Online Scheduling Problems with Deadlines

—

Design and Analysis of Algorithms

PhD Thesis, Marco Riedel
University of Paderborn

Abstract

In this thesis a scheduling problem with jobs of unit size and individual deadlines is studied. It is motivated by a data server for continuous media streams. The model, called "data access problem", is able to cover a subproblem only: the requests for data packets and a set of distributed storage resources. Such a problem can be described by a bipartite graph and its solution assigns resources to requests, i. e. a matching is calculated in the graph. The model works in an online environment.

To solve online problems algorithms have to take irrevocable decisions without knowing future demands. One method of studying problems of that type is competitive analysis.

In the first chapters competitive analysis is formally defined and explained by examples. Basic properties and proof techniques as well as derived methods of analysis are presented and discussed.

Studies are started with an even more abstract model called the "online request server matching problem". It is a new online variant of a matching problem in bipartite graphs. The tight analysis includes an online algorithm and develops basic proof techniques.

Studies of a generalised problem with weighted edges follow.

The basic online matching problem can be extended by different additional concepts (e. g. requests with interval characteristics, lookahead and block input). These variants are intermediate models on the way to analyse the data access problem. Therefore, the required analysing techniques can be developed step by step.

Algorithms for another model variant are analysed by a computer programme for small problem instances. For that model online algorithms could be improved significantly. The observation of the developing process results in some design rules for online algorithms which should be considered for scheduling problems of that type.

Competitive analysis is applied to all problems studied here and lower as well as upper bounds for the competitive ratio are determined.