This homework is due by 5pm on Thursday Mar 13th. Please hand it to the CS174 homework box on the second floor of Soda Hall.

1. Use Chernoff to bound the probability of more than $0.6n$ heads in $n$ coin tosses.

2. Consider a collection $X_1, \ldots, X_n$ of $n$ independent geometrically distributed random variables with mean 2. Let $X = \sum_{i=1}^{n} X_i$ and $\delta > 0$.

   (a) Derive a bound on $\Pr(X \geq (1 + \delta)(2n))$ by applying a Chernoff bound to a sequence of $(1 + \delta)(2n)$ fair coin tosses.

   (b) Directly derive a Chernoff bound on $\Pr(X \geq (1 + \delta)(2n))$ using the moment generating function for geometric random variables.

   (c) Which bound is better?

3. Let $M$ be an $n$-dimensional hypercube parallel computer. Let $a$ and $b$ be two paths in the hypercube graph from random start points to random end points. Give an upper bound on the probability that packets that start at the same time step and move along $a$ and $b$ will collide. For this problem, a collision occurs if the two packets arrive at the same CPU at the same time.

4. Suppose we have $n$ jobs to distribute among $m$ processors. For simplicity, we assume that $m$ divides $n$. A job takes 1 step with probability $p$ and $k > 1$ steps with probability $1 - p$. Use Chernoff bounds to determine upper and lower bounds (that hold with high probability) on when all jobs will be completed if we randomly assign exactly $n/m$ jobs to each processor.