

# COMPSCI 111 / 111G

*Mastering Cyberspace:  
An introduction to practical computing*

## Databases

Understanding and creating databases

## Learning Outcomes

Explain the difference between a database and a database management system

Identify a field, record and table in a relational database

Identify primary and foreign keys

Use a relationship diagram to identify the relationships between different fields

## Databases

### Database

- A (large) collection of data about a particular topic

### Examples of databases:

- Library book collection
- Patient files from doctor's office
- Car dealer customer records
- Video store movie collections
- Supermarket daily transactions
- An address book
- Student marks
- Wine cellar inventory

<http://en.wikipedia.org/wiki/Database>

## Dangers of databases

### Databases collect information

- Information can be misused
- Information can be misinterpreted
- Incorrect information can be entered
- Errors can occur in database software

### We rely on databases

- Bank accounts / transactions
- Tax returns
- Police records
- Student records
- Credit ratings

# Database Management Systems

## Databases:

- Data that is organised in a systematic way
- Entities (e.g., students, classes)
- Relationships (e.g., Ann is enrolled in CS111)

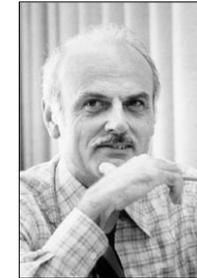
## A Database Management System (DBMS)

- Software package designed to store and manage databases
- Microsoft Access
- MySQL
- Oracle

# Relational Databases

## Relational Model

- Introduced in the late 1970's
- Provides a conceptual view of the database
- Information seen as tables with rows and columns
- Most widely used model today



Edgar Codd

# Definitions

## Field

- A single piece of data (e.g. name)

## Record

- A collection of fields (e.g. name, address, phone number)

## Table / File

- A collection of records

**Records** →

Id	First Name	Surname	Street	Suburb
1	Homer	Simpson	742 Evergreen Terrace	Springfield
2	Peter	Griffin	31 Spooner Street	Quahog
3	Philip	Fry	Planet Express Offices	New New York

→ **Fields**

# Relations

## Primary key

- Each table must have a primary key.
- Field (non-null) or combination of fields that makes each record unique.
- Cannot have two records in a table with the same primary key.

## Foreign Key

- A field in a table that is related to the primary key in another table.
- We can use the foreign key and primary key to join information in the two tables where there are common values.
- This field can hold null values.

## Referential Integrity

- All values in the foreign key field of a table must also be contained in the table to which it is related or be null.

[http://en.wikipedia.org/wiki/Referential\\_Integrity](http://en.wikipedia.org/wiki/Referential_Integrity)

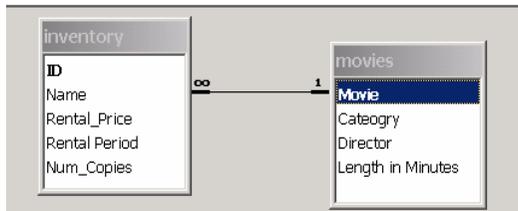
## Example

### Primary keys

- The first table (inventory) has a primary key called ID.
- The second table (movies) has a primary key called Movie.

### Foreign key

- The inventory table has a foreign key (name).
- Related to the primary key in the movies table.
- Every entry for name in inventory table must have a corresponding entry for Movie in the movie table



## Looking at the Data

### If we look at the data in this database:

Movie	Category	Director	Length in Minutes
Blade II	ACTION	Guillermo del Toro	116
Lord of the Rings	FANTASY	Peter Jackson	178
Minority Report	ACTION	Steven Spielberg	145
Monsters, Inc.	COMEDY	Peter Docter	92
The Graduate	COMEDY	Mike Nichols	105

We can see that there is only one row for each movie title in this table. Movie is our primary key.

But there can be many rows for the movies in the second table.

ID	Name	Rental_Price	Rental_Period	Num_Copies
1	Lord of the Rings	\$3.00	1	5
2	Lord of the Rings	\$7.00	3	1
3	Monsters, Inc.	\$5.00	2	2
4	Blade II	\$6.00	2	3
5	Minority Report	\$4.00	1	2
6	Minority Report	\$6.00	3	1

This is because the movie name does not make a record unique in this table. This table has a primary key that is a unique ID.

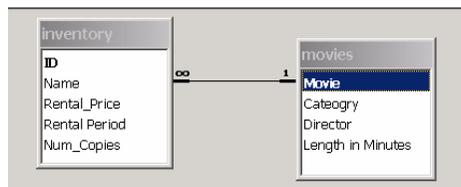
## Relationships

### Many values

- More than one record in Inventory with the same name
- E.g. "Star Wars" can occur several times

### One value

- Each Movie name in movie table is unique
- This is because Movie is a primary key.



