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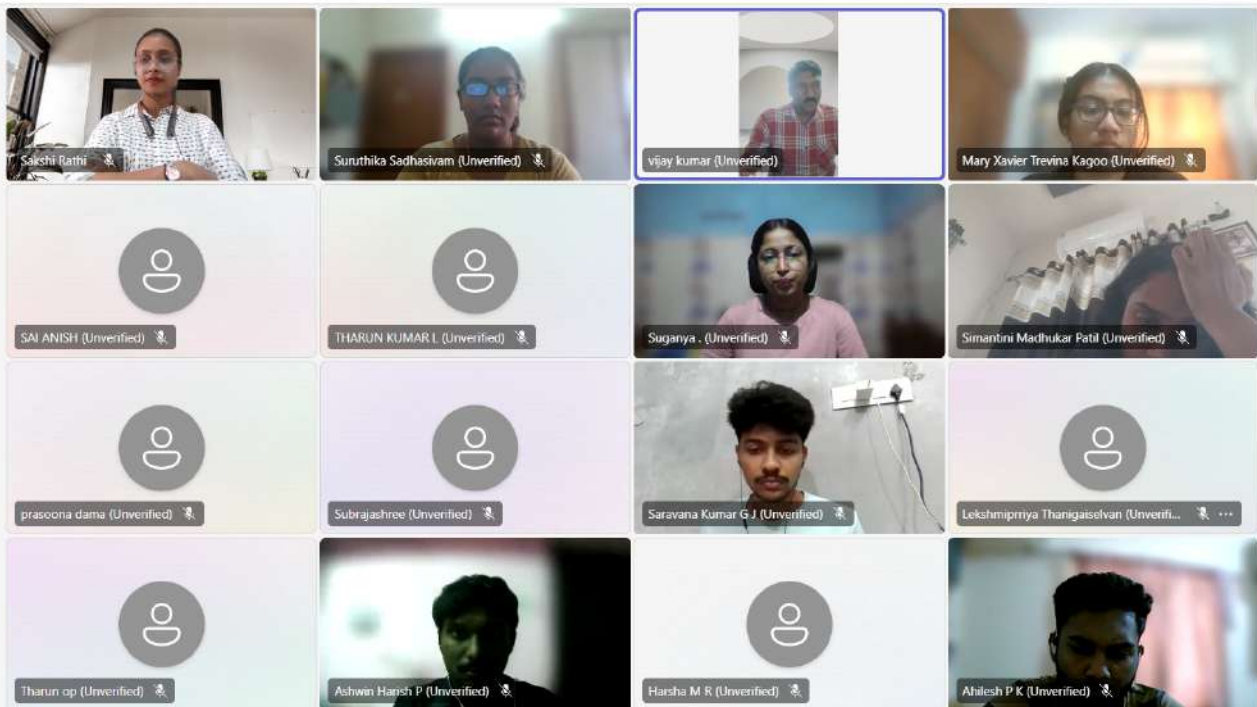
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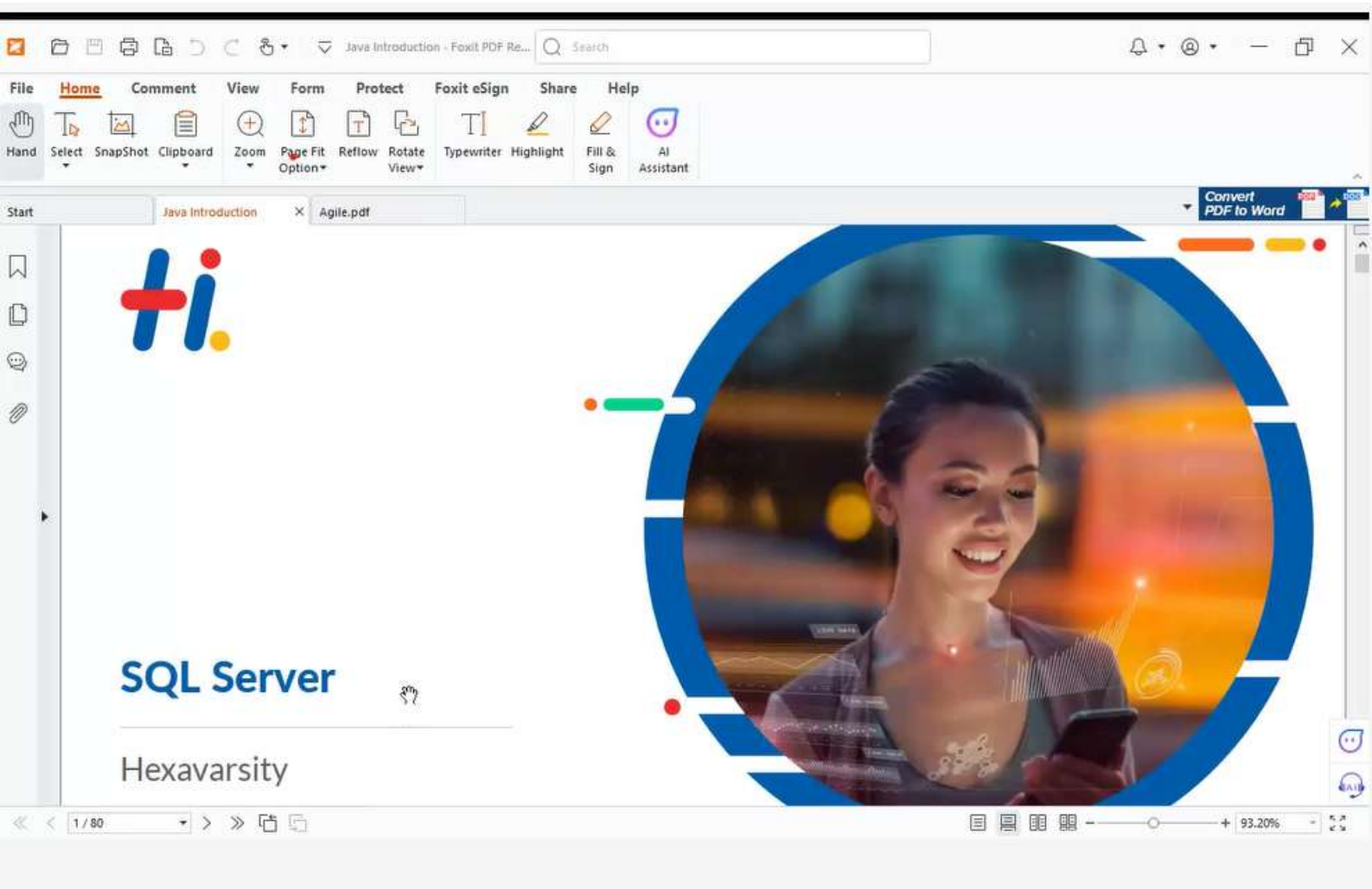


