# 09 Final Exam Revision

Q1. Study this class:

class Histogram {

public char symbol = '\*';

protected String[] categories;

protected int[] frequencies;

public Histogram(int numCategories) {

categories = new String[numCategories];

frequencies = new int[numCategories];

for (int index=0; index<numCategories; index++) {

categories[index] = "unlabeled";

frequencies[index] = 0;

}

}

public void setCategory(int index, String name, int frequency) {

categories[index] = name;

frequencies[index] = frequency;

}

public String toString() {

String result = "";

for (int index=0; index<categories.length; index++) {

result+=categories[index]+": ";

result+=repeatSymbol(frequencies[index]);

result+="\n";

}

return result;

}

protected String repeatSymbol(int numTimes) {

String result = "";

for (int index=0; index<numTimes; index++)

result += symbol;

return result;

}

}

(a) Identify (i) the constructor, (ii) the fields and (iii) the methods.

(b) Predict the output of the following code fragments, or state that there will be an error. If there is an error, state the line on which the error occurs and explain.

Histogram hist1 = new Histogram(3);

hist1.setCategory(0, " Apples", 4);

hist1.setCategory(1, "Bananas", 2);

hist1.setCategory(2, "Oranges", 5);

println( hist1 );

Outcome:

Histogram hist2 = new Histogram(4);

hist2.setCategory(0, "Chocolate", 10);

hist2.symbol='!';

hist2.setCategory(1, " Onions", 3);

println( hist2 );

Outcome:

Histogram hist3 = new Histogram();

hist3.setCategory(0, "Cars ", 3);

hist3.setCategory(1, "Bikes", 5);

println( hist3 );

Outcome:

Histogram hist4 = new Histogram(2);

hist4.setCategory(0, "Poppies", 10);

hist4.setCategory(2, "Roses", 3);

println( hist4 );

Outcome:

Histogram hist5 = new Histogram(4), hist6;

hist5.setCategory(0, "Chocolate", 10);

hist6=hist5;

hist6.symbol='!';

hist6.setCategory(1, " Onions", 3);

println( hist6 );

Outcome:

Q2. A cumulative histogram is a histogram in which each value is added to the sum of the values that have gone before. For example if there are 3 Apples, 2 Bananas and 6 Oranges, then the numbers in the normal histogram will be (3,2,6) but in a cumulative histogram they will be (3,5,11).

Create a subclass of Histogram called CumulativeHistogram. You **only** need to override the toString() method to solve this problem.

Here is a template for the class:

class CumulativeHistogram extends Histogram {

public CumulativeHistogram(int numCategories){

super(numCategories);

}

public String toString() {

// \*\*\*\*\*\*\*\*\* Fill in this method

}

}

And here is some test code:

Histogram hist = new Histogram(3);

hist.setCategory(0, " Apples", 4);

hist.setCategory(1, "Bananas", 2);

hist.setCategory(2, "Oranges", 5);

println( hist );

CumulativeHistogram hist2 = new CumulativeHistogram(3);

hist2.setCategory(0, " Apples", 4);

hist2.setCategory(1, "Bananas", 2);

hist2.setCategory(2, "Oranges", 5);

println( hist2 );

And its output:

Apples: \*\*\*\*

Bananas: \*\*

Oranges: \*\*\*\*\*

Apples: \*\*\*\*

Bananas: \*\*\*\*\*\*

Oranges: \*\*\*\*\*\*\*\*\*\*\*

Q3. Design the classes, properties, methods, and class relationships for the following problems. Present your answers as a UML class diagram.

(a) *You are to write a program to make slide shows, similar to but simpler than Powerpoint. Each slide should have a variety of components on it, such as text boxes and images. Slide shows should also have options to create themes, for example common transitions between slides and common backgrounds and styles. Add functionality to show a slideshow and navigate back and forth between slides.*

(b) *Your programming assignment describes a Processing sketch that you need to construct. Given the description of the problem in the handout, construct the UML diagram for solution as well as you possibly can.*

Q4. Study these classes:

abstract class Vehicle {

abstract public void drive();

}

class Car extends Vehicle {

public String make, model;

public void drive() {

println("a car drives");

}

}

class Minivan extends Car{

public float numSeats;

public void drive() {

println("a minivan drives");

}

}

class SportsCar extends Car{

public float topSpeed;

public void drive() {

println("a sportscar drives");

}

}

abstract class Bicycle extends Vehicle {

public String manufacturer;

public void drive() {

println("a bike is ridden");

}

}

class MountainBike extends Bicycle{

}

class Tandem extends Bicycle{

}

(a) Draw as well as you can the corresponding UML diagram

(b) Predict the output of the following code fragments, or state that there will be an error. If there is an error, state the line on which the error occurs and explain.

SportsCar myCar = new SportsCar();

myCar.drive();

myCar.make = "Ferrari";

Outcome:

Bicycle bike = new Bicycle();

bike.drive();

bike.manufacturer = "24Seven";

Outcome:

Tandem tandem = new Tandem();

tandem.manufacturer = "24Seven";

tandem.drive();

Outcome:

Vehicle vehicle = new MountainBike();

vehicle.drive();

Outcome:

SportsCar sporty = new SportsCar();

sporty.topSpeed = 210;

println( "sporty's top speed is "+sporty.topSpeed );

Outcome:

SportsCar sporty2 = new SportsCar();

Car car = sporty2;

car.topSpeed = 180;

println( "sporty2's top speed is "+car.topSpeed );

Outcome:

SportsCar sporty3 = new SportsCar();

Car car = sporty3;

((SportsCar)car).topSpeed = 250;

println( "sporty3's top speed is "+((SportsCar)car).topSpeed );

Outcome:

Minivan van = new Minivan();

van.numSeats = 8;

van.make = "Mazda";

van.model = "Estima";

van.drive();

Outcome:

Minivan van2 = new Minivan(), van3;

van3 = van2;

van3 = null;

van2.drive();

van3.drive();

Outcome:

Minivan van4 = new Minivan();

Car someCar = van4;

someCar.make="Toyota";

someCar.drive();

println("van4's make = " + van4.make );

van4.drive();

Outcome:

Q5. Imagine that you have written a function called randomPattern() that draws a certain number of random circles and a certain number of random squares on the screen. The header of the function is:

void randomPattern(int numCircles, int numSquares);

If there is something wrong with one of the parameters (i.e. if its negative), then the function should write out an error message to the console and do nothing.

Since there is effectively an infinite number of different *test cases* (a test case is one call to the function such as randomPattern(4,5)) and you can’t test every possibility, how would go about testing this function to ensure that it is correct? That is, what would your best set of test cases be?

Q6. In the PVector class, the method get() returns a *copy* of the PVector. Explain the difference between:

PVector a = new PVector(10,12);

PVector b = a;

and

PVector a = new PVector(10,12);

PVector b = a.get();

Q7. Consider this class definition, which adds a new field q to the PVector class:

public class MyVector extends PVector {

public float q;

public MyVector(float x, float y, float q) {

super(x, y);

this.q=q;

}

}

(a) What does the call to super() do? Why is there no field for x and y in the class?

(b) What is the difference between this.q and q?

Suppose you (try to) run the following code:

MyVector mine = new MyVector(230,120,33);

PVector yours = new PVector(100,100);

println(mine.dist(yours));

println(yours.dist(mine));

(c) Will it work?

(d) If there is no method dist() defined for class MyVector, what does it mean to call mine.dist()?

(e) The call to mine.dist(yours) expects a PVector as a parameter to the dist() method, but yours is not a PVector. Why does this work/not work?