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Relational Database Management System

Education
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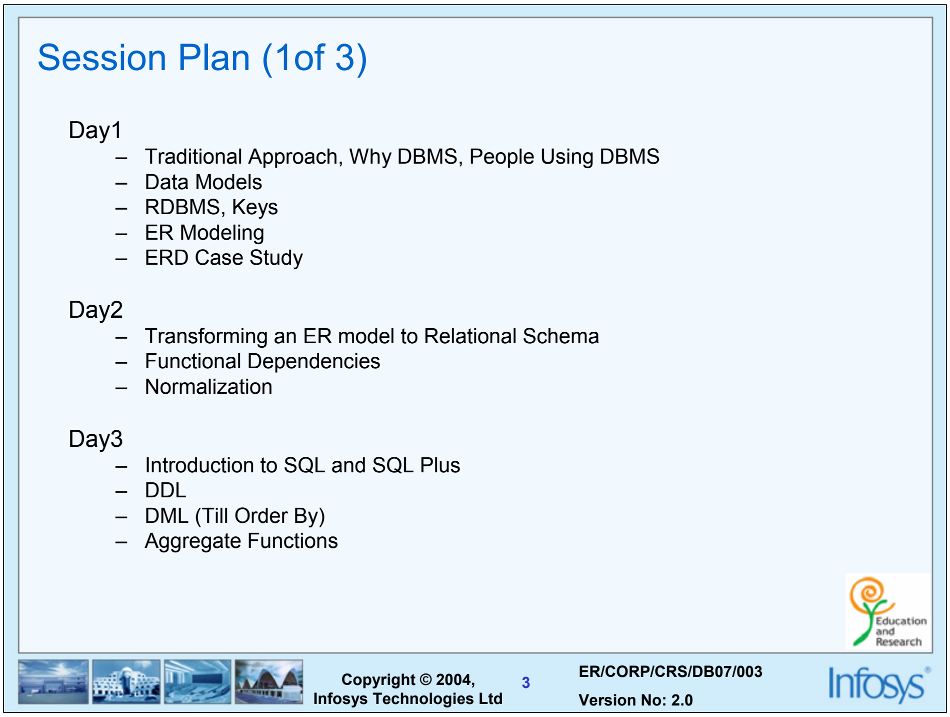
Welcome to this course on Relational Database Management System!

Course Objectives

- To introduce basic RDBMS concepts

- To create familiarity with SQL

- To introduce the concept of transaction processing and discuss certain issues in the same



Session Plan (1of 3)

Day1

- Traditional Approach, Why DBMS, People Using DBMS
- Data Models
- RDBMS, Keys
- ER Modeling
- ERD Case Study

Day2

- Transforming an ER model to Relational Schema
- Functional Dependencies
- Normalization

Day3

- Introduction to SQL and SQL Plus
- DDL
- DML (Till Order By)
- Aggregate Functions

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Session Plan (2 of 3)

Day 4

- Group By and Having, Relational Algebra
- Joins
- Independent Sub Queries
- Use of EXISTS and NOT EXISTS

Day 5

- Correlated Sub queries + Exists
- Views
- DCL + Embedded SQL

Day 6

- Transaction, OLTP, ACID
- Serial Transactions and Serializability
- Issues of Concurrency
- Locking

Session Plan (3 of 3)

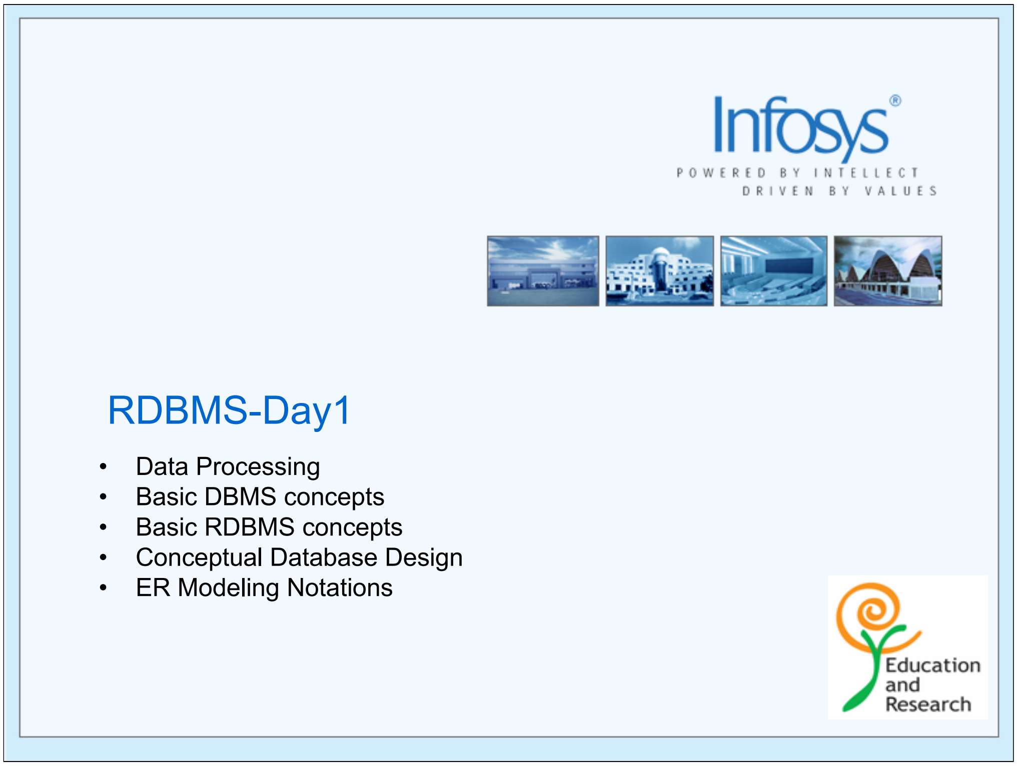
Day 7

- Time Stamping
- Immediate Update + Deferred Update + Check Point
- Difference between OLTP and OLAP
- OLAP
- Data Ware Housing
- Data Mart
- Summary

References

- “Database system concepts”, Henry F Korth, Abraham Silberschatz, Second ed., McGraw-Hill International editions, Computer Science Series(1991)
- "Fundamentals of Database Systems", Elmasri, Navathe,

  Third ed, Addison Wesley
- "An introduction to Database Systems", C.J.Date, Sixth ed., Narosa Publications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RDBMS-Day1

- Data Processing
- Basic DBMS concepts
- Basic RDBMS concepts
- Conceptual Database Design
- ER Modeling Notations

Data processing

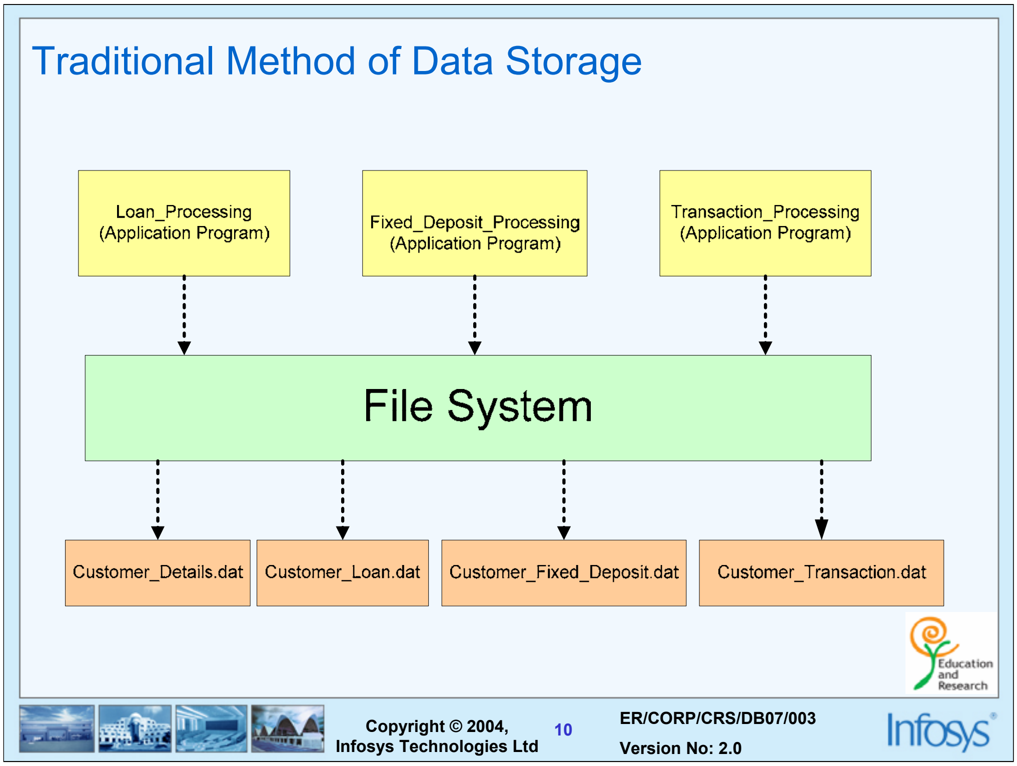
- Data Collection
- Recording
- Sorting
- Classifying
- Calculating
- Retrieving
- Summarizing
- Communicating

Data processing modes

- **Batch processing:**
- Transactions are collected in a group & processed together.

- **On-line (interactive) processing:**
- Transactions are processed as & when they appear.

- **Real-time processing:**
- It is a parallel time relationship with on-going activity & the information produced is useful in controlling the current / dynamic activity.

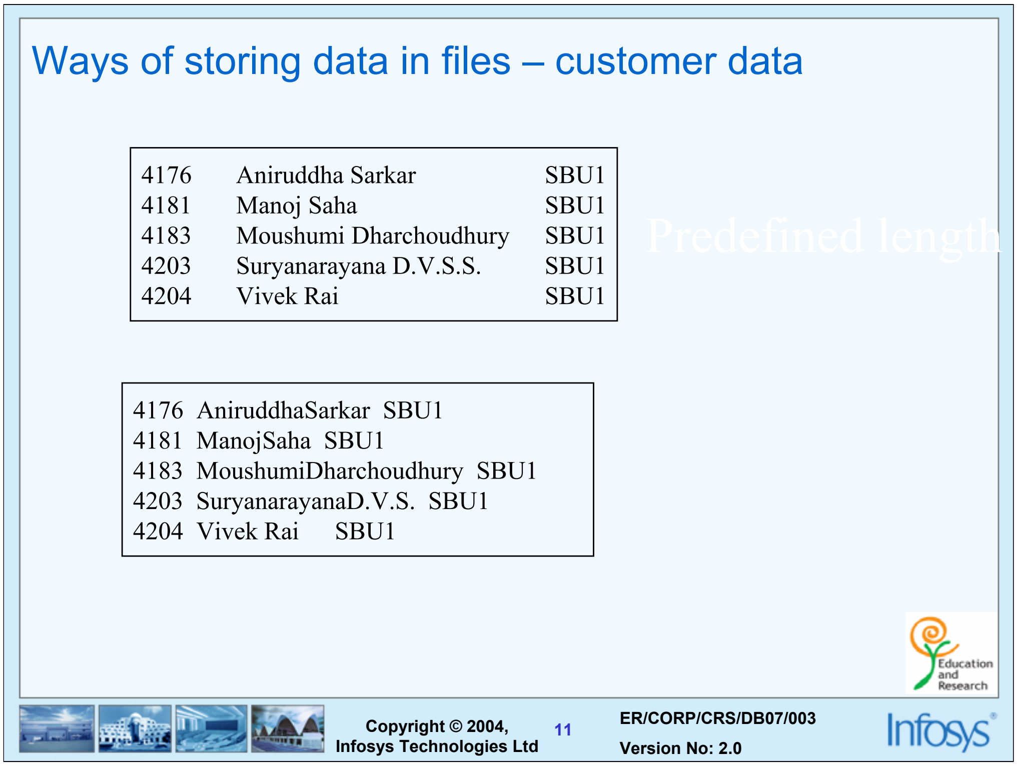


Traditional Method of Data Storage

Loan_Processing (Application Program)
Fixed_Deposit_Processing (Application Program)
Transaction_Processing (Application Program)
File System
Customer_Details.dat
Customer_Loan.dat
Customer_Fixed_Deposit.dat
Customer_Transaction.dat
Education and Research

•In the traditional approach, we used to store information in flat files which are maintained by the file system under the operating system’s control.

•Application programs go through the file system to access these flat files



Ways of storing data in files – customer data

```
4176    Aniruddha Sarkar          SBU1
4181    Manoj Saha                SBU1
4183    Moushumi Dharchoudhury    SBU1
4203    Suryanarayana D.V.S.S.    SBU1
4204    Vivek Rai                 SBU1
```

Predefined length

```
4176  AniruddhaSarkar  SBU1
4181  ManojSaha  SBU1
4183  MoushumiDharchoudhury  SBU1
4203  SuryanarayanaD.V.S.  SBU1
4204  Vivek Rai      SBU1
```

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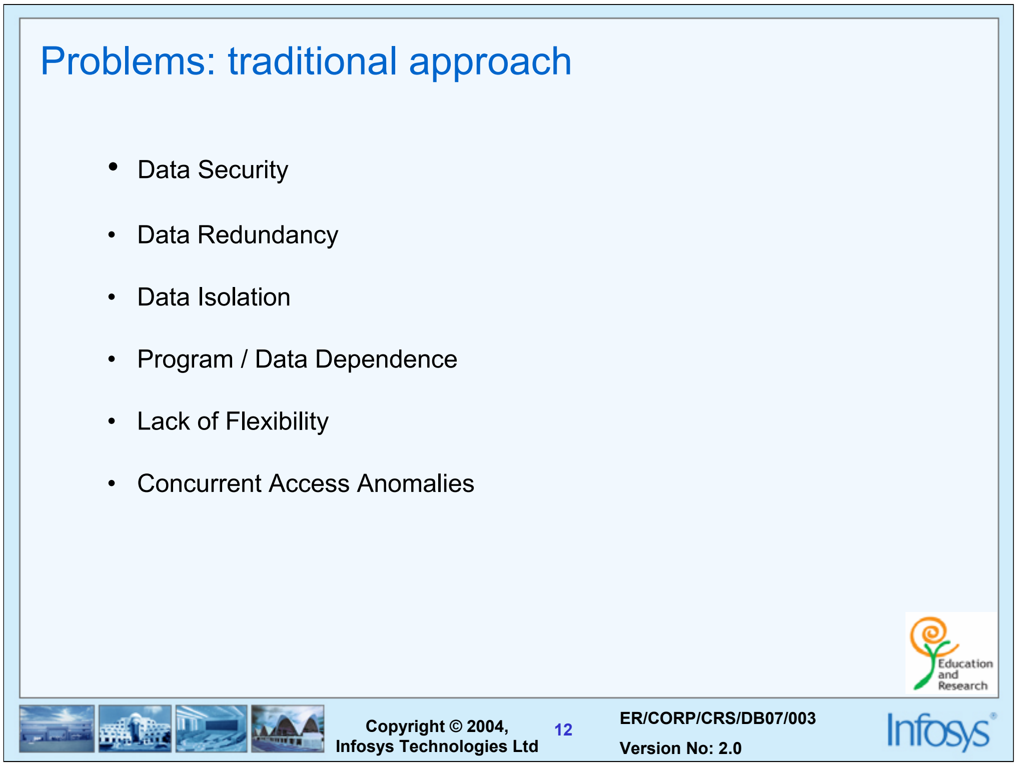
- •Data used to be stored in the form of records in the files.

