

Management Information Systems

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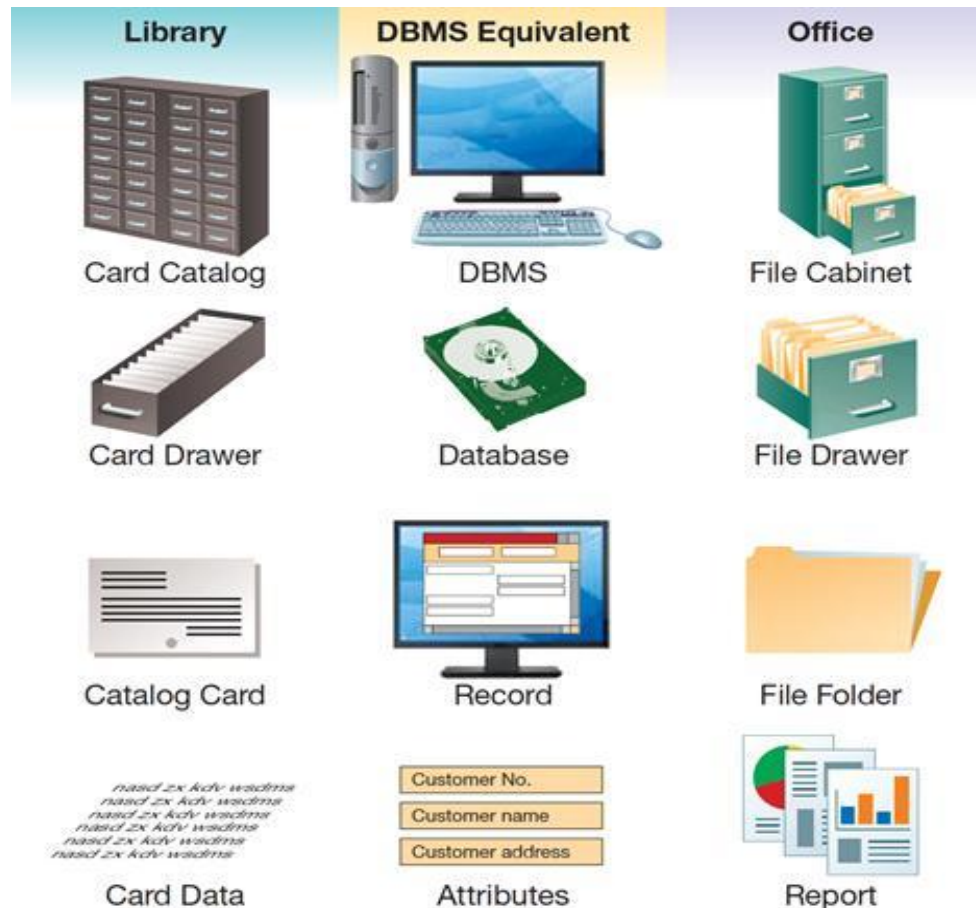
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Relationship Databases

Databases: Foundation Concepts



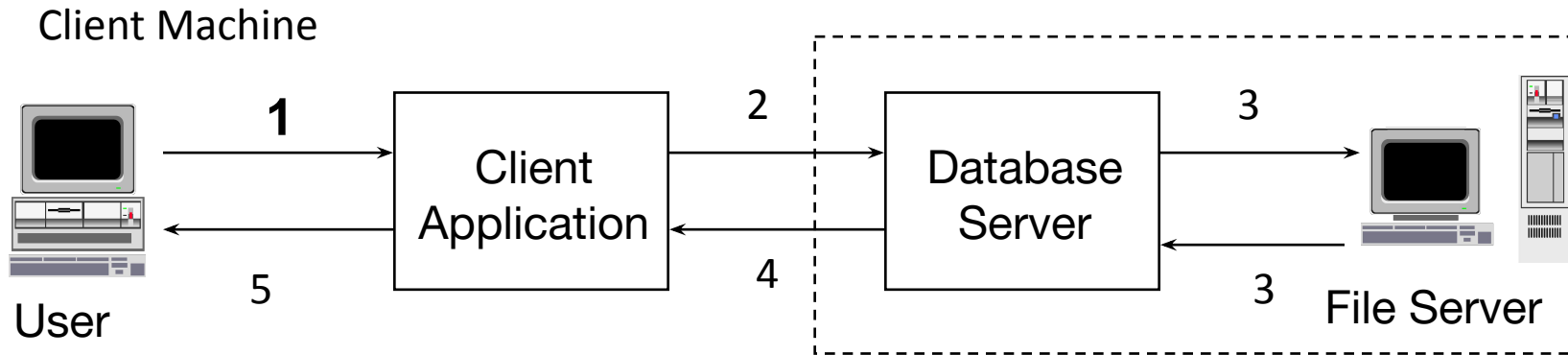
- **Database (DB):** Integrated collection of shared data designed to meet the varied information needs of an organization.



Databases: Advantages

Advantages	Description
Minimal data redundancy	There is a single copy of the data
Improved data consistency	Eliminating redundancy improves consistency
Increase security	Simplifies enforcement of access restrictions
Improved data quality	Centralized control, minimized redundancy, and improved data consistency enhance data quality
Improved data accessibility and sharing	A centralized system makes it easier to deploy and control access in or out of the organization
Enforcement of standards	Centralized data management standardizes rules
Program-data independence	Easier to evolve and alter software to changing business needs when independent
Increased productivity of application development	Data standards make it easier to build and modify applications
Reduced program maintenance	Changes in data replicate seamlessly

Databases: Client-Server Architecture



1. User enters query through client application's user interface.
2. Client application sends the formulated query to the database server.
3. Database server processes request. Search all records.
4. Database server returns only the results from the query.
5. Client application's user interface displays retrieved information.
 - Mechanism: SQL via SQL*Net, ODBC, Stored Procedures, Remote Procedure Calls
 - Access is not a database server.

Databases: Foundation Concepts

- **A Database Management System (DBMS):** Collection of software program that receives and satisfies all requests for data.
- **A Relational Database Management System (RDBMS):** DBMS which processes data with the Relational Data Model.
 - **Relational databases**
 - Information is organized into related tables.
 - Each table captures information about a different entity.
 - Columns are different fields of information
 - attributes of the entity
 - Each row represents one instance
 - a specific example of the entity
 - The most prevalent type of database used.

Databases: Benefits of RDBMS



- Integration of Data
 - Data are organized into a single, logical structure
- Sharing of Data
- Enforcement of Standards
 - Centralized data administration function
 - All changes to the data standards have to be approved by the Database Administrator.

Databases: Benefits of RDBMS



- Uniform Security, Privacy and Integrity Controls
 - Controls for accessing, updating and protecting data are established by data administration
- Data Accessibility and Responsiveness
 - Provides multiple retrieval paths to each item of data
- Data Independence
 - The separation of data descriptions from application programs that use the data.

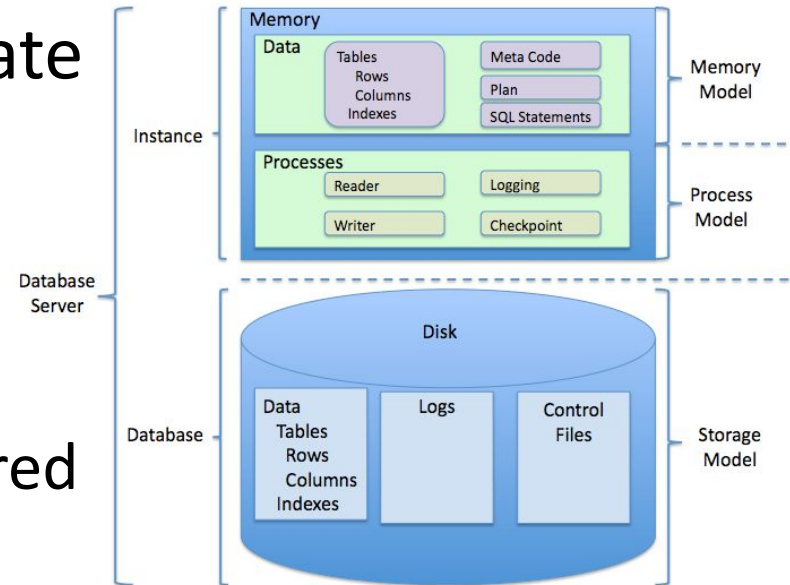
Databases: Benefits of RDBMS



- Reduces Program Maintenance
 - Due to the data independence
- User Friendly
 - SQL is easy-to-learn language that allows to work with higher level data structures
- Supported by Mathematics Theory
 - RDBMS is the only DBMS that is supported by the relational algebra

Databases: Relationship Model

- Invented by E. F. Codd in 1969
- Dominate the markets since late 1980s
- Strengths:
 - Simplicity
 - End-user orientation
 - Standardization (SQL – Structured Query Language)
 - Value-based instead of pointer-based to provide data independence
 - Endorsed by major computer companies



Databases: Relationship Model



- A model represents both entities and relationships in a table structure.
 - **Relation**: A mathematical concept about an entity
- Properties of a Relation:
 - No duplicate rows in a relation.
 - Each row must be uniquely identified by a primary key.
 - The order of rows in a relation is insignificant
 - The order of columns in a relation is insignificant.
 - All attributes must be atomic (single value).
- Data are logically presented in two dimensional tables (files)
 - rows (records)
 - columns (attributes, fields, data item).

Databases: Relationship Model



- **Table:** Group of homogeneously defined records
 - Each table has a unique name.
 - Each table captures information about a different entity
- **Record:** Collection of values that describe an entity.
 - The rows of a table are known as records.
- **Field:** Contains a single piece of data for the subject of the record
 - The columns of a table are known as fields (or attributes)
- **Key:** An attribute or a set of attributes which can uniquely identify a record in a table.

