CM1603 - Database Systems

Week 02 | Entity Relationship Diagrams – Part 1

Dileeka Alwis – Lecturer / Level Coordinator,

Department of Computing, IIT

ROBERT GORDON UNIVERSITY ABERDEEN
TEF Gold
INFORMATICS INSTITUTE OF TECHNOLOGY

Learning Outcomes

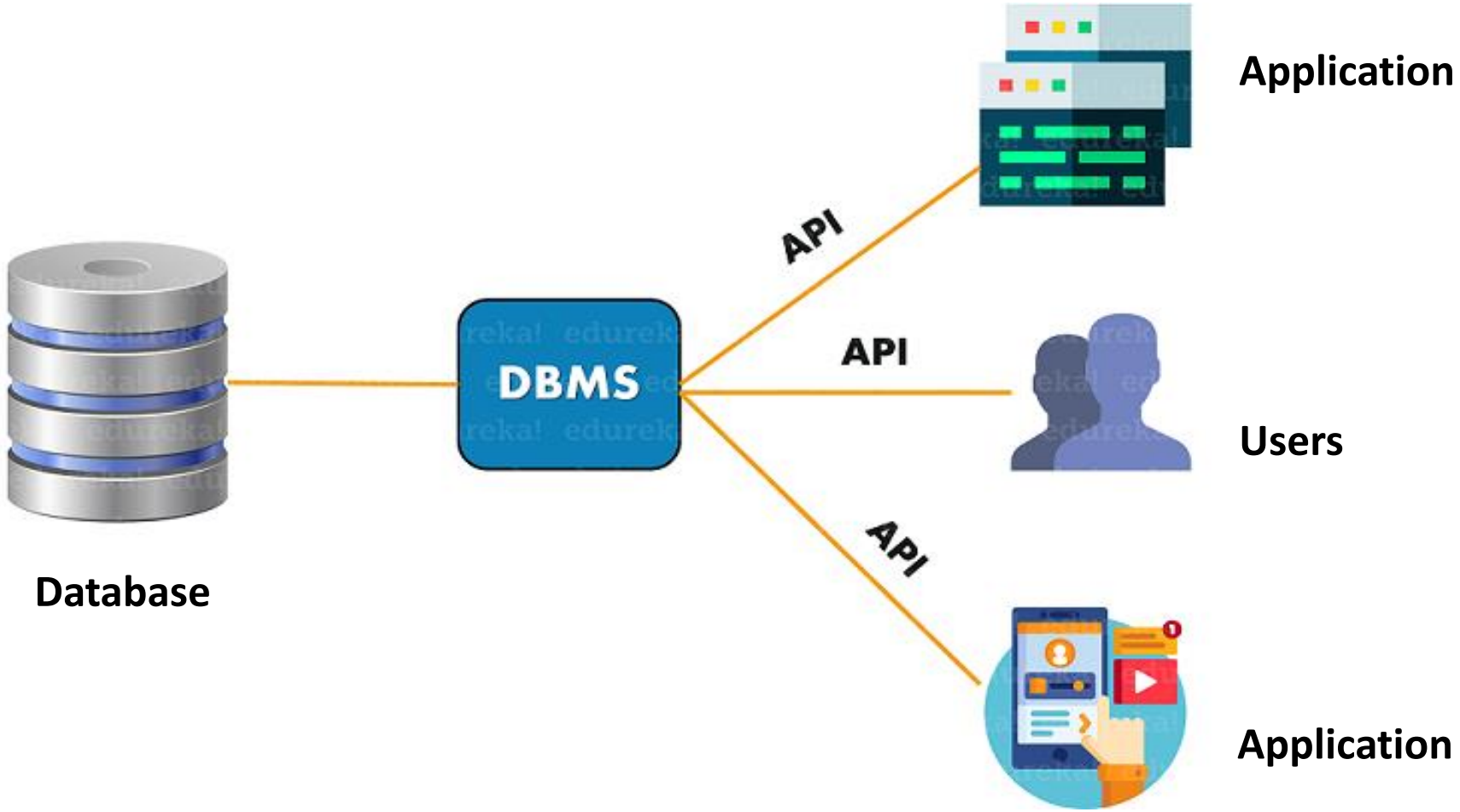
- Covers LO1 for Module - Describe and Understand underlying theory and principles of relational database management systems (RDBMS).

- On completion of this lecture, students are expected to be able to:
  - Identify steps for database designing
  - Identify entities , attributes and relationships
  - To identify cardinality ratios.

