DEPARTMENT OF PHYSICS & ASTRONOMY
3459 EXAM-1
10:00 - 13:00 : November 11th 2008

Please read the exam guidelines, rules, instructions and marking criteria at `http://moodle.ucl.ac.uk/mod/wiki/view.php?id=13963&page=Mid-term+exam` (linked from the *Exams and coursework* page).

This exam is worth 25% of your final mark for the course and is made up of two parts:

- 15 multiple-choice questions, worth 7.5% of your final mark;
- a programming exercise, worth 17.5% of your final mark.

You should endeavour to spend no more than 30 minutes on the multiple-choice section.

Both the answers to the multiple-choice questions (in a file called `mc.txt`) and Java source code of your solution to the programming exercise should be uploaded using Moodle under the section headed “Exam 1”.

DEPARTMENT OF PHYSICS & ASTRONOMY
3459 EXAM-1
PROGRAMMING EXERCISE

Note : no knowledge of particle physics is required to answer this question.

You will write Java classes and methods to read data from two URLs, analyse the data and present the results.

Four different particle physics experiments observe a number of collisions that contain evidence of the production of Higgs bosons, called "Higgs events". The file at the following location contains a list of such events :

`http://www.hep.ucl.ac.uk/undergrad/3459/exam-data/HiggsData.txt`

Each line contains data for a single Higgs event, in the following order :

- the name of the experiment,
- the measured mass (in arbitrary units) of the Higgs boson.

In order for an experiment to claim the discovery of the Higgs boson, the number of events detected in a certain mass range must be much larger than the number expected from background processes alone. The following file :

`http://www.hep.ucl.ac.uk/undergrad/3459/exam-data/ExperimentData.txt`

contains, for each experiment, information in the following order :

- the name of the experiment,
- the minimum mass allowed for Higgs boson events,
- the maximum mass allowed for Higgs boson events,
- the expected number of background events for that mass range (not necessarily an integer).

You should write a program using appropriate classes and methods to read the data from the two URLs and store them in suitable collection objects. For each experiment you should :

- print out the number of Higgs events that fall within the mass range specified for that experiment, N_H;
- calculate and print out the "significance" parameter $(N_H - N_B)/\sqrt{N_B}$, where N_B is the expected number of background events;
- print out whether that experiment can claim discovery of the Higgs boson, which requires $(N_H - N_B)/\sqrt{N_B} > 5$.

DEPARTMENT OF PHYSICS & ASTRONOMY
3459 EXAM-1
MULTIPLE CHOICE

You should endeavour to spend no more than 30 minutes on the multiple-choice section.

DO NOT WASTE TIME CODING THE QUESTIONS TO GET THE ANSWERS

You should enter your answers to the multiple-choice questions into a text file called `mc.txt` created using a text editor such as WordPad. The file should have the following format:

```
YOUR NAME
01 a
02 b
03 c
...
14 b
15 a
```

There is exactly one correct answer to each question.

Q1 What does `private` mean in the following code extract?

```
public class AccessControl {
  private double v;
  public void setV(double d) {v = d;}
}
```

(a) The variable `v` can only be accessed from the main program.
(b) The variable `v` can only be accessed from the `AccessControl` class.
(c) The value of the variable `v` cannot be changed once it has been set.
(d) The variable `v` is stored in an encrypted form.

Q2 How many lines of output will the following line print to the screen?

```
for (int i=0; i<10; i++) {System.out.println("test");}
```

(a) 0
(b) 9
(c) 10
(d) 11

Q3 What number will the following code fragment print to the screen?

```
int x = 0;
while (x<5) x = x + 1;
System.out.println(x);
```

(a) 0
(b) 4
(c) 5
(d) 6

Q4 What will the following code fragment print to the screen?

```
String s = "1" + 1;
System.out.println(s);
```

(a) 1
(b) 2
(c) 3
(d) 11

Q5 Which of the following methods will NOT compile when incorporated into a class?

(a) `private static void funcA() {}`
(b) `private int funcB() {return 1;}`
(c) `public void funcC(int j) {}`
(d) `private double funcD() {System.out.println(1.2);}`

Q6 What number will be printed to the screen by the following program?

```
public class NoReason {
  private int nonStaticVar = 1;
  private static int staticVar = 2;
  public static void main(String[] args) {
    NoReason a = new NoReason();
    NoReason b = new NoReason();
    a.nonStaticVar = 4;
    b.staticVar = 8;
    System.out.println(a.nonStaticVar + a.staticVar);
  }
}
```

(a) 3
(b) 6
(c) 9
(d) 12

Q7 Which of the following lines would not be possible (would not compile) if inserted after the `// here` line?

```
public class Another {
  public void funcA() {System.out.println("A");}
  public static void funcB() {System.out.println("B");}
  public static void main(String[] args) {
    Another a = new Another();
    // here
  }
}
```

(a) `funcA();`
(b) `funcB();`
(c) `a.funcA();`
(d) `a.funcB();`

Q8 What is printed to the screen by the following program?

```
public class TryThis {
  private int j = 1;
  public TryThis() {}
  public TryThis(int i) {j = i;}
  public void print() {System.out.println(j);}
  public static void main(String[] args) {
    TryThis t = new TryThis(5);
    t.print();
  }
}
```

(a) `0`
(b) `1`
(c) `5`
(d) `6`

Q9 What is printed to the screen when the following program is run?

```
public class ExceptionTest {
  public static main(String[] args) {
    try {
      methodA();
    } catch (Exception e) {
      System.out.println("exception");
    } finally {
      System.out.println("finally");
    }
  }

  private void methodA() throws Exception { }
}
```

(a) nothing
(b) `exception`
(c) `exception`
`finally`
(d) `finally`

Q10 What will be printed to the screen by the following code fragment?

```
Scanner s = new Scanner("alpha beta gamma delta");
StringBuilder sb = new StringBuilder();
while (s.hasNext()) {
  sb.append(s.next().charAt(2));
}
System.out.println(sb);
```

(a) `abgd`
(b) `leae`
(c) `ptml`
(d) `gamm`

Q11 What will happen when the following code fragment is run?

```
double x = Double.parseDouble("1"); System.out.println(x);
```

(a) `one` is printed to the screen;
(b) `1.0` is printed to the screen;
(c) `x` is printed to the screen;
(d) the program crashes because a `NumberFormatException` is thrown.

Q12 What will be printed to the screen when the following code fragment is run?

```
StringBuilder sb1 = new StringBuilder();
sb1.append("A");
StringBuilder sb2 = sb1;
sb1.append("B");
System.out.println(sb2);
```

(a) `AB`
(b) `A`
(c) `B`
(d) nothing

Q13 What does this line of code do?

```
String[] q = new String[10];
```

(a) Creates an array that can hold references to 10 `String` objects.
(b) Creates an array that can hold references to 11 `String` objects.
(c) Creates a Vector that hold references to 10 `String` objects.
(d) Converts the number 10 into a `String`.

Q14 Which of the following lines will successfully create a `Vector` object and add an `Integer` element?

(a) `Vector<int> v = new Vector(); v.add(2);`
(b) `Vector<Integer> v = new Vector<Integer>(); v.add(2);`
(c) `Vector<Integer> v = new Vector<Integer>(); v[0] = 2;`
(d) `Vector<Integer> v = {2};`

Q15 What will be printed to the screen if the following code fragment is executed?

```
HashMap<Integer,String> data = new HashMap<Integer,String>();
data.put(1,"first");
data.put(2,"second");
System.out.println(data.get(1));
```

(a) `1`
(b) `2`
(c) `first`
(d) nothing since an error will occur when the code is compiled

END OF PAPER