CSCI 104 Written HW#1

Problem 1.

(a) The while loop is $i < n$ w $i = 2$, $i = i \times i$

Follows the pattern $i = 2^{2^k}$

terminates when $2^{2^k} \geq n$

$\therefore 2^k = \log n$

so $k \geq \log_2(\log_2(n))$

Hence no. of iterations is $\boxed{\Theta(\log \log n)}$

(b) Outer loop runs n times

Approximately $n/\sqrt{n} = \sqrt{n}$ values of i satisfying the cond.

For each i, loop runs i^3 times.

Since $1^3 + 2^3 + \cdots k^3 = \Theta(k^4)$

Total work $= n^{(3/2)} \cdot \Theta((\sqrt{n})^4)$

$= n^{3/2} \cdot \Theta(n^2) = \boxed{\Theta(n^{7/2})}$

(c) Triple nested $n \times n \times \log n$ in worst case.

But each $A[k]$ matches atmost one i value.

Total inner loop executions $= n \times \log n$.

$\therefore \boxed{\Theta(n \log n)}$

(d) Array grows $10 \rightarrow 15 \rightarrow 22 \rightarrow \cdots$ (factor of 3/2)

main loop: n iterations $= \Theta(n)$

Hence total: $\boxed{\Theta(n)}$

Problem 2:

(a) llvec(in1 = 1→2→3→4→null, in2 = 5→6→null)

Step by step trace:

1. llvec(1→2→3→4, 5→6)
   - Both non-null, so 1→next = llvec(5→6, 2→3→4)

2. llvec(5→6, 2→3→4)
   - Both non-null so 5→next = llvec(2→3→4, 6→null)

3. llvec(2→3→4, 6→null)
   - Both non-null, so 2→next = lvec(6→null, 3→4→null)

4. llvec(6→null, 3→4→null)
   - Both non-null, so 6→next = lvec(3→4→null, null)

5. llvec(3→4→null, null)
   - in2 is null, so return 3→4→null

Working backwards:
- Step 4: 6→next = 3→4, so 6→3→4
- Step 3: 2→next = 6→3→4 so 2→6→3→4
- Step 2: 5→next = 2→6→3→4 so 5→2→6→3→4
- Step 1: 1→next so 1→5→2→6→3→4

Merge ans = **1→5→2→6→3→4→null**

(b) Step by step traces:

1. llvec (null, 2→null)
   - in1 == null, so return in 2

Ans: 2→null

(Base case - when 1st parameter is null, return the second parameter unchanged)