WINTER EXAMINATION 2005

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 letter in the string "murcia" when sorted using quicksort. Explain (by sketching a calculation of the number of comparisons involved) why the worst case behaviour of this algorithm is $\mathbf{O}(n^2)$.

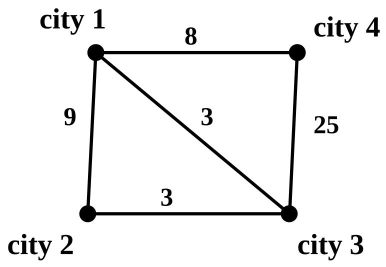
2. Write (in pseudocode) an algorithm to calculate $n!$ using

   (a) iteration,

   (b) recursion.

   Is there any difference in the performance of these two algorithms?

3. The diagram below shows a road network between four cities, with the length of each road marked. Let D_{ij} be the length of the shortest route from city i to city j (e.g. D_{12} = length of shortest route from city 1 to city 2 = 6 (travelling via city 3)) **Using the Dynamic Programming method**, calculate the matrix D (Hint: start by writing down the matrix A where A_{ij} is the length of the edge between i and j, $A_{ij} = \infty$ if there is no edge between i and j, and $A_{ii} = \infty$). For full marks you must both obtain the correct answer **and** illustrate your method.



4. (a) Using exactly 5 nodes/vertices, draw an example of

      i. a cyclic connected graph

      ii. an acyclic disconnected graph

      iii. a ternary tree

   (b) Draw the graphs corresponding to the following sets:

      i. $V = \{v_1, v_2, v_3\}, \quad E = \{(v_3, v_3), (v_1, v_2), (v_2, v_2)\}$

      ii. $V = \{a, b, c, d, e\}, \quad E = \{(d, e), (a, e), (d, b), (c, b)\}$

      iii. $V = \{1, 2\}, \quad E = \{(1, 1), (1, 2), (2, 2)\}$

      State which (if any) of these graphs are trees.

Beannachtaí na Nollag ort