



THE UNIVERSITY
of LIVERPOOL

SUMMER 2002 EXAMINATIONS

Bachelor of Arts : Year 3
Bachelor of Science : Year 3
Bachelor of Science : Year 4

EFFICIENT PARALLEL ALGORITHMS

TIME ALLOWED : Two Hours and a Half

INSTRUCTIONS TO CANDIDATES

Credit will be given to the best four questions only

If you attempt to answer more than the required number of questions (in any section), the marks awarded for the excess questions will be discarded (starting with your lowest mark).



THE UNIVERSITY
of LIVERPOOL

1.

- a) Describe the Parallel Random Access Machine (PRAM) model. (6 marks)
- b) Why is the Parallel Random Access Machine (PRAM) model useful? (5 marks)
- c) List advantages and disadvantages of the Parallel Virtual Machine. (8 marks)
- d) What is the distinction between CRCW and CREW PRAM models ? (6 marks)

2.

- a) Describe the balanced binary tree technique in parallel computations. (7 marks)
- b) Describe $O(\log n)$ parallel time computation of the prefix sums. (10 marks)
- c) Describe an $O(\log n)$ parallel time computation that adds n numbers on a CREW PRAM. (8 marks)

3.

- a) Describe how two sorted tables of size n can be merged in $O(\log n)$ time using the parallel computation of ranks. (11 marks)
- b) Describe the divide-and-conquer approach to parallel computations through the example of the parallel merge-sort. (8 marks)
- c) Draw the sorting network which sorts 4 elements in 3 parallel steps. (6 marks)



THE UNIVERSITY
of LIVERPOOL

- 4.
- a) Write a high-level description of the odd-even merging. (15 marks)
- c) What is the effect of the operation compare-exchange in sorting networks ? (4 marks)
- c) Formulate the zero-one principle for sorting and merging networks. (6 marks)
- 5.
- a) Describe how to compute the maximum of n numbers on the hypercube in logarithmic time. (10 marks)
- b) Describe the hypercube network of processors. (7 marks)
- c) Describe the perfect shuffle network of processors. (8 marks)
- 6.
- a) Write a high-level description of expression evaluation using tree contraction. (12 marks)
- d) What does it mean that a problem is P-complete ? (7 marks)
- c) List and define two P-complete problems. (6 marks)