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 who 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?

- 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

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?

Copyright notice

©Copyright David G. Messerschmitt, 2000.
This material may be used, copied, and distributed freely for educational purposes as long as this copyright notice remains attached. It cannot be used for any commercial purpose without the written permission of the author.
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"
- "1101110101101011011011011011010"

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>: &gt;</td>
<td>x3A</td>
<td>00111010</td>
</tr>
<tr>
<td>; &gt;</td>
<td>x3B</td>
<td>00111011</td>
</tr>
<tr>
<td>&lt;&lt; &gt;</td>
<td>x3C</td>
<td>00111100</td>
</tr>
<tr>
<td>=&gt; &gt;</td>
<td>x3D</td>
<td>00111101</td>
</tr>
<tr>
<td>&lt;/ &gt;</td>
<td>x3E</td>
<td>00111110</td>
</tr>
<tr>
<td>@ &gt;</td>
<td>x3F</td>
<td>00111111</td>
</tr>
<tr>
<td>&lt;A&gt;</td>
<td>x40</td>
<td>01000000</td>
</tr>
<tr>
<td>&lt;B&gt;</td>
<td>x41</td>
<td>01000001</td>
</tr>
<tr>
<td>&lt;C&gt;</td>
<td>x42</td>
<td>01000010</td>
</tr>
<tr>
<td>&lt;D&gt;</td>
<td>x43</td>
<td>01000011</td>
</tr>
<tr>
<td>&lt;E&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)

Structure

Interpretation

A picture

This picture conveys information

This information is represented in this computer, but how?

Representation of picture: image

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

Representation needs to be standardized

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

Communicate data to another user or organization

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

Analog information cannot be regenerated

Communication

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

\[
0 + \text{noise} \rightarrow 0 \\
1 + \text{noise} \rightarrow 1 
\]

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

Copyright notice

©Copyright David G. Messerschmitt, 2000. This material may be used, copied, and distributed freely for educational purposes as long as this copyright notice remains attached. It cannot be used for any commercial purpose without the written permission of the author.
**What is Architecture?**

How do you architect a solution?

---

**Architecture**

A system is decomposed into interacting subsystems.

Each subsystem may have a similar internal decomposition.

---

**Three elements of architecture**

- Decomposition
- Functionality
- Interaction
- Responsibility
- Cooperation

---

**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**

- Local-area network
- Server
- Mainframe
Three-tier client/server

- Client
- Enterprise data server
- Application 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

Networked computing infrastructure

by

David G. Messerschmitt
**Example of Layering: networking**

- **Physical**
  - Bits
  - Frames
  - Packets
  - Messages

- **Transport**
  - Application

- **Network**
  - Application

- **Application**

**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>Tea</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>San Francisco</td>
<td>Hotel</td>
<td>346</td>
</tr>
<tr>
<td>2013</td>
<td>Chicago</td>
<td>BackPack</td>
<td>423</td>
</tr>
<tr>
<td>2014</td>
<td>San Francisco</td>
<td>Hotel</td>
<td>256</td>
</tr>
<tr>
<td>2015</td>
<td>Chicago</td>
<td>BackPack</td>
<td>145</td>
</tr>
<tr>
<td>2016</td>
<td>San Francisco</td>
<td>Hotel</td>
<td>268</td>
</tr>
<tr>
<td>2017</td>
<td>Chicago</td>
<td>Hotel</td>
<td>148</td>
</tr>
<tr>
<td>2018</td>
<td>San Francisco</td>
<td>BackPack</td>
<td>97</td>
</tr>
<tr>
<td>2019</td>
<td>Chicago</td>
<td>Hotel</td>
<td>140</td>
</tr>
<tr>
<td>2020</td>
<td>San Francisco</td>
<td>BackPack</td>
<td>148</td>
</tr>
<tr>
<td>2021</td>
<td>Chicago</td>
<td>Hotel</td>
<td>148</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

A private internet is called an intranet

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

Client - Server Computing

Client Server Example

Client: "I want to see www.google.com"

Server:
**Client Server Example – Layers Revealed**

- **Client**
  - Application:
    - [Image]
- **Server**
  - Application:
    - [Image]

**3-Tier Client Server Architecture example**

- **Client**
  - Clicks, keystrokes
  - What is Bob’s balance?
  - $0.50

- **Application Server**
  - What is Bob’s balance?
  - Shared data

**3-Tier Client Server Architecture example**

- **Client**
  - Application Logic
  - What is Bob’s balance?

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

**3-Tier Client Server Architecture example**

- **Client**
  - Application Logic
  - What is Bob’s balance?
  - Shared data

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

**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>

In some implementations, Application Logic and Web Server can be put on different machines.
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
- Protect critical data
- Decouple data administration and application administration

Client

Application Server

Shared data

Financial institution

Customer

Book distribution centers

Consumer

Enterprise

Inter-enterprise

Client

Server

Peer

Peer

Book
distributors

Customers

Merchandise

Orders

Book

Acquirer

Bank

Fulfillment logic

Databases

Peer to peer