- •Records consist of various fields which are delimited by a space , comma , tab etc.

- •There used to be special characters to mark end of records and end of files.



Problems: traditional approach

- Data Security
- Data Redundancy
- Data Isolation
- Program / Data Dependence
- Lack of Flexibility
- Concurrent Access Anomalies

Disadvantages of the traditional approach

Data Security: The data as maintained in the flat file(s) is easily accessible and therefore not secure

Example: *Consider the Banking System. The Customer_Transaction file has details about the total available balance of all customers. A Customer wants information about his account balance. In a file system it is difficult to give the Customer access to only his data in the file. Thus enforcing security constraints for the entire file or for certain data items are difficult.*

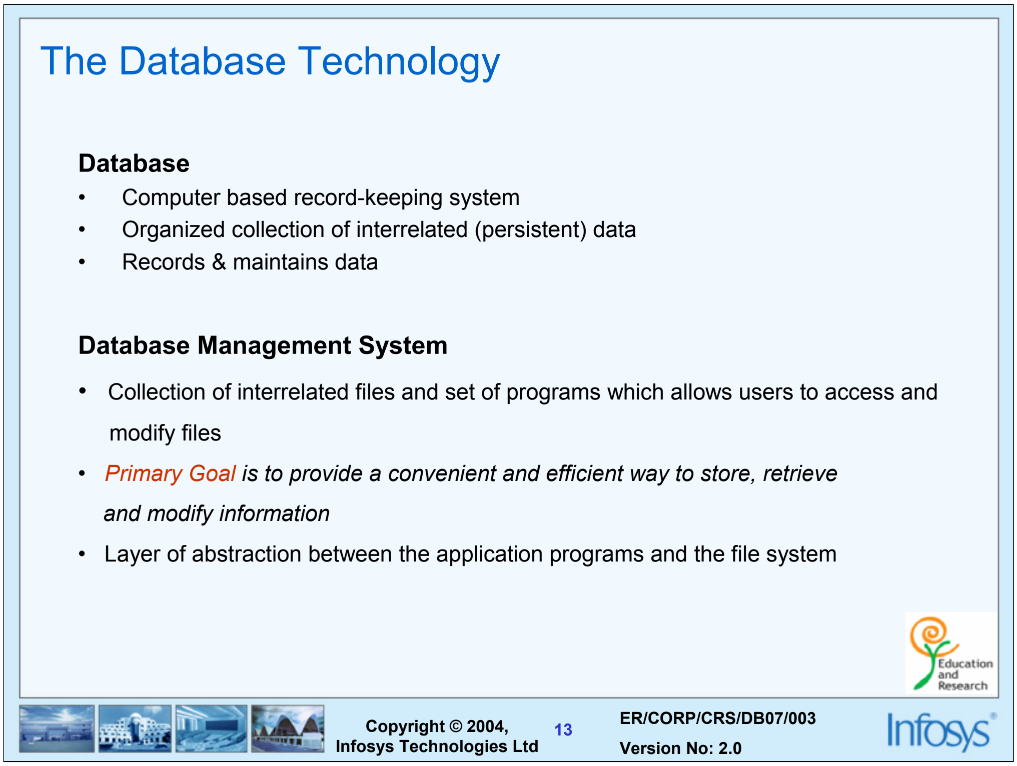
Data Redundancy: Often the same information is duplicated in two or more files.

This duplication of data (redundancy) leads to higher storage and access cost. In addition it may lead to data *inconsistency*[2]. For Example, assume the same data is repeated in two or more files. If change is made to data in one file, it is required that the change be made to the data in the other file as well. If this is not done, it will lead to error during access to the data.

Example: *Assume Customer's details such as Cust_Last_Name, Cust_Mid_Name, Cust_First_Name, Cust_Email is stored both in the Customer_Details file and the Customer_Fixed_Deposit file. If the Email ID of one Customer, for example, Langer S. Justin changes from Langer_Justin@yahoo.com to Langer_Justin@rediffmail.com, the Cust_Email has to be updated in both the files; otherwise it will lead to inconsistent data.*

However, one can design file systems with minimal redundancy. Data redundancy is sometimes preferred. Example: Assume the Customer's details such as Cust_Last_Name, Cust_Mid_Name, Cust_First_Name and Cust_Email are not stored in the Customer_Fixed_Deposit file. If it is required to get this information about the customer along with his fixed deposit details, it would mean that the details be retrieved from two files. This would mean an increased overhead. It is thus preferred to store the information in the Customer_Fixed Deposit file itself.

Data Isolation: Data Isolation means that all the related data is not available in one file. Generally, the data is scattered in various files, and the files may be in different formats, therefore writing new application programs to retrieve the appropriate data is difficult.



The Database Technology

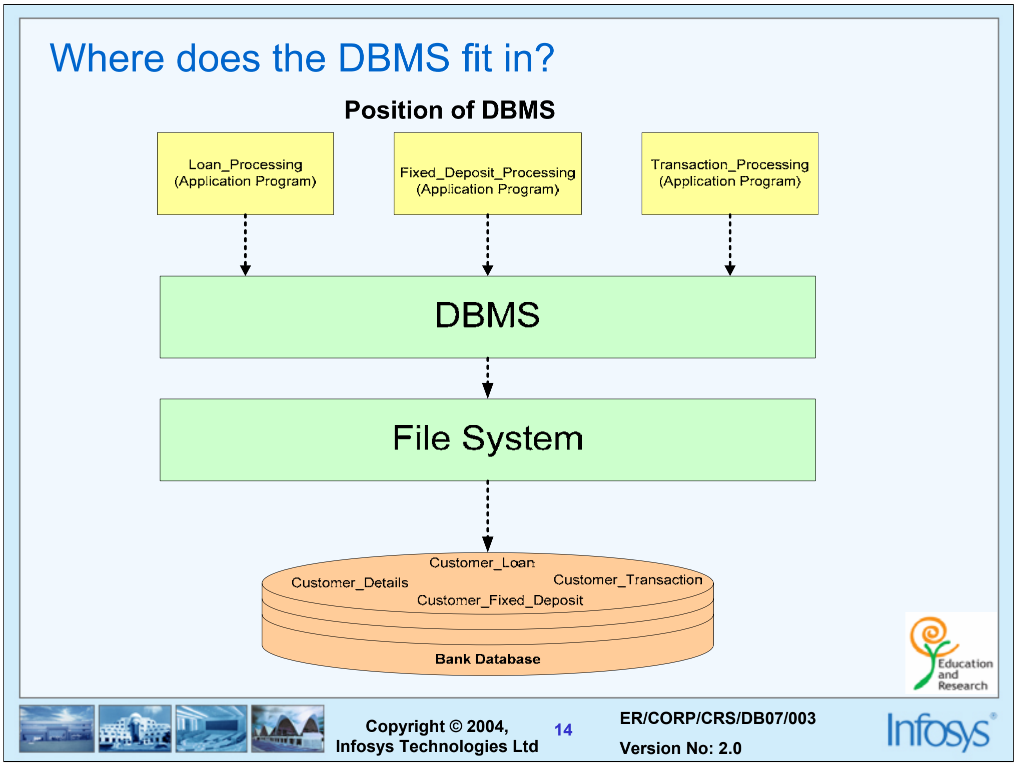
Database

- Computer based record-keeping system
- Organized collection of interrelated (persistent) data
- Records & maintains data

Database Management System

- Collection of interrelated files and set of programs which allows users to access and modify files
- *Primary Goal is to provide a convenient and efficient way to store, retrieve and modify information*
- Layer of abstraction between the application programs and the file system

•Application programs request the DBMS to retrieve, modify, insert or delete data for them



Where does the DBMS fit in?

Position of DBMS

Loan_Processing (Application Program)

Fixed_Deposit_Processing (Application Program)

Transaction_Processing (Application Program)

DBMS

File System

Customer_Loan

Customer_Details

Customer_Transaction

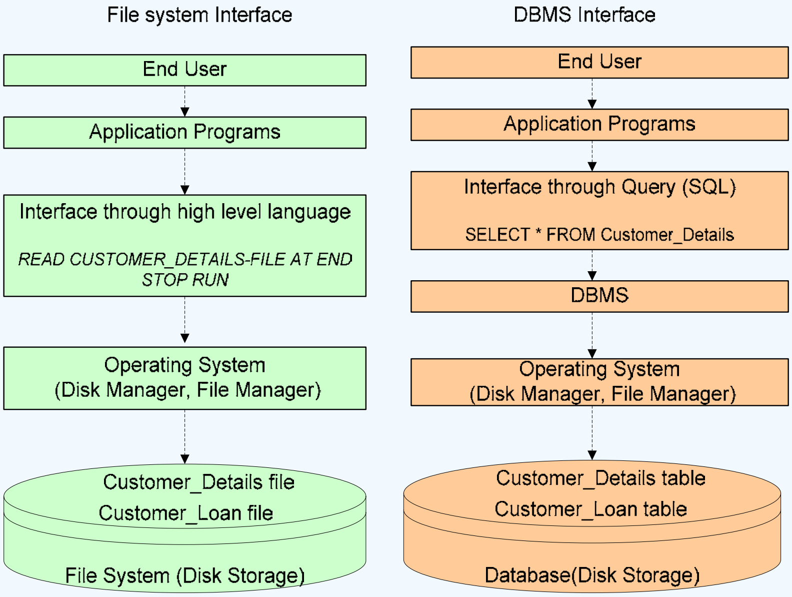
Customer_Fixed_Deposit

Bank Database

- Now, the DBMS acts as a layer of abstraction on top of the File system.

- You might have observed that, for interacting with the file system, we were using high level language functions for example, the ‘c’ file handling functions. For interacting with the DBMS we would be using a Query language called SQL

Difference Between File and DBMS Operations



File system Interface

End User

Application Programs

Interface through high level language

READ CUSTOMER_DETAILS-FILE AT END STOP RUN

Operating System (Disk Manager, File Manager)

Customer_Details file

Customer_Loan file

File System (Disk Storage)

DBMS Interface

End User

Application Programs

Interface through Query (SQL)

SELECT * FROM Customer_Details

DBMS

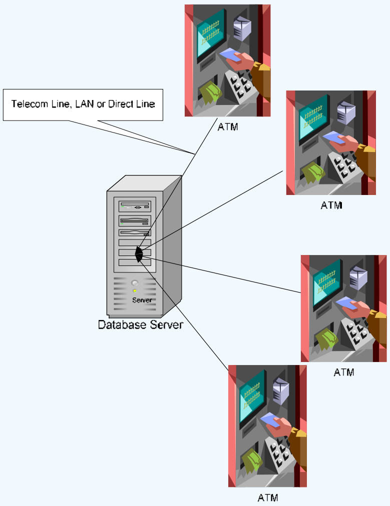
Operating System (Disk Manager, File Manager)

Customer_Details table

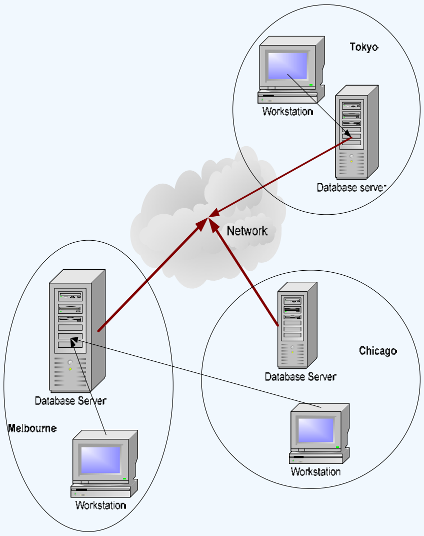
Customer_Loan table

Database(Disk Storage)

Types of Databases



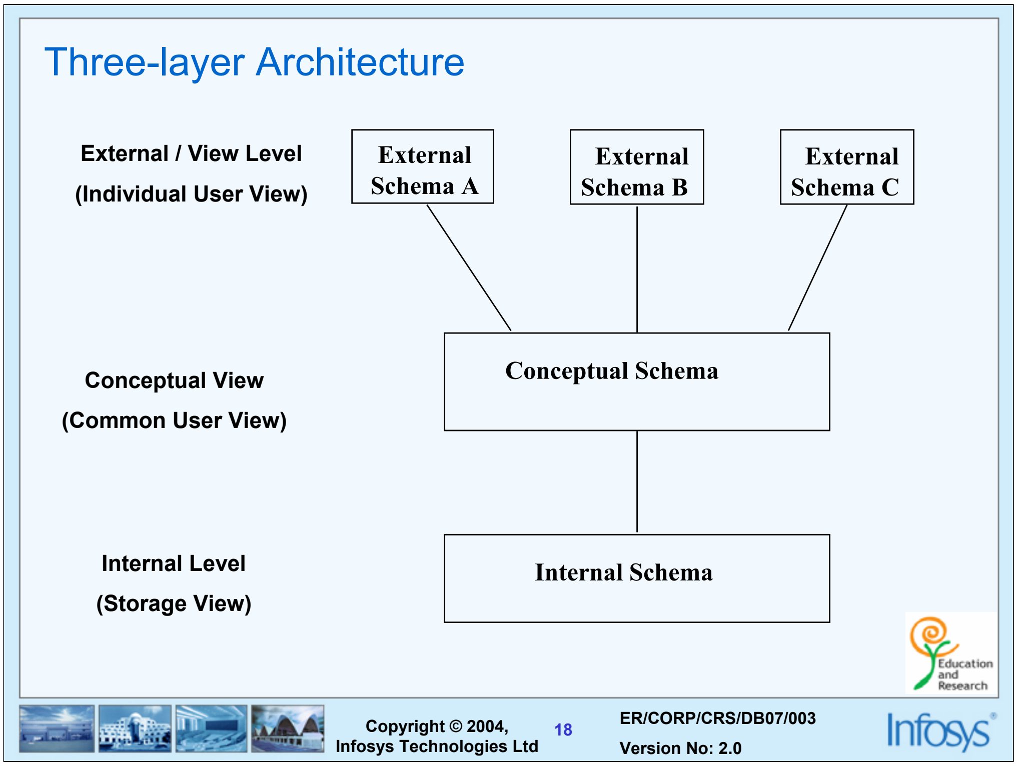
Centralized Database



Distributed Database

TYPES OF DATABASES

Centralized	Distributed
• All data is located at a single *site* • Allows for greater control over accessing and updating data • Vulnerable to failure as they depend on the availability of resources at the central site ***Example:*** *The account information of customers is stored in a particular branch office of a bank. This information must be shared across all Automated Teller Machines (ATM), so that customers can withdraw money from their accounts. Instead of storing the customer information in every ATM machine it can be stored at a common place (the branch office of the bank) and shared over a network.*	• The database is stored on several computers - from personal computers up to mainframe systems • Computers in a distributed system communicate with one another through various communication media, such as high speed networks or telephone lines • Distributed databases are geographically separated and managed • Distributed databases are separately administered • Distributed databases have a slower interconnection ***Example:*** *Consider the bank system. The bank's head office is located at Chicago and the branch offices are at Melbourne and Tokyo. The bank database is distributed across the branch offices. The branch offices are connected through a network*



Three-layer Architecture

External / View Level

(Individual User View)

