Class Announcements

- Midterm Thursday 10/27
- Study guide to be posted soon
- Assignment 3 due Tuesday 10/25

E-commerce Marketing

- Internet provides marketers with new ways of identifying and communicating with customers.
- Long tail marketing:
  - Sell large number of unique items
  - Relatively few of each item sold
- Behavioral targeting: tracking online behavior of individuals on thousands of Web sites.
- Advertising formats include search engine marketing, display ads, rich media, and e-mail.

Architecture

by

David G. Messerschmitt

What is Architecture?

How do you architect a solution?
A system is decomposed into interacting subsystems. Each subsystem may have a similar internal decomposition.

Three elements of architecture:
- Decomposition
- Organization
- Functionality
- Responsibility
- Interaction
- Cooperation

System examples:
Let’s quickly look at some system decomposition examples:
- Quick tour of information technology systems
  - Time sharing
    - Point-to-point wire
    - ASCII terminal (no graphics)
    - Mainframe (database and application server)
  - Two-tier client/server
    - Local-area network
    - Server
    - Mainframe
  - Three-tier client/server
    - Client
    - Enterprise data server
    - Application server
**System integration**

1. Architecture
2. Subsystem implementation
3. System integration

Bring together subsystems and make them achieve desired system functionality
- Testing
- Modifications often needed

**Emergence**

Subsystems are
- Specialized
- Have simple functionality

Higher-level system functionality arises from the interaction of subsystems
Called: Emergence

E.g. airplane flies, but subsystems can’t

**Why system decomposition?**

- Divide and conquer approach to containing complexity
- Reuse
- Consonant with industry structure (unless system is to be supplied by one company)
- Others?

**Networked computing infrastructure**

by

David G. Messerschmitt

**Layering**

**Example of Layering: networking**

- Application
- Messages
- Transport
- Packets
- Network
- Frames
- Link
- Bits
- Physical
- Signals
Software Layering

- Application
- Middleware
- Operating System

Operating system functions
- Graphical user interface (client only)
- Hide details of equipment from the application
- Multitasking
- Resource management
  - Processing, memory, storage, etc
- etc

Middleware Functions
- Capabilities that can be shared by many applications, but that is not part of OS
  - Example: Database Management System (DBMS)
- Hide details of OS from application
  - Java Virtual Machine
- More purposes we’ll talk about later.

What’s a database?
- Database
  - File with specified structure
  - Example: relational table

A Database

<table>
<thead>
<tr>
<th>Year</th>
<th>City</th>
<th>Accommodation</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>Oakland</td>
<td>Resort</td>
<td>150</td>
</tr>
<tr>
<td>2002</td>
<td>Oakland</td>
<td>Bed &amp; Breakfast</td>
<td>300</td>
</tr>
<tr>
<td>2002</td>
<td>Oakland</td>
<td>Resort</td>
<td>290</td>
</tr>
<tr>
<td>2002</td>
<td>Berkeley</td>
<td>Camping</td>
<td>120000</td>
</tr>
<tr>
<td>2002</td>
<td>Berkeley</td>
<td>Bed &amp; Breakfast</td>
<td>3400</td>
</tr>
<tr>
<td>2002</td>
<td>Berkeley</td>
<td>Resort</td>
<td>300000</td>
</tr>
<tr>
<td>2002</td>
<td>Alameda</td>
<td>Camping</td>
<td>8700</td>
</tr>
<tr>
<td>2003</td>
<td>Alameda</td>
<td>Bed &amp; Breakfast</td>
<td>3240</td>
</tr>
<tr>
<td>2003</td>
<td>Oakland</td>
<td>Bed &amp; Breakfast</td>
<td>345</td>
</tr>
<tr>
<td>2003</td>
<td>Oakland</td>
<td>Resort</td>
<td>870</td>
</tr>
<tr>
<td>2003</td>
<td>Oakland</td>
<td>Bed &amp; Breakfast</td>
<td>117000</td>
</tr>
<tr>
<td>2003</td>
<td>Berkeley</td>
<td>Resort</td>
<td>8100</td>
</tr>
<tr>
<td>2003</td>
<td>Berkeley</td>
<td>Bed &amp; Breakfast</td>
<td>416000</td>
</tr>
<tr>
<td>2003</td>
<td>Alameda</td>
<td>Camping</td>
<td>7600</td>
</tr>
<tr>
<td>2003</td>
<td>Alameda</td>
<td>Bed &amp; Breakfast</td>
<td>6700</td>
</tr>
</tbody>
</table>

Storage Middleware example: DBMS
- Database Management System (DBMS)
  - Manage Multiple databases
  - Allow multiple applications to access common databases
  - Implement standard data “lookup” (query) functions.
Client - Server Computing

Client Server Example

Client

Server

"I want to see www.google.com"

Client Server Example - Layers Revealed

Client

Server

Application:

Infrastructure

Packet

Packet

Internet

Packet

Packet

Infrastructure

3-Tier Client Server Architecture example

Client

Application Server

Web Server

Common Gateway Interchange

Application Logic

Shared data

3-Tier Client Server Architecture example

Client

Application Server

Web Server

Application Logic

Shared data

Shared data

Database Management System (DBMS)

Database

What is Bob’s balance? $0.50

1-Tier Client Server Architecture example

Client

Application Server

Web Server

Application Logic

Shared data

2-Tier Client Server Architecture example

Client

Application Server

Web Server

Application Logic

Shared data

Shared data

Database Management System (DBMS)

Database

What is Bob’s balance? $0.50

3-Tier Client Server Architecture example

Client

Application Server

Web Server

Application Logic

Shared data

Shared data

Database Management System (DBMS)

Database

What is Bob’s balance? $0.50

4-Tier Client Server Architecture example

Client

Application Server

Web Server

Application Logic

Shared data

Shared data

Database Management System (DBMS)

Database

What is Bob’s balance? $0.50

5-Tier Client Server Architecture example

Client

Application Server

Web Server

Application Logic

Shared data

Shared data

Database Management System (DBMS)

Database

What is Bob’s balance? $0.50

6-Tier Client Server Architecture example

Client

Application Server

Web Server

Application Logic

Shared data

Shared data

Database Management System (DBMS)

Database

What is Bob’s balance? $0.50
3-Tier Client Server Architecture example

Application Server

Web Server

Java Servlet

Application Logic

Database Management System (DBMS)

Database

Client

Shared data

In some implementations, Application Logic and Web Server can be put on different machines.

What is Bob’s Balance?

Relational Database

<table>
<thead>
<tr>
<th>Customer</th>
<th>Balance</th>
<th>Customer Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alice</td>
<td>$527</td>
<td>Silver</td>
</tr>
<tr>
<td>Bob</td>
<td>$0.50</td>
<td>Bronze</td>
</tr>
<tr>
<td>Charles</td>
<td>$1000000</td>
<td>Gold</td>
</tr>
</tbody>
</table>

DBMS Responsibilities

- Hide Changes in the Database hardware from the Application
- Standard operations on the data, including searches, such a search is called a **query**.
- Separate Database Management from Applications, so that many applications can access the same data.
- Security, Integrity, Backup, fault tolerance, etc.

3-Tier Client Server Architecture in General

- Takes inputs from client
- Decides what to be done next
- Decides what shared data to access and manipulates it
- Processes shared data
- Accept instructions from user
- Make requests of server
- Display responses of server
- Support multiple applications with common data
- Decouple data administration and application administration

- Client
- Application Server
- Shared data