Section 7.2: The Class P

These exercises reflect material from our text, *Introduction to the Theory of Computation*, by Michael Sipser, PWS Publishing Co., 1997, as well as *Introduction to Algorithms*, by Cormen, Leiserson, and Rivest, MIT Press, 1990.

Basic Concepts

Define the following concepts:

(a) P

(b) A language L

The Class P

(CLR 36.1-5) Suppose that there exists a TM, M, which can accept any string, x, in a language L, but the machine M runs in superpolynomial time if $x \notin L$. Argue that L can be decided in polynomial time.

(CLR Theorem 36.2) Show that $P = \{L : L \text{ is } \underline{\text{accepted}} \text{ by a polynomial} - \text{time algorithm}\}$.

(CLR 36.1-3) Give a formal encoding of directed graphs as binary strings using an adjacency-matrix representation. Do the same thing using an adjacency-list representation. Argue that the two representations are polynomially related.

(CLR 36.1-6) Show that an algorithm that makes at most a constant number of calls to polynomial-time subroutines runs in polynomial time, but that making a polynomial number of calls to polynomial-time subroutines may result in an exponential-time algorithm.

(CLR 36.1-7) Show that the class P, viewed as a set of languages, is closed under union, intersection, concatenation, complement, and Kleene star.