CS 2510 Exam 1 – Spring 2010

Name: _____

Student Id (last 4 digits): _____

• Write down the answers in the space provided.
• You may use all syntax that you know from *FunJava* other than *abstract classes*. If you need a method and you don't know whether it is provided, define it. You do not need to include the curly braces for every `if` or every `else`, as long as the statements you write are otherwise correct in FunJava.
• For tests you only need to provide the expression that computes the actual value, connecting it with an arrow to the expected value. For example `s.method() -> true` is sufficient.
• Remember that the phrase "design a class" or "design a method" means more than just providing a definition. It means to design them according to the **design recipe**. You are *not* required to provide a method template unless the problem specifically asks for one. However, be prepared to struggle if you choose to skip the template step.
• We will not answer *any* questions during the exam.

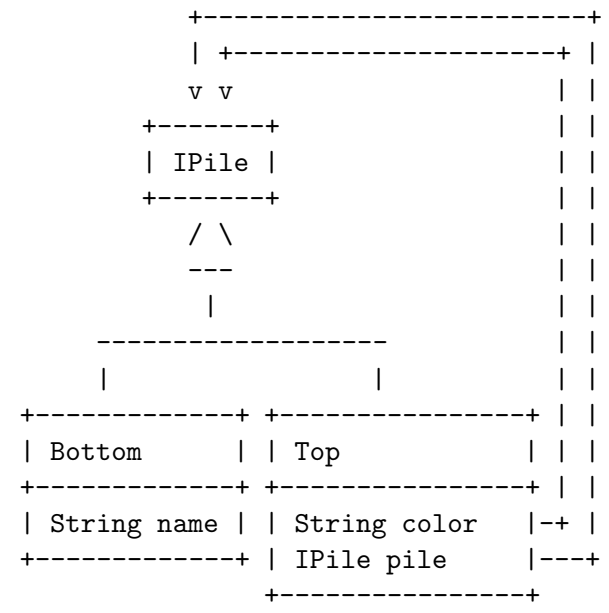
Good luck.

Problem	Points	/
1		/27
Total		/27

25 Points

Problem 1

Here is a Java class diagram that describes a very cold person covered with a pile of blankets:



A. *(2 points)*

Write down the Java class and interface definitions that are represented by this class diagram.

Solution [POINTS 3: 1 point for the interface, 1 point for the class `Bottom`, 1 point for the class `Top`]

```
// to represent a pile of blankets with someone below
interface IPile{ }

// to represent a person on the bottom of the pile
class Bottom implements IPile{
  String name;

  Bottom(String name){
    this.name = name;
  }
}

// to represents a pile of blankets atop a person
class Top implements IPile{
  String color;
  IPile pile;

  Top(String color, IPile pile){
    this.color = color;
    this.pile = pile;
  }
}
```

B. *(2 points)*

Make examples of three piles - one without anything on top, plus two other piles, one of which must have at least two `Top`s.

Solution [POINTS 2: one point for the `Bottom`, and one point for the example with two `Top`s.]

```
IPile pat = new Bottom("Pat");
IPile kim = new Bottom("Kim");

IPile patPile =
  new Top("red", new Top("blue", new Top("green", this.pat)));
IPile kimPile =
  new Top("green", new Top("black", this.kim));
IPile bigPile = new Top("red", new Top("yellow",
  new Top("blue", new Top("yellow", new Top("red", this.pat)))));
```

C. *(5 points)* Design the method `hasColor` that determines whether a pile includes a top of a given color.

Solution [POINTS 5: 1 point purpose/header; 1 point body in each class; 2 points examples – should include result 0 and result > 1]

```
// in the interface IPile:
  // is there a given color in this pile?
  boolean hasColor(String color);

// in the class Bottom:
  // is there a given color in this pile?
  boolean hasColor(String color){
    return false;
  }

// in the class Top:
  /* TEMPLATE:
    ... this.color ...                -- String
    ... this.pile ...                 -- IPile

    ... this.pile.hasColor(String) ...    -- boolean
  */

  // is there a given color in this pile?
  boolean hasColor(String color){
    return this.color.equals(color) ||
           this.pile.hasColor(color);
  }

// in the class Examples:
  // test the method hasColor
  boolean testHasColor(Tester t){
    return
    t.checkExpect(this.pat.hasColor("red"), false) &&
    t.checkExpect(this.patPile.hasColor("red"), true) &&
    t.checkExpect(this.kimPile.hasColor("red"), false) &&
    t.checkExpect(this.bigPile.hasColor("red"), true);
  }
```

D. *(8 points)*

Looking at the two piles you wonder which one is bigger. Design the method `isBigger` that determines whether one pile is bigger than another one.

