CSCI 136 Written Exam #0 **Name: _____**
Fundamentals of Computer Science II
Spring 2013

This exam consists of 5 problems on the following 7 pages.

You may use your single-side hand-written 8 ½ x 11 note sheet during the exam. You may use a simple handheld calculator. No computers, mobile devices, cell phones, or other communication devices of any kind are permitted.

If you have a question, raise your hand and I will stop by. Since partial credit is possible, **please write legibly and show your work**.

Problem	Points	Score
1	8	
2	15	
3	12	
4	12	
5	12	
Total	59	

1. **Loops, Input, Exceptions** (8 points). Consider the following program:

```
public class Prob1
{
    public static void main(String[] args)
    {
        int i = 0;
        double d = 0.0;
        for (String s : args)
        {
            try
            {
                d += Double.parseDouble(s);
                i++;
            }
            catch (NumberFormatException e)
            {
            }
        }
        System.out.printf("%d / %d : %.2f\n", i, args.length, d);
    }
}
```

Below are four example executions of the program. Give the output produced by the program. If the given input would cause a runtime error, write "runtime error". If it would cause a compile error, write "compiler error".

Command line	**Output**
% java Prob1 1.0 2.0 0.5	3 / 3 : 3.50
% java Prob1 -1 -2 -0.5	3 / 3 : -3.50
% java Prob1 1.0 two 0.5	2 / 3 : 1.50
% java Prob1	0 / 0 : 0.00

2. **Inheritance, Collections** (15 points). Consider the class hierarchy given on the last page of the exam.

a) Which data types could you successfully create with the `new` operator? Circle ***all*** that apply.

I. `Person`
II. `Student`
III. `Employee`
IV. `Faculty`
V. `Staff`

b) Assume someone has declared an array of type `Employee`. Concrete objects of what types could be stored in this array? Circle ***all*** that apply.

I. `Person`
II. `Student`
III. `Employee`
IV. `Faculty`
V. `Staff`

c) The `toString()` method in the class `Faculty` is an example of what? Circle the ***single best*** answer.

I. Overloaded method
II. Overridden method
III. Polymorphism
IV. Auto-boxing
V. Ducking an exception

d) The constructors in the class `Staff` are an example of what? Circle the ***single best*** answer.

I. Polymorphic methods
II. Abstract methods
III. Overloaded methods
IV. Overridden methods
V. Auto-unboxed methods

e) Consider the following code snippet:

```
ArrayList<Faculty> list = new ArrayList<Faculty>();
// ... (code that adds a bunch of faculty members)
Collections.sort(list); // sort by number of advisees
```

You get the following compile error:

```
Bound mismatch: The generic method sort(List<T>) of type Collections is not
applicable for the arguments (ArrayList<Faculty>). The inferred type Faculty is
not a valid substitute for the bounded parameter <T extends Comparable<? super T>>
```

What do you need to do to the `Faculty` class to make the sort work? Circle ***all*** that apply.

I. Add "`implements Comparable<Faculty>`" to the class declaration.
II. Add "`implements Comparable<ArrayList<Long>>`" to the class declaration.
III. Add "`implements Comparable`" to the declaration of the `Faculty` class.
IV. Add "`implements Comparable<Integer>`" to the class declaration.
V. Add a method "`public int compareTo(Person other)`"
VI. Add a method "`public void sort(ArrayList<Faculty>)`"
VII. Add a method "`public int compareTo(Faculty other)`"

f) Various instance variables are declared in the class hierarchy. Put a checkmark in the boxes corresponding to the instance variables (left column) that are directly accessible in instance methods of each class (top row). That is, instance variables that could be used without going through another method.

	Person	Student	Employee	Faculty	Staff
name	X	X	X	X	X
id		X			
gpa		X			
totalCredits		X			
salary			X	X	X
sickDays			X		
advisees				X	
tenured				X	
safety					X

g) Each Faculty object keeps track of the list of student ID's that faculty member is responsible for. Advisees can be added and removed one-at-a-time by ID. Add code to the following three methods to correctly implement this functionality:

```
public Faculty(String n, int sal, boolean ten)
{
   super(n, sal);
   this.tenured = ten;
   advisees = new ArrayList<Long>();
}

public void addAdvisee(long id)
{
   advisees.add(id);
}

public boolean removeAdvisee(long id)
{
   return advisees.remove(id);
}
```

