1. Suppose I have a binary pattern $P$ which is $n \times n \times n$ and a text $T$ which is $m \times m \times m$, and I want to find all occurrences of $P$ in $T$. Show how to solve this problem in $O(m^3)$ time, assuming operations on $O(\log(m))$ bit primes take constant time.

2. Consider the problem of finding the occurrences of any of a given set of $k$ patterns $P_1, P_2, \ldots, P_k$ in a text $T$. You may assume that the size of any pattern is $m$, and the size of $T$ is $n$. Your algorithm should use expected time $O(n + mk)$.

3. Recall in the fingerprinting lecture that we discussed the string equality problem. In this problem, Alice has a string $x \in \{0, 1\}^n$ and would like to send a message $M$ to Bob, who holds a string $y \in \{0, 1\}^n$. Bob should be able to figure out if $x = y$ with probability at least $1 - \delta$.

   (a) Recall in class that we gave a few bounds on the length of the message $M$ required to solve this problem, as a function of $n$ and $\delta$. Please state the best bound that we gave in class. Using $\Theta(\cdot)$ notation is fine.

   (b) If we want $\delta = 1/(10n)$, what does your bound in the previous part simplify to?

   (c) Now suppose Bob actually has $n$ strings $y^1, y^2, \ldots, y^n$, where each $y^i \in \{0, 1\}^n$, and would like to check if $x = y^i$ for each $i = 1, 2, \ldots, n$. Argue that if $\delta = 1/(10n)$, then Bob will succeed on all of the $n$ checks simultaneously, with error probability at most $1/10$. The union bound $\Pr[A \text{ or } B] \leq \Pr[A] + \Pr[B]$ may be useful.