### Relationship between the inventory and movies tables

- *Many-to-one*

## Using Microsoft Access

### Database management program

- MS Access

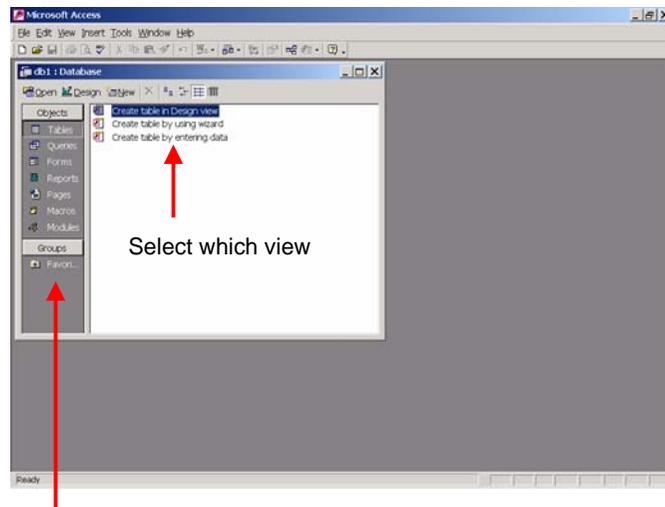
### What can we do?

- It allows us to create relational databases
- It gives us a powerful query tool to access the data
- It has a report writer to create reports from this data

### Advanced tools (not used in this course)

- It has a form tool to allow us a graphical data entry environment
- Like Excel and Word, it has a Macro language that allows us to automate our work.

# Using Microsoft Access

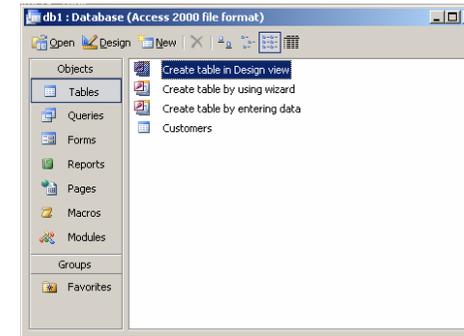


Choose Tables, Queries, Reports

# Creating a table (1)

## Different ways of creating a table

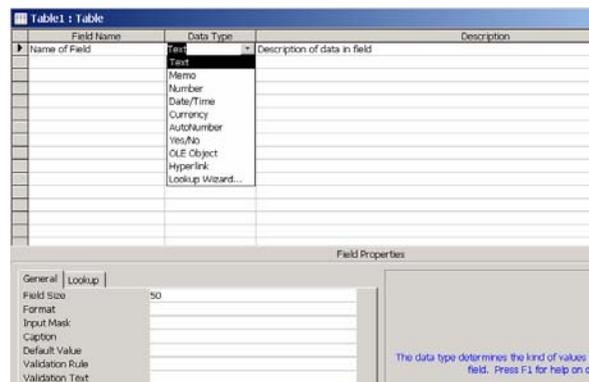
- Use Design view



# Creating a table (2)

## List all the fields we want

- Field name
- Field type
- Description is optional, but is useful documentation



# Creating a primary key

## To create a primary key for the table

- Select the fields that will form the key
- Right-click
- Choose "Primary Key"

## Data integrity ensured

- Null values not permitted
- No duplicates

Companies : Table			
	Field Name	Data Type	Description
PK	ID	AutoNumber	Unique ID and Primary Key
	Comp. Size	Text	Company Name
	Gross	Number	Number of employees in company
		Currency	Annual gross revenue of this company

# Adding a relationship

## Define a relationship between tables

- Tools menu, select "Relationships"

Parts – primary key – **pid**  
 Catalog – primary key – **sid+pid**  
           foreign keys – **pid** (parts)  
                           **sid**(suppliers)  
 Suppliers – primary key - **sid**

# Adding Data

## Data must be added in correct order

- If relationship exists between primary and foreign key
- Primary key data added first
- Foreign key data added second

## Referential Integrity

- Add Parts and Suppliers before Catalog data
- Data in Catalog is rejected if it refers to an sid or pid that does not exist yet.

# Referential Integrity

*All values given in a foreign key field must also be contained in the table that it is related to (or be null)*

## Example:

- If our supplier table has the following information, we cannot add a record to the Catalog table with an sid of 5

sid	sname	address
1	Acme Widget Suppliers	1 Grub St., Potemkin Village, IL 61801
2	Big Red Tool and Die	4 My Way, Bermuda Shorts, OR 90305
3	Perfunctory Parts	99999 Short Pier, Terra Del Fuego, TX 41299
4	Alien Aircraft Inc.	2 Groom Lake, Rachel, NV 51902

# A One-to-One Relationship

Movies : Table			Directors : Table	
Movie	Length in Minut	Director	Name	Age
Blade II	116	Guillermo del Toro	Guillermo del Toro	40
Lord of the Rings	178	Peter Jackson	Mike Nichols	73
Minority Report	145	Steven Spielberg	Peter Docter	36
Monsters Inc.	92	Peter Docter	Peter Jackson	43
The Graduate	105	Mike Nichols	Steven Spielberg	58

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## A Many-to-One Relationship

Title	Year	Singer
Ain't No Sunshi	1971	Bill Withers
All Night Long	1985	Lionel Richie
Hello	1984	Lionel Richie

Name	Year of Birth
Bill Withers	1938
Lionel Richie	1949



## Revision

### Things to know before the exam ☺

- The difference between a database and a DBMS
- What tables, fields and records are
- What a Primary Key of a table is
- What Foreign Keys are
- One-to-many and many-to-one relations between tables