Online algorithms and competitive analysis

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Timetable: 20 hrs. Class meets on Tuesday and Thursday from 10:00 to 12:00. First lecture on Tuesday, April 9, 2013. Room 318 DEI/G (Dept. of Information Engineering).

Course requirements: The course assumes basic grounding in algorithms and their analysis (one undergraduate course in algorithms and data structures is sufficient).

Examination and grading: Students will be required to form research groups of two or three people; to conduct research on a topic of their choice (ideally related to their doctoral research) in the field of online algorithms; and to present their results in a paper to be submitted to an online algorithms conference or workshop. Grading will be based on the research paper (80%) and on class participation (20%).

Aim: An introduction to online algorithms and competitive analysis.

Course contents:

An online problem is one where at least a partial solution must be produced before the entire input can be processed. A classic example would be to choose whether to accept or decline job offers as they are received: while ideally one would like to see all offers before choosing the "best", in practice one must choose to accept or decline an offer when it is received, without knowledge of future ones. Since an online algorithm does not know the whole input, it is forced to make decisions that may later turn out to be suboptimal. The study of online algorithms focuses on the quality of decision-making that is possible in this setting; competitive analysis formalizes this idea by comparing the relative performance of an online algorithm to the performance obtainable if one had complete knowledge of the input.

1. Introduction: renting skis and dealing with hangovers.

2. Randomized algorithms and adversaries: paging, web caching, and slot machines.

3. Dynamic data structures: online management of lists and trees.

4. Generalizations: the k-server problem and metric task systems.

5. Refinements and practical considerations: paging revisited and the stock market.

6. Ties to other fields: game theory, control theory and operations research.

References:

1. Allan Borodin, Ran El-Yaniv: Online Algorithms and Competitive Analysis, Cambridge University Press, 1999.
2. Selected articles from the literature.