CS3001, Algorithm Design and Analysis
Tutorial 4
Coursework Questions

16. Suppose a pattern for string matching is input slowly one character at a time (for example via a keyboard). We want to do the pattern matching simultaneously as far as possible. (`emacs` provides such an incremental search feature.)
In other words: Immediately after the k-th character is input we want to find (while the next character is typed) the first place in the text matching the first k characters.
Modify the KMP algorithm accordingly. (4 Points)

17. Let A be an algorithm that finds the k-th largest of n elements using a sequence of element comparisons. Prove that A collects enough information to determine which elements are larger than the k-th largest and which elements are smaller (without having to do more comparisons). (4 Points)

18. a) Extend the sequence comparison algorithm to return not only the cost matrix C but also to print out an optimal sequence of editing steps. Give an explicit algorithm in (Pseudo-)code. (4 Points)
b) Apply the algorithm to find the minimal edit steps to change 'APPLE MACINTOSH' into (its anagram) 'LAPTOP MACHINES'. (2 Points)

19. Consider the following *bottleneck* problem: The input is a bipartite graph $G = (V, E)$, $|V| = n$, $|E| = m$ with weights $w(e)$ attached to all edges. The *bottleneck weight* of a matching M is defined as the weight of the maximum weight edge in M.
Design an algorithm to find among all the maximum matchings in G the matching with the smallest bottleneck weight. (A description in informal terms is sufficient. You do not need to give pseudo code.) You may assume that the edges are sorted with respect to their weight. The algorithm should run in time $O\left(\sqrt{n}(n+m)\log m\right)$. (Show that this holds!)
Hints: You may use known algorithms as building blocks: If you remove all edges of weight bigger than x and search for a maximum matching in the remaining graph (this search takes time $O\left(\sqrt{|V|}(|V|+|E|)\right)$ using the improved algorithm) you can test whether a matching with bottleneck weight less than x exists. (6 Points)

Hand in solutions by Tuesday, December 1st, 10am, to me or the Comp.Sci. Secretaries.