Written examination in Operating Systems

November 17th 2014

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	**Σ**	Grade
Maximum points:	10	9	8	5	8	10	10	10	15	5	90	—
Achieved points:												

Last name: First name: Student number:

Question 1)

Points: .....

Maximum points: 0,5+0,5+1+1,5+3+0,5+3=10

a) Batch processing is always...

☐ interactive ☐ non-interactive

b) Name an application of batch mode in practice, which is still popular today.

c) What is the difference between 8 bit, 16 bit, 32 bit and 64 bit operating systems?

d) Which three digital bus systems contains each computer system according to the Von Neumann Architecture?

e) Which tasks are carried out by the three digital bus systems of subtask d)?

f) What is the Front Side Bus (FSB)?

g) Name three possible ways for processes to read data from Input/Output devices.

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Question 2)

Points: .....

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

a) What are tracks in HDDs?

b) What are sectors (= blocks) in HDDs?

c) What are cylinders in HDDs?

d) What are clusters in HDDs?

e) Which factors influence the access time of HDDs?

f) Name four advantages of SSDs over HDDs.

g) Name an advantage and a drawback of NOR memory.

h) Name an advantage and a drawback of NAND memory.

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Question 3)

Points: .....

Maximum points: 8

a) How many drives are allowed to fail in a RAID 0 array without data loss?

b) How many drives are allowed to fail in a RAID 1 array without data loss?

c) How many drives are allowed to fail in a RAID 5 array without data loss?

d) Please comment the statement: „A RAID array can be used to replace the regular backup of important data“.

e) Why is it not useful to store all parity information on a single drive, but to distribute the parity information on all drives?

f) What is the net capacity of a RAID 0 array?

g) What is the net capacity of a RAID 1 array?

h) What is the net capacity of a RAID 5 array?

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Question 4)

Points: .....

Maximum points: 5

Please mark for each one of the following statements, whether the statement is true or false.

a) Real mode is suited for multitasking systems.
☐ True ☐ False

b) When static partitioning is used, internal fragmentation occurs.
☐ True ☐ False

c) When dynamic partitioning is used, external fragmentation cannot occur.
☐ True ☐ False

d) When segmentation is used, the operating system maintains a segment table for each process.
☐ True ☐ False

e) Internal fragmentation cannot occur with segmentation.
☐ True ☐ False

f) External fragmentation cannot occur with segmentation.
☐ True ☐ False

g) With paging, all pages have the same length.
☐ True ☐ False

h) Modern operating systems use only segmentation.
☐ True ☐ False

i) One advantage of long pages is little internal fragmentation.
☐ True ☐ False

j) Modern operating systems (for x86) operate in real mode and use only segmenting.
☐ True ☐ False

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Question 5)

Points: .....

Maximum points: 0,5+0,5+0,5+0,5+2+1+1+1+1=8

a) Do DOS/Windows file systems between uppercase and lowercase?

☐ Yes ☐ No

b) Do UNIX file systems differentiate between uppercase and lowercase?

☐ Yes ☐ No

c) Do modern operating systems accelerate requests to stored data with a cache in the main memory.

☐ Yes ☐ No

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

☐ write-back ☐ write-through

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

f) What is an absolute path name?

g) What is a relative path name?

h) What sort of data processing is maximum accelerated by defragmenting?

i) For which scenario is defragmenting useful?

Last name: First name: Student number:

Question 6)

Points: .....

Maximum points: 10

a) Why does the process control block not store all process context information?

b) What is the task of the dispatcher?

c) What is the task of the scheduler?

d) What is a zombie process?

e) What is the task of the process control block?

f) What is the PID?

g) What is the PPID?

h) What is the effect of calling the system call `fork()`?

i) What is the effect of calling the system call `exec()`?

j) What is `init` and what is its task?

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Question 7)

Points: .....

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

a) How does static multilevel scheduling work?

b) How does multilevel feedback scheduling work?

c) Which scheduling strategies operate preemptive?

