Databases 1 – Organisation and Creation

Today’s lecture

• What is a database?
• Understanding how data is organised in a database
• Creating a database in Microsoft Access

What is a database?

• A (typically large) collection of data about a particular topic, organized systematically
• Examples:
  – Catalogue of library books
  – Patients’ files in a clinic
  – Entries in an address book
  – Students in a class
• Computers allow us to store and manage databases that contain very large amounts of information

Aspects of a database

• Before we can create our database, we need to decide how to:
  1. Organize data in our database
  2. Enter data in our database
  3. Retrieve data from our database
  4. Present the retrieved data to the user
Question?

- What websites have you visited that probably use a database?

1. Organising data - models

- A model defines how data is organized and structured within the database
  - We’re going to look at the relational model in this course
- When deciding what data to store in a database, we need to think about:
  - Entities: things about which we store information
    - Eg. students in uni, courses in uni
  - Relationships: specific connections among entities
    - Eg. students enrolled in CompSci111/111G

1. Organising data - tables

- The relational model was developed by Edgar Codd in 1970
- Data is stored and organized in tables
  - A table’s columns are called fields; an entity’s attributes
  - A table’s rows are called records; one instance of an entity
- A collection of tables form a database

<table>
<thead>
<tr>
<th>StudentId</th>
<th>Name</th>
<th>Address</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>12345</td>
<td>C. Brown</td>
<td>12 Apple St.</td>
<td>555-1234</td>
</tr>
<tr>
<td>67890</td>
<td>L. Van Pelt</td>
<td>34 Pear Ave.</td>
<td>555-5678</td>
</tr>
<tr>
<td><strong>22222</strong></td>
<td>P. Patty</td>
<td>56 Grape Blvd.</td>
<td><strong>555-9999</strong></td>
</tr>
</tbody>
</table>

1. Organising data

- Tables are connected together using relationships, thereby creating connections between different entities
1. Organising data

- There are two parts to a relationship: **primary key** and **foreign key**
- **1. Primary key:**
  - Generally, all tables must have a primary key field
  - All records must have a value in the primary key field
  - The primary key’s value must be unique

![Primary key](image1.png)

**Referential integrity**

- An important concept underlying relationships between tables
- Referential integrity requires all values of a foreign key field to be:
  - Present in the related primary key field, OR
  - Null (ie. blank)

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**Question?**

- Which field makes a good primary key in a table?
Referential integrity

<table>
<thead>
<tr>
<th>Students</th>
<th></th>
<th>Enrolments</th>
</tr>
</thead>
<tbody>
<tr>
<td>ID</td>
<td>Name</td>
<td>Date of birth</td>
</tr>
<tr>
<td>5468975</td>
<td>Joe Cameron</td>
<td>19/08/1992</td>
</tr>
<tr>
<td>1258956</td>
<td>Steve Smith</td>
<td>17/05/1995</td>
</tr>
<tr>
<td>6697826</td>
<td>Tom Bloggs</td>
<td>30/06/1965</td>
</tr>
</tbody>
</table>

Insert 9998881, COMPSCI111, 22/12/2015 into Enrolments ✗
Insert 6697826, COMPSCI105, 16/12/2015 into Enrolments ✓
Insert 6697826, COMPSCI105, 01/12/2015 into Enrolments ✓
Delete 5468975, from Students ✗
Delete 5468975, from Enrolments ✓

Types of relationships

• There are three kinds of relationship that can exist between tables
  • **One to one**: one record in PK related to one record in FK
    – Eg. student can only have one transcript
  • **One to many**: one record in PK related to multiple records in FK
    – Eg. student can have multiple emergency contacts
  • **Many to many**: multiple records in PK related to multiple records in FK
    – Eg. many students can be enrolled in many papers

Many to Many

• The many-to-many relationships are usually implemented by a pair of one-to-many relationships using three tables

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</tbody>
</table>

<table>
<thead>
<tr>
<th>Enrolments</th>
<th></th>
<th>Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td>StudentID</td>
<td>Code</td>
<td>Date enrolled</td>
</tr>
<tr>
<td>5468975</td>
<td>COMPSCI101</td>
<td>01/01/2016</td>
</tr>
<tr>
<td>1258956</td>
<td>COMPSCI103</td>
<td>15/12/2015</td>
</tr>
<tr>
<td>6697826</td>
<td>COMPSCI107</td>
<td>15/12/2015</td>
</tr>
</tbody>
</table>

Exercises

1. What is the primary key and the foreign key (if one exists) for the Label table?
2. What is the primary key and the foreign key (if one exists) for the Artist table?
3. What is the primary key and the foreign key (if one exists) of the Albums table?
Aspects of a database

- Before we can create our database, we need to decide how to:
  1. **Organize** data in our database
     - Models, tables, relationships
  2. **Enter** data in our database
  3. **Retrieve** data from our database
  4. **Present** the retrieved data to the user

Database Management System (DBMS)

- Application software that is used to manage databases.
- Four main functions:
  - Definition
  - Update
  - Querying
  - Administration
- Examples:
  - Microsoft Access
  - Microsoft SQL Server

Creating a database

Templates

Creating a new database
Creating a table

- **Design view**: create/view the fields in the table
- **Datasheet view**: create/view data in the table
Datasheet view

- Allows us to enter data into our table
- Need to ensure that we enter the correct type of data in each field (e.g., no text in a number field)

Creating relationships

- Relationships view allows us to create relationships between fields in different tables
- Database Tools tab → Relationships button
Creating relationships

Inserting data

• Can we insert this record in the Enrolments table?

Inserting data

• This won’t work; StudentID’s value (‘5’) doesn’t exist in the primary key ID

Summary

• A database is used to store information in a systematic and orderly manner
• The relational model uses tables to store information about entities and relationships to connect tables together
• Relationships require tables, primary keys, foreign keys. Referential integrity is an important concept
• Microsoft Access is a popular DBMS that we can use to insert and manage data in our database