Algorithm Engineering Lab Assignment 1

Brian Zahoransky (brian.zahoransky@uni-jena.de)

February 22, 2021

1. Describe how parallelism differs from concurrency.

In both cases, progress is achieved on multiple tasks. However, the term parallelism is more concrete. Concurrency also allows multiple tasks proceeded alternately by one processing unit. On the other hand, parallelism means that tasks actually run at the same time. For example, it may be enabled through multiple cores in a processor.

2. What is fork-join parallelism?

In short, it starts with one main thread getting forked and joined (eventually multiple times) until the work is completed. Fork-join parallelism also allows side threads to proceed fork-join parallelism. However, before the program determines, all threads are joined to the main thread.

3. About which „new“ (2005) CPU technologies does Sutter report?

Hyper-threading: A hyper-threading-processor contains commonly two program counters and register files. That enables the processor to switch immediately between two tasks, whereas a regular processor needs thousands of circles.

Multi-core: A Processor with multiple independent cores.

Caches: The register files of a processor are fast and relatively small due to physical conditions. Whereas the main memory provides much more capacity, but data needs much more time to get to the processing unit. Therefore, caches were invented. They are not as fast as registers but still faster than the main memory. Further, they do not provide as much space as the main memory but still more than register files.

4. What do you think, can we have a free lunch again if we exploit them in our applications?

It seems to be a challenging task to predict the future, especially in the long term. The free lunch may continue for the next five to ten years. One supporting point is the growing caches at the moment. According to the text, the end of increasing clock speed was somehow surprising for the processor producers. It seems possible that similar issues appear in cache development. For example, physical space could become an issue. Even if this happens, a rising number of processors is almost sure. Today’s supercomputers have already millions of nods, containing hundreds of cores each. Thus, writing a well-scaling code also means a free lunch.

5. Discuss one thing you find particularly interesting in Chapter 1 from Computer Systems: A Programmer's Perspective.

The following section discusses how a letter appears on the screen after hitting a key using the terms introduced in chapter 1.7. Consider, the command shell is opened, and the letter "z" is pressed at the keyboard. Now an electric signal is sent to the keyboard's microprocessor. There, the signal gets translated into a binary file and is sent to a process inside the computer. This process is called the driver. After reaching the virtual memory of the driver, the file will be translated into a new file. It is now understandable by the operating system. The created file continues its way to the shell process. After reaching the virtual memory of the shell and being processed, a further file is sent to the driver of the monitor. Having passed this driver, a file, understandable by the monitor, is sent to its processor. There, the file is processed, the screen will be updated and show the character "z".