Lesson Outline

- Database System
- Database Design
  - 3 phrases of DB design
  - 6 steps of DB designing
- Introduction to Entity Relationship Diagram
  - Entity
  - Attribute
  - Relationship

Database System



Database System

- **Database (DB)**
  - Shared collection of logically related data (& description)
  - Designed to meet information needs of an organization

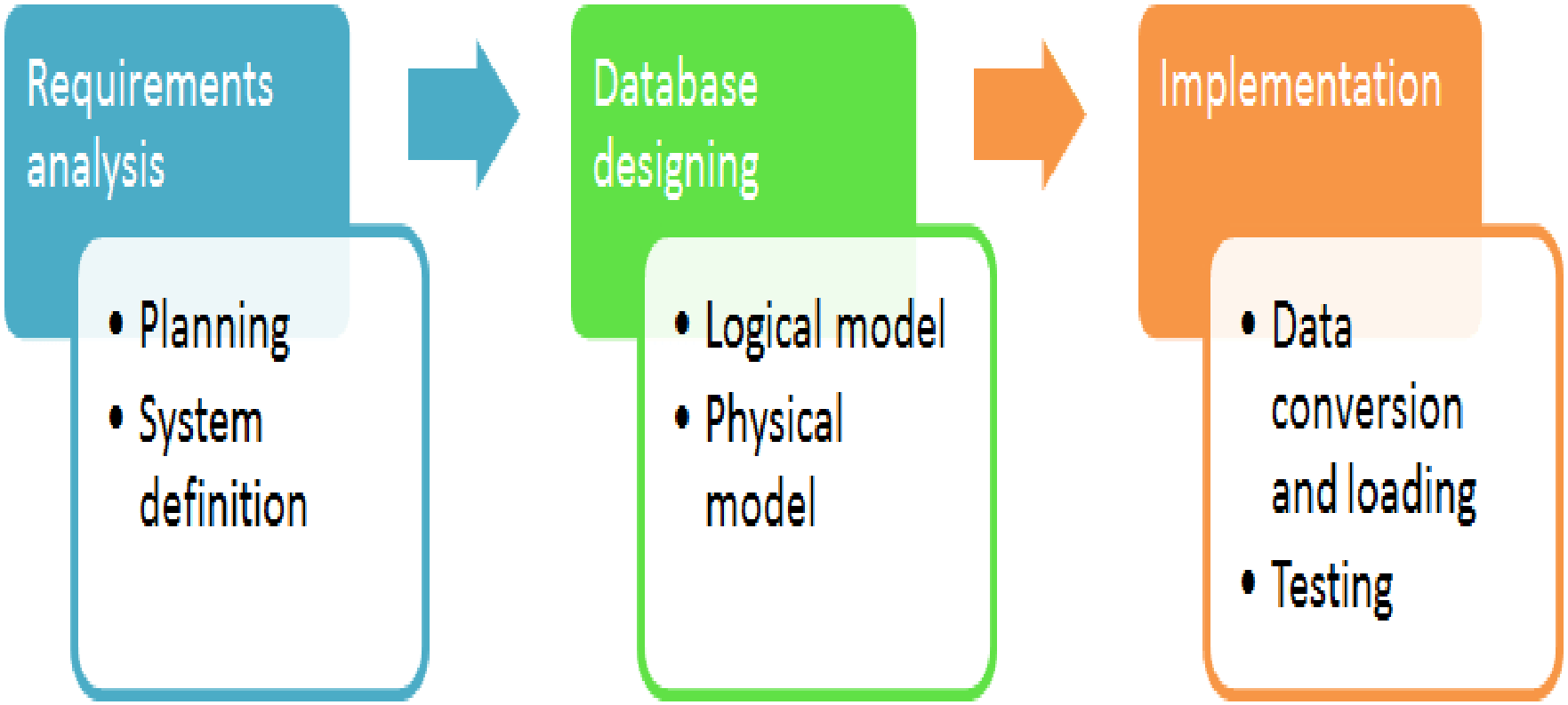
- **Database Management Systems (DBMS)**
  - Software enables users to define, create maintain the DB
  - Provides controlled access to this DB

- **Database Application**
  - Computer program that interacts with DB by issuing a request (SQL statement) to the DBMS.

  e.g. online retailing system, booking system, stock management system, electronic medical record, etc.

