## **Computer Sciences Department**

## **University of Wisconsin-Madison**

## **CS/ECE 552 – Introduction to Computer Architecture**

## **In-Class Exercise (04/16)**

**Answers to all questions should be uploaded on Canvas.**

1. [1 point] (Twist on Check Yourself 6.1) From the textbook: True or False: To benefit from a multiprocessor, an application must be concurrent.

Given that the answer is false, what is one example type of application that is not concurrent but does benefit from multiprocessors.

Graphic application

2. [4 points] Consider the following piece of sequential C code.

char a[128], b[128]; /\* each char is 1 byte (8 bits) in size \*/

for (int i = 0; i < 48; i++) { **// LOOP 1**

if ((a[i] % 7) == 0) {

b[i] += a[i] + ‘A’;

}

b[i] += a[i] + ‘B’;

}

for (int i = 0; i < 49; i++) { **// LOOP 2**

b[i] += a[i] + ‘C’;

}

Consider running the above code on a machine with SIMD instructions with 128-bit wide registers, datapath, and ALUs capable of processing 16 8-bit packed operands in a cycle.

1. [2 points] Will LOOP1 running on the above machine see a 15X speedup over a sequential (non-SIMD) machine? If yes, explain why. If no, explain the key impediments to achieving the speedup.

No, since it contain condition branch.

1. [2 points] Will LOOP2 running on the above machine see a 15X speedup over a sequential (non-SIMD) machine? If yes, explain why. If no, explain the key impediments to achieving the speedup.

Yes. No condition branch.

3. [6 points] Consider your program running on a parallel processor.

1. [2 points] Applying Amdahl's Law, you estimate that when executing on two cores, the speedup of your entire program is 1.5x. What is the fraction of your program that can be parallelized?

1/((1-f)+f/2) = 1.5 => f = 2/3

1. [2 points] You decide to switch to a new parallel processor equipped with six general-purpose cores and an accelerator that can speed up half of the sequential (i.e., non-parallel) portion of your program by 3x. What is the speedup of your entire program on this new processor?

**4**

1. [2 points] If you did not have this accelerator and you only had the option to add more general-purpose cores, how many cores would you need to add (on top of the six that you already have) to achieve at least 98% of the speedup in Q2b above?

infinite