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/*
* NAME: Megan Chu
* ID: A12814536
* LOGIN: cs12waot
*/
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1. Answer: Running time is O(n)

Explanation: There is one instruction in the first line that executes once. There is one instruction in the loop header that executes (100n + 1) + 1 times (including the last loop check). There is 1 instruction in the body of the loop that executes 100n + 1 times. The total of the run times is:

(1) + ((100n + 1) + 1) + (100n + 1)
= 1 + 2(100n + 1) + 1
= 200n + 4
= O(n)

2. Answer: Running time is O(n^3)

Explanation: There is one instruction in the first line that executes once. There is one instruction in the loop header that executes ((n^3)/4 + 1) times (including the last loop check). There is 1 instruction in the body of the loop that executes ((n^3)/4) times. The total of the runtimes is:

(1) + ((n^3)/4 + 1) + ((n^3)/4)
= 1 + 2((n^3)/4) + 1
= (n^3)/2 + 4
= O(n^3)

3. Answer: Running time is O(logn)

Explanation: There is one instruction in the first line that executes once. There is one instruction in the loop header that executes (logn + 1) + 1 (base 2) times (including the last loop check). There is 1 instruction in the body of the loop that executes logn + 1 times. The total of the runtimes is:

(1) + (logn + 1) + 1 + (logn + 1)
= 1 + 2(logn + 1) + 1
= 2logn + 4
= O(logn)

4. Answer: Running time is O(1)

Explanation: There is one instruction in the first line that executes once. There is one instruction in the loop header that executes 100 + 1 times (including the last loop check). There is 1 loop in the body of the first loop that executes log1000 + 1 times (including last check) instruction in the body of the loop that executes log1000 times.
The total of the runtimes is:

1 + (100 + 1) + (log1000 + 1) + log1000
= 1 + 101 + 2log1000 + 1
= 103 + 2log1000
= O(1)

5. Answer: Running time is O(n^2)

Explanation: There is one instruction in the first line that executes once. There is one instruction in the first loop header that executes n + 1 times (including the last loop check). There is 1 instruction in the second loop in the body of the first loop that executes 1 + 2 + 3 + 4 + ... + n times with for each different loop the first loop loops. If n = 10, the second loop would have looped a total of 1 + 2 + ... + 10 = 55 times. The average times that the second loop loops each time would be 55/10, which is 5.5 = (11/2) = (10+1)/2 We can say that the runtime of the second loop is O((n+1)/2), for each time the first loop loops. The body of the second for loop therefore also has run time O((n+1)/2). Combining the runtimes of the two loops, we have:

n((n + 1)/2)
= (n^2 + n)/2
= O(n^2 + n)
= O(n^2)

6. Answer: Running time is O(nlogn)

Explanation: There is one instruction in the first line that executes once. There is one instruction in the loop header that executes logn + 1 (base 2) times (including the last loop check). There is 1 instruction in the second loop in the body of the first loop that executes (n/4 + 1) + 1 times including the last loop check each time the outer loop loops. The body of the inner loop executes (n/4 + 1) times each time the outer loop loops. The total of the runtimes is:

O(1 + (logn + 1)((n/4 + 1) + 1) + (logn + 1)(n/4 + 1))
= O((logn)(n/4) + (logn)(n/4))
= O(2(logn)(n))
= O(nlogn)

7. Answer: Running time is O(n^3)

Explanation: There is one instruction in the firstloop header that executes 2n + 1 times (including the last loop check). There is 1 instruction in the second loop that executes (n^2 + 1) + 1 times (including last loop check). The loop in the second loop executes (n + 1) + 1 times (including last loop check). The runtime of the second loop and nested loop body is O(((n^2 + 1) + 1)((n + 1) + 1)). We can simplify this to O((n^2)(n)) or O(n^3). Combining the runtimes with the first loop, we have O((2n + 1) + n^3), which simplifies to O(n^3).

8. Answer: Running time is O(n^3)

Explanation: There is one instruction in the first line that executes one time. There is an instruction in the first loop header that executes n + 1 times (including the last loop check). The loop in the first loop executes an average of (n^2)/2 times each time the outer loop loops. The runtime of the first loop and nested loop body is O(((n + 1))((n^2)/2)). We can simplify this to O((n)(n^2)) or O(n^3).

9. Answer: Running time is O(n^2)

Explanation: The first loop executes n times including the last check. The nested loop executes an average of (n/2) times for each time the outer loop loops. The runtime for the first loop and its nested loop combined is then O((n)(n/2)), simplified to O(n^2).

10. Answer: Running time is O((logn)^2)

Explanation: The first loop executes logn times. The nested for loop executes logn times in the worst case where i = n. We can consider that the simplified runtime for the nested loop is O(logn). The total runtime would hence be O ((logn)(logn)) or simplified to O((logn)^2).