BLG335E, Analysis of Algorithms I, Fall 2013
Project 2
Handed out: 23.10.2013
Due: 12.11.2013, until 11.30 PM

Problem: In this project, you are expected to build a priority queue (PQ). PQ is an abstract data type (ADT) and you will implement it using the heap data structure.

In an online auction website, users can bid for an item and can increase their bids later. In addition, site manager periodically selects the highest bidder and sends him/her the item. After the submission, existing bids (except the winner) are retained and the users continue to bid and increase their bids so they can be the next highest bidder who will receive the next item.

You need to implement a PQ using the heap data structure that supports the following operations: **[30 pts.]**

- New user bids can be added to the heap [INSERT].
- Bids can be updated (only increase is allowed) [INCREASE-KEY].
- Current maximum bid can be removed from the heap by the site manager [EXTRACT-MAX].

You also need to develop a simulation of the auction website with the following features: **[20 pts.]**

- Maximum bid is removed after every 100 bids (new or update).
- Each bid is an update with a probability of **p** and a new bid with a probability of **1-p**.
- If a bid is update, it updates a random bid with an increment of 25%.
- Otherwise, it is new bid and its amount is read from the provided input file.
- Simulation stops after **m** operations (new bid, updated bid or maximum removal)

Your program should run from the command line with the following format:.

./studentID_AoA1_P2 m p

The output should be the bid values of auction winners, number of new bids and updates as well as the total running time in milliseconds.

Detailed Instructions:
- All your code must be written in C++ using object oriented approach and able to compile and run on Linux using g++. It should not require any external libraries including STL.
- Submissions will be done through the Ninova server. You must submit all your program and header files. You must also submit a softcopy report.

- Your report is expected to contain the following:

   1) Explanation of implemented PQ operations and corresponding auction website features with their theoretical running times. **[10 pts.]**

   2) A graph demonstrating the effect of the **m** choice on the running time. You should run the simulation for different values of **m** between 1000 and 100000 for a constant **p** (0.2). **[10 pts.]**

   3) Your detailed comments on the graph in (2). Is the graph as what you have expected? Does it match to the theoretical running times? **[10 pts.]**

   4) A graph demonstrating the effect of the **p** choice on the running time. You should run the simulation for different values of **p** {0.1, 0.2, …, 0.9} for a constant **m** (you should choose an appropriate value for **m**). **[10 pts.]**

   5) Your detailed comments on the graph in (4). Is the running time affected by **p**? Why do you think it is effected or not effected? **[10 pts.]**