CS 692: Data Structures and Algorithms Capstone Exam, Spring 2022.
Choose any 2 of the 3 problems.

Full name: _____   Net ID:_____

Question 1) (10 points each)
Consider the following recurrence relations and solve them to come up with a precise function of n in closed form (that means you should resolve all sigmas, recursive calls of the function, etc. An asymptotic answer is not acceptable here). Justify your solution and show all your work.

   a) $T(n) = 2T(n/2) + 7n$ where $T(1) = 1$ and $n = 2^k$ for a non-negative integer k.

   b) For each function f(n) below, give an asymptotic upper bound using "Big-Oh". Choose from the

following list (the list has no particular order):

      $O(n^3)$, $O(n \log n)$, $O(n)$, $O(2^n)$, $O(1)$, $O(n)$, $O(\log n)$, $O(n \log \log n)$, $O(\log^3 n)$, $O(n^3 \log n)$,
      $O(n^n)$, $O(n!)$, $O(n \log n)$, $O(n^2)$, $O(\log \log \log n)$

You should give the tightest bound possible. No need to justify your answer.

    a) $f(n) = \log (7n^3) + 16$
    b) $f(n) = 2^n + 10n^4 + 100$
    c) $f(n) = n^2 + n \log n$

    d) $f(n) = \begin{cases} n^6 F 2 J, & J Q12 \\ 3 J + 5, & J > 12 = J @ E @ \end{cases}$ a singly linked list. Declare the data structure code for the following operations:
        a) empty_check