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1 Introduction

1.1 What is JFreeChart?

JFreeChart is a class library for drawing charts. It is written entirely in Java, and should run on any implementation of the Java 2 platform (SDK 1.2.2 or later). JFreeChart makes use of the Java 2D API for drawing charts, so it won’t work with earlier versions of Java. The latest version, plus any bug reports or other announcements, can be found at:

http://www.jrefinery.com/jfreechart

JFreeChart is licensed using the open-source GNU Lesser General Public Licence (LGPL). See Appendix A for details.

1.2 This Document

This document has been written for version 0.7.1 of JFreeChart.

The JFreeChart software is free, but this document is not. If you are using JFreeChart for closed-source development work, and want to use this documentation, then you are required to pay a registration fee of £30 (credit card payments are accepted via a link on the JFreeChart web page). Companies are encouraged to register multiple copies. Payment includes access to any updates to the documentation for one year from the date of registration.

You are welcome to evaluate this document before purchasing it. I rely on your honesty to pay for the documentation if you use it, as this makes life simpler for everyone. Don’t be a freeloader.

I have put in considerable effort to ensure that the information in this document is up-to-date and accurate, but I cannot guarantee that it does not contain errors. You must use this document at your own risk or not use it at all.

1.3 Acknowledgements

JFreeChart contains code and ideas from many people. At the risk of missing someone out, I would like to thank the following people for their contributions: Andrzej Porebski, Bill Kelemen, David Berry, Matthew Wright, David Li, Sylvain Vieujot, Serge V. Grachov, Jonathan Nash, Hans-Jurgen Greiner, Joao Guilherme Del Valle, Mark Watson, Soren Caspersen, Laurence Vanhelsuwe, Martin Cordova, Wolfgang Irler and Craig MacFarlane.

1.4 Comments and Suggestions

If you have any comments or suggestions regarding this document, please send e-mail to: david.gilbert@jrefinery.com
2 Sample Charts

This section shows some sample charts created using the JFreeChart demonstration application. It is intended to give a reasonable overview of the types of charts that JFreeChart can generate.

2.1 Pie Charts

JFreeChart can create *pie charts* using any data that conforms to the `PieDataset` interface:

![Pie Chart Example](image1.png)

Individual pie sections can be "exploded", and the chart can take on an elliptical shape, as shown in the next example:

![Pie Chart Example](image2.png)

The original pie chart implementation was contributed by Andrzej Porebski.

2.2 Bar Charts

A range of bar charts can be created with JFreeChart, using any data that conforms to the `CategoryDataset` interface.

The first example is a *horizontal bar chart*:

![Bar Chart Example](image3.png)
Using exactly the same data, but changing the orientation, we can generate a vertical bar chart:

Vertical bar charts can be displayed with a 3D effect (thanks to Serge Grachov):

The bars can be stacked in a stacked horizontal bar chart:
...and similarly a stacked vertical bar chart:

The stacked vertical bar chart can be displayed with a 3D effect (again thanks to Serge Grachov):

2.3 Line Chart

The line chart is generated using the same CategoryDataset that is used for the bar charts:
The data is the same, but the line chart gives you another presentation option.

2.4 XY Plots

A third type of dataset, the XYDataset, is used to generate further chart types. The standard XY plot has numerical x and y axes. By default, lines are drawn between each data point:

Shapes can be drawn at data points, rather than drawing lines between data points, for a scatter plot:

JFreeChart supports time series charts:
It is possible to add a moving average line to a time series plot:

You can display high-low-open-close data (thanks to Andrzej Porebski), using HighLowDataset (an extension of XYDataset):

Bar charts over a numerical domain can be drawn using IntervalXYDataset (another extension of XYDataset):
2.5 Combined Charts

Bill Kelemen has extended JFreeChart to allow for combined charts, including overlaid charts:

...horizontally combined charts:

...vertically combined charts:
2.6 Future Development

Given the open development model of JFreeChart, it is likely that many more chart types will be developed in the future as developers modify JFreeChart to meet their requirements. Check the JFreeChart web-page for updates:

http://www.jrefinery.com/jfreechart
3 Downloading and Installing JFreeChart

3.1 Download
You can download the latest version of JFreeChart from:

http://www.jrefinery.com/jfreechart

There are two versions of the JFreeChart download:

<table>
<thead>
<tr>
<th>File:</th>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>jfreechart-0.7.1.tar.gz</td>
<td>JFreeChart for Linux/Unix.</td>
</tr>
<tr>
<td>jfreechart-0.7.1.zip</td>
<td>JFreeChart for Windows.</td>
</tr>
</tbody>
</table>

The two files contain the same source code. All the text files in the Windows download have been recoded into DOS format (both carriage return and line feed at the end of each line).

JFreeChart uses the JCommon Class Library (currently version 0.5.3). The JCommon runtime jar file is included in the JFreeChart download, but if you require the source code (recommended) then you should also download JCommon from:

http://www.jrefinery.com/jcommon

There is a separate PDF document for JCommon, which includes full instructions for downloading and unpacking the files.

3.2 Unpacking the Files
After downloading JFreeChart, you need to unpack the files. You should move the download file to a convenient directory—when you unpack JFreeChart, a new subdirectory will be created in the same location as the download file.

3.2.1 Unpacking on Linux/Unix
To extract the files from the download on Linux/Unix, enter the following command:

    tar xzvf jfreechart-0.7.1.tar.gz

This will extract all the source, run-time and documentation files for JFreeChart into a new directory called jfreechart-0.7.1.

3.2.2 Unpacking on Windows
To extract the files from the download on Windows, enter the following command:

    jar -xvf jfreechart-0.7.1.zip

This will extract all the source, run-time and documentation files for JFreeChart into a new directory called jfreechart-0.7.1.
3.2.3 The Files

The top-level directory (`jfreechart-0.7.1`) contains two files and four subdirectories, as described in the following table:

<table>
<thead>
<tr>
<th>File/Directory</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>jars</td>
<td>A directory containing the JFreeChart and JCommon runtime jar files.</td>
</tr>
<tr>
<td>javadoc</td>
<td>A directory containing the Javadoc HTML files.</td>
</tr>
<tr>
<td>licence-LGPL.txt</td>
<td>The licence for JFreeChart.</td>
</tr>
<tr>
<td>README</td>
<td>Important information - read this first!</td>
</tr>
<tr>
<td>servlet</td>
<td>A directory containing files required for the servlet demonstration.</td>
</tr>
<tr>
<td>source</td>
<td>A directory containing the source code for JFreeChart.</td>
</tr>
</tbody>
</table>

You should spend some time familiarising yourself with the files included in the download. In particular, you should always read the README file.

3.3 Running the Demonstration Application

A demonstration application is included with JFreeChart, to give you some idea of what the class library can do. It is not necessary to recompile the library to run the demonstration application. All the classes are precompiled in the jar files.

To run the demo, type the following command¹ all on one line:

```
java -classpath jfreechart-0.7.1.jar:jcommon-0.5.3.jar com.jrefinery.chart.demo.JFreeChartDemo
```

Depending on your system setup, you may need to specify the full path for the java executable. You may also need to type the full path to the JFreeChart and JCommon jar files.

3.4 Compiling the Source

You can recompile the source files (contained in the source folder) using the javac tool, although it’s recommended that you set up a project in your favourite development environment.

At the command line, change to the source directory, then type the following command:

```
javac -g:none -O -verbose -classpath .:../jars/jcommon-0.5.3.jar com/jrefinery/chart/demo/JFreeChartDemo.java
```

This compiles the demonstration application and all the JFreeChart classes (javac compiles each class for which it cannot find a .class file provided that it can find the corresponding .java source file). The class files are written to the same directories as the source files.

¹If you are using Windows, you should use a semi-colon rather than a colon to separate the jar files.
3.5 Generating the Javadoc Documentation

The JFreeChart source code contains comprehensive Javadoc comments. You can use the javadoc tool to generate HTML documentation files directly from the source code.

To generate the documentation, enter the following command:

```
javadoc -sourcepath <your-source-directory> -d <your-output-directory>
com.jrefinery.chart com.jrefinery.chart.event com.jrefinery.chart.ui
```
4 Developing with JFreeChart

This section presents a tutorial on how to use the JFreeChart class library in your own projects.

4.1 Overview

The JFreeChart class coordinates the entire process of drawing charts. One method:

```java
public void draw(Graphics2D g2, Rectangle2D area, DrawInfo info);
```

...instructs the JFreeChart object to draw a chart onto a specific area on a graphics device.²

In broad terms, JFreeChart achieves this by obtaining data from a Dataset, and delegating the drawing to a Plot object.

The JFreeChart class can work with many different dataset implementations, and even more Plot subclasses. The following table summarises the combinations that are currently available:

<table>
<thead>
<tr>
<th>Dataset:</th>
<th>Compatible Plot Types:</th>
</tr>
</thead>
<tbody>
<tr>
<td>PieDataset</td>
<td>PiePlot.</td>
</tr>
<tr>
<td>CategoryDataset</td>
<td>HorizontalBarPlot, VerticalBarPlot, LinePlot, StackedHorizontalBarPlot, StackedVerticalBarPlot.</td>
</tr>
<tr>
<td>XYDataset</td>
<td>XYPlot with various renderers.</td>
</tr>
<tr>
<td>IntervalXYDataset</td>
<td>VerticalXYBarPlot.</td>
</tr>
<tr>
<td>HighLowDataset</td>
<td>XYPlot with a HighLowRenderer.</td>
</tr>
<tr>
<td>CandleStickDataset</td>
<td>XYPlot with a CandleStickRenderer.</td>
</tr>
</tbody>
</table>

There are a lot of combinations, but don’t worry, just keep in mind that a chart usually has one Dataset and one Plot.

4.2 Creating Your First Chart

To illustrate, let’s create a pie chart using JFreeChart. First, we need to create a dataset. The DefaultPieDataset class in the JCommon Class Library is designed just for this purpose:

```java
// create a dataset...
DefaultPieDataset data = new DefaultPieDataset();
data.setValue("Category 1", new Double(43.2));
data.setValue("Category 2", new Double(27.9));
data.setValue("Category 3", new Double(79.5));
```

Next, we need to create a chart. A convenient way to do this in JFreeChart is to use the ChartFactory class:

```java
// create a chart...
JFreeChart chart = ChartFactory.createPieChart("Sample Pie Chart", data, true);
```

²Java supports several graphics devices—including the screen, the printer, and buffered images—via different implementations of java.awt.Graphics2D. Thanks to this abstraction, JFreeChart can generate charts on any of these target devices, as well as others implemented by third parties (for example, the SVG Generator of the Batik Project).
Notice how we have passed a reference to the dataset to the factory method. The chart object retains this reference so that it can obtain data later on when it is drawing the chart.

Now we have a chart, but we don’t yet have anywhere to draw it. Let’s create a frame to display the chart in. The JFreeChartFrame class already knows how to display charts:

```java
// create and display a frame...
JFreeChartFrame frame = new JFreeChartFrame("Test", chart);
frame.pack();
frame.setVisible(true);
```

And that’s all there is to it...here is the complete program, so that you know which packages you need to import:

```java
package com.jrefinery.chart.demo;
import com.jrefinery.data.DefaultPieDataset;
import com.jrefinery.chart.ChartFactory;
import com.jrefinery.chart.JFreeChart;
import com.jrefinery.chart.JFreeChartFrame;
public class First {
    public static void main(String[] args) {
        // create a dataset...
        DefaultPieDataset data = new DefaultPieDataset();
        data.setValue("Category 1", new Double(43.2));
        data.setValue("Category 2", new Double(27.9));
        data.setValue("Category 3", new Double(79.5));
        // create a chart...
        JFreeChart chart = ChartFactory.createPieChart("Sample Pie Chart", data, true);
        // create and display a frame...
        JFreeChartFrame frame = new JFreeChartFrame("Test", chart);
        frame.pack();
        frame.setVisible(true);
    }
}
```

Hopefully this has convinced you that it is not difficult to create and display charts with JFreeChart. Of course, there is much more to learn...

### 4.3 More about Datasets

In the previous section, we used the DefaultPieDataset class to supply data for our chart. JFreeChart can work with this class, because it implements the PieDataset interface. Take a look at this interface now, by looking at the source code or the Javadoc HTML pages for the JCommon Class Library, or in the reference section towards the end of this document.

All of the datasets used by JFreeChart are defined by interfaces. This allows you to implement your own dataset using whatever data structures make sense for your own project. Of course, there are default classes available (in the JCommon Class Library) that implement each of the interfaces used by JFreeChart. You are free to use these default implementations.

---

3One of the many advantages of open source software is that you can always refer to the source code to find out how things work.
4.4 Customising Charts

After you create a chart, you may want to change some of its attributes. In this section I describe some common chart customisations.

4.4.1 Adding Chart Titles

Charts are created with only one title (or sometimes no title at all). It is relatively simple, however, to add more titles and subtitles to the chart, using the following method in the JFreeChart class:

```java
public void addTitle(AbstractTitle title);
```

Adds a title to the chart.

The title is some concrete subclass of `AbstractTitle`, for example `TextTitle`. The placement of the title at the top, bottom, left or right of the chart is controlled by a property of the title itself.

You can add as many titles as you like to a chart, but keep in mind that as you add more titles there will be less and less space available for plotting data.

