DB Module

NgeeAnn

School of InfoComm Technology

Activity

Part I

Databases

Day 2

Prepared by Staff of School of ICT

Topics

- Conceptual Data Modeling using Entity – Relationship Model
- Entity-Relationship Model
  - Entity
  - Attribute
  - Key
  - Relationship

Why is Database Design Important?

- Assume that you are given the task of designing a database for a company!
- How do you decide:
  - How many tables should be there in your database?
  - How many columns should be there in each table?
  - What are these columns?

Why is Database Design Important (cont...)?

- Why is the following table not considered as a good design?

StudentID	Name	ModuleCode	SubjectName	Grade	Description
11111	Alicia	DB	Database	A	Excellent
11111	Alicia	OOP	Object-Oriented Programming	B	Very Good
22222	Peter	CT	Critical Thinking	C	Good
33333	John	DB	Database	B	Very Good
33333	John	OOP	Object-Oriented Programming	A	Excellent
33333	John	NF	Network Fundamentals	A	Excellent

Why is Database Design Important (cont...)?

- A better design could be:

StudentID	Name
11111	Alicia
22222	Peter
33333	John

Grade	Description
A	Excellent
B	Very Good
C	Good

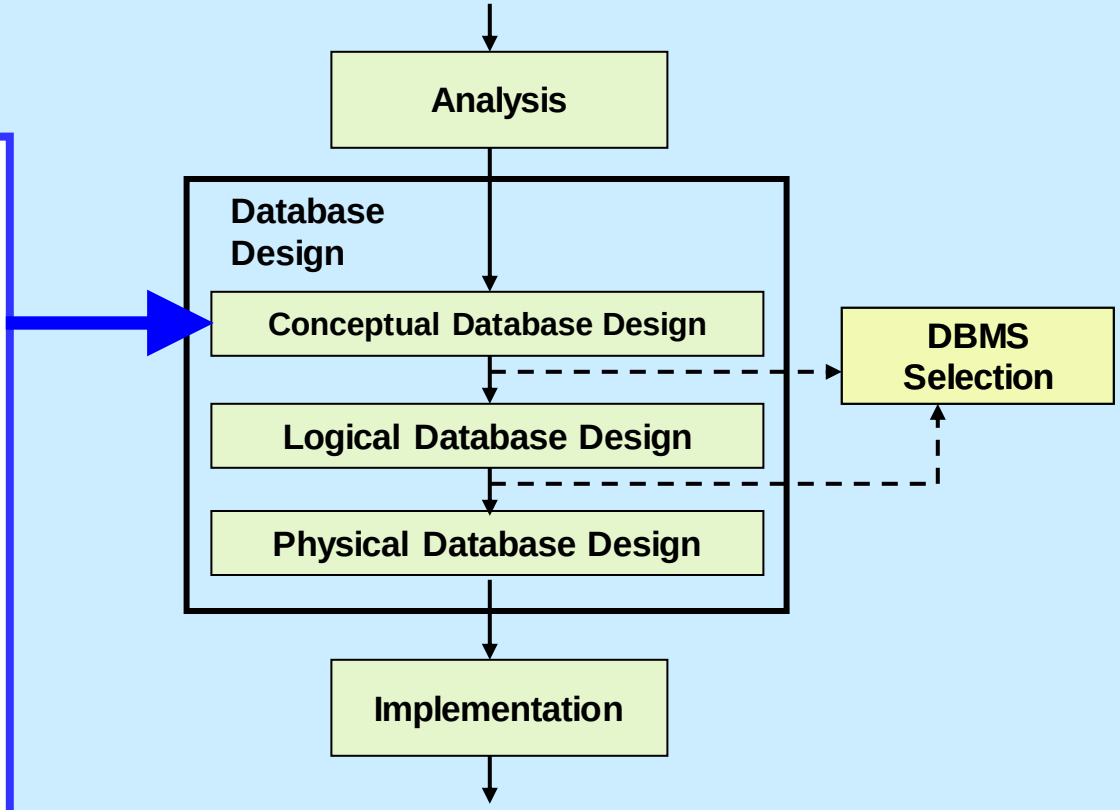
StudentID	ModuleCode	Grade
11111	DB	A
11111	OOP	B
22222	CT	C
33333	DB	B
33333	OOP	A
33333	NF	A

ModuleCode	SubjectName
DB	Database
OOP	Object-Oriented Programming
CT	Critical Thinking
NF	Network Fundamentals

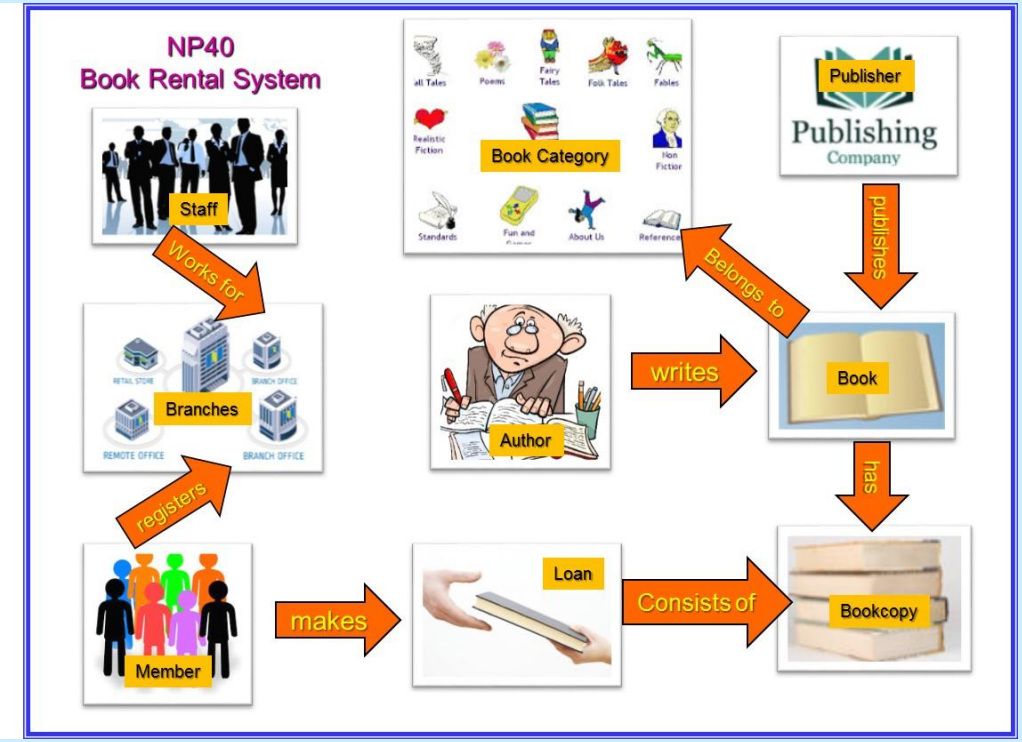
Database Design Stage in Database Application Lifecycle

Conceptual Database Design

To construct a model that captures the overall structure of organisational data, while being independent of any DBMS or other implementation consideration.

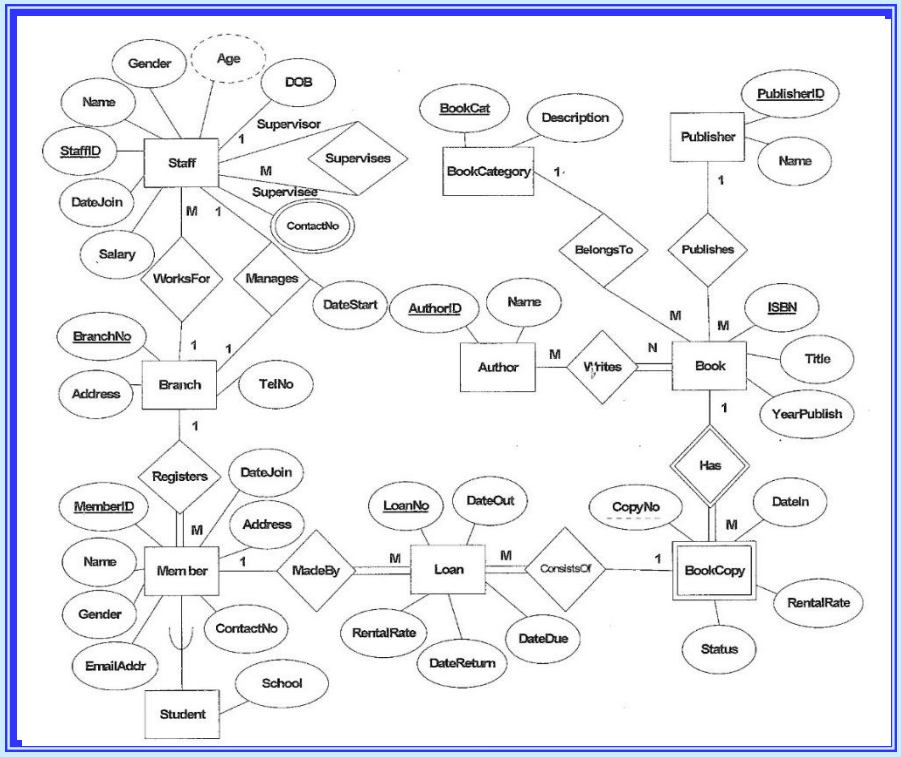


Conceptual Data Modelling



A tool is required for communications between the database designers and end users during analysis phase of database development.

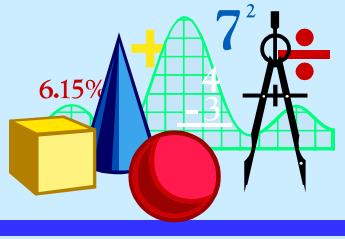
Conceptual Data Modelling



NP40
Book Rental System

- **E-R (Entity-Relationship) Model is the tool often used to construct a conceptual data model.**
  - Relative ease of use.
  - Widespread CASE tool support.
  - Belief that entities and relationships are natural modelling concepts in the real world.

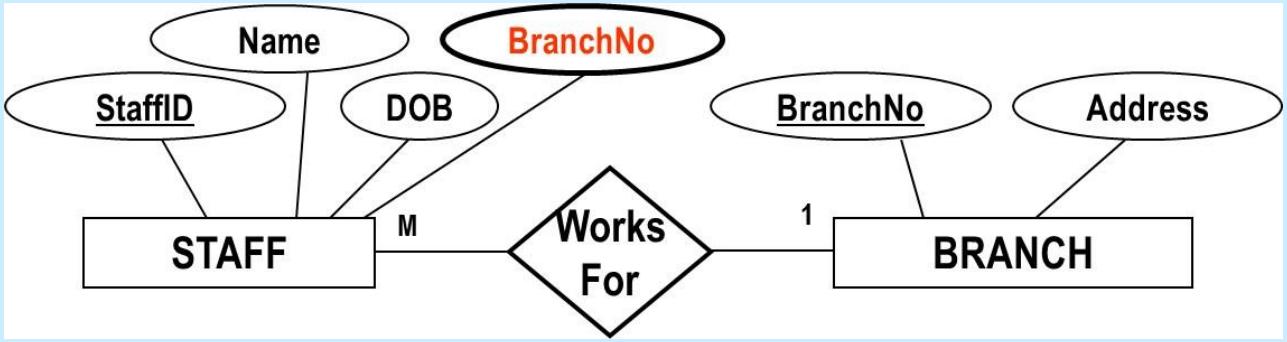
E-R MODEL

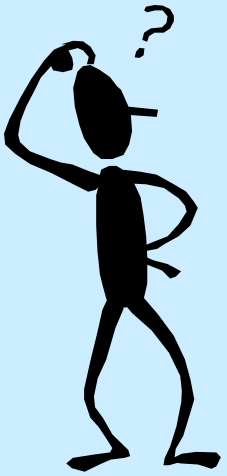


- E-R Model was introduced in a key article by Chen (1976).
- The model was subsequently extended to include additional constructs by Chen & others (1986, 1991).
- Refer to Appendix for the Notations used for the E-R Model.

E-R Model

- Provides a detailed and logical representation of the data of an organisation or a business area.
- Expressed in terms of Entities of business environment, Relationships (or associations) among these entities, and the Attributes (or properties) of both entities and relationships.

