# HÁSKÓLI ÍSLANDS
Iðnaðarverkfræði-, vélaverkfræði- og tölvunarfræðideild

TÖL401G: Stýrikerfi / Operating Systems · Vormisseri 2022

**Assignments 23–24 · Due 12.4.2022, 13:00**

There will be one further “bonus” assignments published next week. (“Bonus” means that solutions will not be presented at dæmatími, but your submission gets graded. If these grades belong to your best 12 assignments grades, they will contribute towards the overall final grade.)

## Assignment 23

Consider three different *File Allocation Table (FAT)*-based file systems: the first has only 10 KB clusters, the second has only 1 KB clusters, the third has only 0.5 KB clusters:

1. In this file system, 1000 files of size 0.5 KB, 100 files of size 5 KB, and 10 files of size 50 KB shall be stored at the same time. How large (in KB) is for each of the three above cluster sizes the amount of storage that cannot be used due to internal fragmentation?
2. The FAT shall be used to manage clusters that comprise altogether exactly 1500 KB. (The space required for storing the FAT itself shall not be included in the 1500 KB.)
   (a) For each of the above three cluster sizes, investigate whether it is at all possible to manage all the files from part 1. using the above FAT? Justify your answer for each cluster size!
   (b) Now, the FAT itself shall be stored in clusters: How many clusters are occupied by the above FAT at each of the three cluster sizes provided that cluster numbers are stored within the FAT using 16 Bits (“FAT16”)?

## Assignment 24

Consider an *I-node*-based file system:

1. Each *I-node* supports storing 98 direct block pointers, one pointer to a *single indirect block*, and one pointer to a *double indirect block*. Each indirect block supports storing 100 block pointers. Each block has a size of 1 KB. What is the maximum file size that can be managed in such a file system?

2. Consider the absolute path `/usr/bin/vi`. Which disk accesses are required to check whether the file `vi` really exists in the directory `/usr/bin`?

   Assume that the root directory has already been loaded into a cache of the operating system and thus no disk access is required to know the contents of the root directory.

   Note: Do not refer to abstract disk accesses such as "read directory", but mention really each individual disk access that may be needed to load data blocks (which contain, e.g., file contents or directory contents), metadata such as I-nodes, or anything else; in addition to mentioning the disk accesses themselves, describe what kind of information is used from each of these accesses.

3. Consider the following system calls and describe for each the involved file system *updates*:

   (a) `link("ParentDirectory/existingFile","ParentDirectory/newFile")` to create a hard link *newFile* that points to *existingFile*.

   (b) `symlink("ParentDirectory/existingFile","ParentDirectory/newFile")` to create a symbolic link *newFile* that points to *existingFile*.

   (c) `unlink("ParentDirectory/existingFile")` that deletes the *additional* hard link *ParentDirectory/existingFile* to a file (i.e. after deleting this hard link, still other hard links remain pointing to the same file).

   Note: Describe the filesystem updates in terms of "Allocate a data block *XYZ* with content *ABC*", "Create an I-node pointing to data block *XYZ*", "Add to *ABC* a directory entry pointing to *XYZ*", "Update part *ABC* of I-node *XYZ*", "Update part *ABC* of directory entry *XYZ*", etc.

## Preparation

Read chapters 10 and 11 as preparation for class on next Tuesday and Thursday respectively.

Examples from each chapter will be explained in videos that are available in Canvas via the tab "Panapto".

Report via Ed Discussion any questions that you have, so that we can clarify this during Zoom-class or directly via Ed Discussion.