4.4.2 Modifying Chart Titles

To modify a title that has already been added to a chart, you can make use of the following methods in the JFreeChart class:

```java
public AbstractTitle getTitle(int index);
```

Returns a title from the chart’s list of titles. Note that the index is zero-based.

```java
public List getTitles();
```

Returns the complete list of titles for the chart.

You will need to cast the title to an appropriate class before you can change its properties.

4.4.3 Changing Plot Properties

You can change many properties associated with the chart’s plot and axes. First, you need to get a reference to the `Plot` using the following method in the JFreeChart class:

```java
public Plot getPlot();
```

Returns a reference to the chart’s plot.

Properties that are common to all plot types can be changed easily. For example, to change the colors used for the series in a plot:

```java
Plot plot = myChart.getPlot();
plot.setSeriesPaint(myPaintArray);
```

Some properties can only be changed after you have cast the result of the `getPlot()` method to an appropriate subclass of `Plot`. For example, if you want to set the gaps between the bars in a bar plot, you will need to use something like this:
BarPlot plot = (BarPlot)myChart.getPlot();
plot.setCategoryGapsPercent(0.10);

Refer to the documentation for the individual Plot subclasses for more information about the properties that you can change.

4.4.4 Changing Axis Properties

You can change the properties of the axes by getting a reference to the axis from the Plot as follows:

Plot plot = myChart.getPlot();
Axis hAxis = plot.getHorizontalAxis();
hAxis.setLabel("Categories");
hAxis.setLabelFont(someFont);

As with the plot, some properties can only be changed after you have cast the result of the getHorizontalAxis() method to some appropriate subclass of Axis.
5 Special Topics

This section presents special topics related using the JFreeChart class library in your own projects.

5.1 Scalable Vector Graphics

5.1.1 Introduction

Scalable Vector Graphics (SVG) is a standard language for describing two-dimensional graphics in XML format. It is a Recommendation of the World Wide Web Consortium (W3C).

Thanks to some excellent work by developers in The Apache XML Project, you can use the Batik SVG Toolkit to write charts, created using JFreeChart, to SVG format. The Batik SVG Toolkit is an open source toolkit written in Java, available from:

http://xml.apache.org/batik

At the time of writing, the latest version of Batik is 1.1.1.

5.1.2 Batik and JFreeChart

Getting JFreeChart to work with Batik is relatively painless. I’ve only spent a limited amount of time working with Batik, so I’m no expert, but here I will describe a simple program that creates a chart and saves it in SVG format in a file. Hopefully this will be enough to get you started.

First, you should download Batik and install it according to the instructions provided on the Batik web page.

Next, create a project in your favourite Java development environment, and type in the following program:

```java
package svgtest;
import com.jrefinery.data.DefaultPieDataset;
import com.jrefinery.chart.JFreeChart;
import com.jrefinery.chart.ChartFactory;
import java.awt.geom.Rectangle2D;
import java.io.*;
import org.apache.batik.svggen.SVGGraphics2D;
import org.apache.batik.dom.GenericDOMImplementation;
import org.w3c.dom.Document;
import org.w3c.dom.DOMImplementation;
public class Application {
    public static void main(String[] args) throws IOException {
        // create a dataset...
        DefaultPieDataset data = new DefaultPieDataset();
        data.setValue("Category 1", new Double(43.2));
        data.setValue("Category 2", new Double(27.9));
        data.setValue("Category 3", new Double(79.5));
        // create a chart
        JFreeChart chart = ChartFactory.createPieChart("Sample Pie Chart", data, true);
        // THE FOLLOWING CODE BASED ON THE EXAMPLE IN THE BATIK DOCUMENTATION...
    }
}
```
Get a DOMImplementation
DOMImplementation domImpl = GenericDOMImplementation.getDOMImplementation();

Create an instance of org.w3c.dom.Document
Document document = domImpl.createDocument(null, "svg", null);

Create an instance of the SVG Generator
SVGGraphics2D svgGenerator = new SVGGraphics2D(document);

Ask the chart to render into the SVG Graphics2D implementation
chart.draw(svgGenerator, new Rectangle2D.Double(0, 0, 400, 300));

Finally, stream SVG to a file using UTF-8
// character to byte encoding
boolean useCSS = true; // we want to use CSS style attribute
Writer out = new OutputStreamWriter(new FileOutputStream(new File("test.svg")),
  "UTF-8");
svgGenerator.stream(out, useCSS);
}
})

To compile the program, you need to ensure that the following jar files are on
your classpath:

<table>
<thead>
<tr>
<th>File:</th>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>jcommon-0.5.3.jar</td>
<td>Common classes from JRefinery.</td>
</tr>
<tr>
<td>jfreechart-0.7.1.jar</td>
<td>The JFreeChart class library.</td>
</tr>
<tr>
<td>batik-awt-util.jar</td>
<td>Batik runtime files.</td>
</tr>
<tr>
<td>batik-dom.jar</td>
<td>Batik runtime files.</td>
</tr>
<tr>
<td>batik-ext.jar</td>
<td>Batik runtime files.</td>
</tr>
<tr>
<td>batik-svgen.jar</td>
<td>Batik runtime files.</td>
</tr>
<tr>
<td>batik-util.jar</td>
<td>Batik runtime files.</td>
</tr>
<tr>
<td>batik-xml.jar</td>
<td>Batik runtime files.</td>
</tr>
</tbody>
</table>

Running this program creates a file test.svg in SVG format.

5.1.3 Viewing the SVG

Batik includes a viewer application which you can use to open the SVG file:
If you play about with the viewer, zooming in and out and transforming the chart, you will begin to appreciate the power of the SVG format.
6 Package Overview

The following sections contain reference information for the packages that make up JFreeChart.

<table>
<thead>
<tr>
<th>Package:</th>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>com.jrefinery.chart</td>
<td>The main chart classes.</td>
</tr>
<tr>
<td>com.jrefinery.chart.combination</td>
<td>Combination charts.</td>
</tr>
<tr>
<td>com.jrefinery.chart.data</td>
<td>Some data fitting classes (to be moved).</td>
</tr>
<tr>
<td>com.jrefinery.chart.event</td>
<td>The event classes.</td>
</tr>
<tr>
<td>com.jrefinery.chart.tooltips</td>
<td>The tooltip classes.</td>
</tr>
<tr>
<td>com.jrefinery.chart.ui</td>
<td>User interface classes.</td>
</tr>
<tr>
<td>com.jrefinery.chart.demo</td>
<td>The demonstration application.</td>
</tr>
</tbody>
</table>

Additional information can be found in the Javadoc-generated HTML documentation for JFreeChart.
7 Package: com.jrefinery.chart

This package contains the major classes and interfaces in the JFreeChart class library.

7.1 AbstractTitle

7.1.1 Overview
The base class for all chart titles. Several concrete sub-classes have been implemented, including: TextTitle, DateTitle and ImageTitle.

The JFreeChart class maintains a list of titles, which can hold zero, one or many titles.

7.1.2 Constructors
The default constructor:

    protected AbstractTitle(int position, int horizontalAlignment, int verticalAlignment, Insets insets);

Creates a new AbstractTitle.

7.1.3 Notes
The original version of this class was written by David Berry. I’ve since made a few changes to the original version, but the idea for allowing a chart to have multiple titles came from David.

This class implements Cloneable, which is useful when editing title properties because you can edit a copy of the original, and then either apply the changes or cancel the changes.

See Also
    ImageTitle, TextTitle.

7.2 Axis

7.2.1 Overview
An abstract class representing an axis (horizontal or vertical). The Plot class is responsible for maintaining references to axes.

The following diagram shows all the subclasses of Axis:
7.2.2 Constructors

To create a new Axis:

protected Axis(String label);

Creates a new Axis, with the specified label.

7.2.3 Attributes

The Axis class has the following attributes:

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plot</td>
<td>The plot that the axis belongs to.</td>
</tr>
<tr>
<td>Label</td>
<td>The axis label.</td>
</tr>
<tr>
<td>LabelFont</td>
<td>The font for the axis label.</td>
</tr>
<tr>
<td>LabelPaint</td>
<td>The color for the axis label.</td>
</tr>
<tr>
<td>LabelInsets</td>
<td>The space to leave blank around the axis label.</td>
</tr>
<tr>
<td>TickLabelsVisible</td>
<td>A flag controlling the visibility of tick labels.</td>
</tr>
<tr>
<td>TickLabelFont</td>
<td>The font for the tick labels.</td>
</tr>
<tr>
<td>TickLabelPaint</td>
<td>The color for the tick labels.</td>
</tr>
<tr>
<td>TickLabelInsets</td>
<td>The space to leave around the tick labels.</td>
</tr>
<tr>
<td>TickMarksVisible</td>
<td>A flag controlling the visibility of tick marks.</td>
</tr>
<tr>
<td>TickMarkStroke</td>
<td>The stroke used to draw the tick marks.</td>
</tr>
</tbody>
</table>

The following default values are used for attributes wherever necessary:

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEFAULT_AXIS_LABEL_FONT</td>
<td>new Font(&quot;SansSerif&quot;, Font.PLAIN, 14);</td>
</tr>
<tr>
<td>DEFAULT_AXIS_LABEL_PAINT</td>
<td>Color.black;</td>
</tr>
<tr>
<td>DEFAULT_AXIS_LABELInsets</td>
<td>new Insets(2, 2, 2, 2);</td>
</tr>
<tr>
<td>DEFAULT_TICK_LABEL_FONT</td>
<td>new Font(&quot;SansSerif&quot;, Font.PLAIN, 10);</td>
</tr>
<tr>
<td>DEFAULT_TICK_LABEL_PAINT</td>
<td>Color.black;</td>
</tr>
<tr>
<td>DEFAULT_TICK_LABELInsets</td>
<td>new Insets(2, 1, 2, 1);</td>
</tr>
<tr>
<td>DEFAULT_TICK_STROKE</td>
<td>new BasicStroke(1);</td>
</tr>
</tbody>
</table>

7.2.4 Notes

The Axis class implements a notification mechanism that informs registered listeners that a change has been made to an axis. The following methods are used:
public void addChangeListener(AxisChangeListener listener);
Registers an object to receive notification whenever the axis changes.

public void removeChangeListener(AxisChangeListener listener);
Deregisters an object, so that it no longer receives notification when the axis changes.

public void notifyListeners(AxisChangeEvent event);
Notifies all registered listeners that a change has been made to the axis.

The axis class also implements a utility method for drawing vertical text:

protected void drawVerticalString(String text, Graphics2D g2, float x, float y);
Draws text at the specified location, running from the bottom to the top of the screen. This method is used to draw axis labels.

See Also
AxisChangeEvent, AxisChangeListener, AxisNotCompatibleException.

7.3 AxisNotCompatibleException

7.3.1 Overview
An exception that indicates that an attempt has been made to assign an axis to a Plot where the axis is not compatible with the plot type (for example, a VerticalCategoryAxis will not work with an XYPlot).

7.3.2 Constructors
To create a new exception:

public AxisNotCompatibleException(String message);
Creates a new exception.

7.3.3 Notes
The AxisNotCompatibleException is a subclass of RuntimeException.

See Also
PlotNotCompatibleException.

7.4 Bar

7.4.1 Overview
A utility class for representing a bar in a BarPlot.

7.4.2 Notes
Used temporarily during the drawing process only.

4This method may get moved elsewhere as it has uses beyond drawing labels for axes.
See Also

BarPlot.

7.5 BarPlot

7.5.1 Overview

A base class for generating bar plots—extends Plot and implements CategoryPlot. In the current implementation, there are two concrete subclasses: HorizontalBarPlot and VerticalBarPlot.

This class implements the CategoryPlot interface, which enables the category axis to query the bar plot for the positioning of categories.

7.5.2 Constructors

There are two constructors for BarPlot—the first requires all properties to be specified, the second assumes default values for most properties. Refer to the Javadoc or the source code for details.

```java
protected BarPlot(Axis horizontalAxis, Axis verticalAxis);
```

Creates a new BarPlot.

7.5.3 Attributes

The BarPlot class has the following attributes:

<table>
<thead>
<tr>
<th>Attribute:</th>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>IntroGapPercent</td>
<td>The space before the first bar.</td>
</tr>
<tr>
<td>TrailGapPercent</td>
<td>The space after the last bar.</td>
</tr>
<tr>
<td>CategoryGapsPercent</td>
<td>The space between the last bar in one category, and the first bar in the next category.</td>
</tr>
<tr>
<td>ItemGapsPercent</td>
<td>The space between two bars in the same category.</td>
</tr>
<tr>
<td>ToolTipGenerator</td>
<td>The tooltip generator (optional).</td>
</tr>
</tbody>
</table>

This diagram illustrates the purpose of the "gap" attributes:

![Diagram illustrating gap attributes]

The following default values are used for attributes wherever necessary:

<table>
<thead>
<tr>
<th>Name:</th>
<th>Value:</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEFAULT_INTRO_GAP_PERCENT</td>
<td>0.05 (5 percent)</td>
</tr>
<tr>
<td>DEFAULT_TRAIL_GAP_PERCENT</td>
<td>0.05 (5 percent)</td>
</tr>
<tr>
<td>DEFAULT_CATEGORY_GAPS_PERCENT</td>
<td>0.20 (20 percent)</td>
</tr>
<tr>
<td>DEFAULT_ITEM_GAPS_PERCENT</td>
<td>0.15 (15 percent)</td>
</tr>
</tbody>
</table>
7.5.4 Notes
The BarPlot subclasses are tooltip enabled.