DATABASE SYSTEM = DB + DBMS + DB APPLICATIONS

Database Design



3 Phases of the Database Design

- **Conceptual database design**
  - Construct a model of the data used in a firm, independent of *all* physical considerations.

- **Logical database design**
  - Construct a model of the data used in a firm based on specific data organisation.
    (eg: relational schema)
  - It is independent of DBMS & other physical considerations.

- **Physical database design**
  - Produce description of the DB implementation for DBMS
  - Create base relations, file organizations and indexes
  - Create any integrity constraints and security measures

6 main steps of DB Designing

1. Requirements Analysis
   - *What does the user want?*

2. Conceptual Database Design (Entity Relationship Diagram)
   - *Defining the entities, attributes, and the relationships*

3. Logical Database Design (Map ER to Relational Schema)

4. Schema Refinement (fine tune)

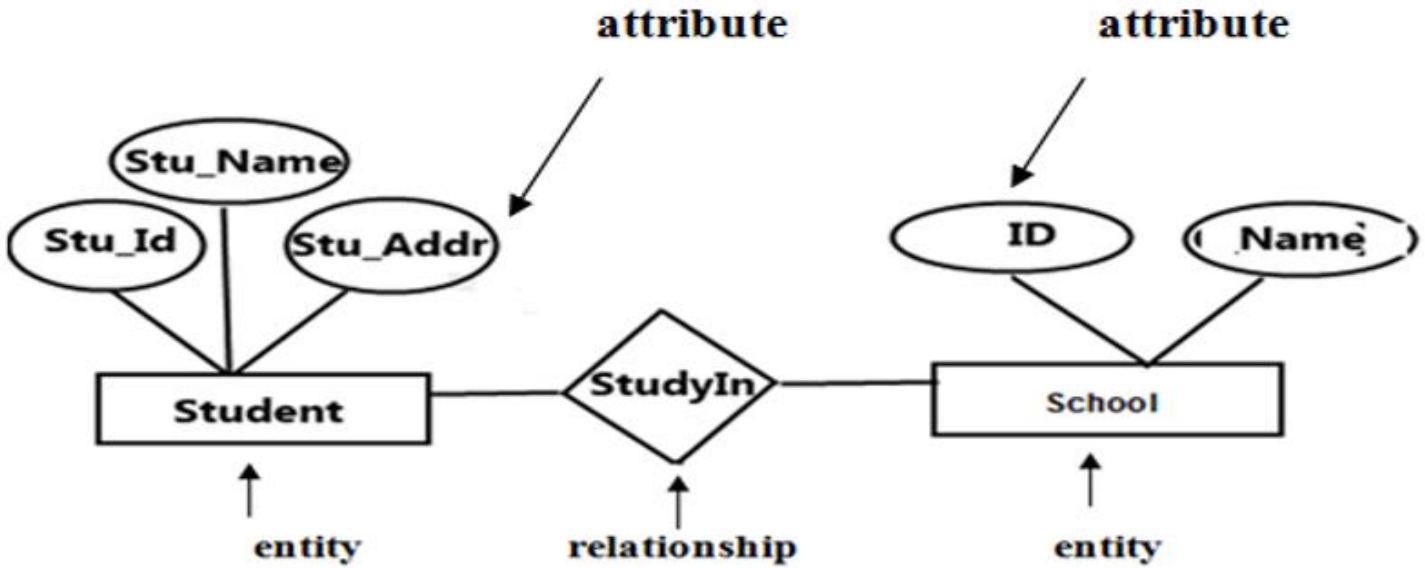
5. Physical Database Design
   - *Implementation of the design using a Database Management System*

6. Security Design
   - *Implement Controls to ensure security and integrity*

Conceptual Design

- The information gathered in the requirements analysis phase is used to create a **high-level description of the data** in a conceptual data model or semantic data model.

Eg. Entity Relationship Mode



Entity Relationship Diagram (ERD)

- Represent the real-world problem in the pictorial form to make it easy for the stakeholders to understand.
- Uses the concept of entities, relationships and attributes.
- Different entities are identified with their characteristics (attributes) and entities are related using relationships.
- This model is good to design a database, which can then be turned into tables in relational model.

ERD Scenario (Problem Statement)

Your university is planning to create a new database to save the details related to academic transactions. The database needs to have details about students, programs, modules, lecturers etc.

