Question 1
Amdahl’s law can be applied in contexts other than parallel processing. Suppose that a numerical application consists of 30% floating point and 70% integer/control operations – these are based on operation counts rather than their execution times. The execution time of a floating-point operation is three times as long as other operations. We are considering redesigning of the floating-point unit in a microprocessor to make it faster.

a. Formulate a more general version of Amdahl’s law in terms of selective speed of a portion of a computation rather than in terms of parallel processing.

b. How much faster should the new floating-point unit be for 25% overall speed improvement?

c. What is the maximum speed-up that we can hope to achieve by only modifying the floating-point unit?

Question 2
Consider two versions of the task graph in Fig. 1.13. Version U corresponds to each node requiring unit computation time. Version E/O corresponds to each odd-numbered node taking unit time and each even-numbered node taking twice as long.

a. Convert the E/O version to an equivalent V version where each node is unit-time.

b. Find the maximum attainable speed-up for each of the U and V versions.

c. What is the minimum number of processors needed to achieve the speed-ups of part (b)?

d. What is the maximum attainable speed-up in each case with three processors?

e. Which of the U and V versions of the task graph would you say is “more parallel” and why?

Question 3
Devise an algorithm that would sort N items on N/2 processors of a linear array. Items are to enter and exist from the left of the array. Illustrate your algorithm using the data in Figure 2.9.

Question 4
Determine the following properties of a k-ary tree:

a. Node degree

b. Diameter

c. Number of nodes

d. Number of links
Question 5
Determine the following properties of a r X j mesh and torus:
  a. Node degree
  b. Diameter
  c. Number of nodes
  d. Number of links

Question 6
Suppose processors in a linear array compose messages of the form mcast (x, a, b) with the meaning that the data value x must be sent (multicast) to all processors with indices in the interval [a, b]. Packet routing and broadcasting correspond to the special cases mcast(x, j, j) and mcast(x, 0, p-1) of this more general mechanism. Develop the algorithm for handling such a multicast message by a processor.

Due: Feb. 15, 2007

Please pay attention to the following requirements regarding all your homework assignments:

- Always use standard size (8½ × 11) paper. Do not use papers torn-off from spiral bound notebooks.
- Write the course number, section, homework number, and your name (as appears in course roster) on top of the first page.
- Only write on one side of the paper.
- Solution of the problems cannot be fragmented i.e. Problem 2’s solution in its entirety should follow Problem 1’s solution.
- Write clearly, neatly, concisely, and in an orderly fashion.
- Draw schematics and circuit diagrams when applicable.
- Show steps involved getting to the final answer, no credit may be given for the work not shown.
- Box-in your final answers when appropriate.
- Staple all homework pages together before you turn them in. No paper clips or torn off edges is allowed.

Up to 50% of your grade will be deducted if these guidelines are not followed.