See Also
HorizontalBarPlot, VerticalBarPlot.

7.6 CandlestickRenderer
7.6.1 Overview
Renders data for an XYPlot in the form of candlesticks. Implements the XYItemRenderer interface.

7.6.2 Constructors
To create a new renderer:

    public CandlestickRenderer(double candleWidth);

    Creates a new renderer.

7.6.3 Notes
This renderer requires a HighLowDataset.

See Also
XYItemRenderer.

7.7 CategoryAxis
7.7.1 Overview
An abstract base class for axes that display labels for categorical data.
CategoryAxis extends Axis. Known subclasses include HorizontalCategoryAxis and VerticalCategoryAxis.

7.7.2 Notes
Note that this class doesn’t add anything to Axis—it occupies its place in the class hierarchy purely for descriptive purposes.

See Also
Axis.

7.8 CategoryPlot
7.8.1 Overview
An interface that should be implemented by any subclass of Plot that displays categorical data. It allows the axis to determine the position of each category, so that it can place the category labels correctly. Plots can vary in the way they distribute categories along an axis.
7.8.2 Methods
The interface defines the following methods:

```java
public List getCategories();
Returns an ordered list of the categories
```

```java
public double getCategoryCoordinate(int category, Rectangle2D area);
Returns the coordinate (horizontal or vertical depending on the plot) of
the center of the specified category.
```

```java
public CategoryDataset getDataset();
A convenience method that returns the dataset as a CategoryDataset.
```

7.8.3 Notes
The CategoryDataset interface is part of the JCommon Class Library.

See Also
CategoryAxis.

7.9 ChartFactory
7.9.1 Overview
This class provides a range of static methods for constructing charts. These
methods make it easier to create charts with default properties.

7.9.2 Methods

```java
public static JFreeChart createPieChart(String title, PieDataset data,
boolean legend);
Creates a pie chart for the given PieDataset.
```

```java
public static JFreeChart createVerticalBarChart(String title,
String categoryAxisLabel, String valueAxisLabel, CategoryDataset data,
boolean legend);
Creates a vertical bar chart for the given CategoryDataset.
```

```java
public static JFreeChart createVerticalBarChart3D(String title,
String categoryAxisLabel, String valueAxisLabel, CategoryDataset data,
boolean legend);
Creates a vertical bar chart with 3D effect for the given CategoryDataset.
```

```java
public static JFreeChart createStackedVerticalBarChart(String title,
String categoryAxisLabel, String valueAxisLabel, CategoryDataset data,
boolean legend);
Creates a stacked vertical bar chart for the given CategoryDataset.
```

```java
public static JFreeChart createStackedVerticalBarChart3D(String title,
String categoryAxisLabel, String valueAxisLabel, CategoryDataset data,
boolean legend);
Creates a stacked vertical bar chart with 3D effect for the given CategoryDataset.
```
public static JFreeChart createHorizontalBarChart(String title, String categoryAxisLabel, String valueAxisLabel, CategoryDataset data, boolean legend);  
Creates a horizontal bar chart for the given CategoryDataset.

public static JFreeChart createStackedHorizontalBarChart(String title, String categoryAxisLabel, String valueAxisLabel, CategoryDataset data, boolean legend);  
Creates a stacked horizontal bar chart for the given CategoryDataset.

public static JFreeChart createLineChart(String title, String categoryAxisLabel, String valueAxisLabel, CategoryDataset data, boolean legend);  
Creates a line chart for the given CategoryDataset.

public static JFreeChart createXYChart(String title, String xAxisLabel, String yAxisLabel, XYDataset data, boolean legend)  
Creates an XY plot for the given XYDataset.

public static JFreeChart createScatterPlot(String title, String xAxisLabel, String yAxisLabel, XYDataset data, boolean legend)  
Creates a scatter plot for the given XYDataset.

public static JFreeChart createTimeSeriesChart(String title, String timeAxisLabel, String valueAxisLabel, XYDataset data, boolean legend)  
Creates a time series chart for the given XYDataset.

public static JFreeChart createVerticalXYBarChart(String title, String xAxisLabel, String yAxisLabel, IntervalXYDataset data, boolean legend)  
Creates a vertical XY bar chart for the given IntervalXYDataset.

public static JFreeChart createHighLowChart(String title, String timeAxisLabel, String valueAxisLabel, HighLowDataset data, boolean legend)  
Creates a high-low-open-close chart for the given HighLowDataset.

public static JFreeChart createCandlestickChart(String title, String timeAxisLabel, String valueAxisLabel, HighLowDataset data, boolean legend)  
Creates a candlestick chart for the given HighLowDataset.

7.9.3 Notes
These methods are provided for convenience only. You are not required to use them.

See Also
JFreeChart.

7.10 ChartUtilities
7.10.1 Overview
This class contains some useful methods for use with charts.
7.10.2 Methods

The methods include:

```java
public static void saveChartAsPNG(File file, JFreeChart chart, int width,
int height);
Saves a chart to a PNG format image file.
```

```java
public static void saveChartAsJPEG(File file, JFreeChart chart, int width,
int height);
Saves a chart to a JPEG format image file.
```

7.10.3 Notes

PNG tends to be a better format for charts than JPEG since the compression is "lossless" for PNG.

See Also

JFreeChart.

7.11 DateAxis

7.11.1 Overview

The base class for axes that display date/time values—extends Axis. This class is designed to be flexible about the range of dates/times that it can display—anything from several milliseconds to several decades should be handled.

7.11.2 Constructors

This class has two constructors—the first requires all properties to be specified, while the second assumes default values for many properties.

7.11.3 Attributes

DateAxis defines the following properties:

<table>
<thead>
<tr>
<th>Attribute:</th>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>minimumDate</td>
<td>The minimum date (or time) visible on the axis.</td>
</tr>
<tr>
<td>maximumDate</td>
<td>The maximum date (or time) visible on the axis.</td>
</tr>
<tr>
<td>tickUnits</td>
<td>The DateUnit used for tick marks.</td>
</tr>
<tr>
<td>tickLabelFormatter</td>
<td>The SimpleDateFormat object used to format the tick labels.</td>
</tr>
</tbody>
</table>

7.11.4 Notes

In the current implementation, there is one subclass: HorizontalDateAxis, which can be used with an XYPlot to present time series data.

See Also

HorizontalDateAxis, DateUnit.
7.12 DateTitle

7.12.1 Overview
A chart title that displays the current date. Since charts can have multiple titles, this class enables the current date to be added in various positions relative to the chart (often at the bottom).

7.12.2 Notes
The original version of this class was written by David Berry (dberry@dallas.net).

See Also
AbstractTitle.

7.13 DateUnit

7.13.1 Overview
Represents a fixed unit of time. This class is used to specify the tick units on a DateAxis.

7.13.2 Constructors
The constructor:

```java
public DateUnit(int field, int count);
```
Creates a new DateUnit.

The `field` attribute is one of the following:

<table>
<thead>
<tr>
<th>Time Unit</th>
<th>Constant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>Calendar.YEAR</td>
</tr>
<tr>
<td>Month</td>
<td>Calendar.MONTH</td>
</tr>
<tr>
<td>Day</td>
<td>Calendar.DATE</td>
</tr>
<tr>
<td>Hour</td>
<td>Calendar.HOUR_OF_DAY</td>
</tr>
<tr>
<td>Minute</td>
<td>Calendar.MINUTE</td>
</tr>
<tr>
<td>Second</td>
<td>Calendar.SECOND</td>
</tr>
<tr>
<td>Millisecond</td>
<td>Calendar.MILLISECOND</td>
</tr>
</tbody>
</table>

7.13.3 Notes
Refer to the Javadoc HTML files and source code for details.

See Also
DateAxis.

7.14 HighLow

7.14.1 Overview
Not yet documented.
7.14.2 Notes
Refer to Javadoc HTML files and source code for details.

7.15 HighLowRenderer
7.15.1 Overview
A renderer that can be used with the XYPlot class and a HighLowDataset to create high-low-open-close charts.

7.15.2 Notes
Refer to Javadoc HTML files and source code for details.

See Also
XYPlot.

7.16 HorizontalAxis
7.16.1 Overview
An interface that must be implemented by all horizontal axes. The methods defined by this interface are used by the Plot that owns the axis, for layout purposes.

7.16.2 Methods
The interface defines two methods. The plot will call one of these two methods, depending on the implementation.

```java
public Rectangle2D reserveAxisArea(Graphics2D g2,
Plot plot, Rectangle2D drawArea, double reservedWidth);
Calculates the area that the horizontal axis requires to draw itself. If this method is used, it will be called after the vertical axis has determined the width that it requires—the argument reservedWidth contains this value.

public double reserveHeight(Graphics2D g2, Plot plot,
Rectangle2D drawArea);
Estimates the height that the horizontal axis requires to draw itself. If this method is used, it will be called before the vertical axis is asked to calculate the area that it requires—the height returned by this method will be passed to the vertical axis.
```

See Also
VerticalAxis.

7.17 HorizontalBarPlot
7.17.1 Overview
This plot draws a bar chart using data from a CategoryDataset, where the categories are plotted against the vertical axis and the numerical data is plotted against the vertical axis.
7.17.2 Constructors
This class provides two constructors—one that requires all the attributes for the plot to be specified, the other assumes a number of default values. Refer to the Javadoc or the source code for details.

7.17.3 Methods
Some notes on the methods for HorizontalBarPlot:

```
public double getCategoryCoordinate(...);
```
This method returns the y-coordinate of the center of the specified category. The category axis will call this method to determine where to place the category labels, because it has no knowledge of the distribution of categories (these could vary, depending on the nature of the plot).

See Also
BarPlot, HorizontalValuePlot, VerticalBarPlot.

7.18 HorizontalBarRenderer
7.18.1 Overview
Not yet documented.

7.18.2 Notes
Refer to Javadoc HTML files and source code for details.

7.19 HorizontalCategoryAxis
7.19.1 Overview
A horizontal axis that displays labels for categorical data. This class extends CategoryAxis and implements HorizontalAxis.

7.19.2 Constructors
There are two constructors defined, one that sets up the axis with mostly default properties, and another that requires the caller to specify all the properties for the axis. Refer to the Javadoc or the source code for details.

```
public HorizontalCategoryAxis(String label);
```
Creates a new axis, using default values where necessary.

7.19.3 Attributes
The axis can display category labels with a horizontal or vertical orientation—this is controlled by the VerticalCategoryLabels attribute. The remaining properties for this class are inherited from CategoryAxis.
7.19.4 Notes

In the current implementation, this class can be used with LinePlot and VerticalBarPlot.

This class relies on the Plot to implement the CategoryPlot interface. This is because the axis has no control over the visual presentation of the data—in particular, the axis cannot know how the categories are to be distributed along the axis, so it must query the Plot via the defined interface.

See Also
CategoryAxis, VerticalCategoryAxis.

7.20 HorizontalCategoryItemRenderer

7.20.1 Overview

Not yet documented.

7.20.2 Notes

Refer to Javadoc HTML files and source code for details.

7.21 HorizontalDateAxis

7.21.1 Overview

An axis that displays numerical data in date format—this class extends DateAxis and implements HorizontalAxis.

7.21.2 Attributes

The axis can display category labels with a horizontal or vertical orientation—this is controlled by the verticalTickLabels property.

The remaining properties for this class are inherited from DateAxis. Although the axis displays dates for tick labels, it is still working with Number objects. The numbers are interpreted as the number of milliseconds since 1 January 1970 (that is, the encoding used by java.util.Date).

See Also
DateAxis.

7.22 HorizontalNumberAxis

7.22.1 Overview

An horizontal axis that displays numerical data—this class extends NumberAxis and implements HorizontalAxis.
7.22.2 Constructors

There are three constructors for this class. One requires the caller to specify all the axis properties, while the other two use some default properties. Refer to the Javadoc or the source code for details.

7.22.3 Methods

Some notes on the methods in HorizontalNumberAxis:

- `public void autoAdjustRange();` Obtains the minimum and maximum data values from the Plot, provided that it implements HorizontalValueRange, and adjusts the axis range accordingly. Note that the autoRangeIncludesZero flag is checked in this method.

- `public void refreshTicks(...);` A utility method for calculating the positions of the ticks on an axis, just prior to drawing the axis. This method checks the autoTickUnits flag, and automatically determines a suitable “standard” tick size if required.

7.22.4 Notes

Refer to the Javadoc HTML files and the source code for details.

See Also
- NumberAxis, HorizontalNumberAxis.

7.23 HorizontalValuePlot

7.23.1 Overview

An interface that returns the minimum and maximum values in the “horizontal direction” for a two-dimensional plot. The values could be from the dataset’s domain or range, depending on the orientation of the plot.

This interface is known to be implemented by HorizontalBarPlot.

7.23.2 Methods

This interface has two methods:

- `public Number getMinimumHorizontalDataValue();` Returns the minimum data value in the horizontal direction for the plot;

- `public Number getMaximumHorizontalDataValue();` Returns the maximum data value in the horizontal direction for the plot;

7.23.3 Notes

Refer to the Javadoc HTML files and source code for details.

See Also
- VerticalValuePlot.
7.24 ImageTitle

7.24.1 Overview

A chart title that displays an image.

7.24.2 Notes

Refer to Javadoc HTML files and source code for details.

