

# Data Independence Scenarios



The ability to modify a schema definition in one level without affecting a schema definition in the next higher level is called data independence.

There are two levels of data independence:

i) Physical Data Independence

ii) Logical Data Independence

Physical data independence: Physical data independence is the ability to modify the physical schema without causing application programs to be rewritten.

Logical data independence: Logical data independence is the ability to modify the logical schema without causing application programs to be rewritten. Modifications at the logical level are necessary whenever the logical structure of the database is altered.

Logical data independence is more difficult to achieve than physical data independence since application programs are heavily dependent on the logical structure of the data they access. EXPLAIN WITH SCENARIOS



## Data Independence Explanation with Scenarios

**Data independence** refers to the ability to modify the schema at one level of a database system without affecting the schema at the next higher level. It ensures that changes made to the structure of data do not impact the applications that access the data.

There are two types of data independence:

1. **Physical Data Independence**
2. **Logical Data Independence**

### 1. Physical Data Independence

#### Definition:

Physical data independence is the ability to change the **physical schema** (how data is stored on the disk) without requiring changes to the **logical schema** (how data is structured and organized) or the application programs.

#### Scenario:

Imagine a company's database stores its employee records on a server. Currently, the data is stored on a hard disk (HDD). Due to performance issues, the database administrators decide to move this data to a faster solid-state drive (SSD) or even distribute it across multiple servers for faster access.

- **Change:** The storage technology or the internal structure for storing data on the disk (e.g., creating indexes, moving to a new storage system like SSD).
- **Impact:** Since this change only affects the physical layer, the **logical structure of the data** (such as the organization of employee records) and the **application programs** that access the employee data (like an HR system) will **remain unaffected**.

**Physical data independence** allows for changes at the physical storage level without requiring changes to the application logic.

## 2. Logical Data Independence

### Definition:

Logical data independence is the ability to change the **logical schema** (structure of the database, such as adding or removing fields) without affecting the **external schema** (views or how data is presented to users) or application programs.

### Scenario:

Suppose the company decides to modify the database by adding a new attribute, such as "Emergency Contact" for each employee, or by merging two tables, like "Employee" and "Department", to optimize data access.

- **Change:** The logical structure of the database is altered by adding or removing fields, merging tables, or changing relationships between entities.
- **Impact:** As long as the **views** (external schema) that the applications and users access remain unchanged, the application programs (e.g., HR system) do not need to be modified. For example, if a payroll system was using a view of the employee data that doesn't involve "Emergency Contact," the system won't need to be changed when that new field is added.

**Logical data independence** is more challenging to achieve because application programs often rely heavily on the logical structure of the data (like the layout of tables and relationships). Any change to this structure can potentially break or require modification of the application logic.

### Key Difference:

- **Physical Data Independence** deals with changes in how data is **stored** and optimized, while maintaining the same logical structure.
- **Logical Data Independence** deals with changes in the **logical structure** or schema, without impacting how the data is presented to the users or application programs. This is harder to achieve because of the deeper dependence on the logical structure of data.

### Summary of Scenarios:

1. **Physical Data Independence:** Changing the physical storage method (e.g., from HDD to SSD) without needing to modify the application code.
2. **Logical Data Independence:** Adding a new attribute to a table or merging tables without affecting how users or applications view the data.

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