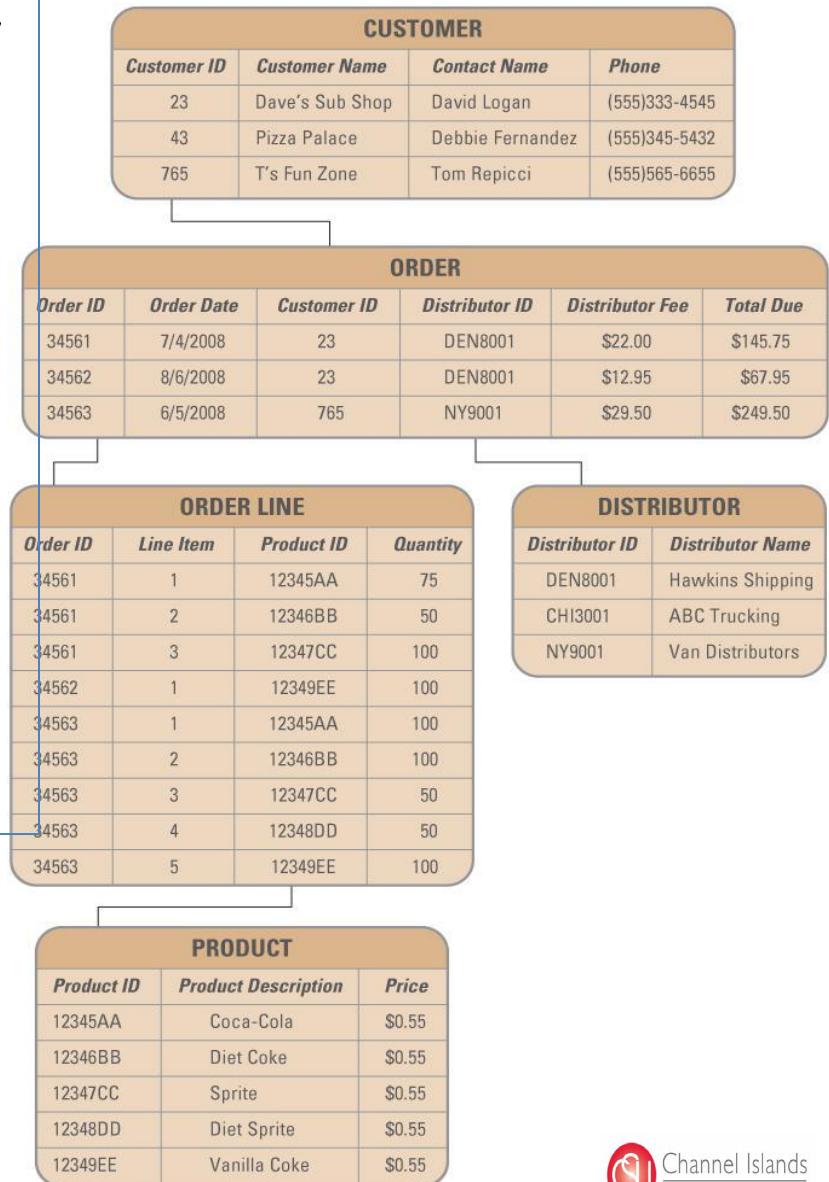
Databases: Relationship Model



- **Primary Key:** Unique identifier for a database record.
 - Table can contain only one primary key constraint
 - Enforces the entity integrity of the table
 - Simple Key: A key contains only one column.
 - Compound Key: A key has more than one column.
- **Foreign Key:** An attribute or a set of attributes in a table which also plays the role of a primary key in another tables.
 - Acts as a cross-reference between tables because it references the primary key of another table, thereby establishing a link between them.

Databases: Relationship Model

- Tables, Columns, Rows, Primary Keys, Foreign Keys and Relationships
 - Each entity associated with a table.
 - Attributes are columns of the table.
 - Each attribute is given a data type.
 - Unique identifiers are “primary keys”
 - Relationships are embodied as “foreign keys”
 - An attribute whose value is the unique identifier in another table.



Databases: Relationship Model

Order Number: 34562			
Coca-Cola Bottling Company of Egypt Sample Sales Order			
Customer: Dave's Sub Shop		Date: 8/6/2008	
Quantity	Product	Price	Amount
100	Vanilla Coke	\$0.55	\$55
		Distributor Fee	\$12.95
		Order Total	\$67.95

CUSTOMER			
Customer ID	Customer Name	Contact Name	Phone
23	Dave's Sub Shop	David Logan	(555)333-4545
43	Pizza Palace	Debbie Fernandez	(555)345-5432
765	T's Fun Zone	Tom Repicci	(555)565-6655

ORDER					
Order ID	Order Date	Customer ID	Distributor ID	Distributor Fee	Total Due
34561	7/4/2008	23	DEN8001	\$22.00	\$145.75
34562	8/6/2008	23	DEN8001	\$12.95	\$67.95
34563	6/5/2008	765	NY9001	\$29.50	\$249.50

ORDER LINE			
Order ID	Line Item	Product ID	Quantity
34561	1	12345AA	75
34561	2	12346BB	50
34561	3	12347CC	100
34562	1	12349EE	100
34563	1	12345AA	100
34563	2	12346BB	100
34563	3	12347CC	50
34563	4	12348DD	50
34563	5	12349EE	100

DISTRIBUTOR	
Distributor ID	Distributor Name
DEN8001	Hawkins Shipping
CHI3001	ABC Trucking
NY9001	Van Distributors

PRODUCT		
Product ID	Product Description	Price
12345AA	Coca-Cola	\$0.55
12346BB	Diet Coke	\$0.55
12347CC	Sprite	\$0.55
12348DD	Diet Sprite	\$0.55
12349EE	Vanilla Coke	\$0.55

Databases: Relationship Model




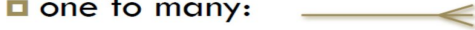
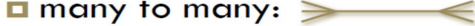
- To retrieve information from a relational database, it is necessary to associate or relate data from separate tables.
- The three types of relationships among entities:
 - one-to-one, 
 - one-to-many, 
 - and many-to-many. 

TABLE TB15 Rules for Expressing Relationships Among Entities and Their Corresponding Data Structures

Relationship	Example	Instructions
One-to-one	Each team has only one home stadium, and each home stadium has only one team.	Place the primary key from one table (e.g., Stadium) into the other (e.g., Team) as a foreign key.
One-to-many	Each player is on only one team, but each team has many players.	Place the primary key from the table on the “one” side of the relationship (e.g., Team) as a foreign key in the table on the “many” side of the relationship (e.g., Player).
Many-to-many	Each player participates in many games, and each game has many players.	Create a third table (e.g., Player Statistics) and place the primary keys from each of the original tables (e.g., Player and Team) together in the third as a combination primary key.

Databases: Relationship Model

- **Index:** Data structure used to speed up data retrieval or enforce constraints on the records in a table.
 - Automatic query optimization algorithms to determine indices when searching the database.
- **Null value:** An empty value for a field.
- **View:** Logic representation of another table or combination of tables.
 - Derives its data from the tables on which it is based.
 - Permits to query subsets of data as though they are an actual table.
 - Only the view definition is stored in the database
 - Updatable view affects the underlying table.
 - Saved view is called Query in Access.

Databases: Relationship Model



- **Referential Integrity:** The relationship between a referencing (child) table and a referenced (parent) table.
- Essence of a Relational Data Model:
 - Representation of Entities
 - Representation of Relationship
 - Database Integrity Rules:
 - **Primary Key Rule:** Each primary key within a table has a value that is unique.
 - No duplicates allowed.
 - **Referential Integrity Rule:** For any value in the referencing columns of a (child) table, there must exist a row in the referenced (parent) table such that the value of the referencing columns equals the value of the corresponding referenced columns.
 - Within a relational database, all values that are present on a child table should also be present on its parent table
 - » There cannot be a child without a parent
 - **Existing Rule:** Primary key cannot have a null value

Review Questions

- How is information organized the relationship database?
- What are two main properties of a relation?
- How are rows that describe an entity called in the relationship database table?
- What are the other names for a column of the relationship database table?
- What do you call the unique identifier for a database record?
 - What is a foreign key?
- Explain Referential Integrity Rule in your own words.

Databases: Data Modeling and Entity Relationship Diagram



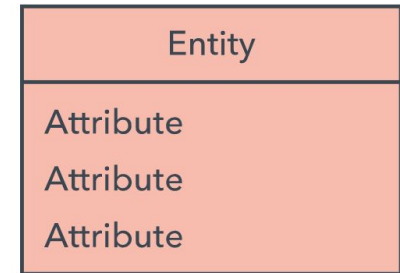
- **Data modeling** is a technique to document a software system using diagrams and symbols.
 - used to represent communication of data.
- **Entity Relationship Diagram (ERD):**
 - The highest level of abstraction for the data model
 - Graphical representation of data requirements
 - Use ERD symbols to illustrate Entities, Attributes and Relationships between Entities
 - ERD Tools
 - [Top 8 Free ER Diagram Tools in 2021](#)

Databases: Data Modeling and Entity Relationship Diagram



- **Basic ERD Symbols**

- Entity
 - Rectangle
- Attribute
 - Inside of entity's rectangle
 - or oval / circle
- Relationships between Entities
 - Lines
 - or diamonds



- [ERD Relationship Symbols Quick Reference](#)

▣ one to one:

▣ one to many:

▣ many to many:

Databases: Data Modeling and Entity Relationship Diagram

- **How to draw a basic ER diagram**

- **Purpose and scope**

- Define the purpose and scope of what you're analyzing or modeling.

- **Entities**

- Identify the entities that are involved, drawing them in rectangles and labeling them as nouns.

- **Relationships**

- Determine how the entities are all related. Draw lines between them to signify the relationships and label them as verbs directly on the connecting lines. (Can be shown as diamonds)

- **Attributes**

- Layer in more details by adding key attributes of entities inside of entity's rectangles. (Can be shown as an oval or circle)

- **Primary Key**

- Identify or create Primary Key for each Entity. Label Primary Key attribute as PK or add key symbol, or underline attribute name.

