

## COMPUTER SCIENCE TRIPOS Part IB – 2014 – Paper 3

### 1 Algorithms II (FMS)

- (a) In the context of multithreaded algorithms, define *work* and *span*, and state the work law and the span law. [3 marks]
- (b) Prove that the performance of a greedy scheduler is optimal to within a factor of 2. (Proving all intermediate theorems is not required if you state them correctly.) [4 marks]
- (c) Version *A* of a multithreaded algorithm takes 500 seconds on a uniprocessor machine and 50 seconds on a 32-processor machine. Version *B* takes the same time as *A* on a single processor but only 24 seconds on the 32-processor machine.
- (i) Define the *parallelism* of a computation and compute the parallelism of algorithms *A* and *B*. Which of the two has higher parallelism, and by how much? (*Hint*: use one of the greedy scheduler theorems to derive an approximation for one of the unknowns.) [6 marks]
- (ii) Estimate the running times of algorithms *A* and *B* on a 4-processor and on a 1024-processor machine, explaining how you obtain them. [3 marks]
- (iii) Sketch possible computation DAGs for algorithms *A* and *B* and use them to discuss the results obtained. As the number of processors in the host machine varies, is *A* or *B* faster? [4 marks]