- ☐ First Come First Served
- ☐ Round Robin with time quantum
- ☐ Shortest Job First
- ☐ Longest Job First
- ☐ Shortest Remaining Time First
- ☐ Longest Remaining Time First
- ☐ Fair share
- ☐ Static multilevel scheduling
- ☐ Multilevel feedback scheduling

d) What is the advantage of signaling compared with busy waiting?

e) Which four conditions must be fulfilled at the same time as precondition that a deadlock can arise?

- ☐ Recursive function calls
- ☐ Mutual exclusion
- ☐ Frequent function calls
- ☐ Nested `for` loops
- ☐ No preemption
- ☐ Hold and wait
- ☐ > 128 processes in `blocked` state
- ☐ Iterative programming
- ☐ Circular wait
- ☐ Queues

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Question 8)

Points: .....

Maximum points: 10

a) 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) What is the effect, when a process tries to write data into a pipe without free capacity?

e) Which two different types of pipes exist?

f) Which two different types of sockets exist?

g) Communication via pipes works...

☐ memory-based ☐ stream-based
☐ object-based ☐ message-based

h) Communication via message queues works...

☐ memory-based ☐ stream-based
☐ object-based ☐ message-based

i) Communication via shared memory segments works...

☐ memory-based ☐ stream-based
☐ object-based ☐ message-based

j) Communication via sockets works...

☐ memory-based ☐ stream-based
☐ object-based ☐ message-based

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Question 9)

Points: .....

Maximum points: 15

In a warehouse, packages are delivered constantly by a supplier and picked up by two deliverers. The supplier and the deliverers need to pass through a gate. The gate can always be passed only by a single person. The supplier brings three packages with every shipment to the incoming goods section. One of the deliverers can pick two packages with every pickup from the outgoing goods section. The other deliverer can pick only a single package per pickup from the outgoing goods section.

Exactly one process `Supplier`, one process `Deliverer_X` and one process `Deliverer_Y` exist.

For synchronizing the three processes, create the required semaphores, assign them values and insert semaphore operations.

These conditions must be met:

- Only a single process can pass through the gate.
  It is impossible that multiple processes pass though the gate simultaneously.
- Only one of both existing deliverers can access the outgoing goods section.
  It is impossible that both deliverers access the outgoing goods section simultaneously.
- It should be possible that the supplier and one of the deliverers can simultaneously unload and pick goods.
- The capacity of the warehouse is 10 packages.
- No deadlocks are allowed.
- At the beginning, the warehouse contains no packets and the gate, as well as the incoming goods section and the outgoing goods section are free.

Source: TU-München, Übungen zur Einführung in die Informatik III, WS01/02

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Question 9 – Continuation)

```
Supplier
{
  while (TRUE)
  {

    <Pass through gate>;

    <Enter incoming
    goods section>;

    <Unload 3 packets>;

    <Leave incoming
    goods section>;

    <Pass through gate>;

    }
}
```

```
Deliverer_X
{
  while (TRUE)
  {

    <Pass through gate>;

    <Enter outgoing
    goods section>;

    <Pick 2 packets>;

    <Leave outgoing
    goods section>;

    <Pass through gate>;

    }
}
```

```
Deliverer_Y
{
  while (TRUE)
  {

    <Pass through gate>;

    <Enter outgoing
    goods section>;

    <Pick 1 packet>;

    <Leave outgoing
    goods section>;

    <Pass through gate>;

    }
}
```

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Question 10)

Points: .....

Maximum points: 1+1+1+1+0,5+0,5=5

a) What is the difference between Semaphores versus blocking?

b) What is a binary semaphore?

c) What is a strong semaphore?

d) What is a weak semaphore?

e) Which type of semaphores has the same functionality as the mutex?

f) Which Linux/UNIX command returns information about existing shared memory segments, message queues and semaphores?