COP 3337
Programming II

Examination 4

Name: _____

Sample

This exam has 2 additional pages. Please answer each question on the page on which it is asked. You may write on the back of the **facing** page if you need to.

1. (a) For each of the following operations, state whether `ArrayList` is much better, `LinkedList` is much better, or whether both are basically the same.

   - `add( 0, x )`
   - `get( idx )`
   - `remove( x )`
   - `add( x )`

   (b) For each of the following, state whether it is true for `Lists` only, `Sets` only, both `Lists` and `Sets`, or neither `Lists` nor `Sets`.

   - has an efficient `contains` operation
   - allows duplicates
   - supports `add` and `remove` of a single object

2. Class `Multiset`, shown below is used to maintain a collection of `Strings`, **in which duplicates are allowed**. It stores a map in which the key is a `String`, and the value is the number of occurrences of the `String`.

```
class MultiSet
{
   // Constructor and most methods not shown

   private Map<String,Integer> counts;

   // Return size of the MultiSet
   // If counts  = [ hello=2, world=1, zebra=1 ]
   // This routine returns 4
   public int size( )
     { /* You provide implementation */ }

   // Return true if x is in this Multiset
   public boolean contains( String x )
     { /* You provide implementation */ }

   // Add a new item
   public void add( String x )
     { /* You provide implementation */ }

   // Remove an item.
   // If x is not found, return false.
   // If x is present with count 1, remove it from the map.
   // If x is present with count > 1, lower the count by 1.
   // If x was present return true.
   public boolean remove( String x )
     { /* You provide implementation */ }
}
```

(a) Implement `contains`.

(b) Implement `add`.

(c) Implement `remove`.

(d) Implement `size`.