Conceptual View

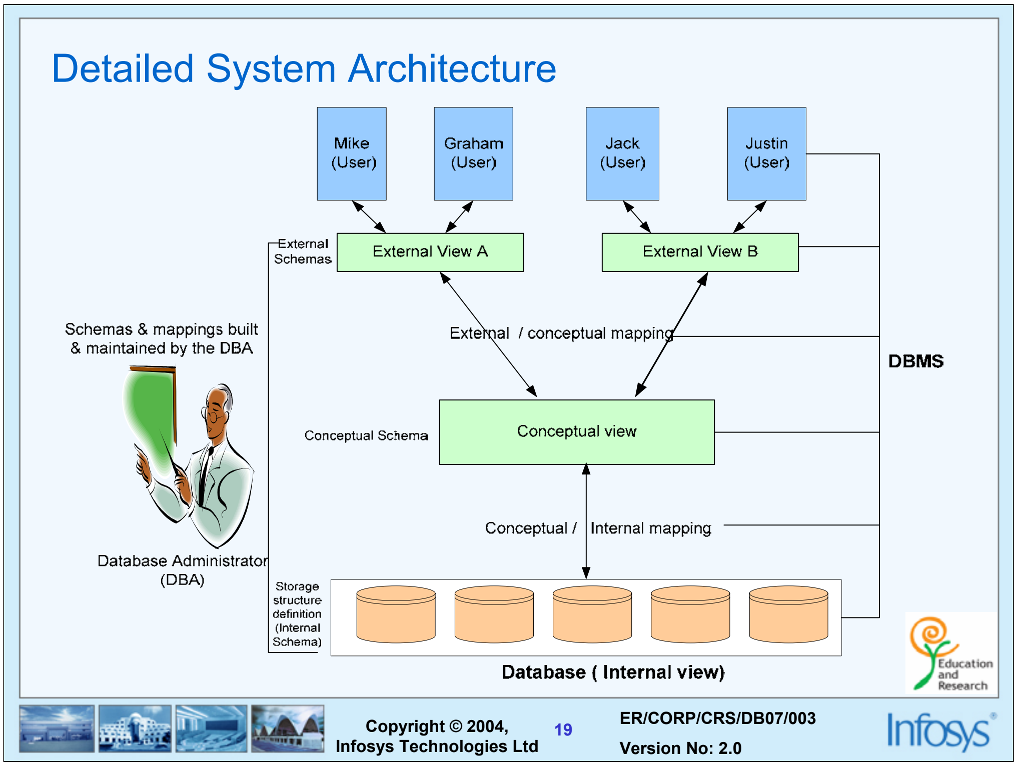
(Common User View)

Internal Level

(Storage View)

Services provided by a DBMS

- Data management
- Data definition
- Transaction support
- Concurrency control
- Recovery
- Security & integrity
- Utilities- facilities like data import & export, user management, backup, performance analysis, logging & audit, physical storage control



Detailed System Architecture

Mike (User)

Graham (User)

Jack (User)

Justin (User)

External Schemas

External View A

External View B

External / conceptual mapping

DBMS

Schemas & mappings built & maintained by the DBA

Conceptual Schema

Conceptual view

Conceptual / Internal mapping

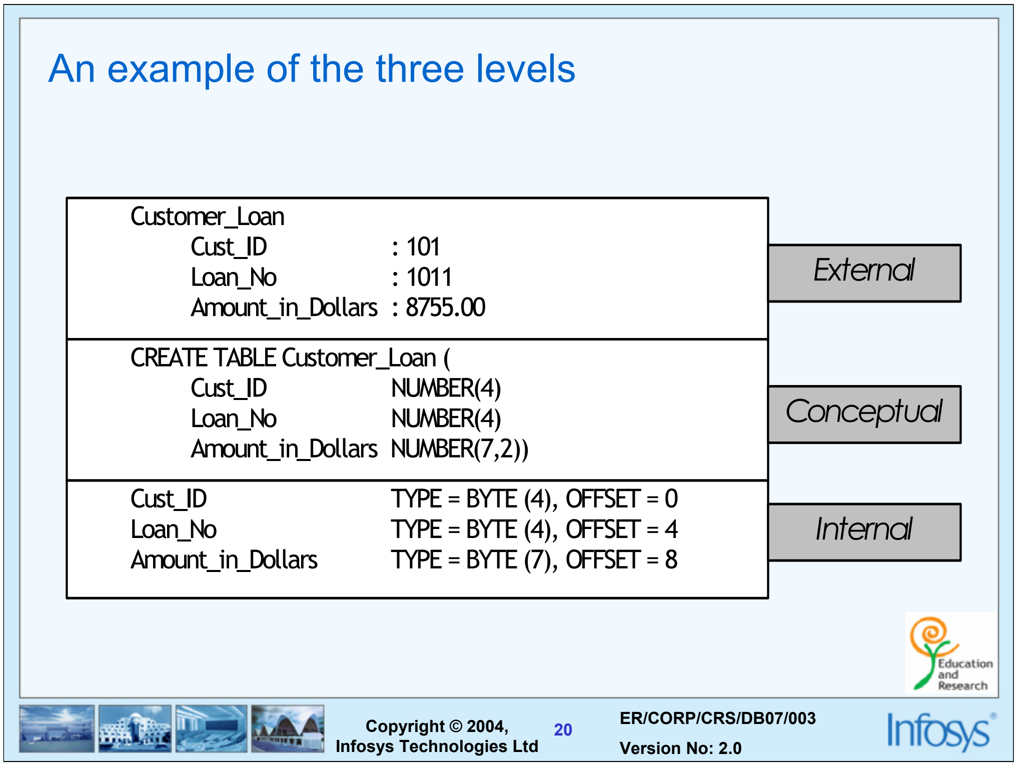
Database Administrator (DBA)

Storage structure definition (Internal Schema)

Database (Internal view)

Education and Research

In the above figure, the three level of DBMS architecture is depicted. The External view is how the Customer, Smith A. Mike views it. The Conceptual view is how the DBA views it. The Internal view is how the data is actually stored.



An example of the three levels

External

```
Customer_Loan
        Cust_ID              : 101
        Loan_No              : 1011
        Amount_in_Dollars    : 8755.00
```

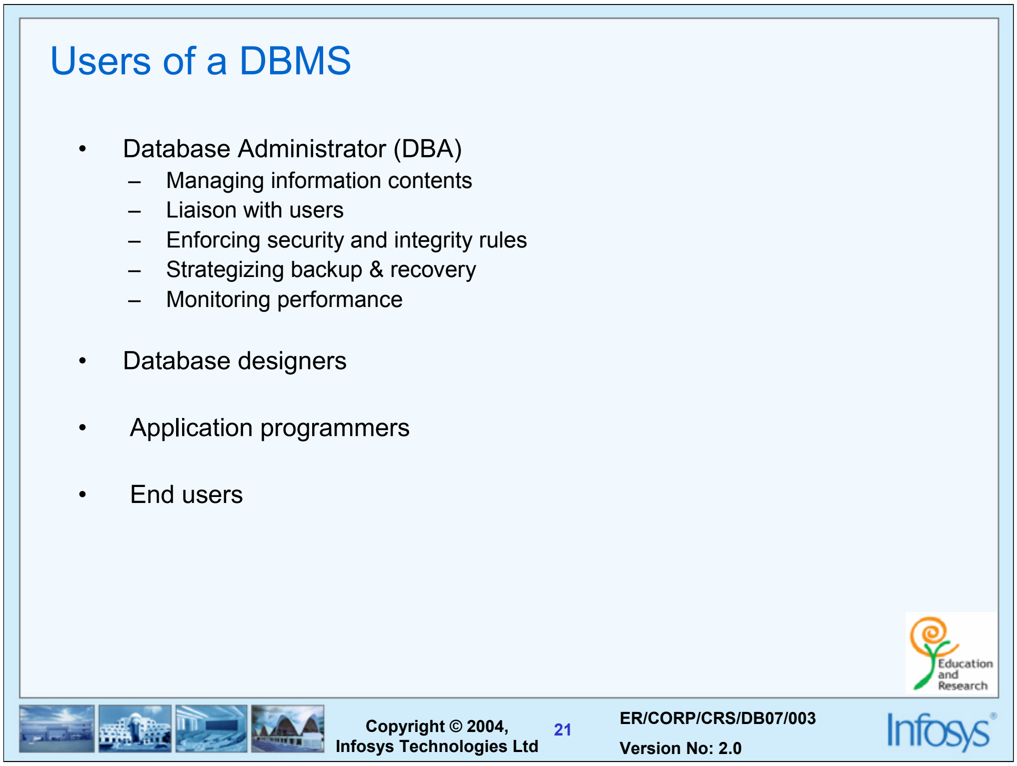
Conceptual

```
CREATE TABLE Customer_Loan (
        Cust_ID              NUMBER(4)
        Loan_No              NUMBER(4)
        Amount_in_Dollars    NUMBER(7,2))
```

Internal

```
Cust_ID                      TYPE = BYTE (4), OFFSET = 0
Loan_No                      TYPE = BYTE (4), OFFSET = 4
Amount_in_Dollars            TYPE = BYTE (7), OFFSET = 8
```

Education and Research



Users of a DBMS

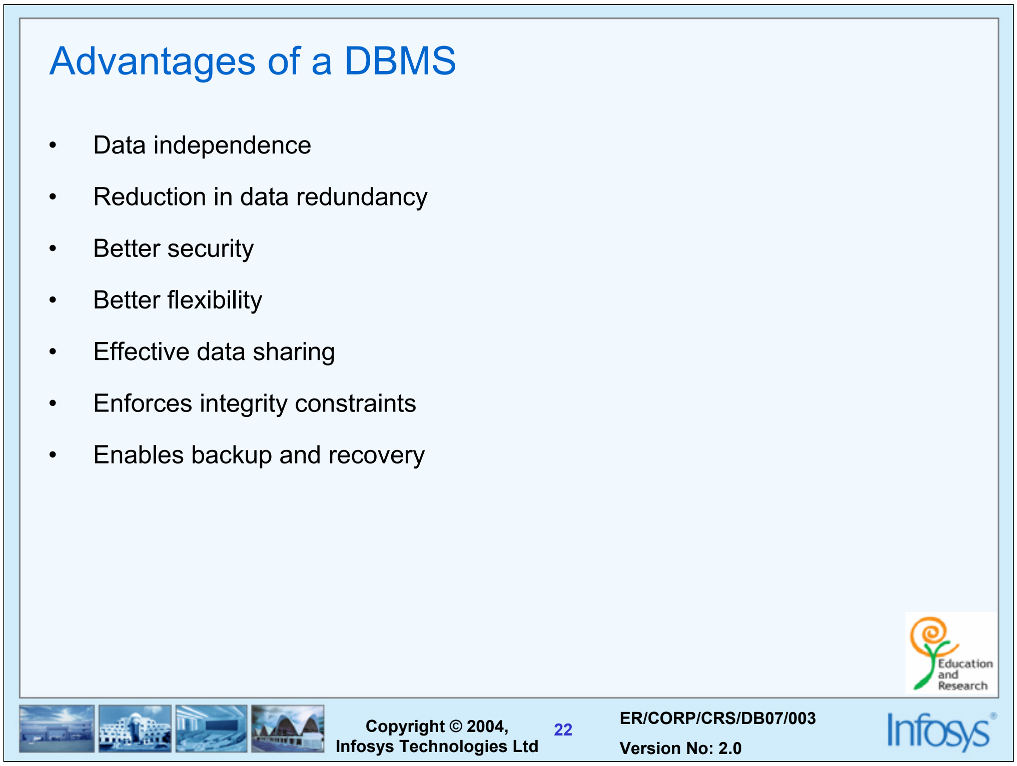
- Database Administrator (DBA)
  - Managing information contents
  - Liaison with users
  - Enforcing security and integrity rules
  - Strategizing backup & recovery
  - Monitoring performance
- Database designers
- Application programmers
- End users

•DBA is a key person and takes care of most administrative tasks as mentioned in the slide

•Database designers, design the database elements

•Application programmers, make use of the various database elements and write programs to retrieve data from them

•End users use the DBMS



Advantages of a DBMS

- Data independence
- Reduction in data redundancy
- Better security
- Better flexibility
- Effective data sharing
- Enforces integrity constraints
- Enables backup and recovery

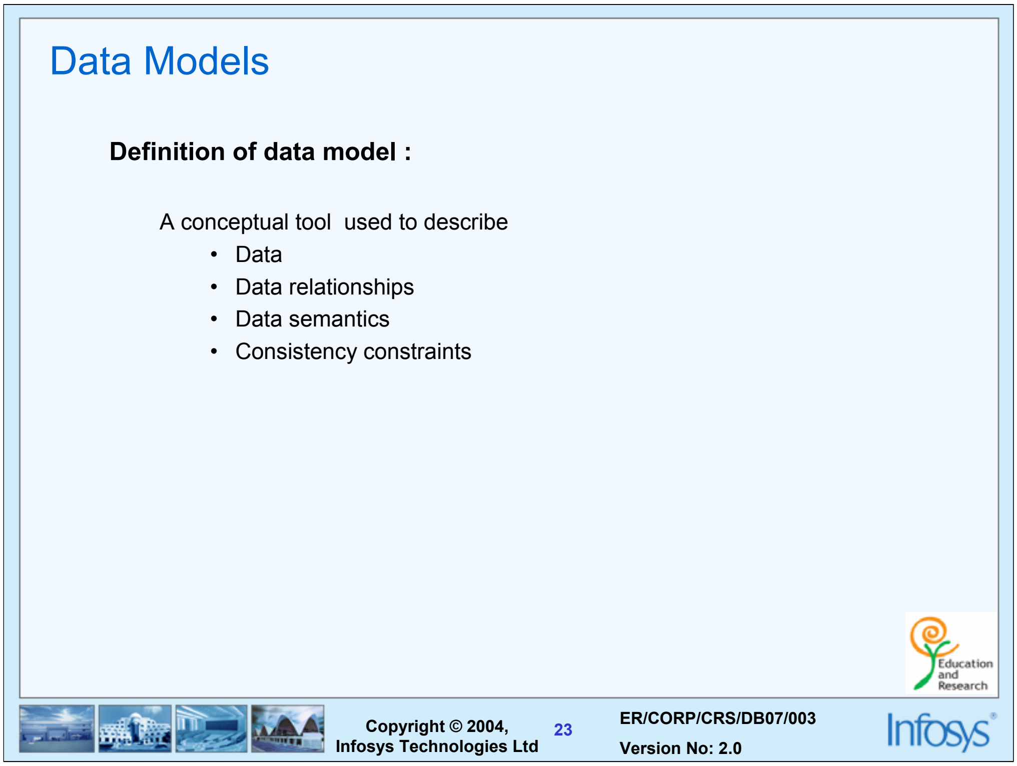
1. Users and application programs need not know exactly where or how the data is stored in order to access it

2. Proper database design can reduce or eliminate data redundancy and confusion

3.Support for unforeseen (ad hoc) information requests are better supported - ***better flexibility***

4. Data can be more effectively shared between users and/or application programs

Data can be stored for long term analysis (data warehousing)



Data Models

Definition of data model :

