Class announcements
- Midterm Tuesday!
  - Study guide to be posted soon.

Student Presentation
- Jimmy Chen

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
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?

Data

A bit is "0" or "1" — the atom of the information economy.

Data is a collection of bits, like:
- "0101110111010110"
- "0000011"
- "11101101011010111011011101".

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.

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.
**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;:</td>
<td>x3A</td>
<td>00111010</td>
</tr>
<tr>
<td>;:</td>
<td>x3B</td>
<td>00111011</td>
</tr>
<tr>
<td>&lt;:</td>
<td>x3C</td>
<td>00111100</td>
</tr>
<tr>
<td>&lt;=&gt;</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>
</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?

**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

An approximation: $300 \times 200 \times 8$ bits = 480,000 bits (but it can be compressed)

**Color picture**

A color picture can be represented by three monochrome images…

At the expense of three times as many bits

**Terminology**

- **Information**: Communicate data to another user or organization
- **Data processing**: if the representation is not standardized, the information is garbled!

**Representation needs to be standardized**
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

Analog information can be copied, but not regenerated
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 + noise ≤ 0
1 + noise ≤ 1

Replication of information requires knowledge of representation

Information

Replication of information also presumes knowledge of its representation

Data

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

Every .xxx DOS file is a representation

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?

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?

Client Server Example

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

Server:

Client Server Example

3-Tier Client Server Architecture example

Client

Clicks, keystrokes

Application Server

What is Bob's balance?

$0.50

Shared data