See Also
AbstractTitle.

7.25 JFreeChart

7.25.1 Overview

The JFreeChart class is central to the entire chart generation process. This class co-ordinates a collection of other classes with the aim of producing attractive charts in a variety of situations.

JFreeChart has been designed to draw charts onto a Java 2D graphics device (java.awt.Graphics2D) which means that charts can be drawn on any device supported by Java. Usually, developers are interested in drawing charts on the screen, but you have the option to also output charts to the printer, an offscreen image buffer, a scalable vector graphics (SVG) generator or whatever. Thanks to Graphics2D the same drawing code is used in all cases.

7.25.2 Constructors

All constructors require you to supply a Dataset and a Plot instance. You need to make sure that the plot and the dataset are compatible (refer to the plot’s documentation for details).

The simplest constructor is:

public JFreeChart(Dataset data, Plot plot);

Creates a new JFreeChart instance. The chart will have no title, and no legend.

For greater control, a more complete constructor is available:

public JFreeChart(Dataset data, Plot plot, String title, Font titleFont, boolean createLegend);

Creates a new JFreeChart instance. This constructor allows you to specify a single title (you can add additional titles, later, if necessary).

7.25.3 Attributes

The JFreeChart class has the following attributes:
<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>titles</td>
<td>A list of the titles for the chart.</td>
</tr>
<tr>
<td>legend</td>
<td>The chart legend.</td>
</tr>
<tr>
<td>data</td>
<td>The dataset.</td>
</tr>
<tr>
<td>plot</td>
<td>The plot.</td>
</tr>
<tr>
<td>antialias</td>
<td>A flag that indicates whether or not the chart should be drawn with anti-aliasing.</td>
</tr>
<tr>
<td>chartBackgroundPaint</td>
<td>The background paint for the chart.</td>
</tr>
<tr>
<td>seriesPaint</td>
<td>An array of paints used to identify series within a plot.</td>
</tr>
<tr>
<td>seriesStroke</td>
<td>An array of pen strokes used to plot the data for each series.</td>
</tr>
<tr>
<td>seriesOutlinePaint</td>
<td>An array of paints used to draw the outlines of series.</td>
</tr>
<tr>
<td>seriesOutlineStroke</td>
<td>An array of pen strokes used to draw the outlines of series.</td>
</tr>
</tbody>
</table>

### 7.25.4 Methods

To add a title to the chart:

```java
def addTitle(AbstractTitle title):
    Adds a title to the chart.
```

To set the legend for a chart:

```java
def setLegend(Legend legend):
    Sets the legend for a chart.
```

You can change the chart’s dataset at any time, but you need to be sure that the new dataset is compatible with the type of plot currently set for the chart:

```java
def setDataset(Dataset data):
    Changes the dataset for a chart.
```

You can control whether or not the chart is drawn with anti-aliasing (switching anti-aliasing ON can improve the on-screen appearance of charts):

```java
def setAntiAlias(boolean flag):
    Sets a flag controlling whether or not anti-aliasing is used when drawing the chart.
```

Some plot types have the ability to generate tooltips, which can be useful if the chart is being displayed on-screen. To enable this function, you need to register a tooltip manager with the chart:

```java
def setToolTips(ToolTips tooltips):
    Sets a tooltip manager with the chart.
```

To draw the chart:

```java
def draw(Graphics2D g2, Rectangle2D chartArea, DrawInfo info):
    Draws the chart on the Graphics2D device. If the info argument is not null, it will be populated with information about the dimensions of the chart drawing.
```

To receive notification of any change to a chart, a listener object should register via this method:
public void addChangeListener(ChartChangeListener listener);
Register to receive chart change events.

To stop receiving change notifications, a listener object should deregister via this method:

public void removeChangeListener(ChartChangeListener listener);
Deregister to stop receiving chart change events.

7.25.5 Notes
JFreeChart works with Dataset interfaces that are defined in the JCommon Class Library. You can download JCommon from:

http://www.jrefinery.com/jcommon

The ChartFactory class provides some convenient methods for creating "ready-made" charts.

The Java2D API is used throughout JFreeChart, so JFreeChart does not work with JDK1.1 (a common question from applet developers, although hopefully less of an issue as browser support for Java2 improves).

A chart can have multiple titles (see AbstractTitle), although often you will require just one title or no title at all.

See Also
ChartFactory, JFreeChartPanel, Plot.

7.26 JFreeChartFrame

7.26.1 Overview
A frame containing chart within a JFreeChartPanel.

7.26.2 Constructors
There are two constructors:

public JFreeChartFrame(String title, JFreeChart chart);
Creates a new JFreeChartFrame containing the specified chart.

The second constructor gives you the opportunity to request that the chart is contained within a JScrollPane:

public JFreeChartFrame(String title, JFreeChart chart, boolean scrollPane);
Creates a new JFreeChartFrame containing the specified chart.

7.26.3 Notes
Refer to Javadoc HTML files and source code for details.

See Also
JFreeChartPanel.
7.27 JFreeChartPanel

7.27.1 Overview
Provides a wrapper around JFreeChart to provide a convenient means of including a chart in a Swing-based user-interface. Extends javax.swing.JComponent.

7.27.2 Constructors
The standard constructor accepts a JFreeChart as the only parameter, and creates a panel that displays the chart. By default, the panel is automatically updated whenever the chart changes:

```java
public JFreeChartPanel(JFreeChart chart);
Creates a new JFreeChartPanel.
```

7.27.3 Notes
The panel includes support for displaying tooltips for a chart.

See Also
JFreeChart.

7.28 Legend

7.28.1 Overview
Not yet documented.

7.28.2 Notes
Refer to Javadoc HTML files and source code for details.

7.29 Line

7.29.1 Overview
Not yet documented.

7.29.2 Notes
Refer to Javadoc HTML files and source code for details.

7.30 LineAndShapeRenderer

7.30.1 Overview
Not yet documented.

7.30.2 Notes
Refer to Javadoc HTML files and source code for details.
7.31 LinePlot
7.31.1 Overview
Not yet documented.

7.31.2 Notes
Refer to Javadoc HTML files and source code for details.

7.32 NumberAxis
7.32.1 Overview
The base class for axes (both horizontal and vertical) that display numerical data—extends ValueAxis.

7.32.2 Constructors
The NumberAxis class is abstract. Therefore you cannot instantiate this class directly—you must use a subclass (for example, HorizontalNumberAxis or VerticalNumberAxis).

Subclasses can call one of two constructors for the NumberAxis class. The simpler version requires only the axis label to be specified, with all other attributes taking default values:

```java
protected NumberAxis(String label);
```

Creates a new NumberAxis.

The other constructor takes an extensive list of parameters, allowing much greater control over the construction of the axis. Refer to the Javadoc HTML pages or the source code for details.

7.32.3 Attributes
The following table lists the properties defined by NumberAxis:

<table>
<thead>
<tr>
<th>Attribute:</th>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>MinimumAxisValue</td>
<td>The lowest value displayed on the axis.</td>
</tr>
<tr>
<td>MaximumAxisValue</td>
<td>The highest value displayed on the axis.</td>
</tr>
<tr>
<td>AutoRangeIncludesZero</td>
<td>A flag that indicates whether or not zero is always included when the axis range is determined automatically.</td>
</tr>
<tr>
<td>AutoRangeMinimumSize</td>
<td>If the axis range is determined automatically, it is guaranteed never to be less than this value.</td>
</tr>
<tr>
<td>UpperMargin</td>
<td>The margin to allow at the upper end of the axis scale (expressed as a percentage of the total axis range).</td>
</tr>
<tr>
<td>LowerMargin</td>
<td>The margin to allow at the lower end of the axis scale (expressed as a percentage of the total axis range).</td>
</tr>
<tr>
<td>TickUnit</td>
<td>The spacing between ticks on the axis.</td>
</tr>
<tr>
<td>StandardTickUnits</td>
<td>A collection of standard tick units. If auto-tick-selection is on, one of these tick units will be selected automatically.</td>
</tr>
</tbody>
</table>

Keep in mind that many other attributes are inherited from ValueAxis.
The following default values are used for attributes wherever necessary:

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEFAULT_MINIMUM_AXIS_VALUE</td>
<td>0.0</td>
</tr>
<tr>
<td>DEFAULT_MAXIMUM_AXIS_VALUE</td>
<td>1.0</td>
</tr>
<tr>
<td>DEFAULT_UPPER_MARGIN</td>
<td>0.05 (5 percent)</td>
</tr>
<tr>
<td>DEFAULT_LOWER_MARGIN</td>
<td>0.05 (5 percent)</td>
</tr>
<tr>
<td>DEFAULT_MINIMUM_AUTO_RANGE</td>
<td>new Double(0.0000001)</td>
</tr>
<tr>
<td>DEFAULT_TICK_UNIT</td>
<td>new NumberTickUnit(new Double(1.0), new DecimalFormat(&quot;0&quot;);</td>
</tr>
</tbody>
</table>

7.32.4 Methods

To set the lower bound for the axis:

public void setMinimumAxisValue(double value);
Sets the lower bound for the axis. If the AutoRange attribute is true it is automatically switched to false. Registered listeners are notified of the change.

To set the upper bound for the axis:

public void setMaximumAxisValue(double value);
Sets the upper bound for the axis. If the AutoRange attribute is true it is automatically switched to false. Registered listeners are notified of the change.

If you have set the AutoRange flag to true (so that the axis range automatically adjusts to fit the current data), you may also want to set the AutoRangeIncludesZero flag to ensure that the axis range always includes zero:

public void setAutoRangeIncludesZero(boolean flag);
Sets the AutoRangeIncludesZero flag.

When the AutoTickUnit property is set to true, the axis will select a tick unit from a set of standard tick units. You can define your own standard tick units for an axis with the following method:

public void setStandardTickUnits(TickUnits units);
Sets the standard tick units for the axis.

7.32.5 Notes

This class defines a default set of standard tick units. You can override the default settings by calling the setStandardTickUnits(...) method.

See Also
TickUnits, ValueAxis.

7.33 NumberTickUnit

7.33.1 Overview

A numerical tick unit. The NumberAxis class creates a collection of standard tick units from which it can choose an appropriate tick unit for the range of data it is trying to display.
7.33.2 Constructors
The standard constructor:

```java
public NumberTickUnit(Number value, NumberFormat formatter);
```
Creates a new number tick unit.

7.33.3 Notes
Extends the TickUnit class.

See Also
TickUnit.

7.34 PiePlot
7.34.1 Overview
The PiePlot class draws pie charts, using data obtained through the PieDataset interface (part of the JCommon Class Library).

7.34.2 Constructors
The default constructor:

```java
protected PiePlot();
```
Creates a pie plot with default attributes.

7.34.3 Attributes
The PiePlot class has the following attributes:

<table>
<thead>
<tr>
<th>Attribute:</th>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>InteriorGapPercent</td>
<td>The space to leave blank around the outside of the pie.</td>
</tr>
<tr>
<td>Circular</td>
<td>Circular or elliptical pie.</td>
</tr>
<tr>
<td>RadiusPercent</td>
<td>Controls the radius of the unexploded pie.</td>
</tr>
<tr>
<td>SectionLabelType</td>
<td>The type of labels for the pie sections.</td>
</tr>
<tr>
<td>SectionLabelFont</td>
<td>The font for the section labels.</td>
</tr>
<tr>
<td>SectionLabelPaint</td>
<td>The color for the section labels.</td>
</tr>
<tr>
<td>SectionLabelGapPercent</td>
<td>The gap for the section labels.</td>
</tr>
<tr>
<td>ExplodePercentages[]</td>
<td>The amount to 'explode' each pie section.</td>
</tr>
<tr>
<td>PercentFormatter</td>
<td>A formatter for the percentage labels.</td>
</tr>
<tr>
<td>ToolTipGenerator</td>
<td>A plug-in tooltip generator.</td>
</tr>
</tbody>
</table>

The following default values are used where necessary:

<table>
<thead>
<tr>
<th>Name:</th>
<th>Value:</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEFAULT_INTERIOR_GAP</td>
<td>0.20 (20 percent)</td>
</tr>
<tr>
<td>DEFAULT_RADIUS</td>
<td>1.00 (100 percent)</td>
</tr>
<tr>
<td>DEFAULT_SECTION_LABEL_FONT</td>
<td>new Font(&quot;SansSerif&quot;, Font.PLAIN, 10);</td>
</tr>
<tr>
<td>DEFAULT_SECTION_LABEL_PAINT</td>
<td>Color.black;</td>
</tr>
<tr>
<td>DEFAULT_SECTION_LABEL_GAP</td>
<td>0.10 (10 percent)</td>
</tr>
</tbody>
</table>
7.34.4 Methods

A pie plot is drawn with this method:

```java
public void draw(Graphics2D g2, Rectangle2D drawArea, ToolTips tooltips);
```

Draws the pie plot within the specified drawing area.

If `tooltips` is not `null`, then tooltips will be generated for each pie section as the pie plot is drawn.

The `JFreeChart` class usually calls the `draw(...)` method for you.

To set the tooltip generator (optional) for the pie plot:

```java
public void setToolTipGenerator(PieToolTipGenerator generator);
```

Registers a tooltip generator with the pie plot. If you write your own generator, you can have full control over the tooltip text that is generated for each pie section.

7.34.5 Notes

`PiePlot` inherits axes from the `Plot` class. You should leave these set to `null`.

