

COMP308 (1999/2000)

Efficient Parallel Algorithms

Time allowed: Two hours and a half

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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 marks)

1.

a) What are advantages and disadvantages of the Parallel Virtual Machine ? (10 marks)

b) Why the Parallel Random Access Machine (PRAM) model is useful. (8 marks)

c) Describe how the parallel-do statement of the PRAM works: (7 marks)

d) Describe the write conflicts in the PRAM model ? (

2.

a) Describe a constant time parallel computation on a CRCW PRAM of the maximum of  $n$  numbers using  $O(n^2)$  processors. (7 marks)

b) How in part (a) might the number of processors be reduced whilst retaining a constant time computation ? (8 marks)

c) How one can compute on a CRCW PRAM the first position containing 1 in a table containing zeros and ones in  $O(1)$  time with  $O(n)$  processors ? (10 marks)

3. a) Describe the balanced binary tree technique in parallel computations. (7 marks)

b) Describe an  $O(\log n)$  parallel time computation that adds  $n$  numbers on a CREW PRAM. (8 marks)

c) Describe  $O(\log n)$  parallel time computation of the prefix sums. (10 marks)

4.

- a) Describe the divide-and-conquer approach to parallel computations through the example of the parallel merge-sort. (9 marks)
- b) Describe how two sorted tables of size  $n$  can be merged in  $O(\log n)$  time using the parallel computation of ranks. (11 marks)
- c) What is the overall running time of parallel merge-sort ? (4 marks)
- 5.
- a) What is the effect of the operation compare-exchange in sorting networks ? (5 marks)
- b) Draw the sorting network which sorts 4 elements in 3 parallel steps. (6 marks)
- c) Write a high-level description of the odd-even merging. (7 marks)
- a) Describe the zero-one principle for testing correctness of sorting and merging networks. How is this principle used to justify correctness of odd-even merging ? (7 marks)
- 6.
- a) Write a high-level description of expression evaluation using tree contraction. (10 marks)
- b) Describe the hypercube network of processors. (8 marks)
- c) What does it mean that a problem is P-complete ? (7 marks)