A conceptual tool used to describe

- Data
- Data relationships
- Data semantics
- Consistency constraints

Commercial Packages

•Hierarchical Model - IMS

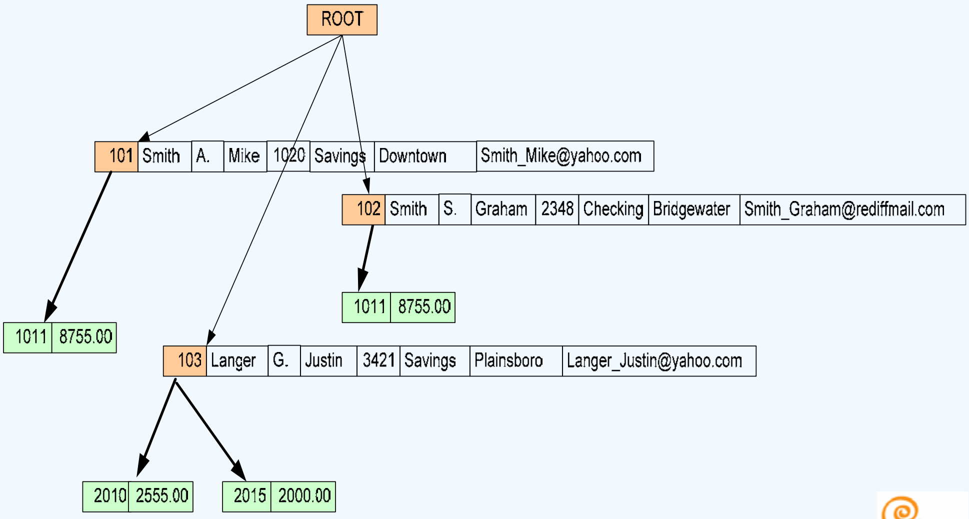
•Network Model - IDMS

•Relational Model - Oracle, DB2

Types of data models

- Object based logical model
  - Entity relationship model
- Record based logical model
  - Hierarchical data model
  - Network data model
  - Relational data model

Record based data model – Hierarchical data model



ROOT

101 Smith A. Mike 1020 Savings Downtown Smith_Mike@yahoo.com

1011 8755.00

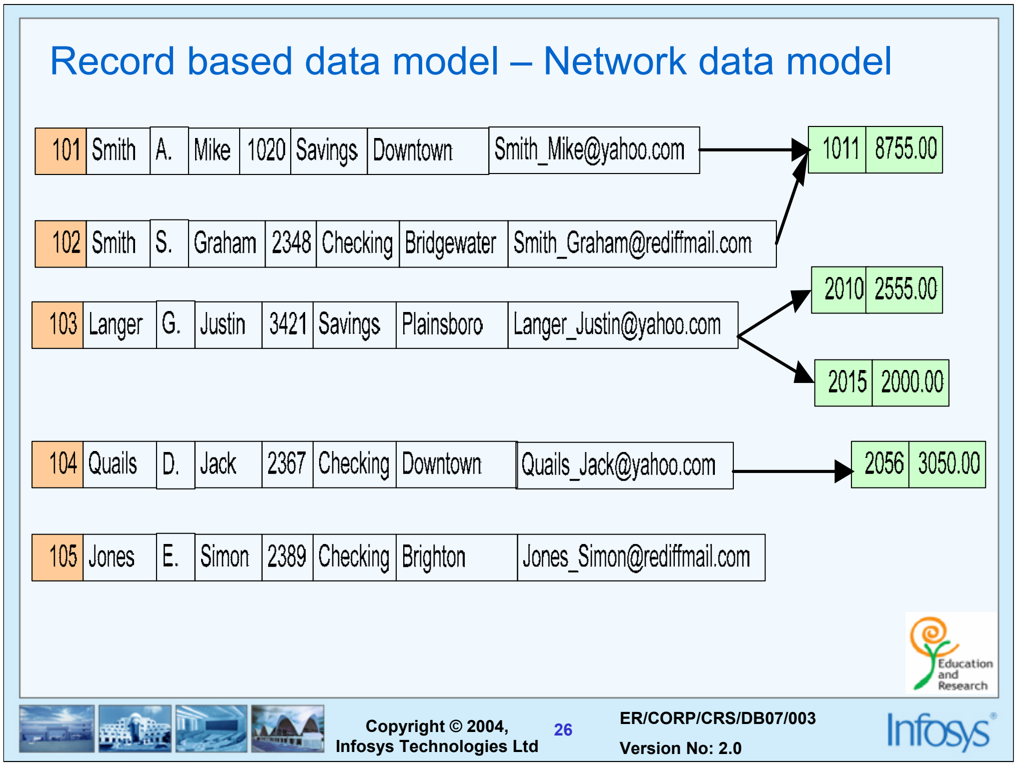
102 Smith S. Graham 2348 Checking Bridgewater Smith_Graham@rediffmail.com

1011 8755.00

103 Langer G. Justin 3421 Savings Plainsboro Langer_Justin@yahoo.com

2010 2555.00

2015 2000.00

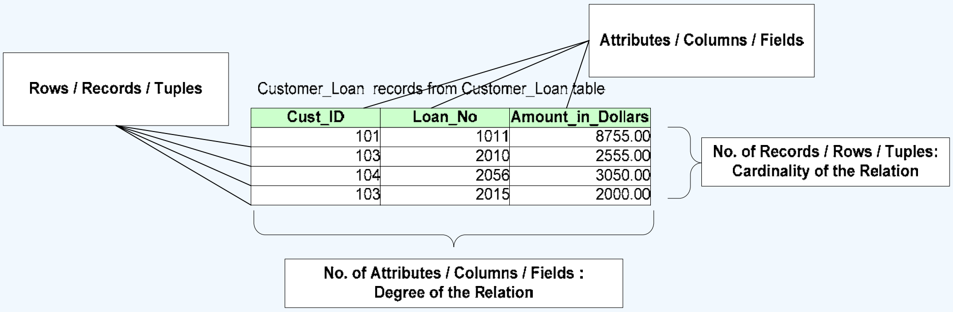


Record based data model – Network data model

101	Smith	A.	Mike	1020	Savings	Downtown	Smith_Mike@yahoo.com
102	Smith	S.	Graham	2348	Checking	Bridgewater	Smith_Graham@rediffmail.com
103	Langer	G.	Justin	3421	Savings	Plainsboro	Langer_Justin@yahoo.com
104	Quails	D.	Jack	2367	Checking	Downtown	Quails_Jack@yahoo.com
105	Jones	E.	Simon	2389	Checking	Brighton	Jones_Simon@rediffmail.com

1011	8755.00
2010	2555.00
2015	2000.00
2056	3050.00

Record based data model – Relational data model



Attributes / Columns / Fields

Rows / Records / Tuples

Customer_Loan records from Customer_Loan table

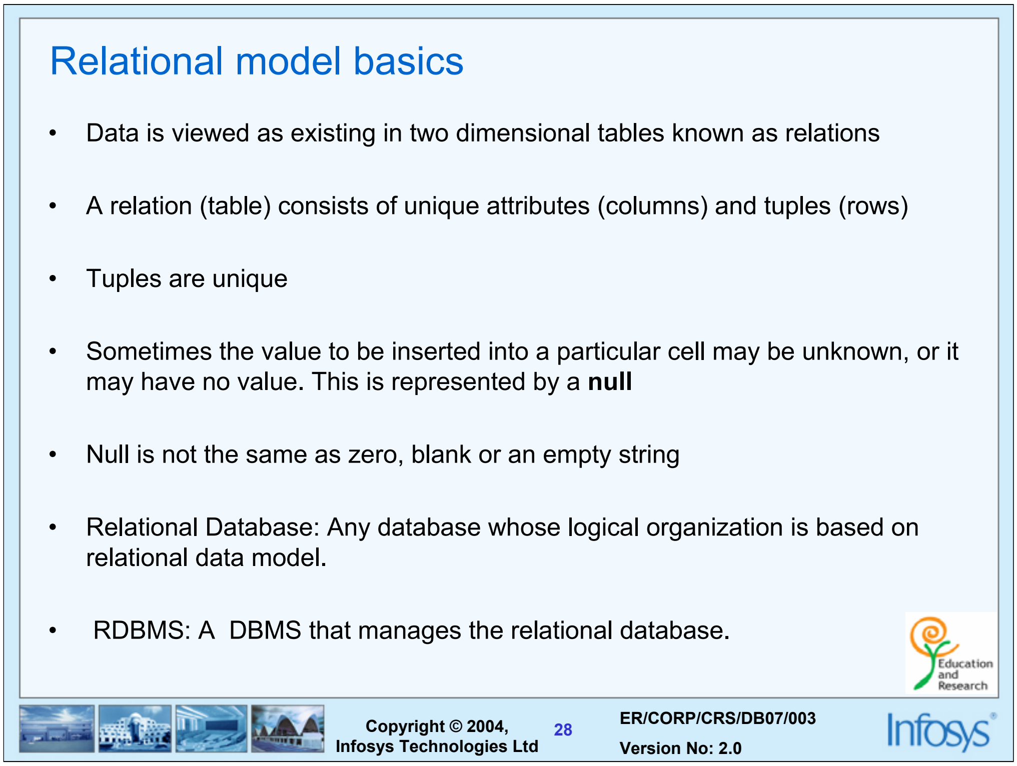
Cust_ID	Loan_No	Amount_in_Dollars
101	1011	8755.00
103	2010	2555.00
104	2056	3050.00
103	2015	2000.00

No. of Records / Rows / Tuples: Cardinality of the Relation

No. of Attributes / Columns / Fields : Degree of the Relation

Cust_ID	Cust_Last_ Name	Cust_Mid _Name	Cust_First _Name	Account _No	Account_ Type	Bank_Branch	Cust_Email
101	Smith	A.	Mike	1020	Savings	Downtown	Smith_Mike@yahoo.com
102	Smith	S.	Graham	2348	Checking	Bridgewater	Smith_Graham@rediffmail.com
103	Langer	G.	Justin	3421	Savings	Plainsboro	Langer_Justin@yahoo.com
104	Quails	D.	Jack	2367	Checking	Downtown	Quails_Jack@yahoo.com
105	Jones	E.	Simon	2389	Checking	Brighton	Jones_Simon@rediffmail.com

Customer_Detail records from Customer_Details table

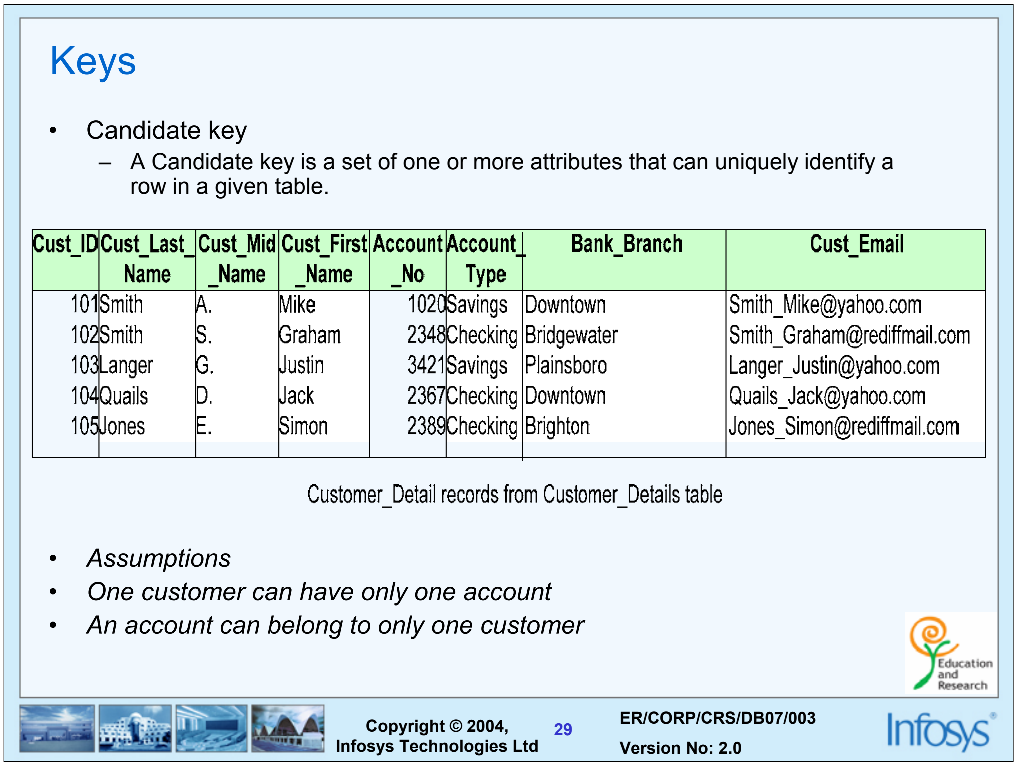


Relational model basics

- Data is viewed as existing in two dimensional tables known as relations
- A relation (table) consists of unique attributes (columns) and tuples (rows)
- Tuples are unique
- Sometimes the value to be inserted into a particular cell may be unknown, or it may have no value. This is represented by a **null**
- Null is not the same as zero, blank or an empty string
- Relational Database: Any database whose logical organization is based on relational data model.
- RDBMS: A DBMS that manages the relational database.

•Though logically data is viewed as existing in the form of two dimensional tables, actually, the data is stored under the file system only.

•The RDBMS provides an abstraction on top of the file system and gives an illusion that data resides in the form of tables.



Keys

- Candidate key
  - A Candidate key is a set of one or more attributes that can uniquely identify a row in a given table.

Cust_ID	Cust_Last_Name	Cust_Mid_Name	Cust_First_Name	Account_No	Account_Type	Bank_Branch	Cust_Email
101	Smith	A.	Mike	1020	Savings	Downtown	Smith_Mike@yahoo.com
102	Smith	S.	Graham	2348	Checking	Bridgewater	Smith_Graham@rediffmail.com
103	Langer	G.	Justin	3421	Savings	Plainsboro	Langer_Justin@yahoo.com
104	Quails	D.	Jack	2367	Checking	Downtown	Quails_Jack@yahoo.com
105	Jones	E.	Simon	2389	Checking	Brighton	Jones_Simon@rediffmail.com

Customer_Detail records from Customer_Details table

- *Assumptions*
- *One customer can have only one account*
- *An account can belong to only one customer*

Superkey

An attribute, or group of attributes, that is sufficient to distinguish every tuple in the relation from every other one.

Each super key is called a *candidate key*

A candidate key is all those set of attributes which can uniquely identify a row. However, any subset of these set of attributes would not identify a row uniquely

For example, in a shipment table, "S#, P#" is a candidate key. But, S# alone or P# alone would not uniquely identify a row of the shipment table.

Primary key

The candidate key that is chosen to perform the identification task is called the ***primary key*** and any others are ***alternate keys***

Every tuple must have, by definition, **a unique value for its primary key.** A primary key which is a combination of more than one attribute is called a ***composite primary key***

Foreign key

•A *foreign* key is a "copy" of a primary key that has been exported from one relation into another to represent the existence of a relationship between them. A foreign key is a copy of the *whole* of its parent primary key i.e if the primary key is composite, then so is the foreign key

•Foreign key values do not (usually) have to be unique

•Foreign keys can also be *null*

•A composite foreign key **cannot** have some attribute(s) null and others non-null

Overlapping candidate keys: Two candidate keys overlap if they involve any attribute in common. For e.g, in an Employee table, E#, Ename and Emailid, Ename are two overlapping candidate keys. (they have Ename in common)

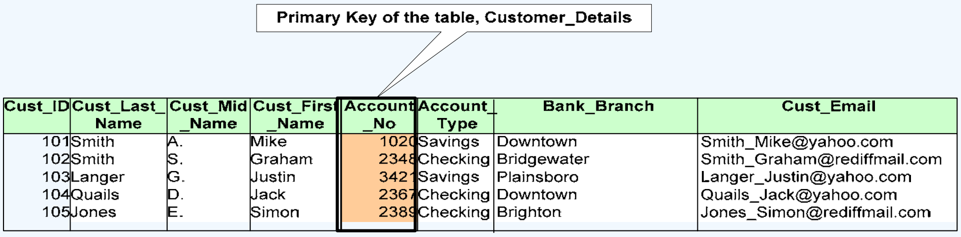
Attribute that does not participate in any candidate key is called a **Non-key attribute**

Keys

- Super key
  - Any superset of a candidate Key is a super key.

