Written examination

Operating Systems

February 25th 2020

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: _____

- You are allowed to use a *self prepared*, *single sided DIN-A4 sheet* in the exam. Only *handwritten originals* are allowed, but no copies.
- Use the provided sheets.
- Do *not* use a red pen.
- Time limit: *90 minutes*
- Turn off your mobile phones!

Result:

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

1.0: 90.0-85.5, **1.3**: 85.0-81.0, **1.7**: 80.5-76.5, **2.0**: 76.0-72.0, **2.3**: 71.5-67.5,
2.7: 67.0-63.0, **3.0**: 62.5-58.5, **3.3**: 58.0-54.0, **3.7**: 53.5-49.5, **4.0**: 49.0-45.0, **5.0**: <45

Last name: First name: Student number:

Question 1)

Points: .....

Maximum points: 0.5+0.5+0.5+0.5+0.5+0.5+1=4

a) Explain what scheduling is.

b) Explain what swapping is.

c) Explain how memory protection works.

d) Explain why memory protection is useful.

e) Name the scheduling concept that modern operating systems implement.

f) Operate modern operating systems in singletasking oder multitasking mode?

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

Last name: First name: Student number:

Question 2)

Points: .....

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

a) Explain the difference between 8-bit, 16-bit, 32-bit and 64-bit operating systems.

b) Name the two essential criteria of real-time operating systems.

c) Name the two types of real-time operating systems.

d) Name and explain two advantages of hybrid kernels.

e) Your colleague recommends you to relocate frequently used server daemons, such as web server, email server, SSH server and FTP server, from the user mode to the kernel mode. What is your opinion about this idea? Give reasons for your answer. Explain at least one benefit and one drawback on this idea.

f) Explain why the Linux kernel does not belong to the microkernel category.

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Question 3)

Points: .....

Maximum points: 1+1+1.5+0.5+1+0.5+0.5+0.5+0.5=7

a) Name two rotating magnetic digital data storages.

b) Name two non-rotating magnetic digital data storages.

c) Name three benefits of data storage without moving parts compared to data storage with moving parts.

d) Name one non-persistent data storage.

e) Explain what random access is.

f) Is the GNU Bash a compiler or an interpreter?

g) Is the GCC a compiler or an interpreter?

h) Is the Javac a compiler or an interpreter?

i) Is Python a compiler or an interpreter?

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Question 4)

Points: .....

Maximum points: 1.5+1.5+3+1+1+2+1=11

a) Name the three components that a CPU contains.

b) Name the three digital bus systems that each computer system includes according to the Von Neumann architecture.

c) Explain the tasks that are carried out by the three digital bus systems of subtask b).

d) Explain what the Front Side Bus is.

e) The chipset contains two components. Name them.

f) Name the tasks of the components of subtask e).

g) Explain why it is impossible to implement the optimal replacement strategy OPT.

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Question 5)

Points: .....

Maximum points: 1+0.5+0.5+0.5+0.5+1+1+1+3=9

a) Name the two basic cache write policies.

b) Name the cache write policy of subtask a) in which inconsistencies may occur.

c) Name the cache write policy of subtask a) which causes a lower system performance.

d) Name the cache write policy of subtask a) which uses so called dirty bits.

e) Explain why dirty bits are used.

f) Name the factors that influence the access time of HDDs.

g) Describe the factors of subtask f).

h) Explain what causes a page fault exception to occur.

i) Explain the reaction of the operating system, when a page fault exception occurs.

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Question 6)

Points: .....

Maximum points: 0.5+0.5+0.5+0.5+0.5+1+1+2+1.5=8

a) Name one RAID level, that improves the data transfer rate for write.

b) Name one RAID level, that 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 one advantage and one drawback of software RAID compared to hardware RAID.

g) Explain the key message of Laszlo Belady's anomaly.

h) Some scheduling algorithms were not discussed in detail during class because they cannot be used under realistic conditions. Explain why they cannot be used under realistic conditions.

i) Name three unrealistic scheduling algorithms from subtask h).

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Question 7)

Points: .....

Maximum points: 2+0.5+0.5+2+1+1+1+1+1=10

a) Name one advantage and one drawback of small clusters in the file system compared to large clusters.

b) UNIX file systems ignore uppercase and lowercase characters.

☐ true ☐ false

c) Most operating systems operate according to the principle...

☐ write-back ☐ write-through

d) Name one advantage and one disadvantage of a cache in the main memory, which is used by the operating system to accelerate the requests to stored data.

e) `opsys_course/week_05/opsys_slides_05_en.tex` is...

☐ an absolute path name ☐ a relative path name

f) Name two Linux file systems.

g) Name two Windows file systems.

h) Name one file system that implements a journal.

i) Name one file system that implements extents.

