ADM III: Online Optimierung, WS 2013/2014
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Problemsheet 1

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The elevator problem is informally described as follows. We have a building of f different floors $F = \{0, \dots, f-1\}$, and an elevator e that starts on floor f_0 at time $t_0 = 0$. There are n passengers, and each passenger i presses the elevator button at some time t_i in floor a_i with the intention of going to floor b_i (we assume b_i to be known already at time t_i). Of course, at every time the elevator is only aware of the passengers that have pressed a button previously.

Let f_t be the floor the elevator is at at time $t \in \mathbb{N}$. At time t, the elevator takes each of the following actions in order:

1. pick up all passengers i on floor f_t with $t_i \leq t$
2. deliver all passengers i with $b_i = f_t$ that were picked up previously
3. move one floor up or down (if possible), or stay at floor f_t, i.e. $f_{t+1} \in \{f_t - 1, f_t, f_t + 1\} \cap F$.

The objective is to deliver all passengers as quickly as possible, and to return to floor f_0 afterwards.

Exercise 1. Formulate the elevator problem formally as a request answer game. Your formulation should allow simultaneous button presses.
*Note: You do **not** need to use this formulation in the exercises below!*

Exercise 2. Show that no deterministic algorithm for the elevator problem has competitive ratio smaller 2 if the elevator does not need to return to f_0.

Exercise 3. Give a deterministic algorithm for the elevator problem with constant competitive ratio as close to 2 as possible (and prove this ratio for your algorithm).