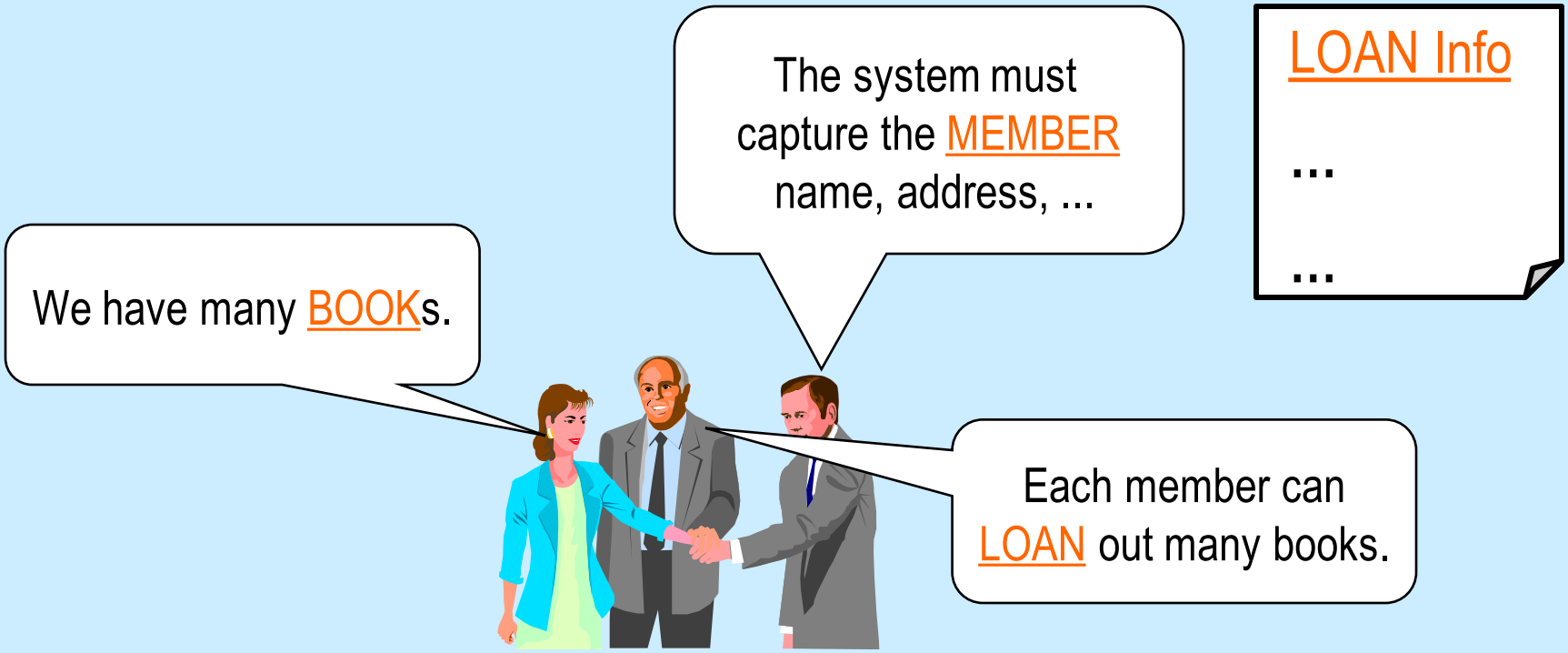




Entity

Entity

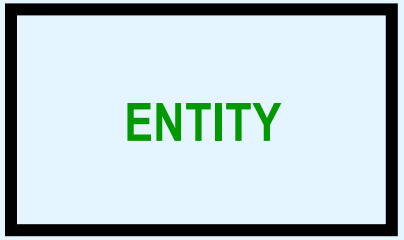
- **Person, place, object, event or concept in the organisation or business area to be modelled.**



Entity

Notation:

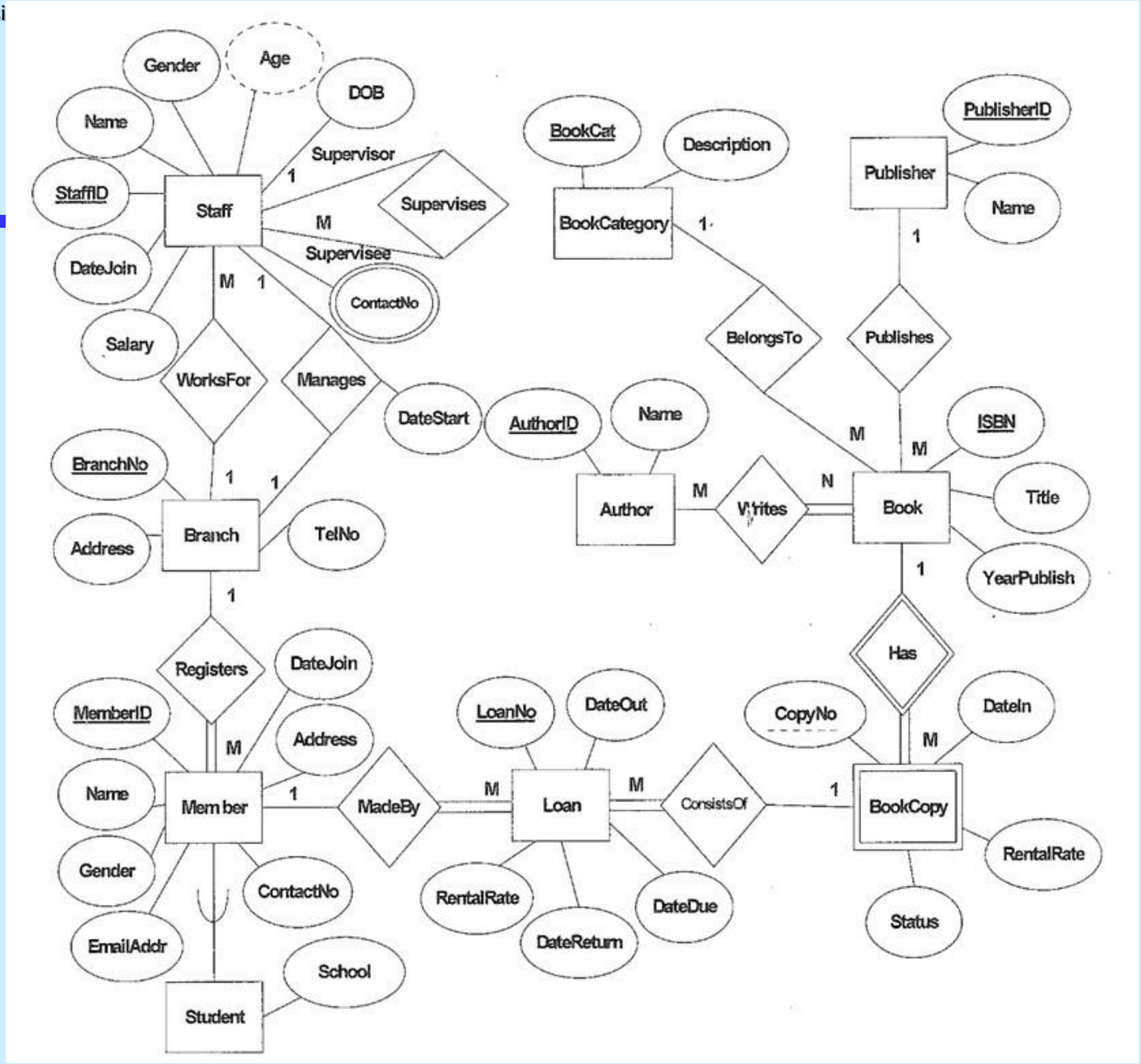
An entity is represented by a rectangular box.