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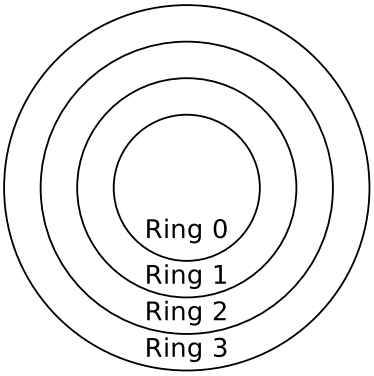
Question 8)

Points: .....

Maximum points: 0.5+0.5+1+2+2+2+1=9

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



a) Name the ring in which the kernel of the operating system runs.

b) Name the ring in which the applications of the users run.

c) Explain which processes (in which ring!) have full access to the hardware.

d) Explain what a system call is.

e) Explain what a context switch is.

f) Name two reasons why user mode processes should not call system calls directly.

g) Explain the alternative concept to system calls, when user mode processes shall not call system calls directly.

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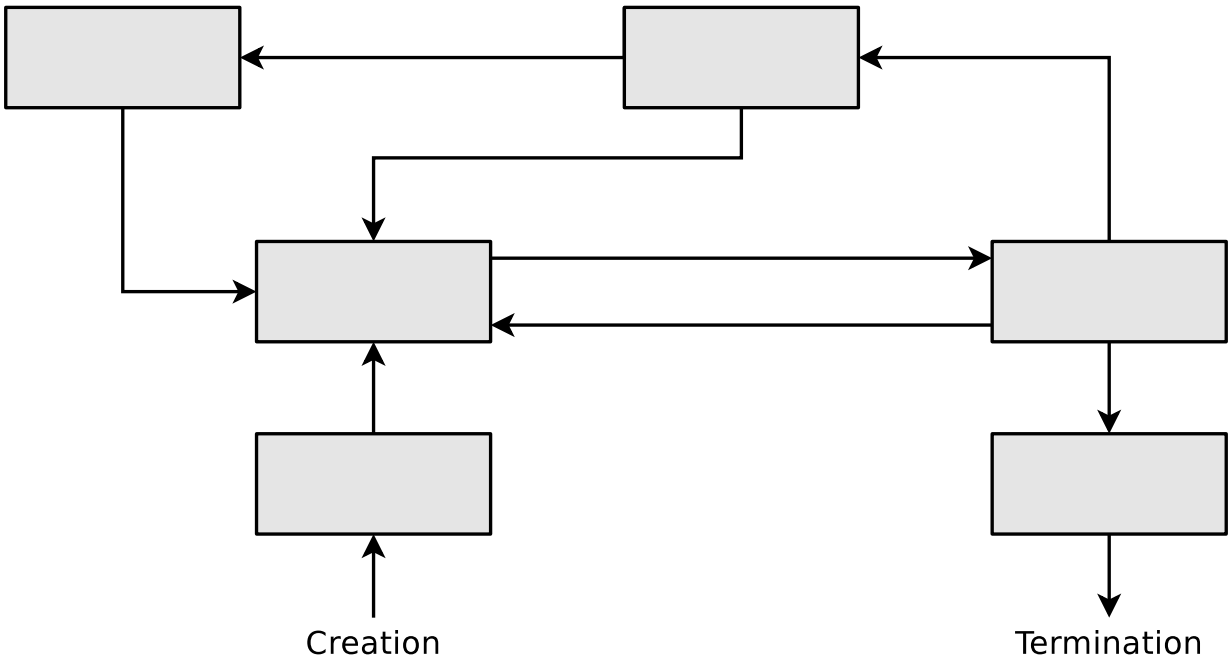
Question 9)

Points: .....

Maximum points: 6+2=8

a) Enter the names of the states in the diagram of the process state model with 6 states.



b) Explain what a zombie process is.

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Question 10)

Points: .....

Maximum points: 1+0.5+0.5+1+1+1+1+1=7

a) Explain what must be considered, when inter-process communication via shared memory segments is used.

b) According to which principle operate message queues?

☐ Round Robin ☐ LIFO ☐ FIFO ☐ SJF ☐ LJF

c) How many processes can communicate with each other via a pipe?

d) Explain the effect, when a process tries to write data into a pipe without free capacity.

e) Name the two different types of pipes.

f) Name the two different types of sockets.

g) Explain what a critical section is.

h) Explain what a race condition is.

Last name: First name: Student number:

Question 11)

Points: .....

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

a) Explain why external fragmentation of main memory is not a problem in the main memory management concept, implemented by modern operating systems.

b) Explain where internal fragmentation happens in the main memory management of modern operating systems.

c) Explain the advantage of signal and wait compared to busy waiting.

d) Explain what a barrier is.

e) Name the two problems that can arise from blocking.

f) Explain the difference between signaling and blocking.