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**Homework 2**

1. According to the L'Hospital Rule, we have:

The rank of the growth rate, precisely, from the lowest to the highest, would be:

Among them the growth rate of is equal to that of . While by convention, though less precisely, we simply regard that all have the growth rates that can be approximated to that of.

2. (a)

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| (1) | /\*1\*/ Sum = 0;  /\*2\*/ for(i = 0; i < N; i++)  /\*3\*/ Sum++;  Analysis:   * Line 1 counts for 1 unit. * Line 3 counts for 2 units per time executed (1 +, 1 =) and executed N times, so totally 2N units. * Line 2 has hidden costs, i.e., 1 assignment, N+1 units for testing, and N units for incrementing, so totally counts for 2N + 2 units. * To sum up, 4N + 3 units. O(N). |
| (2) | /\*1\*/ Sum = 0;  /\*2\*/ for(i = 0; i < N; i++)  /\*3\*/ for(j = 0; j < N; j++)  /\*4\*/ Sum ++;  Analysis:   * Line 1 counts for 1 unit. * Line 2 counts for 2N + 2 units, according to the previous analysis. * Line 3 counts for 2N + 2 units per time in the i-loop and executed N times, so totally units. * Line 4 counts for 2 units per time and executed times, so totally units. * To sum up, units. O(). |
| (3) | /\*1\*/ Sum = 0;  /\*2\*/ for(i = 0; i < N; i++)  /\*3\*/ for(j = 0; j < N \* N; j++)  /\*4\*/ Sum ++;  Analysis:   * Line 1 counts for 1 unit. * Line 2 counts for 2N + 2 units, according to the previous analysis. * Line 3 counts for units per time in the i-loop and executed N times, so totally units. * Line 4 counts for 2 units per time and executed times, so totally units. * To sum up, units. O(). |
| (4) | /\*1\*/ Sum = 0;  /\*2\*/ for(i = 0; i < N; i++)  /\*3\*/ for(j = 0; j < i; j++)  /\*4\*/ Sum ++;  Analysis:   * Line 1 counts for 1 unit, line 2 counts for 2N + 2 units. * Line 3 counts for 2i + 2 units per time in the i-loop, where n iterations are executed, so units in total. * Line 4 counts for 2 units per time in the j-loop, where i iterations are executed per time in the i-loop, so units in total. * To sum up, units. O(). |
| (5) | /\*1\*/ Sum = 0;  /\*2\*/ for(i = 0; i < N; i++)  /\*3\*/ for(j = 0; j < i \* i; j++)  /\*4\*/ for(k = 0; k < j; k++)  /\*5\*/ Sum ++;  Analysis:   * Line 1 counts for 1 unit, line 2 counts for 2N + 2 units. * Line 3 counts for units per time in the i-loop, where N iterations are executed, so units in total. * Line 4 counts for 2j + 2 units per time in the j-loop, where iterations are executed per time in the i-loop, so units in total. * Line 5 counts for 2 units per time in the k-loop, where j iterations are executed per time in the j-loop, so units in total. * Totally units. O(). |
| (6) | /\*1\*/ Sum = 0;  /\*2\*/ for(i = 0; i < N; i++)  /\*3\*/ for(j = 0; j < i \* i; j++)  /\*4\*/ if(j % i == 0)  /\*5\*/ for(k = 0; k < j; k++)  /\*6\*/ Sum ++;  Analysis:   * Line 1 counts for 1 unit, line 2 counts for 2N + 2 units, and line 3 counts for units, according to the previous analysis. * Line 4 counts for 2 units per time in the j-loop, where iterations are executed per time in the i-loop, so units in total. * Line 5 counts for 2j + 2 units per time for each , so units in total. * Line 6 counts for 2 units per time in the k-loop, where iterations are executed, so units in total. * Totally units. O(). |

2. (b) The following displays, in each of which the first value of N is selected such that the running time is approximately 100 ms and the sequent values are multiples of the head, are print-screens of *terminal* where the fragments are executed.

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| (1) |  | (2) |  |
| (3) |  | (4) |  |
| (5) |  | (6) |  |

2. (c) It can be seen from above that the growth of the running time in each of the six fragments is quite similar to the growth of the correlated function of N computed in (a). Take, for example, fragment (1). With a complexity of O(N), the running time grows (approximately) linearly as the initial value of N being multiplied by 2, 3, 4 and 5 consecutively. Similarly, the running time of fragment (2) and (4), with a complexity of O(), grow (approximately) quadratically in reaction to the linear growth of N. Same as the other fragments. Therefore, it can be concluded that the Big-Oh analysis in (a) is correct.