cat("\nDot product (B %*% C):\n"); print(dot_product)

#iii. Replace all values greater than 50 in the second array with 99
C[C > 50] <- 99
cat("\nMatrix C after replacing values > 50 with 99:\n"); print(C)
```

Program input

Output

```
[2,] 7896 1596 1920 2652
[3,] 5676 1040 2760 7740
[4,] 3000 5624 7600 2408

Dot product (B %*% C):
      [,1]  [,2]  [,3]  [,4]
[1,] 18360 13580 19840 21352
[2,]  9964 11652 10528 14252
[3,] 11176 13276 14760 16480
[4,] 16240 12504 17072 19136

Matrix C after replacing values > 50 with 99:
     [,1] [,2] [,3] [,4]
[1,]   32   99   20   99
[2,]   99   42   99   99
[3,]   99   40   99   99
[4,]   50   99   99   99

[Execution complete with exit code 0]
```

C[C > 50] <- 99
cat("\nMatrix C after replacing values > 50 with 99:\n"); print(C)

iv. Concatenate both arrays vertically and then split into equal parts

```r
# Generate even numbers between 20 and 100
print("K.Nichal haas RegNo:22BCE9651")
even_nums <- seq(20, 100, by = 2)

# Create two 4x4 matrices
B <- matrix(sample(even_nums, 16, replace = TRUE), nrow = 4)
C <- matrix(sample(even_nums, 16, replace = TRUE), nrow = 4)

cat("Matrix B:\n"); print(B)
cat("Matrix C:\n"); print(C)

# i. Element-wise multiplication
elem_mult <- B * C
cat("\nElement-wise multiplication:\n"); print(elem_mult)

# ii. Dot product (matrix multiplication)
dot_product <- B %*% C
cat("\nDot product (B %*% C):\n"); print(dot_product)

#iii. Replace all values greater than 50 in the second array with 99
C[C > 50] <- 99
cat("\nMatrix C after replacing values > 50 with 99:\n"); print(C)

# iv. Concatenate vertically and split into equal parts
combined <- rbind(B, C)
cat("\nCombined matrix:\n"); print(combined)
```

Program input

Output

```
Matrix C after replacing values > 50 with 99:
     [,1] [,2] [,3] [,4]
[1,]   46   99   99   99
[2,]   99   99   36   99
[3,]   26   99   99   20
[4,]   99   99   48   34

Combined matrix:
     [,1] [,2] [,3] [,4]
[1,]   84   56   24   56
[2,]   86   42   96   92
[3,]   90   60   38   84
[4,]   80   76   82   24
[5,]   46   99   99   99
[6,]   99   99   36   99
[7,]   26   99   99   20
[8,]   99   99   48   34

[Execution complete with exit code 0]
```

# iv. Concatenate vertically and split into equal parts
combined <- rbind(B, C)
cat("\nCombined matrix:\n"); print(combined)

3. Create a structured NumPy array to store employee records with attributes: Employee_ID (integer), Name (string, max length 15), Department (string, max length 10), and Salary (float).

```
print("K.Nichal haas RegNo:22BCE9651")
#3. Create a structured NumPy array to store employee records with attributes: Employee_ID (integer), Name (string, max length 15), Dep
# Create structured employee data frame
employees <- data.frame(
  Employee_ID = c(101, 102, 103, 104),
  Name = c("Alice", "Bob", "Charlie", "David"),
  Department = c("HR", "IT", "Finance", "IT_Manager"),
  Salary = c(70000, 80000, 65000, 90000)
)
cat("Original Employee Data:\n")
print(employees)
```

Program input

Output

```
[1] "K.Nichal haas RegNo:22BCE9651"
Original Employee Data:
  Employee_ID    Name Department Salary
1         101   Alice         HR  70000
2         102     Bob         IT  80000
3         103 Charlie    Finance  65000
4         104   David IT_Manager  90000

[Execution complete with exit code 0]
```

```
# Create structured employee data frame
employees <- data.frame(
  Employee_ID = c(101, 102, 103, 104),
  Name = c("Alice", "Bob", "Charlie", "David"),
  Department = c("HR", "IT", "Finance", "IT_Manager"),
  Salary = c(70000, 80000, 65000, 90000)
)
cat("Original Employee Data:\n")
print(employees)
```

i. Add a new employee record to the array.

