EEE4084F 2012 Quiz 1

Solutions

Q1. (a) Wall clock time refers to time in the real work (as opposed to a simulated virtual reality) – it is also intended to capture the concept of human time. We think in terms closer to seconds that milliseconds. Thus there is no point in measuring wall clock time in a resolution beyond seconds or hundreds of milliseconds.

(b) Correlation is a statistical function for comparing two equal-sized sets of values. This function returns a correlation coefficient that ranges from -1 to 1, this coefficient giving an indication of how similar the two sets of data are. If the correlation coefficient is 1, this infers a perfect match (e.g. correl(A,A) where A is a vector of values). Whereas the value -1 implies a perfect opposite. (e.g. correl(A,-A)). A value of 0 means there is no correlation.

(c) A good approach to timing programs is to do the ensure there is as few unpredictable influences on the test as possible. Generally, for running a PC-based system with a modern operating system, this involves closing all programs except those that are essential to doing the test. Also, background services can be shut down (e.g. SSHD, Apache server, etc) to further improve predictability (but in most cases, the background services aren't effecting things much so it's not worth the time stopping and starting these services). Using averaging is a necessity to get a reliable result. Furthermore, due to caching effects and virtual memory, it is a recommendable strategy to do the time test multiple times, but discard the first result when calculating the average.

Q2. (a) The code in Appendix A starts by loading an image called happy.jpg. Four threads are then spawned. Each thread works on different rows of the loaded image, swapping around pixels. However, the swapping of the pixels has no overall effect on the appearance of the image (essentially think of swapping the value of A and B two: A obviously retains the same value after this is done). In effect all the program does is show the image that was loaded.

Q2. (b) As explained above, there is no change, so the image would look like this:

You can try the Quiz1_SwapTest.zip file uploaded to Quizzes in the Vula resources if you are still not convinced.

Q2. (c) D – The interlaced memory partitioning approach is used.

Q2. (d) D. Interlacing is defined as splitting a rectangular block of data by rows, each task (i.e. thread) working on alternating rows at a time. In a four-processor system, the threads would follow a progression of thread 1 working on row 1, row 5, row 10, etc. with process 2 working on row 2, row 6 and so on.

Q3. (a) D – Lincoln Labs

Q3. (b) D – 2005

Q3. (c) c1. The interest in DSP was mainly about the faster and better math computation performance they DSPs offered over the more basic microprocessors.

(Just some more background to support the argument, which I don't expect in the answer:) The earlier microcontrollers / microprocessors were designed around control and peripheral interfacing, generally only with simply integer arithmetic (e.g. rather limited instructions like ADD, MUL and SUB without any divide – maybe not even a MUL, having to use add and shifts instead). DSP processors however were design to support steamed signal processing together with more sophisticated and faster math processing; for example instead of just add and compare it had divide as well, including built-in support for at least fixed-point math if not floating point math as well.

Q3. (c) c2. C (code library).

Q3. (d) The bizarre unit GPOS/liter is a unit that relates Giga Processing Operations per Second to the volume of the computer system in liters. Where one liter is defined as $1000cm^3 = 1dm^3$ (where dm stands for 'decimeter', which is a unit of volume used more frequently in Europe). It relates to the size of the computer system (not the volume for example that a FPGA on its own takes up, but including the circuit board and free space within the enclosure).

Q4. (a) The temporal paragraph relates to expressing computation in terms of spaces and relations between spaces. The temporal paradigm relates to time and doing steps of operation in order. The advantage of spatial approach is that it can be better mapped to hardware (e.g. circuits) whereas the advantage of temporal is that it can be clearer, easier to understand and easier to formulate and describe. The disadvantage of spatial is that it can be difficult to express complex computations in this way, it can lead to a messy description (think a spiderweb of intersecting paths) and thus difficult for people who didn't produce the model to understand. The disadvantage of temporal is that it tends to be results in computation descriptions that don't have the more natural mapping to a parallel solution as is often the case with a spatial description.

Q4. (b) SMP stands for Symmetric Multiprocessor (this is the official definition which will earn you marks; the term is sometimes confused with Shared Memory Processor which is an invalid answer).

Q4. (c) Often a large portion of a program's code is seldom executed (eg. Only at startup) or might never be executed (e.g. exception handling). A parallel computer program tends to spend most time in a small section of the code, the 'critical section'. Hence, parallelizing all the code can be waste considering that sequential code run by one processor is usually easier to write. Consequently, it is often only the critical section that is made into a parallel solution, and hence most of the code is left as sequential code.

Q5. (a) A Q5. (b) B Q5. (c) B Q6. (a) A

An irrelevant aside: It might be lost on most, but the altruistic purpose of this question was to celebrate 40 years of ABBA music (from the group's first single in 1972 which was initially marketed under a different name).

Q6. *Bonus question answers:* SP2, RAPTOR, KASSPER