Solution [POINTS 8: 1 point purpose/header; 1 point body for the `Bottom` class, 1 point body for the `Top` class, 3 points for definition of the helper method(purpose + header; body; examples/tests), 2 points for examples for the `isBigger` method.]

```
// in the interface IPile:
  // is this pile bigger than the given one?
  boolean isBigger(IPile that);

  // compute the size of this pile
  int pileSize();

// in the class Bottom:
  // is this pile bigger than the given one?
  boolean isBigger(IPile that){
    return false;
  }

  // compute the size of this pile
  int pileSize(){
    return 0;
  }

// in the class Top:
  // is this pile bigger than the given one?
  boolean isBigger(IPile that){
    return this.pileSize() > that.pileSize();
  }

  // compute the size of this pile
  int pileSize(){
    return 1 + this.pile.pileSize();
  }
// in the class Examples:
  // test the method isBigger
  boolean testIsBigger(Tester t){
    return
    t.checkExpect(this.pat.isBigger(this.kim), false) &&
    t.checkExpect(this.pat.isBigger(this.kimPile), false) &&
```

```
  t.checkExpect(this.patPile.isBigger(this.kim), true) &&
  t.checkExpect(this.kimPile.isBigger(this.patPile), false) &&
  t.checkExpect(this.bigPile.isBigger(this.kimPile), true);
}

// test the method pileSize
boolean testPileSize(Tester t){
  return
  t.checkExpect(this.pat.pileSize(), 0) &&
  t.checkExpect(this.patPile.pileSize(), 3) &&
  t.checkExpect(this.kimPile.pileSize(), 2) &&
  t.checkExpect(this.bigPile.pileSize(), 5);
}
```

E. *(6 points)*

Now you wonder whether two piles have any blankets of the same color. Design the method `commonColor` that determines whether two piles share at least one color of blankets.

Solution [POINTS 6: 1 point purpose/header; 1 point body for the `Bottom` class, 2 points body for the `Top` class (should invoke `that.hasColor`, 2 points for examples for the `commonColor` method.]

```
// in the interface IPile:
  // does this pile and the given pile have a color in common?
  boolean commonColor(IPile that);

// in the class Bottom:
  // is there a given color in this pile?
  boolean hasColor(String color){
    return false;
  }

// in the class Top:
  // does this pile and the given pile have a color in common?
  boolean commonColor(IPile that){
    return that.hasColor(this.color) ||
           this.pile.commonColor(that);
  }

// in the class Examples:
  // test the method commonColor
  boolean testCommonColor(Tester t){
    return
    t.checkExpect(this.pat.commonColor(this.kim), false) &&
    t.checkExpect(this.pat.commonColor(this.kimPile), false) &&
    t.checkExpect(this.patPile.commonColor(this.kim), false) &&
    t.checkExpect(this.kimPile.commonColor(this.patPile), true) &&
    t.checkExpect(this.bigPile.commonColor(this.kimPile), false) &&
    t.checkExpect(this.bigPile.commonColor(this.patPile), true);
  }
```

F. *(4 points)*

Show the templates for all classes in this problem for which you have designed methods.

Solution [POINTS 4: 1 point template for `Bottom`, 3 points template for `Top`: 1 point for fields, 1 point for methods for contents, 1 point for data types]

```
// in the class Bottom
   TEMPLATE:
    FIELDS:
    ... this.name ...                -- String

    METHODS:
    ... this.hasColor(String) ...      -- boolean
    ... this.isBigger(IPile) ...       -- boolean
    ... this.pileSize() ...            -- int
    ... this.commonColor(IPile) ...    -- boolean

    METHODS FOR FIELDS:


// in the class Top
 TEMPLATE:
  FIELDS:
  ... this.color ...                -- String
  ... this.pile ...                 -- IPile

  METHODS:
  ... this.hasColor(String) ...      -- boolean
  ... this.isBigger(IPile) ...       -- boolean
  ... this.pileSize() ...            -- int
  ... this.commonColor(IPile) ...    -- boolean

  METHODS FOR FIELDS:
  ... this.pile.hasColor(String) ...      -- boolean
  ... this.pile.isBigger(IPile) ...       -- boolean
  ... this.pile.pileSize() ...            -- int
  ... this.pile.commonColor(IPile) ...    -- boolean
```