CS2134 Homework 2
Spring 2016
Due*11:00 p.m. Tues Feb 9, 2016

February 5, 2016

Assignment 2 includes a programming portion and a written portion. The programming portion must compile and should consist of a single file (hw02.cpp). The written portion should consist of a single file (hw02written) in a *.pdf* format. Be sure to include your name at the beginning of each file! You must hand in both files via NYU Classes. *No late assignments will be accepted.*

Programming Part:

1. For the class called `IntArray` implement a deep copy constructor, a move constructor, a destructor, and a move assignment operators. Use the `std::swap` function if appropriate, and below where you used the `std::swap` function, write as a comment the code to perform the same steps without using the `std::swap` function.

   You may implement the `put` and `get` methods to test your code. You will not be graded on these methods.

   Implement the methods outside the class interface.

```
class IntArray{
public:

    IntArray(int n = 0): size(n), array(new int[n]){}
    // add your methods here

    void put (int  i, int value);
    int get( int i);
private:
    int * array;
    int size;
};
```

*A bonus of %10 percent will be given if you turn in this homework assignment by Mon. Feb 8 at 11:00 p.m.

Written Part

1. For each of the following code fragments, determine the worst case running time using **Big-Oh** notation as a function of n.

(a)
```
int sum = 0;
for (int k = n; k>=1; k = (int) k/3)
       sum += k;
cout << sum;
```

(b)
```
for (int j = 1; j <= n; j++)
{
    for (int i = j; i > 1; i/=9)
        cout << "(" << i << ", " << j << ") " ;
    cout << endl;
}
```

(c)
```
template <class Comparable>
int min(const vector<Comparable> & items)
{
    if (items.size() == 0) return -1;

    int min_index = 0;

    for (int i = 0; i < items.size(); ++i)
        if (items[i] < items[min_index])
            min_index = i;

    return min_index;
}
```

(d)
```
for( i = 0; i < n; ++i)
   for (j = 0; j < n; ++j)
      a[i][j] = b[i][j] + c[i][j];
```

(e)
```
void in_order( vector<int> & a )
{
     int j = 0;
     for( int p = 1; p < a.size( ); p++ )
     {
          print(a); // This function takes O(n) time.
          Comparable tmp = a[ p ];
          for( j = p; j > 0 && tmp < a[ j - 1 ]; j-- )
                    a[ j ] = a[ j - 1 ];
          a[ j ] = tmp;
     }
 }
```

2. For the following functions, order them by their rates of growth from fastest to slowest: $n, \sqrt{n}, n^{1.5}, n^2, n \log n, n \log^2 n, n/2, n^3$. Indicate which functions grow at the same rate.

3. What is the difference between `delete []` and `delete`?

4. For programming problem 1, Using *big-Oh* notation if `size =` n, give the worst case running time for the:

   (a) copy constructor

   (b) move constructor

5. Using *big-Oh* notation what is the running time of the following code snippets where `v` is a vector of `n > 0` integers.

   (a)
```
void f( vector<int> b )
{
    cout << b[0];
}
int main( )
{
    // code to create the vector v which will not be included in your run time
    f( v );
}
```

   (b)
```
void f( vector<int> & b )
{
    cout << b[0];
}
int main( )
{
    // code to create the vector v which will not be included in your run time
    f( v );
}
```

6. If your code contained the following functions[1]

```
// Function 1
void f( const string & s )
{
    cout << "Function 1 was called." << endl;
}

// Function 2
void f( string & s )
{
    cout << "Function 2 was called." << endl;
}

// Function 3
void f( string && s )
{
    cout << "Function 3 was called." << endl;
}
```

State which function was called for each of the following.

(a) `f(string("hello"));`

(b)
```
string s1 = "hello";
f(s1);
```

(c)
```
string s2 = "hello";
f( std::move(s2) );
```

(d)
```
const string s3 = "hello";
f(s3);
```

7. Determine if the specified expression is an *rvalue* or an *lvalue:*

- `int x = 3;` // what is `x`
- `char * ptr = new char[3];` // what is `new char[3]`
- `int f( )  return 1;` // What is the return value of the function `f`
- `string && sRef = string("What?");` // what is `sRef`

[1]Please run these functions to check your answer. Do not turn in your code.

8. Anything wrong with this code? If there is, please describe what the problem is, otherwise state there is no problem.

```
string & getName( )
{
    string name;
    cout << "Please enter your name:  ";
    cin >> name;
    cout << "Hi " << name << '!' << endl;
    return name;
}
int main( )
{
     cout << getName( );
}
```