Tick 6*

You will need to complete the optional parts described in Workbook 6 before attempting Tick 6*. In this exercise you will extend your graphical interface to the Game of Life you wrote in Workbook 6 to include an additional panel containing statistics about the configuration as it evolves. You should produce the same statistics as you computed in Tick 4*, and additionally you should include graphs showing the evolution of these statistics over the previous one hundred generations.

![Example screenshot of the statistics display](image)

**Figure 1. Example screenshot of the statistics display**

To complete this tick you should create a new package called `uk.ac.cam.your-crsid.tick6star` and implement a new class called `StatisticsPanel` which extends `JPanel`. The class should provide an implementation of a method called `update` with the following prototype:

```java
public void update(World w);
```

You should copy the code from your Tick 6 submission into your new package and update your `GuiLife` program to include the `StatisticsPanel` by adding it to the main window for the graphical interface and specifying `BorderLayout.EAST` as its layout position. You will also need to modify `GuiLife` to call `update` whenever the state of the world changes.

**Hints:**

- In order to draw arbitrary content onto a `JPanel` you need to override the `paintComponent` method (see `GamePanel.java` for an example).

- You may find it helpful to create an additional class called `Graph`, which extends `JPanel`, to hold your line graphs. In the constructor for this class set the layout manager to be an instance of `BorderLayout`. You can add a title to the graph by adding a `JLabel` with `BorderLayout.NORTH` as its layout position, and add the actual data plot (as another class extending `JPanel`) using the `BorderLayout.CENTER` layout position. This structure will ensure that your plot automatically resizes nicely if the user changes the size of the main window.

- You can find out the width of a component when drawing using the `getWidth` and `getHeight` methods.
• You can draw text on to a Graphics context using the drawString method.

• The alignment of text in a Graphics context must be done manually by adjusting the position you start drawing at. To do this you need to know the size of your text string. Here is a sample method which accepts 0, 1 or 2 (representing left, centre or right alignment) for halign (horizontal alignment) or valign (vertical alignment).

```java
protected void drawString(Graphics g, String text, int x, int y,
        int halign, int valign) {
    FontMetrics m = g.getFontMetrics();
    Rectangle2D r = m.getStringBounds(text, g);
    x -= r.getWidth() * halign / 2;
    y += r.getHeight() * valign / 2;
    g.drawString(text, x, y);
}
```

• The coordinate (0,0) is the top left pixel in a Graphics context.

To complete your tick you need to prepare a jar file with the contents of all the classes you have written in this workbook and email it to ticks1a-java@cl.cam.ac.uk. Your jar file should contain:

uk/ac/cam/your-crsid/tick6star/HelloSwingWorld.java
uk/ac/cam/your-crsid/tick6star/HelloSwingWorld.class
uk/ac/cam/your-crsid/tick6star/CommandLineOptions.java
uk/ac/cam/your-crsid/tick6star/CommandLineOptions.class
uk/ac/cam/your-crsid/tick6star/TextLife.java
uk/ac/cam/your-crsid/tick6star/TextLife.class
uk/ac/cam/your-crsid/tick6star/GuiLife.java
uk/ac/cam/your-crsid/tick6star/GuiLife.class
uk/ac/cam/your-crsid/tick6star/GamePanel.java
uk/ac/cam/your-crsid/tick6star/GamePanel.class
uk/ac/cam/your-crsid/tick6star/Strings.java
uk/ac/cam/your-crsid/tick6star/Strings.class
uk/ac/cam/your-crsid/tick6star/ControlPanel.java
uk/ac/cam/your-crsid/tick6star/ControlPanel.class
uk/ac/cam/your-crsid/tick6star/PatternPanel.java
uk/ac/cam/your-crsid/tick6star/PatternPanel.class
uk/ac/cam/your-crsid/tick6star/SourcePanel.java
uk/ac/cam/your-crsid/tick6star/SourcePanel.class
uk/ac/cam/your-crsid/tick6star/WorldImpl.java
uk/ac/cam/your-crsid/tick6star/WorldImpl.class
uk/ac/cam/your-crsid/tick6star/ArrayWorld.java
uk/ac/cam/your-crsid/tick6star/ArrayWorld.class
uk/ac/cam/your-crsid/tick6star/PackedWorld.java
uk/ac/cam/your-crsid/tick6star/PackedWorld.class
uk/ac/cam/your-crsid/tick6star/AgingWorld.java
uk/ac/cam/your-crsid/tick6star/AgingWorld.class
uk/ac/cam/your-crsid/tick6star/Pattern.java
uk/ac/cam/your-crsid/tick6star/Pattern.class
uk/ac/cam/your-crsid/tick6star/PackedLong.java
uk/ac/cam/your-crsid/tick6star/PackedLong.class
uk/ac/cam/your-crsid/tick6star/PatternLoader.java
uk/ac/cam/your-crsid/tick6star/PatternLoader.class
uk/ac/cam/your-crsid/tick6star/PatternFormatException.java
uk/ac/cam/your-crsid/tick6star/PatternFormatException.class
uk/ac/cam/your-crsid/tick6star/StatisticsPanel.java
uk/ac/cam/your-crsid/tick6star/StatisticsPanel.class