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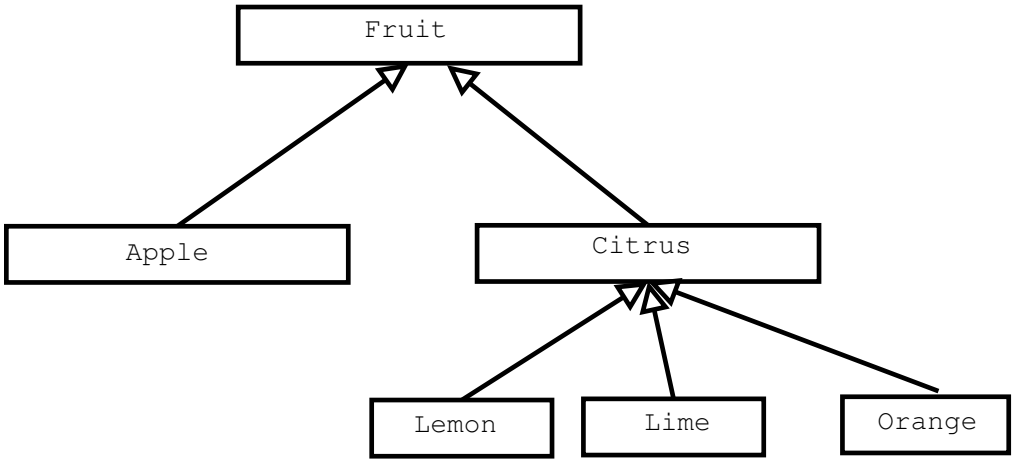
ProblemSet 1
Advanced Java Topics

Problem 1

Suppose that `Fruit`, `Apple`, `Citrus`, `Lemon`, `Lime`, `Orange` are classes defined in the following inheritance hierarchy.



1. Can you create the following objects in a way specified? For each of them state "yes" if you can, or explain why not. Assume that each class provides default constructor.

   (a) `Fruit f = new Citrus();`
   (b) `Fruit f = new Lime();`
   (c) `Citrus c = new Fruit();`
   (d) `Citrus c = new Orange();`
   (e) `Apple a = new Citrus();`
   (f) `Citrus c = new Citrus();`

2. Each of the default constructors contains a print statement that states which classes constructor is called. `Fruit` class constructor prints "Fruit constructor called"; `Apple` class constructor prints "Apple constructor called"; and so on. Show the output when the following objects are created:

   (a) `Fruit f = new Lemon();`
   (b) `Apple a = new Apple();`

Problem 2

Write a method that given a sorted `ArrayList` object of Java strings (objects of class String) removes all duplicates. Your method should modify the `ArrayList` object passed to it. The method should return a boolean value indicating if the list was modified or not (`true` for "has been modified", `false` for "has not been modified"). For example, if the original list passed to your method contains the following strings:

```
Argentina, Chile, Chile, Czech Republic, France, Georgia, India, India, Poland, Romania, Romania
```

your method should remove one occurrence of Chile, India and Romania. The resulting list should contain:

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Argentina, Chile, Czech Republic, France, Georgia, India, Poland, Romania

Problem 3

Consider the following class definition

```
1  public class Foo implements Comparable<Foo>{
2
3      double x;
4      double y;
5
6      public Foo ( double x, double y ) {
7          this.x = x;
8          this.y = y;
9      }
10
11     public int compareTo ( Foo other ) {
12         double d1 = x*x + y*y;
13         double d2 = other.x * other.x + other.y * other.y;
14         if ( d1 < d2 ) return -1 ;
15         if ( d1 == d2 ) return 0;
16         return 1;
17     }
18
19     public String toString ( ) {
20         return "( " + x + ", " + y + " )"; //returns ( x, y )
21     }
22 }
```

Given the array `fooList` of `Foo` objects pictured below (the values of `x` and `y` data fields are stated for each array element), show what the array will look like after the call to `Arrays.sort(fooList)`.

0	1	2	3	4	5	6	7	8	9
$x = 1.0$	$x = -2.0$	$x = 1.0$	$x = 1.0$	$x = 2.5$	$x = -1.0$	$x = 0.0$	$x = -1.0$	$x = 0.0$	$x = 0.0$
$y = 1.0$	$y = 2.0$	$y = 2.0$	$y = -1.0$	$y = 0.0$	$y = 0.0$	$y = 3.0$	$y = -4.0$	$y = 0.0$	$y = 1.5$

Problem 4

Part A Given the definition of the `Foo` class in **Problem 3**, write the lines of code that are needed to create an `ArrayList` object and fill it with ten (10) `Foo` objects initialized with random values of `x` and `y` (Hint: this should be done with a loop). Do not write the entire program, just the lines that create and populate the `ArrayList` object.

Part B Give the ArrayList object that you created in Part A, write a single statement that will sort that array.

Problem 5

A subclass inherits _____ from its superclass.

- private methods
- protected methods

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- public methods
- constructors

Extra Challenge

What does the following Java code print:

```
1
2 public class PolymorphismQ3 {
3
4   public static void f(A x) {
5     A y = x;
6     y.key = x.key + 1;
7   }
8
9   public static void f(B x) {
10    B y = new B();
11    y.key = x.key + 2;
12    x = y;
13  }
14
15  public static void main(String[] args) {
16    A p = new A( );
17    p.key = 3;
18    B q = new B( );
19    q.key = 10;
20    f(p);
21    System.out.println(p.key);
22    f(q);
23    System.out.println(q.key);
24    p = q;
25    f(p);
26    System.out.println(p.key);
27  }
28 }
29
30
31 class A {
32   public int key;
33 }
34
35 class B extends A {
36 }
```