Some of the answers to these questions can be found using the lecture slides, the recommended textbooks or other sources (question marked with *). Some questions may have more than one possible answer, or be more or less open for discussion. Note that no answers (solutions) will be given to these questions, but if help is needed the assistants will be available to answer questions. The concepts marked with <mark>yellow</mark> are important and should be fully understood.

Filesystems

1. Short answer problem

    (a) Describe the three storage levels that have been introduced in the lecture.

    (b) Describe common <mark>filesystem</mark> (FS) features.

    (c) What is an <mark>index node (inode)</mark>?

    (d) Discuss <mark>hard links</mark> and <mark>symbolic links</mark> based on the example from the lecture slide 31.

2. FS calculations

    (a) Calculate the <mark>maximum file size</mark> for a <mark>ext3 FS</mark> using triple indirect addressing as presented to you during the lecture. Assume a 4KB block size, and 32 bit block pointers in the inode data structure.

    (b) Calculate the maximum file size for a <mark>ext4 FS</mark> using extents. Assume a 4KB disk block size and consider the ext4_extent data structure defined in ext4.h.

    (c) Argue about the <mark>maximum ext3 file system size</mark> for 4KB block size. Refer to the corresponding inode struct definition in the Linux kernel code.

    (d) Argue about the <mark>maximum ext4 file system size</mark> using extents for a 4KB block size. Refer to the corresponding inode struct definition in the Linux kernel code.

3. Describe <mark>internal</mark> and <mark>external fragmentation</mark>, give examples for both.

4. Different algorithms exist to operate harddisk cylinder access. Let Q be a cylinder request queue for a given harddisk drive:

$$Q = \{86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130\}$$

Assume that the harddisk's head is currently at cylinder 143, the previous request was at cylinder 125, and the disk has in total 5000 cylinders which are numbered 0 through 4999. Starting from the current head position, what is the total distance (in cylinders) that the disk arm moves to satisfy all pending requests in Q?

    (a) FCFS

    (b) SSTF

    (c) SCAN

    (d) C-Look