Keys

- Primary key
  - During the creation of the table, the Database Designer chooses one of the Candidate Key from amongst the several available, to uniquely identify row in the given table.



Primary Key of the table, Customer_Details

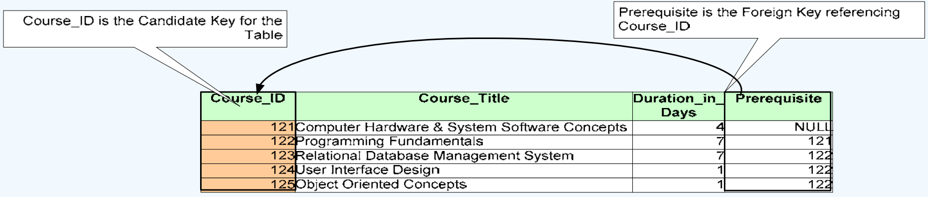
Cust_ID	Cust_Last_Name	Cust_Mid_Name	Cust_First_Name	Account_No	Account_Type	Bank_Branch	Cust_Email
101	Smith	A.	Mike	1020	Savings	Downtown	Smith_Mike@yahoo.com
102	Smith	S.	Graham	2348	Checking	Bridgewater	Smith_Graham@rediffmail.com
103	Langer	G.	Justin	3421	Savings	Plainsboro	Langer_Justin@yahoo.com
104	Quails	D.	Jack	2367	Checking	Downtown	Quails_Jack@yahoo.com
105	Jones	E.	Simon	2389	Checking	Brighton	Jones_Simon@rediffmail.com

Customer_Detail records from Customer_Details table

  - Give preference to numeric column(s)
  - Give preference to single attribute
  - Give preference to minimal composite key

Keys

- Foreign key
  - A Foreign Key is a set of attribute (s) whose values are required to match values of a Candidate key in the same or another table.



Course_ID is the Candidate Key for the Table

Prerequisite is the Foreign Key referencing Course_ID

Course_ID	Course_Title	Duration_in_ Days	Prerequisite
121	Computer Hardware & System Software Concepts	4	NULL
122	Programming Fundamentals	7	121
123	Relational Database Management System	7	122
124	User Interface Design	1	122
125	Object Oriented Concepts	1	122

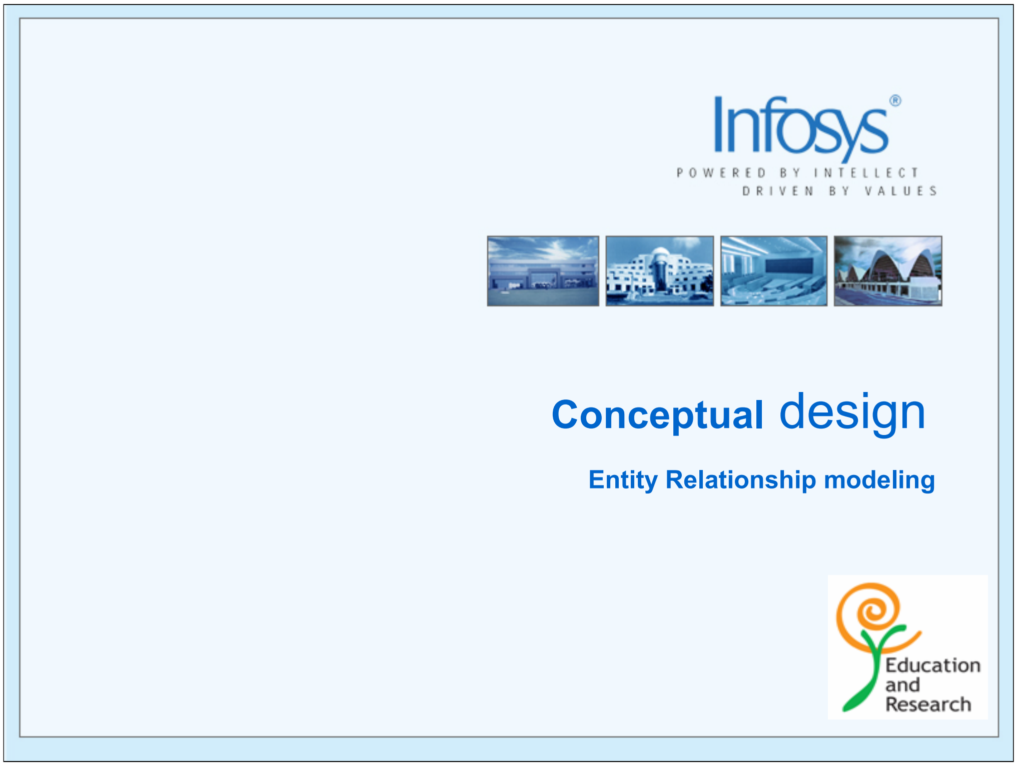
- Point to remember
  - A Foreign Key is a set of attributes of a table, whose values are required to match values of some Candidate Key in the same or another table
  - The constraint that values of a given Foreign Key must match the values of the corresponding Candidate Key is known as Referential constraint
  - A table which has a Foreign Key referring to its own Candidate Key is known as Self-Referencing table
  - Any superset of a Candidate Key is a Super Key
  - The attributes other than the Primary Key attributes in a table/relation are called Non-Key attributes

Keys

- Non-Key Attributes
  - The attributes other than the Candidate Key attributes in a table/relation are called Non-Key attributes.

    OR

  - The attributes which do not participate in any of the Candidate keys..



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Conceptual design

Entity Relationship modeling

Education and Research

Database Design Techniques

- Top down Approach
  - E R Modeling
- Bottom Up approach
  - Normalization

ER modeling

- **ER modeling:** A graphical technique for *understanding* and organizing the data independent of the actual database implementation

- **Entity:** Any thing that may have an independent existence and about which we intend to collect data.

  Also known as **Entity type.**

- **Entity instance:** a particular member of the entity type e.g. a particular student

- **Attributes:** Properties/characteristics that describe entities

- **Relationships:** Associations between entities

Attributes

- The set of possible values for an attribute is called the **domain** of the attribute Example:
  - The domain of attribute ***marital status*** is just the four values: single, married, divorced, widowed
  - The domain of the attribute month is the twelve values ranging from January to December
- **Key attribute***:* The attribute (or combination of attributes) that is unique for every entity instance
  - E.g the account number of an account, the employee id of an employee etc.
- If the key consists of two or more attributes in combination, it is called a **composite key**

Simple Vs composite attribute

- **Simple attribute**: cannot be divided into simpler components

  E.g age of an employee

- **Composite attribute**: can be split into components

  E.g Date of joining of the employee.

  – Can be split into day, month and year

Single Vs Multi-valued Attributes

- **Single valued** : can take on only a single value for each entity instance

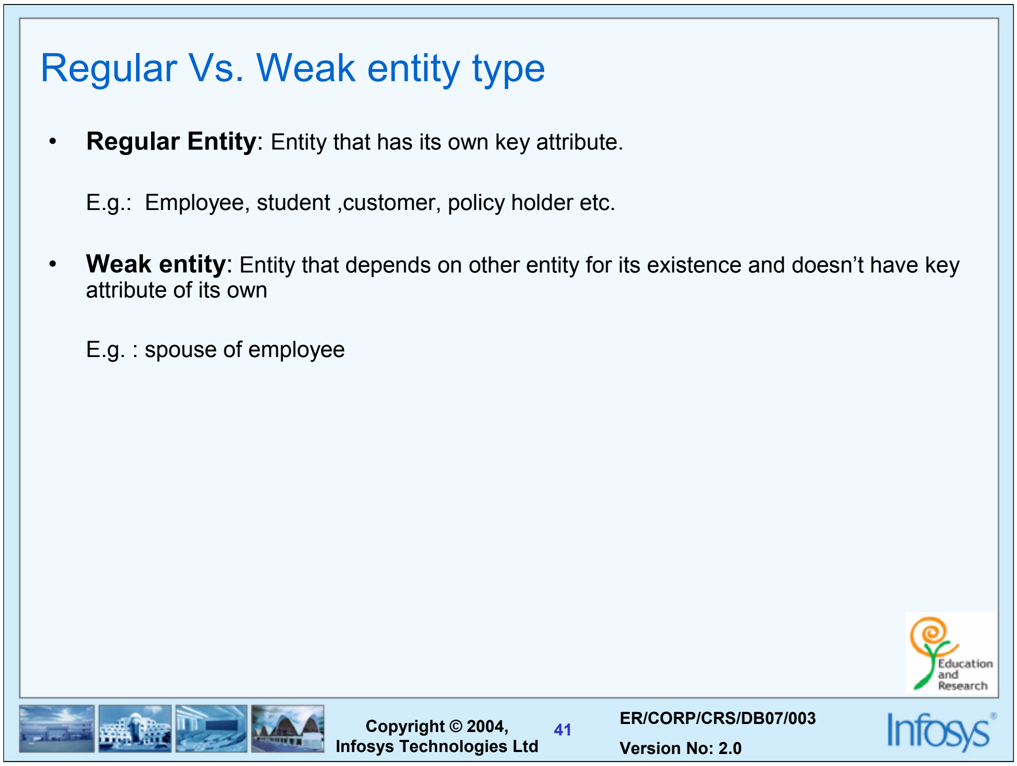
  E.g. ***age*** of employee. There can be only one value for this

- **Multi-valued**: can take many values

  E.g. ***skill set*** of employee

Stored Vs Derived attribute

- **Stored Attribute**: Attribute that need to be stored permanently.
  - E.g. ***name*** of an employee
- **Derived Attribute**: Attribute that can be calculated based on other attributes
  - E.g. : ***years of service*** of employee can be calculated from date of joining and current date



Regular Vs. Weak entity type

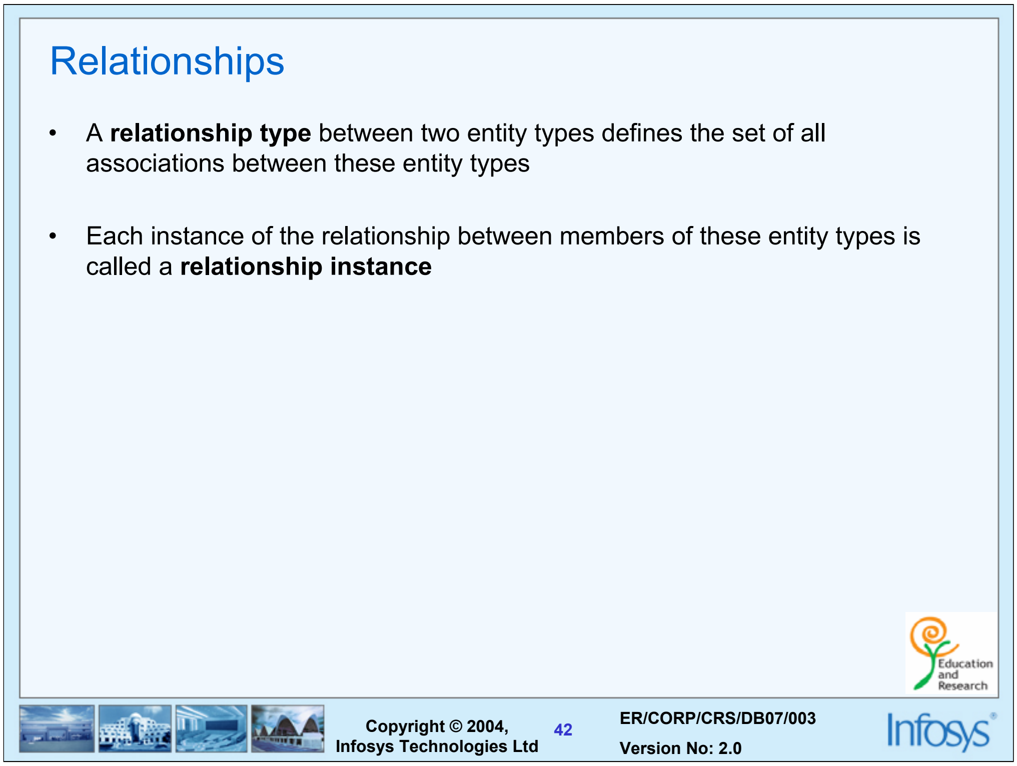
- **Regular Entity**: Entity that has its own key attribute.

  E.g.: Employee, student ,customer, policy holder etc.

- **Weak entity**: Entity that depends on other entity for its existence and doesn't have key attribute of its own

  E.g. : spouse of employee

The spouse data is identified with the help of the employee id to which it is related



Relationships

- A **relationship type** between two entity types defines the set of all associations between these entity types

- Each instance of the relationship between members of these entity types is called a **relationship instance**

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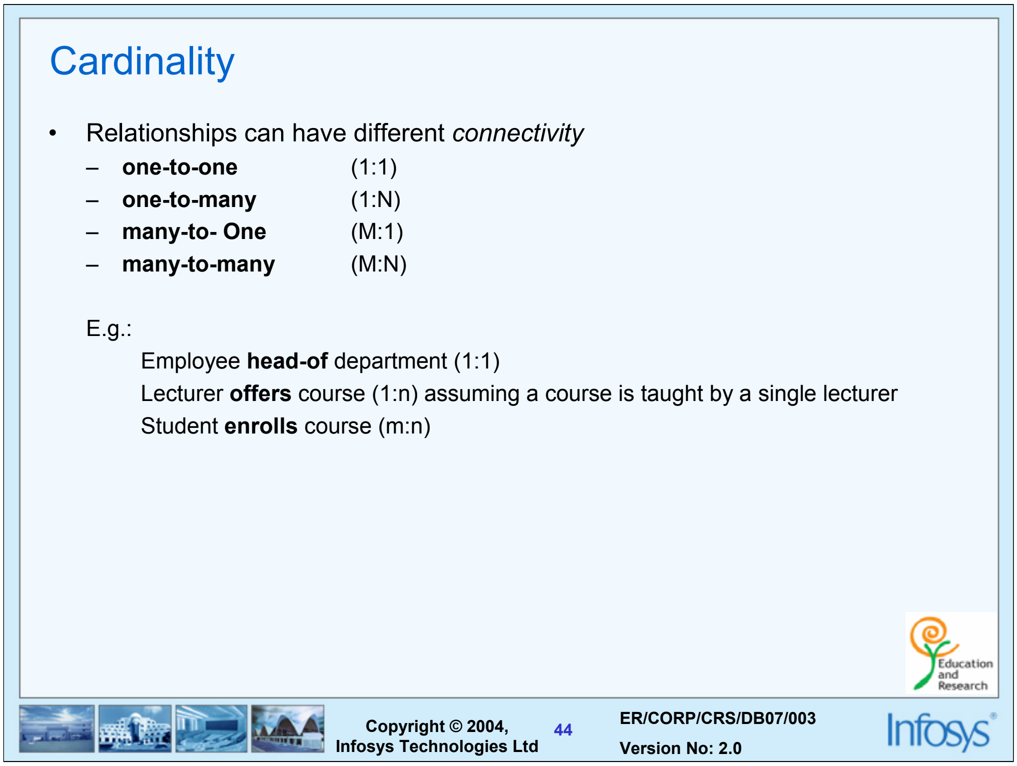
E.g if **Works-for** is the relationship between the Employee entity and the department entity, then Ram works for Comp.sc department, shyam works –for electrical department ..etc are relationship instances of the relationship, works-for