See Also

`Plot`.

7.35 Plot

7.35.1 Overview

An abstract base class that controls the visual representation of data in a chart. The `Plot` manages a horizontal axis and a vertical axis.

The plot is given an area (the `draw area`) by the `JFreeChart` object, into which it must draw the axes and the data. The following diagram shows how this area is divided:

```
<table>
<thead>
<tr>
<th>Vertical Axis</th>
<th>Plot Area</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
```

Determining the dimensions of these regions is an awkward problem. The plot area can be resized arbitrarily, but the vertical axis and horizontal axis sizes are more difficult. Note that the height of the vertical axis is related to the height of the horizontal axis, and, likewise, the width of the vertical axis is related to the width of the horizontal axis. This results in a "chicken and egg" problem, because changing the width of an axis can affect its height (especially if the tick
units change with the resize) and changing its height can affect the width (for the same reason).

There are a number of concrete subclasses of Plot, including: HorizontalBarPlot, VerticalBarPlot, PiePlot, XYPlot and HighLowPlot.

7.35.2 Constructors
To create a new Plot:

```java
protected Plot(Axis horizontalAxis, Axis verticalAxis);
```

Creates a new Plot, with the specified axes.

7.35.3 Attributes
The Plot class has the following attributes:

<table>
<thead>
<tr>
<th>Attribute:</th>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chart</td>
<td>The chart that the plot belongs to.</td>
</tr>
<tr>
<td>VerticalAxis</td>
<td>The vertical axis.</td>
</tr>
<tr>
<td>HorizontalAxis</td>
<td>The horizontal axis.</td>
</tr>
<tr>
<td>Insets</td>
<td>The amount of space to leave around the outside of the plot.</td>
</tr>
<tr>
<td>BackgroundPaint</td>
<td>The color used to draw the background of the plot area.</td>
</tr>
<tr>
<td>OutlineStroke</td>
<td>The pen/brush used to draw an outline around the plot area.</td>
</tr>
<tr>
<td>OutlinePaint</td>
<td>The color used to draw an outline around the plot area.</td>
</tr>
<tr>
<td>SeriesPaint</td>
<td>An array of Paint objects used for the series colors.</td>
</tr>
<tr>
<td>SeriesStroke</td>
<td>An array of Stroke objects used for drawing series.</td>
</tr>
<tr>
<td>SeriesOutlinePaint</td>
<td>An array of Paint objects used for the series outline colors.</td>
</tr>
</tbody>
</table>

7.35.4 Notes
Refer to Javadoc HTML files and source code for details.

See Also
JFreeChart.

7.36 PlotException
7.36.1 Overview
Not yet documented.

7.36.2 Notes
Refer to Javadoc HTML files and source code for details.
7.37 PlotNotCompatibleException

7.37.1 Overview
An exception that indicates that an attempt has been made to assign a plot to a chart where the plot is not compatible with the chart’s current Dataset. For example, an XYPlot will not work with a CategoryDataset.

7.37.2 Constructors
To create a new exception:

```java
public AxisNotCompatibleException(String message);
```
Creates a new exception.

7.37.3 Notes
The PlotNotCompatibleException class is a subclass of RuntimeException.

See Also
AxisNotCompatibleException.

7.38 StackedHorizontalBarRenderer

7.38.1 Overview
Not yet documented.

7.38.2 Notes
Refer to Javadoc HTML files and source code for details.

7.39 StackedVerticalBarRenderer

7.39.1 Overview
Not yet documented.

7.39.2 Notes
Refer to Javadoc HTML files and source code for details.

7.40 StackedVerticalBarRenderer3D

7.40.1 Overview
Not yet documented.

7.40.2 Notes
Refer to Javadoc HTML files and source code for details.
7.41 StandardLegend
7.41.1 Overview
This class is soon to be replaced by LegendTitle.

7.42 StandardTitle
7.42.1 Overview
Not yet documented.

7.42.2 Notes
Refer to Javadoc HTML files and source code for details.

7.43 StandardXYItemRenderer
7.43.1 Overview
The default renderer for the XYPlot class. This renderer represents data by
drawing lines between \((x, y)\) data points and/or drawing shapes at each \((x, y)\)
data point.

7.43.2 Constructors
To create a StandardXYItemRenderer:

```java
public StandardXYItemRenderer(int type);
```
Creates a new renderer. The type argument should be one of: LINES, SHAPES or SHAPES_AND_LINES.

7.43.3 Notes
This class implements the XYItemRenderer interface.
The XYPlot class will use an instance of this class as its default renderer.

See Also
XYPlot, XYItemRenderer.

7.44 TextTitle
7.44.1 Overview
A standard chart title—extends AbstractTitle.

7.44.2 Notes
The original version of this class was written by David Berry.

See Also
AbstractTitle.
7.45  Tick

7.45.1  Overview
A utility class representing a tick on an axis. Used temporarily during the
drawing process only.

7.45.2  Constructors
The standard constructor:

```java
public Tick(Object value, String text, float x, float y)
```

Creates a tick.

See Also
TickUnit.

7.46  TickUnit

7.46.1  Overview
An abstract class representing a tick unit. Subclasses include NumberTickUnit.

7.46.2  Constructors
The standard constructor:

```java
public TickUnit(Number value);
```

Creates a new tick value.

7.46.3  Notes
Implements the Comparable interface, so that a collection of TickUnit objects
can be sorted easily using standard Java methods.

See Also
NumberTickUnit.

7.47  TickUnits

7.47.1  Overview
A collection of tick units. Used by the Number axis class to store a list of
"standard" tick units, from which an appropriate tick unit is selected as the
chart is being redrawn.

7.47.2  Constructors
The default constructor:

```java
public TickUnits();
```

Creates a new collection of tick units, initially empty.
7.47.3 Methods
To add a new tick unit to the collection:

public void add(TickUnit unit);
Adds the tick unit to the collection.

To find the tick unit in the collection that is closest in size to another tick unit:

public TickUnit getNearestTickUnit(TickUnit unit);
Returns the tick unit that is closest in size to the specified unit.

7.47.4 Notes
The NumberAxis class has a private method createStandardTickUnits() that generates a tick unit collection (of standard tick sizes) for use by numerical axes.

See Also
TickUnit.

7.48 Title
7.48.1 Overview
Not yet documented.

7.49 ValueAxis
7.49.1 Overview
The base class for all (horizontal and vertical) axes that display "values". Ultimately, values are represented as double primitives, but subclasses of ValueAxis have been implemented that give the appearance of working with Number and Date objects.

Known subclasses of ValueAxis include DateAxis and NumberAxis.

7.49.2 Constructors
To construct a ValueAxis:

public ValueAxis(String label);
Creates a ValueAxis with the specified label. All other attributes take default values.

If you want more control over the settings for the axis, use this constructor:

protected ValueAxis(String label, Font labelFont, Paint labelPaint, Insets labelInsets, boolean tickLabelsVisible, Font tickLabelFont, Paint tickLabelPaint, Insets tickLabelInsets, boolean tickMarksVisible, Stroke tickMarkStroke, boolean autoRange, boolean autoTickUnit, boolean gridLinesVisible, Stroke gridStroke, Paint gridPaint);
Creates a ValueAxis.
7.49.3 Attributes

The ValueAxis class has the following attributes:

<table>
<thead>
<tr>
<th>Attribute:</th>
<th>Description:</th>
</tr>
</thead>
<tbody>
<tr>
<td>AutoRange</td>
<td>A flag controlling whether or not the axis automatically adjusts its range to reflect the range of data values.</td>
</tr>
<tr>
<td>AutoTickUnit</td>
<td>A flag controlling whether or not the tick units are selected automatically.</td>
</tr>
<tr>
<td>GridLinesVisible</td>
<td>A flag controlling whether or not grid lines are displayed.</td>
</tr>
<tr>
<td>GridLineStroke</td>
<td>The stroke used to draw the grid lines.</td>
</tr>
<tr>
<td>GridLinePaint</td>
<td>The color for the grid lines.</td>
</tr>
</tbody>
</table>

The following default values are used for attributes wherever necessary:

<table>
<thead>
<tr>
<th>Name:</th>
<th>Value:</th>
</tr>
</thead>
<tbody>
<tr>
<td>DEFAULT_GRID_LINE_STROKE</td>
<td>new BasicStroke(0.5f, BasicStroke.CAP_BUTT, BasicStroke.JOIN_BEVEL, 0.0f, new float[] 2.0f, 2.0f, 0.0f);</td>
</tr>
<tr>
<td>DEFAULT_GRID_LINE_PAINT</td>
<td>Color.grey;</td>
</tr>
</tbody>
</table>

7.49.4 Methods

A key function for a ValueAxis is to convert a data value to an output coordinate for plotting purposes. The output coordinate will be dependent on the area into which the data is being drawn:

```java
public double translateValueToJava2D(double value, Rectangle2D dataArea);  
```

Converts a data value into a co-ordinate within the dataArea. The dataArea is the rectangle inside the plot's axes.

See Also
Axis, DateAxis, NumberAxis.

7.50 VerticalAxis

7.50.1 Overview

An interface that must be implemented by all vertical axes. The methods defined by this interface are used by the Plot that owns the axis, for layout purposes.

7.50.2 Methods

The interface defines two methods. The plot chooses which of these two methods to call when laying out the axes.

```java
public Rectangle2D reserveAxisArea(Graphics2D g2, Plot plot, Rectangle2D drawArea, double reservedHeight);  
```

Calculates the area that the vertical axis requires to draw itself. If this method is used, it will be called after the horizontal axis has estimated the height that it requires—the argument reservedHeight contains this value.
public double reserveWidth(Graphics2D g2, Plot plot, Rectangle2D drawArea);

Estimates the width that the vertical axis requires to draw itself. If this method is used, it will be called before the horizontal axis is asked to calculate the area that it requires—the width returned by this method will be passed to the horizontal axis.

See Also
HorizontalAxis.

7.51 VerticalBarPlot

7.51.1 Overview

This plot draws a standard bar chart using data from a CategoryDataset, where the categories are plotted against the horizontal axis and the numerical data is plotted against the vertical axis.

7.51.2 Constructors

The simplest constructor requires only the axes to be specified:

public VerticalBarPlot(CategoryAxis horizontalAxis, ValueAxis verticalAxis);

Creates a vertical bar plot. Default values are assumed for most attributes.

For more complete control, use the following constructor:

public VerticalBarPlot(CategoryAxis horizontalAxis, ValueAxis verticalAxis,
Insets insets, double introGapPercent, double trailGapPercent,
double categoryGapPercent, double itemGapPercent, CategoryToolTipGenerator
toolTipGenerator);

Creates a vertical bar plot.

7.51.3 Methods

The category axis will need to ask the plot for the coordinate of a particular category, since the plot controls the distribution of the categories. This method is used:

public double getCategoryCoordinate(...);

This method returns the x-coordinate of the center of the specified category. The category axis will call this method to determine where to place the category labels, because it has no knowledge of the distribution of categories (these could vary depending on the nature of the plot).

7.51.4 Notes

The bar widths cannot be controlled directly. Instead, you set the amount (percentage) of the total space that should be allocated to the gaps between the bars, and then the bar widths are determined automatically.
7.52 VerticalBarPlot3D
7.52.1 Overview
Not yet documented.

7.52.2 Notes
Refer to Javadoc HTML files and source code for details.

7.53 VerticalBarRenderer
7.53.1 Overview
Not yet documented.

7.53.2 Notes
Refer to Javadoc HTML files and source code for details.

7.54 VerticalBarRenderer3D
7.54.1 Overview
Not yet documented.

7.54.2 Notes
Refer to Javadoc HTML files and source code for details.

7.55 VerticalCategoryAxis
7.55.1 Overview
A vertical axis that displays categorical data. This class extends CategoryAxis. As for the other category axes, this class relies on the plot to provide information about how the categories are distributed along the axis (this information is obtained via the CategoryPlot interface).

7.55.2 Constructors
There are two constructors for this class. One requires all the attributes for the axis to be specified, the other provides for default values on some attributes. Refer to the Javadoc or source code for details.
The default constructor:

```java
public VerticalCategoryAxis(String label);
```

Creates a new VerticalCategoryAxis.

See Also
CategoryAxis, HorizontalCategoryAxis.
7.56  VerticalNumberAxis

7.56.1  Overview

A vertical axis that displays numerical data—this class extends NumberAxis.

7.56.2  Constructors

There are three constructors for this class. One requires all the attributes for the
axis to be specified, the other two provide for default values on some attributes.
Refer to the Javadoc or source code for details.

7.56.3  Methods

A list of important methods:

public void autoAdjustRange();
This method obtains the maximum and minimum data values from the
Plot, provided that it implements VerticalValueRange, and adjusts the
axis range accordingly. Note that the autoRangeIncludesZero flag is
checked in this method.

public void refreshTicks(...);
A utility method for calculating the positions of the ticks on an axis, just
prior to drawing the axis. This method checks the autoTickUnits flag,
and automatically determines a suitable “standard” tick size if required.

private void calculateAutoTickUnits(...);
This method is used to pick a standard tick size from the array defined
in NumberAxis. The approach used is to find the smallest tick units such
that the tick labels do not overlap.

See Also
NumberAxis, HorizontalNumberAxis.

7.57  VerticalNumberAxis3D

7.57.1  Overview

Not yet documented.

