Class announcements

- Assignment 3 due Thursday

- Reading for next class
  - Messerschmitt Ch 5, Sun Case
  - Suggestion: Read Messerschmitt Ch5 first.

- MIDTERM NEXT WEEK!!!
  - 5/4
Student Presentations
SCM

- Thousands of orders per day, each with different requirements!
- Adjusting orders from suppliers constantly according to demand
- Minimal inventories
  - Cut costs
  - Much more sensitive to errors or disruptions
- **mass customization** requires sophisticated SCM
Networked Computing in direct Procurement

- History predates Internet
- *Electronic Data Interchange* (EDI)
  - Exchange order information between firms involved in direct procurement
  - Usually large firms who could afford proprietary communication links
  - Initially order and invoice
  - Existed since 70’s
- *Financial EDI* (FEDI) later added EFT payment capability
Networked Computing in direct Procurement

- XML (Extensible Markup Language) is another data interchange format making an impact on inter-enterprise commerce

- We will talk more about this later in the quarter.
Indirect Procurement

- Sporadic purchase of goods and services to support organizational objectives
  - Example: Office Furniture
Alibris

- Why did Interloc succeed so early on?
Alibris

- If Interloc is so successful, why change it?

- What will change as Interloc becomes Alibris?
Alibris

- Why did Manley feel they needed the Sparks facility?

- How does the Sparks facility keep them from becoming disintermediated?
Alibris

Should Alibris actually buy books and fill up the Sparks facility?
Alibris

- What problems is Alibris having with its e-commerce capabilities?

- Why is Alibris having so much trouble setting up simple e-commerce capabilities?

- Is this really that hard??

- Is it rare for a new-software product from an established, reputable vendor not to work properly?
Alibris

- Should Alibris stick with Oracle? Or switch back to Thunderstone?
Alibris

- Should Manley take the “white knight’s” offer and fire the whole IT staff?!
Alibris

- Rejects “white knight” offer
- Manley secures another bridge loan
- Goes Live 1998
- Thunderstone’s software works ok
- 1 million books at Sparks warehouse by 2000
  - Originally all on consignment from dealers
  - Later, purchases books
- 2002 - Revenue $31 million, loss $7.2 million
- 2003 - Revenue $45.5 million, loss $4.8 million
- March 2004 files for “auction based” IPO
  - May 2004, withdraws IPO after price too low
  - Still Relying on Private Financing
Data and information

by

David G. Messerschmitt
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Key concept

The key commodity manipulated by information technology is information.
To be manipulated in a computing/networking environment, information must be represented by data.

What is information?
Information

From a user (human) perspective...
...recognizable patterns that influence you in some way
(perspective, understanding, behavior...)

In the computing infrastructure, information has a somewhat different connotation as structure and interpretation added to data
Data

A bit is “0” or “1” — the atom of the information economy

Data is a collection of bits, like

- “0101110111010110”
- “0000011”
- “111011101011010110110111011011010”

Note: the terms data and information are not always used consistently!
Representation

- Take the place of the original
- Equivalent to, in the sense that the original can be reconstructed from its representation
- Often the original can only be approximately reconstructed, although it may be indistinguishable to the user
  - e.g. audio or video
## ASCII

<table>
<thead>
<tr>
<th>Alphabet</th>
<th>Hex</th>
<th>Binary</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;7&gt;</td>
<td>/x37</td>
<td>00110111</td>
</tr>
<tr>
<td>&lt;8&gt;</td>
<td>/x38</td>
<td>00111000</td>
</tr>
<tr>
<td>&lt;9&gt;</td>
<td>/x39</td>
<td>00111001</td>
</tr>
<tr>
<td>&lt;:&gt;</td>
<td>/x3A</td>
<td>00111010</td>
</tr>
<tr>
<td>&lt;*&gt;</td>
<td>/x3B</td>
<td>00111011</td>
</tr>
<tr>
<td>&lt;&lt;&lt;&gt;</td>
<td>/x3C</td>
<td>00111100</td>
</tr>
<tr>
<td>&lt;&lt;=</td>
<td>/x3D</td>
<td>00111101</td>
</tr>
<tr>
<td>&lt;/&gt;&gt;</td>
<td>/x3E</td>
<td>00111110</td>
</tr>
<tr>
<td>&lt;?&gt;</td>
<td>/x3F</td>
<td>00111111</td>
</tr>
<tr>
<td>&lt;At&gt;</td>
<td>/x40</td>
<td>01000000</td>
</tr>
<tr>
<td>&lt;A&gt;</td>
<td>/x41</td>
<td>01000001</td>
</tr>
<tr>
<td>&lt;B&gt;</td>
<td>/x42</td>
<td>01000010</td>
</tr>
<tr>
<td>&lt;C&gt;</td>
<td>/x43</td>
<td>01000011</td>
</tr>
<tr>
<td>&lt;D&gt;</td>
<td>/x44</td>
<td>01000100</td>
</tr>
</tbody>
</table>

Note that this representation is not unique…

…this one happens to be a **standard** (ANSI X3.110-1983)
A picture

This picture conveys information

This information is represented in this computer, but how?
Expanding a small portion of the picture, we see that it is represented by square pixels...

....300 tall by 200 wide.....

....with a range of 256 intensities per pixel

300 • 200 • 8 bits = 480,000 bits (but it can be compressed)
A color picture can be represented by three monochrome images…

At the expense of three times as many bits
Terminology

Information \[\rightarrow\] Representation

Data \[\rightarrow\] Communicate data to another user or organization

Data processing

Information

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Representation needs to be standardized

If the representation is not standardized, the information is garbled!

