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Concerns: Evaluation of doctoral thesis of Tomáš Ebenlendr

Dear prof. Němeček,

please find below my evaluation of the doctoral thesis of Tomáš Ebenlendr, which you have requested in your letter from March 1, 2011. My assessment of the thesis is **absolutely positive**, and in my opinion clearly demonstrates the strong ability of Ebenlendr to perform creative and innovating scientific work.

The topic of the thesis is the competitive analysis of certain classes of machine scheduling problems. In all considered problems the goal is to minimize the maximum job completion time (the so-called makespan), and in all considered problems different machines are running at different speeds (which can be concisely summarized in a speed-vector). The various considered problems differ in certain side-constraints, and in certain pieces of knowledge on the input structure that make the life of the decision-maker easier. The considered problem variants include the case where the sum of all job processing times is known, the case where the largest job processing time is known, the case where the optimal makespan is known (approximately), the case where all job processing times form into a small known interval, and the case where the jobs are presented in decreasing order of processing times. All considered models and problem variants are natural and fundamental, and have been investigated in the literature before. (A decade ago I spent myself considerable time on some of these problems, without being able to settle them.)

The approach in the thesis is very elegant: it provides a unified way of looking at all these problem classes through a linear programming formulation. The central linear program is formulated on page 26 (Definition 2.3.1), then carefully analyzed, and finally modified,

adapted, and streamlined to fit with the respective problem variants. The intellectual main breakthrough is perhaps the idea that such a linear programming approach actually can work out; this might sound easy, but definitely it is not, as lots of smart people have worked in this direction and all failed to get a result.

And then there are lots of results derived through lots of hard work. The hard work consists in analyzing the various linear programs that result from the various program variants. For the main variant (without any side conditions), the linear program allows Ebenlendr to determine the optimal competitive vector for every vector of machine speeds. This is easy to do for every single speed-vector (as it just amounts to solving an LP). The master question is to find the speed-vectors that yield the worst competitive ratios (that is, to identify the most nasty and difficult processing environments). The master question leads to a quadratic program with a bad computational behavior. Ebenlendr does not solve the QP exactly, but investigates it through numerical studies; this yields a lower bound on the worst possible competitve ratio (and it also leaves room for future research).

I already said that there are lots of hard work behind the results, and the hard work is clearly visible in the write-up. It is a mixture of theoretical insights and computational experiments. Some of the results are broken into exactly the right case distinctions. Just slicing up the problem into exactly the right cases needs a lot of good intuition, and for settling the various cases one needs to be in good command ot the mathematical tools.

The writing style of the thesis is very good (though the English is not always perfect), and the presentation is clear. Ebenlendr shows great mathematical maturity in handling the problem under investigation, and the thesis demonstrates an excellent mathematical intuition.

All in all, I consider this an outstanding piece of work that considerably advances the field of scheduling. The thesis contains a wealth of (new) fully determined competitive ratios, and I am convinced that it will become a milestone for our area.

Sincerely,

Gerhard Woeginger