Exercise Sheet 1

Exercise 1 (Different Client-Server Scenarios)

Company X runs 8,000 computer workplaces.

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

What are the electricity costs per year for 24/7 operation when the electricity price is $0.24 \in \text{/kWh}$?

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: $600 \text{ MB} = 600 * 10^6 \text{ Byte}$, thickness: 1.2 mm) are used?
 - DVDs (capacity: $4.3 \text{ GB} = 4.3 * 10^9 \text{ Byte}$, thickness: 1.2 mm) are used?
 - Blu-rays (capacity: $25 \text{ GB} = 25 * 10^9 \text{ Byte}$, thickness: 1.2 mm) are used?

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• HDDs (capacity: $2 \text{ TB} = 2 * 10^{12} \text{ Byte}$, thickness: 2.5 cm) are used?

Attention: Calculate the solutions for both options:

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

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

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.

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