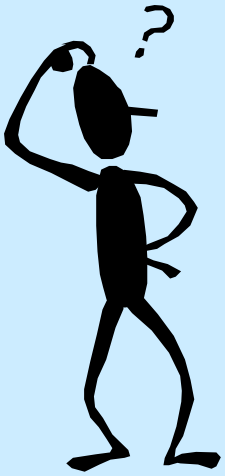


Examples:

Entity

Can you identify all the entities in this model?





Attribute

Attribute

- A property or characteristic of an entity that is of interest to the organisation or business area concerned.
  - Each entity has a set of attributes associated with it.
- An example:
  - SALESPERSON entity has attributes:

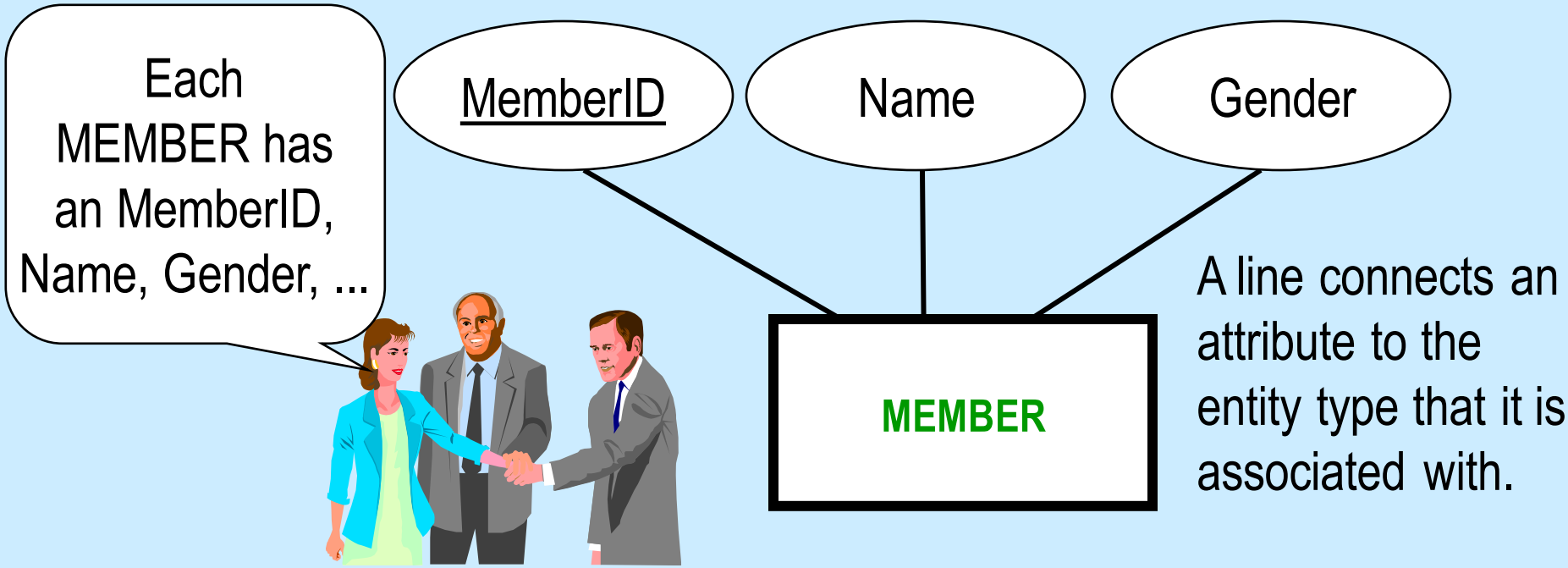
    employee number, name, date of birth, sex ,...

NB: Relationships may also have attributes.

Attribute

Notation:

An attribute is represented by an oval.



Classification of Attributes

- An attribute can be classified by the component(s) it has:
  - SIMPLE attribute
  - COMPOSITE attribute
- An attribute can be classified by the value its holds:
  - SINGLE-VALUED attribute
  - MULTI-VALUED attribute

Simple Attribute

A simple attribute composed of a SINGLE component with an independent existence.

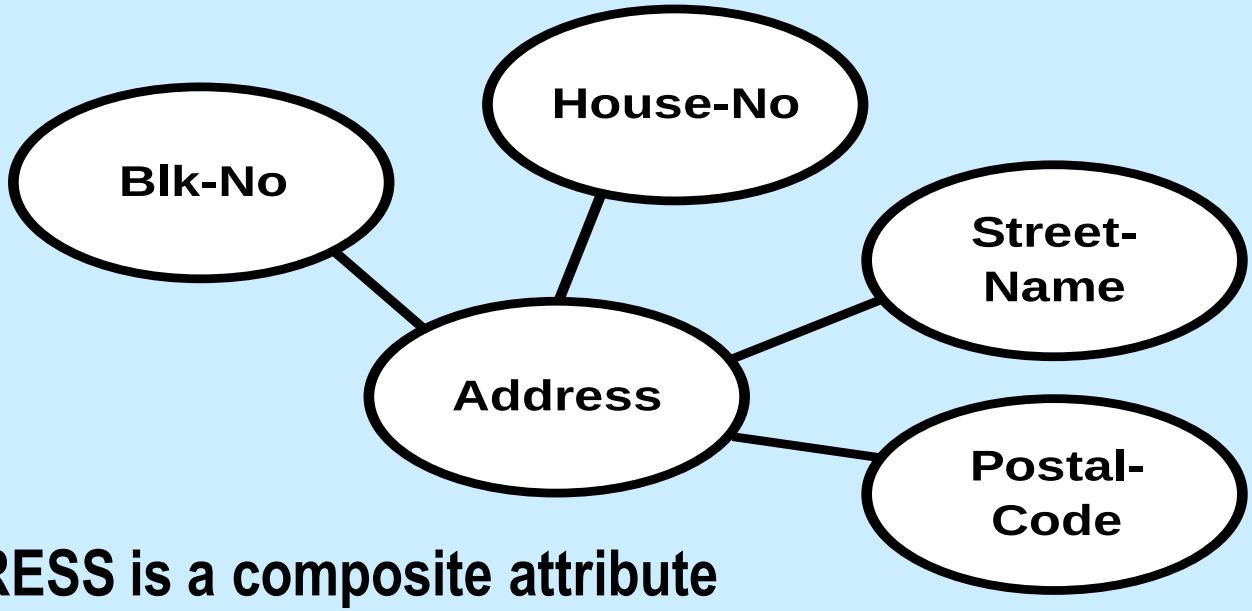
- **Simple attributes cannot be further divided and are sometimes called Atomic attributes.**
  - **Examples: Gender, Salary, Color**

Notation:

A Simple Attribute is represented by an oval.

