Outline For Today

- Class Announcements
- Student Presentation
- Messerschmitt Ch5
- Sun N-Tier Case
Class Announcements

- The second batch of readers is at the bookstore!

- Makeup quiz available for those that were unable to take the last quiz because of not being able to get reader
  - Honor system - please don’t retake unless you were unable to get the reader
    - Monday April 25 (4:00-4:30) E2 room 194.
Class announcements

- Assignment 3 out
  - (due today!!)
- Reading for next class
  - Messerschmitt Ch 6,

- Student Presentations Monday
  - Bao Tran (News Article)
  - Amrita Singh (News article)
Class announcements

- Business Paper Proposal due April 25
  - ~2 pages
  - Discuss:
    - What you plan to include in your paper
    - How you plan to organize it.
  - Include a list of some references you plan to cite.
  - Check out class webpage for more details.
  - Come to office hours this week if needed
Midterm April 27

- Midterm April 27
  - 1 week from today
  - Covers up to Sun Case and Messerschmitt Ch5
  - Study:
    - Terms & Concepts
    - NO ROI calculations!!!
      - Small Error in the formula I gave you for Assignment 2
      - We will review this after the midterm.
    - Case Studies
  - Study guide Available
Student Presentation

David Isaacs
The Internet

by

David G. Messerschmitt
What is the Internet

- An **internet** is a “network of networks”
  - Interconnect standard for LAN’s, MAN’s, and WAN’s

- **Internet** = the major global internet

- A private internet is called an **intranet**

- An **extranet** is an interconnection of intranets through the Internet
Intranet

Private internet
May be connected to Internet
  - **Firewall** creates a protected enclave
Extranet

Intranets connected through an unprotected domain (typically the Internet)

Encryption and other security technologies used to

- protect proprietary information
- prevent imposters, vandals, etc
Lock icon indicates this is an extranet.
Certificate is the server’s credential.
Client Server Example

**Client**

“I want to see

**www.google.com**

**Server**

```html
<html>
<head>
<meta http-equiv="content-type" content="text/html; charset=UTF-8">
<title>Google</title>
</head>
<body>
<!--
body,td,a,p,.h{font-family:arial,sans-serif;}
.h{font-size: 20px;}
.q{color:#0000cc;}
//-->
... 
</body>
</html>
```
Client Server Example - Layers Revealed

Client

Application:

Server

Application

Internet

Packet

Packet

Packet

Packet

Infrastructure

Infrastructure

<html><head><meta http-equiv="content-type" content="text/html; charset=UTF-8"><title>Google</title><style><!--
body,td,a,p,.h{font-family:arial,sans-serif;}
.h{font-size: 20px;}
.q{color:#0000cc;}//-->
</head>

//--> ...
Email application

Email client sends message to server

Message is stored on POP server

Later, recipient’s email client retrieves message from server

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Chat application

Chat clients send user’s typing to server

Chat server aggregates typing from all users and sends to all clients

Other user’s clients display aggregated typing from chat server

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3-Tier Client Server Architecture example

Client

Application Server

Clicks, keystrokes

What is Bob’s balance?

$0.50

Shared data

Balance $0.50

What is Bob’s balance?

$0.50

Client

Application Server
3-Tier Client Server Architecture example

- Client
- Application Server
  - Web Server
  - Application Logic
  - Common Gateway Interchange
- Shared data
3-Tier Client Server Architecture example

- **Client**
- **Application Server**
  - **Web Server**
  - **Application Logic**
  - **Database Management System (DBMS)**
  - **Database**
- **Common Gateway Interchange**

- **Shared Data**

**Example:**
- What is Bob's Balance?
3-Tier Client Server Architecture example

In some implementations, Application Logic and Web Server can be put on different machines.
# 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>Shiv</td>
<td>$10000000</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

Client
- Accept instructions from user
- Make requests of server
- Display responses of server

Application Server
- Takes inputs from client
- Decides what to be done next
- Decides what shared data to access and manipulates it
- Processes shared data

Shared data
- Support multiple applications with common data
- Protect critical data
- Decouple data administration and application administration
Web server

Customer logic

Databases

Customers Merchandise Orders

Fulfillment logic

Acquirer bank Book distributors

Outside links

Consumer e-commerce

Inter-enterprise e-commerce

Web browser

Book merchant

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Web browser

Customer logic

Databases

Customers

Merchandise

Orders

Fulfillment logic

Outside links

Acquirer bank

Book distributors

Web server

Consumer e-commerce

Inter-enterprise e-commerce

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Peer to peer

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Peer to Peer

- What is peer to peer good for?
Sun N-tier case

- What does Sun make?
  - Workstations
  - Servers
  - Software
How Successful had Sun been up to 1998?