3. Loops, Conditionals, String (12 points). A school converts letter grades to a value as follows:

A	A-	B+	B	B-	C+	C	C-	D	F
4.0	3.7	3.3	3.0	2.7	2.3	2.0	1.7	1.0	0.0

A student's GPA (grade point average) is computed by using these floating-point values weighted by the number of credits of the class in which each grade was earned. So for example, if a student has completed two classes, getting an A in a 4-credit class and a B- in a 3-credit class, his GPA is:

(4 * 4.0 + 3 * 2.7) / 7 = 3.442857

a) Complete the following helper method that converts a `String` containing a letter grade to its floating-point value. Your method should work regardless of whether the grade is in upper- or lower-case. Recall that the `String` data type has methods `toUpperCase()` and `toLowerCase()`. If the passed in grade is not a grade in the above table, throw a `RuntimeException` indicating "Invalid grade".

```
private double convertGrade(String grade)
{
   String [] grades = {"A", "A-", "B+", "B", "B-", "C+", "C", "C-", "D", "F"};
   double [] val    = {4.0, 3.7 , 3.3 , 3.0, 2.7 , 2.3 , 2.0, 1.7 , 1.0, 0.0};

   for (int i = 0; i < grades.length; i++)
   {
      if (grade.toUpperCase().equals(grades[i]))
         return val[i];
   }
   throw new RuntimeException("Invalid grade");
}
```

b) Using your `convertGrade()` method, implement the addCourse() method in the `Student` class from the diagram on the last page of the exam. Your method should result in updating the object's instance variables so as to reflect the student's new GPA and total credits.

```
public void addCourse(String grade, int credits)
{
   double cum = gpa * totalCredits;
   cum += convertGrade(grade) * credits;
   totalCredits += credits;
   gpa = cum / totalCredits;
 }
```

4. Exceptions, Collections (12 points).

a) Java has both checked and unchecked exceptions. Briefly describe the difference. Provide an example of a typical exception of each type.

Checked exceptions must be placed within a try-catch block (otherwise you will get a compile error). An example is `FileNotFoundException` which must be caught when creating a `PrintWriter` object.

Unchecked exception are not required to be in a try-catch block. Normally this our a programming error such as the `ArrayIndexOutOfBoundsException` or `NullPointerException`.

b) Describe a problem where a ***list*** abstract data type (ADT) would be most appropriate. Why is a ***list*** the best choice for this problem?

Storing a list of names in alphabetical order. The list ADT tracks the order of elements in the collection which would be required if we wanted to keep them in a certain order.

c) Describe a problem where a ***map*** abstract data type (ADT) would be most appropriate. Why is a ***map*** the best choice for this problem?

Keeping track of the number of times a set of words have each been seen in a large text file. The map ADT allows us to quickly find a given word in the collection and modify its value.

d) Describe a problem where a ***set*** data type (ADT) would be most appropriate. Why is a ***set*** the best choice for this problem?

Creating a spell checking program. The set would track words that are in a known dictionary of correctly spelled words. The set ADT allows us to determine if a given key is present or not in a collection.

5. Methods (12 points). Match the method description on the left with the ***best*** method on the right. Assume candidate methods appear inside a class named Book. The Book class knows things like the author, title, and all the text of a book (the exact details are not important). Not every letter will be used. Each letter will be used ***at most once***.

__E__ A method that can determine if a Book contains exactly the same text as another Book.

__A__ You have an object c of type Book. This method is called implicitly by the following line:

```
System.out.println(c);
```

__G__ A method that can calculate how many times each word in a set of words appears in a Book. For example, the method might calculate that "whale" occurs 10 times and "ocean" appears 17 times.

__O__ A copy constructor that creates a Book based on another Book.

__J__ A method that can return the count of the number of words that overlap in two Book objects.

__K__ A method that can return the set of possible misspelled words in a Book given a passed in dictionary of known good words.