Degree of a Relationship

- **Degree**: the number of entity types involved

One	*Unary*
Two	*Binary*
Three	*Ternary*

*E.g.: employee **manager-of** employee is unary*
*employee **works-for** department is binary*
*customer **purchase** item, shop keeper is a ternary relationship*



Cardinality

- Relationships can have different *connectivity*

– **one-to-one**	(1:1)
– **one-to-many**	(1:N)
– **many-to- One**	(M:1)
– **many-to-many**	(M:N)

E.g.:

Employee **head-of** department (1:1)
Lecturer **offers** course (1:n) assuming a course is taught by a single lecturer
Student **enrolls** course (m:n)

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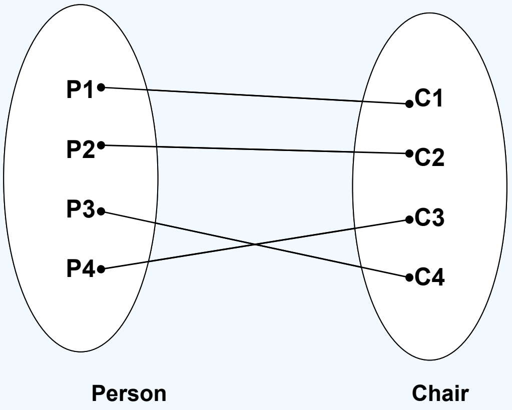
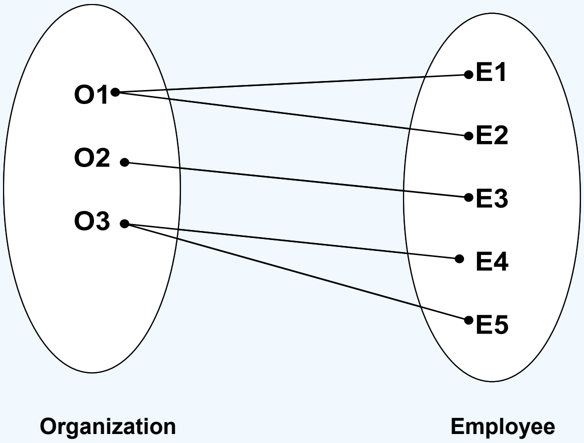
The minimum and maximum values of this connectivity is called the **cardinality of the relationship**

Cardinality – One - To - One



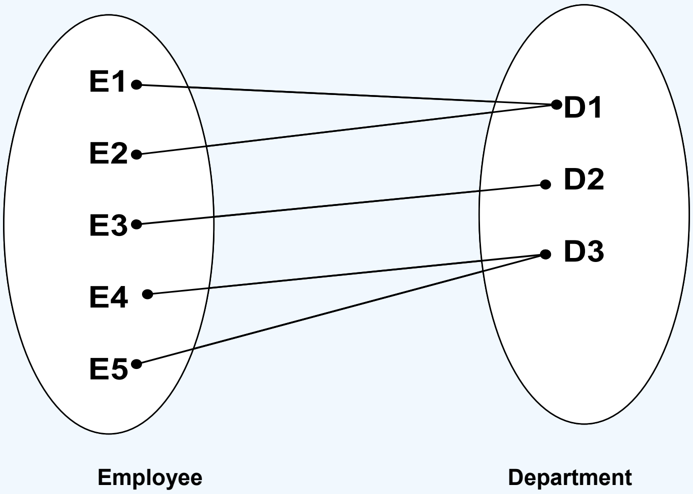
One instance of entity type Person
is related
to one instance of the entity type Chair.

Cardinality – One -to- Many



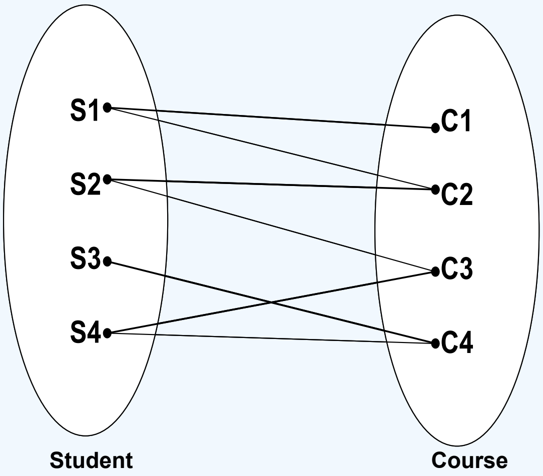
One instance of entity type Organization
is related
to multiple instances of entity type Employee

Cardinality – Many-to-One

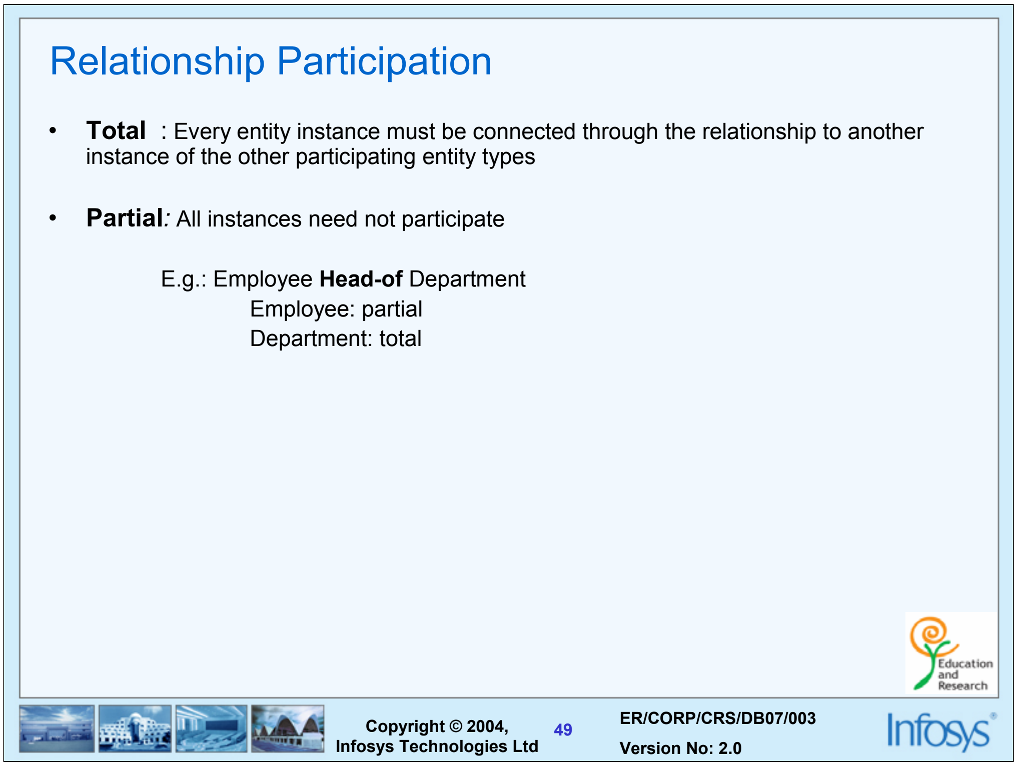


Reverse of the One to Many relationship.

Cardinality – Many-to-Many



Multiple instances of one Entity are related to multiple instances of another Entity.



Relationship Participation

- **Total** : Every entity instance must be connected through the relationship to another instance of the other participating entity types
- **Partial***:* All instances need not participate

E.g.: Employee **Head-of** Department
Employee: partial
Department: total

All employees will not be head-of some department. So only few instances of employee entity participate in the above relationship. But each department will be headed by some employee. So department entity's participation is total and employee entity's participation is partial in the above relationship

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DRIVEN BY VALUES

ER Modeling -Notations

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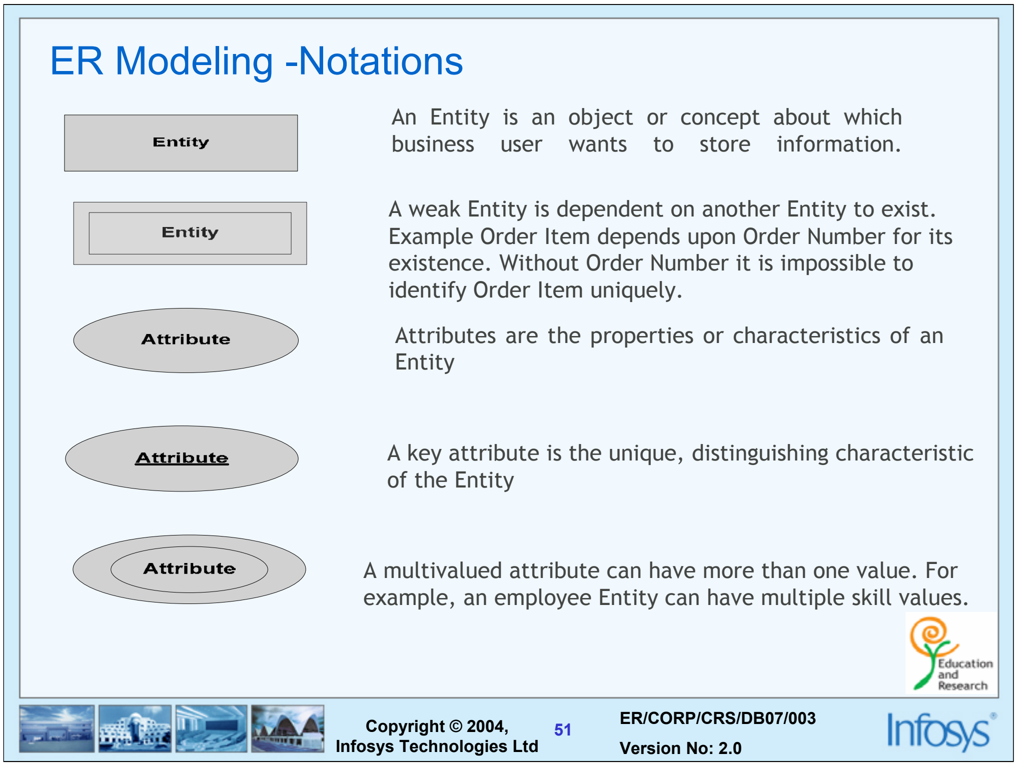


ER Modeling -Notations

Entity

An Entity is an object or concept about which business user wants to store information.

Entity

A weak Entity is dependent on another Entity to exist. Example Order Item depends upon Order Number for its existence. Without Order Number it is impossible to identify Order Item uniquely.

Attribute

Attributes are the properties or characteristics of an Entity

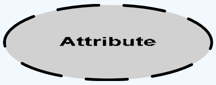
<u>Attribute</u>

A key attribute is the unique, distinguishing characteristic of the Entity

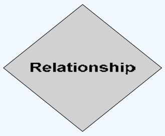
Attribute

A multivalued attribute can have more than one value. For example, an employee Entity can have multiple skill values.

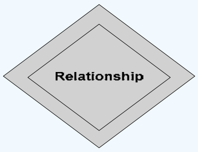
ER Modeling -Notations



A derived attribute is based on another attribute. For example, an employee's monthly salary is based on the employee's basic salary and House rent allowance.

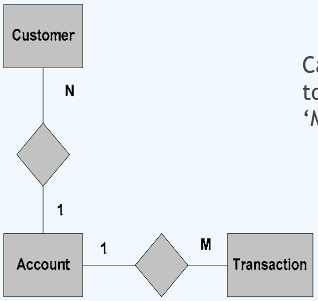


Relationships illustrate how two entities share information in the database structure.

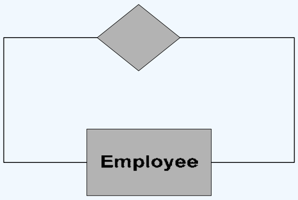


To connect a weak Entity with others, you should use a weak relationship notation.

ER Modeling -Notations

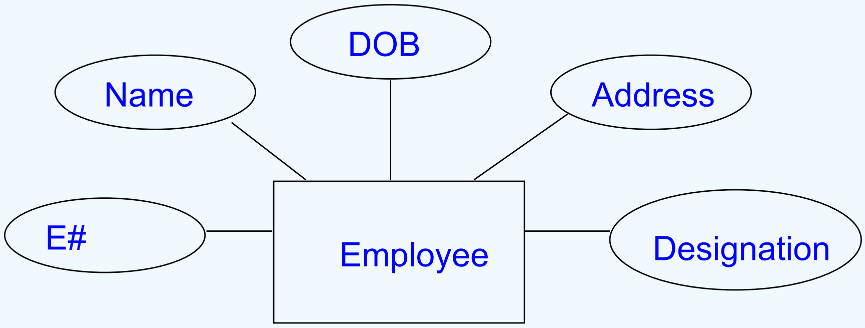


Cardinality specifies how many instances of an Entity relate to one instance of another Entity. M,N both represent ‘MANY’ and 1 represents ‘ONE’ Cardinality



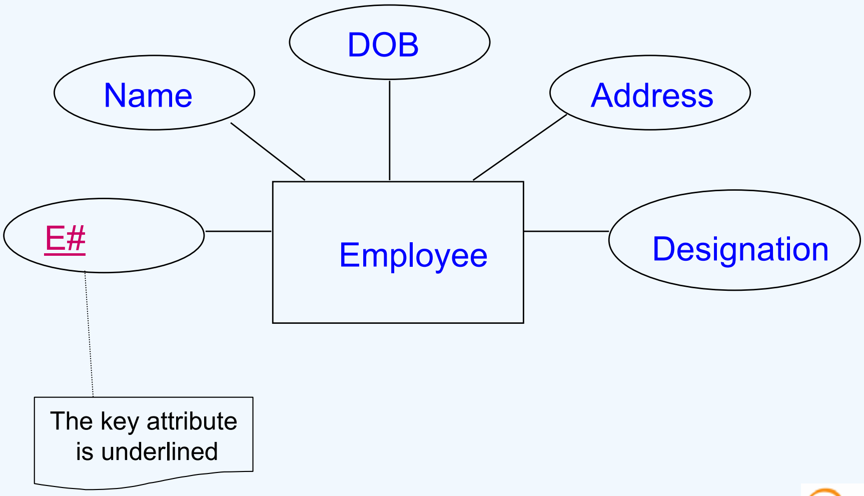
In some cases, entities can be self-linked. For example, employees can supervise other employees

