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Second Assignment
Selected Topics in Efficient Algorithms

To be returned in the lectures on November 20th, 2007.

Exercise 1: Consider the paging problem. Assume that the size of the fast memory is h for the optimal offline algorithm but k for the online algorithm ($h \leq k$). Here the online algorithm has some advantage in terms of additional memory.

1. Show that for every deterministic c-competitive online algorithm $c \geq \frac{k}{k-h+1}$ holds.
2. Show that FIFO achieves a competitive ratio of $\frac{k}{k-h+1}$.

Exercise 2: Assume you are standing on the ground level of a stairway with n steps. In every round you can either go *one* step up (if you are not on top yet) or go down *all* steps. Stepping one step up or down takes you one unit of time. Answer the following two questions and prove the correctness of answer two via a potential function argument.

1. What is the largest possible time needed for one round?
2. How much time do you need amortized to run through a sequence of k rounds beginning on the ground level of the stairway?

Exercise 3: In the lectures three kinds of adversaries were defined. Show informally, that for any algorithm ALG it holds

$$\overline{R}_{\text{oblivious}}(\text{ALG}) \leq \overline{R}_{\text{adaptive online}}(\text{ALG}) \leq \overline{R}_{\text{adaptive offline}}(\text{ALG})$$

where $\overline{R}_{\text{ADV}}(\text{ALG})$ is the infimum over all numbers c such that ALG is c-competitive against the adversary ADV.

Exercise 4: Transform the word `argara` via the Burrows-Wheeler transformation and re-transform it again. Do this in a fashion that your proceeding is traceable. Give a pseudocode implementation for the *re*transformation of Burrows-Wheeler.

Please visit the following link frequently for ongoing information:
`http://www.informatik.uni-freiburg.de/~ipr/ipr_teaching/ws07_08/selected_topics.html`