CSC 226 FALL 2020
ALGORITHMS AND DATA STRUCTURES II
ASSIGNMENT 2
UNIVERSITY OF VICTORIA

1. Consider the experiment of tossing a fair coin four times.
   a) What is sample space associated with this experiment? Label a heads H and a tails T.
   b) Let A be the event that heads are flipped first. What is $Pr(A)$?
   c) Let B be the event that exactly two heads and two tails are flipped (in any order).What is $Pr(B)$?
   d) Let A and B be as defined above, what is $Pr(A \cap B)$?
   e) Let X be the number of heads flipped. What is the expected value of X?

2. A coin has $1/4$ chance of having heads, $3/4$ chance of having tails. It is tossed n times.
   a) What is the expected number of coin tosses needed to get a heads?
   b) What is the probability that the number of heads equals the number of tails? Write the expression using $\binom{n}{x}$ notation.

3. If we change the randomized QUICKSORT algorithm so that it repeatedly randomly selects a pivot and runs PARTITION until it finds a good pivot, and suppose we keep track of the pivots used so far so we never use one twice for the same array, what is the worst case cost of the algorithm? Give a recurrence for this and its asymptotic solution (you can use the master method.)

4. Draw the 11-item hash table resulting from hashing the keys 12, 44, 13, 88, 23, 94, 11, 39, 20, 16, and 5, using hash function $h(k) = (2k+5) \bmod 11$, assuming collisions are handled by each of the following:
   a) Separate chaining.
   b) Linear probing.
   c) Quadratic probing up to the point where the method fails because no empty slot is found.
   d) Double hashing using the secondary hash function $h'(k) = 7 - (k \bmod 7)$.

5. Professor Marley hypothesizes that he can obtain substantial performance gains by modifying the chaining scheme to keep each list in sorted order. How does the professor's modification affect the running time for successful searches, unsuccessful searches, insertions, and deletions?