34 (100 PTS.) Multiple Choice Practice

The following problems are multiple choice. Each question has a *single* answer. Make the best possible choice if multiple options seem correct to you — for algorithms, faster is always better.

Note that this homework will NOT be collected or graded, however we will release the solutions. More examples of multiple choice questions like these can be found in the study section materials for the final exam.

34.A. (3 points)
Given a DFA N and an NFA M with n and m states, respectively. Then there is a DFA M' that accepts the language $L(N) \setminus L(M)$.

(A) True, and the number of states of M is at most $n2^m$.
(B) True, and the number of states of M is at most nm.
(C) True, and the number of states of M is at most $2^n 2^m$, and no other answer applies.
(D) False.
(E) True, and the number of states of M is at most $(m+n)2^{(m+n)/2}$.

34.B. (3 points)
Let $L_1, L_2 \subseteq \Sigma^*$ be context-free languages. Then the language $L_1 \cap L_2$ is always context-free.

(A) None of the other answers.
(B) False if the languages L_1 and L_2 are decidable, , and no other answer is correct.
(C) True only if the languages L_1 and L_2 are decidable, and no other answer is correct.
(D) True.
(E) False.

34.C. (3 points)
Given an undirected graph G with n vertices and m edges, and a number k, deciding if G has a spanning tree with maximum degree k is

(A) Can be done in polynomial time.
(B) Can be done in $O((n+m)\log n)$ time, and there is no faster algorithm.
(C) Can be done in $O(n \log n + m)$ time, and there is no faster algorithm.
(D) NP-Complete.
(E) Can be done in $O(n+m)$ time.

34.D. (2 points)

You are given a set $\mathcal{I} = \{I_1, I_2, \ldots, I_n\}$ of n weighted intervals on the real line. Consider the problem of computing a value $x \in \mathbb{R}$, that maximizes the total weight of the intervals of $\mathcal{I}$ containing x. This problem:

(A) Can be done in polynomial time.

(B) Undecidable.

(C) NP-Complete.

(D) Can be done in linear time.

(E) NP-Hard.

34.E. (3 points)

Consider the problem of checking if a graph has k vertices that are all adjacent to each other. This problem can be solved in

(A) It is NP-Complete, so it can not be solved efficiently.

(B) Polynomial time.

(C) None of the other answers are correct.

(D) Maybe polynomial time – we do not know. Currently fastest algorithm known takes exponential time.

34.F. (2 points)

Consider a Turing machine (i.e., program) M that accepts an input $w \in \Sigma^*$ if and only if there is a CFG G such that $w \in L(G)$. Then the language of $L(M)$ is

(A) context-free.

(B) Σ^*.

(C) finite.

(D) undecidable.

(E) not well defined.