

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). A, etc 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 $J = 2^k$ for a non-negative integer k .
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):

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

You should give the tightest bound possible. You need to justify your answer.

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

- d) $f(n) = \begin{cases} 3n + 5, & n < 12 \\ n^2, & n > 12 \end{cases}$
code for the following operations:
a) empty_check

a singly linked list. Declare the data structure