Composite Attribute

A composite attribute composed of MULTIPLE components, each with an independent existence.



A line connects the component attribute to the composite attribute.

ADDRESS is a composite attribute consisting of 4 simple attributes.

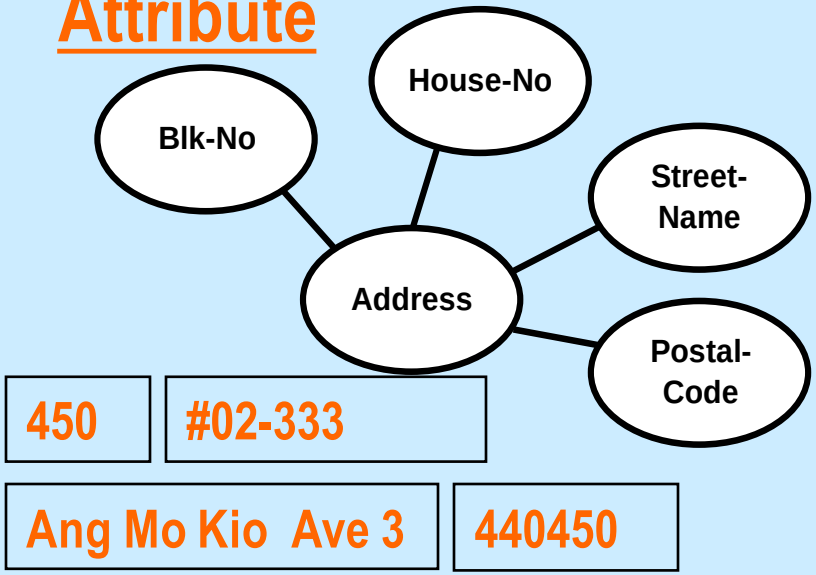
Simple or Composite Attribute?

Simple Attribute

Address

Block 450, Ang Mo Kio Ave 3, #02-333, Singapore 440450

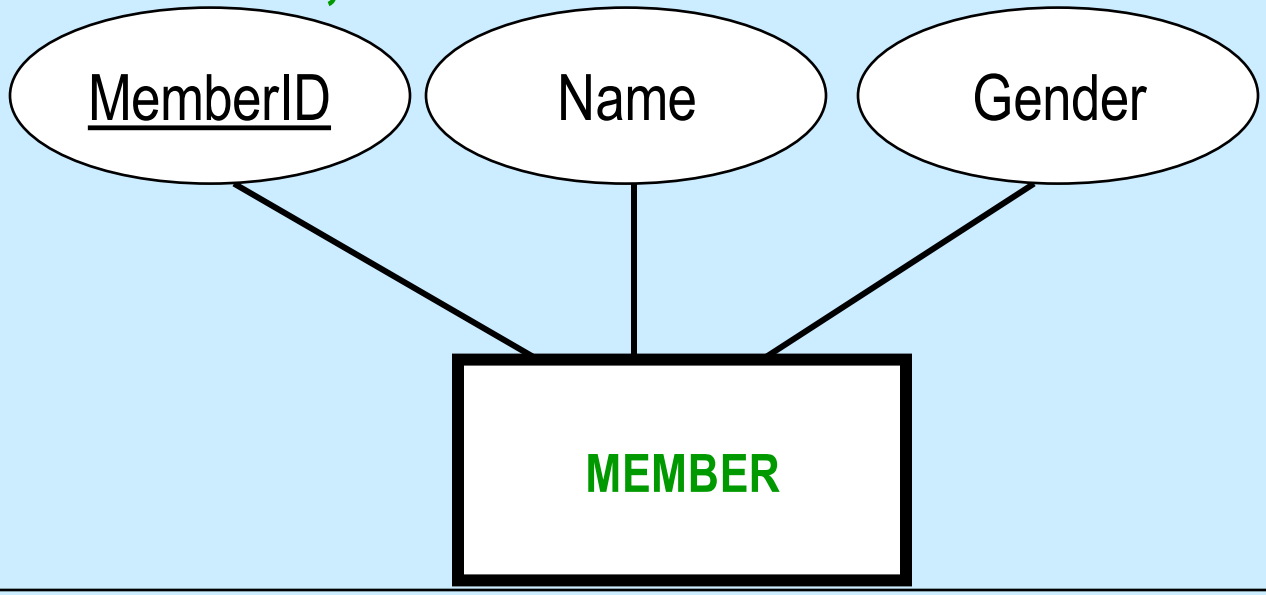
Composite Attribute



The decision to model the Address attribute as a simple attribute or composite attribute is dependent on whether the user view of the model refers to the Address attribute as a SINGLE UNIT or INDIVIDUAL COMPONENTS.

Single-Valued Attribute

- An attribute that holds a single value for a single entity.
  - Each MEMBER entity has only a single value for MemberID, Name and Gender.