A student can enroll with only one program and each program has multiple modules. One lecturer deliver many modules and each module can be delivered by several lecturers. Students are required to attend lectures and the system needs to keep records about student attendance for each lecture and the attendance percentage for each module per student. A student is allowed to repeat a modules for three times while the attempt and marks should be recorded for each exam. The database needs to have details about the guardian of each student in order to contact them if required.

Entity

- A group of objects with the same properties, which are identified as having an independent existence.

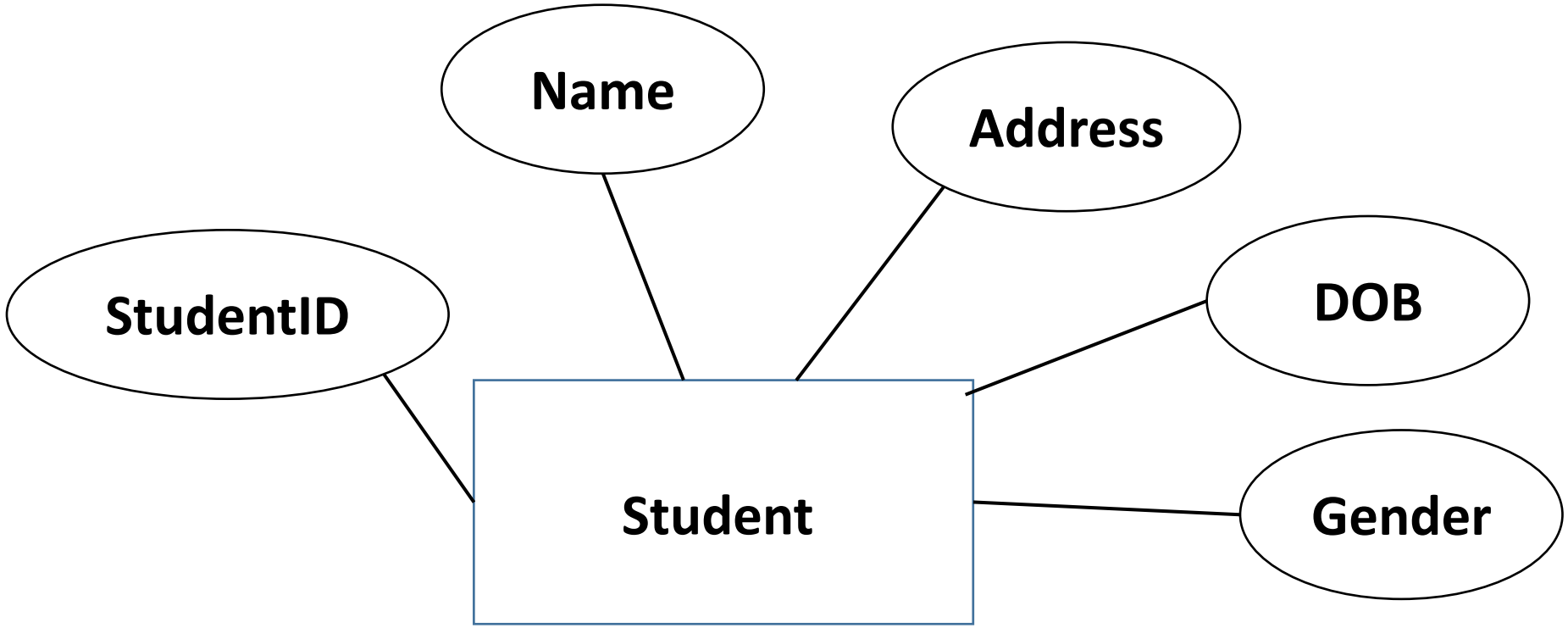
- May be an object with,
  - Physical existence (eg: Student, Lecturer, Faculty)
  - Conceptual existence (eg: Course, Subject, Marks)

Student

- **Entity occurrence**
  - Uniquely identifiable object of an entity type.
  - Eg: John, Ann, Kate, Peter, etc. are Students

Attributes

- Each entity has attributes.
- Properties that describe it.



Types of Attributes

- Several types of attributes occur in the ER model:
  - Simple attribute
  - Composite attribute
  - Single valued attribute
  - Multi valued attribute
  - Stored attribute
  - Derived attribute

Simple (Atomic) Attributes

- Attributes that are not divisible into smaller components.

