

# Grundzüge der Wirtschaftsinformatik *Introduction to Business Information Systems*

Unit 4

Prof. Dr. Martin Hepp  
<http://www.heppnetz.de>  
[mhepp@computer.org](mailto:mhepp@computer.org)

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

## 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)

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

2

## 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

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

3

## 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?

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

4

## Assignment from last week

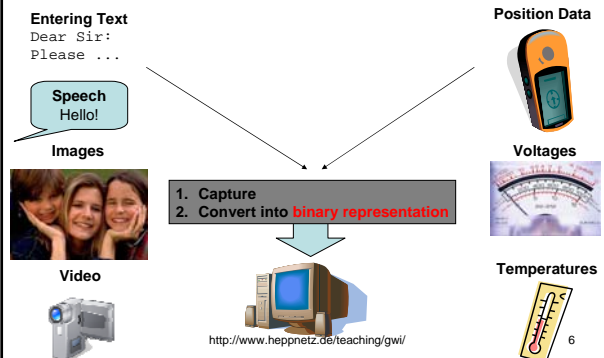
- W12: pp. 93-211, 387-515
- Review the slides

W11 = Hansen/Neumann: Wirtschaftsinformatik 1; W12 = Hansen/Neumann: Wirtschaftsinformatik 2; IBIS = Wigand et al: Introduction to Business Information Systems.

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

5

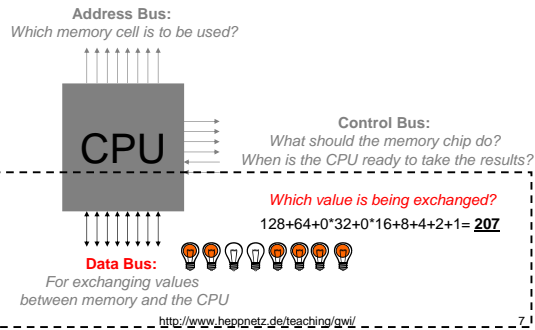
## Overview: Collecting Input



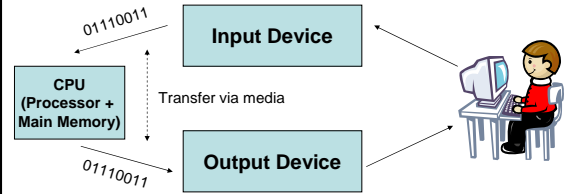
<http://www.heppnetz.de/teaching/gwi/>

6

## Remember: Computers can process digital data only!



## Input and Output Devices

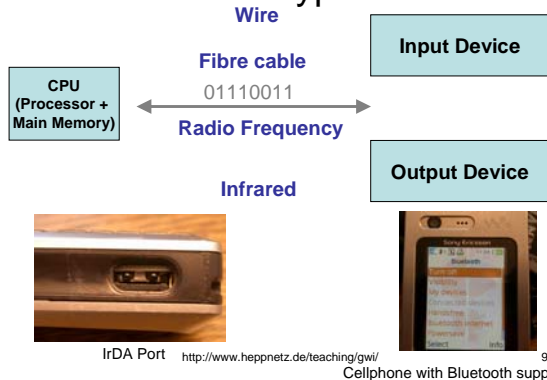


cf. Hansen/Neumann p. 216

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

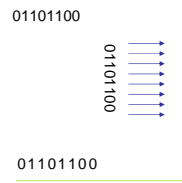
8

## Transmission: Types of Media



## 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).



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

10

## 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

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

11

## Input Devices for Texts and Numbers

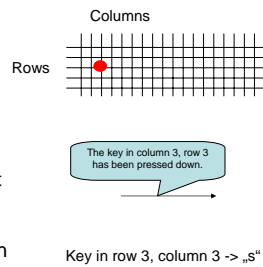
- Keyboards
- Handwriting Recognition
- Simplified Handwriting
- Speech Recognition

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

12

## 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



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

13

## 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

Tutorial  
 $\mathcal{T} = \begin{matrix} \bullet \\ \bullet \\ \bullet \end{matrix} ?$



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

14

## 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

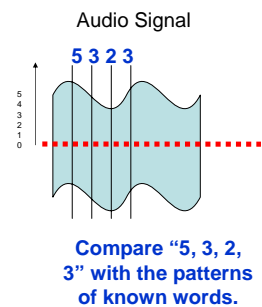


<http://www.heppnetz.de/teaching/gwi/>

15

## 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.

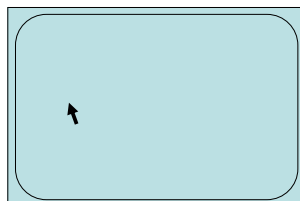


<http://www.heppnetz.de/teaching/gwi/>

16

## 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://www.heppnetz.de/teaching/gwi/>

17

## Computer Mouse: Opto-mechanical



<http://computer.howstuffworks.com/mouse.htm/printable>

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

18

## Optical Computer Mouse

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



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

19

## Repetitive Strain Injury (RSI)

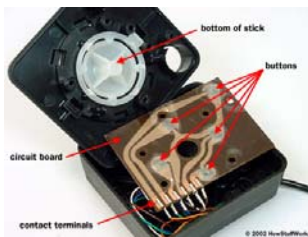
- Continuous usage of computer input devices can cause serious injuries and chronic pain.
- This is known as *Repetitive Strain Injury*.
- **Watch out and see a doctor if using a keyboard or computer mouse causes pain!**



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

20

## Joystick: Digital



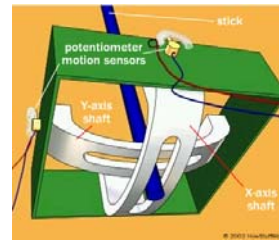
A digital joystick has four or more buttons (switches) to capture the position of the stick and the "fire" button.

