Introduction

Why taking this course??

- "What is the use of all the courses I have taken so far?"
  - This course uses a lot of the basics introduced in the 200/300 level courses
- "I want to work in an interdisciplinary environment"
  - Be an application developer working with people from other areas (e-commerce, science, administration, law, etc. etc.)
- "I love the internals of how computers and systems work"
  - Be a database administrator or a DBS developer: a DBMS is an entire operating system and more
- "I want to work with computer languages, human-computer interaction, multimedia, logic, communication, distributed systems, knowledge management -- It's all there

Example Applications

- What data would you store in a database system (DBS, DBMS, RDBMS)?

University Data and its use

- What information is stored?
  - Provide at least 5 classes
- How is the data used?
  - Provide at least 3 queries (information that you want to retrieve from the system)
  - Provide at least 3 modifying actions (actions that insert data or modify data)
- Why cumbersome to do this with files?

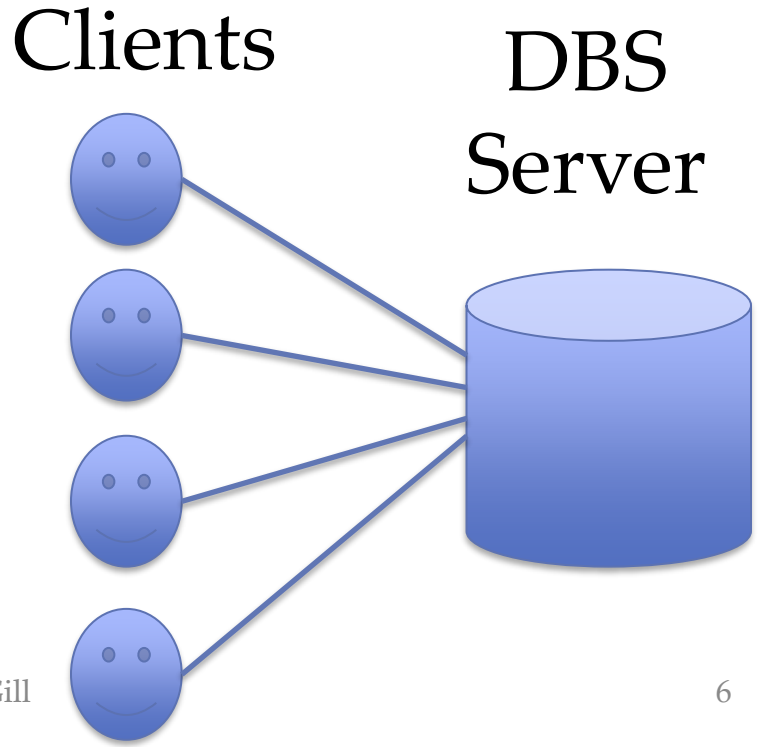
Working with Data

- Defining a Schema
- Inserting Data/Updating Data
- Querying Data
- Application Programming

- Focus: Relational data and **SQL**
- Other data models:
  - Differences and similarities with SQL

Database Management System

- Complex software system
- storage, management and manipulation of data, mostly data that follows "some" structure
- Well-structured data model: relational, graph, semi-structured, object-oriented
- Powerful ***data-centric*** interface
  - Define structure of data
  - Insert/change data
  - Advanced queries
- Efficiency
- Concurrency
- Persistence



Database Systems?

- PostgreSQL
- MariaDB
- DB2
- Oracle

Relational Data Model

Cartoon Characters

Sid (int)	FirstName (string)	LastName (string)	…
123	Bugs	Bunny	
124	CardCapturer	Sakura	
125	Dora	The Explorer	

Relation = Table

tuple = row

attribute = column header

Simple, powerful, mathematically sound

Data Models covered

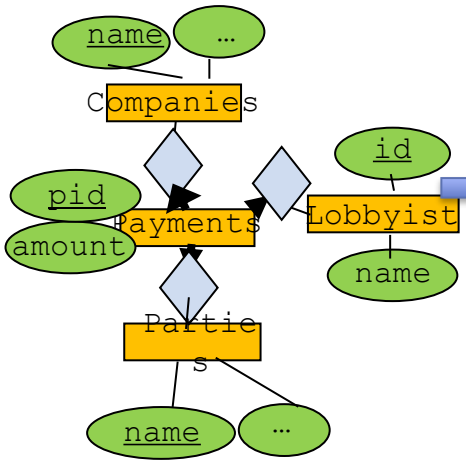
- Semantic data model
  - (Entity Relationship) ER
- Relational
- Graph

