WINTER EXAMINATION 2006

ALGORITHMS AND INFORMATION SYSTEMS (CT102)

Dr. M. Mc Gettrick

Time allowed: *one* hour.
Attempt *three* questions.

1. Write down (step by step) the position of each digit in the number "961738" when sorted using bubblesort. How many comparisons are required in this bubblesort? How many comparisons would be required if the number had twice as many digits (i.e. had 12 digits)?

2. Write (in pseudocode) an algorithm that uses binary search to find an item `X` in an *ordered* list `L` of length `n` (i.e. the list items are `L(1), L(2), L(3),...,L(n)`). State (in "Big Oh" notation) the complexity of your algorithm. If a binary search of 1,000,000 items took 5 seconds on the computer, would you expect a binary search of 4,000,000 items to take

   (a) less that 5 seconds?

   (b) between 5 and 10 seconds?

   (c) between 10 and 20 seconds?

   (d) more than 20 seconds?

3. Describe a *Divide and Conquer* algorithm which allows us to multiply two n-digit numbers in

   (a) $\mathbf{O}(n^2)$

   (b) $\mathbf{O}(n^{\sqrt{3}})$

   State any approximations you make along the way.

4. Consider the graph described by the sets $V = \{A, B, C, D, E, F\}$ and $E = \{(B, C), (C, E), (E, F), (F, D), (D, E), (F, C), (D, C)\}$

   (a) Draw the graph

   (b) State whether or not it is

      i. cyclic

      ii. connected

   (c) Suppose we label the seven edges in set E with the "distances" $\{4, 7, 10, 11, 15, 6, 8\}$ (i.e. edge (B, C) is of length 4, edge (C, E) is of length 7, etc.). Imagine the graph as a road network, and starting from a specific city, we want to visit the four cities C,D,E,F, returning to base, using the shortest possible route. State which route is proposed by the *Greedy Strategy* if we start at city

      i. F

      ii. C

      and calculate the length of these routes. From observation, are they in fact optimal?

Beannachtaí na Nollag oraibh go leir