Communicate data to another user or organization

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Regeneration

- Make a precise copy of the data (copy bit by bit)
- If you know the representation, this is equivalent to making a precise copy of the information
- Each such precise copy is called a generation
- Process is called regeneration
Replication of information

Anything that can be regenerated can be replicated any number of times.

This is a blessing and a curse.
Analog information cannot be regenerated

We will never know exactly what the original of this Rembrandt looked like.

Analog information can be copied, but not regenerated.
Discrete information can be regenerated

Regeneration can preserve data (but not its original physical form)

Regeneration is possible for information represented digitally (which is tolerant of physical deterioration)

0 + noise $\rightarrow$ 0
1 + noise $\rightarrow$ 1
Replication of information requires knowledge of representation.

Replication of information also presumes knowledge of its representation.

Replication preserves the integrity of the data, but that is not sufficient.

Every .xxx DOS file is a representation.

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Implications

Digitally represented information can be preserved over time or distance in its precise original form by occasional regeneration

- digital library
- digital telephony

Replication of data is easy and cheap
Implications (con’t)

- Replication of information requires knowledge of the structure and interpretation
  - Standardization or some other means
- Extreme supply economies of scale
- You can give away or sell and still retain
- Unauthorized replication or piracy relatively easy
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
Functionality
Organization
Responsibility
Interaction
Cooperation

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System examples

Let's quickly look at some system decomposition examples

- Quick tour of information technology systems
Time sharing

ASCII terminal (no graphics)

Point-to-point wire (no network)

Mainframe (database and application server)
Two-tier client/server
Three-tier client/server

Client

Application server

Enterprise data server
System integration

Architecture

-> subsystem implementation

-> system integration

Bring together subsystems and make them cooperate properly to achieve desired system functionality

- Always requires testing
- May require modifications to architecture and/or subsystem implementation
Emergence

Subsystems are more specialized and simpler functionality.

Higher-level system functionality arises from the interaction of subsystems.

Emergence includes capabilities that arise purely from that interaction (desired or not).

- 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?
Layering

- Elaboration or specialization
- Services
- Existing layers
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
<table>
<thead>
<tr>
<th>Year</th>
<th>City</th>
<th>Accommodation</th>
<th>Tourists</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>Oakley</td>
<td>Bed&amp;Breakfast</td>
<td>14</td>
</tr>
<tr>
<td>2002</td>
<td>Oakley</td>
<td>Resort</td>
<td>190</td>
</tr>
<tr>
<td>2002</td>
<td>Oakland</td>
<td>Bed&amp;Breakfast</td>
<td>340</td>
</tr>
<tr>
<td>2002</td>
<td>Oakland</td>
<td>Resort</td>
<td>230</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>3450</td>
</tr>
<tr>
<td>2002</td>
<td>Berkeley</td>
<td>Resort</td>
<td>390800</td>
</tr>
<tr>
<td>2002</td>
<td>Albany</td>
<td>Camping</td>
<td>8790</td>
</tr>
<tr>
<td>2002</td>
<td>Albany</td>
<td>Bed&amp;Breakfast</td>
<td>3240</td>
</tr>
<tr>
<td>2003</td>
<td>Oakley</td>
<td>Bed&amp;Breakfast</td>
<td>55</td>
</tr>
<tr>
<td>2003</td>
<td>Oakley</td>
<td>Resort</td>
<td>320</td>
</tr>
<tr>
<td>2003</td>
<td>Oakland</td>
<td>Bed&amp;Breakfast</td>
<td>280</td>
</tr>
<tr>
<td>2003</td>
<td>Oakland</td>
<td>Resort</td>
<td>210</td>
</tr>
<tr>
<td>2003</td>
<td>Berkeley</td>
<td>Camping</td>
<td>115800</td>
</tr>
<tr>
<td>2003</td>
<td>Berkeley</td>
<td>Bed&amp;Breakfast</td>
<td>4560</td>
</tr>
<tr>
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<td>Berkeley</td>
<td>Resort</td>
<td>419000</td>
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<tr>
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<td>Albany</td>
<td>Camping</td>
<td>7650</td>
</tr>
<tr>
<td>2003</td>
<td>Albany</td>
<td>Bed&amp;Breakfast</td>
<td>6750</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.
The Internet

by

David G. Messerschmitt
Intranet

*Private* internet

Often connected to Internet

- Firewall creates a protected enclave
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**
Client - Server Computing
Client Server Example

Client

“I want to see
www.google.com”

Server

<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;}
//--&gt; ...
</style></head><body><div>...<br>
</div></body></html>
Client Server Example - Layers Revealed

Client

Application:

Infrastructure

Packet

Packet

Internet

Packet

Packet

Server

Application

Internet
3-Tier Client Server Architecture example

Client

Clicks, keystrokes

Application Server

What is Bob’s balance?

$0.50

Shared data

Clicks, keystrokes

What is Bob’s balance?

$0.50
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

Common Gateway Interchange

Application Logic

What is Bob’s Balance?

Database Management System (DBMS)

Database

Shared data

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.

What is Bob’s Balance?

Database Management System (DBMS)
## 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

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
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Clients ➔ Customers ➔ Merchandise ➔ Orders ➔ Databases

Customer logic ➔ Acquirer bank ➔ Fulfillment logic

Customers ➔ Merchandise ➔ Orders ➔ Book distributors

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Peer to peer

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