Exercise Sheet 4

Exercise 1 (Hard Disk Drives)

1. What are sectors (= blocks) in HDDs?
2. What are tracks in HDDs?
3. What are cylinders in HDDs?
4. What are clusters in HDDs?
5. Why is it impossible to improve the performance (especially the latency) of HDDs infinitely?
6. Which factors influence the access time of HDDs?
7. Describe the factors of subtask 6.

Exercise 2 (Disk Geometry of HDDs)

An old HDD provides these information:

```
Western Digital WD Caviar 64AA           Enheanced IDE Hard Drive
Drive parameters     13328 cyl    15 heads    63 spt    6448.6 MB
S/N: WM653  321 5163    MDL: WD64AA - 00AAA4    DATE: 02 FEB 2000
```

1. Calculate the capacity of one disk of the HDD.
   (Provide the calculation steps!)
2. Calculate the capacity of one track of the HDD.
   (Provide the calculation steps!)
3. Calculate the total capacity of the HDD.
   (Provide the calculation steps!)
4. Do the information on the HDD describe the physical disk geometry?
   (Explain your answer!)

Exercise 3 (Solid State Drives)

1. Why is it wrong to call SSDs Solid State Disks?
2. Name four advantages of SSDs over HDDs.

3. Name two drawbacks of SSDs over HDDs.
4. Why are erase operations on flash memory more complex than read operations?
5. Name an advantage and a drawback of NOR memory.
6. Name an advantage and a drawback of NAND memory.
7. Describe the difference between NAND memory of the categories Single-Level Cell (SLC), Multi-Level Cell (MLC) and Triple-Level Cell (TLC).
8. What is the objective of wear leveling algorithms?

Exercise 4 (RAID)

1. Which RAID levels improve the data transfer rate for write?

   ☐ RAID-0 ☐ RAID 1 ☐ RAID 5

2. Which RAID levels improve the reliability?

   ☐ RAID-0 ☐ RAID 1 ☐ RAID 5

3. How many drives are allowed to fail in a RAID 0 array without data loss?
4. How many drives are allowed to fail in a RAID 1 array without data loss?
5. How many drives are allowed to fail in a RAID 5 array without data loss?
6. Please comment the statement: „A RAID array can be used to replace the regular backup of important data“.
7. Why is it not useful to store all parity information on a single drive, but to distribute the parity information on all drives?
8. What is the net capacity of a RAID 0 array?
9. What is the net capacity of a RAID 1 array?
10. What is the net capacity of a RAID 5 array?
11. How are the parity information of a RAID 5 array calculated?
12. Name one advantage and one drawback of software RAID compared with hardware RAID.

Exercise 5 (Character Count, Time and Date, Aliases, Redirecting, Search for Files)

1. Create a file `Quote.txt` with this content by using the command `echo`:

   ```
   Was man nicht weiß,
   das eben brauchte man,
   und was man weiß,
   kann man nicht brauchen.

   Gothe (Faust)
   ```

2. Print out the number of characters in the file `Quote.txt` by using the command `wc`.

3. Print out the number of words in the file `Quote.txt` and redirect the output into the command `wc`.

4. Print out the calendar of the year 1999 and redirect the output into a new file `Calendar.txt`.

5. Use the command `date` to create an output in the shell with the current date and formated like this example:

   ```
   Heute ist Donnerstag, der 24. Oktober 2013.
   Es ist 16:08 Uhr und 07 Sekunden.
   In UNIX-Zeit ist es genau: 1382623687
   ```

   Redirect the output in a way that it is attached at the file `Calendar.txt`.

6. Calculate the number of entries (files and directories) in the directory `/dev` with the command `wc`. Additionally, the processing speed must be measured.

7. Print out a list of existing aliases in the shell.

8. Create an alias `zeit`, which produces the output of subtask 5.

9. Remove the alias `zeit`.

10. Search with an appropriate command all files in your home directory, which match these search criteria:

    - Search only for files and not for directories or links.
    - The file name must contain the string `BTS` (case insensitive)
    - The files must belong to your user account (user ID).
    - The age of the files must be at least 1 day.
    - The last modification must have taken place more than 3 days ago.
    - The file size must be at least 10 kB.

    For each file found, the number of lines must be printed out in the shell.