Algorithms and Complexity
2015
Extra Mästarprov 1: Algorithms

This test is given to students who failed to get E on the ordinary Mästarprov 1. It consists of two problems. If both problems are solved correctly (basically) the test gives grade E. Your solutions should be handed in latest May 26th.

1. Fixpoints in sequences
Given a sorted array of distinct integers $A[1, ..., n]$, we say that a fix point is an index i such that $A[i] = i$. Of course, there doesn't have to be any fix points in a sequence. Design a divide-and-conquer algorithm that runs in time $O(\log n)$ and decides if there are any fix points in the sequence. The algorithm doesn't have to find all fix points, just decide if there are any fix points. Prove that the time complexity is correct.

2. Study planning
A student has a number of subjects to study. She has N days to do it. Let us number the days $1, 2, ..., N$. Every day she has K hours left for her studies. For each subject i there is an number t_i of hours needed to master the subject. For each subject there is a deadline d_i such that $1 \leq d_i \leq N$. To be precise, the task should be completed at the end of the day. Is it possible for her to plan her studies so that no deadline is exceeded? How should the studies be planned? We are allowed to split the studies on several different days. Find a greedy algorithm that tells her which subjects to study each day.