

### **Question 13.1: Open Files**

- a. Discuss the in-kernel data structures that are required to allow for a Unix-like handling of open files.

### **Question 13.2: Disk Space Allocation**

- a. How does contiguous allocation work? What are the advantages and problems of this approach?
- b. How does linked allocation work? What is its major problem?
- c. What is the basic idea of a File Allocation Table (FAT)?
- d. How does indexed allocation work?
- e. Using indexed allocation, the maximum size of a file depends on the size of the index block. Discuss various approaches that allow for very large files without increasing the size of an index block.
- f. Consider a filesystem that uses inodes to represent files. Assume that disk blocks are 8 KiB in size and a pointer to a disk block is 4 bytes long. An inode contains 12 pointers to direct blocks, and one pointer to a single, double, and triple indirect block, respectively. What is the maximum size a file can have?

### **Question 13.3: File System Implementation**

- a. What are hard links?
- b. What are symbolic links?
- c. Suppose you have created a file  $f$ , a hard link  $h$  to the same file, and a symbolic link  $s$  to  $f$ . What happens if you rename  $f$  to  $g$ ? Is the file still accessible via the hard link  $h$ ? How about the symbolic link  $s$ ?
- d. Would the same be true if you had copied  $f$  to  $g$  first and then removed  $f$ ?
- e. What happens if you now create a new file  $f$ ?
- f. How can directories be implemented? What information is stored in them?
- g. Which of the following data are typically stored in an inode: (a) filename, (b) name of containing directory, (c) file size, (d) file type, (e) number of symbolic links to the file, (f) name/location of symbolic links to the file, (g) number of hard links to the file, (h) name/location of hard links to the file, (i) access rights, (j) timestamps (last access, last modification), (k) file contents, (l) ordered list of blocks occupied by the file?

For each item state whether it is required or optional. For items not stored in inodes, state where the information is stored (if at all).

### **Question 13.4: Virtual File System**

- a. What is the purpose of the VFS layer in an operating system?
- b. Discuss potential drawbacks of using a VFS.
- c. Describe the effect of mounting a filesystem.