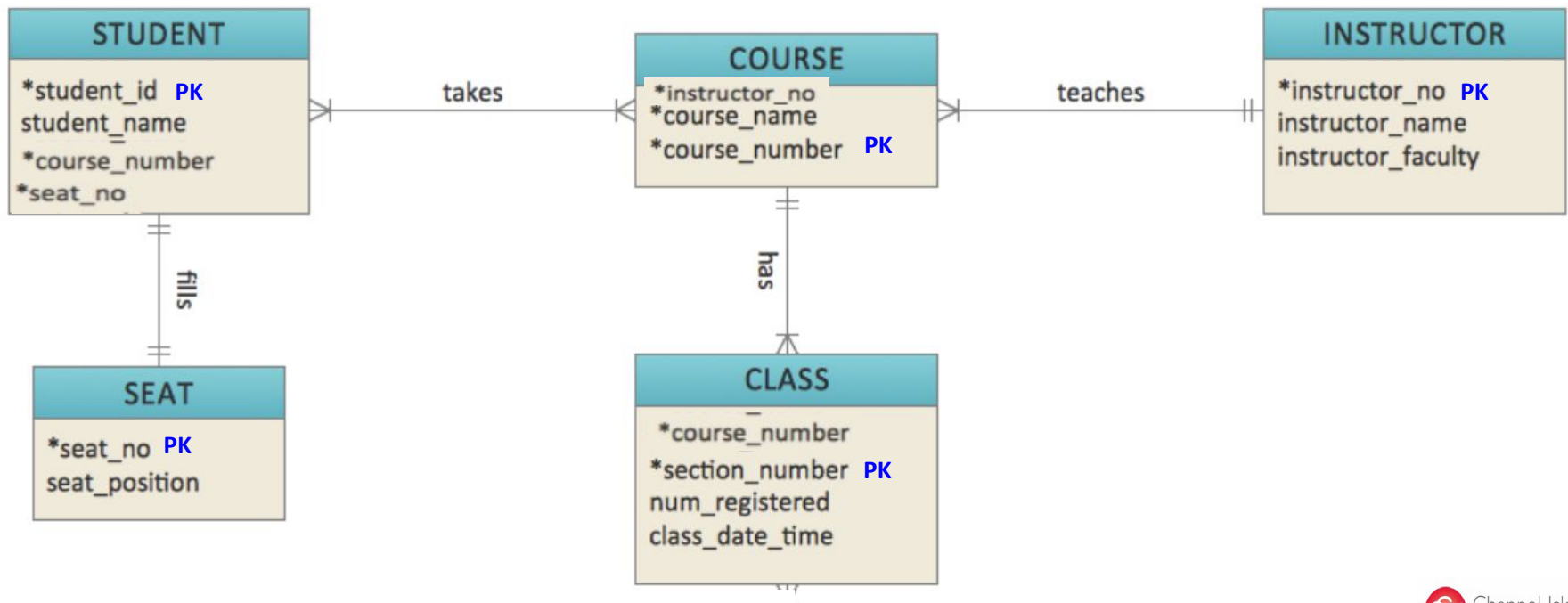
- **Cardinality**

- Show whether the relationship is 1-1, 1-many or many-to-many.

Databases: Data Modeling and Entity Relationship Diagram

- **Example:**

- The database stores information on courses, classes, students, seats and instructors.
- Each student can take many classes, and each class can be taken by many students..
- One instructor can teach many courses, but one course can only be taught by one instructor.
- Each course can have many classes, but each class belongs to one course.
- Each student fills one seat and one seat is assigned to only one student.



Databases: SQL Programming



- **Structured Query Language (SQL):** Standard language used to define and manipulate data in a RDBMS
 - Express actions to be performed on a relational database.
 - Standardized to allow portability across different products.
 - Can be used interactively or embedded in host languages such as C, C++, Java, PASCAL, COBOL, etc.
 - Functions on sets of records rather than individual records.
 - References to data are symbolic; they do not use any physical data structures such as pointers.
 - [What is SQL?](#)

Databases: SQL Programming

- SQL is divided into three sublanguages:
 - DDL (Data Definition Language)
 - Create, alter and drop database and database objects
 - Impose integrity constraints on tables
 - Automatically update system catalog tables
 - Add comments to the tables.
 - DML (Data Manipulation Language)
 - Retrieve
 - Insert
 - Update
 - Delete rows
 - DCL (Data Control Language)
 - Grant and Revoke privileges and roles
 - Controls concurrent access to database.

Databases: SQL Programming

- DDL Commands:
 - CREATE DATABASE: Creates a database.
 - CREATE TABLE: Creates a table and defines its columns and their data types.
 - CREATE SYNONYM: Creates an alternate name for a table or view.
 - CREATE VIEW: Defines a logical table, or view of data derived from columns and rows of existing tables and views.
 - CREATE INDEX: Creates an index on one or more columns of a table, for the purpose of speeding data retrieval, and enforcing uniqueness constraints.
 - ALTER: Adds, removes or renames table columns, or changes the data types of columns. Also used to create or drop UNIQUE, PRIMARY, FOREIGN KEY and CHECK constraints to enforce uniqueness, referential integrity.

Databases: SQL Programming

- DDL Commands:
 - DROP DATABASE: Deletes database and all objects associated with it.
 - DROP TABLE: Deletes a table and the indexes built on that table.
 - DROP SYNONYM: Deletes an alternate name for a table or view from the system catalog.
 - DROP VIEW: Deletes a view from the system catalog.
 - DROP INDEX: Deletes a specified index. Note that an index created as the result of a UNIQUE, PRIMARY or FOREIGN KEY constraint can only be dropped by dropping the constraint through the ALTER command.
 - RENAME: Changes a table name.
 - COMMENT ON: Places a remark on a database object in the appropriate system catalog table.

Databases: SQL Programming

- DML Commands:
 - SELECT: Retrieves data from one or more tables.
 - UPDATE: Modifies the data in one or more rows of a table.
 - INSERT: Inserts one or more rows into a table.
 - DELETE: Deletes one or more rows from a table.

Databases: SQL Programming

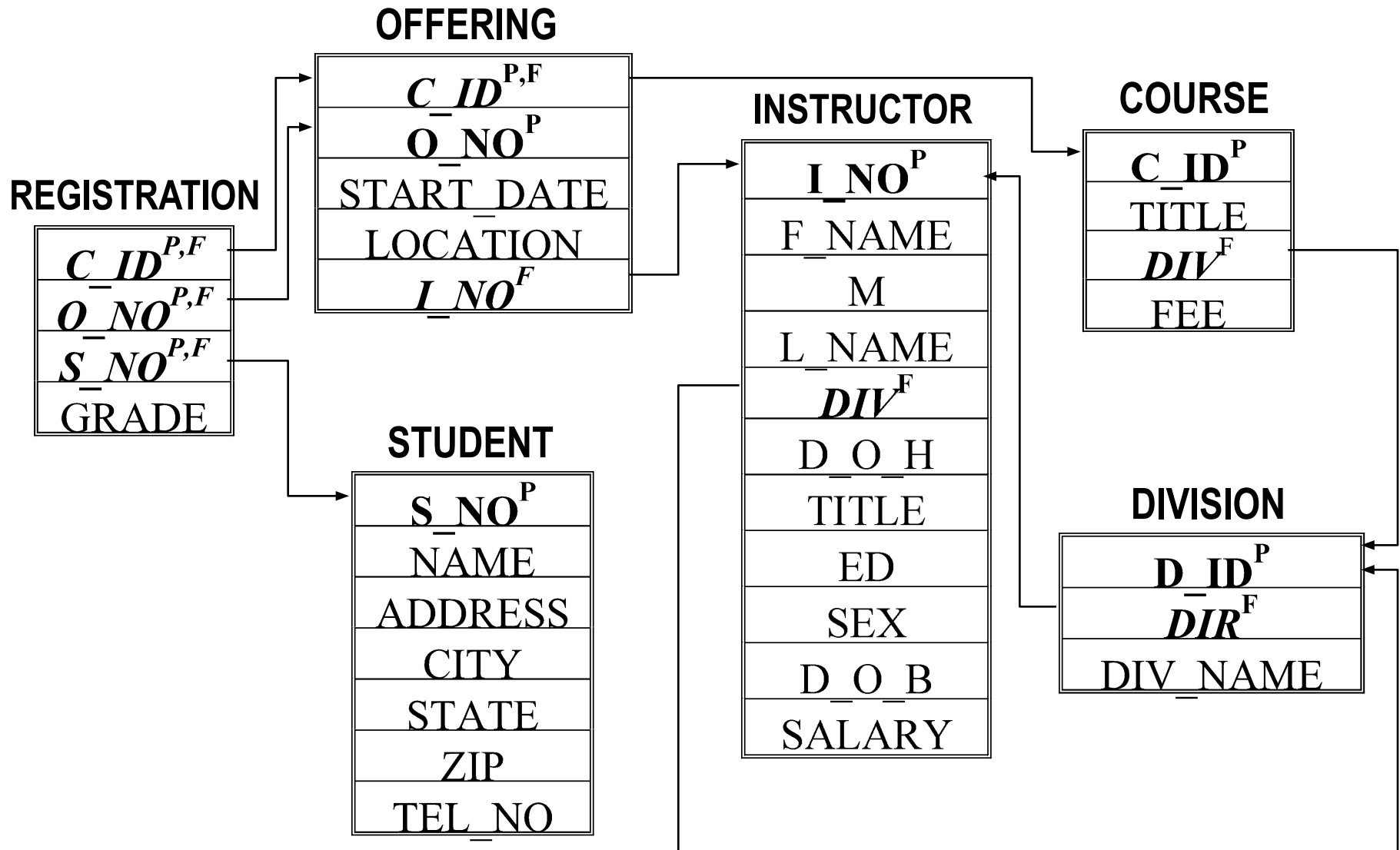
- DCL Commands:
 - COMMIT: Instructs the system to make all DML commands executed by a transaction permanent.
 - ROLLBACK: Instructs the system to reverse all DML commands executed by a transaction.
 - GRANT: Assigns database access privileges to database users.
 - REVOKE: Cancels database access privileges from database users.
 - LOCK: Permits users to explicitly acquire table locks.
 - UNLOCK: Used to unlock a table prior to the commit point.