```
print("K.Nichal haas RegNo:22BCE9651")
#3. Create a structured NumPy array to store employee records with attributes: Employee_ID (integer), Name (string, max length 15), Dep
# Create structured employee data frame
employees <- data.frame(
  Employee_ID = c(101, 102, 103, 104),
  Name = c("Alice", "Bob", "Charlie", "David"),
  Department = c("HR", "IT", "Finance", "IT_Manager"),
  Salary = c(70000, 80000, 65000, 90000)
)
cat("Original Employee Data:\n")
print(employees)

# i. Add new employee record
new_emp <- data.frame(Employee_ID = 105, Name = "Eve", Department = "Manager", Salary = 95000)
employees <- rbind(employees, new_emp)
cat("\nAfter adding new employee:\n")
print(employees)
```

Program input

Output

```
[1] "K.Nichal haas RegNo:22BCE9651"
Original Employee Data:
  Employee_ID    Name Department Salary
1         101   Alice         HR  70000
2         102     Bob         IT  80000
3         103 Charlie    Finance  65000
4         104   David IT_Manager  90000

After adding new employee:
  Employee_ID    Name Department Salary
1         101   Alice         HR  70000
2         102     Bob         IT  80000
3         103 Charlie    Finance  65000
4         104   David IT_Manager  90000
5         105     Eve    Manager  95000

[Execution complete with exit code 0]
```

```
# i. Add new employee record
new_emp <- data.frame(Employee_ID = 105, Name = "Eve", Department = "Manager", Salary = 95000)
employees <- rbind(employees, new_emp)
cat("\nAfter adding new employee:\n")
print(employees)
```

ii. Extract all employees whose salary is above 75,000.

```
print("K.Nichal haas RegNo:22BCE9651")
#3. Create a structured NumPy array to store employee records with attributes: Employee_ID (integer), Name (string, max length 15), Dep
# Create structured employee data frame
employees <- data.frame(
  Employee_ID = c(101, 102, 103, 104),
  Name = c("Alice", "Bob", "Charlie", "David"),
  Department = c("HR", "IT", "Finance", "IT_Manager"),
  Salary = c(70000, 80000, 65000, 90000)
)
cat("Original Employee Data:\n")
print(employees)

# i. Add new employee record
new_emp <- data.frame(Employee_ID = 105, Name = "Eve", Department = "Manager", Salary = 95000)
employees <- rbind(employees, new_emp)
cat("\nAfter adding new employee:\n")
print(employees)

# ii. Extract employees with salary > 75,000
high_salary <- subset(employees, Salary > 75000)
cat("\nEmployees with Salary > 75,000:\n")
print(high_salary)
```

Program input

Output

```
2         102     Bob         IT  80000
3         103 Charlie    Finance  65000
4         104   David IT_Manager  90000

After adding new employee:
  Employee_ID    Name Department Salary
1         101   Alice         HR  70000
2         102     Bob         IT  80000
3         103 Charlie    Finance  65000
4         104   David IT_Manager  90000
5         105     Eve    Manager  95000

Employees with Salary > 75,000:
  Employee_ID  Name Department Salary
2         102   Bob         IT  80000
4         104 David IT_Manager  90000
5         105   Eve    Manager  95000

[Execution complete with exit code 0]
```

high_salary <- subset(employees, Salary > 75000)
cat("\nEmployees with Salary > 75,000:\n")
print(high_salary)

iii. Sort the array based on Employee_ID in ascending order.

```
print("K.Nichal haas RegNo:22BCE9651")
#3. Create a structured NumPy array to store employee records with attributes: Employee_ID (integer), Name (string, max length 15), Dep
# Create structured employee data frame
employees <- data.frame(
  Employee_ID = c(101, 102, 103, 104),
  Name = c("Alice", "Bob", "Charlie", "David"),
  Department = c("HR", "IT", "Finance", "IT_Manager"),
  Salary = c(70000, 80000, 65000, 90000)
)
cat("Original Employee Data:\n")
print(employees)

# i. Add new employee record
new_emp <- data.frame(Employee_ID = 105, Name = "Eve", Department = "Manager", Salary = 95000)
employees <- rbind(employees, new_emp)
cat("\nAfter adding new employee:\n")
print(employees)

# ii. Extract employees with salary > 75,000
high_salary <- subset(employees, Salary > 75000)
cat("\nEmployees with Salary > 75,000:\n")
print(high_salary)

# iii. Sort by Employee_ID (ascending)
sorted_emp <- employees[order(employees$Employee_ID), ]
cat("\nSorted by Employee_ID:\n")
print(sorted_emp)
```

Program input

Output

```
3         103 Charlie    Finance  65000
4         104   David IT_Manager  90000
5         105     Eve    Manager  95000

Employees with Salary > 75,000:
  Employee_ID  Name Department Salary
2         102   Bob         IT  80000
4         104 David IT_Manager  90000
5         105   Eve    Manager  95000

Sorted by Employee_ID:
  Employee_ID    Name Department Salary
1         101   Alice         HR  70000
2         102     Bob         IT  80000
3         103 Charlie    Finance  65000
4         104   David IT_Manager  90000
5         105     Eve    Manager  95000

[Execution complete with exit code 0]
```

# iii. Sort by Employee_ID (ascending)
sorted_emp <- employees[order(employees$Employee_ID),]
cat("\nSorted by Employee_ID:\n")
print(sorted_emp)

iv. Increase the salary of employees in the ‘IT’ department by 10%.