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Data Storage



- Information storage and retrieval (data processing) is a major part of the software application development in the IT industry.
- It is mandatory for every software professional to be aware of the approach of data storage and retrieval systems.

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- **Data:** Known facts, figures, objects and events which can be stored.
 - Structured: numbers, text, dates
 - Unstructured Data: images, video, documents
 - Examples:
 - ✓ RDBMS 02/01/2016 "It is raining"
- **Information:** Data that is processed to be useful
 - Examples:
 - ✓ Course Code is 1
 - ✓ The course name is RDBMS
 - ✓ The begin date of course is 02/01/2016
 - ✓ The temperature dropped 20 degrees and then it started raining.



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File structure is defined in the program code

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Database approach

- Data is stored in the database as a collection of data files.
- Database:
 - A collection of related data.
- Database Management System (DBMS):
 - A software package/ system to facilitate the creation and maintenance of a computerized database.
- Database System:
 - The DBMS software together with the database

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Limitations of traditional approach

- Separation and isolation of data
 - Each program maintains its own set of data.
 - Users of one program may be unaware of potentially useful data held by other programs.
- Duplication of data
 - Same data is held by different applications.
 - Wasted space and potentially different values and/or different formats for the same item.
- No Concurrent access to data
- Poor security
- Lack of data sharing
- No simultaneous application access to data
- No data independence
 - File structure is defined in the program code



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Data Model

- What is data model?
 - Integrated collection of concepts (Tool) for describing data, relationships between data, and constraints on the data in a database.
- Why data model?
 - To represent data in an understandable way.
- Types of data models include:
 - Object-Based Data Models
 - Entity-Relationship, Semantic, Functional, Object-Oriented.
 - Record-Based Data Models
 - Relational Data Model, Network Data Model, Hierarchical Data Model, Physical Data Models

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Relational data model

- Proposed in 1970 by E.F.Codd (IBM), first commercial system in 1981-82.
- Now in several commercial products (e.g. DB2, ORACLE, MS SQL Server, SYBASE, INFORMIX).
- Several free open source implementations, e.g. MySQL, PostgreSQL

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Relational data model

Grades Table		
Student ID	Course	Grade
1234	MKT211	A
1234	MIS315	B
2345	ACT211	B
2345	MIS315	B
3456	ACT211	A
3456	FIN311	A
4567	ACT211	A
4567	FIN311	B
9991	MKT211	B