Databases: SQL Programming

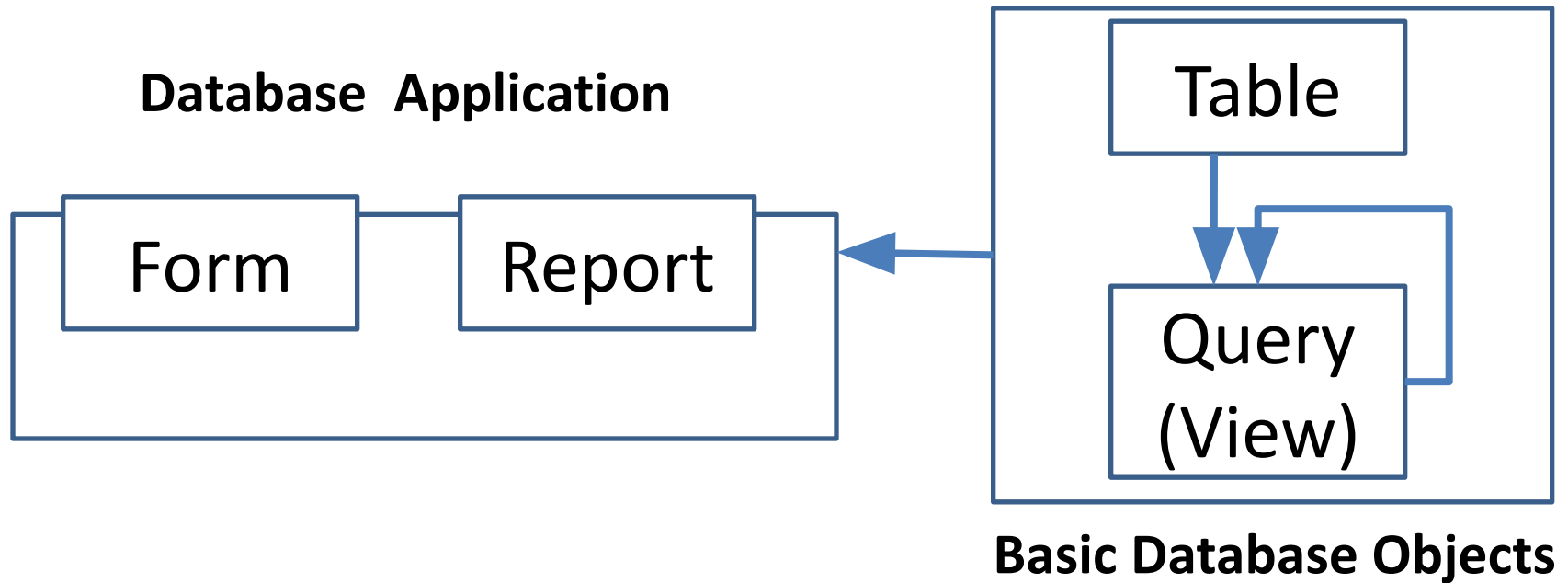
- MySQL
 - Open-source
 - Great for small to mid-sized organizations.
 - Fast, efficient, cheap
 - Doesn't support full SQL but a good portion of it.



Databases: Sample Structure



Databases: Objects and Applications



- You can create a query against a table or a query or both
- You can create a form or report against a table or a query or both

Databases: MS Access Objects

- MS Access Objects

- Tables

- used to hold all the information or data

- Forms

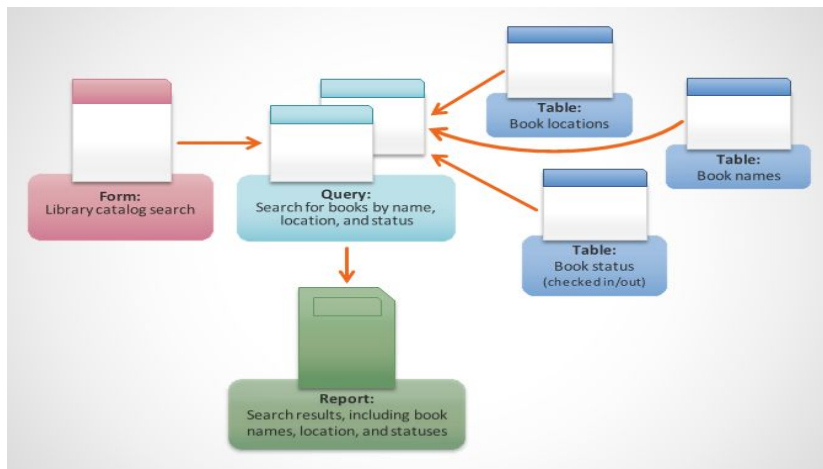
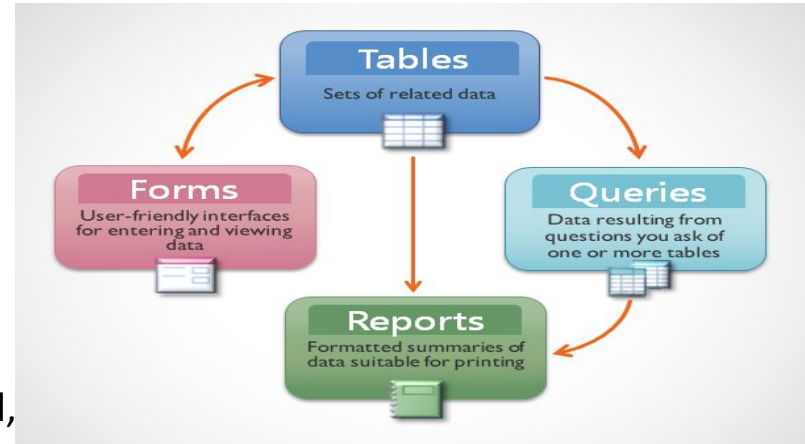
- used to capture data to be added, modified, or deleted from a database by the users.

- Queries

- used to retrieve data from a database

- Reports

- present the information in a database



Databases: Relationships

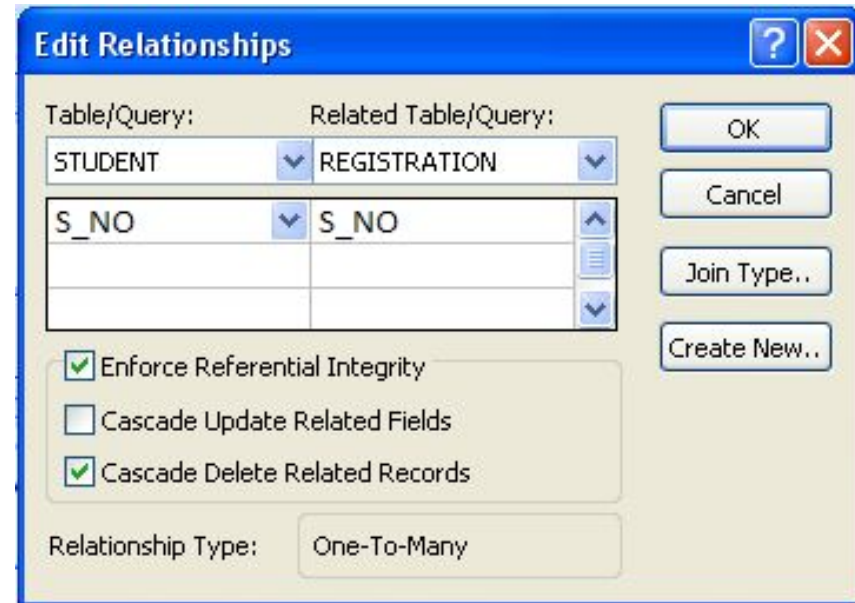
- Define Relationships in Access

- Referential Integrity

- You can't enter a value in the Foreign Key field of one (Child) table if there is not a matching value in the Primary Key of the related (Parent) table.
 - You can't delete a record from the primary (Parent) table if a matching record exists in the related (Child) table.
 - You can't change the value in the Primary Key of the Parent table if there are related records in the Child table

