Types of Data Structures in R

(Type & Dimensionality)

Roman Urdu Study Notes

Data Structure kya hoti hai?

Data Structure ek tareeqa hota hai jisme R language data ko **store, organise aur analyse** karti hai. R me data structures ka selection **data type** aur **dimensions** par depend karta hai.

Classification of Data Structures

Neeche table image ke mutabiq data structures ko classify karta hai:

Data Structure	Type	Dimensionality
Atomic Vector	Homogeneous	1
List	Heterogeneous	1
Matrix	Homogeneous	2
Array	Homogeneous	n
Factor	Homogeneous	1
Data Frame	Heterogeneous	2

Atomic Vectors

Definition

Atomic Vector R ka basic data structure hai jo **sirf aik hi type** ka data store karta hai.

Explanation

Vector me sirf numbers, characters ya logical values hoti hain. Mixed data allowed nahi hota.

R Examples

```
marks <- c(60, 70, 80, 90)
names <- c("Ali", "Sara", "Ahmed")
status <- c(TRUE, FALSE, TRUE)
ages <- c(18L, 20L, 22L)
```

```
prices <- c(10.5, 20.75, 30.00)
```

List

Definition

List ek aisa data structure hai jo **different types** ka data aik sath store karta hai.

Explanation

List ke andar vector, number, character, data frame ya even doosri list ho sakti hai.

R Examples

```
student <- list("Ali", 21, TRUE)
emp <- list(name="Sara", age=25, salary=50000)
data1 <- list(marks=c(80,85,90))
nested <- list(a=1, b=list(x=10, y=20))
df <- data.frame(id=1:3, score=c(70,80,90))
list_with_df <- list(info=df)
```

Matrix

Definition

Matrix ek **2-dimensional** data structure hai jo same type ka data rows aur columns me store karta hai.

Explanation

Matrix me sirf homogeneous data hota hai aur rows × columns ka structure hota hai.

R Examples

```
m1 <- matrix(c(1,2,3,4), nrow=2)
m2 <- matrix(1:6, nrow=2, byrow=TRUE)
m3 <- matrix(c("A","B","C","D"), nrow=2)
m4 <- matrix(10:21, nrow=4, ncol=3)
m5 <- diag(3)
```

Array

Definition

Array matrix ka extended form hai jo **2 se zyada dimensions** me data store karta hai.

Explanation

Array multi-dimensional hota hai jaise 3D ya 4D data.

R Examples

```
a1 <- array(1:12, dim=c(2,3,2))
a2 <- array(1:8, dim=c(2,2,2))
a3 <- array(runif(10), dim=c(5,2))
a4 <- array(c("A","B","C","D"), dim=c(2,2))
a5 <- array(c(TRUE,FALSE), dim=c(1,2,1))
```

Factor

Definition

Factor categorical data ko represent karta hai jisme values **levels** ki form me hoti hain.

Explanation

Factor zyada tar gender, status aur categories ke liye use hota hai.

R Examples

```
gender <- factor(c("Male","Female","Male"))
edu <- factor(c("BS","MS","PhD"))
rating <- factor(c("Low","Medium","High"),
                 levels=c("Low","Medium","High"),
                 ordered=TRUE)
status <- factor(c("Pass","Fail","Pass"))
dept <- factor(c("HR","IT","Finance"))
```

Data Frame

Definition

Data Frame ek **2-dimensional** tabular structure hai jisme columns different types ke ho sakte hain.

Explanation

Rows observations hoti hain aur columns variables. R me data analysis ke liye sab se zyada use hota hai.

R Examples

```
df1 <- data.frame(Name=c("Ali","Sara","Ahmed"),
                  Age=c(20,22,21))

df2 <- data.frame(ID=1:3,
                  Marks=c(80,85,90),
                  Pass=TRUE)

df3 <- data.frame(Gender=factor(c("Male","Female")),
                  Score=c(75,88))

df4 <- data.frame(RollNo=1:4,
                  Grade=c("A","B","A","C"))

df5 <- data.frame(Name=c("Ali","Sara"),
                  Salary=c(50000,60000),
                  Permanent=c(TRUE,TRUE))
```

Quick Summary

- Vector → 1D, same type
- List → 1D, mixed type
- Matrix → 2D, same type
- Array → nD, same type
- Factor → categorical data

- Data Frame → 2D, mixed type