Databases

Why?

- Abstraction of logical from physical structure
- Allows separation of a program’s “business logic” from concerns about traversal of the data

Types of databases

- Object
  - direct representation of programming language objects
- Relational (<= dominant)
  - Tables
  - Operations
    - Select, project, union
    - Join (natural, inner, outer, left, right, …)
  - Indexes
- Hierarchical (e.g., XML)
  - Parent-child
- Network
- Flat files (e.g., spreadsheet, text file)

Hierarchical Model

Fig. 3.3 Sample data in hierarchical form (parent superior to offspring).
Network Model

Relational Database

Underlying Concepts

- Individual entities
- Their properties
- Relations among them
  - 1-1
  - 1-n (or n-1)
  - n-n
- Integrity
- Transactions

Relational Model

Relational Algebra Operations

- Select—subset of rows with conditions
- Project—subset of columns
- Join A and B
  - Outer: cross product of all rows in A and B, result includes all columns of each
  - Natural: select rows of cross-product in which matching columns have same values
  - Join on specific column relations (=, >, <, …)
- Grouping operations (partition by criteria)
- Summarization (count, max, min, average)
MySQL SELECT syntax

```sql
SELECT [ALL | DISTINCT | DISTINCTROW ]
[HIGH_PRIORITY] [STRAIGHT_JOIN] [SQL_SMALL_RESULT]
[SQL_BIG_RESULT] [SQL_BUFFER_RESULT] [SQL_CACHE | SQL_NO_CACHE]
[SQL_CALC_FOUND_ROWS]
select_expr, ...
FROM table_references
[WHERE where_condition]
[GROUP BY {col_name | expr | position}]
[ASC | DESC], ...
[HAVING where_condition]
[ORDER BY {col_name | expr | position}]
[ASC | DESC], ...
[LIMIT ([offset,] row_count | row_count OFFSET offset)]
[PROCEDURE procedure_name(argument_list)]
[INTO OUTFILE 'file_name' export_options
 | INTO DUMPFILE 'file_name'
 | INTO @var_name [, @var_name]]
[FOR UPDATE | LOCK IN SHARE MODE]
```

MySQL SELECT examples

```sql
select * from persnl_public where last_name='Bird';

select pat_num from persnl_public, ppr
where persnl_public.persnl_id=ppr.provider_id
and persnl_public.last_name='Bird';

select d.last_name,d.first_name
from persnl_public as p, ppr, pat_demograph as d
where p.persnl_id=ppr.provider_id
and ppr.pat_num=d.pat_num
and p.last_name='Bird';

select p.last_name,p.first_name,count(*) as c
from persnl_public as p join ppr
on p.persnl_id=ppr.provider_id
group by p.persnl_id
having c>1
order by c desc;
```