A. `public String toString()`

B. `public static String toString()`

C. `public void toString(String s)`

D. `public boolean foo(String s)`

E. `public boolean foo(Book a)`

F. `public boolean foo()`

G. `public int [] foo(String [] s)`

H. `public int foo(ArrayList<String> s)`

I. `public int foo(HashSet<String> s)`

J. `public int foo(Book a)`

K. `public HashSet<String> foo(HashSet<String> s)`

L. `public String [] foo()`

M. `public void foo(String s)`

N. `public Book()`

O. `public Book(Book a)`

P. `public Book(other)`

Q. `private Book(Book a)`

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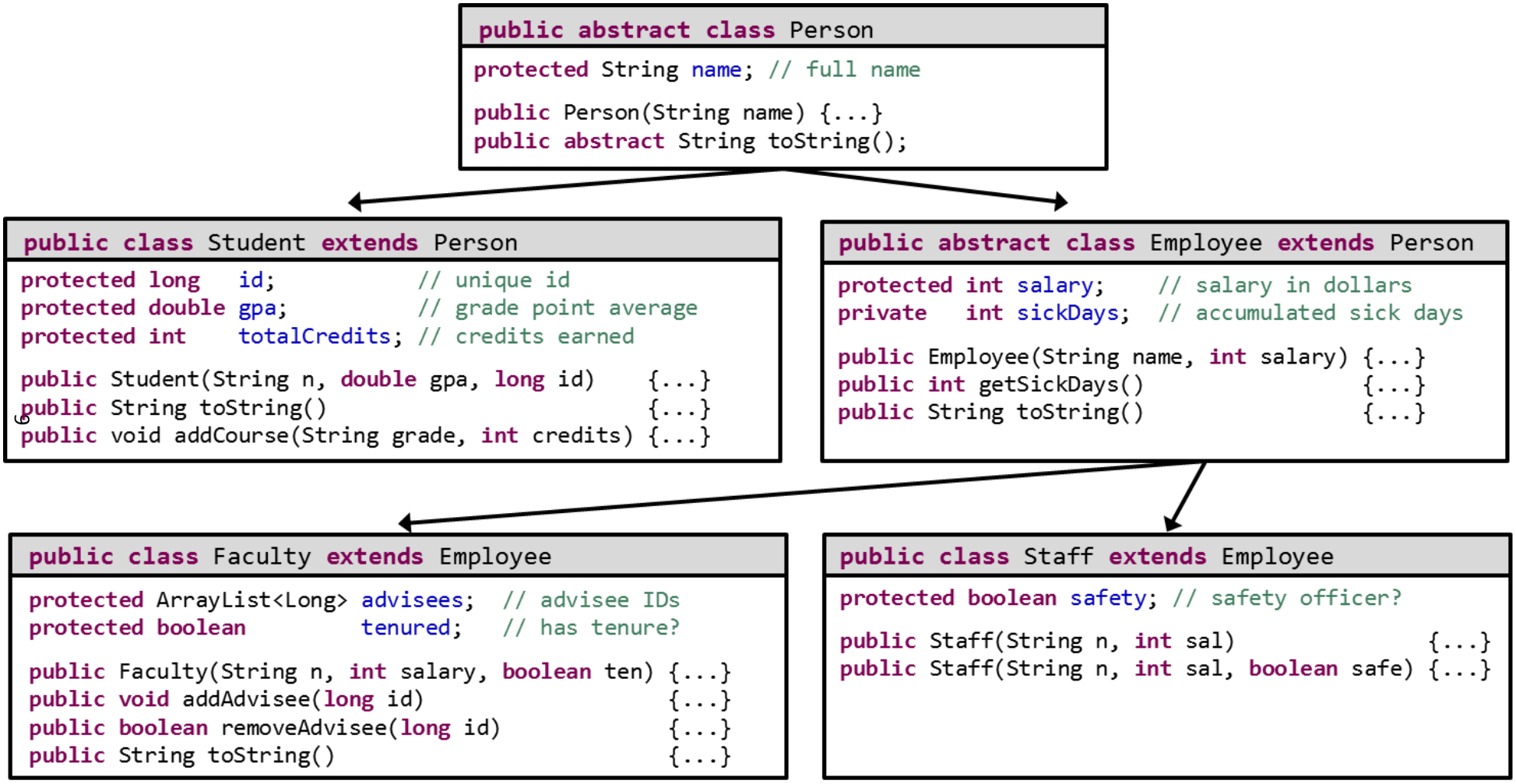
public abstract class Person
protected String name; // full name
public Person(String name) {...}
public abstract String toString();
public class Student extends Person
protected long id; // unique id
protected double gpa; // grade point average
protected int totalCredits; // credits earned
public Student(String n, double gpa, long id) {...}
public String toString() {...}
public void addCourse(String grade, int credits) {...}
public abstract class Employee extends Person
protected int salary; // salary in dollars
private int sickDays; // accumulated sick days
public Employee(String name, int salary) {...}
public int getSickDays() {...}
public String toString() {...}
public class Faculty extends Employee
protected ArrayList<Long> advisees; // advisee IDs
protected boolean tenured; // has tenure?
public Faculty(String n, int salary, boolean ten) {...}
public void addAdvisee(long id) {...}
public boolean removeAdvisee(long id) {...}
public String toString() {...}
public class Staff extends Employee
protected boolean safety; // safety officer?
public Staff(String n, int sal) {...}
public Staff(String n, int sal, boolean safe) {...}