ENEL4AA - Design and Analysis of Algorithms - 2016

Assignment 2: 11 April 2016
Due: Friday, 29 April 2016

- You will have to Demonstrate your working code on **Tuesday: 3 May 2016**.
- All submitted code must be adequately commented and neatly formatted. The Assignment must be done in **C++ only**.
- Your reports must be at most 5 pages long. Only PDFs and MS Word documents will be accepted.

Question: *Design Methods*

To take care of the environment, the government is allowing people to sponsor an acre of land. This was so successful they are swamped with replies. Help them by **sorting the claims** as below.

Write a program to read in a list of land claims and sort them. Each land claim is represented by its coordinates (x y). The output must be sorted in **increasing order of x–coordinates**, and where these are equal, in **decreasing order of y–coordinates**.

Example: If claims have come in for the following coordinates

(5 4) (2 3) (5 7) (4 6) (1 2) (2 3) (5 6) (4 4)

then the sorted output is

(1 2) (2 3) (2 3) (4 6) (4 4) (5 7) (5 6) (5 4)

Some claims may be for the same block of land. In these cases, all claims for the same block of land must be included in the output.

Constraints
$1 \leq N \leq 100,000,000$
$1 \leq x_i, y_i \leq 100$
where x_i, y_i are the coordinates of claim $i, 1 \leq i \leq N$

Input for the example
8
5 4
2 3
5 7
4 6
1 2
2 3
5 6
4 4

Output for the Example
1 2
2 3
2 3
4 6
4 4
5 7
5 6
5 4

Input: Your program should read from the file land.txt. The first line of land.txt will contain a single integer, N, which is the number of land claims that have been filed. The next N lines will each contain two integers separated by a space, which are the x and y coordinates (in that order) of each land claim.

Output: Your program should write to the file land.out. Your output should consist of N lines, each of which must contain two integers separated by a space which are the x and y co-ordinates of the sorted land claims.
Time limit: 5 seconds; **MEMORY LIMIT:** 1Mb

Hint Do NOT try to load up all the land claims into memory and sort them – you only have 1Mb of memory, and this won't fit 100,000,000 integers. Rather don't even worry about the big scary 100,000,000: look at the other constraints and come up with something clever.

To Submit:
A report detailing your program and the algorithm used. Include the following in your report:

- Analysis of the running time of your algorithm using experimental methods, i.e. timing your program for variable input sizes and plotting graphs of input size vs. time.
- Any other details that you deem relevant.

For Demonstration:

- An operational program as per the specification in the given question.
- Demonstrate the use and understanding of theory learned from the course
- Any other additional functionality of your program.

Remember **TEST 2: 6 May 2016**