Karl Revale

CSCI104 Written Homework #1

Problem 1: Runtime Analysis

a) $\theta(log(logn))$

i) i starts at 2 $\rightarrow i^2 \rightarrow i_k = 2^{2^k}$

ii) Stops when $i_k \geq n = 2^{2^k} \geq n \rightarrow k \geq log_2 log_2 n$

iii) $T(n) = \sum_{k=0}^{log_2 log_2 n - 1} \theta(1)$

iv) $T(n) = \theta(log(logn))$

b) $\theta(n^{\frac{7}{2}})$

i) $T(n) = \sum_{i=1}^{n} (i \% \sqrt{n} = 0 \sum_{k=0}^{i^3 - 1} \theta(1))$

ii) $\sum_{j=1}^{\sqrt{n}} \sum_{k=0}^{(j\sqrt{n})^3 - 1} \theta(1) = \sum_{j=1}^{\sqrt{n}} (j\sqrt{n})^3 = \theta(n^{\frac{7}{2}})$

c) $\theta(n^2 logn)$

i) $T(n) = \sum_{i=1}^{n} \sum_{k=1}^{n} 1 \sum_{m=1}^{log_2 n} 1$

ii) $\sum_{i=1}^{n} \sum_{k=1}^{n} 1 = n^2 \rightarrow T(n) = n^2 logn = \theta(n^2 logn)$

d) $\theta(n)$

i) size = 10 $\rightarrow$ 15 $\rightarrow$ 22.5 (22) $\rightarrow$ 33.75 (33) $\rightarrow$ (49) … $10 \cdot \frac{3}{2}^x$

ii) If statement runs for increments of i < n divisible by size (which increases exponentially until reaching n) $\rightarrow 10(\frac{3}{2})^x \leq n \rightarrow x \leq log_{\frac{3}{2}}(\frac{n}{10})$ (add +1 for i=10)

iii) $T(n) = \sum_{i=0}^{n} \theta(1) + \sum_{k=0}^{log_{\frac{3}{2}}(\frac{n}{10})} (1 + \sum_{j=0}^{10(\frac{3}{2})^i} 1) = \sum_{k=0}^{log_{\frac{3}{2}}(\frac{n}{10})} 10(\frac{3}{2})^k \rightarrow$ geometric series

iv) $T(n) = \theta(n) + \theta(10(\frac{3}{2})^{log_{\frac{3}{2}}(\frac{n}{10})}) = \theta(n) + \theta(n)$

Problem 2: Linked List Recursion Tracing

a) 1, 5, 2, 6, 3, 4

i) Iteration 1: run llrec(1,5) → 1,

ii) Iteration 2 (1->next): run llrec(5,2) → 1, 5

iii) Iteration 3 (5->next): run llrec(2,6) → 1, 5, 2

iv) Iteration 4 (2->next): run llrec(6,3) → 1, 5, 2, 6

v) Iteration 5 (6->next): run llrec(3,null) → 1, 5, 2, 6, 3

vi) Iteration 6: returns 3 (in2 is null), 3's next is unmodified as 4 → 1, 5, 2, 6, 3, 4

b) 2

i) First if statement is triggered, with in1 being null. Since in2 is equal to 2, "2" is returned.