Hw 1

Part A

$$\sum_{i=0}^{n} O(1)$$

$$2^{\log_2 n}$$

$$\log_2(\log_2 n)$$

$$O(\log_2 \log_2 n)$$

$i=2$
$i=4$
$i=16$
$i=256$
$i=2^{2^n}$

Part B

$$\sum_{0}^{\sqrt{n}} \sum_{0}^{i^3} O(1)$$

$i \% \sqrt{n} == 0$

$n=9$

$i=1$ x
$i=2$ x
$i=3$ ✓
$i=4$ x
$i=5$ x
$i=6$ ✓
$i=7$ x
$i=8$ x
$i=9$ ✓

$n=4$

$i=1 \quad 1 \% \sqrt{4} \neq 0$
$i=2 \quad 2 \% \sqrt{4} = 0$ ✓
$i=3 \quad 3 \% \sqrt{4} \neq 0$
$i=4 \quad 4 \% \sqrt{4} = 0$ ✓

if statement runs $\sqrt{n}$ # of times

$i=2$

inner loop runs till $2^3 = 8$

$i=4$ inner loop runs till $4^3 = 64$

$$\sum_{0}^{\sqrt{n}} \sum_{0}^{i^3} O(1) \to \sum_{0}^{\sqrt{n}} O(i^3)$$

$$\sum_{0}^{\sqrt{n}} O(j\sqrt{n})^3$$

$$\sum_{0}^{\sqrt{n}} O(j^3 n^{3/2})$$

inner loop only runs on multiples of $\sqrt{n}$ so $i = j\sqrt{n}$

$$n^{3/2} \sum_{0}^{\sqrt{n}} i^3 = \left(\frac{\sqrt{n}(\sqrt{n}+1)}{2}\right)^2 = O(\sqrt{n}^4)$$

$O(n^{3/2} \cdot n^2)$

$O(n^{7/2})$

Part C

$$\sum_{1}^{n} \sum_{1}^{n} \sum_{1}^{\log n} O(1)$$

$$\sum_{1}^{n} \sum_{1}^{n} O(\log n)$$

$$\sum_{1}^{n} O(n \cdot \log n)$$

$$O(n^2 \cdot \log n)$$

m	= m+m
1	1+1=2
2	2+2=4
4	4+4=8
8	8+8=16
⋮	⋮
	2^n

Part D

adding to 1 → $\sum_{0}^{n} O(1) + \sum_{0}^{size} O(1)$

$O(n) + \sum_{0}^{\log_{1.5}(n)} O$

size$_1$ = 10 — 10

3(10)/2 — 15

size$_2$ 15 — 22

3(15)/2 — 33

size increases by roughly 1.5 so ↳ $\log_{1.5}(n)$

≈22

3(22)/2

66/2 = 33

when copying into bigger array the number of times it is ran is about $O(n)$ because the largest term is n.

size = n

$$O(n) + \sum_{0}^{n} O(1) = O(n) + O(n) =$$

$$O(n)$$

Linked List Recursion Tracing

question a

llrec

Lists in1 = 1, 2, 3, 4 in2 = 5, 6

llrec(1, 5) 1 next -> (5, 2) returns 1	->	llrec(5, 2) 5 -> (2, 6) returns 5	->	llrec(2, 6) 2 -> (6, 3) returns 2

-> | llrec(6, 3)
6 -> (3, null)
return 6 | -> | llrec(3, null)
return 3 |
|---|---|---|

Each value as we recurse up is prepended

llrec returns 1 -> 5 - 2 - 6 - 3

question B

in1 = nullptr in2 = 2

llrec(nullptr, 2) return 2

-> returns 2