Data Structures and Algorithms (INFO-F413)

Jean Cardinal

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Contact

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Registering

Please send an email to jcardin@ulb.ac.be to register and include you in the course mailing list. Prefix your subject line with the course mnemonic [INFO-F413].

Content

References. The course will be mostly based on the following references:

- "*Probability and Computing*", by M. Mitzenmacher and E. Upfal, Cambridge – abbreviated 'MU' in what follows. Available at the statistics library (NO building, Campus Plaine, 9th floor, IST 68J05 MITZ 2005).
- "*Introduction to Algorithms*", by Cormen, Leiserson, Rivest, and Stein, MIT Press – abbreviated 'CLRS' in what follows. The 3rd edition is available at the computer science library (NO building, Campus Plaine, 8th floor, CSL 005.1 CORM2009).
- "*Data Structures and Algorithms in C++/Java*", by M. A. Weiss, Pearson – abbreviated 'W' in what follows. Available at the computer science library (CSL 005.133 C++ WEIS2006 and CSL 005.73 WEIS2007, respectively).

Topics. The primary aim of the course is to exemplify the use of simple mathematical tools for the analysis and improvement of the performance of fundamental algorithms. It will consist essentially of the following material:

Background (CLRS)

- Asymptotics
- Sorting by comparison
- Binary search trees

Randomization (MU)

- Polynomial identity testing (MU Chapter 1)
- Randomized minimum cut (MU Chapter 1 + Bootstrapping techniques)

- Applications of the Harmonic series:
  - The Coupon Collector Problem (MU Chapter 2)
  - A quick analysis of QuickSort (MU Chapter 2)
  - Randomized median computation (MU Chapter 3)

Hashing (MU & CLRS)

- Universal hashing (MU Chapter 13, CLRS)
- Perfect hashing (CLRS)
- Bloom filters (MU Chapter 5)

Amortization (W & CLRS)

- Introductory examples
- The potential method (W)
- Dynamic arrays (CLRS)
- Binomial queues (W)
- Splay trees (W)

Note that this list may be subject to change.

Evaluation

A list of presentation topics involving advanced data structures and analysis techniques will be handed out later in the semester. Students will be asked to choose a topic in the list and:

1. give a 20-minute presentation (**40%** of final grade)
2. write a short report (approx. 5-8 pages) with the following:
   (a) a summary of the studied data structure / algorithm, how it works, the complexity analysis, (**30%**)
   (b) an original implementation of the structure / algorithm **AND/OR** a short experimental study of the behavior of the structure / algorithm based on an original or publicly available implementation. (**30%**)

The evaluation will be based on the understanding and the proper use of the technical material seen in the lectures, as well as on the clarity of the explanations. The source material will consist either of research papers or lecture notes.

Additionally, the evaluation may include bonus points from weekly assignments involving experimenting with implementations of algorithms.

Ethics

Plagiarism will be severely sanctioned. Plagiarism cases include reusing someone else's text or figure, or any kind of work, without explicitly mentioning it. Please refer to the following webpages:
`http://www.bib.ulb.ac.be/fr/aide/eviter-le-plagiat/`
`http://www.plagiarism.org/`.