- Eg:

  StudentID – 1001

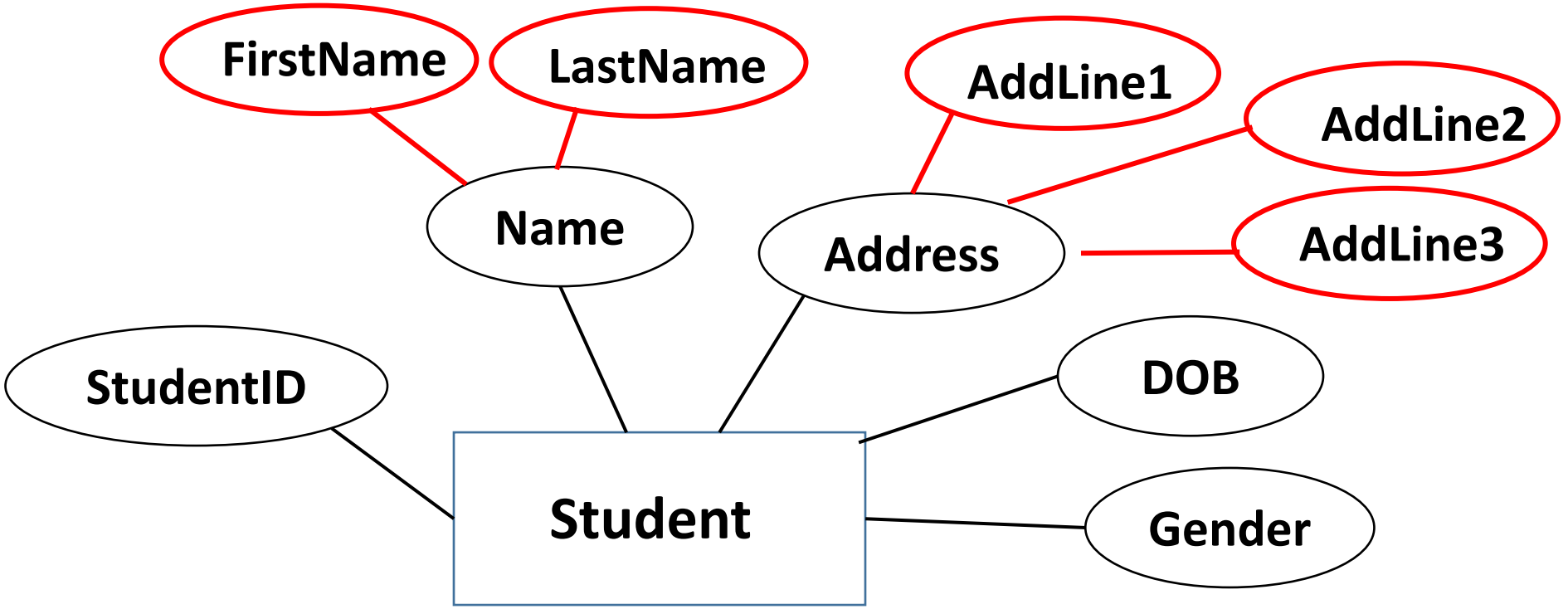
  FirstName – John

  Gender – M

  Age - 25

Composite Attributes

- Attributes can be divided into smaller subparts.
- The value of a composite attribute is the concatenation of the values of its component simple attributes.



Single Valued Attributes

- An attribute that has a single value for a particular entity.

- Eg:

