Posudek diplomové práce

Matematicko-fyzikální fakulta Univerzity Karlovy

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Thesis title	Two-phase scheduling with unknown speeds
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Program	Computer Science – Discrete Models and Algorithms

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Review text:

Summary of the thesis

The topic of the thesis is two-phase scheduling in the model with unknown speeds introduced in the paper by Eberle et al. We are given m machines of unknown speeds and n jobs characterized by their processing times (size). In the first phase, an algorithm has to partition the jobs into b bags (b is given) without knowing the machine speeds; in the second phase, the bags are scheduled optimally with makespan objective after the speeds become known. The robustness ratio of the algorithm is the worst-case ratio of the algorithm's makespan to the optimal one (achieved with a priori knowledge of the speeds).

Similarly to the original paper, the thesis studies several variants of the problem and gives the following results.

(1) For infinitesimally small jobs, an optimal algorithm is given for any m and $b \geq m$. This generalizes the optimal ratio of $e/(e-1) \approx 1.58$ for $b = m$ from Eberle et al. Both of these results build on the previously known techniques from online preemptive scheduling. In similar contexts, an optimal algorithm is natural and expected. Still, obtaining it requires some careful work.

(2) For jobs of bounded size (comparing to the average machine load), the thesis achieves an algorithm that has performance close to the optimal ratio for infinitesimally small jobs. This case is new, the obtained bound is elegant and uses good insights.

(3) For unit jobs, the thesis gives an algorithm for $b = m$ with ratio 1.6, improving upon 1.8 from Eberle et al. I value this as the strongest result of the thesis. The ratio is fairly close, perhaps even surprisingly, to the case of infinitesimal jobs.

Technically, this part combines several ingredients. For large n, it applies the previously mentioned bound for jobs of bounded size. For small m and n, the bound is verified by computer simulation of the algorithm on all inputs. In the most interesting case of large m and medium-size n, the solution involves analyzing certain fractional solutions and carefully bounding the rounding errors.

(4) For general jobs, the thesis gives no new results, only reproves the $2 - 1/m$ upper bound from Eberle et al., in the form for general $b \geq m$ (which is also reported in Eberle et al.).

Contribution of the student, presentation, specific comments

The work of the student was very independent. He is the main author of the new results, they were obtained with only a small guidance.

The presentation is reasonable but not perfect. It would benefit from more time spent on polishing and streamlining some of the arguments.

One (minor) drawback is a short overview of the related results. While only one or two papers are directly relevant for the results, there is more literature that could be covered in a more comprehensive introduction.

For the main result, it seems to me that it could be optimized so that fewer cases are examined by the computer simulation. Appendix B shows that the brick surplus is roughly linear in $\lambda = m/n$, while the proof uses only a constant lower bound for $\lambda \geq 4$. If the linear upper bound is used instead, the number of examined cases should decrease by an order of magnitude.

Overall evaluation

I consider this to be a very good thesis, containing new publishable results. It made a good progress on an interesting problem.

I recommend the thesis for defense.

I suggest to not consider the thesis for the annual award.

Feb 5, 2024

Signature: