# Homework 2: Due Before Class, Thursday, Sept. 8

'handin cs4961 hw2 <file>'

Problem 1: (Coherence) #2.15 in textbook

(a) Suppose a shared-memory system uses snooping cache coherence and write-back caches. Also suppose that core 0 has the variable x in its cache, and it executes the assignment x=5. Finally, suppose that core 1 doesn't have x in its cache, and after core 0's update to x, core 1 tries to execute y=x. What value will be assigned to y? Why?

(b) Suppose that the shared-memory system in the previous part uses a directory-based protocol. What value will be assigned to y? Why?

(c) Can you suggest how any problems you found in the first two parts might be solved?

# Homework 2, cont.

Problem 2: (Bisection width/bandwidth)

(a) What is the bisection width and bisection bandwidth of a 3-d toroidal mesh.

(b) A planar mesh is just like a toroidal mesh, except that it doesn't have the wraparound links. What is the bisection width and bisection bandwidth of a square planar mesh.

Problem 3 (in general, not specific to any algorithm): How is algorithm selection impacted by the value of $\lambda$?

# Homework 2, cont.

## Problem 4: (λ concept) #2.10 in textbook

Suppose a program must execute $10^{12}$ instructions in order to solve a particular problem. Suppose further that a single processor system can solve the problem in $10^6$ seconds (about 11.6 days). So, on average, the single processor system executes $10^6$ or a million instructions per second. Now suppose that the program has been parallelized for execution on a distributed-memory system. Suppose also that if the parallel program uses p processors, each processor will execute $10^{12}/p$ instructions, and each processor must send $10^9$ (p-1) messages. Finally, suppose that there is no additional overhead in executing the parallel program. That is, the program will complete after each processor has executed all of its instructions and sent all its messages, and there won't be any delays due to things such as waiting for messages.

(a) Suppose it takes $10^{-9}$ seconds to send a message. How long will it take the program to run with 1000 processors, if each processor is as fast as the single processor on which the serial program was run?

(b) Suppose it takes $10^{-3}$ seconds to send a message. How long will it take the program to run with 1000 processors?