Name	Signature	Student Id Nr	*Points*

581305-6 Computer Organization I, mini exam 4, 9.12.2019 (12 p)

Write your answer on this exam paper in the space given. Please notice, that the exam paper is 2-sided..

a) [4 p] I/O implementation. The keyboard is implemented with interrupt-driven (indirect) I/O. User process (P) has asked(e.g., with service call *c=readchar(kbd)*) the keyboard device driver (DD) to read one key press. The device driver is implemented as a (privileged) subroutine. We assume for now, that the user has not yet pressed that key ('a') but will soon press it.

i. [1 p] How does the DD give the command to read next key press to the keyboard device controller process (DCP) running on the keyboard device controller (DC)?
If any (CPU) process management events happen at this time, please explain them.

ii. [2 p] How will DD know, that some key ('a') is pressed? How will DCP tell DD about it?
How will DD know which key was pressed?
If any (CPU) process management events happen at this time, please explain them.

iii. [1 p] When and how will P get the character code for the pressed key ('a') from DD?
If any (CPU) process management events happen at this time, please explain them.

b) [4 p] Linking. Module N has (e.g.) variable X. Module M has calls to subroutine S in module N. Modules M and N are linked so that M is first, and N second.

i. [1 p] How are the references to X inside module N modified during linking?
How do you know which addresses must be modified and onto what values?

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ii. [1 p] How are the calls in module M to subroutine S in module N modified during linking? How do you know which addresses must be modified and onto what values?

iii. [1 p] When is static linking better than dynamic linking? Explain. (One example is enough)

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c) [4 p] Java-ohjelmien suoritus

i. [2 p] How is statement Y=X*X done in JVM byte code, when X and Y are local variables in method. Where are X and Y located? How do you reference X and Y in (numeric) JVM byte code? (It does not matter, if you do not remember exact byte code syntax. Use opcodes similar to ttk-91.)

ii. [2 p] What does statement ”Java program P is executed with JIT-compilation” mean? In what form is P at execution time, and how is that form achieved?