7.57.2  Notes

Refer to Javadoc HTML files and source code for details.

7.58  VerticalValuePlot

7.58.1  Overview

An interface that returns minimum and maximum data values in the “vertical
direction” for a two-dimensional plot. The values could be from the dataset
domain or range, depending on the orientation of the plot.
7.58.2 Methods
This interface has two methods:

public Number getMinimumVerticalDataValue();
Returns the minimum data value in the vertical direction for the plot.

public Number getMaximumVerticalDataValue();
Returns the maximum data value in the vertical direction for the plot.

7.58.3 Notes
This interface is known to be implemented by LinePlot, VerticalBarPlot and XYPlot.

See Also
HorizontalValuePlot.

7.59 VerticalXYBarPlot
7.59.1 Overview
Not yet documented.

7.59.2 Notes
Refer to Javadoc HTML files and source code for details.

7.60 VerticalXYBarRenderer
7.60.1 Overview
Not yet documented.

7.60.2 Notes
Refer to Javadoc HTML files and source code for details.

7.61 XYItemRenderer
7.61.1 Overview
An interface that must be implemented by a renderer so that it can work with an XYPlot. By changing the renderer for an XYPlot, you can change the appearance of the plot.
Several implementations of this interface are available:

- StandardXYItemRenderer;
- CandlestickRenderer;
- HighLowRenderer;
- VerticalXYBarRenderer.
7.61.2 Methods

There is just one method in this interface:

```java
public Shape drawItem(Graphics2D g2, Rectangle2D plotArea, Plot plot, ValueAxis horizontalAxis, ValueAxis verticalAxis, XYDataset data, int series, int item, double translatedRangeZero);
```

Draws a single data item on behalf of `XYPlot`.

7.61.3 Notes

Some renderers require a specific subclass of `XYDataset`.

See Also
- `XYPlot`.

7.62 XYPlot

7.62.1 Overview

Draws a visual representation of data from an `XYDataset`, where the horizontal axis measures the x-values and the vertical axis measures the y-values.

It is possible to display time series data with `XYPlot` by employing a `HorizontalDateAxis` in place of the usual `HorizontalNumberAxis`. In this case, the x-values are interpreted as milliseconds as used in `java.util.Date`.

7.62.2 Constructors

The simplest constructor requires just the axes to be specified:

```java
public XYPlot(ValueAxis horizontalAxis, ValueAxis verticalAxis);
```

Creates an XY plot. Default values are used where necessary.

```java
public XYPlot(ValueAxis horizontalAxis, ValueAxis verticalAxis, Insets insets, Paint background, Stroke outlineStroke, Paint outlinePaint);
```

Creates an XY plot.

7.62.3 Methods

To get the current renderer for the plot:

```java
public XYItemRenderer getItemRenderer();
```

Returns the current renderer.

To set a new renderer for the plot:

```java
public void setItemRenderer(XYItemRenderer renderer);
```

Sets a new renderer.
The `XYPlot` class works with a `renderer` to control the visual representation of the data. By default, a renderer is installed that draws lines between each of the data points.

`XYPlot` implements both `HorizontalValuePlot` and `VerticalValuePlot`, enabling the axes to automatically determine the range of data that is available for the plot.

**See Also**
- `Plot`, `StandardXYItemRenderer`.
8 Package: com.jrefinery.chart.combination

This package includes most of the classes—written by Bill Kelemen—for creating combination charts.

8.1 AbstractAxisRange

8.1.1 Overview
A base class for representing an axis range.

8.1.2 Constructors
To create a new range:

```java
public AbstractAxisRange(Object min, Object max);
```
Creates a new range.

8.1.3 Methods
A list of important methods:

```java
public void combine(AxisRange range);
```
Extends this range (if necessary) to cover another range.

See Also
AxisRange.

8.2 AxisRange

8.2.1 Overview
An interface for an axis range.

8.2.2 Methods
The interface defines three methods:

```java
public Object getMin();
```
Returns the minimum value in the range.

```java
public Object getMax();
```
Returns the maximum value in the range.

```java
public void combine(AxisRange range);
```
Extends this range (if necessary) to incorporate another range.

See Also
AbstractAxisRange.

8.3 CombinableAxis

8.3.1 Overview
Interface for an axis in a combined chart.
8.4 CombinedChart
8.4.1 Overview
An extension of JFreeChart for displaying combined charts.

See Also
JFreeChart.

8.5 CombinedHorizontalDateAxis
8.5.1 Overview
An extension of HorizontalDateAxis for use in combined charts.

See Also
HorizontalDateAxis.

8.6 CombinedHorizontalNumberAxis
8.6.1 Overview
An extension of HorizontalNumberAxis for use in combined charts.

See Also
HorizontalNumberAxis.

8.7 CombinedPlot
8.7.1 Overview
A plot for creating combined charts.

See Also
CombinedChart.

8.8 CombinedVerticalNumberAxis
8.8.1 Overview
An extension of VerticalNumber axis used for creating combined charts.

See Also
CombinedPlot.

8.9 DateAxisRange
8.9.1 Overview
Not yet documented.
8.9.2 Notes
Refer to Javadoc HTML files and source code for details.

8.10 NumberAxisRange
8.10.1 Overview
Not yet documented.

8.10.2 Notes
Refer to Javadoc HTML files and source code for details.

8.11 OverlaidHorizontalDateAxis
8.11.1 Overview
Not yet documented.

8.11.2 Notes
Refer to Javadoc HTML files and source code for details.

8.12 OverlaidHorizontalNumberAxis
8.12.1 Overview
Not yet documented.

8.12.2 Notes
Refer to Javadoc HTML files and source code for details.

8.13 OverlaidPlot
8.13.1 Overview
Not yet documented.

8.13.2 Notes
Refer to Javadoc HTML files and source code for details.

8.14 OverlaidVerticalNumberAxis
8.14.1 Overview
Not yet documented.

8.14.2 Notes
Refer to Javadoc HTML files and source code for details.
9 Package: com.jrefinery.chart.data

This package contains some classes for data fitting. These will eventually be rewritten and moved into another package.

9.1 LinearPlotFitAlgorithm
9.1.1 Overview
Not yet documented.

9.1.2 Notes
Refer to Javadoc HTML files and source code for details.

9.2 MovingAveragePlotFitAlgorithm
9.2.1 Overview
Not yet documented.

9.2.2 Notes
Refer to Javadoc HTML files and source code for details.

9.3 PlotFit
9.3.1 Overview
Not yet documented.

9.3.2 Notes
Refer to Javadoc HTML files and source code for details.

9.4 PlotFitAlgorithm
9.4.1 Overview
Not yet documented.

9.4.2 Notes
Refer to Javadoc HTML files and source code for details.
10 Package: com.jrefinery.chart.event

This package contains classes and interfaces that are used to broadcast and receive events relating to changes in chart properties. By default, some of the classes in the library will automatically register themselves with other classes, so that they receive notification of any changes and can react accordingly. For the most part, you can simply rely on this default behaviour.

10.1 AxisChangeEvent

10.1.1 Overview

An event that is used to provide information about changes to axes.

See Also
AxisChangeListener.

10.2 AxisChangeListener

10.2.1 Overview

An interface through which axis change event notifications are posted. If a class needs to receive notification of changes to an axis, then it needs to implement this interface and register itself with the axis.

10.2.2 Methods

The interface defines a single method:

```java
public void axisChanged(AxisChangeEvent event);
```

Receives notification of a change to an axis.

See Also
AxisChangeEvent.

10.3 ChartChangeEvent

10.3.1 Overview

An event that is used to provide information about changes to a chart.

See Also
ChartChangeListener.

10.4 ChartChangeListener

10.4.1 Overview

An interface through which chart change event notifications are posted. If a class needs to receive notification of changes to a chart, then it needs to implement this interface and register itself with the chart.
10.4.2 Methods

The interface defines a single method:

```java
public void chartChanged(ChartChangeEvent event);

Receives notification of a change to a chart.
```

See Also
ChartChangeEvent.

10.5 LegendChangeEvent

10.5.1 Overview

An event that is used to provide information about changes to a legend.

See Also
LegendChangeListener.

10.6 LegendChangeListener

10.6.1 Overview

An interface through which legend change event notifications are posted. If a class needs to receive notification of changes to a legend, then it needs to implement this interface and register itself with the legend.

10.6.2 Methods

The interface defines a single method:

```java
public void legendChanged(LegendChangeEvent event);

Receives notification of a change to a legend.
```

See Also
LegendChangeEvent.

10.7 PlotChangeEvent

10.7.1 Overview

An event that is used to provide information about changes to a plot.

See Also
PlotChangeListener.

10.8 PlotChangeListener

10.8.1 Overview

An interface through which plot change event notifications are posted. If a class needs to receive notification of changes to a plot, then it needs to implement this interface and register itself with the plot.
10.8.2 Methods

The interface defines a single method:

```java
public void plotChanged(PlotChangeEvent event);
Receives notification of a change to a plot.
```

See Also

PlotChangeEvent.

10.9 TitleChangeEvent

10.9.1 Overview

An event that is used to provide information about changes to a plot.

See Also

TitleChangeListener.

10.10 TitleChangeListener

10.10.1 Overview

An interface through which title change event notifications are posted. If a class needs to receive notification of changes to a title, then it needs to implement this interface and register itself with the title.

10.10.2 Methods

The interface defines a single method:

```java
public void titleChanged(TitleChangeEvent event);
Receives notification of a change to a title.
```

See Also

TitleChangeEvent.
11 Package: com.jrefinery.chart.tooltips

This package contains some classes for generating tooltips.

11.1 CategoryToolTipGenerator

11.1.1 Overview

The interface that should be implemented by a *category tooltip generator*. The idea is that you can develop your own tooltip generator, register it with a plot, and take full control over the tooltip text that is generated.

11.1.2 Methods

This interface defines a single method:

```java
public String generateToolTip(CategoryDataset data, int series, Object category);
```

This method is called whenever the plot needs to generate a tooltip. It should return the tooltip text (which can be anything you want to make it).

11.1.3 Notes

The *StandardCategoryToolTipGenerator* is one implementation of this interface, but you are free to write your own implementation to suit your requirements.

11.2 PieToolTipGenerator

11.2.1 Overview

The interface that should be implemented by a *pie tooltip generator*. The idea is that you can develop your own tooltip generator, register it with a *PiePlot*, and take full control over the tooltip text that is generated.

11.2.2 Methods

This interface defines a single method:

```java
public String generateToolTip(PieDataset data, Object category);
```

This method is called whenever the *PiePlot* needs to generate a tooltip. It should return a *String* that will be used as the tooltip text.

11.2.3 Notes

The *StandardPieToolTipGenerator* is one implementation of this interface, but you are free to write your own implementation to suit your requirements.

See Also

*StandardPieToolTipGenerator*. 

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11.3 StandardCategoryToolTipGenerator
11.3.1 Overview
A default implementation of the CategoryToolTipGenerator interface.

11.3.2 Notes
Refer to Javadoc HTML files and source code for details.

See Also
CategoryToolTipGenerator.

11.4 StandardHighLowToolTipGenerator
11.4.1 Overview
A default implementation of the HighLowToolTipGenerator interface.

11.4.2 Notes
Refer to Javadoc HTML files and source code for details.

See Also
HighLowToolTipGenerator.

11.5 StandardPieToolTipGenerator
11.5.1 Overview
A default implementation of the PieToolTipGenerator interface.

11.5.2 Notes
Refer to Javadoc HTML files and source code for details.

See Also
PieToolTipGenerator.

11.6 StandardToolTips
11.6.1 Overview
An implementation of the ToolTips interface, this class can be registered with a chart via the setToolTips(...) method and will collect tooltips as the chart is being drawn.

11.6.2 Constructors
Use the default constructor to create a new tooltip manager:

    public StandardToolTips();

    Creates a new tooltip manager.
11.6.3 Methods
This class provides implementations for all the methods in the ToolTips interface.

11.6.4 Notes
This implementation is not highly optimised. If you are using generating charts with large numbers of data items, you should either stop using tooltips, or write a more efficient implementation.

See Also
ToolTips.

11.7 StandardXYToolTipGenerator
11.7.1 Overview
A default implementation of the XYToolTipGenerator interface.

11.7.2 Notes
Refer to Javadoc HTML files and source code for details.

See Also
XYToolTipGenerator.

11.8 ToolTip
11.8.1 Overview
A simple class representing a tooltip. It records the tooltip text, and the area that the tooltip applies to.

11.8.2 Notes
This class is immutable.

See Also
ToolTipGenerator.

11.9 ToolTipGenerator
11.9.1 Overview
Not yet documented.

11.9.2 Notes
Refer to Javadoc HTML files and source code for details.
11.10  ToolTips

11.10.1  Overview

An interface defining the methods to be supported by a tooltip manager.

If you set a tooltip manager for a chart, then it will collect tooltips as the chart is being drawn (provided that the Plot subclass is capable of generating tooltips). The JFreeChartPanel class makes use of this facility to provide chart tooltips.

11.10.2  Notes

By default, there is no tooltip manager set for a chart.

See Also

StandardToolTips.

11.11  XYToolTipGenerator

11.11.1  Overview

The interface that should be implemented by a XY tooltip generator. The idea is that you can develop your own tooltip generator, register it with a plot, and take full control over the tooltip text that is generated.