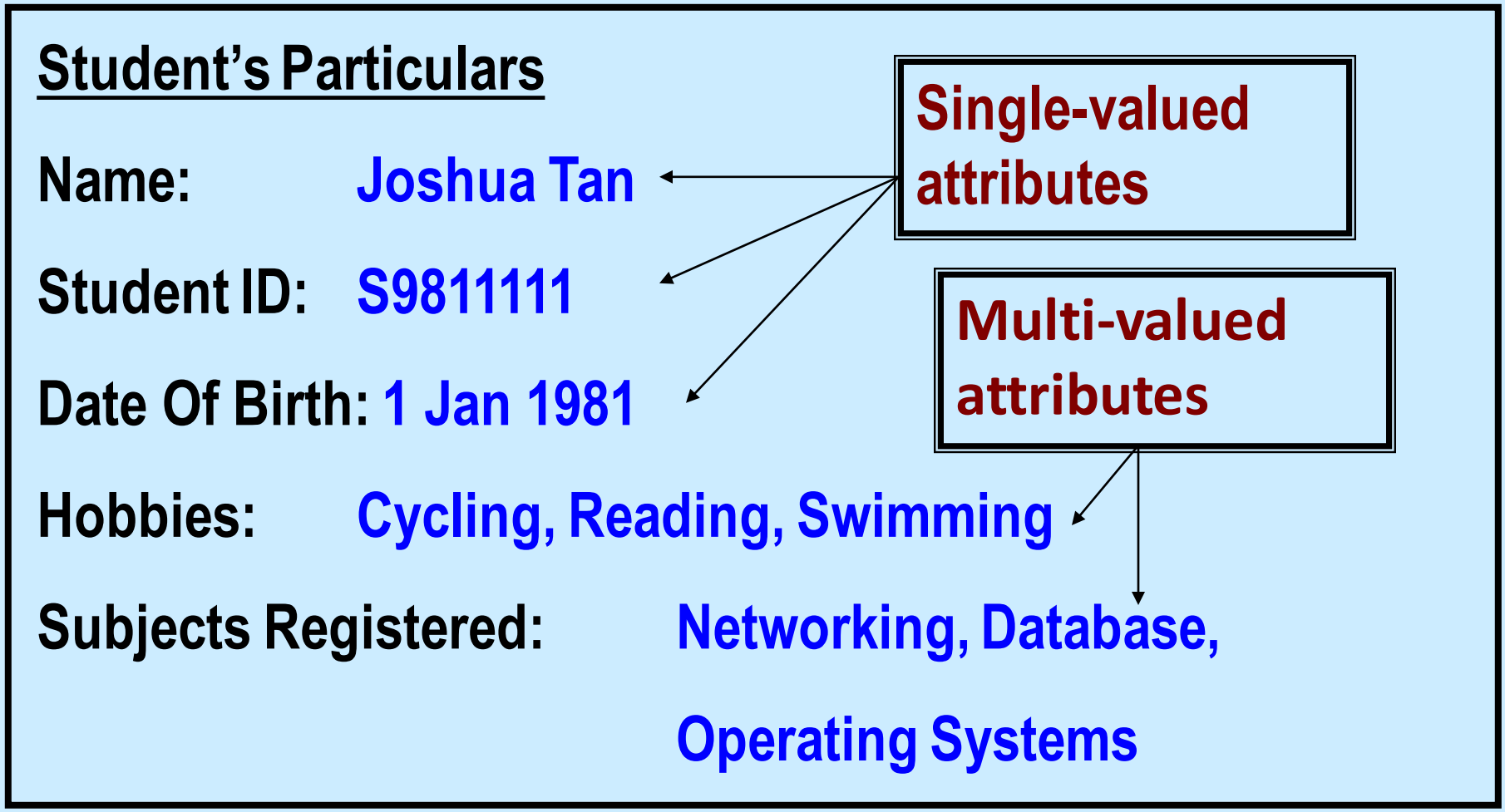
Multi-Valued Attribute

- An attribute that holds multiple values for a single entity.
  - A SALESPERSON entity can have one or more values for Contact Numbers (hand phone, pager, office) and Qualifications.

Notation

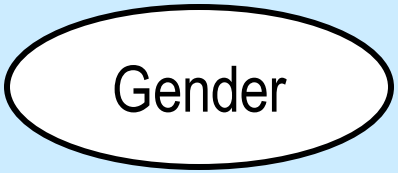
Multi-valued attribute
is represented by double ovals.

