Written examination in Operating Systems

July 21st 2015

Last name:
First name:
Student number:
I confirm with my signature that I will process the written examination alone and that I feel healthy and capable to participate this examination. I am aware, that from the moment, when I receive the written examination, I am a participant of this examination and I will be graded.
Signature:

- Provide on all sheets (including the cover sheet) your *last name*, *first name* and *student number*.
- Use the provided sheets. Own paper must *not* be used.
- Place your *ID card* and your *student ID card* on your table.
- You are allowed to use a *self prepared*, *single sided DIN-A4 sheet* in the exam. Only *handwritten originals* are allowed, but no copies.
- You are allowed to use a non-programmable calculator.
- Answers, written with pencil or red pen are *not* accepted.
- Time limit: 90 minutes
- Turn off your mobile phones!

Result:

Question:	1	2	3	4	5	6	7	8	9	10	11	12	Σ	Grade
Maximum points:	6	6	6	10	7	7	10	8	7	9	10	4	90	
Achieved points:														

Question 1)

Points:

Maximum points: 6

- a) Why causes batch processing an acceleration effect, when multiple tasks are executed?
- b) Name an application of batch mode, which is still popular today.
- c) What is spooling?
- d) What is the name of the quasi-parallel program or process execution?
- e) What is scheduling?
- f) What is swapping?

Question 2)

Points:

Maximum points: 2+2+2=6

a) Describe the difference in the structure of a monolithic kernel compared with a microkernel.

b) Name <u>one</u> advantage and <u>one</u> drawback of monolithic kernels.

c) Name $\underline{\mathrm{one}}$ advantage and $\underline{\mathrm{one}}$ drawback of microkernels.

Question 3)

Points:

Maximum points: 2+3+1=6

a) Explain the two file entries "." and "..." in the output of 1s?

```
$ mkdir new_directory
$ cd new_directory
$ ls -1 --all --size --human-readable
insgesamt 8,0K
4,0K drwxr-xr-x 2 bnc users 4,0K Jul 12 11:03 .
4,0K drwxr-xr-x 119 bnc users 4,0K Jul 12 11:03 ..
```

b) Explain the permissions of the file convert_script.py.

```
$ ls -l --all --size --human-readable
insgesamt 16K
4,0K drwxr-xr-x 2 bnc users 4,0K Jul 12 09:14 .
4,0K drwxr-xr-x 119 bnc users 4,0K Jul 12 09:13 ..
8,0K -rwxr-xr-- 1 bnc users 7,0K Jul 12 09:22 convert_script.py
```

(Note: Describe which operations the different users/groups are allowed to carry out with the file.)

c) Which command is used to modify the permissions of files?

Question 4)

Points:

Maximum points: 1,5+1,5+3+1+1+2=10

- a) Which three components contains the CPU?
- b) Which three digital bus systems contains each computer system according to the Von Neumann architecture?
- c) Which tasks are carried out by the three digital bus systems of subtask b)?

- d) What is the Front Side Bus?
- e) Which two components contains the chipset?
- f) Name the task of each component of the chipset.

Student number:

Question 5)

Points:

Maximum points: 2+1+2+2=7

A HDD provides these information:

IBM Travelstar		MODEL: DBCA-204860 E182115 T
RATED: 5V 500m	A	MADE IN THAILAND BY IBM STORAGE
P/N: 21L9510	4090 MB	16NOV99
FRU: 22L0018	MLC:F41941	(7944 CYL. 16 HEADS. 63 SEC/T)

a) Calculate the capacity of <u>one surface area</u> of one disk of the HDD. (Provide the calculation steps!)

Note: The number of cylinders (CYL) is equal with the number of tracks per disc. The size of each sector (SEC) is 512 Byte.

- b) Calculate the capacity of one track of the HDD. (Provide the calculation steps!)
- c) Calculate the total capacity of the HDD. (Provide the calculation steps!)
- d) How many discs contains the HDD? Note: Each disk has two surface areas. (Provide the calculation steps!)

Question 6)

Points:

Maximum points: 1+1+1+1+1+2=7

- a) Name <u>one</u> RAID level, which improves the data transfer rate for write.
- b) Name <u>one</u> RAID level, which improves the reliability.
- c) How many drives are allowed to fail in a RAID 0 array without data loss?
- d) How many drives are allowed to fail in a RAID 1 array without data loss?
- e) How many drives are allowed to fail in a RAID 5 array without data loss?
- f) Name <u>one</u> advantage and <u>one</u> drawback of software RAID compared with hardware RAID.

Question 7)

Points:

Maximum points: 10

The Buddy method for allocating memory to processes shall be used for a memory with a capacity of 1024 kB. Perform the provided operations and give the occupancy state of the memory after each operation.



(!!! CAUTION !!! With the second template you can save time, if you want to try it all over again. Please mark clearly which one of your solutions shall be considered during the correction!)



Question 8)

Points:

Maximum points: 1+3+1+1+2=8

- a) Which information stores an inode?
- b) Name three examples of metadata in the file system.

c) What is a cluster in the file system?

- d) How can a UNIX file system (e.g. ext2/3), which does not implement extents, address more than 12 clusters?
- e) Name <u>one</u> advantage and <u>one</u> drawback of small clusters in the file system compared with large clusters.

Question 9)

Points:

Maximum points: 7

- a) Name (or describe) <u>one</u> useful application for the command sed.
- b) Name (or describe) <u>one</u> useful application for the command awk.
- c) Describe what this command does:

\$ echo "ERROR" >> /tmp/msg.txt

d) Describe what this command does:(Note: Focus on a difference with the command from subtask c).)

\$ echo "ERROR" > /tmp/msg.txt

- e) Name (or describe) <u>one</u> useful application for the command head.
- f) Name (or describe) <u>one</u> useful application for the command tail.
- g) Name (or describe) <u>one</u> useful application for the command grep.

Question 10)

Points:

Maximum points: 1+1+1+1+2+2+1=9

x86-CPUs contain 4 privilege levels ("rings") for processes.

- a) In which ring runs the kernel of the operating system?
- b) In which ring run the applications of the users?



- c) Processes of which ring have full access to the hardware?
- d) What is a system call?
- e) What is a context switch?

- f) Name two reasons why user mode processes should not call system calls directly.
- g) What alternatives exist, if user mode processes should not call system calls directly?

Question 11)

Points:

Maximum points: 4+2+1+1+2=10

a) A parent process (PID = 100) with the characteristics, described in the table below, creates a child process (PID = 200) by using the system call fork(). Enter the four missing values into the table.

	Parent Process	Child Process
PPID	99	
PID	100	200
UID	25	
Rückgabewert von fork()		

b) Explain the difference between preemptive and non-preemptive scheduling.

- c) Name <u>one</u> drawback of preemptive scheduling.
- d) Name <u>one</u> drawback of non-preemptive scheduling.
- e) Name <u>four</u> scheduling strategies, for which the CPU runtime (= execution time) of the processes are <u>not</u> required be known.
 (Note: This means that only scheduling methods are correct here, which can be used in practice under realistic conditions.)

Question 12)

Points:

Maximum points: 4

a) Does a deadlock occur? Perform the deadlock detection with matrices.

Existing resource vector = $\begin{pmatrix} 4 & 8 & 6 & 6 & 5 \end{pmatrix}$

	0	2	1	0	0		3	3	2	4	5]
Current allocation matrix =	2	3	1	0	4	Request matrix $=$	0	3	1	4	0
	1	0	2	1	1		0	2	3	5	4