11.11.2  Methods

This interface defines a single method:

public String generateToolTip(XYDataset data, int series, int item);

This method is called whenever the XYPlot needs to generate a tooltip. It should return a String that will be used as the tooltip text.

11.11.3  Notes

Refer to Javadoc HTML files and source code for details.

See Also

StandardXYToolTipGenerator.
12 Package: com.jrefinery.chart.ui

This package contains user interface classes that can be used to modify chart
properties. These classes are optional—they are used in the demonstration
application, but you do not need to include this package in your own projects
if you do not want to.

12.1 AxisPropertyEditPanel
12.1.1 Overview
Not yet documented.

12.1.2 Notes
Refer to Javadoc HTML files and source code for details.

12.2 ChartPropertyEditPanel
12.2.1 Overview
A panel that displays all the properties of a chart, and allows the user to edit
the properties. The panel uses a JTabbedPane to display four sub-panels: a
TitlePropertyPanel, a LegendPropertyPanel, a PlotPropertyPanel and a
panel containing “other” properties (such as the anti-alias setting and the back-
ground paint for the chart).

The constructors for this class require a reference to a Dialog or a Frame.
Whichever one is specified is passed on to the TitlePropertyPanel and is used
if and when a sub-dialog is required for editing titles.

12.2.2 Notes
Refer to Javadoc HTML files and source code for details.

12.3 LegendPropertyEditPanel
12.3.1 Overview
Not yet documented.

12.3.2 Notes
Refer to Javadoc HTML files and source code for details.

12.4 NumberAxisPropertyEditPanel
12.4.1 Overview
Not yet documented.

12.4.2 Notes
Refer to Javadoc HTML files and source code for details.
12.5  PlotPropertyEditPanel

12.5.1  Overview
Not yet documented.

12.5.2  Notes
Refer to Javadoc HTML files and source code for details.

12.6  TitlePropertyEditPanel

12.6.1  Overview
Not yet documented.

12.6.2  Notes
Refer to Javadoc HTML files and source code for details.
13 Package: com.jrefinery.data

This package is part of the JCommon Class Library, which can be downloaded from:

http://www.jrefinery.com/jcommon

The reference documentation for this package is included here, even though it is not strictly part of the JFreeChart Class Library, because JFreeChart makes extensive use of the interfaces and classes in this package.

13.1 AbstractDataset

13.1.1 Overview

A useful base class for implementing the Dataset interface (or extensions). This class provides a default implementation of the change listener mechanism.

13.1.2 Constructors

The default constructor:

```java
protected AbstractDataset();
```

Allocates storage for the registered change listeners.

13.1.3 Methods

```java
public void addChangeListener(DatasetChangeListener listener);
```

Registers a change listener with the dataset. The listener will be notified whenever the dataset changes.

```java
public void addChangeListener(DatasetChangeListener listener);
```

Deregisters a change listener. The listener will be no longer be notified whenever the dataset changes.

13.1.4 Notes

You can implement a dataset without subclassing AbstractDataset. This class is provided simply for convenience to save you having to implement your own change listener mechanism.

See Also

Dataset, DatasetChangeListener, AbstractSeriesDataset.

13.2 AbstractSeriesDataset

13.2.1 Overview

A useful base class for implementing the SeriesDataset interface (or extensions). This class extends AbstractDataset.

13.2.2 Constructors

The default constructor:

```java
protected AbstractSeriesDataset();
```

Simply calls the constructor of the superclass.
13.2.3 Methods
Implementations are provided for the following methods:

```java
public String[] getLegendItemLabels();
```
Returns an array of series names.

13.2.4 Notes
You can implement a dataset without subclassing `AbstractSeriesDataset`. This class is provided simply for convenience.

**See Also**

`Dataset`.

13.3 BasicTimeSeries

13.3.1 Overview
A time series is a data structure that associates numeric values with particular time periods. In other words, a collection of data values in the form `(timeperiod, value)`.

The time periods are represented by subclasses of `TimePeriod`. Subclasses include `Year`, `Quarter`, `Month`, `Week`, `Day`, `Hour`, `Minute`, `Second` and `Millisecond`. Different subclasses of `TimePeriod` cannot be mixed in one time series.

A time series may contain zero, one or many time periods with associated data values.

13.3.2 Constructors
There are three constructors:

```java
public BasicTimeSeries(String name);
```
Creates an empty time series for daily data (that is, one value per day).

```java
public BasicTimeSeries(String name, Class timePeriodClass);
```
Creates an empty time series. The caller specifies the time period.

```java
public BasicTimeSeries(String name, String domain, String range, Class timePeriodClass);
```
Creates an empty time series. The caller specifies the time period, plus strings describing the domain and range.

13.3.3 Methods

```java
public void add(TimePeriod period, Number value) throws SeriesException;
```
Adds a new value to the time series. Throws an exception if the time period is not unique within the series.

13.3.4 Notes
The class name was formerly `TimeSeries`, but this has been changed to avoid confusion with the subclass in the `com.jrefinery.finance` package.

**See Also**

`TimeSeriesCollection`
13.4 CategoryDataset

13.4.1 Overview

An interface (extending SeriesDataset) that defines the structure of a category dataset. The dataset consists of a table of series and categories. A value is associated with each combination of series and category (null values are permitted).

13.4.2 Methods

To obtain the number of categories:

```java
public int getCategoryCount();
```

Returns the number of categories in the dataset.

To get a list of the categories in the dataset:

```java
public List getCategories();
```

Returns a list of the categories in the dataset.

To get the value for a series/category combination:

```java
public Number getValue(int series, Object category);
```

Returns the value associated with a particular series and category. The value may be null.

13.4.3 Notes

You can use any Object instance to represent a category. Using String is convenient, as the toString() method is used whenever a label is required for a category.

This interface is intended for reading data, not updating it.

See Also

DefaultCategoryDataset, SeriesDataset.

13.5 CombinationDataset

13.5.1 Overview

An interface for combining datasets. Written by Bill Kelemen.

13.5.2 Notes

This interface is used to create combined charts with the JFreeChart class library.

See Also

CombinedDataset.
13.6 CombinedDataset

13.6.1 Overview
An implementation of the CombinationDataset interface. Written by Bill Kelemen.

13.6.2 Notes
This class is used to create combined charts with the JFreeChart class library.

See Also
CombinationDataset.

13.7 Dataset

13.7.1 Overview
The base interface for datasets. Not useful in its own right, this interface is further extended by PieDataset, CategoryDataset and SeriesDataset.

13.7.2 Methods
A couple of methods relate to the use of datasets for drawing charts (see JFreeChart):

- public int getLegendItemCount();
  Returns the number of items to display in the legend.
- public String[] getLegendItemLabels();
  Returns an array of strings to use as labels in the legend.

Two further methods are used for registering change listeners with the dataset:

- public void addChangeListener(DatasetChangeListener listener);
  Registers a change listener with the dataset.
- public void removeChangeListener(DatasetChangeListener listener);
  Deregisters a change listener.

13.7.3 Notes
This interface is not intended to be used directly, you should use an extension of this interface such as PieDataset, CategoryDataset or XYDataset.

See Also
PieDataset, SeriesDataset.

13.8 DatasetChangeEvent

13.8.1 Overview
An event that is used to provide information about changes to datasets.

See Also
DatasetChangeListener.
13.9 DatasetChangeListener

13.9.1 Overview
An interface through which dataset change event notifications are posted. If a class needs to receive notification of changes to a dataset, then it needs to implement this interface and register itself with the dataset.

13.9.2 Methods
The interface defines a single method:

```java
public void datasetChanged(DatasetChangeEvent event);
```
Receives notification of a change to a dataset.

See Also
DatasetChangeEvent.

13.10 Datasets

13.10.1 Overview
A collection of utility methods for working with datasets.

13.10.2 Methods
To get the minimum and maximum domain values in a dataset:

```java
public static Number getMinimumDomainValue(Dataset data);
```
Returns the minimum domain value for the dataset.

```java
public static Number getMaximumDomainValue(Dataset data);
```
Returns the maximum domain value for the dataset.

To get the minimum and maximum range values in a dataset:

```java
public static Number getMinimumRangeValue(Dataset data);
```
Returns the minimum range value for the dataset.

```java
public static Number getMaximumRangeValue(Dataset data);
```
Returns the maximum range value for the dataset.

To create a PieDataset from a CategoryDataset:

```java
public static PieDataset createPieDataset(CategoryDataset data, Object category);
```
Returns a pie dataset by taking all the values in the category dataset for the specified category.

```java
public static PieDataset createPieDataset(CategoryDataset data, int series);
```
Returns a pie dataset by taking all the values in the category dataset for the specified series.

See Also
DomainInfo, RangeInfo.
13.11 Day

13.11.1 Overview

A subclass of TimePeriod that represents one day. This class is designed to be used with the BasicTimeSeries class, but (hopefully) is general enough to be used in other situations.

13.11.2 Constructor

To construct a Day instance:

```java
public Day(int day, int month, int year);
```

Creates a new Day instance. The year argument should be in the range 1900 to 9999.

To create a Day instance based on a SerialDate:

```java
public Day(SerialDate day);
```

Creates a new Day instance.

To create a Day instance based on a Date:

```java
public Day(Date time);
```

Creates a new Day instance.

The default constructor creates a Day instance based on the current system date:

```java
public Day();
```

Creates a new Day instance for the current system date.

13.11.3 Methods

To access the day:

```java
public SerialDate getDay();
```

Returns the day as a SerialDate.

There is no method to set the day, because this class is immutable.

Given a Day object, you can create an instance representing the previous day or the next day:

```java
public TimePeriod previous();
```

Returns the previous day, or null if the lower limit of the range is reached.

```java
public TimePeriod next();
```

Returns the next day, or null if the upper limit of the range is reached.

To convert a Day object to a String object:

```java
public String toString();
```

Returns a string representing the day.

```java
public static Day parseDay(String s) throws TimePeriodFormatException;
```

Parses the string and, if possible, returns a Day object.
13.11.4 Notes
In the current implementation, the day can be in the range 1-Jan-1900 to 31-Dec-9999.
The Day class is immutable. This is a requirement for all TimePeriod subclasses.

See Also:
TimePeriod, BasicTimeSeries, SerialDate.

13.12 DefaultCategoryDataset
A quick and dirty implementation of the CategoryDataset interface. This class is due for a rewrite.

See Also
CategoryDataset

13.13 DefaultPieDataset

13.13.1 Overview
A convenient implementation of the PieDataset interface.

13.13.2 Constructors
The default constructor creates an empty pie dataset:

    public DefaultPieDataset();
    Creates a new dataset, initially empty.

    public DefaultPieDataset(Collection values);
    Creates a new dataset containing the values supplied. Section names are automatically generated.

13.13.3 Methods
To get the value for a particular category:

    public Number getValue(Object category);
    Returns the number associated with a category. This method can return null.

To set the value for a particular category:

    public void setValue(Object category, Number value);
    Sets the number associated with a category.

13.13.4 Notes
The dataset can contain null values.

See Also
PieDataset.
13.14 DefaultXYDataset

A quick and dirty implementation of the XYDataset interface. This class is in the process of being replaced by XYSeriesCollection.

See Also
XYDataset

13.15 DomainInfo

13.15.1 Overview

An interface that provides information about the minimum and maximum values in a dataset’s domain.

13.15.2 Methods

To get the minimum value in the dataset’s domain:

```
public Number getMinimumDomainValue();
```

Returns the minimum value in the dataset’s domain.

To get the maximum value in the dataset’s domain:

```
public Number getMaximumDomainValue();
```

Returns the maximum value in the dataset’s domain.

13.15.3 Notes

It is not mandatory for a dataset to implement this interface. However, sometimes it is necessary to calculate the minimum and maximum values in a dataset. Without knowing the internal structure of a dataset, the only means of determining this information is iteration over the entire dataset. If there is a more efficient way to determine the values for your data structures, then you can implement this interface and provide the values directly.

See Also
RangeInfo.

13.16 HighLowDataset

An extension of the XYDataset interface, that supplies data in the form of “high/low, open/close” items.

```
public Number getHighValue(int series, int item);
```

Returns the high value for an item within a series.

```
public Number getLowValue(int series, int item);
```

Returns the low value for an item within a series.

```
public Number getOpenValue(int series, int item);
```

Returns the open value for an item within a series.

```
public Number getCloseValue(int series, int item);
```

Returns the close value for an item within a series.

This interface is used in the JFreeChart library.
13.17 Hour

13.17.1 Overview

A subclass of TimePeriod that represents one hour in a particular day. This class is designed to be used with the BasicTimeSeries class, but (hopefully) is general enough to be used in other situations.

13.17.2 Constructor

To construct an Hour instance:

```java
public Hour(int hour, Day day);
```
Creates a new Hour instance. The hour argument should be in the range 1 to 24.

To construct an Hour instance based on a java.util.Date:

```java
public Hour(Date time);
```
Creates a new Hour instance.

A default constructor is provided:

```java
public Hour();
```
Creates a new Hour instance based on the current system time.

13.17.3 Methods

To access the hour:

```java
public int getHour();
```
Returns the hour (in the range 1 to 24).

To access the day:

```java
public Day getDay();
```
Returns the day.

There is no method to set the hour or the day, because this class is immutable.