Single and Multi-Valued Attributes



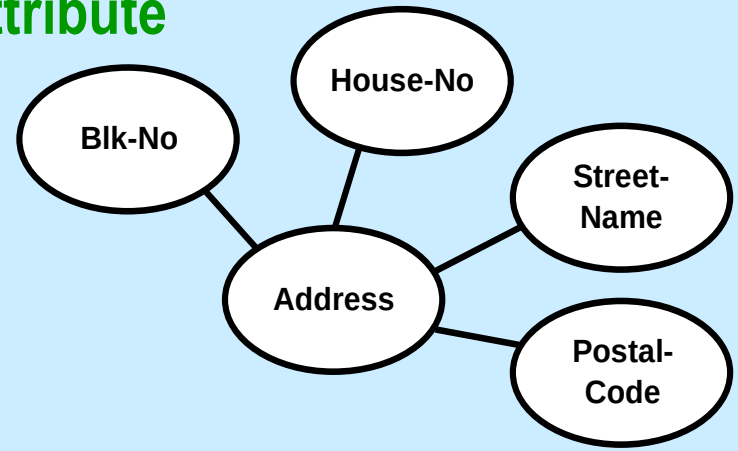
Possible Attribute Types

Simple, Single-Valued Attribute

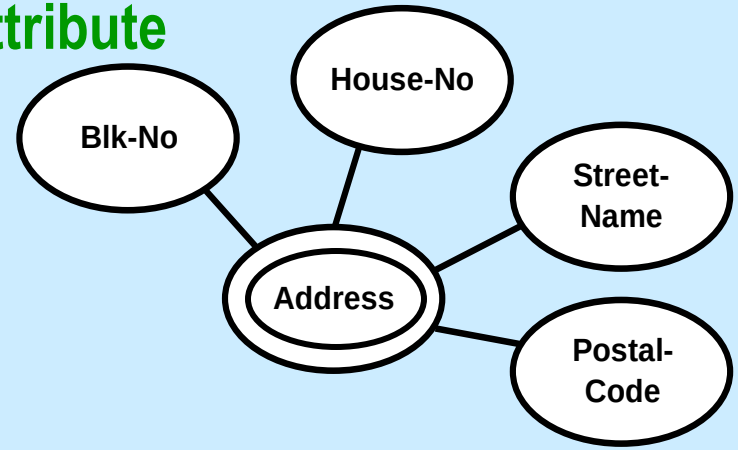


Simple, Multi-Valued Attribute

Composite, Single-Valued Attribute



Composite, Multi-Valued Attribute



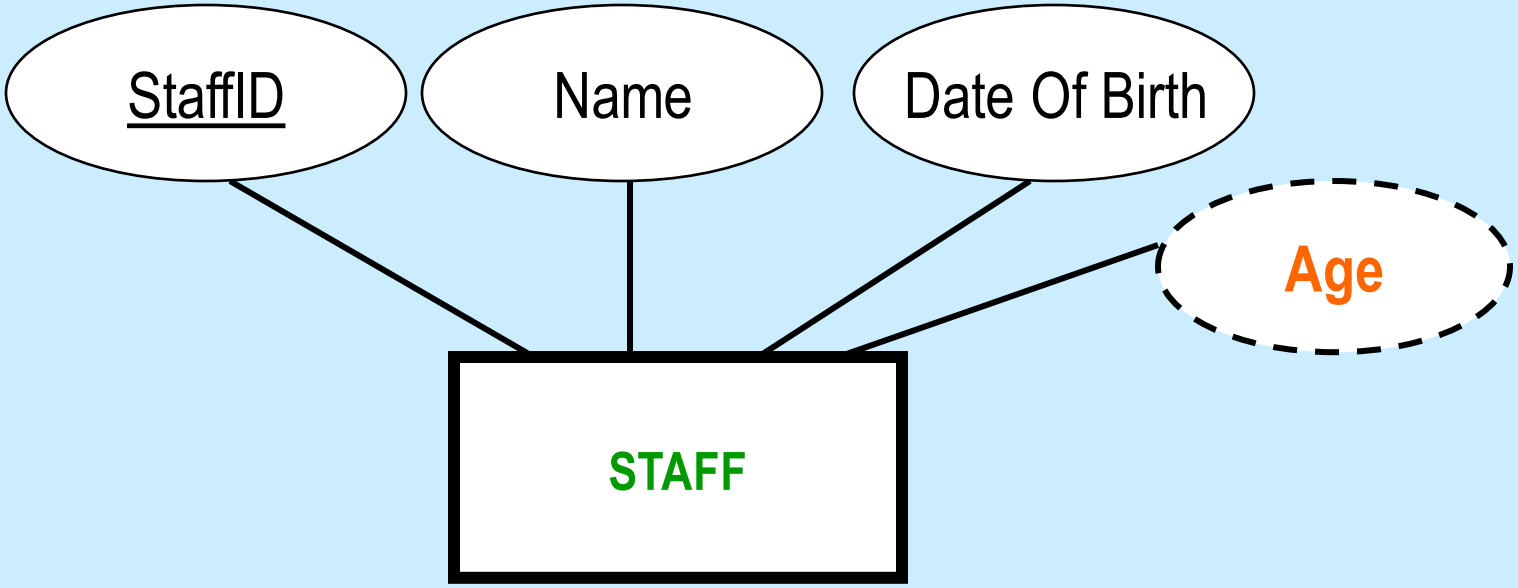
Derived Attribute

- An attribute that represents a value that is derivable from the value of a related attribute or set of attributes, not necessarily in the same entity.
  - Age of a person can be derived from his date of birth.
  - Number of employees working for a department can be derived by counting the number of employees that work for that department.

Derived Attribute

Notation

Derived attribute is represented by a dotted oval.



Key Attribute

- Every entity type must have an attribute or a set of attributes that uniquely identifies each entity instance.
  - This key or uniqueness constraint prohibits any two instances from having the same value for the key attribute simultaneously.
  - Some entity types have more than one key attribute.

Key Attribute

- Examples:
  - Each STAFF entity has a unique StaffID.
  - Each BRANCH entity has a unique BranchNo.
  - Each BOOKCOPY entity is uniquely identified by its ISBN and CopyNo.

Criteria for Selecting a Primary Key

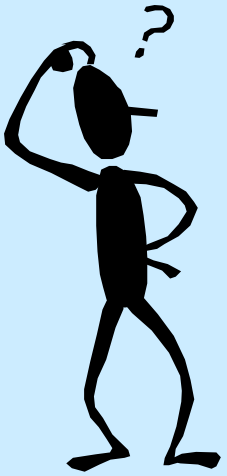
1. Choose a candidate key that will not change its value over the life of each instance of the entity type.
2. Choose a candidate key such that for each instance of the entity type, the attribute is guaranteed to have valid value and not be null.
3. Avoid use of so-called intelligent keys, whose structure indicates classifications, locations, and so on.
4. Consider substituting a single-attribute Surrogate Key for a large composite key.

Surrogate Key

- A Surrogate Key is a new attribute that is specifically introduced into an entity to serve as a key to uniquely identify each instance.
- Guidelines for selecting a Surrogate Key:
  - If we cannot select a natural identifier that can guarantee uniqueness of each instance.
  - If the primary key is a large composite key that consists of a number of attributes.

Surrogate Key (Cont...)

- LoanNo of Loan table (Refer to Appendix B: pg B-5 & B-6) is a good example for a surrogate key.
- If not the LoanNo, what could have been the primary key of Loan table?
- Answer:
  - (Assuming no member borrows and returns the same book (ISBN) with the same copy number on the same date)
  - Is this the primary key PK ?==> (ISBN, CopyNo, MemberID, DateOut, DateReturn)

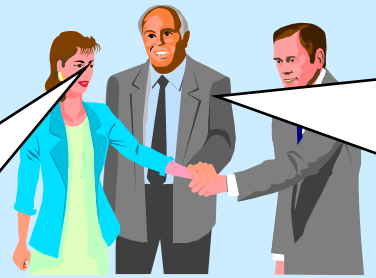


Relationship

Relationship

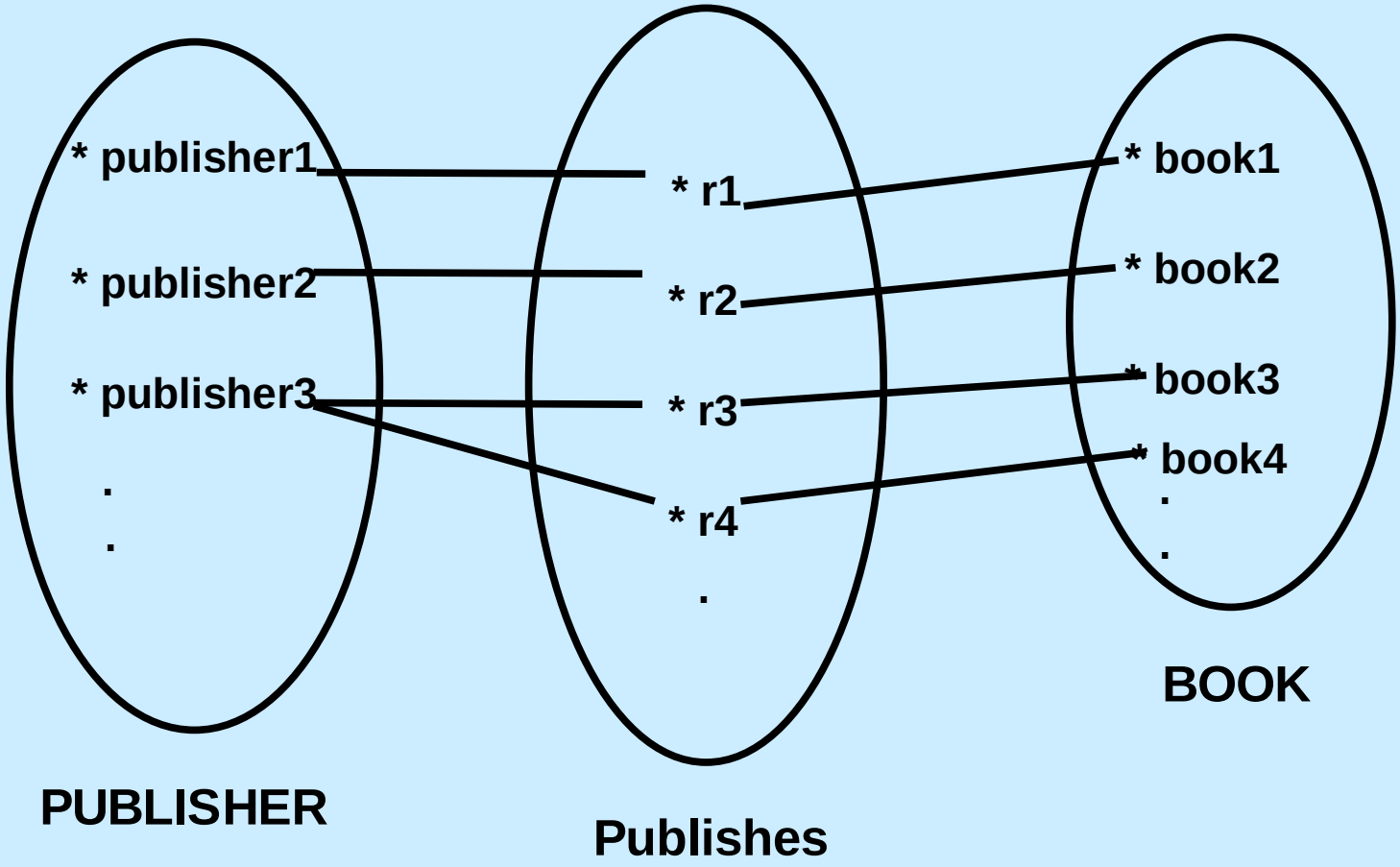
- A relationship is an association between the instances of one or more entities that is of interest to the organisation.

