Midterm Topics (1)

• Concurrency & Synchronization
  – Process vs. Thread
  – Concurrent Programming
  – Race conditions, mutual exclusion, synchronization

• IPC
  – Shared memory vs. Message passing
  – Mmap for shared memory across different processes
  – UNIX Fifos and Pipes for messaging

• Networking Introduction
  – Network structure
  – Circuit vs. packet switching & TDM vs. FDM
  – Network stack & Layering (OSI & TCP/IP models)
Midterm Topics (2)

• Link Layer
  – Framing (how to divide bit streams into frames)
  – Error detection & error correction
  – Link layer protocols (stop & wait, sliding window)

• Network Layer
  – Connectionless vs. connection-oriented service
  – Routing concepts and routing algorithms
  – Count-to-infinity problem

• Transport Layer
  – Sockets
  – Flow control and sequence numbers
Midterm Topics (3)

• Relational databases
  – Relation schema, Relations, domains, constraints
  – Relational algebra operations

• SQL
  – SQL terminology
  – SQL query operations & options; how to retrieve data

• Database transactions
  – Database model for transactions
  – Motivation for concurrency control (3 problems)
  – System log
  – ACID properties of transactions
  – Serializability
PostgreSQL

• Also called Postgres
• Open source relational database system
• Based on SQL
• Features:
  – ACID compliant (i.e. the properties we want for transactions)
  – Supports foreign keys, joins, views
  – Many useful built-in data types
  – Interfaces for C/C++, Java, Python, Ruby, …
  – Sophisticated query optimizer
• Other common SQL alternatives
  – SQLite, MySQL
Postgres Installation

- Open-source; available for Linux, MacOS, Windows, ...
- I'll show steps for Linux; tested using Ubuntu VM image
  - [https://vm-manage.oit.duke.edu/vm_manager](https://vm-manage.oit.duke.edu/vm_manager)
- Install Postgres:
  
  ```bash
  sudo apt-get install postgresql
  sudo apt-get install postgresql-contrib
  ```
- Install C++ API:
  
  ```bash
  sudo apt-get install libpq-dev
  wget http://pqxx.org/download/software/libpqxx/libpqxx-4.0.tar.gz
  tar xvfz libpqxx-4.0.tar.gz
  cd libpqxx-4.0
  ./configure
  make
  make install
  ```
Other Setup

- By default, installation creates a user 'postgres'

- Connect to postgres server and set up password
  
  ```
  sudo su - postgres
  psql
  ALTER USER postgres with encrypted password 'abc123';
  ```
  
  - Then execute command '\q' to leave postgres
  - Then 'exit' to exit from 'postgres' user back to your default user ID

- Find file pg_hba.conf in your system and edit as follows:
  
  ```
  sudo vim /etc/postgresql/9.3/main/pg_hba.conf
  ```
  
  - Change this line:
    
    ```
    local  all      postgres                          peer
    ```
  
  - To:
    
    ```
    local  all      postgres                          md5
    ```
Create a Database

• Start Postgres
  psql -U <userid>
  e.g. psql -U postgres

• Create database
  CREATE DATABASE testdb;

• Connect to database:
  \l  # to list available databases
  \c testdb  # to connect to 'testdb' database
  sudo apt-get install postgresql-contrib
Database Operations

• Create tables

```
CREATE TABLE COMPANY(
    ID INT PRIMARY KEY     NOT NULL,
    NAME           TEXT    NOT NULL,
    AGE            INT     NOT NULL,
    ADDRESS        CHAR(50),
    SALARY         REAL,
    JOIN_DATE      DATE
);
```

• List info about tables in a database

```
\d                      # Show overview of all tables
\d company              # Show details of 'company' table
```
Database Operations

- Insert rows into a table
  
  \[
  \text{INSERT INTO COMPANY (ID,NAME,AGE,ADDRESS,SALARY,JOIN\_DATE) VALUES (1, 'Paul', 32, 'California', 20000.00 ,'2001-07-13');}
  \]
  \[
  \text{INSERT INTO COMPANY (ID,NAME,AGE,ADDRESS,JOIN\_DATE) VALUES (2, 'Allen', 25, 'Texas', '2007-12-13');}
  \]
  \[
  \text{INSERT INTO COMPANY (ID,NAME,AGE,ADDRESS,SALARY,JOIN\_DATE) VALUES (3, 'Teddy', 23, 'Norway', 20000.00, DEFAULT );}
  \]
  \[
  \text{INSERT INTO COMPANY (ID,NAME,AGE,ADDRESS,SALARY,JOIN\_DATE) VALUES (4, 'Mark', 25, 'Rich-Mond ', 65000.00, '2007-12-13'), (5, 'David', 27, 'Texas', 85000.00 , '2007-12-13');}
  \]

- Query a database
  
  \[
  \text{SELECT * from COMPANY;}
  \]
  \[
  \text{SELECT ID, NAME, SALARY FROM COMPANY;}
  \]