CSE111: Data Structures

Assignment – Algorithm complexity analysis

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Program: cs

A. What is the time complexity of the following code fragments?

1. What is the runtime of this code?

```
void printSumAndProduct(int[] array, int length) {  // O(n)
    int sum = 0;
    int product = 1;
    for (int i = 0; i < length; i++) {
        sum += array[i];
    }
    for (int i = 0; i < length; i++) {
        product *= array[i];
    }
   cout<<sum <<"," << product;
}
```


2. What is the runtime of this code?

```
void printPairs(int[] array, int length) {  O(n*n)
    for (int i = 0; i < length; i++) {
        for (int j = 0; j < length; j++) {
            cout<<array[i] << "," << array[j];
        }
    }
}
```

3. What about this code that has an inside loop with i + 1

```
void printPairs(int[] array, int length) {  O(n^2)
    for (int i = 0; i <length; i++) {
        for (int j = i + 1; j <length; j++) {
            cout<<array[i] << "," << array[j];
        }
    }
}
```

This would give us something like:

(1, 2) (1, 3) (1, 4) (1, 5)

(2, 3) (2, 4) (2, 5)

(3, 4) (3, 5)

(4, 5)

4. What is the runtime of this code that has two different arrays?

```
void printArrays(int[] arrayA, int Asize, int[] arrayB, int Bsize) {
    for(int a= 0; a < Asize; a++) {
        for(int b= 0; b< Bsize; b++) {
                if(a > b) {
                    cout<<a << “, ” << b;
                }
        }
    }
}
```

5. What would happen if in the same code we introduce another internal loop that has a constant value?

```
void printArrays(int[] arrayA, int Asize, int[] arrayB, int Bsize) {   O(n)
    for(int a= 0; a < Asize; a++) {
        for(int b= 0; b< Bsize; b++) {
            for (int i = 0; i < 1000000; i++) {
                cout<<a << "," << b;
            }
        }
    }
}
```

6. This code computes the product of two variables, what is the runtime of this code?

```
int product(int a, int b) {  O(n)
  int sum = 0;
  for (int i = 0; i < b; i++) {
    sum += a;
  }
  return sum;
}
```

B. What is the dominating terms and the time complexity of the following expressions?

Expression	Dominant term(s)	$O(\ldots)$
$5 + 0.001n^3 + 0.025n$	0.001n^3	n^3
$500n + 100n^{1.5} + 50n \log_{10} n$	100n^1.5	2^1.5
$0.3n + 5n^{1.5} + 2.5 \cdot n^{1.75}$	2.5n^1.75	2^1.75
$n^2 \log_2 n + n(\log_2 n)^2$	n^2logn	n^2 logn
$n \log_3 n + n \log_2 n$	nlogn	nlogn
$3 \log_8 n + \log_2 \log_2 \log_2 n$	3log_8_n	log8(n)
$100n + 0.01n^2$	0.01n^2	n^2
$0.01n + 100n^2$	100n^2	n^2
$2n + n^{0.5} + 0.5n^{1.25}$	0.5n^1.25	n^1.25
$0.01n \log_2 n + n(\log_2 n)^2$	n(log2(n))^2	n(log2(n))^2
$100n \log_3 n + n^3 + 100n$	n^3	n^3
$0.003 \log_4 n + \log_2 \log_2 n$	0.003log4(n)	log4(n)

C. Which Algorithm is Best?

A venture capitalist is trying to decide which of 3 startup companies to invest in and has asked for your help. Here's the timing data for their prototype software on some different size test cases:

n	foo-a	foo-b	foo-c
10	10 u-sec	5 u-sec	1 u-sec
20	13 u-sec	10 u-sec	8 u-sec
30	15 u-sec	15 u-sec	27 u-sec
100	20 u-sec	50 u-sec	1000 u-sec
1000	?	?	?

Which company has the "best" algorithm?

the foo-a is the best one, because it has the lowest rate of change.