

Entity-Relationship Diagram: University

1. Complex, Multivalued, and Derived Attributes

- **Complex Attributes:**
The entity **PERSON** includes the attributes **NAME** and **LAST NAME**, which can be considered composite attributes.
- **Multivalued Attributes:**
The entity **PERSON** has the attribute **PHONE**, meaning a person can have multiple contact numbers.
- **Derived Attributes:**
The entity **STUDENT** has the attribute **AGE (DV)**, which can be calculated from **DATE_OF_BIRTH**.

2. Weak Entities

- **ENROLLMENT** is a weak entity because it depends on both **STUDENT** and **COURSE** for its existence. Its primary key is based on these two entities.

3. Cardinalities

- **One-to-One (1:1):**
No explicit 1:1 relationship is specified in the diagram.
- **One-to-Many (1:N):**
 - A **PROFESSOR** manages a single **DEPARTMENT**, and each **DEPARTMENT** is managed by only one **PROFESSOR**.
 - A **PROFESSOR** teaches multiple **COURSES**, but each **COURSE** is taught by only one **PROFESSOR**.
- **Many-to-Many (M:N):**
The **ENROLLMENT** relationship indicates that a **STUDENT** can enroll in multiple **COURSES**, and a **COURSE** can have multiple enrolled **STUDENTS**.

4. Relationships with Attributes

- **ENROLLMENT** has attributes **ENROLLMENT_DATE** and **FINAL_GRADE**, which provide additional information about the student's course registration.

5. Roles in Recursive Relationships

- The **REPORTS TO** relationship among **PROFESSORS** establishes a hierarchy where one professor can report to another.

6. Generalization / Specialization

- The entity **PERSON** specializes into **PROFESSOR** and **STUDENT**.
- This specialization is **disjoint**, meaning a person can be either a **STUDENT** or a **PROFESSOR**, but not both at the same time.
- The specialization is **total**, meaning that every **PERSON** must be classified as either a **STUDENT** or a **PROFESSOR**.

7. Disjoint / Overlapping Specialization & Total / Partial Participation

- **Disjoint:** As mentioned, a **PERSON** can only be either a **STUDENT** or a **PROFESSOR**.
- **Total Participation:**
 - Every **STUDENT** must be enrolled in at least one **COURSE**.
 - Every **COURSE** must have enrolled students.
- **Partial Participation:**
 - Not all **PROFESSORS** are required to teach courses.
 - Not all **STUDENTS** must report to a **PROFESSOR**.

Conclusion

This entity-relationship diagram clearly represents the structure of a university, with well-defined attributes, appropriate cardinalities, and entity specialization. The visual representation makes it easier to understand how data is organized and related within an academic environment.