Q1 (30 points)	Q2 (5 points)	Q3 (20 points)	Q4 (10 points)	Q5 (35 points)

Test of Operating Systems and Computer Networks (2019-201700139-1A)

October 11, 2019, **13:45–14:45 (total duration: 60 mins)**
Module coordinator: Doina Bucur, Instructor: Suzan Bayhan

- You may use 1 A4 document with *your own notes as cheatsheet* for this exam and a *simple* calculator. You can use scrap paper.
- Graphical calculators, laptops, mobile phones, books etc. are not allowed. Please put those in your bag now!
- Total number of points: 100. Total number of pages: 6.

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:

Q1. Operating Systems (total 30 points)
The below questions are multiple choice questions and only one answer must be selected.

a) [5 points] Which of the following is FALSE?
*(choose **one** and write in the box, no explanation is needed)*
A- An operating system acts as a resource allocator and manages resource allocation between applications.
B- An operating system is a program controlling the execution of all other programs.
C- An operating system runs only after the user starts browsing the web.
D- One can have two or more different operating systems running on a computer by the help of virtual machines.
E- Windows, Linux, and Android are some well-known examples of operating systems. [ ]

b) [5 points] A computer can operate in at least two modes. These two modes of operation are:
(*choose **one** and write in the box, no explanation is needed)*
A) supervisor mode and system mode
B) kernel mode and privileged mode
C) physical mode and logical mode
D) user mode and kernel mode
E) hardware mode and software mode

[D]

c**) [5 points] How can an operating system avoid the CPU being blocked by a process that is computation-intensive and therefore needs long CPU time?**
*(choose **one** and write in the box, no explanation is needed)*
A- The process is put into blocked state to avoid it running for a long time.
B- The CPU has a time-out mechanism which puts the executing process after this time-out period to the waiting queue.
C- The operating system allocates a separate memory space to each process.
D- Computation-intensive processes are scheduled separately on a different CPU.

B

d**) [5 points] Can a user run a program which requires memory larger than the main memory of the computer?**
*(choose **one** and write in the box, no explanation is needed)*
A- *No, because CPU implements time-outs.*
B- No, because the process must be fully copied to the main memory for execution.
C- Yes, because the hard disk can be used as virtual memory to pretend that there is more memory than there physically is.
D- Yes, because process can be compressed to fit into main memory.

C

e**) [5 points] Why does a file containing a single byte, typically use 4096 bytes of hard disk space?** (choose **one** and *write in the box, no explanation is needed)*
A- This might happen due to an operating system error and must be fixed.
B- Because a file's metadata is usually large and would need a lot of space.
C- Because each file gets allocated enough space to grow to the maximum allowed size, which is 4096 bytes.
D- Because hard disk space is allocated in blocks of 4096 bytes.

D

Q2- Operating System: [5 points]

a) **[5 points] Suppose a process is started. During its execution, this process experiences operating system time-outs *two* times. Moreover, this process waits for user input *three times*. How many times does this process pass through the *waiting* state?** *(write **one** number in the box, no explanation is needed)*

6

Q3- Computer Networks (total 25 points)

The below questions are multiple choice questions and only one answer must be selected.

a) [5 points] Layered design of the Internet provides advantages in many ways. Which of the following is NOT one of these advantages?

A- Layered design makes it easier to discuss and understand a very complex system.
B- It provides a modular structure which makes updating system components easier.
C- It helps the processes to run without going into blocked state.
D- It decreases complexity of the design by separating services each layer must provide.

C

b) **[5 points] In the hourglass model of the Internet protocols, the thin-waist of the Internet is _____ .**
(choose **one** and write in the box, no explanation is needed)

A

A- IP because it is the only protocol at the network layer.
B- TCP because it guarantees delivery of the packets via acknowledgements.
C- UDP because it is a lightweight transport protocol.
D- HTTP because it is used for web browsing.

c) [5 points] Which of the following is FALSE?
(choose **one** and write in the box, no explanation is needed)

C

A- A TCP connection is uniquely identified by source and destination IP addresses and source and destination ports at each end.
B- A TCP connection is a bidirectional connection between two hosts.
C- A TCP connection has always the same port number at both hosts.
D- TCP is a transport layer protocol.

d) [5 points] Which of the following is TRUE? *(choose **one**, no explanation needed)*

B

A- A TCP acknowledgement number is the sequence number of the last byte of the application-layer data that has been received (by the sender of the TCP packet).
B- The sequence number is the byte number of the first byte of data in the TCP packet sent.
C- A TCP packet must always have application-layer data.
D- A TCP packet carries either the application-layer data or the acknowledgement information.

e) [5 points] Which of the following is FALSE?: *(choose **one**, no explanation needed)*

C

A- In circuit switching, physical path is established between the two communications end points.
B- Circuit switching is a good option when the users need a constant number of bits per second.
C- Packet switching reserves bandwidth for each packet before the packet is sent.
D- In packet switching, packets travel independently from each other and might follow different paths.

