Test of Pearl 101 — Operating Systems and Computer Networks

Pearls of Computer Science (201700139) / Introduction to BIT (201700149)
Bachelor module 1.1, EWI

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- You may use 1 A4 document with your own notes for this exam and a *simple* calculator.
- Scientific or graphical calculators, laptops, mobile phones, books etc. are not allowed. ***Put those in your bag now!***
- Questions marked with (MC) must be answered on the separate multiple-choice form, at the number indicated in the circle.
- Other questions have a box in which you can write the answer on this paper; this paper must be handed in.
- Total number of points: 100.
  Total number of pages: 4.

Your name:

(please underline your family name (i.e., the name on your student card), so that we know how to sort)

Your student number:

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1. Operating systems

5 pt (a) In the context of operating systems, an important part of "memory management" is:

MC**01**

A. Bookkeeping of which part of memory is used for which process.
B. Organizing data stored on a harddisk in blocks and files.
C. Installing extra memory chips in the computer.
D. Not losing your USB memory sticks.

5 pt (b) When an operating system needs to temporarily stop a process from executing, it...

MC**02**

A. ...will overwrite the process's data in memory by data from another process.
B. ...will store in memory all information needed to resume the process later.
C. ...can't do so; it has to wait until the process is blocked to wait for input.
D. ...can't do so; it has to wait until the process finishes by itself.

5 pt (c) Why is "swapping" useful?

MC**03**

A. If part of the memory is defective, data can be safely stored elsewhere.
B. It speeds up the loading of data from disk to memory.
C. Multiple processes can each use the computer's entire memory.
D. Multiple processes can fairly share the computer's memory.

5 pt (d) Why does a file containing a single byte, typically use 4096 bytes of harddisk space?

MC**04**

A. Because the metadata also needs to be stored.
B. Because harddisk space is allocated in blocks of 4096 bytes.
C. Because each file gets allocated enough space to grow to the maximum allowed size, which is 4096 bytes.
D. This is nonsense, such a file only uses 1 byte of disk space.

5 pt (e) What is a virtual machine?

MC**05**

A. A machine so expensive that one can only dream about it.
B. Using hard disk space to virtually enlarge a computer's main memory.
C. A theoretical construct to reason about fundamental limits to computing.
D. A piece of software running on a computer, "imitating" another computer.

5 pt (f) Suppose a process is started, waits *three times* for a keypress, then does some computations and finally terminates. During the computations, it is interrupted by an operating system timeout *once* for other processes to run.
How many times does this process pass through the "blocking" state?

MC**06** A. 0 B. 1 C. 2 D. 3 E. 4 F. 5 G. 6

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35 pt all together

2. Networks – protocols

Here you see a few network packets as displayed by Wireshark:

nr.	source IP	destination IP		source/dest.port	TCP seq./ack.numbers
1	130.89.1.1	130.89.2.2	TCP	7701 > 56922 [ACK]	Seq=1000 Ack=2001 Len=90
2	130.89.1.1	130.89.2.2	TCP	7701 > 56922 [ACK]	Seq=1090 Ack=2001 Len=20
3	130.89.1.1	130.89.2.2	TCP	1066 > 56922 [ACK]	Seq=1110 Ack=2001 Len=20
4	130.89.2.2	130.89.1.1	TCP	56922 > 7701 [ACK]	Seq=2001 Ack=1110 Len=40
5	130.89.2.2	130.89.1.1	TCP	56922 > 1066 [ACK]	Seq=2001 Ack=1130 Len=0
6	130.89.1.1	130.89.2.2	TCP	7701 > 56922 [ACK]	Seq=1110 Ack=2041 Len=0
7	130.89.1.1	130.89.2.2	TCP	1066 > 56922 [ACK]	Seq=1110 Ack=2001 Len=20

(a) How many different TCP connections are there in this trace?

MC**07** A. 0 B. 1 C. 2 D. 3 E. 4 F. 5 G. 6

(b) Should any reply be sent in response to packet nr. 6 in the trace?

MC**08**

A. No, since this packet was lost.
B. No, since this packet is a retransmission.
C. No, since this packet contains no new data.
D. No, since its sequence number is not correct.
E. No, since one of the port numbers is not correct.
F. Yes, with `Seq=` [ ] and `Ack=` [ ]

(You only need to fill in the boxes if you choose answer F.)

(c) Should any reply be sent in response to packet nr. 7 in the trace?

MC**09**

A. No, since this packet was lost.
B. No, since this packet is a retransmission.
C. No, since this packet contains no new data.
D. No, since its sequence number is not correct.
E. No, since one of the port numbers is not correct.
F. Yes, with `Seq=` [ ] and `Ack=` [ ]

(d) At each layer of the layering model of the Internet, there are many different protocols, with the exception of the network layer, which has only one protocol. Why is that?

MC**10**

A. This is needed to ensure reliable delivery of data.
B. This is because physics is the same for everyone.
C. This is needed to ensure a worldwide address format.
D. This is because both ends of a link must be compatible.
E. This is needed to give applications a uniform look & feel.

(e) Suppose IP addresses would not be assigned systematically; any computer could just be assigned any address, as long as that address is not in use anywhere else. What would the consequence be?

MC**11**

A. There would not be enough IP addresses.
B. It would be hard to distinguish between client and server computers.
C. The tables used by routers to forward the packets would become very long.
D. Nothing serious; assigning them systematically is only done for convenience.

(f) Port 80 is said to be the "well-known" port for web traffic. What does this mean?

MC**12**

A. It is forbidden to use other ports than 80 for web traffic.
B. Incoming traffic to destination port 80 is meant for a web server.
C. Traffic coming from source port 80 is coming from a web browser.
D. Web-related traffic usually has port 80 as both the source and destination port.

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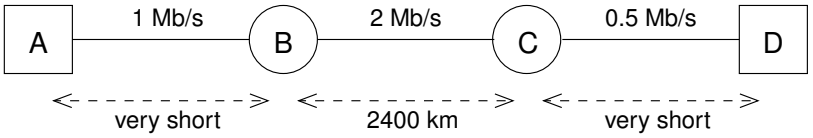
3. Networks – delay

Consider a network consisting of an endhost A, two routers B and C, and an endhost D. The only path from A to D is via B and C. The link speeds and distances are as indicated in the figure.



We assume that the computation time needed by routers B and C to decide where to send the packet, is negligible. We also assume that signals travel over the cables at a speed of 200 000 km/s.

An application on host A generates two packets of 2000 bits each (incl. headers), simultaneously at time $t = 0$. There is no other traffic in this network.

13 pt (a) Calculate the transmission and propagation delays for one packet on each of the links, or indicate why it is negligible:

Transmission delay on link A–B:

Propagation delay on link A–B:

Transmission delay on link B–C:

Propagation delay on link B–C:

Transmission delay on link C–D:

Propagation delay on link C–D:

22 pt
(b), (c), (d)
together

(b) At what time will the **first** packet have arrived completely at **host D**? Show your calculation.

Conclusion: Arrival time at host D: and queueing at node(s) (if any):

(c) At what time will the **second** packet have arrived completely at **node C**? Show your calculation.

Conclusion: Arrival time at node C: and queueing at node(s) (if any):

(d) At what time will the **second** packet have arrived completely at **host D**? Show your calculation.

Conclusion: Arrival time at host D: and queueing at node(s) (if any):