Advanced Programming

Middle Term Paper

Start Date: 6/11/2012
Submission deadline: 13/11/2012 (send a single PDF file to attardi@di.unipi.it)

Rules:

The assignment must be produced personally by the student, signed implicitly via his mail address.

You are allowed to discuss with others the general lines of the problems, provided that each student eventually formulates his own solution. Each student is expected to understand and to be able to explain his solution.

You are allowed to consult reference material, provided that references are mentioned.

It is not considered acceptable:

- **to consult or setup an online forum, to request help of consultants in producing the paper**
- to develop code or pseudo-code with others
- to let others use someone's code
- to show or to examine the work of other students.

Violation of these rules will result in the cancellation of the exam and a report to the Presidente del Consiglio di Corso di Studio.

For the programming exercises you can choose a programming language among C++, C# and Java.

Exercise 1

Consider auctions for Pay-Per-Click advertisements. An advertiser wishing to display an ad (a string of less than 95 characters) can offer to pay up to a given price for a keyword. If a query matching the keyword is performed, the ad may be displayed with the query results. If more than one advertiser has bid for the same keyword, the top k with the highest bid are chosen. Each advertiser will be charged 1 cent more than the amount of the bid below it, but only if his ad is clicked. Each bid includes the keyword and the price offered. A campaign by an advertiser consists in a set of bids and a total amount to spend on those bids.

Define suitable classes to represent advertisers, bids, campaigns and stream of queries.

Exercise 2

Implement the auction for advertisement bids: given a stream of queries and a set of campaigns, it must associate up to k ads to each query, charging the appropriate amount to each bidder.

Exercise 3

Extend the bids to allow multiple keywords and revise the auction system accordingly.

Exercise 4

Extend the system to take into account the click-through rate for bids, i.e. the rate between the number of times the ad has been clicked and the number of times the ad has been shown. Revise the auction system so that it will maximize the ad revenue expectation, i.e. the expected price paid for each displayed ad.

Exercise 5

Discuss the advantages and disadvantages of passing parameters by reference and by result. Compare their use to the case of returning values. Describe which languages provide these mechanisms, which syntax they use and how they implement them. In which of these languages, the result can be a function?