IIP First Partial - ETSInf
Date: November 11th, 2013. Time: 1.5 hours.

1. 7 points An implementation of an application for managing a star catalogue is required. The class `CelestialBody` must be implemented using the following guidelines:

   a) (0.5 points) Define public constant class attributes (`static`) for representing the different types of celestial bodies to be considered, `STAR`, `NEBULA`, and `GALAXY`, with respective values 0, 1, and 2. These attributes must be employed when required.

   b) (0.5 points) Define private instance attributes for `name` (`String`), `type` (`int`), `brightness` (`double`, which represents its apparent brightness), and `distance` in light-years (`double`).

   c) (1 point) Implement two constructors:

   - One general constructor that receives the appropriate parameters in order to initialise all the instance attributes; you can suppose that all parameters have correct values.
   - One default constructor (with no parameters) that creates a `CelestialBody` with name "Sirius", type `STAR`, brightness -1.42 and distance 8.7.

   d) (0.5 points) Write the consultor `get` and modifier `set` methods the instance attribute `brightness`.

   e) (1 point) Write an `equals` method (that overrides the `equals` method of the `Object` class) to check that two `CelestialBody` objects are equal. Two `CelestialBody` are equal if and only if all their attributes are coincident.

   f) (1 point) Write a `toString` method (that overrides the `toString` method of the `Object` class) that returns a `String` with format: "`name`: `type` (`brightness`, `distance`)"; e.g., "Sirius: Star (-1.42, 8.70)". All numbers must be rounded to two decimals. Type of the celestial body must appear as "Star", "Nebula", or "Galaxy". Employ the `switch` statement.

   g) (0.5 points) Write the `absoluteMagnitude` that calculates the absolute magnitude (brightness of the celestial body for a fixed distance) by applying the following formula: $M = b + 4 \log d$, with M absolute magnitude, b apparent brightness, and d distance. Employ the `log10` method of the `Math` library for calculating the logarithm in the formula.

   h) (1 point) Write the method `moreBrilliant` that returns 1 when the current `CelestialBody` is more brilliant in absolute magnitude than another `CelestialBody` given as parameter, 0 if they have the same absolute magnitude, and -1 when given `CelestialBody` is more brilliant in absolute magnitude than the current one. Notice that absolute magnitude of the two celestial bodies must be used, since their luminosity can only be compared when they are at the same distance.

   i) (1 point) Write the method `visibleWith` that returns a `String` that describes how the celestial body can be observed, according to the following table:

Brightness	Visibility
< 5	"with the naked eye"
≥ 5 and < 7	"with binoculars"
≥ 7 and ≤ 25	"with telescope"
> 25	"with large telescope"

2. 3 points Considering the class of the previous question, **you must** implement a Java program class `TestCelestialBody` with a `main` method that performs the following operations:

   a) Create a `CelestialBody` object for the star "Alfa Centauri", with brightness 4.6 and distance 4.3 light-years. Then show its data on the screen.

   b) Create a `CelestialBody` object with name, type, brightness, and distance asked to the user. Calculate its absolute magnitude and show it on the screen.

   c) Show a message on the screen that indicates which `CelestialBody` of the two created is more brilliant according to their absolute magnitude.

Solution:

CelestialBody.java

```
public class CelestialBody {
  public final static int STAR = 0;
  public final static int NEBULA = 1;
  public final static int GALAXY = 2;
  private String name;
  private int type;
  private double brightness, distance;

  public CelestialBody(String n, int t, double b, double d) {
    name=new String(n); type=t; brightness=b; distance=d;
  }

  public CelestialBody() {
    name=new String("Sirius");
    type=STAR;
    brightness=-1.42;
    distance=8.7;
  }

  public double getBrightness() { return brightness; }
  public void setBrightness(double b) { brightness=b; }

  public boolean equals(Object o) {
    return o instanceof CelestialBody &&
           name.equals(((CelestialBody) o).name) &&
           type==((CelestialBody) o).type &&
           brightness==((CelestialBody) o).brightness &&
           distance==((CelestialBody) o).distance;
  }

  public String toString() {
    String s=name+": ";
    switch(type) {
      case STAR: s+="Star "; break;
      case NEBULA: s+="Nebula "; break;
      case GALAXY: s+="Galaxy "; break;
    }
    s+="("+Math.round(brightness*100)/100.0+", "+Math.round(distance*100)/100.0+")";
    return s;
  }

  public double absoluteMagnitude() { return brightness + 4 * Math.log10(distance); }

  public int moreBrilliant(CelestialBody c) {
    if (absoluteMagnitude()>c.absoluteMagnitude()) return 1;
    if (absoluteMagnitude()<c.absoluteMagnitude()) return -1;
    return 0;
  }

  public String visibleWith() {
    if (brightness<5) return "with the naked eye";
    if (brightness<7) return "with binoculars";
    if (brightness<=25) return "with telescope";
    return "with large telescope";
  }

}
```

CelestialBody.java

TestCelestialBody.java

```
import java.util.*;

public class TestCelestialBody {

  public static void main(String [] args) {
    Scanner kbd = new Scanner(System.in).useLocale(Locale.US);

    CelestialBody c1 = new CelestialBody("Alfa Centauri",CelestialBody.STAR,4.6,4.3);
    System.out.println(c1);

    System.out.print("Name: ");
    String name=kbd.nextLine();
    System.out.print("Type (0: star, 1: nebula, 2: galaxy): ");
    int type=kbd.nextInt();
    System.out.print("Apparent brightness: ");
    double b=kbd.nextDouble();
    System.out.print("Distance in light-years: ");
    double d=kbd.nextDouble();
    CelestialBody c2 = new CelestialBody(name,type,b,d);
    System.out.println("Absolute magnitude: "+c2.absoluteMagnitude());

    if (c1.moreBrilliant(c2)==1) System.out.println(c1+" is the most brilliant");
    else if (c1.moreBrilliant(c2)==-1) System.out.println(c2+" is the most brilliant");
    else System.out.println("Both celestial bodies present the same brightness");

  }

}
```

TestCelestialBody.java