Attributes



Represented by ellipses connected to the entity type by straight lines

Key attribute



DOB

Name

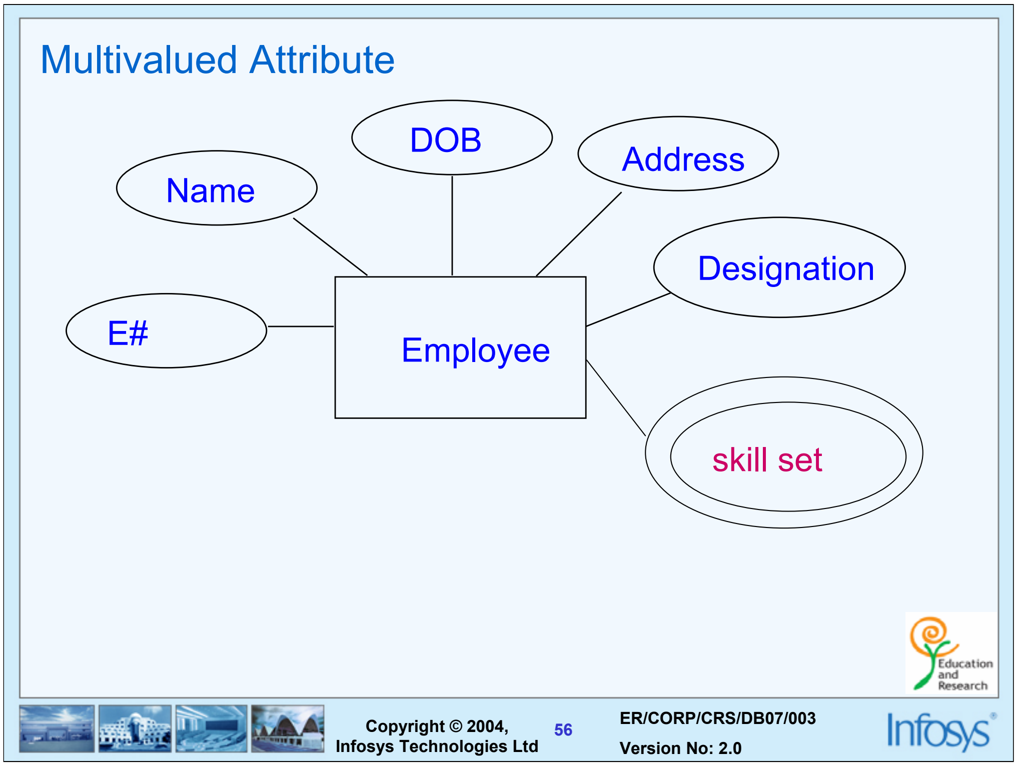
Address

E#

Employee

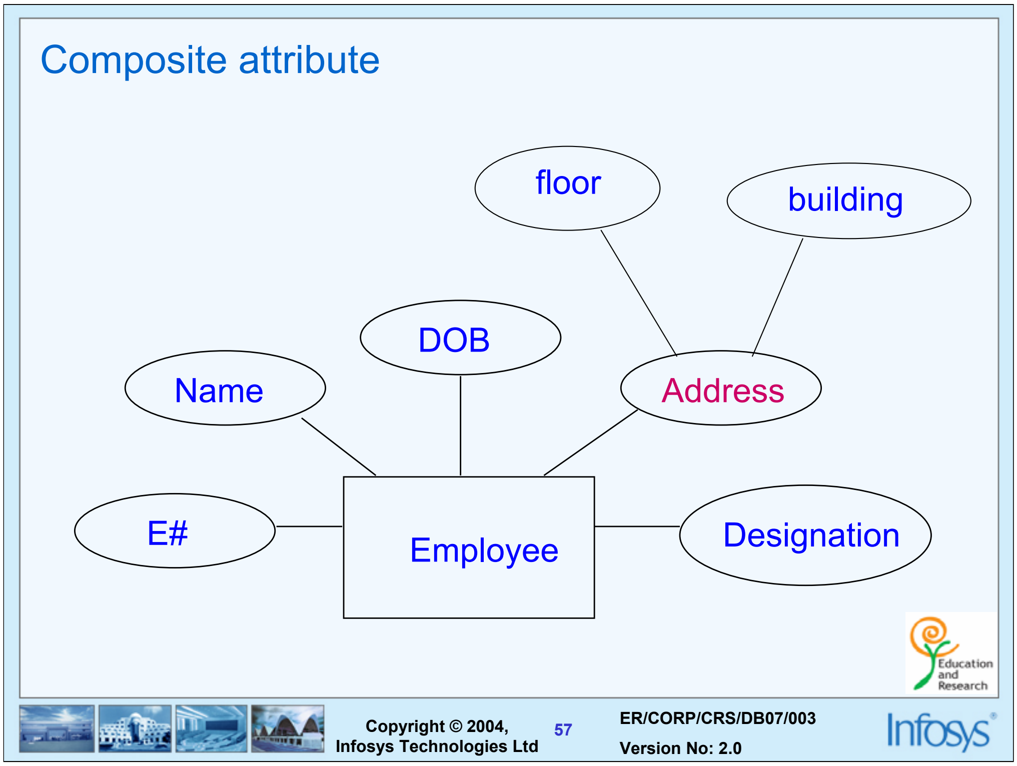
Designation

The key attribute is underlined



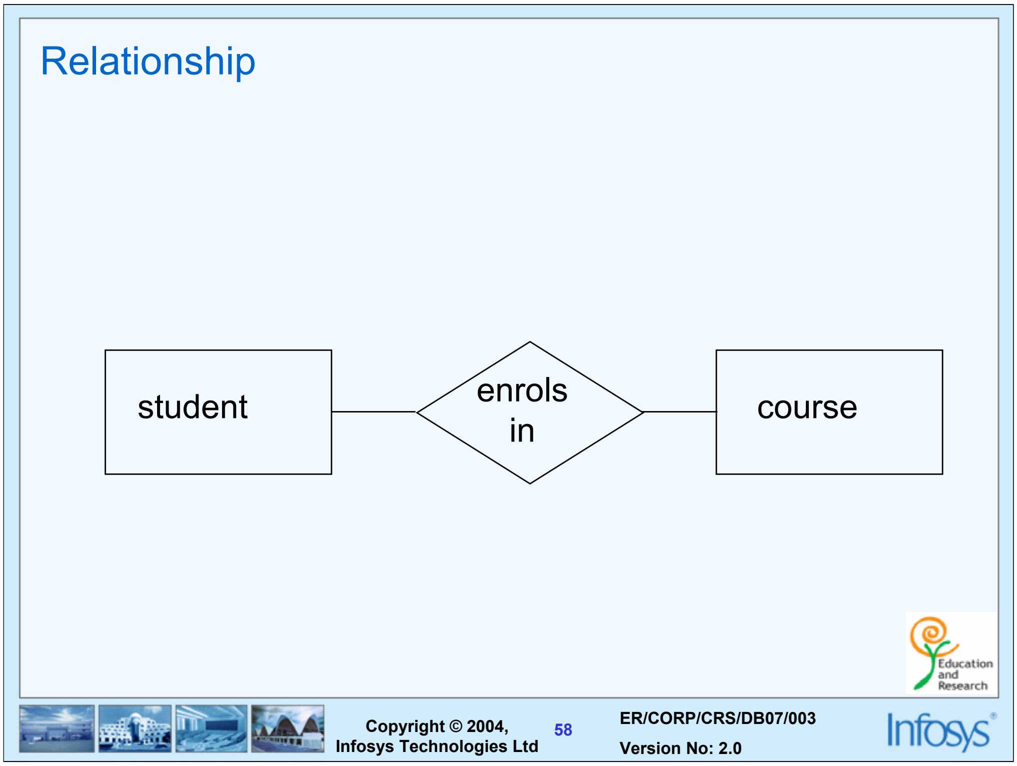
Multivalued Attribute

Indicated by a double lined ellipse as shown in the figure



Composite attribute

Represented by an ellipse from which other ellipses emanate and represent the component attributes. E.g Address



Relationship

student

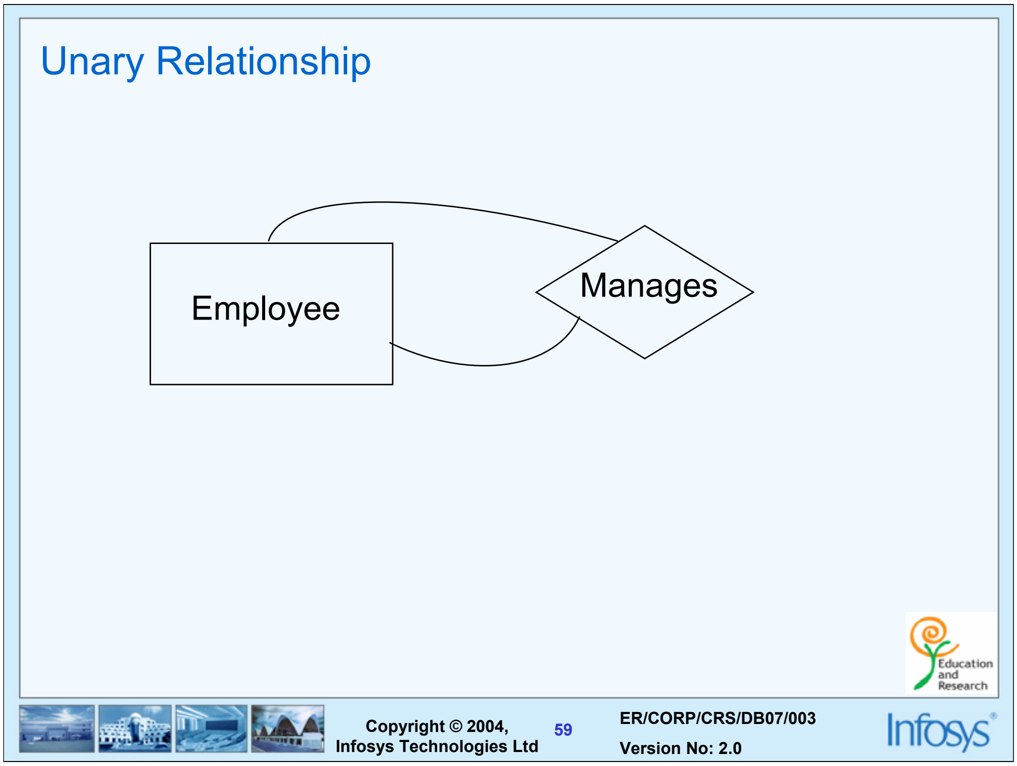
enrols in

course

- A relationship is represented as a diamond between two entity types.

- It has a label that explains the relationship. Usually the convention is to read the ER diagram from top to bottom and from left to right.
- So, the relationship name is so chosen as to make sense when read from left to right.

- The relationship above is read as student enrolls-in course



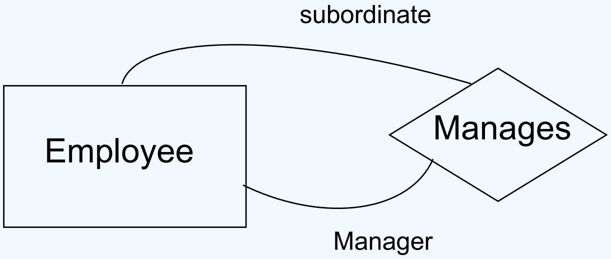
Unary Relationship

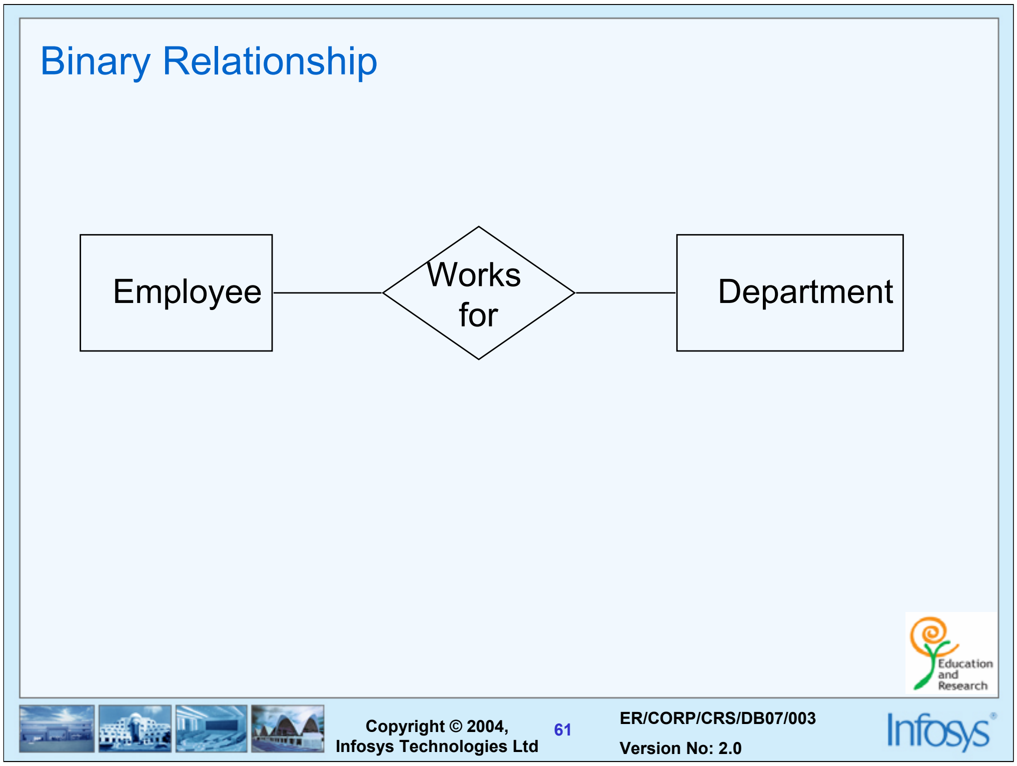
- A unary relationship is represented as a diamond which connects one entity to itself as a loop.

- The relationship above means, some instances of employee manage other instances of Employee.