<http://computer.howstuffworks.com/joystick.htm/printable>

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

21

## 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**.

<http://computer.howstuffworks.com/joystick.htm/printable>

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

22

## 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/>

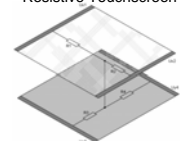
23

## 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



Resistive Touchscreen



Source: Wikipedia

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

24

## Input Devices for Visual Information

- Scanners
- Digital Camera
- Webcam
- Digital Video Camera

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

25

## 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



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

26

## Scanners (2)



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

27

## 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



Lens

CCD

Harddisk,  
Flash Memory,  
DVD-R

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

28

## Other Input Devices

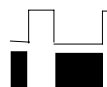
- Barcode Reader
- RFID
- OCR
- Analog/Digital Converters

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

29

## 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.



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

30

## 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**.



Narrow-Wide-Narrow-Narrow-Wide-Narrow-Wide-Narrow-Narrow  
010010100  
(Code 39 Start/Stop character)

## Barcodes

Why can a barcode reader deal with varying reading speeds?

And why must one try to move the reader at a constant speed?

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

32

## Barcode Applications



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

33

## RFID

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

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

34

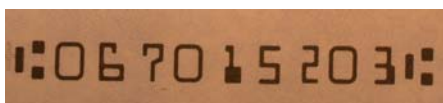
## Optical Character Recognition

- Reconstructing the characters from text

1234, T, Hepp

T = ?

- Regular fonts
- Specially designed OCR fonts

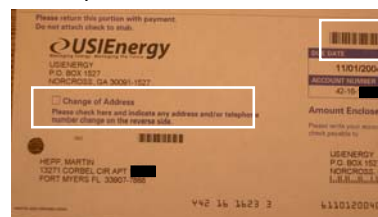


<http://www.heppnetz.de/teaching/gwi/>

35

## 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



36

## Analog/Digital Converters

- Special equipment for converting a voltage into a binary value

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

37

## Output Devices

- Screen Output
  - Displays
    - Cathode Ray Tubes (CRT)
    - TFT / Flatscreens
    - Liquid Crystal Displays
    - Projectors
  - Graphics Cards
- Printers
  - Impact
  - Non-impact
- Plotters

- Sound Card

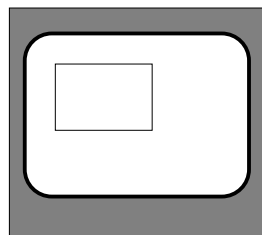
<http://www.heppnetz.de/teaching/gwi/>

38

## Screen Output: Principle

Video Memory

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

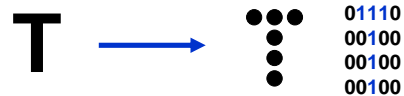


Monitor

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

39

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



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

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

41

## Printers

- Impact
  - Xerographic („Laser“)
  - Thermal
  - Inkjet

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

42

## Laser Printer

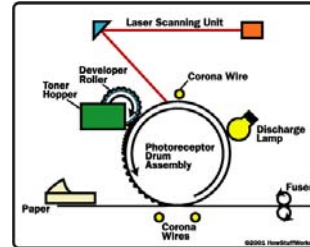


A laser beam or LED is used to paint an **electrostatic image of the page to print**. Then, the printer coats the drum with a fine black powder (the toner). Toner particles remain only at electrically charged points.

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

43

## Laser Printers



<http://computer.howstuffworks.com/laser-printer.htm/printable>

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

44

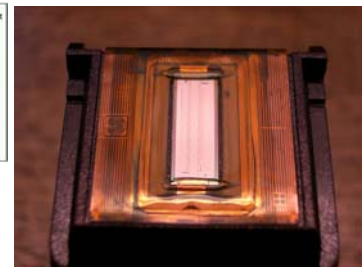
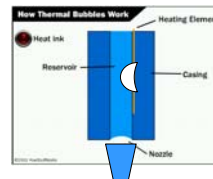
## Ink-jet Printer



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

45

## Ink-Jet Printer



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

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

46

## Total Cost of Ownership (TCO)

Purchase Price } determined by  
 + Installation, Training } the chosen brand  
 + Supplies } determined by  
 + Maintenance } usage and brand

TCO

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

47

## 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

Approach 1		Approach 2	
Purchase Price	\$ 300	Purchase Price	\$ 300
Supplies $15,000 * 0.065$	\$ 975	30 Boxes of Paper $30 * \$ 10$	\$ 300
<b>TCO</b>	<b>\$ 1275</b>	8 Toner Kits $8 * \$ 50$	\$ 400
		2 Drum Kits	\$ 400
		<b>TCO</b>	<b>\$ 1400</b>

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

49

## 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.

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

50

## Thank you!

The slides and additional materials will be available at

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