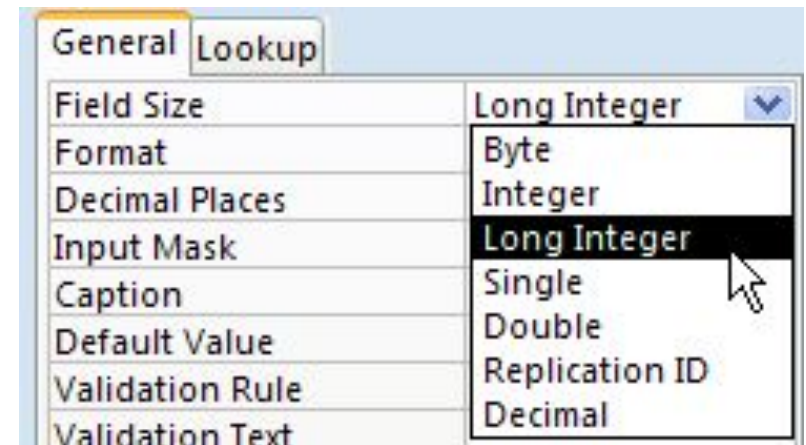
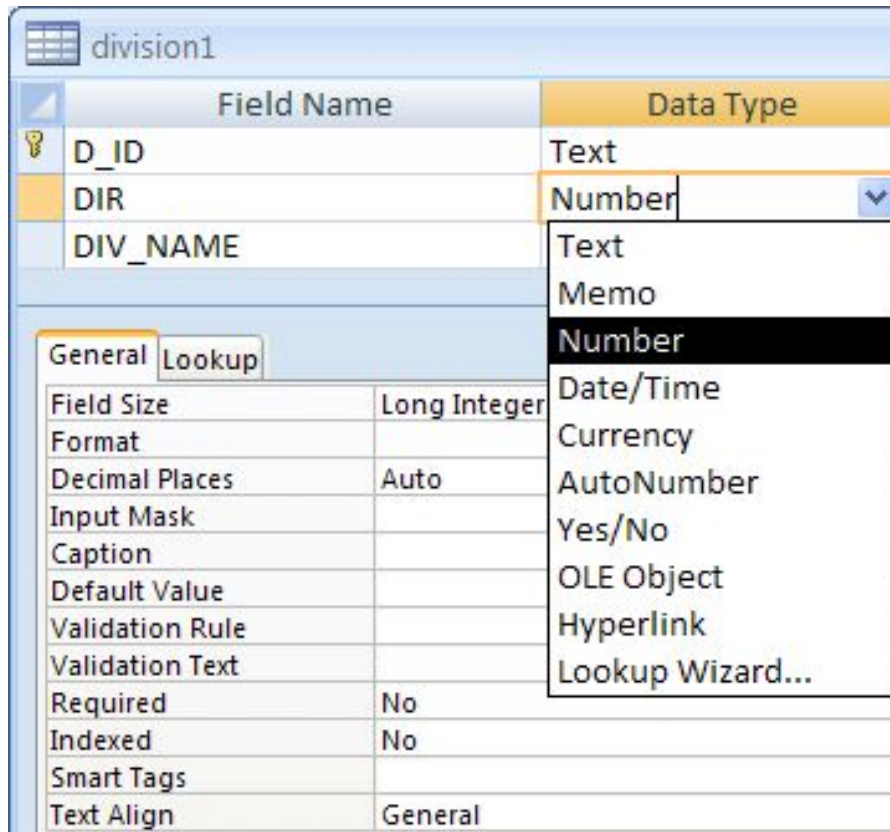
- Join Type

- One to One
 - One to Many



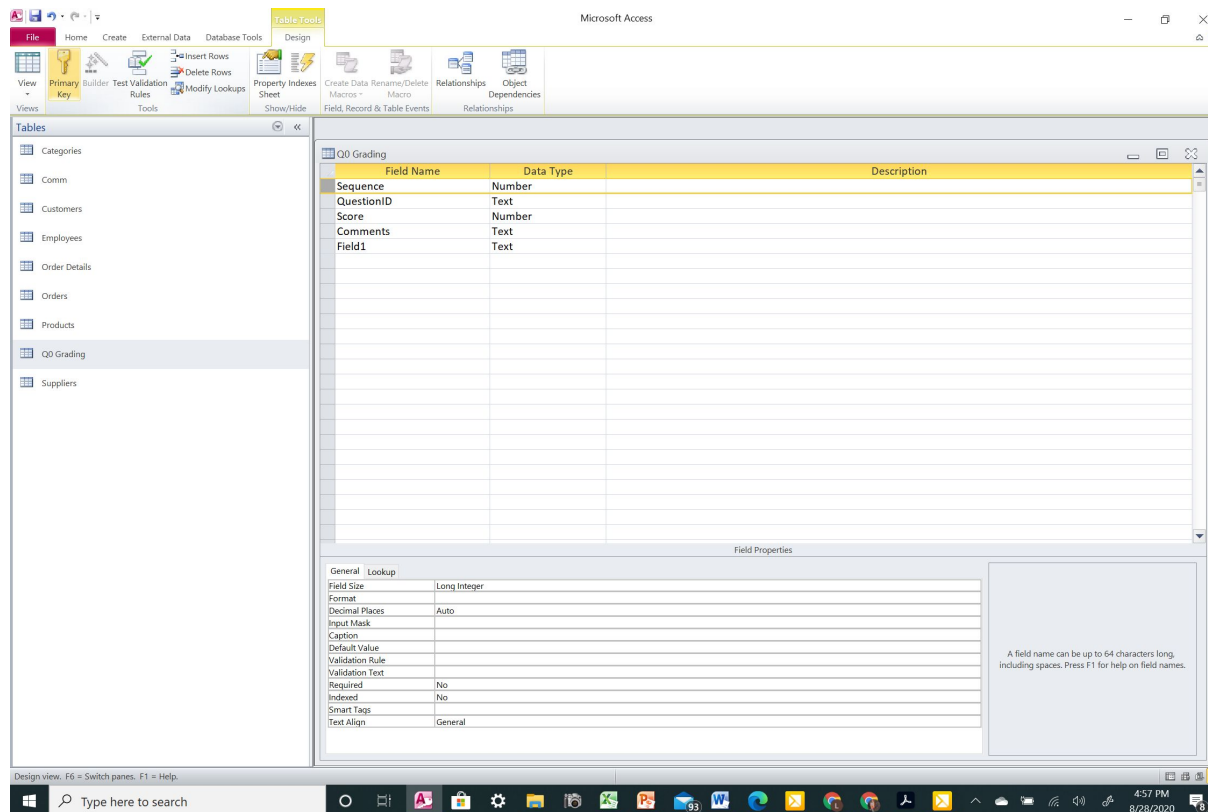
Databases: Create Table

- Create Table in MS Access
 - Switch to Design View
 - Identify fields



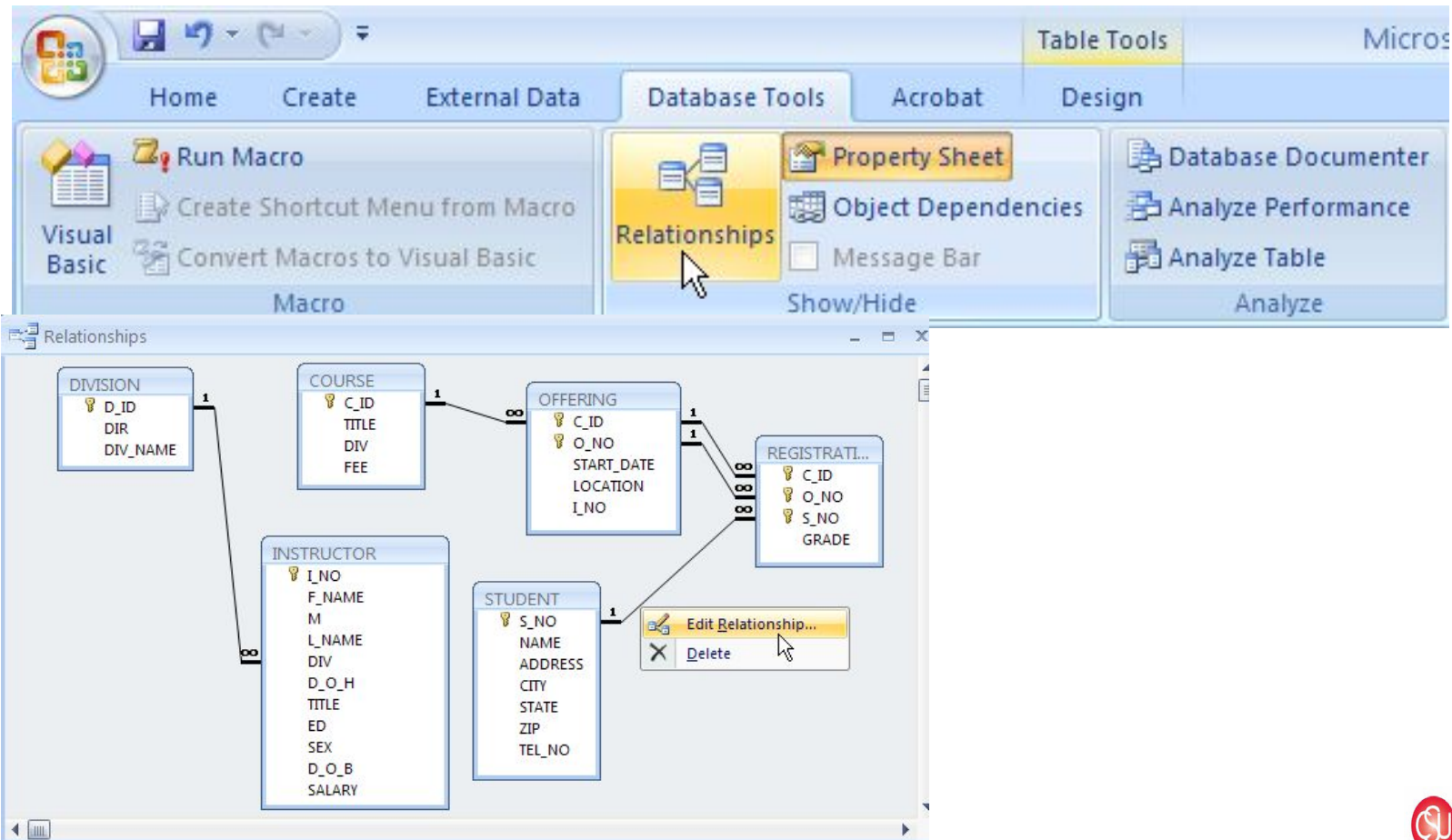
Databases: Create Table

- Create Table in MS Access
 - Assign Primary Key
 - Highlight the field
 - Click on Primary Key in toolbar menu



Databases: Relationships

- Define Relationships in MS Access
 - To create relationship drag the primary key of a table into foreign key of another table



Databases: Normalization

- First Normal Form
 - No repeating value.