```
# Create structured employee data frame
employees <- data.frame(
  Employee_ID = c(101, 102, 103, 104),
  Name = c("Alice", "Bob", "Charlie", "David"),
  Department = c("HR", "IT", "Finance", "IT_Manager"),
  Salary = c(70000, 80000, 65000, 90000)
)
cat("Original Employee Data:\n")
print(employees)

# i. Add new employee record
new_emp <- data.frame(Employee_ID = 105, Name = "Eve", Department = "Manager", Salary = 95000)
employees <- rbind(employees, new_emp)
cat("\nAfter adding new employee:\n")
print(employees)

# ii. Extract employees with salary > 75,000
high_salary <- subset(employees, Salary > 75000)
cat("\nEmployees with Salary > 75,000:\n")
print(high_salary)

# iii. Sort by Employee_ID (ascending)
sorted_emp <- employees[order(employees$Employee_ID), ]
cat("\nSorted by Employee_ID:\n")
print(sorted_emp)

# iv. Increase salary of IT department employees by 10%
employees$Salary[employees$Department == "IT"] <-
  employees$Salary[employees$Department == "IT"] * 1.10
cat("\nAfter 10% raise for IT department:\n")
print(employees)
```

Program input

Output

```
5         105   Eve    Manager  95000

Sorted by Employee_ID:
  Employee_ID    Name Department Salary
1         101   Alice         HR  70000
2         102     Bob         IT  80000
3         103 Charlie    Finance  65000
4         104   David IT_Manager  90000
5         105     Eve    Manager  95000

After 10% raise for IT department:
  Employee_ID    Name Department Salary
1         101   Alice         HR  70000
2         102     Bob         IT  88000
3         103 Charlie    Finance  65000
4         104   David IT_Manager  90000
5         105     Eve    Manager  95000

[Execution complete with exit code 0]
```

iv. Increase salary of IT department employees by 10%
employees$Salary[employees$Department == "IT"] <-
  employees$Salary[employees$Department == "IT"] * 1.10
cat("\nAfter 10% raise for IT department:\n")
print(employees)

v. Retrieve the names of employees who have ‘Manager’ in their department.

```
  Salary = c(70000, 80000, 65000, 90000)
)
cat("Original Employee Data:\n")
print(employees)

# i. Add new employee record
new_emp <- data.frame(Employee_ID = 105, Name = "Eve", Department = "Manager", Salary = 95000)
employees <- rbind(employees, new_emp)
cat("\nAfter adding new employee:\n")
print(employees)

# ii. Extract employees with salary > 75,000
high_salary <- subset(employees, Salary > 75000)
cat("\nEmployees with Salary > 75,000:\n")
print(high_salary)

# iii. Sort by Employee_ID (ascending)
sorted_emp <- employees[order(employees$Employee_ID), ]
cat("\nSorted by Employee_ID:\n")
print(sorted_emp)

# iv. Increase salary of IT department employees by 10%
employees$Salary[employees$Department == "IT"] <-
  employees$Salary[employees$Department == "IT"] * 1.10
cat("\nAfter 10% raise for IT department:\n")
print(employees)

# v. Retrieve names of employees who have 'Manager' in their department
manager_names <- employees$Name[grepl("Manager", employees$Department)]
cat("\nEmployees with 'Manager' in Department:\n")
print(manager_names)
```

Program input

Output

```
  Employee_ID    Name Department Salary
1         101   Alice         HR  70000
2         102     Bob         IT  80000
3         103 Charlie    Finance  65000
4         104   David IT_Manager  90000
5         105     Eve    Manager  95000

After 10% raise for IT department:
  Employee_ID    Name Department Salary
1         101   Alice         HR  70000
2         102     Bob         IT  88000
3         103 Charlie    Finance  65000
4         104   David IT_Manager  90000
5         105     Eve    Manager  95000

Employees with 'Manager' in Department:
[1] "David" "Eve"

[Execution complete with exit code 0]
```

# v. Retrieve names of employees who have 'Manager' in their department
manager_names <- employees$Name[grepl("Manager", employees$Department)]
cat("\nEmployees with 'Manager' in Department:\n")
print(manager_names)