Parallel Scientific Computing: Models, Algorithms and Implementation: Assignment 1

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CS435 / CS635 – Winter 2008

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1 Guidelines

Date of postage. Thursday, February 7, 2008.

Normal date for submission. Thursday, February 21, 2008.

Due format. The assignment can be returned to the instructor by email in a form of a postscript, PDF or text file. Alternatively, a printed version can be delivered to his mail box in the Computer Science Department or given to him in class.

Collaboration. You are expected to do this assignment on your own without assistance from anyone else in the class. However, you can use the literature, and in particular the book *Modern Computer Algebra* and the references therein.

Marking. This assignment will be marked out of 40. Each of the Exercises 2 and 3 is worth 15 points. Exercise 1 is worth 10 points.

2 Preliminariy Remarks

Questions 1 and 2 are related to the chapter *Parallel Sorting Algorithms* whereas Question 3 is related to both the introductory chapter *Parallel Scientific Computing: Models, Algorithms and Implementation.* and the chapter *Performances and scalability of parallel algorithms.* For all questions, we rely on the PRAM model and neglect all communication costs.

3 Question 1

The proof of Lemma 3 is only a sketch. Write a detailed proof for this Lemma

4 Question 2

Give a complexity analysis for the lexicographic sorting on 3-D meshes. You should discuss seperately

- the case where the number p of nodes equals the number N of items to sort and
- the case where N is larger than p.

For $N >> p$ you should estimate the speed-up per processor $E(n, p)$ and comment on the scalability of this algorithm.

5 Question 3

We consider Strassen's algorithm for multiplying matrices described on Pages 11 to 13 of the introductory chapter. We assume that every operation on coefficients (addition and multiplication) has a unit cost.

1. Describe the computation directed acyclic graph associated with the multiplication of two square matrices of order 2 and then of order 4.
2. For each of the abve DAGs, give T_1 and T_∞ together with the speed-up per processor $E(n, p)$ (for a given number of nodes p).

optional Generalize the above results to the case of the multiplication of two square matrices of order 2^k.