- Founded in 1982
- Open Standards Workstation
  - Unix Operating System (Solaris)
  - TCP/IP networking
- 1988 - Revenues $1 billion
- 1993 - Market value $3.0 billion
- 1997 - Jumped from 3rd to 1st in Unix Server Market.
How Successful had Sun been up to 1998?

- 1993 - “The network is the computer.”
- 1994 - Internet explodes in popularity
Microsoft mid to late 90s

- Dominated Desktop software
  - Users familiar with Windows, Office, etc.

- NT servers
  - Fine for small intranets, “not industrial strength”
What is Java?
- Programming Language
- Portable between computers with different operating systems
- Easy to write programs in
- Easier re-use
- But, programs are slow
What problems did the micro era produce?

- Desktops are expensive to maintain
  - TCO for windows PC $9900!

- Every PC had a lot of software that had to be maintained
  - Office, Windows, etc...

- Small differences, like the order in which software is installed, could make different PCs behave differently!
In the Networking Era

- These “bloated” PCs are networked and termed *fat clients*.
- But networking of PCs offered the possibility of
  - putting most of the functionality into servers
  - *Getting rid of much of the software on the client*
  - These clients would be called *thin clients*.
- Sun, Oracle, and others saw it as the future.
Hardware for thin clients

- A **Network Computer** (NC) - a computer with minimal hardware that depends on a network connection to a server to function.
  - Be careful not to confuse it with the phrase “networked computer!”
  - Example: Sun’s JavaStation (1996-2000)
  - It is the hardware one would use to implement a *thin-client* computing model.
Another term from that era...

A *NetPC* was a PC introduced by Microsoft and Intel in 1996

- Same software as a normal PC
- Did not allow users to install their own software
- NetPC died out
- Features of it, and Microsoft’s Zero Administration Kit, live on in today’s version of windows.
Microsoft Vision

- Keep “fat-client” model
- Add some features to Windows to reduce administration costs
Sun’s Vision

- Thin Client model.
- Application Servers with Applications written in Java.
- NCs could retrieve applications from application server as needed.
- Applications compatible with any NC hardware and OS.
- Applications could be fixed, added, updated at the server level, rather than maintaining each PC.
Exhibit 1  Three-tier Architecture

Tier One

Tier Two

Tier Three

Asia

United States

Europe

Client Applets
Client Hardware

Applets
App Server

Applets
App Server

Applets
App Server

These had to be managed locally. If code needed to be updated, each app server had to be shut down, updated and rebooted.

JDBC: Stands for Java Database Connectivity. It is a programming interface that lets Java applications access a database via the SQL language.

RMI: Stands for Remote Method Invocation. It is the method by which a remote Java object from one location can be invoked from other Java virtual machines.

HTTP: Stands for HyperText Transport Protocol. It is the communications protocol used to connect to servers on the World Wide Web.
Sun N-Tier

Step 1: The user logs into his client and calls down an application. This message is sent to the Application Server.

Step 2: An initial applet is sent to the client. At the same time a servlet is sent to the Webtop Server.

Step 3: The applet talks back and forth with the Webtop Server via the LAN.

Step 4: As new data is received (i.e., a new customer’s name) the App Server communicates with the database to update that information.

Remote: The database and App Server communicate with the Webtop Server via a WAN.

Local: The Webtop Server and client communicate via a LAN.

**Exhibit 3** How the N-tier Architecture Works
Sun’s Performance

<table>
<thead>
<tr>
<th>Year</th>
<th>Net Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>355.8</td>
</tr>
<tr>
<td>1995</td>
<td>476.4</td>
</tr>
<tr>
<td>1996</td>
<td>762.4</td>
</tr>
<tr>
<td>1997</td>
<td>762.9</td>
</tr>
<tr>
<td>1998</td>
<td>1,031.3</td>
</tr>
<tr>
<td>1999</td>
<td>1,854.0</td>
</tr>
<tr>
<td>2000</td>
<td>927.0</td>
</tr>
<tr>
<td>2001</td>
<td>(587.0)</td>
</tr>
<tr>
<td>2002</td>
<td>(3,429.0)</td>
</tr>
<tr>
<td>2003</td>
<td>(388.0)</td>
</tr>
<tr>
<td>2004</td>
<td>(106.0)</td>
</tr>
</tbody>
</table>
Today

- 3-tier model common.
- Sun’s version of 4-tier model not-common.
- N-tier model where Websserver and Application Server on separate equipment also common.
- Sun’s hardware business not strong.
  - Linux on cheap PCs most common servers
  - Microsoft desktops replacing Sun workstations
Today

- **Java**
  - Common in Server implementations
    - Example: Java Servlet implementing application logic in a banking application.
  - Often used to push simple applets onto client
  - Not common
    - For “big” desktop applications
    - Office Suite in Java not popular
  - *Microsoft is still in business...*