

## OS 2018 Problem Sheet #6

**Warning: Whenever you prefix a shell command with `sudo`, make sure you know what you are doing. And never work as root unless you know what you are doing.**

### Problem 6.1: *file systems*

(1+1+1+1+1+2+2+1 = 10 points)

On Linux systems, you can create a file system in a regular file and then mount it into your file system tree:

```
dd of=vhd.ext3 bs=1k seek=4096 count=0
sudo mkfs -t ext3 vhd.ext3
sudo modprobe loop
mkdir ./mnt
sudo mount vhd.ext3 ./mnt
```

Your new filesystem will now appear under the `./mnt` directory.

- The new file system is not empty. What is the purpose of the directory that is contained in the new file system?
- Change the current working directory so that you are located in the new file system. Run the shell command `stat -f .` and explain the difference between free blocks and available blocks.
- Change the current working directory such that it is outside the new file system. Delete the underlying file `vhd.ext3`. What happens to the mounted file system?
- Change the current working directory such that you are located in the new file system again and run `stat -f ..`. Create a large file in the new file system using the following command:

```
sudo dd of=big.data bs=1k seek=4096 count=0
```

Run `stat -f .` again. How have the free block and free inode numbers changed? Explain what you observe.

- Change the current working directory such that you are located in the new file system again. Execute the following commands:

```
sudo chattr +i big.data
sudo rm big.data
```

Explain what you observe. Learn about tools that can display file attributes.

- Change the current working directory such that you are located outside of the new file system again. Install a statically linked version of `busybox` on your system (e.g., `'sudo apt install busybox-static'` on a Debian or Ubuntu system). Now copy the `busybox` program into your new file system and then run a `chroot` command:

```
sudo mkdir -p mnt/bin
sudo cp /bin/busybox mnt/bin/busybox
sudo ln mnt/bin/busybox mnt/bin/sh
sudo chroot mnt /bin/sh
```

Explain what has happened when you executed the `chroot` command. Why was it important to copy a statically linked version of `busybox`?

- g) From the busybox shell running in a chroot environment, what do you have to do in order to run a command like `vi` (without copying `vi` into the chroot environment)? What do you have to do in addition in order to run commands like `ps` or `top`?
- h) Terminate the shell in the chroot environment and change the current working directory such that it is outside the new file system. Run the following commands:

```
stat -f .  
sudo umount ./mnt  
stat -f .
```

(If the `umount` fails, think about why it might fail and try to resolve the problem without drastic measures such as rebooting your computer.) If you compare the results produced by the two `stat` commands, what do you observe?