Logistics

- **Lecture**
  - Tuesdays, 13:15 - 14:45, Auditorium Maximum (Building 33)

- **Tutorial and Exercises**
  - Wednesdays, 11:30 – 13:00, Building 33 Room 2401 (in German)
  - Thursdays, 09:45 - 11:15, Building 43 Room 4/126 (in German)
  - Thursdays, 15:00 - 16:30, Building 33 Room 2216 (in German)
  - Thursdays, 16:45 - 18:15, Building 33 Room 2116 (in German)

- **Exam**
  - At the end of the Winter trimester, in conjunction with the exam in „Accounting“ (by recommendation of the Dean of Studies)
Structure of the Lecture

Unit 1: Introduction
Unit 2: Central Processing Units
Unit 3: Storage and Data Structures
Unit 4: Input and Output Devices
Unit 5: Software
Unit 6: Networks, Data Interchange, and the Internet
Unit 7: Design, Development, Deployment, and Operations of Information Systems
Unit 8: Office Applications
Unit 9: Enterprise Applications
Unit 10: Supply Chain Applications and E-Business
Unit 11: Management Support Systems
Unit 12: Exam Review

Link to the Previous Unit

• Last Unit:
  – How can binary data be stored persistently, so that it remains available even if the power supply is interrupted?
  – How can we translate
    • numerical values,
    • text, and
    • complex data items into a sequence of binary numbers?
  – What techniques can help us retrieve a needed data item from a large data collection quickly?

• Today:
  – How can we collect information from reality and get it into a computer system?
  – How can we display or print out computer data?
  – What types of equipment exists and how do they work?
Assignment from last week

• WI2: pp. 93-211, 387-515
• Review the slides

WI1 = Hansen/Neumann: Wirtschaftsinformatik 1; WI2 = Hansen/Neumann: Wirtschaftsinformatik 2; IBIS = Wigand et al: Introduction to Business Information Systems.

Overview: Collecting Input

1. Capture
2. Convert into binary representation
Remember: Computers can process digital data only!

Address Bus:
Which memory cell is to be used?

Control Bus:
What should the memory chip do?
When is the CPU ready to take the results?

Data Bus:
For exchanging values between memory and the CPU

Which value is being exchanged?
$128 + 64 + 0 \times 32 + 0 \times 16 + 8 + 4 + 2 + 1 = 207$

Input and Output Devices

Input Device

CPU (Processor + Main Memory)

Transfer via media

Output Device

cf. Hansen/Neumann p. 216
Transmission: Types of Media

Wire

Fibre cable

Radio Frequency

Infrared

Input Device

Output Device

CPU
(Processor + Main Memory)

01110011

IrDA Port

Cellphone with Bluetooth support

Types of Transmission: Serial vs. Parallel

• When transmitting a byte (8 bits), one can either send
  – a full byte via eight wires (parallel transmission) or
  – one bit at a time via a single wire (serial transmission).
Classification of Input Devices

- By modality (i.e., the type of the input)
  - Manual
  - Optical
  - Audio
- By type of content and purpose
- Discrete vs. continuous

Input Devices for Texts and Numbers

- Keyboards
- Handwriting Recognition
- Simplified Handwriting
- Speech Recognition
Keyboards

- Array of small switches
- Keyboard controller checks for status of switches
- If a key is pressed down, a number reflecting the position of the key is sent to the CPU
- CPU uses a table to translate from the position of that key to the correct character

Handwriting Recognition

- Optical
  - Reconstructing the characters from an image of the handwriting
- On dedicated writing pad
  - Can take into account the speed of individual movements and strokes into account
Simplified Handwriting

- Reduce the complexity of recognition by defining a simplified and standardized way of writing per each character
- Example: Palm Graffiti and Graffiti 2

Speech Recognition

- Spoken language is captured via a microphone and converted into a sequence of values.
- Those values reflect the volume at a given moment in time.
- Then, the sequence of values is compared to the patterns of known words.

Audio Signal

Compare “5, 3, 2, 3” with the patterns of known words.
Pointing Devices

• Computer Mouse
  – Mechanical
  – Optical
• Trackball
• Touchpad
• Joystick
  – Digital
  – Analog
• Lightpen
• Touchscreen
• Data Glove

Cursor: The symbol that indicates the current position on the screen.

http://computer.howstuffworks.com/mouse.htm/printable
Optical Computer Mouse

Takes multiple pictures per second and reconstructs mouse movement from the position of characteristics patterns in the picture.

Repetitive Strain Injury (RSI)

- Continuous usage of computer input devices can cause serious injuries and chronic pain.
- This is known as *Repetitive Strain Injury*.
- Watch out and see a doctor if using a keyboard or computer mouse causes pain!
Joystick: Digital

A digital joystick has four or more buttons (switches) to capture the position of the stick and the “fire” button.