Un-Normalized Relation:

STUDENT	COURSE
Tom	C102
Sam	{C102, C103, C105}
Ralph	{C102, C105}

Normalized Relation:

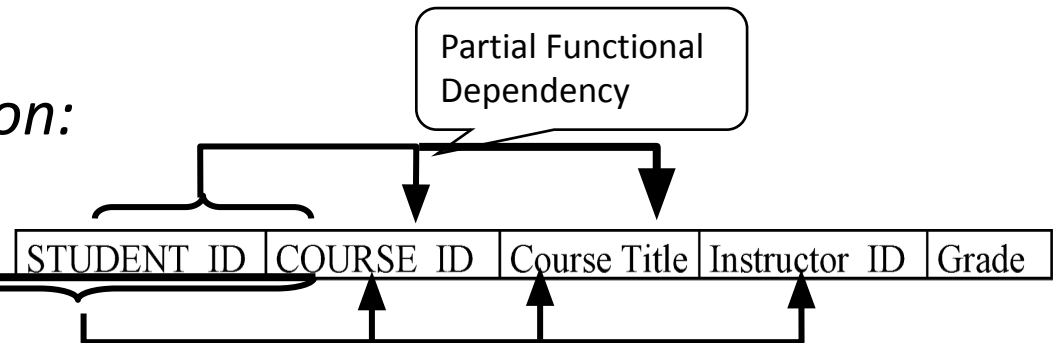
STUDENT	COURSE
Tom	C102
Sam	C102
Sam	C103
Sam	C105
Ralph	C102
Ralph	C105

Databases: Normalization

- **Second Normal Form**

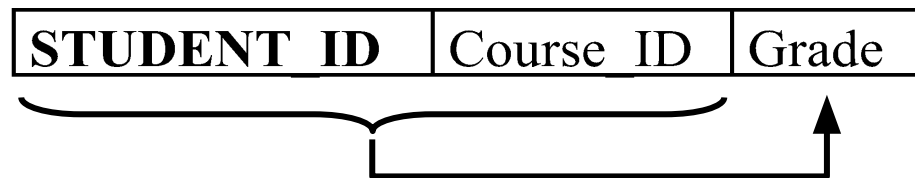
- No any partial functional dependencies.
- Non-identifying attributes are dependent on the entity's unique identifier.

Un-Normalized Relation:

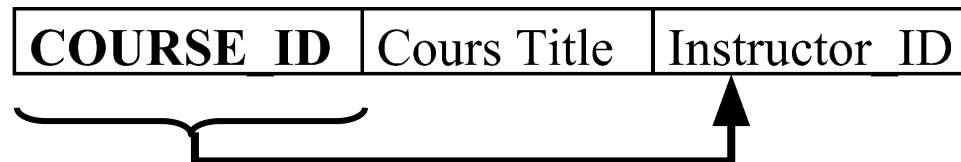


Normalized Relation:

Registration



Course

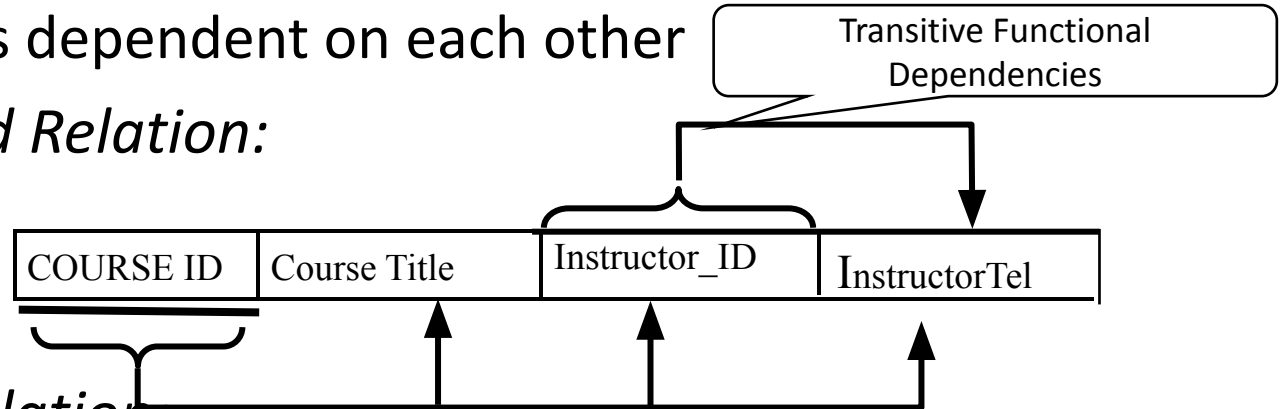


Databases: Normalization

- Third Normal Form

- No transitive functional dependencies
- No attributes dependent on each other

Un-Normalized Relation:



Normalized Relation:

Course

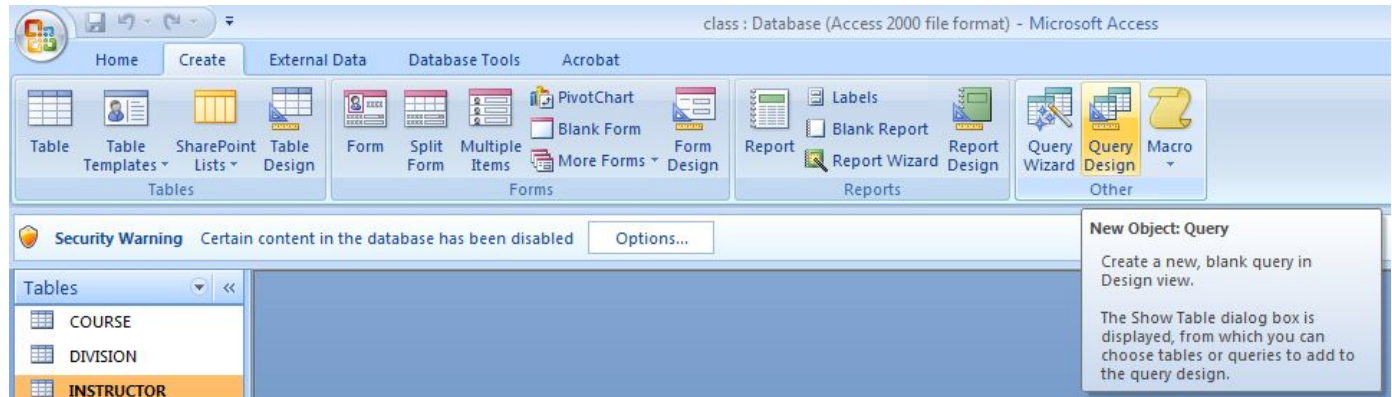
COURSE ID	Cours Title	Instructor ID
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Instructor

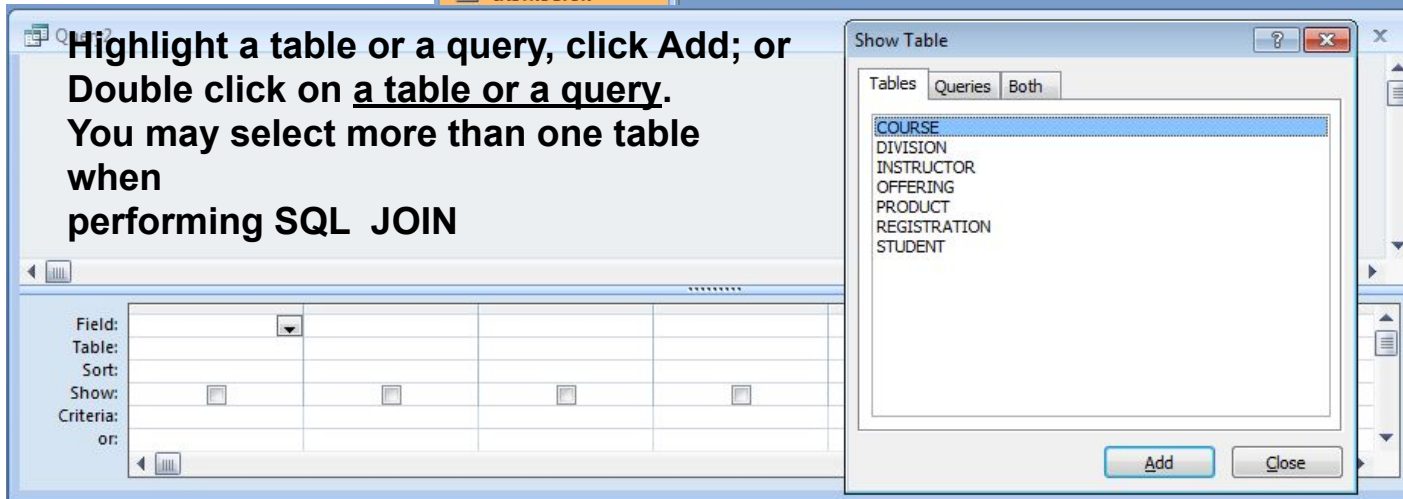
INSTRUCTOR ID	Instructor Tel
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Databases: Query

- Create Query in MS Access
 - To select data from Single or Multiple Tables or Queries or Both
 - Saved View is called Query in MS Access database
 - QUERY in MS Access can be SELECT, INSERT, UPDATE, APPEND or DELETE.



