Institut for Matematik og Datalogi
Syddansk Universitet

May 1, 2019
JFB

# On-Line Algorithms – F19 – Lecture 16

## Announcement

Please note that IMADA has opened positions as instructor for the fall of 2019, see 'ledige stillinger SDU instruktorater' on the Web as well as posters around IMADA. Everyone interested should consider applying! Being instructor and having the responsibility to explain the solution of a problem to fellow students is a very good way of increasing your own understanding. This does not only apply to the stuff you are instructor in: when you have to explain your solution to others you become better at identifying the core of a problem and that helps you become a better student also in other courses. The deadline is short, May 12, so please apply soon. If you are in doubt whether you are suitable, or have any other questions about this, you are very welcome to talk to Kristian Debrabant (mathematics) or Jørgen Bang-Jensen (Computer Science) about it.

## Lecture, April 29–May 1

We continued with the article on bin packing with advice, finishing Theorem 4 and covering up through Lemma 9 in section 5.

## Lecture, May 6

We will finish section 5 of the article on bin packing with advice, including a brief review of (introduction to) reductions. We will then start on the article "The Advice Complexity of a Class of Hard Online Problems", Joan Boyar, Lene M. Favrholdt, Christian Kudahl, Jesper W. Mikkelsen. *Theory of Computing Systems*, 61(4): 1128-1177, 2017. The publication is available through the course's homepage.

## Lecture, May 14

We will continue with the article on the advice complexity of a class of hard online problems.

## Problems for May 7

1. The first problems are from a previous note.

2. For makespan in the identical machines case, where might advice be useful? (Note, this is a vague, open sort of question.)

3. Suppose you have a randomized algorithm for a problem, $X$, which chooses using a uniform distribution between 8 deterministic algorithms for $X$, and achieves a competitive ratio of 2. Can you define a good deterministic algorithm with advice for $X$? Can you say something in general about the relationship between mixed algorithms and advice complexity?

4. For the ski rental problem (see the slides), what is the competitive ratio of the randomized algorithm that on a request (whenever it hasn't yet bought the equipment) decides to buy with probability $p$ and to rent with probability $1-p$? (It will be a function of $p$ and the cost of buying, $d$.)

5. Work out the advice string for optimality for paging, with $k=5$, for the following request sequences: $\langle 1,2,3,4,5,6,1,2,3,4,5,6,1,2,3,4,5,6\rangle$, $\langle 1,2,3,4,5,6,5,4,3,2,1,2,3,4,5,6\rangle$. When $N=k+1$, less advice is sufficient. What?

6. Consider the lower bound proof in Theorem 1 of the article "Online Bin Packing with Advice", with $n=5$ and $k=2$. Which sequences are produced, and how much advice is needed? Are there other sequences one could have included to increase the amount of advice needed?

7. Consider the online algorithm with advice in Theorem 4 of "Online Bin Packing with Advice". What does a bad sequence look like when some critical bin only has one item? What does a bad sequence look like when all critical bins have more than one item?

8. Go through the reduction from 2-SGKH to Binary Separation with the string $\langle 0, 1, 0, 0 \rangle$ as input. Suppose you want to produce values in the range $[1/2, 5/8]$. You may assume that your algorithm for guessing "large" or "small" for Binary Separation alternates, starting with "large".

9. Go through the reduction from Binary Separation to Bin Packing with the sizes $\langle \frac{7}{16}, (S, \frac{15}{32}), (L, \frac{29}{64}), (S, \frac{59}{128}), S \rangle$ as input. Let $\varepsilon = \frac{1}{256}$. You may assume that your algorithm for Bin Packing is First-Fit.