  StudentID – 1001

  FirstName – John

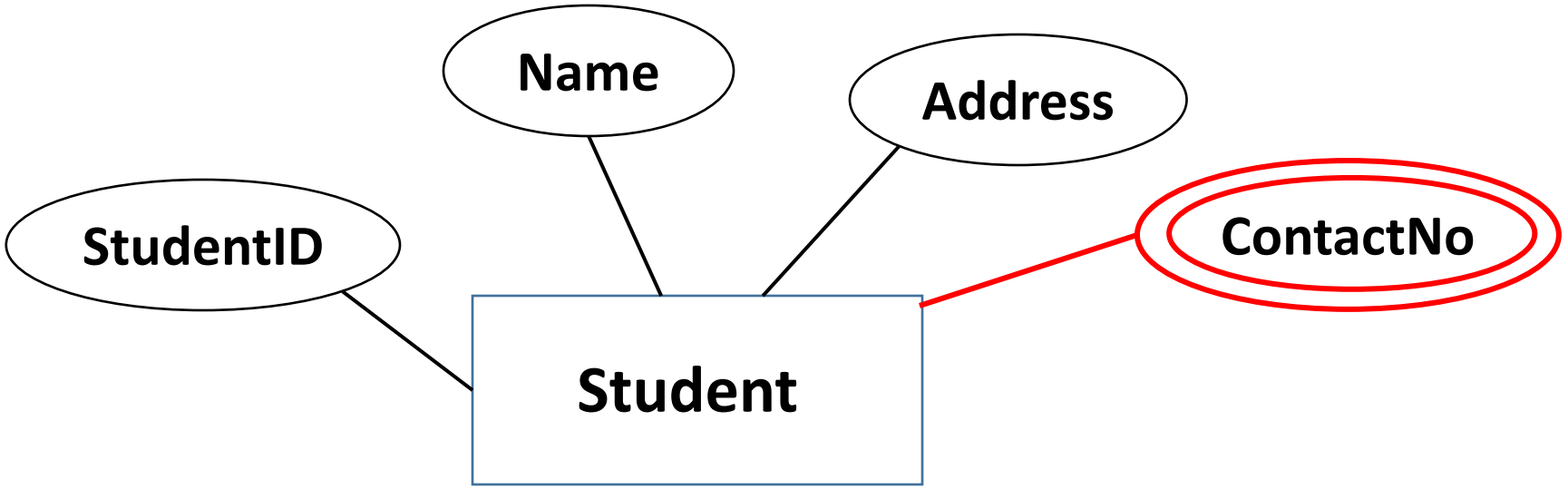
  Gender – M

  Age - 25

  DOB – 12/10/1994

Multi Valued Attributes

- An attribute that has more than one value for a particular entity.
- Eg:
  - ContactNo – 0115446000, 0777885522
  - Qualification – BSc(CS), MSc (IT), Dip(Eng)
  - Hobby – Reading, Swimming, Playing etc



Stored Attributes

- An attribute whose value is fixed and cannot change.

- Eg:

  Gender – F

  DOB – 12/10/1994

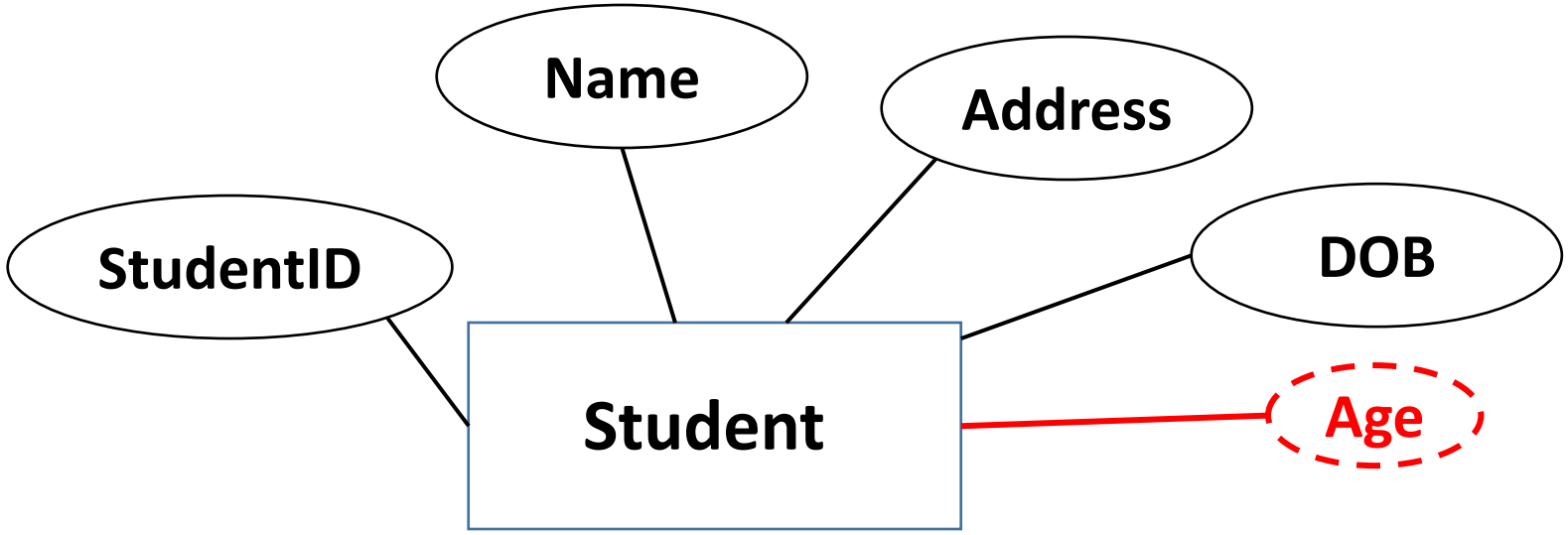
  NIC – 945124578V

  What about Student Age?

Derived Attributes

- An attribute whose value can be derived from another attribute.

- Eg: Age – 25 (derived from DOB or NIC)



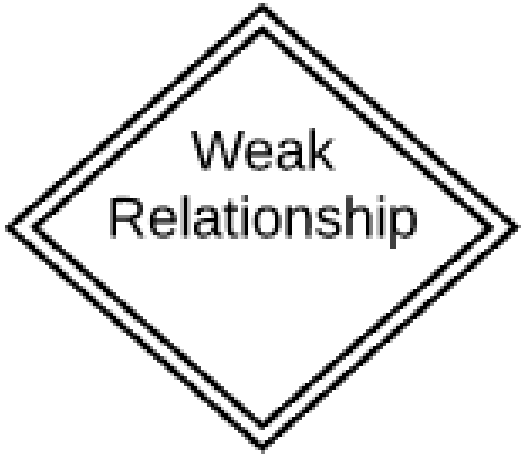
Entity Type

- Strong Entity
  - Exists independently of other types of entities.
  - Has its own primary key.

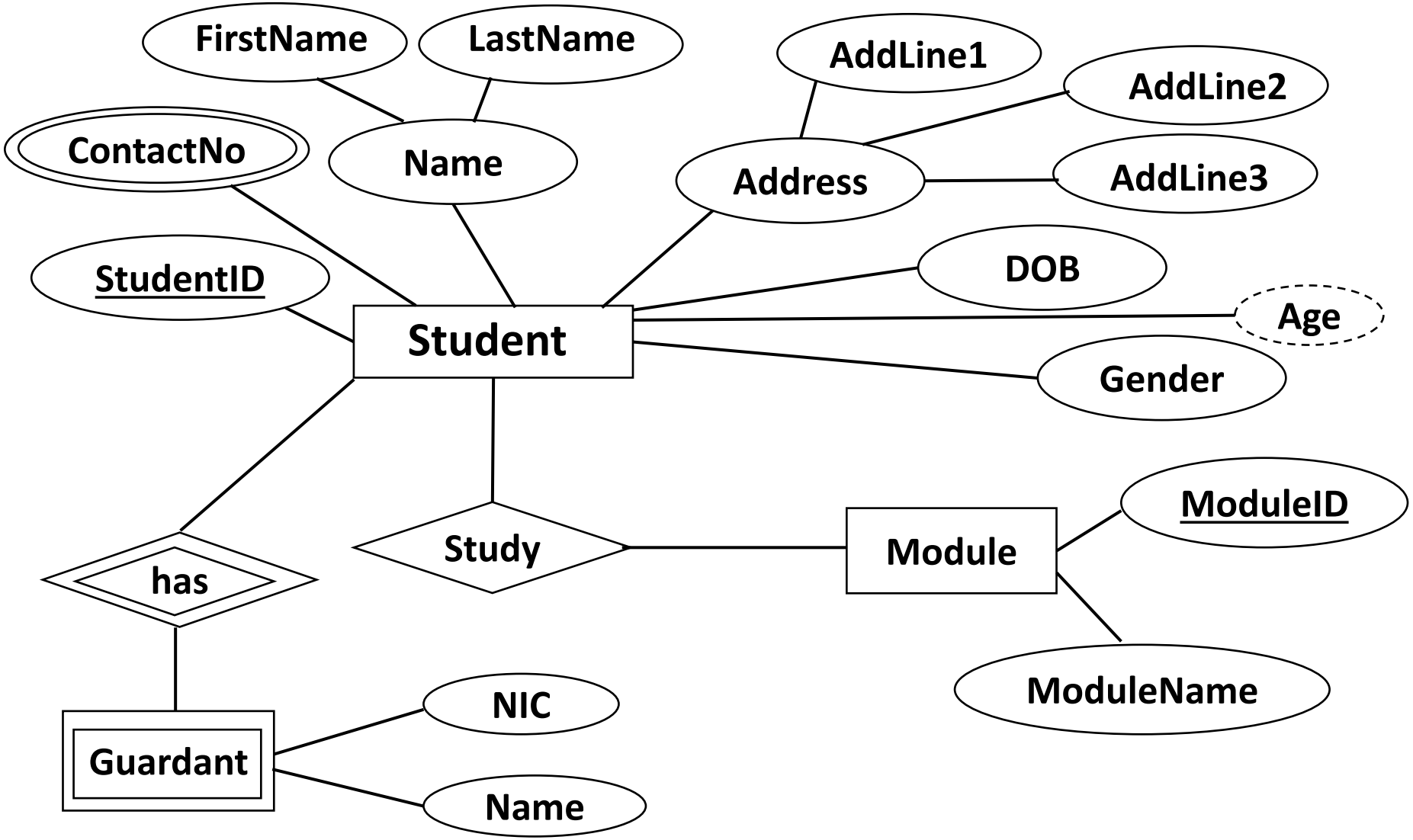
- Weak Entity
  - Dependant on a strong entity.
  - Cannot exist on its own.
  - Does not have its own primary key.

