HW4

To Turn in: please submit the questions and your answers below them in a pdf file on canvas.

Perform a time-complexity (Big-O) analysis for each of the next three problems (problems 1, 2, and 3). For full credit you should be able to produce a logical justification for your answer (a growth rate function can help demonstrate this – but is NOT required – so at least show in general why the Big-O is what it is). Equations you may need: (1) 1 + 2 + 3 + 4 + …+ n = (1 + n) * n / 2; (2) 1 + a + a^2 + a^3 + … + a^n = (a^{n+1} – 1) / (a-1).

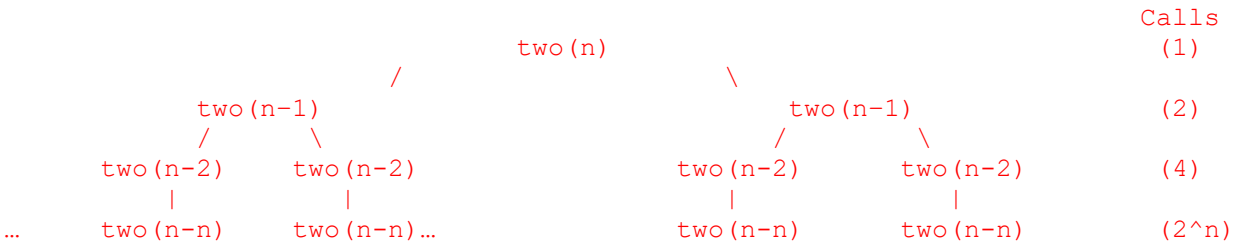
1. (40 Points)

```
public static void two(int n)
{
   if(n > 0)
   {
      System.out.println("n: " +n);
      two(n - 1);
      two(n - 1);
   }
   else if (n < 0)
    {
       two(n + 1);
       two(n + 1);
       System.out.println("n: " + n);
    }
}
```

If n is positive, we enter this loop

```
if(n > 0)
{
      System.out.println("n: " +n);
      two(n - 1);
      two(n - 1);
}
```

Recursive Tree



The bottom level is dominant in the GRF, so big_oh = O(2^n).

---

2. (30 Points)

```
public void three(int n)
{
  int i, j, k;
```

```
  for (i = n/2; i > 0; i = i/2)
      for (j = 0; j < n; j++)
            for (k = 0; k < n; k++)
                  System.out.println("i: " + i + " j: " + j+" k: " + k);

}  // end three
```

In the for loop we have i = i/2, so i will be cut in half for every iteration. The GRF will be similar to that of log(n) which is the dominant factor for all of the 3 loops. Big_oh = O(log_2(n)).

---

3. (30 points)

```
public static void four(int n)
{
   if (n > 1)                    (n-1)
   {
      System.out.println(n);     (n-1)
      four(n-1);                 (n-1)
   }
   for (int i = 0; i < n; i++)    (1)+(n+1)+(n)
     System.out.println(i);       (n)
}
```

As we enter the if statement, there is a recursive call so it will occur n-1 times since n > 1. Same for each statement in the if.

There will be two parts to the GRF since there exists a for loop after the if statement.

GRF for the if is: n - 1 + n - 1 + n - 1 = 3n - 3
GRF for the for is: 1 + n + 1 + n + n = 3n + 2

We then drop the constants from both equations and we end up with n for both, then we multiply them together, thus getting
GRF = n^2
So big_oh = O(n^2)