Homework 1

Due: 17-1-20

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1. Show that $6n^2 + 20n$ is $O(n^3)$

2. Calculate the running time (count the no. of operations and BigOh complexity) of the array subset problem (given below). If we have two sets, represented as unsorted arrays, then we want to test whether every element of the first set (sub) also occurs in the second set.
   a.
```
boolean subset(int[] sub, int[] super) {
        int m = sub.length;
        for (int i = 0; i < m; i++)
            if (!member(sub[i], super) return false;
        return true;
}
```
   b.
```
boolean member(int x, int[] a) {
    int n = a.length;
    for (int i = 0; i < n; i++) {
        if (x == a[i]) return true;
    }
    return false;
}
```

3. Prove that $f(x) = 4x^2 - 5x + 3 = O(x^2)$.

4. For each of the following functions, show the Big O of each using the simplest possible form.
   a. $n^2 + 3n$
   b. $3n^2 + 112n$

5. For each of the following code snippets, provide an analysis of the running time in Big O notation. Show your work
   a.
```
int sum(int a[], int n)
{
```

```
int x = 0;                          // 4 bytes for x
for(int i = 0; i < n; i++)      // 4 bytes for i
{
   x  = x + a[i];
}
return(x);
```

b.
```
{
   int z = a + b + c;
   return(z);
}
```

6. What is time complexity of fun()?

a.
```
int fun(int n)
{
  int count = 0;
  for (int i = n; i > 0; i /= 2)
    for (int j = 0; j < n; j++)
      count += 1;
  return count;
}
```

7. Explain the increasing order of asymptotic complexity of functions f1, f2, f3 and f4? Show your work
   a. f1(n) = 2^n
   b. f2(n) = n^(3/2)
   c. f3(n) = nlogn
   d. f4(n) = n^(logn)

8. What is the time complexity of the following:

```
for (int i = 1; i <=m; i += c)
  {          // some O(1) expressions   }
 for (int i = 1; i <=n; i += c)
  {        // some O(1) expressions   }
```

9. Prove that O(1)+O(1)=O(1).

10. What is the difference between total execution time and time complexity?