Student Table			
Student ID	Student Name	Student Major	Student Email
1234	John Smith	Marketing	jsmith@university.edu
2345	Robert Jackson	MIS	rjackson@university.edu
3456	Anne Sun	Accounting	asun@university.edu
4567	Mary Brown	Finance	mbrown@university.edu
9991	Alex Wilson	Marketing	abrown@university.edu

5.4. Database Models – Information Systems for Business and Beyond

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Relational Model Terminology

- A table with columns and rows.
 - Only applies to logical structure of the database, not the physical structure.
- Attribute is a named column of a relation.
- Domain is the set of allowable values for one or more attributes
- Tuple is a row of a relation.
- Degree is the number of attributes in a relation.
- Cardinality is the number of tuples in a relation.
- Relational Database is a collection of normalized relations with distinct relation names

Diagram illustrating a table structure with labels:

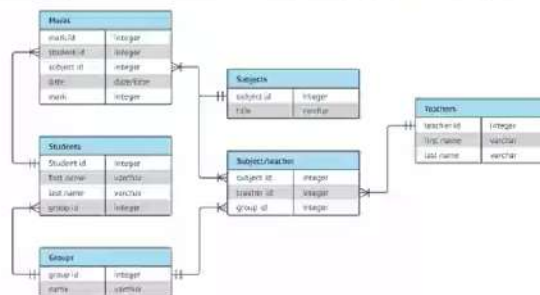
Customer Information			
CustomerID	FirstName	LastName	Address
C0001	John	Smith	123 Example Str
C0002	Susan	Hopkins	45 Sample Blvd

Labels in the diagram:

- Row (points to a horizontal row)
- Column (points to a vertical column)
- Primary Key (points to the CustomerID column)
- Data Field (points to a cell in the Address column)

Entity-Relationship (ER) Model

- ER model helps to capture conceptual database design
- Adopts top-down approach
- Describes the functional data requirements of a real-world problem in the form of ER diagrams
- Consists of Attributes, Entities, Relationships, Identifiers
- UML class diagrams is representative of another way of displaying ER concepts



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IL class diagrams is representative of another way of displaying ER concepts

```
classDiagram
    class Marks {
        mark id Integer
        student id Integer
        subject id Integer
        date date/time
        mark Integer
    }
    class Students {
        Student id Integer
        first name varchar
        last name varchar
        group id Integer
    }
    class Groups {
        group id Integer
        name varchar
    }
    class Subjects {
        subject id Integer
        title varchar
    }
    class Subject_teacher {
        subject id Integer
        teacher id Integer
        group id Integer
    }
    class Teachers {
        teacher id Integer
        first name varchar
        last name varchar
    }
    Marks "1" -- "1" Students
    Marks "1" -- "1" Subjects
    Marks "1" -- "1" Subject_teacher
    Students "1" -- "1" Groups
    Subjects "1" -- "1" Subject_teacher
    Subject_teacher "1" -- "1" Teachers
```

The diagram illustrates the relationships between six entities: Marks, Students, Groups, Subjects, Subject/teacher, and Teachers. Each entity is represented as a class with its attributes and data types. The relationships are shown as lines connecting the classes, with crow's foot notation indicating the cardinality and role of each entity in the relationship.

- Marks** (Attributes: mark id Integer, student id Integer, subject id Integer, date date/time, mark Integer) is connected to **Students**, **Subjects**, and **Subject/teacher**.
- Students** (Attributes: Student id Integer, first name varchar, last name varchar, group id Integer) is connected to **Groups**.
- Groups** (Attributes: group id Integer, name varchar) is connected to **Subject/teacher**.
- Subjects** (Attributes: subject id Integer, title varchar) is connected to **Subject/teacher**.
- Subject/teacher** (Attributes: subject id Integer, teacher id Integer, group id Integer) is connected to **Teachers**.
- Teachers** (Attributes: teacher id Integer, first name varchar, last name varchar) is connected to **Subject/teacher**.

