Exercise Sheet 1

Exercise 1 (Different Client-Server Scenarios)

Company X runs 8,000 computer workplaces.

- Scenario 1: Fat clients (PC)
  - Electical power rating per desktop: 400 watts
  - Electical power rating per screen: 100 watts
- Scenario 2: Thin clients
  - Electical power rating per thin client: 30 watts
  - Electical power rating per screen: 100 watts
  - Electical power rating per server blade: 400 watts
  - Each server blade has enought resources to run 40 virtual desktops

What are the electricity costs per year for 24/7 operation when the electricity price is 0,24 €/kWh?

Exercise 2 (Types of Clients)

Four types of clients exist in the client-server model. Describe the four types. Focus the differences.

Exercise 3 (Storing and transmitting Data)

Common assumptions about data are:

- It is easy to store data today.
- It is easy to transport or transmit data today.

In this exercise, we verify the correctness of these statements.

1. A scientific experiment produces 15 PB of data per year, which need to be stored. What is the height of a stack of storage media, if for storing the data...
   - CDs (capacity: 600 MB = $600 * 10^6$ Byte, thickness: 1.2 mm) are used?
   - DVDs (capacity: 4.3 GB = $4.3 * 10^9$ Byte, thickness: 1.2 mm) are used?

- Blu-rays (capacity: 25 GB = $25 * 10^9$ Byte, thickness: 1.2 mm) are used?
- HDDs (capacity: 2 TB = $2 * 10^{12}$ Byte, thickness: 2.5 cm) are used?

Attention: Calculate the solutions for both options:

- 15 PB = $15 * 10^{15}$ Byte $\Longleftarrow$ this way, the hardware manufacturer calculate
- 15 PB = $15 * 2^{50}$ Byte $\Longleftarrow$ this way, the operating systems calculate

The data of the scientific experiment is transmitted via networks that use fiber-optic cables and provide a bandwidth of 40 Gbit/s.

- How long does it take to transfer the 15 PB via a 40 Gbit/s network?
- How long does it take to transfer the 15 PB via a 100 Mbps Ethernet?

Attention: Calculate the solutions for both options:

- 15 PB = $15 * 10^{15}$ Byte
- 15 PB = $15 * 2^{50}$ Byte

Exercise 4 (Laws and Limitations)

1. What is the central statement of Moore's law?
2. What is the Von Neumann bottleneck?
3. How can the Von Neumann bottleneck be weakened?
4. What is the central statement of Amdahl's law?
5. Which important factor is ignored by Amdahl's law?
6. What is the central statement of Gustafson's law (highlight the difference against Amdahl's law)?

Exercise 5 (Parallel Computers)

1. Describe the shared memory architecture in just a few words.
2. Name two challenges of shared memory architectures.
3. What is the difference between asymmetric and symmetric multiprocessing (SMP)?
4. Give an example for a system in practice which implements the asymmetric multiprocessing architecture.
5. Give an example for a system which implements the symmetric multiprocessing (SMP) architecture.
6. Describe the distributed memory architecture in just a few words.
7. Name a drawback of distributed memory architectures.