Highlight a table or a query, click Add; or Double click on a table or a query. You may select more than one table when performing SQL JOIN



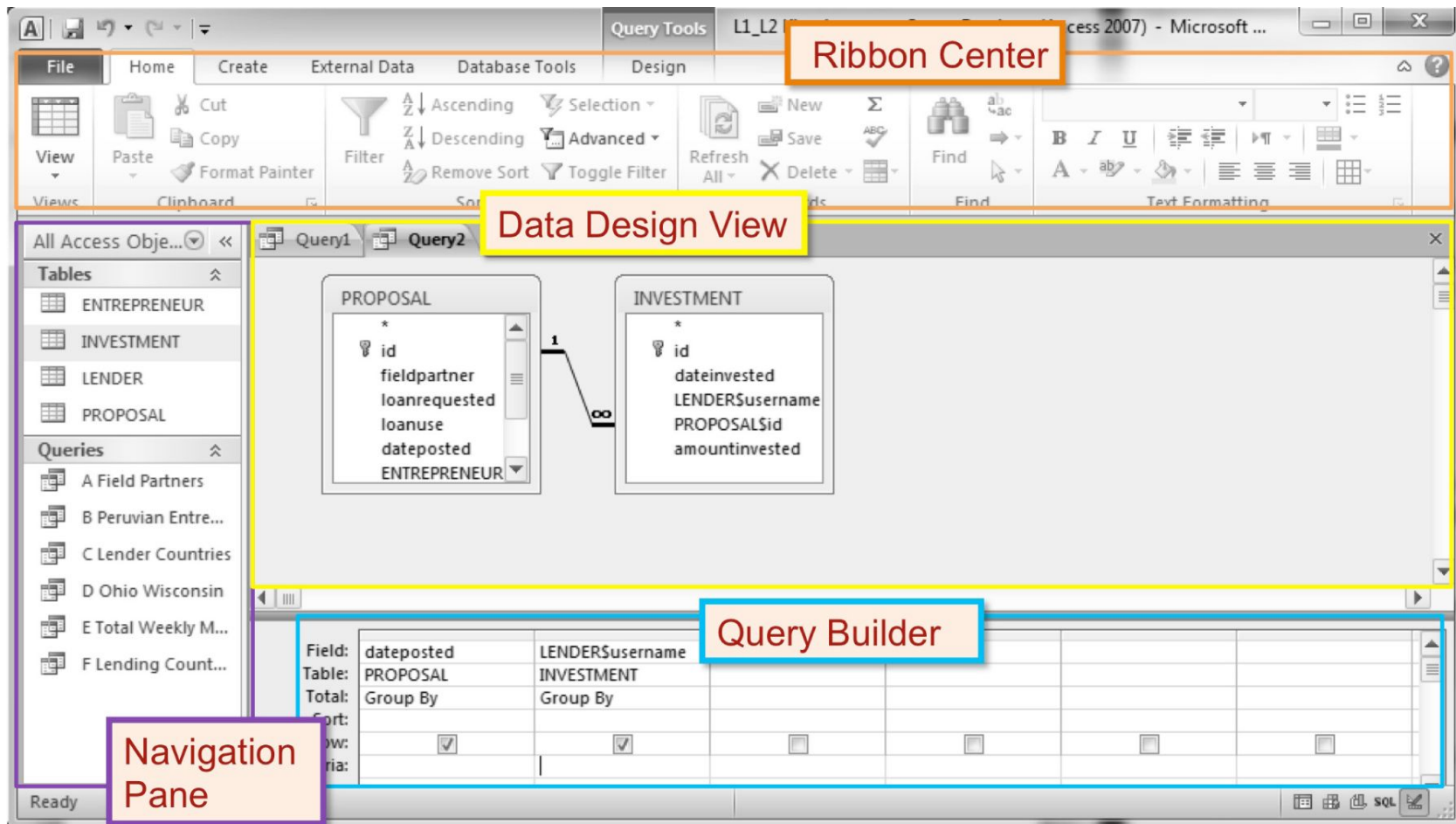
Databases: Query

- Create Query in MS Access
 - Switch to Design view
 - Add table/s
 - Specify criteria

The screenshot shows the Microsoft Access Query Design view for a query named 'Query2'. The design grid is currently empty. A table named 'COURSE' is shown in the 'Show Table' task pane on the left. The table fields are C_ID (primary key), TITLE, DIV, and FEE. Below the design grid, the 'Field' and 'Criteria' rows are visible. The 'Field' row contains 'C_ID', 'TITLE', and 'FEE'. The 'Table' row contains 'COURSE' for each field. The 'Sort' row contains 'Descending' for 'FEE'. The 'Show' row has checkboxes for 'C_ID', 'TITLE', and 'FEE', all of which are checked. The 'Criteria' row contains the criteria '> 250 And <= 350' for the 'FEE' field.

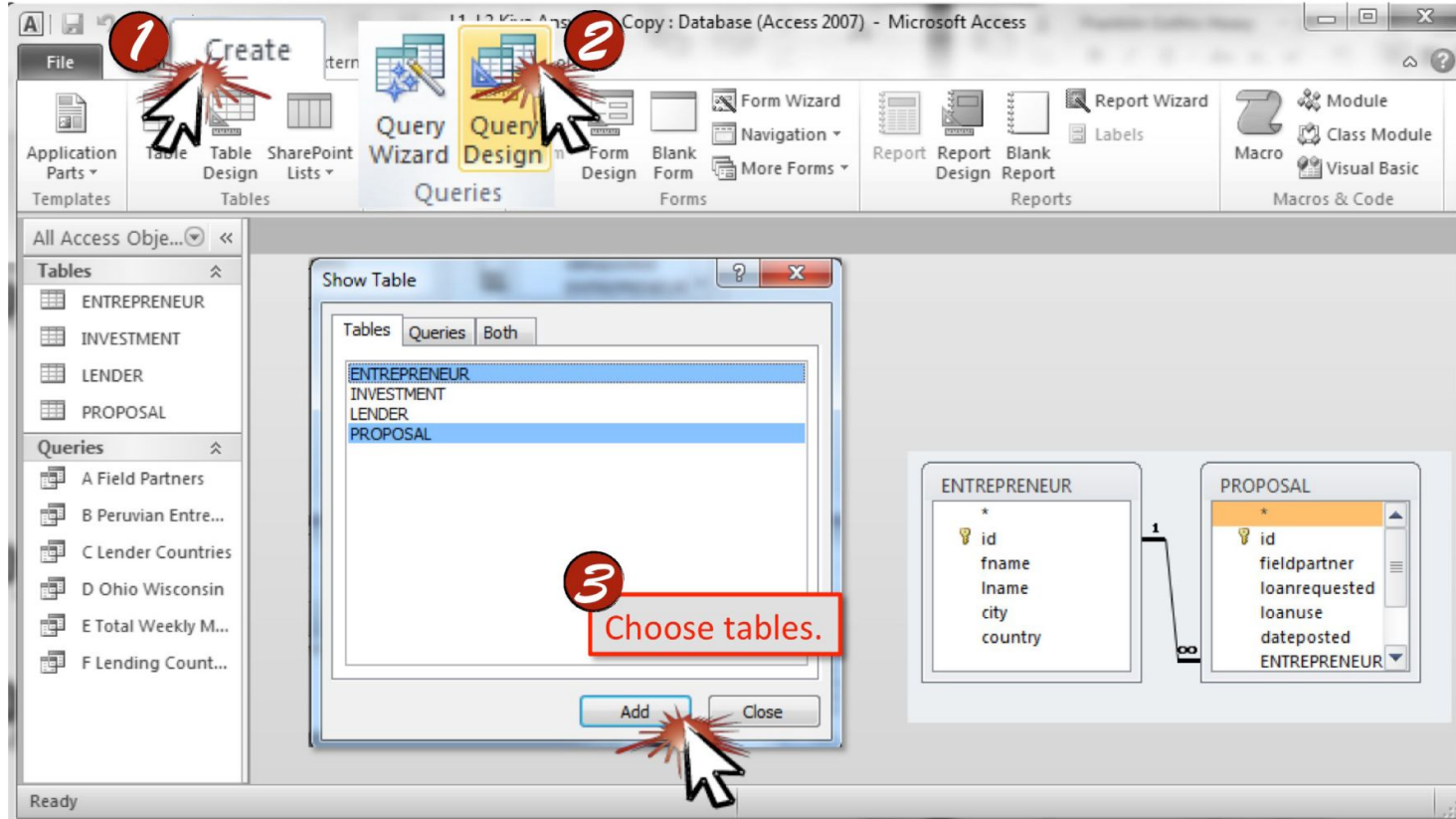
Field:	C_ID	TITLE	FEE		
Table:	COURSE	COURSE	COURSE		
Sort:			Descending		
Show:	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Criteria:			> 250 And <= 350		
or:					

