1 OS Interfaces

Emma just bought a personal Credit Card Reader (CCR), for her online payments, which can be plugged into her computer through a USB port. Being eager to use it, Emma reads the manual, which includes as a first step the installation of the driver for CCR.

(a) Why is this step necessary for CCR’s functionality?

(b) Where is the devise controller for CCR found, in this scenario?

The manual also mentions that CCR requires a specific operating system and a specific web-browser to function.

(c) What might be one reason for these two requirements? Give one reason for each requirement.

After the successful installation, Emma opens the web-browser, enables the web-browser to use CCR by checking the corresponding option at the web-browser’s menu, she visits her favorite e-shop, and then, she buys an object. Finally, Emma is directed to the check-out page.

• She clicks a button, on the window of the web-browser, which says “Read Card Now”.
• She noticed that a green light turned on at CCR.
• She swapped her card through CCR.
• The information of her credit card appeared in the form of the check-out page.

(d) For simplicity, let’s concentrate on three main components: the web-browser (acting as an application), the CCR’s driver and the CCR’s device controller. What is the sequence of system calls and interrupts that took place during the above dotted steps?

Also, for a system call, what component is the caller and what component is the callee, what is the privilege mode of each one, what is the purpose of the system call (i.e. is it a request to read or write data) and what does the callee do to handle the system call?

For an interrupt, what component does initiate the interrupt and what component does handle the interrupt, what is the reason for the interrupt and what does the handler do to successfully complete the interrupt handling?

2 Processes

Somebody may propose all the processes to follow a simpler diagram of state transitions:

\((New) \rightarrow (Running) \rightarrow (End)\).

Please, answer the following questions giving enough justification.

(a) Is the proposed state diagram plausible for an one-processor machine that executes uninterruptedly one process at a time?

(b) Is the proposed state diagram plausible for an one-processor machine that interleaves the execution of multiple processes?

(c) Is the proposed state diagram plausible for a n-processor machine that executes uninterruptedly at most n processes at the same time (each process using a different processor)?

(d) In a system where processes follow the proposed state diagram, is there context switch? And, should processes be accompanied by PCBs?

(e) It seems that the proposed diagram is simpler than the transition diagram on the slides. Why do processes really need to follow the latter?
3 Threads

Somebody may propose to establish a new execution entity, named “clone”, which is similar to a thread but with the difference that clones share everything with each other. So, if somebody creates a multi-cloned process then, the clones of this process share the same code, data, files, registers, program counter and stack. Discuss whether there are any differences between context switching between clones of the same process and executing just one clone of that process. Is “clone” a useful execution entity?

4 Programming Part

We try to build a multi-threaded program that examines a list of integers and returns how many of them are negative. Please, study the code of the file parallel.py and try to fill in the “Fix me” parts, in order to make the program work. When you finish, try to execute the program by typing “python parallel.py n” at the command line, where n is the number of threads that will be generated.

1. In order to appreciate the benefit of a multithreaded program, please try to execute parallel.py changing the n parameter from 1 up to 20. What is the execution-time for each one of these cases? How would you explain the changes in the execution-time?

2. How would you solve the same problem by using multiple processes, rather than multiple threads? Just describe the role of each process, how the work will be split among them, and how the final result will be synthesized from the partial results.