

Exam 1 (100pts)

Name _____

1. (10 pts) Using the master theorem find the runtime complexity of $T(n) = 2T(n/4) + 1$ 2. (30 pts) Given the runtime, $f(n) = n^3 + n^2 + n + 1$ show that

a. $f(n) = \mathcal{O}(n^4)$

b. $f(n) = \Theta(n^3)$

c. $f(n) = \Omega(n^2)$

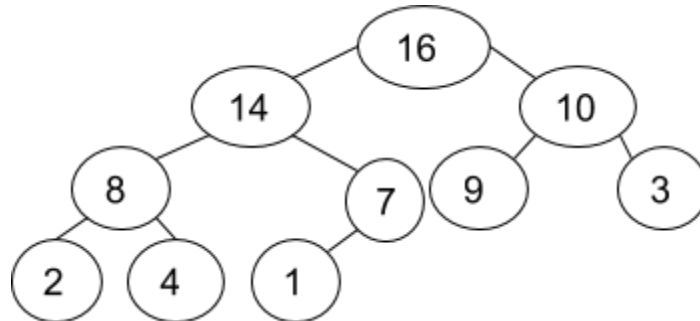
3. (10 pts) Using the substitution method show that $T(n) = 2T(\lfloor n/2 \rfloor) + n$ is in $T(n) = \mathcal{O}(n \lg n)$.4. (10 pts) Solve for the runtime complexity using a recursion tree or backward substitution $T(n) = T(n-1) + n$ with $T(0) = 0$. Note that,

$$\sum_{i=0}^n 1 = n$$

and

$$\sum_{i=0}^n i = \frac{1}{2}n(n+1)$$

5. (15 pts) Given the max heap



- Explain why this is a max heap and not just a binary tree or a min heap?
- If we remove the root node show/draw how we restore the heap (Heapification).
- What is the height of the tree?

6. (10 pts.) Given $A = (2, 8, 7, 1, 3, 5, 6, 4)$ and using the last element as the pivot. Show how the partitioning function from quicksort works. ONLY DO ONE PARTITION.

7. (15 pts.)

- Is bubble sort a stable sorting algorithm? Why or why not?
- Is heapsort a stable sorting algorithm? Why or why not?
- Is bubble sort an in-place sorting algorithm? Why or why not?