Relationships

- An association (connection) between two or more entities.
- An entity cannot exist isolation.
- They always exist in relationships.

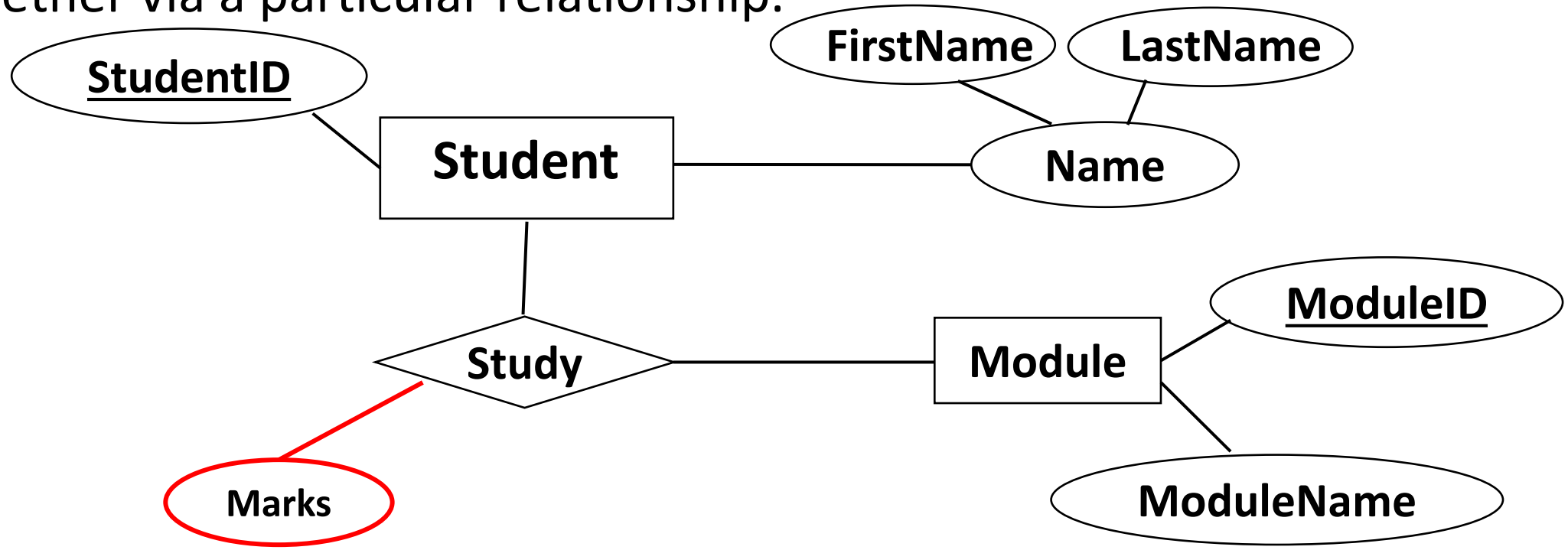


ERD Example


FirstName
LastName
AddLine1
AddLine2
ContactNo
Name
Address
AddLine3
StudentID
DOB
Age
Student
Gender
ModuleID
Study
Module
has
ModuleName
NIC
Guardant
Name

Relationship Attribute

- Attributes in the relationship.
- Relationship attributes may appear when two or more entities link together via a particular relationship.



Thank you

Contact: dileeka.a@iit.ac.lk

ROBERT GORDON UNIVERSITY ABERDEEN
TEF Gold
INFORMATICS INSTITUTE OF TECHNOLOGY