First part of the course

High-level modeling language
Entity-relationship model

Relational Model: Company

Real-life data



Name (string)	HQ (string)	…
Oracle	Austin	
Bombardier	Montreal	
Siemens	Munich	

Query Data

Application Program

```
Connection con =
DriverManager.getConnection
(url,your_userid,your_password) ;
String querySQL = "Select name FROM
Company WHERE HQ = \'Montreal\'";
java.sql.ResultSet rs =
statement.executeQuery ( querySQL ) ;
```

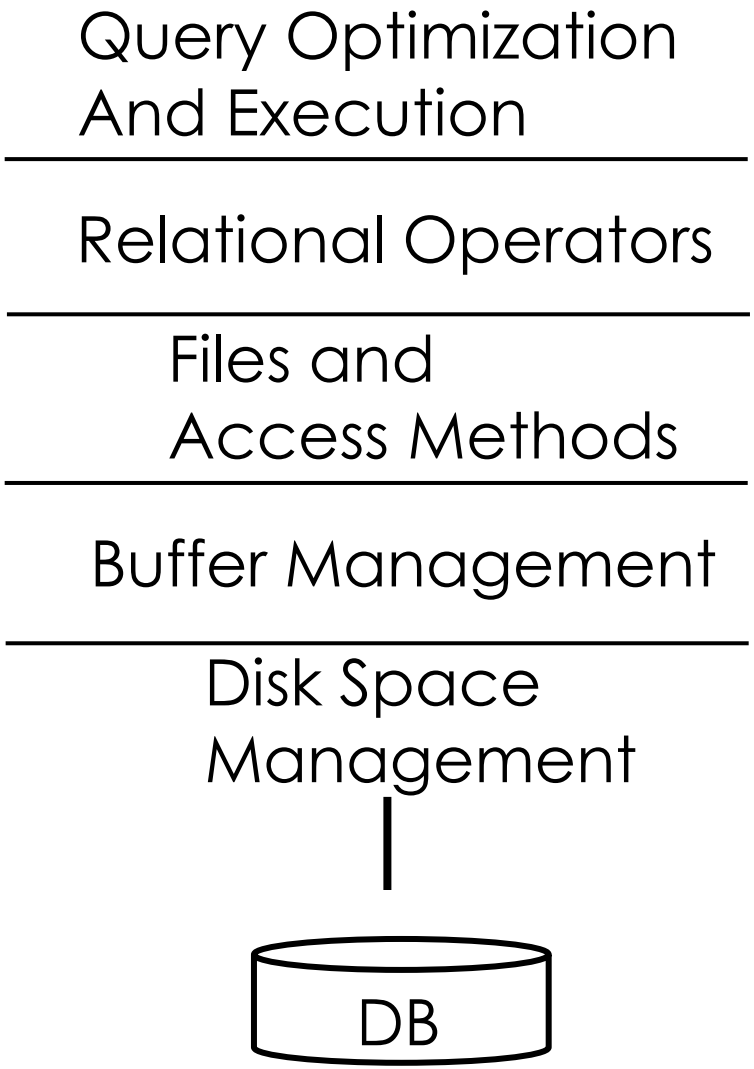
SQL:

```
SELECT name
FROM Company
WHERE HQ = 'Montreal'
```

Relational Algebra:

$$\Pi_{\text{name}} (\sigma_{\text{HQ = 'Montreal'}} (\text{Company}))$$

Internals of a DBS



Transaction Management

- Managing updates

- Handle concurrent access
- Handle failures

Emphasis of the Course

- **Design** of databases
- **Use** of a database
- **Internals**

- Database technology is continuously evolving
  - Understand what are the fundamental concepts of any database system

Database Systems and Data Analytics

- Transform basic data into valuable knowledge
- In 2002 a statistician in Target came up with a list of 25 products in the shopping cart that could give an indication of someone being pregnant.
- Big Data Analytics is emerging as an important trend in analyzing and containing health issues like spread of epidemics. (Eg. COVID, Ebola in West Africa)

Data Analytics