14 credits

26956(a) Software Workshop (MSc) Autumn Term

Your submission should contain for each sub-question fully working programs in form of **.java** files including **main** methods, submitted in form of a single **zip** file. Ideally your programs run and the programs are of a high quality. But the code will be marked line by line, and anything that contributes substantially towards a correct answer will attract some of the marks. Even with minor syntactic inaccuracies full marks may be obtained. While you may want to use an IDE, you do not have to and it may actually be not a good idea if you do not have a working IDE already installed.

(a) **Computation (conditionals, loops, arrays, exceptions)**
Assume that we need for testing purposes **n** randomly generated values of type **double** in the range between **a** and **b**. Write a corresponding method **public static double[] generateTestValues(int n, double a, double b)**. If **a** is greater than **b** or **n** is negative your method should throw an **IllegalArgumentException**. Demonstrate that the code works with four well chosen examples in a **main** method. **[14 marks]**

(b) **Classes, Sub-classes**
An online shop sells items. Each item has a **price** and a **name**. Items are either DVDs or books, for a DVD the **playingTime** is given in addition, for a book the **numberOfPages**. Furthermore any item may be discounted by a **discountPercentage** between 0 (included) and 100 (excluded). Represent the situation by a suitable class structure. Each class should contain a suitable constructor and a **toString** method that presents the information in a suitable human readable form. Make use of inheritance where appropriate. Give suitable examples for the different possibilities of items (DVD versus book, and some items discounted versus some not) in **main** methods.
Important: Justify your design decisions (as Java comments). **[13 marks]**

(c) **Graphics, Graphical User Interfaces**
Two values in a fixed range (such as temperature between -10 and 40, and air pressure between 0.87 hPa and 1.09 hPA, or volume-left and volume-right for two loudspeakers) are to be displayed by two indicators as shown in Figure 1 below. You can assume that the values are already converted to angles between 0 and 90 degrees.

Using only the **Line** and **Polyline** classes write a JavaFX program to produce the corresponding display. Note that angles between **0** and **90** may need to be appropriately converted to angles between **0** and **Math.PI/2**. Note furthermore that a circle segment can be represented by a function **x -> Math.sqrt(1-x*x)**. You may wish to use for your answer the **FunctionGraph.java** example of week 8 in Term 1 (see **wk08.zip** on the Term 1 Canvas page or **https://www.cs.bham.ac.uk/~mmk/FunctionGraph.java**). Your answer must be general and work for any two angles between **0** and **90** degrees.

Figure 1: Expected display for angles **10** degrees and **45** degrees. **[13 marks]**