A Publisher **publishes** many Books.



A Branch **registers** many Members. Each Member **makes** many Loans.

Relationship

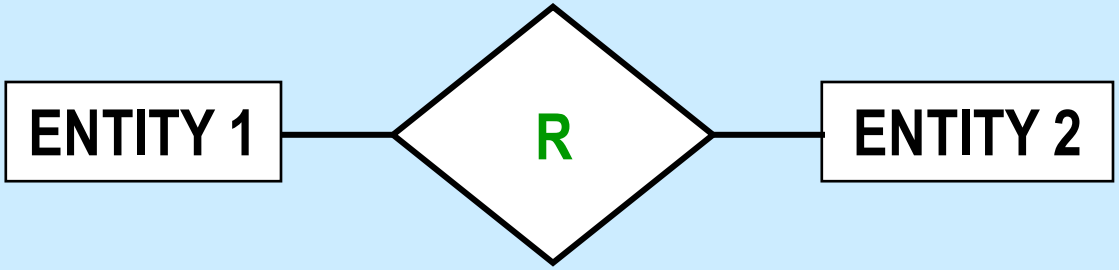


Relationship

- A relationship is a set of associations between two or more participating entities.

Notation

A relationship (R) is represented by a diamond-shaped box and is connected to the entities that are related through this relationship.



Relationship

A Branch **registers** many Members.
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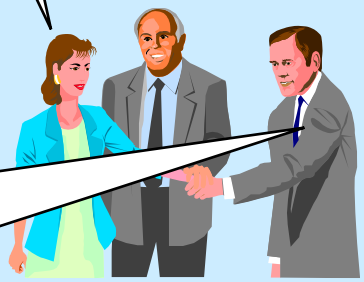
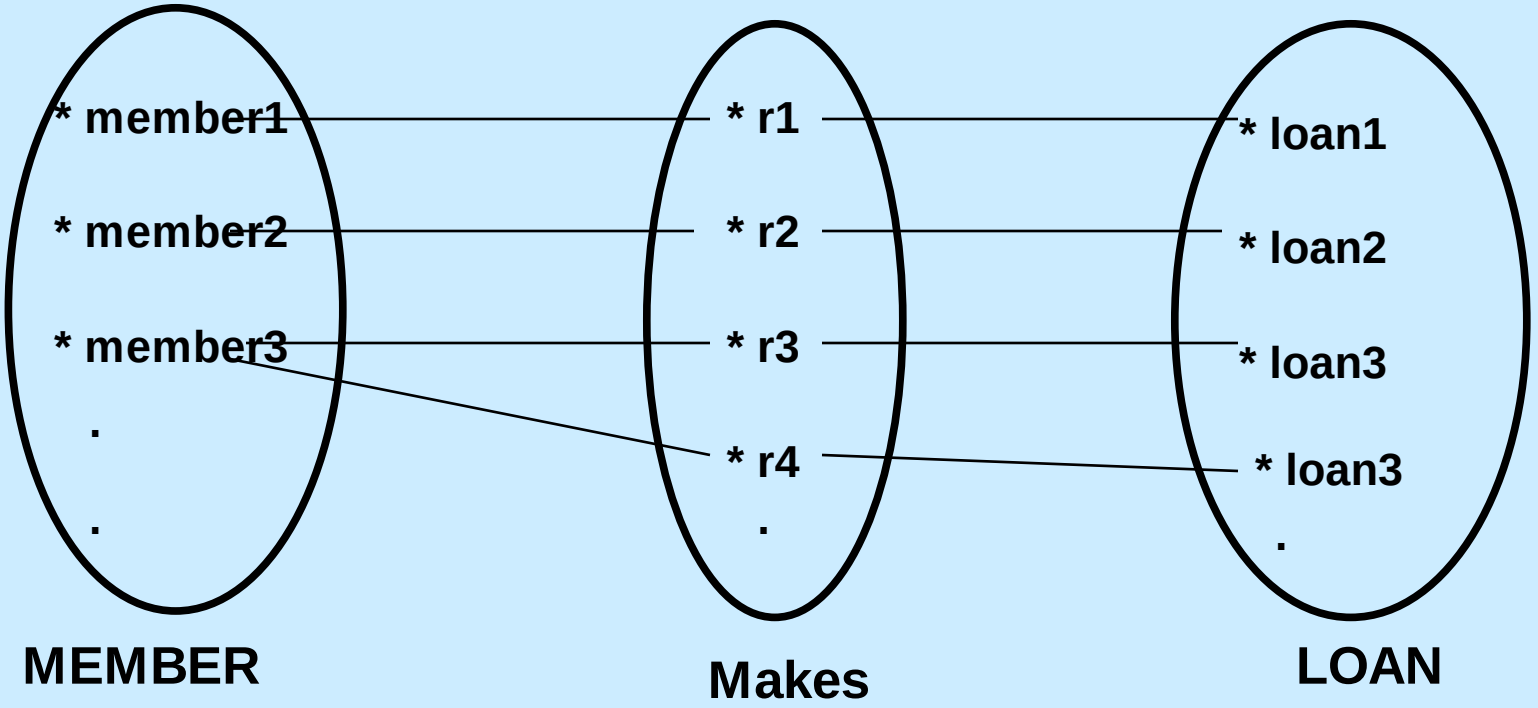
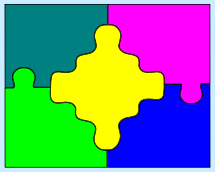


A Publisher can **publish** many Books.

Relationship



Summary



- E-R Model is a tool used to derive the Conceptual Data Model.
- E-R Model consists of Entities, Attributes and Relationships.