EEE4084F Quiz 2: Lectures 4-9

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This quiz is for marks!

PLEASE ANSWER ON A SEPARATE PAGE

MAKE SURE YOUR STUDENT NUMBER IS ON YOUR ANSWER PAGE(s)

TOTAL NUMBER OF QUESTIONS : FIVE

time(min):

#	Question	Marks
Q1	Timing is an important part of establishing whether one solution is better than another. For example, prac 1 involved implementing a median filder and using gettimeofday to measure the time it took. Abswer the following: (a) What exactly is meant by the term 'wall clock time' in the context of benchmarking computation? [2 mark] (b) Present a shot counter argument to the premise: "wall clock time should be measured very accurately, +/- 1us if not better". [2 marks] (c) Briefly describe a recommended practice for timing programs to establish reliable time results (mention at least three methods; 1 mark for quality of answer). [4 marks]	8

This algorithm relates to both Q2 and Q3.

```
Image pic = loadpicture("bigdaddy.jpg"); // load an existing 24-bit image
Image out = new Image(pic.width,pic.height,8); // create a blank 8-bit canvas
out.graymap(); // colour map ranges from RGB(0,0,0) for colour 0 to RGB(255,255,255)
int q = split();
// the above line divides the program into two copies running as separate threads and
// returns: q=0 for thread 1 (original program), q=1 for thread 2 (the new process)
for (int y=q; y<p.height; y+=2) {
  for (int x=0; x<p.width; x++) {
      // do scaled RGB -> gray conversion
      unsigned intensity = (unsigned)((float)
           0.299 * pic.px(x,y).r + 0.587 * pic.px(x,y).g + 0.114 * pic.px(x,y).b);
      // save back into new image
      out.px(x,y) = intensity;
  }
}
if (q==0) out.save("daddy2.gif");
```

#	Question	Marks
Q2	**Answer the following questions in relation to the algorithm above:** (a) In a sentence describe what does the above algorithm does? [2 marks] (b) Is this actually a parallel solution? Or do both threads do the same thing, meaning that you'd get exactly the same result if you removed the int q=slipt(); line in the code (and replaced it with int q=0;). Motivate your answer referring to the code if needed. [4 marks] (c) Choose the letter A-E to specify which type of method has been used to divide up the memory to work on it in parallel in the algorithm. [2 marks] A. Contiguous B. Partitioned C. Interleved D. Interlaced E. Haphazard	8
Q3	**Answer the following questions in relation to the algorithm above:** (a) The above algorithm is a 2-thread solution (the split() function causes the spawning off of a new thread), Briefly describe how you could make this into a 4-thread solution. You can add a code snippet or diagram to help your explanation. [7 marks] (b) The speed-up was a factor of **1.2** when moving from the 1-thread to the 2-thread solution shown above. Assuming that you are running on a 4-core machine, discuss and motivate what speed-up you would expect when moving from this 2-thread solution to a 4-thread solution. [3 marks]	10

Q4	This question relates to textbook CH13. Refer to formulae below if needed. Consider the following system built around a hypothetical Power Vector Processor (PVP) microprocessor chip. The PVP can do 64 simultaneous register arithmatic operations each clock cycle, and can turn off any number of its vector operations (e.g., running from 1 to a maximum of 64 simultaneous operations) per clock. When each vector operation is active it draws current, but when turned off draws zero current (its so little current you can assume it is 0 anyway). The main application that the PVP run involves the following arithmetic operations in the *main loop* : 10 000 x sequential (single-operation) operations 10 000 x 32 simultaneous vector operations 20 000 x 64 simultaneous vector operations The VPV operates at a 100MHz clock (note each instruction compeltes in just 1 clock cycle). (a) What is the relevance of the Required Computation Rate (RCR) metric? Explain the reason for determining this number before completing the design of a system. [2 mark] (a) Assuming system just continues running the main loop of operations as described above, what is the *peak computation rate* for that part of the system? [3 marks] (b) Consider a certain program for which the PVP executes 40 000 sequential instructions (i.e. ops with one vector core turned on) and then ten repeats of the main loop, and then exits. How long would this program take to run? [3 marks] Considering that there are only arithmatic opetations in the main loop, what is the *sustained computation rate* for running this program? [3 marks] (c) If the PVP processor draw on avarage 50W while running the main loop, what can you say about the average power efficiency when the system is running the loop? [3 marks]	11
Q5	(a) Briefly define cloud computing. [3 marks] (b) What is the relation between the hypervisor and the operating system(s) used in a cloud computing system? [2 marks] (c) What is meant by a course-grained problem? Give one example of such a problem or application. [3 marks]	8
Q6	*** BONUS MARK QUESTION: ***	[2]
	In Professor Olukotun talk on 23 March, he spoke about which of the following strategies that the Stanford Pervasive Parallism Lab (PPL) is focusing on as a possible solution to programming parallel systems…? (choose a letter below)	
	A. C++ and Java automatic parallelism B. Partitioning using MPI C. Domain specific lanaguages D. CPU + GPU clusters E. lots of simple processors	
	TOTAL :	45

Appendix -- useful formulae

Required Computation Rate (RCR) = num operations to be executed / time available for computation

Peak Computation Rate = (num arithmetic processor operations per clock cycle) x (maximum clock rate)

Sustained Computation Rate = num arithmetic operations executed by program / time program takes to run

Achievable Efficiency = Sustained Computation Rate / Peak Computation Rate

Power efficiency = computation rate / power consumed

Communication-To-Computation Ratio = time spent calculating / time spent communicating

Power Consumption of CMOS device: $P = CfV^2$

where: C = Gate Capacitance f = Clock Frequency V = Supply Voltage