Role names

- Role names may be added to make the meaning more explicit





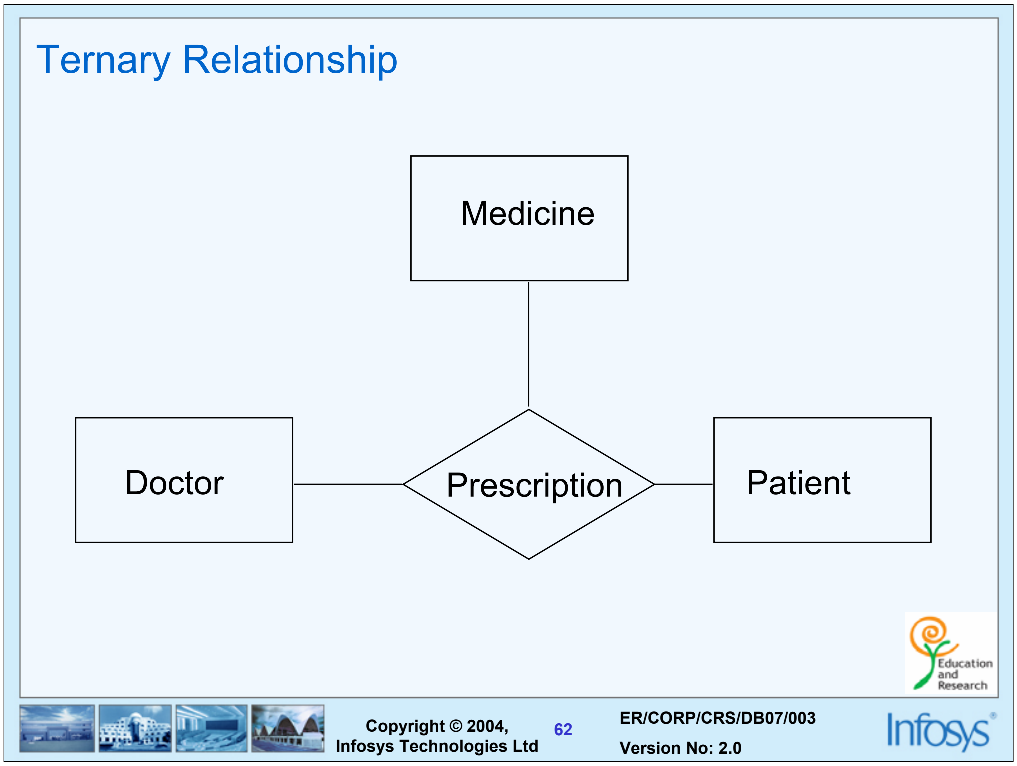
Binary Relationship

Employee

Works for

Department

A relationship between two entity types



Ternary Relationship

Medicine

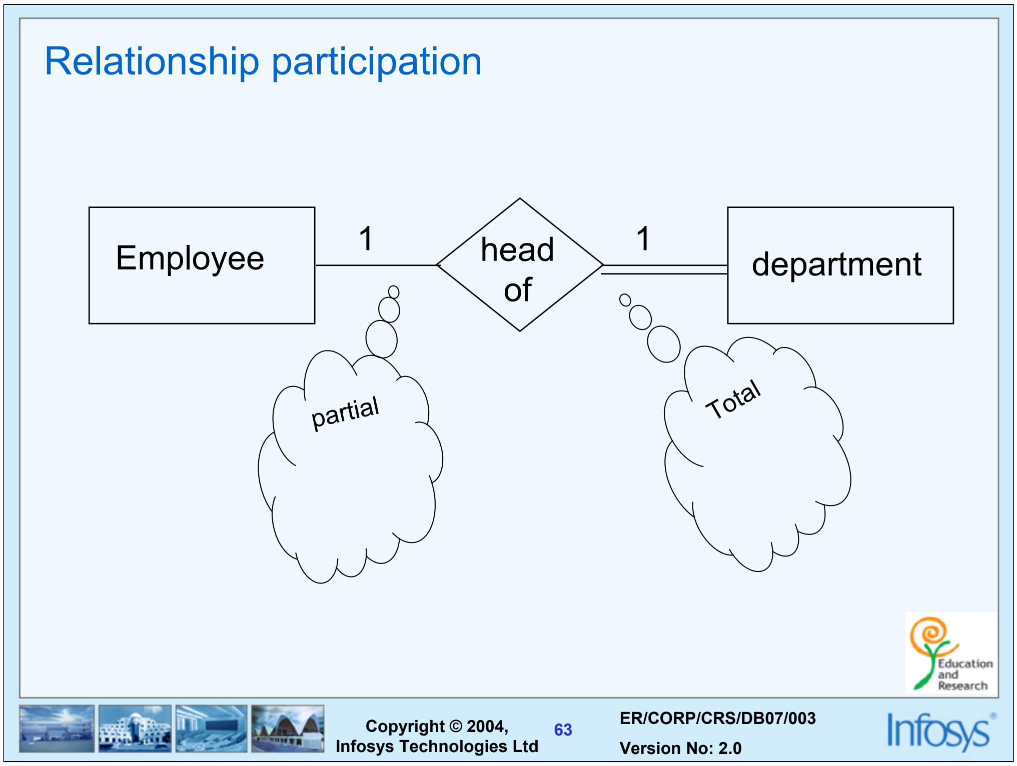
Doctor

Prescription

Patient

Education and Research

A relationship connecting three entity types.



Relationship participation

Employee

1

head of

1

department

partial

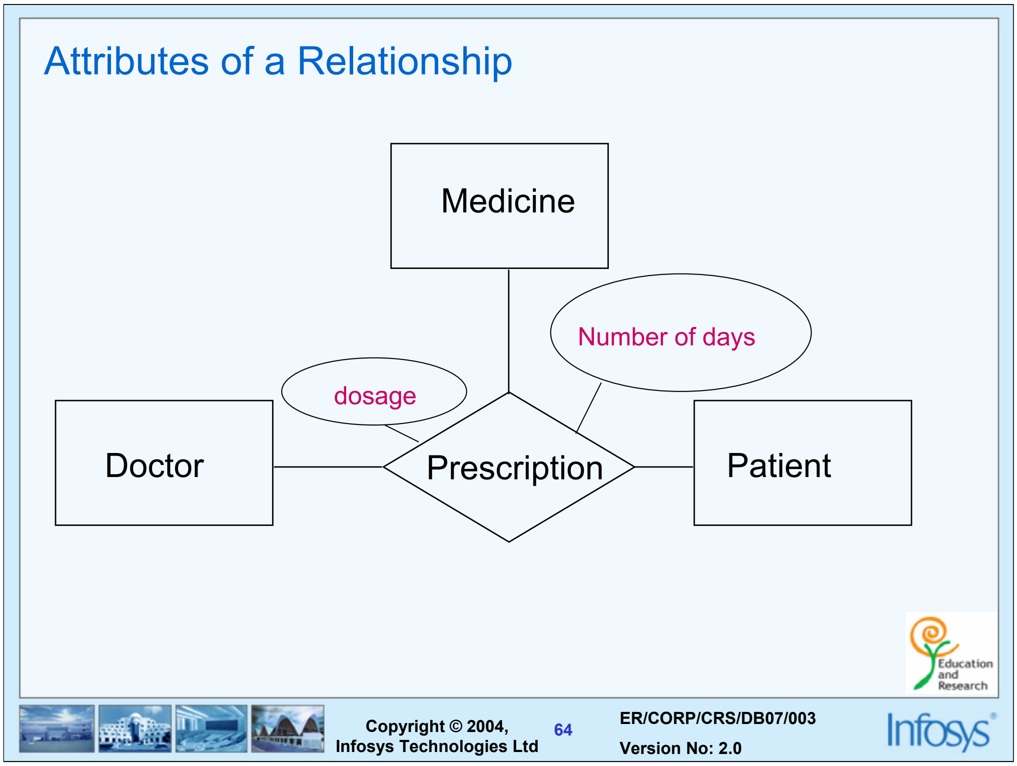
Total

•All instances of the entity type Employee don’t participate in the relationship, Head-of.

•Every employee doesn’t head a department. So, employee entity type is said to partially participate in the relationship.

•But, every department would be headed by some employee.

•So, all instances of the entity type Department participate in this relationship. So, we say that it is total participation from the department side.



Attributes of a Relationship

Medicine

Number of days

dosage

Doctor

Prescription

Patient

Education and Research

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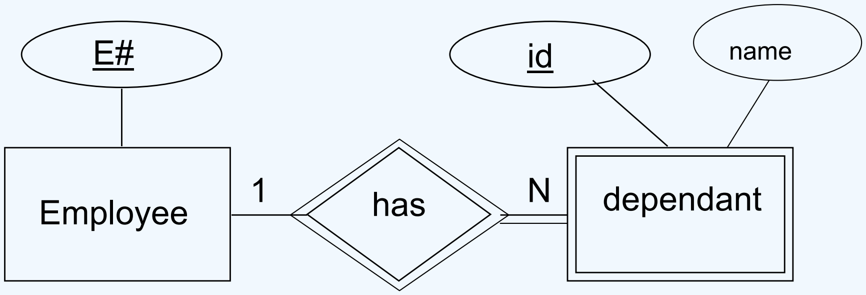
These attributes best describe the relationship rather than any individual entity

Weak entity



The dependant entity is represented by a double lined rectangle and the identifying relationship by a double lined diamond

The identifying relationship is the one which relates the weak entity with the strong entity on which it depends

Case Study – ER Model For a college DB

Assumptions :

- A college contains many departments
- Each department can offer any number of courses
- Many instructors can work in a department
- An instructor can work only in one department
- For each department there is a Head
- An instructor can be head of only one department
- Each instructor can take any number of courses
- A course can be taken by only one instructor
- A student can enroll for any number of courses
- Each course can have any number of students

Steps in ER Modeling

- Identify the Entities
- Find relationships
- Identify the key attributes for every Entity
- Identify other relevant attributes
- Draw complete E-R diagram with all attributes including Primary Key
- Review your results with your Business users

Step 1: Identify the Entities

- DEPARTMENT
- STUDENT
- COURSE
- INSTRUCTOR

Step 2: Find the relationships

- One course is enrolled by multiple students and one student enrolls for multiple courses, hence the cardinality between course and student is Many to Many.
- The department offers many courses and each course belongs to only one department, hence the cardinality between department and course is One to Many.
- One department has multiple instructors and one instructor belongs to one and only one department , hence the cardinality between department and instructor is one to Many.
- Each department there is a “Head of department” and one instructor is “Head of department “,hence the cardinality is one to one .
- One course is taught by only one instructor, but the instructor teaches many courses, hence the cardinality between course and instructor is many to one.

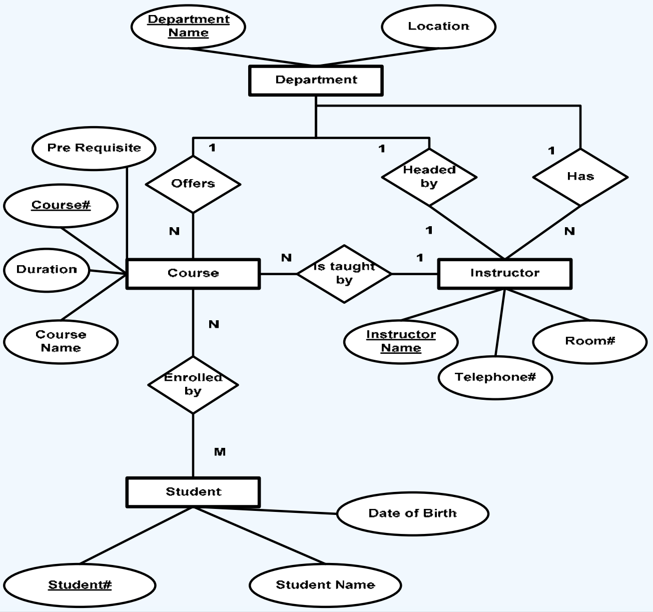
Step 3: Identify the key attributes

- Deptname is the key attribute for the Entity “Department”, as it identifies the Department uniquely.
- Course# (CourseId) is the key attribute for “Course” Entity.
- Student# (Student Number) is the key attribute for “Student” Entity.
- Instructor Name is the key attribute for “Instructor” Entity.

Step 4: Identify other relevant attributes

- For the department entity, the relevant attribute is location
- For course entity, course name,duration,prerequisite
- For instructor entity, room#, telephone#
- For student entity, student name, date of birth

Step 5: Draw complete E-R diagram with all attributes including Primary Key



Case Study – Banking Business Scenario

Assumptions :

- There are multiple banks and each bank has many branches. Each branch has multiple customers
- Customers have various types of accounts
- Some Customers also had taken different types of loans from these bank branches
- One customer can have multiple accounts and Loans

Steps in ER Modeling

- Identify the Entities
- Find relationships
- Identify the key attributes for every Entity
- Identify other relevant attributes
- Draw complete E-R diagram with all attributes including Primary Key
- Review your results with your Business users

Step 1: Identify the Entities

- BANK
- BRANCH
- LOAN
- ACCOUNT
- CUSTOMER

Step 2: Find the relationships

- One Bank has many branches and each branch belongs to only one bank, hence the cardinality between Bank and Branch is One to Many.

- One Branch offers many loans and each loan is associated with one branch, hence the cardinality between Branch and Loan is One to Many.

- One Branch maintains multiple accounts and each account is associated to one and only one Branch, hence the cardinality between Branch and Account is One to Many

- One Loan can be availed by multiple customers, and each Customer can avail multiple loans, hence the cardinality between Loan and Customer is Many to Many.

- One Customer can hold multiple accounts, and each Account can be held by multiple Customers, hence the cardinality between Customer and Account is Many to Many

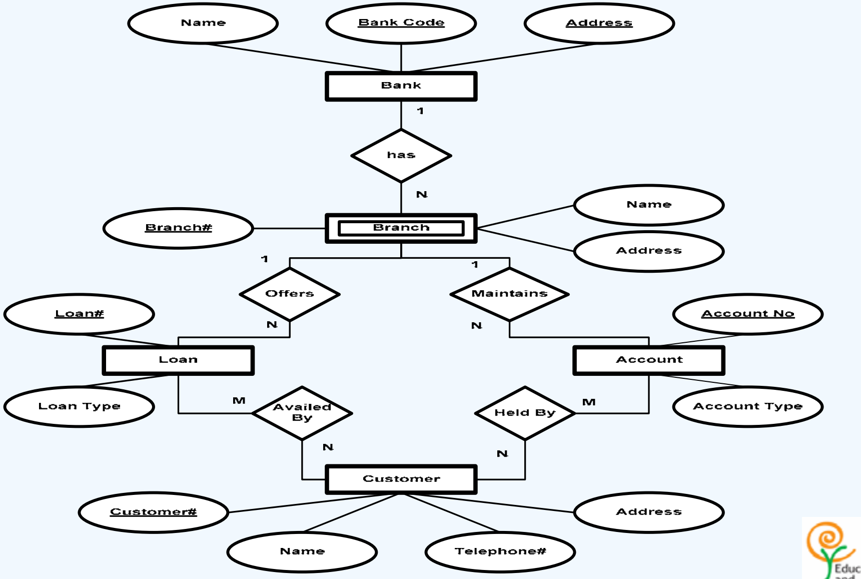
Step 3: Identify the key attributes

- BankCode (Bank Code) is the key attribute for the Entity “Bank”, as it identifies the bank uniquely.
- Branch# (Branch Number) is the key attribute for “Branch” Entity.
- Customer# (Customer Number) is the key attribute for “Customer” Entity.
- Loan# (Loan Number) is the key attribute for “Loan” Entity.
- Account No (Account Number) is the key attribute for “Account” Entity.

Step 4: Identify other relevant attributes

- For the “Bank” Entity, the relevant attributes other than “BankCode” would be “Name” and “Address”.
- For the “Branch” Entity, the relevant attributes other than “Branch#” would be “Name” and “Address”.
- For the “Loan” Entity, the relevant attribute other than “Loan#” would be “Loan Type”.
- For the “Account” Entity, the relevant attribute other than “Account No” would be “Account Type”.
- For the “Customer” Entity, the relevant attributes other than “Customer#” would be “Name”, “Telephone#” and “Address”.

Step 5: Draw complete E-R diagram with all attributes including Primary Key



Merits and Demerits of ER Modeling

Merits

- Easy to understand. Represented in Business Users Language. Can be understood by non-technical specialist.
- *Intuitive* and helps in Physical Database creation.
- Can be generalized and specialized based on needs.
- Can help in database design.
- Gives a higher level description of the system.

Demerits

- Physical design derived from E-R Model may have some amount of ambiguities or inconsistency.
- Sometime diagrams may lead to misinterpretations

Summary

- Most of the application errors are because of miscommunication between the application user and the designer and between the designer and the developer.
- It is always better to represent business findings in terms of picture to avoid miscommunication
- It is practically impossible to review the complete requirement document by business users.
- An E-R diagram is one of the many ways to represent business findings in pictorial format.
- E-R Modeling will also help the database design
- E-R modeling has some amount of inconsistency and anomalies associated with it.

Thank You!