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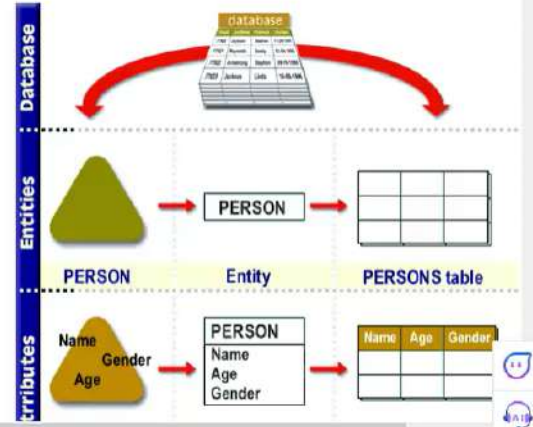
- Entities

- Example: The Person, the Book

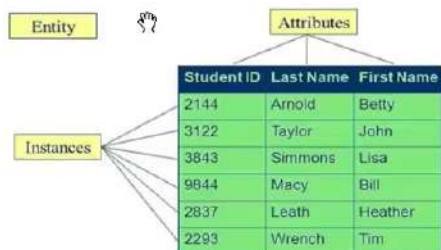
- Attributes are properties used to describe an entity.

- Each attribute has a value set associated with it.

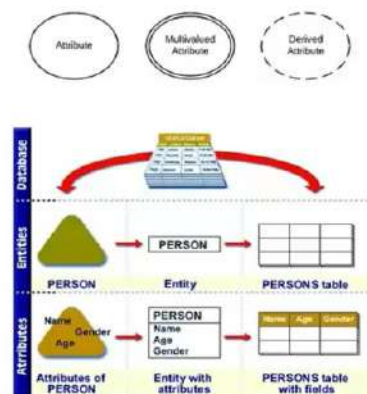
- *Example:*



Entity and Attribute



Representing attributes



Types of Entities

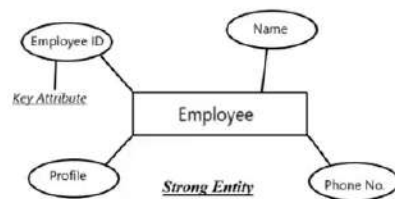


Strong/Regular Entity

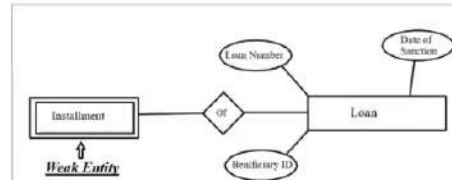
- If an Entity has a key attribute (uniquely identifiable feature), then it is called a Strong Entity.
- Example of a Strong Entity is the Employee

Weak Entity

- It is dependent on a strong entity (identifying owner)...cannot exist on its own, It does not have a unique identifier
- Example: Installment is an Entity, then it can exist only if a Loan exists as an Entity.



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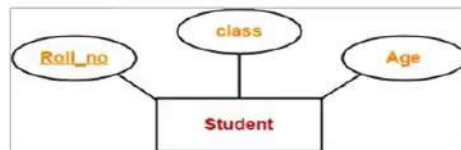


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Types of attributes



Types of attributes

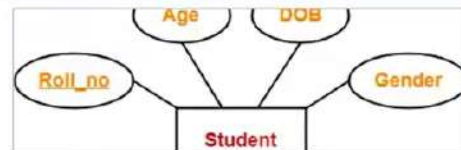
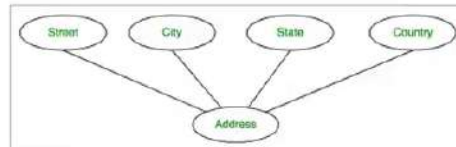


Simple Attributes

Simple attributes are those that cannot be further divided into sub-attributes.

Composite Attributes

Composite attributes are made up of two or more simple attributes.



Single Valued Attributes

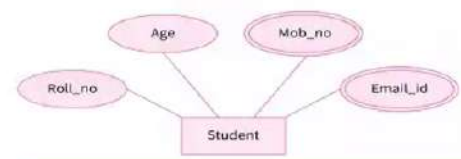
Single-valued attributes can only have one value.

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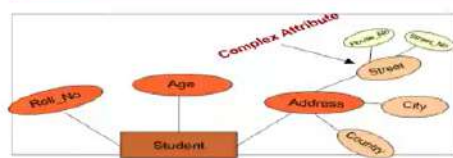
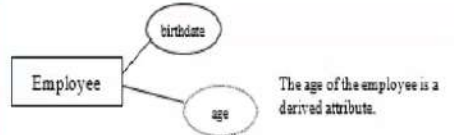
Types of attributes

Types of attributes



Multivalued Attributes
Multivalued attributes can have more than one value.

Derived Attributes
Derived attributes are based on other attributes and are not stored directly in the database.



Complex Attributes
The complex attribute in DBMS involves both multivalued and composite attributes.

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Key

- It is used to uniquely identify any record or row from the table.
- It is also used to establish and identify relationships between tables.

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