Databases: Query



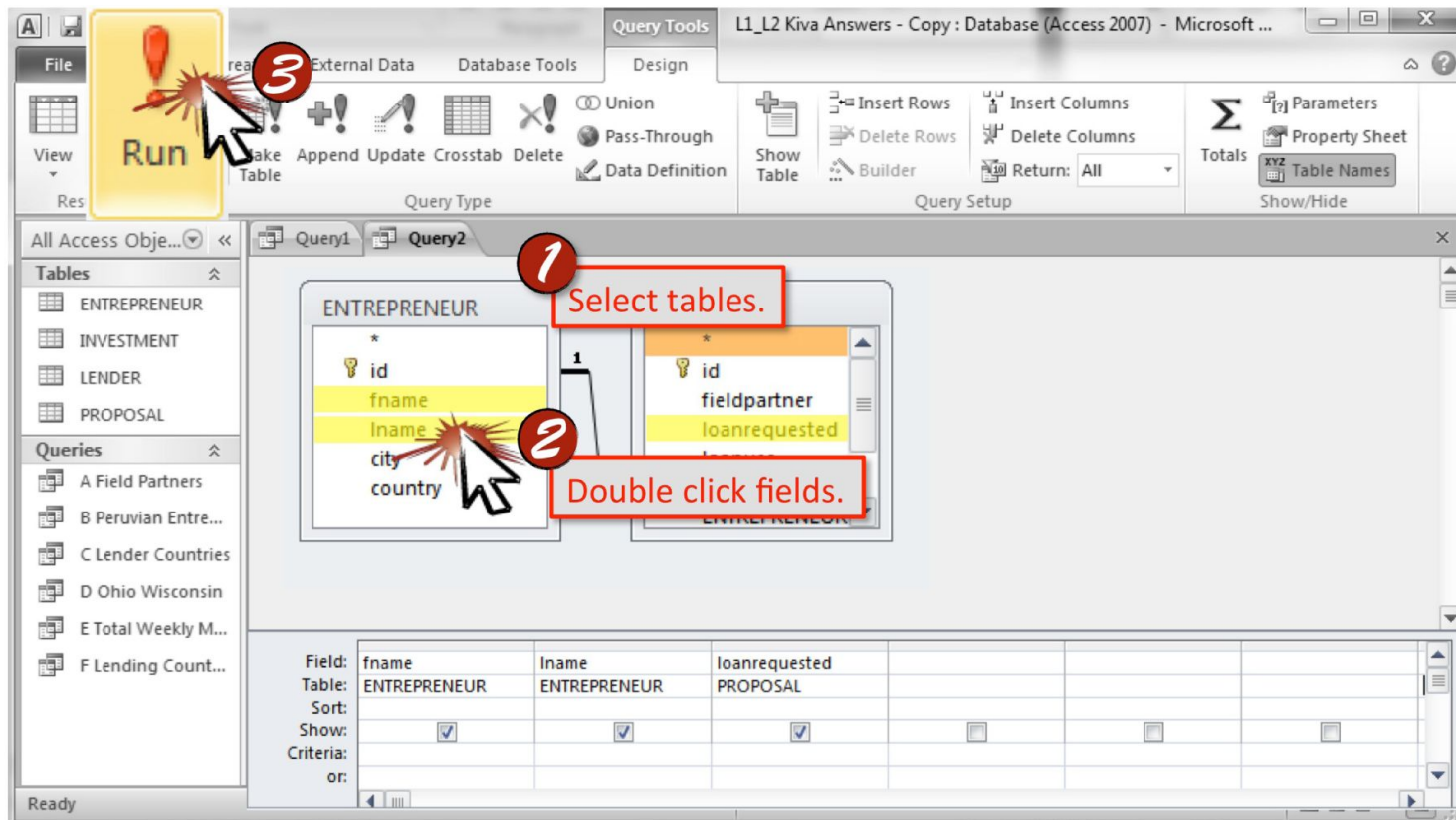
Overview Map of Interface—Reference this map to navigate the Microsoft Access interface.

Databases: Query



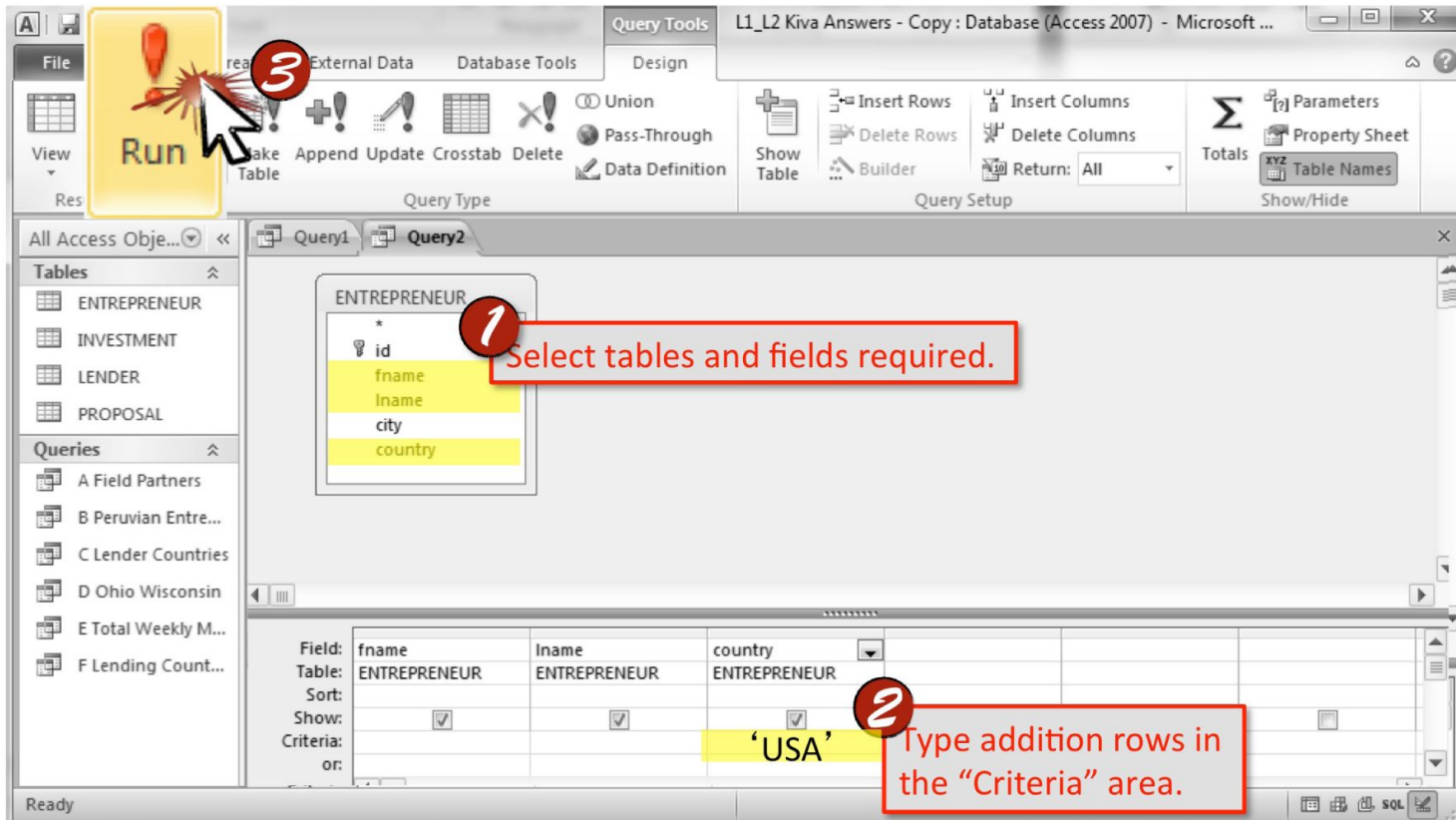
Select Tables—Choose the tables that contain data you will be using in your query. Some queries will require only one table while others will require multiple tables from your database.

Databases: Query



Select Fields—Choose the individual fields that you will require when constructing your query. Consider what you are asking and which pieces of data are necessary to achieve the answer.

Databases: Query



Select Rows—Add criteria to your query to narrow your search. By including additional criteria, you will be able to obtain more powerful information from your data.

Databases: Reports

- Access Report Wizard

Report Wizard

1

Do you want to add any grouping levels?

I_NO
F_NAME
L_NAME
SALARY

>
<
Priority
↑
↓

DIV
I_NO, F_NAME, L_NAME, SALARY

Grouping Options ... Cancel < Back Next > Finish

Report Wizard

2

What sort order and summary information do you want for detail records?

You can sort records by up to four fields, in either ascending or descending order.

1 SALARY Ascending
2 L_NAME Ascending
3 Ascending
4 Ascending

Summary Options ...

Summary Options

3

What summary values would you like calculated?

Field	Sum	Avg	Min	Max
SALARY	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

OK
Cancel

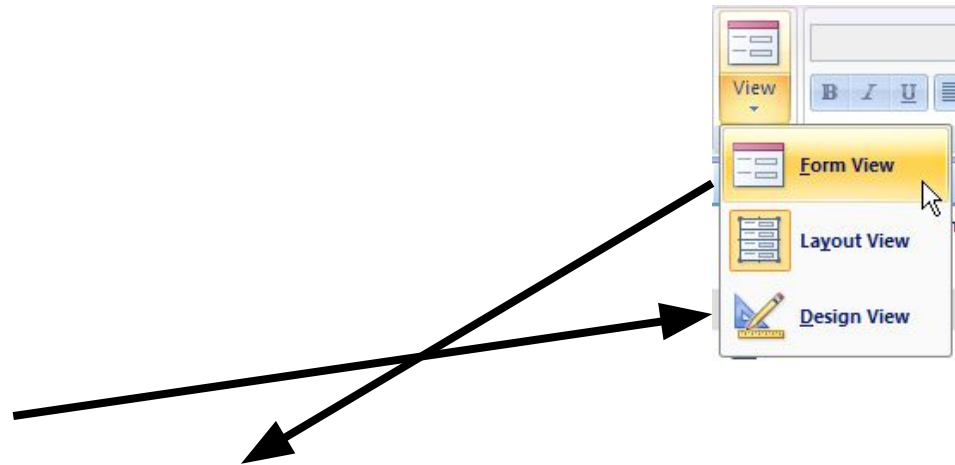
Show
☒ Detail and Summary
☐ Summary Only

☐ Calculate percent of total for sums

Databases: Forms

- MS Access Forms

This screenshot shows the Design View of an MS Access form. The form has a header section labeled 'DIVISION' and a detail section. The detail section contains three text boxes for 'D_ID', 'DIR', and 'DIV_NAME'. Below these is a subform titled 'Division Instructor Master Detail'. The subform has its own header labeled 'INSTRUCTOR' and a detail section with three text boxes for 'I_NO', 'F_NAME', and 'L_NAME'. The form is designed with a blue header and a white detail section.



This screenshot shows the Form View of the same MS Access form. The form is now displaying data. The header section is labeled 'DIVISION'. The detail section contains three text boxes for 'D_ID', 'DIR', and 'DIV_NAME'. Below these is a subform titled 'Division Instructor Master Detail'. The subform displays a table with the following data:

I_NO	F_NAME	L_NAME	SALARY	DIV
1	PATRICK	LEE	72000	D020
19	ALBERT	STONE	60000	D020
21	BRUCE	WANG	48000	D020
*				D020

The form also includes a status bar at the bottom showing 'Record: 1 of 3' and a search bar.

Sources:

Joseph Valacich, Christoph Schneider, *Information Systems Today: Managing in the Digital World*, 8th Edition

John Gallaugher, *Information Systems: A Manager's Guide to Harnessing Technology*, v. 7.0

Minder Chen, Ph.D., Management Information Systems Lectures