CSc 220: Algorithms
Homework 10
Due in Class on Tuesday December 1

Return the homework written on sheet(s) of paper with your name and CSc220 written at the top of each sheet. Please staple multiple sheets together. Remember that collaboration is allowed, but that you must write the solution on your own. Also you must acknowledge all collaborators and all sources (other than the textbook) in your solutions. Each problem is worth 10 points.

Problem 1: Given a polynomial $P(x)$ of degree $n$ and a value $a$, show how to divide $P(x)$ by $(x - a)$ in $\Theta(n)$ time. In other words you must compute polynomial $Q(X)$ of degree $n - 1$ and value $r$ such that

$$P(x) = Q(x) \cdot (x - a) + r$$

How can you use the above algorithm to compute the value $P(a)$?

Problem 2: Given a sequence of values $a_1, \ldots, a_n$ give an algorithm that finds the coefficients of the polynomial $P(x)$ of degree $n$ such that $P(x) = 0$ if and only if $x = a_i$ for some $i$. You can assume the elements $a_i$ are distinct. Your algorithm should run in time $O(n \log^2 n)$.

Problem 3: Given two patterns $P$ and $P'$ you want an algorithm that determines where $P$ or $P'$ appears in a given text $T$. Builds a finite automaton that enters an accepting state only in the above situation. Try to make your automaton as simpler as possible (meaning your score will depends on how small the automaton is).