

NAME:

CS 2102
Exam 1
D-Term 2013

Question 1: ----- (50)

Question 2: ----- (15)

Question 3: ----- (15)

Question 4: ----- (20)

TOTAL: ----- (100)

1. An online catalog company sells different kinds of merchandise. All items sold have a catalog number (int), a price (int), and a shipping weight (double). Clothing items also have a size (int). Luxury clothing includes the name of the designer. Furniture items need to indicate whether or not the furniture needs to be assembled.

Furniture and luxury clothing are taxable items. Taxable items must provide a method that computes the amount of tax on the item:

```
double taxOwed();
```

`taxOwed()` is calculated differently for different kinds of items. All items have a total cost. The total cost of an item is computed by calculating the sum of the price of an item, its shipping cost ($0.03 * \text{the item's shipping weight}$), and, for taxable items, the tax owed.

- (a) (25 points) Using good object-oriented design principles, draw a class diagram that represents a class hierarchy for merchandise. Use the following conventions, and provide the following information in your class diagram:

- interface names should start with the letter “I” (as in `IAAnimal`)
- abstract classes should begin with the letters “Abs” (as in `AbsAnimal`)
- names for concrete classes should *not* begin with “I” or “Abs”
- for every abstract and/or concrete class, indicate the types and names of all fields for that class
- if a complete method definition is to be included in an abstract and/or concrete class, use an ellipsis `{...}` to indicate the method body
- show method signatures where required
- you do not have to show any constructors or the bodies of any methods

Do not write Java code. Draw a class diagram. (You may draw your diagram on the next page.)

(draw your class diagram on this page)

- (b) (25 points) In Java, write the *complete class definition* for luxury clothing. Your class definition must contain any constructors, fields, and methods required for the correct compilation of the class with your class hierarchy (you need to provide the entire body of each constructor/method). The tax owed for luxury clothing items is 5% of the price in excess of \$250 (for example, if the clothing item cost \$300, the tax owed would be 5% of \$50, or \$2.50).

2. (15 points) A programmer is writing software to manage information about people in a genealogical database. The software is keeping track of each person's name, date of birth, and date of death. Sometimes only the year is known for a date, and sometimes the entire date is known (month, day, year).

The program contains these class definitions:

```
class Date{
    int month;
    int day;
    int year;

    Date (int month, int day, int year){
        this.month = month;
        this.day = day;
        this.year = year;
    }
}

class Person<S,T>{
    String name;
    S dob;          // date of birth
    T dod;          // date of death

    Person (String name, S dob, T dod){
        this.name = name;
        this.dob = dob;
        this.dod = dod;
    }
}
```

Provide examples of two Persons in the `Examples` class, as follows:

- a person named Sarah who was born in 1773 and died in 1841
- a person named Will who was born in 1885 and died on June 6, 1923

3. (15 points) Draw examples (pictures, not code) satisfying each of the the following descriptions:

(a) An AVL tree containing the numbers 1 through 8

(b) A heap with the shortest height possible containing the numbers 1 through 8

(c) A binary search tree containing the numbers 1 through 8 that exemplifies the worst-case running time of the operation `hasElt()`

4. (20 points) Identify each of the following statements about ADTs and/or data structures as one of the following:

- a property
- an invariant
- an operation
- an axiom

(a) A stack accesses its elements in last-in-first-out order.

(b) An AVL tree is a height-balanced binary search tree.

(c) For a stack S and an element e , $S.push(e).top() = e$.

(d) A sorted list is a list such that the first element in the list is smaller than all other elements in the list, and the rest of the list is a sorted list.