Homework-2
Due Date: 01/31/2017

Problem 1: Find the order of growth of the running time of the following programs

a.

```
int x = 1, i;
for(i = 0; i < N; i++)
  x++;
```

b.

```
int x = 1, i, j;
for(i = 0; i < N; i++)
  for(j = 1; j < R; j++)
    x = x * j;
```

c.

```
public static int f2(int N)
  int x = 1;
  while(x < N)
    x = x * 2;
  return x;
}
```

d.

```
int x = 0, i;
for(i = 0; i < N; i++)
  x += f2(N);
```

e.

```
int x = 0, i, j;
for(i = 1; i <= N; i++)
  for(j = 1; j <= N+R; j+=i)
    x += j;
```

f.

```
public static int f7(int N) {
   if (N == 1) return 0;
   return 1 + f7(N/2);
}
```

Problem 2: Find the order of growth of the running time of the following programs

a.

```
public static int f1(int N) {
   int x = 0;
   for (int i = 0; i < N; i++)
       x++;
   return x;
}
```

b.

```
public static int f2(int N, int R) {
   int x = 0;
   for (int i = 0; i < R; i++)
      x += f1(i);
   return x;
}
```

c.

```
public static int f3(int N, int R) {
   int x = 0;
   for (int i = 0; i < R; i++)
      for (int j = 0; j < N; j++)
         x += f1(j);
   return x;
}
```

d.

```
public static int f4(int N, int R) {
   int x = 0;
   for (int i = 0; i < N; i++)
      for (int j = 1; j <= R; j += j)
          x++;
   return x;
}
```

e.

```
public static int f5(int N, int R) {
   int x = 0;
   for (int i = 0; i < N; i++)
      for (int j = 1; j <= R; j += j)
          x += f1(j);
   return x;
}
```

Problem 3: Find the order of growth of the running time of the following programs

a.

```
public static int f3(int N) {
   if (N == 0) return 1;
   int x = 0;
   for (int i = 0; i < N; i++)
      x += f3(N-1);
   return x;
}
```

b.

```
public static int f6(int N) {
   if (N == 0) return 1;
   return f6(N-1) + f6(N-1) + f6(N-1);
}
```

c.

```
public static int f7(int N) {
   int x = 0;
   while (N > 0) {
      x++;
      N = N / 2;
   }
   return x;
}
```

d.

```
void silly(int n) {
    if (n <= 0) return;
    System.out.println("n = " + n);
    silly(n/2);
 }
```

e.

```
void silly(int n) {
    if (n <= 0) return;
    System.out.println("n = " + n);
    silly(n-1);
}
```

f.

```
void silly(int n, int x, int y) {
   for (int i = 0; i < n; ++i) {
      if (x < y)
         for (int k = 0; k < n * n; ++k){
            System.out.println("k = " + k);
         }
       else
         System.out.println("i = " + i);
   }
}
```

g.

```
void silly(int n) {
   for (int i = 0; i < n; ++i) {
      for (int j = 0; j < i; ++j) {
         System.out.println("j = " + j);
      }
      for (int k = 0; k < n * 3; ++k) {
         System.out.println("k = " + k);
      }
    }
}
```

i

```
void sunny(int n, int x) {
    for (int k = 0; k < n; ++k)
       if (x < 50) {
          for (int i = 0; i < n; ++i)
             for (int j = 0; j < i; ++j)
                System.out.println("x = " + x);
       } else {
          System.out.println("x = " + x);
       }
}
```

j.

```
void warm(int n) {
    for (int i = 0; i < 2 * n; ++i) {
       j = 0;
       while (j < n) {
          System.out.println("j = " + j);
          j = j + 5;
       }
    }
}
```

k.

```
int silly(int n, int m) {
    if (n < 1) return m;
    else if (n < 10)
      return silly(n/2, m);
    else
      return silly(n - 2, m);
}
```

l.

```
void happy(int n) {
    for (int i = n*n; i > 0; i--) {
       for (int k = 0; k < n; ++k)
           System.out.println("k = " + k);
       for (int j = 0; j < i; ++j)
          System.out.println("j = " + j);
       for (int m = 0; m < 5000; ++m)
          System.out.println("m = " + m);
    }
 }
```

Problem 4. Programming: Submit python files of solutions of the following problems.

a. Devise an experiment to verify that the list index operator is $O(1)$
b. Devise an experiment to verify that get item and set item are O(1) for dictionaries
c. Devise an experiment that compares the performance of the `del` operator on lists and dictionaries.

d. Given a list of numbers in random order, write a algorithm that works in O(nlog(n)) to find the kth smallest number in the list