

Announcements

- ❖ Check class announcements daily
- ❖ You must implement programming projects by yourself

Relational Databases

- ❖ **Database** → group/collection of data that can be accessed, updated and manipulated.
- ❖ **Database model** → How the data is organized (defines different kinds of databases)
 - ❖ Relational database model
 - ❖ Data organized in relations (tables)
 - ❖ Introduced by E.F. Codd
 - ❖ Most popular databases based on this model
 - ❖ Object database model
 - ❖ Hierarchical model
 - ❖ Network model
- ❖ **Database Management System (DBMS)**
 - ❖ Software controlling the use of a database
 - ❖ **RDBMS** → Relational Database Management System

Relational Model

- ❖ Database is a collection of tables
- ❖ Each table has rows and columns
- ❖ A column (field) represents a particular entity (e.g., name, address, etc.)
 - Field Types
 - String
 - Integer
 - Float
 - Enum
 - etc.
- ❖ SQL (Structured Query Language)
 - ❖ Allow us to retrieve, update, manage the database
 - ❖ Example: `select * from friends;`
- ❖ SQL Operations
 - ❖ selections
 - ❖ projections
 - ❖ joins
 - ❖ table/Index management

SQL Commands Review

- ❖ help contents;
- ❖ show databases;
- ❖ create database myDB;
- ❖ use myDB;
- ❖ show tables;
- ❖ create table friends (name varchar(20) primary key, gender enum('M','F'), salary float, id int);
- ❖ describe friends;
- ❖ insert into friends values ("Mary", "F", 10000, 10);
- ❖ insert into friends (name) values ("Jose");
- ❖ select * from friends where salary > 5000;
- ❖ select name,id from friends where salary > 5000;
- ❖ update friends set salary=7778, gender="F" where name = "Pat";
- ❖ delete from friends where name="Pat";
- ❖ show grants;
- ❖ drop table friends;
- ❖ drop database myDB;

Database Transactions

- ❖ Transaction → group of SQL statements that must be executed as a batch
- ❖ Transaction semantics
 - ❖ start transaction
 - ❖ commit
 - ❖ rollback

RDBMS

❖ Systems

❖ Oracle → <http://www.oracle.com>

❖ Sybase → <http://www.sybase.com>

❖ MySQL → <http://www.mysql.com/>

Role of Databases in Web Applications

- ❖ Main data repository
- ❖ Let's see an application example
 - ❖ Airline reservation system
- ❖ What is the role played by:
 - ❖ HTML
 - ❖ JavaScript
 - ❖ PHP (server-side processing language)

Society /Impact of Software Failures

- ❖ Software becoming part of basic infrastructure
 - ❖ Software in cars, appliances
 - ❖ Business transactions moving online
- ❖ Computers becoming increasingly connected
 - ❖ Failures can propagate through internet
 - ❖ Internet worms
 - ❖ Failures can be exploited by others
 - ❖ Viruses
 - ❖ Spyware

Software Contributes to Real Failures

- ❖ Bugs in software may cause real-world failures
- ❖ Example – Air Force F-22A Raptor
 - ❖ Stealth fighter costing \$300 million each
 - ❖ 1.7 millions lines of code for plane's avionics



Software Contributes to Real Failures

- ❖ Air Force F-22A Raptor software fails midair
- ❖ DefenseNews.com (March 5, 2007)
- ❖ “When a dozen Raptors en route from Hawaii to Japan crossed the International Date Line for the first time, the jets’ Global Positioning System navigation avionics went haywire, forcing the pilots to turn around.”
- ❖ **GPS software unable to handle change in longitude from W179.99° to E180°**
- ❖ **Raptor pilots visually followed refueling tankers back to Hawaii**



Software Contributes to Real Failures

- ❖ Happy ending for Raptor?
 - ❖ Lockheed-Martin provided software fix in 48 hours
 - ❖ For “operational security reasons” the USAF declined to elaborate, saying only that the F-22A “experienced a software problem involving the navigation system”
- ❖ Tough being a Raptor test pilot
 - ❖ DefenseNews.com (March 5, 2007)
 - ❖ “When the plane was in developmental stages ... pilots flying the Raptor would often have to reboot the onboard computers that controlled the jet’s high-end functions”

Other Famous Software Failures

- ❖ 1990 AT&T long distance calls fail for 9 hours
 - ❖ Wrong location for C break statement
- ❖ 1996 Ariane rocket explodes on launch
 - ❖ Overflow converting 64-bit float to 16-bit integer
- ❖ 1999 Mars Climate Orbiter crashes on Mars
 - ❖ Missing conversion of English units to metric units
- ❖ Other Failures available at:
 - ❖ http://news.zdnet.com/2424-9595_22-177729.html



Why Is Software So Difficult?

- ❖ Complexity
 - ❖ Software becoming much larger
 - ❖ Millions of line of code
 - ❖ Hundreds of developers
 - ❖ Many more interacting pieces
- ❖ Length of use
 - ❖ Software stays in use longer
 - ❖ Features & requirements change
 - ❖ Data sets increase
 - ❖ Can outlast its creators

Software Projects Fail

- ❖ Anywhere from 25-50% of custom software fail
- ❖ Example – FBI Virtual Case File
 - ❖ Began Jan 2001
 - ❖ Officially scrapped Jan 2005
 - ❖ LA Times (Jan 13, 2005)
 - ❖ “A new FBI computer program designed to help agents share information to ward off terrorist attacks may have to be scrapped... Sources said about **\$100 million would be essentially lost** if the FBI were to scrap the software...”