Joystick: Analog

An analog joystick uses two potentiometers (variable resistors) to capture the direction and position of the stick. This returns not only the mere direction but also the intensity.
Touchpad

• A small device that detects the position and movement of your finger tip
• Works on the bases of changes in the capacity, caused by the presence of a finger

http://www.heppnetz.de/teaching/gwi/

Touchscreen

• A transparent layer mounted on top of a screen that can also determine whether someone touches the screen, and if so, where.
• Various principles
  – Resistive
  – Capacitive
  – Surface Acoustic Wave (SAW): ultrasonic technology

http://www.heppnetz.de/teaching/gwi/
Input Devices for Visual Information

• Scanners
• Digital Camera
• Webcam
• Digital Video Camera

Scanners

• Used to create a pattern of bits that reflects a given image
  – b/w
  – greyscale
  – color
• Most scanners use a CCD (Charge-coupled Device) for capturing the amount of light reflected per pixel
• Color-CCDs mostly use a grid of filters
Scanners (2)

Digital Camera and Digital Video Camera

• Also use CCD technology for capturing still and moving images.
• Think of business potential in integrated computer applications:
  – Car rental: Documenting damages
  – Recording meetings

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Other Input Devices

- Barcode Reader
- RFID
- OCR
- Analog/Digital Converters

Barcodes and Barcode Readers

- A small light source and a photo-sensitive transistor can easily convert such a pattern on paper into a sequence of high / low signals.
Barcodes and Barcode Readers

• Rather simple but highly efficient technology for capturing data from paper and other surfaces
• A barcode contains digits or characters. Each binary number is encoded as a sequence of narrow and wide bars.

Barcodes

Why can a barcode reader deal with varying reading speeds?
And why must one try to move the reader at a constant speed?
Barcode Applications

RFID

• Very small, inexpensive devices that can send a short message to near receivers
• Self-powered or powered by induction
Optical Character Recognition

- Reconstructing the characters from text
  - Regular fonts
  - Specially designed OCR fonts

Data Collection from Paper Documents

- Corporations can include barcodes and checkboxes in paper documents, which can be used for processing the documents automatically.
- Example: Contract number
Analog/Digital Converters

• Special equipment for converting a voltage into a binary value

Output Devices

• Screen Output
  – Displays
    • Cathode Ray Tubes (CRT)
    • TFT / Flatscreens
    • Liquid Crystal Displays
    • Projectors
  – Graphics Cards

• Printers
  – Impact
  – Non-impact

• Plotters

• Sound Card

http://www.heppnetz.de/teaching/gwi/
Screen Output: Principle

Video Memory

```
0000 0000 0000
0111 1111 1110
0100 0000 0010
0111 1111 1110
0000 0000 0000
```

Monitor

http://www.heppnetz.de/teaching/gwi/  39

Fonts: Binary patterns that represent characters, numbers, and symbols

```
T
```

```
01110
00100
00100
00100
```

Each Character is represented by a combination of dots. Those dot patterns are stores as binary numbers.

http://www.heppnetz.de/teaching/gwi/  40
Types of Displays

- Cathode Ray Tubes (CRT)
- Liquid Crystal Displays
- TFT / Flatscreens
- Projectors

Printers

- Impact
- Non-impact
  - Xerographic („Laser“)
  - Thermal
  - Inkjet
Laser Printer

A laser beam or LED is used to paint an electrostatic image of the page to print. Then, the printer coats the drum with a fine black powder (the toner). Toner particles remain only at electrically charged points.

http://www.heppnetz.de/teaching/gwi/
Ink-jet Printer

http://www.heppnetz.de/teaching/gwi/

Ink-Jet Printer

http://computer.howstuffworks.com/inkjet-printer.htm/printable

http://www.heppnetz.de/teaching/gwi/
Total Cost of Ownership (TCO)

Purchase Price
+ Installation, Training
+ Supplies
+ Maintenance

TCO
determined by
the chosen brand

determined by
usage and brand

Problem: Partial Consumption of Consumables

Paper: 10 $/500 sheets → $ 0.02/page
Toner: 50 $/2,000 pages → $ 0.025/page
Drum unit: 200 $/10,000 → $ 0.02/page

When one prints 12,000 pages over the whole life span of the printer, you have to pay for 2 drum units, not 1.2!
Example

<table>
<thead>
<tr>
<th></th>
<th>Approach 1</th>
<th>Approach 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase Price</td>
<td>$ 300</td>
<td>$ 300</td>
</tr>
<tr>
<td>Supplies</td>
<td>$ 975</td>
<td>$ 300</td>
</tr>
<tr>
<td>15,000 * 0.065</td>
<td></td>
<td>30 Boxes of Paper</td>
</tr>
<tr>
<td></td>
<td></td>
<td>30 * $ 10</td>
</tr>
<tr>
<td>TCO</td>
<td>$ 1275</td>
<td>8 Toner Kits</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8 * $ 50</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 Drum Kits</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$ 400</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TCO</td>
</tr>
<tr>
<td></td>
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<td>$ 1400</td>
</tr>
</tbody>
</table>

Assignment for Next Week

- WI2, pp. 301-385; IBIS, pp. 20-31
- Review the slides

WI1 = Hansen/Neumann: Wirtschaftsinformatik 1; WI2 = Hansen/Neumann: Wirtschaftsinformatik 2; IBIS = Wigand et al: Introduction to Business Information Systems.
Thank you!

The slides and additional materials will be available at
http://www.heppnetz.de/teaching/gwi/