Q4: Computer Networks (10 points)

In Table 1, you see a few network packets as displayed by Wireshark (relative sequence numbers are shown).

Table 1: Wireshark trace

Packet#.	Source IP	Dest. IP	Source/Dest. Port	Info
1	130.89.177.195	129.24.28.228	50655→80	[SYN] Seq=0 Len=0
2	130.89.177.195	129.24.28.228	50656→80	[SYN] Seq=0 Len=0
3	129.24.28.228	130.89.177.195	80 → 50656	[SYN, ACK] Seq=0 Ack=1 Len=0
4	130.89.177.195	129.24.28.228	50656→80	[ACK] Seq=1 Ack=1 Len=0
5	130.89.177.195	147.14.18.22	4508→ 443	[SYN] Seq=0 Len=0
6	130.89.177.195	114.229.218.63	4517→23	[SYN] Seq=0 Len=0

a) [5 points] How many different TCP connections are there in this trace? *(one number, no explanation needed)*

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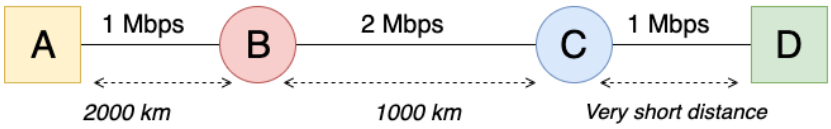
e) [5 points] How many of the connections in the above table have completed their handshake and are ready for application-layer data exchange? *(one number, no explanation needed)*

1

Q5- Computer Networks - delay calculation (total 35 points)

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 between two endpoints are as indicated in the figure.



We assume that the processing 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. There is no other traffic in the network other than host A's traffic.

An application on host A generates *two packets* as follows*:*
- the first packet: at t=0 ms, a packet of 2000 bits
- the second packet: at t=1 ms, a packet of 1000 bits

[12 points] a) For the <u>FIRST PACKET</u>, calculate the transmission and propagation delays on each of the links, or indicate why it is negligible. If it is zero, write 0 in the box. Show your calculation and write the answer with units, i.e., ms.

Transmission delay on link A-B Packet size/link tx rate = 2000 bits/1 Mbps = 2 ms	**Propagation delay on link A-B** distance/signal propagation speed = 2000 km/ 200000 km/s = 10 ms
Transmission delay on link B-C Packet size/link tx rate = 2000 bits/2 Mbps = 1 ms	**Propagation delay on link B-C** distance/signal propagation speed = 1000 km/ 200000 km/s = 5 ms
Transmission delay on link C-D Same as transmission delay from A-B: Packet size/link tx rate = 2000 bits/1 Mbps = 2 ms	**Propagation delay on link C-D** Since the distance is very short, it is negligible, ~ 0 ms

[6 points] b) At what time will **the first packet** arrive completely at host D? Write the arrival time in **ms** in the below box.

20	(ms)

Pk generated	Generation Time	First bit leaves A	All bits totally leave A	From A to B (10 ms) arrival to B	First bit leaves B	All bits totally leave B	From B to C (5 ms) arrival to C	First bit leaves C	All bits totally leave C	From C to D (0) ARRIVES AT D
0 (2000 bits)	0	0	2	12	12	13	18	18	20	20
1 (1000 bits)	1 (waits till first packet totally leaves A)	2	3	13	13	13.5	18.5 (waits till first packet totally leaves C)	20	21	21

[4 points] Does **the first packet** experience any queuing delay?

A) Yes, at node A

B) Yes, at node B

C) Yes, at node C

D) Yes, at node D

E) No, it does not experience any queuing delay

E

[9 points] c) At what time will **the second packet** arrive completely at host D? Write the arrival time in ms in the below box.

21	(ms)

[4 points] Does the **second packet** experience any queuing delay?

A) Yes, only at node A

B) Yes, only at node B

C) Yes, at A and C

D) Yes, at A, B, and C

E) No, it does not experience any queuing delay

C