Given a Hour object, you can create an instance representing the previous hour or the next hour:

```java
public TimePeriod previous();
```
Returns the previous hour, or null if the lower limit of the range is reached.

```java
public TimePeriod next();
```
Returns the next hour, or null if the upper limit of the range is reached.

13.17.4 Notes

The Hour class is immutable. This is a requirement for all TimePeriod subclasses.

See Also:

TimePeriod, BasicTimeSeries, Day.
13.18 IntervalXYZDataset

A natural extension of the IntervalXYDataset interface.

13.19 Millisecond

13.19.1 Overview

A subclass of TimePeriod that represents one millisecond. This class is designed to be used with the BasicTimeSeries class, but (hopefully) is general enough to be used in other situations.

13.19.2 Constructors

To construct a Millisecond instance:

```java
public Millisecond(long millisecond);
```

Creates a new Millisecond instance. The millisecond argument uses the same encoding as java.util.Date.

You can construct a a Millisecond instance based on a java.util.Date instance:

```java
public Millisecond(Date time);
```

Creates a new Millisecond instance representing the same millisecond as the time argument.

A default constructor is provided, which creates a Millisecond instance based on the current system time:

```java
public Millisecond();
```

Creates a new Millisecond instance based on the current system time.

13.19.3 Methods

To access the millisecond:

```java
public int getMillisecond();
```

Returns the millisecond.

There is no method to set the millisecond, because this class is immutable.

Given a Millisecond object, you can create an instance representing the previous millisecond or the next millisecond:

```java
public TimePeriod previous();
```

Returns the previous millisecond, or null if the lower limit of the range is reached.

```java
public TimePeriod next();
```

Returns the next millisecond, or null if the upper limit of the range is reached.
13.19.4 Notes

The Millisecond class is immutable. This is a requirement for all TimePeriod subclasses.

See Also:
TimePeriod, BasicTimeSeries, java.util.Date.

13.20 Minute

13.20.1 Overview

A subclass of TimePeriod that represents one minute in a particular day. This class is designed to be used with the BasicTimeSeries class, but (hopefully) is general enough to be used in other situations.

13.20.2 Constructors

To construct a Minute instance:

```java
public Minute(int minute, Day day);
```
Creates a new Minute instance. The minute argument should be in the range 1 to 24*60.

To construct a Minute instance based on a java.util.Date:

```java
public Minute(Date time);
```
Creates a new Minute instance.

A default constructor is provided:

```java
public Minute();
```
Creates a new Minute instance, based on the current system time.

13.20.3 Methods

To access the minute:

```java
public int getMinute();
```
Returns the minute (in the range 1 to 24*60).

To access the day:

```java
public Day getDay();
```
Returns the day.

There is no method to set the minute or the day, because this class is immutable. Given a Minute object, you can create an instance representing the previous minute or the next minute:

```java
public TimePeriod previous();
```
Returns the previous minute, or null if the lower limit of the range is reached.

```java
public TimePeriod next();
```
Returns the next minute, or null if the upper limit of the range is reached.
13.20.4 Notes

The `Minute` class is immutable. This is a requirement for all `TimePeriod` subclasses.

See Also:
- `TimePeriod`, `BasicTimeSeries`, `Day`.

13.21 Month

13.21.1 Overview

A subclass of `TimePeriod` that represents one month in a particular year. This class is designed to be used with the `BasicTimeSeries` class, but (hopefully) is general enough to be used in other situations.

13.21.2 Constructors

To construct a `Month` instance:

```java
public Month(int month, Year year);
Creates a new `Month` instance. The `month` argument should be in the range 1 to 12.

public Month(int month, int year);
Creates a new `Month` instance.
```

To construct a `Month` instance based on a `java.util.Date`:

```java
public Month(Date time);
Creates a new `Month` instance.
```

A default constructor is provided:

```java
public Month();
Creates a new `Month` instance, based on the current system time.
```

13.21.3 Methods

To access the month:

```java
public int getMonth();
Returns the month (in the range 1 to 12).
```

To access the year:

```java
public Year getYear();
Returns the year.
```

There is no method to set the month or the year, because this class is immutable. Given a `Month` object, you can create an instance representing the previous month or the next month:
public TimePeriod previous();
Returns the previous month, or null if the lower limit of the range is reached.

public TimePeriod next();
Returns the next month, or null if the upper limit of the range is reached.

To convert a Month object to a String object:

public String toString();
Returns a string representing the month.

13.21.4 Notes
In the current implementation, the year can be in the range 1900 to 9999.
The Month class is immutable. This is a requirement for all TimePeriod subclasses.

See Also:
TimePeriod, BasicTimeSeries, Year.

13.22 PieDataset
13.22.1 Overview
The interface for a dataset that associates values with categories.

13.22.2 Methods
Three methods are defined in the interface:

public int getCategoryCount();
Returns the number of categories in the dataset.

public Set getCategories();
Returns the set of categories.

public Number getValue(Object category);
Returns the value associated with a particular category.

13.22.3 Notes
The name of the interface is derived from a common usage for this type of
dataset—the creation of pie charts.

There are some convenient methods for creating a PieDataset object by slicing
a CategoryDataset. Refer to the Datasets class for more details.

See Also
DefaultPieDataset.
13.23 Quarter

13.23.1 Overview

A subclass of TimePeriod that represents one quarter in a particular year. This class is designed to be used with the BasicTimeSeries class, but (hopefully) is general enough to be used in other situations.

13.23.2 Constructor

To construct a Quarter instance:

public Quarter(int quarter, Year year);
Creates a new Quarter instance. The quarter argument should be in the range 1 to 4.

public Quarter(int quarter, int year);
Creates a new Quarter instance.

To construct a Quarter instance based on a java.util.Date:

public Quarter(Date time);
Creates a new Quarter instance.

A default constructor is provided:

public Quarter();
Creates a new Quarter instance based on the current system time.

13.23.3 Methods

To access the quarter:

public int getQuarter();
Returns the quarter (in the range 1 to 4).

To access the year:

public Year getYear();
Returns the year.

There is no method to set the quarter or the year, because this class is immutable.

Given a Quarter object, you can create an instance representing the previous quarter or the next quarter:

public TimePeriod previous();
Returns the previous quarter, or null if the lower limit of the range is reached.

public TimePeriod next();
Returns the next quarter, or null if the upper limit of the range is reached.

To convert a Quarter object to a String object:

public String toString();
Returns a string representing the quarter.
13.23.4 Notes
In the current implementation, the year can be in the range 1900 to 9999.
The Quarter class is immutable. This is a requirement for all TimePeriod subclasses.

See Also:
TimePeriod, BasicTimeSeries, Year.

13.24 RangeInfo
13.24.1 Overview
An interface that provides information about the minimum and maximum values in a dataset’s range.

13.24.2 Methods
To get the minimum value in the dataset’s range:
   public Number getMinimumRangeValue();
   Returns the minimum value in the dataset’s range.
To get the maximum value in the dataset’s range:
   public Number getMaximumRangeValue();
   Returns the maximum value in the dataset’s range.

13.24.3 Notes
It is not mandatory for a dataset to implement this interface. However, sometimes it is necessary to calculate the minimum and maximum values in a dataset. Without knowing the internal structure of a dataset, the only means of determining this information is iteration over the entire dataset. If there is a more efficient way to determine the values for your data structures, then you can implement this interface and provide the values directly.

See Also
DomainInfo.

13.25 Second
13.25.1 Overview
A subclass of TimePeriod that represents one second in a particular day. This class is designed to be used with the BasicTimeSeries class, but (hopefully) is general enough to be used in other situations.

13.25.2 Constructors
To construct a Second instance:
public Second(int second, Day day);
Creates a new Second instance. The second argument should be in the range 1 to 24*60*60.

To construct a Second instance based on a java.util.Date:

public Second(Date date);
Creates a new Second instance.

A default constructor is provided:

public Second();
Creates a new Second instance based on the current system time.

### 13.25.3 Methods

To access the second:

public int getSecond();
Returns the second (in the range 1 to 24*60*60).

To access the day:

public Day getDay();
Returns the day.

There is no method to set the second or the day, because this class is immutable.

Given a Second object, you can create an instance representing the previous second or the next second:

public TimePeriod previous();
Returns the previous second, or null if the lower limit of the range is reached.

public TimePeriod next();
Returns the next second, or null if the upper limit of the range is reached.

### 13.25.4 Notes

The Second class is immutable. This is a requirement for all TimePeriod sub-classes.

See Also:
TimePeriod, BasicTimeSeries, Day.

### 13.26 SeriesChangeListener

The interface through which series change notifications are posted.

### 13.27 SeriesDataset

#### 13.27.1 Overview

A base interface that defines a dataset containing zero, one or many data series.
13.27.2 Methods
The methods in the interface are:

```java
public int getSeriesCount();
// Returns the number of series in the dataset.
public String getSeriesName(int series);
// Returns the name of the series with the specified index (zero based).
```

13.27.3 Notes
This interface is extended by `CategoryDataset` and `XYDataset`.

See Also:
`CategoryDataset`, `XYDataset`.

13.28 SeriesException
An exception generated by a series. For example, a time series will not allow
duplicate time periods—attempting to add a duplicate time period will throw
a `SeriesException`.

13.29 Statistics

13.29.1 Overview
Provides some static utility methods for calculating statistics.

13.29.2 Methods
To calculate the average of an array of `Number` objects:

```java
public static double getAverage(Number[] data);
// Returns the average of an array of numbers.
```

To calculate the standard deviation of an array of `Number` objects:

```java
public static double getStdDev(Number[] data);
// Returns the standard deviation of an array of numbers.
```

To calculate a least squares regression line through an array of data:

```java
public static double[] getLinearFit(Number[] x_data, Number[] y_data);
// Returns the intercept (double[0]) and slope (double[1]) of the linear regression line.
```

To calculate the slope of a least squares regression line:

```java
public static double getSlope(Number[] x_data, Number[] y_data);
// Returns the slope of the linear regression line.
```

To calculate the slope of a least squares regression line:

```java
public static double getCorrelation(Number[] data1, Number[] data2);
// Returns the correlation between two sets of numbers.
```

13.29.3 Notes
This class was written by Matthew Wright.
13.30 SubseriesDataset
A specialised dataset implementation written by Bill Kelemen. To be documented.

13.31 TimePeriod
13.31.1 Overview
An abstract class that represents a fixed period of time. This class and its subclasses are designed to be used with the BasicTimeSeries class.

13.31.2 Methods
Given a TimePeriod instance, you can create another instance representing the previous time period, or the next time period:

```java
public abstract TimePeriod previous();
Returns the previous time period, or null.
```

```java
public abstract TimePeriod next();
Returns the next time period, or null.
```

To get the millisecond at the start, middle and end of the time period (using the same encoding convention as java.util.Date):

```java
public long getStart();
The first millisecond of the time period.
```

```java
public long getMiddle();
The middle millisecond of the time period.
```

```java
public long getEnd();
The last millisecond of the time period.
```

13.31.3 Notes
All TimePeriod subclasses are required to be immutable.

Known subclasses include: Year, Quarter, Month, Week, Day, Hour, Minute, Second and Millisecond.

See Also:
BasicTimeSeries.

13.32 TimePeriodFormatException
An exception that can be thrown by the methods used to convert time periods to strings, and vice versa.

See Also
TimePeriod
13.33 TimeSeriesCollection

13.33.1 Overview

A collection of TimeSeries objects. The collection may contain zero, one or many time series.

TimeSeriesCollection extends AbstractSeriesDataset to provide some of the basic series information.

The collection implements the IntervalXYDataset interface (and, therefore, the XYDataset interface) and can be used as a convenient dataset for the JFreeChart library.

13.33.2 Constructors

You can construct a TimeSeriesCollection in several different ways:

public TimeSeriesCollection();
Creates a new time series collection, initially empty.

public TimeSeriesCollection(BasicTimeSeries series);
Creates a new time series collection, containing a single time series.

Once a collection has been constructed, you are free to add additional time series to the collection. There are not yet any methods for removing a series from a collection (possibly to be implemented in the future).

13.33.3 Methods

To find out how many time series objects are in the collection:

public int getSeriesCount();
Returns the number of time series objects in the collection.

To get a reference to a particular series:

public BasicTimeSeries getSeries(int series);
Returns a reference to a series in the collection.

To get the name of a series:

public String getSeriesName(int series);
Returns the name of a series in the collection. This method is provided for convenience.

To add a series to the collection:

public void addSeries(BasicTimeSeries series);
Adds the series to the collection. Registered listeners are notified that the collection has changed.

To get the number of items in a series:

public int getItemCount(int series);
Returns the number of items in a series. This method is part of the XYDataset interface.
13.33.4 Notes
This class implements the XYDataset and IntervalXYDataset interfaces.

See Also:
AbstractSeriesDataset, BasicTimeSeries, XYDataset and IntervalXYDataset.

13.34 TimeSeriesDataPair
Associates a numerical value with a time period. This class is used by the TimeSeries class.
There are a number of important features. First, the class implements the Comparable interface, allowing data items to be sorted into time order using standard Java API calls. Second, the instances of this class can be easily cloned. Third, the time period element is immutable, so that when a collection of objects is held in sorted order, the sorted property cannot inadvertently be broken.

See Also
TimeSeries

13.35 TimeSeriesTableModel
An initial attempt to display a time series in a JTable.

13.36 Values
An interface for accessing a set of values. This hasn’t been used for anything yet...but the idea was to create a simple data structure that could be passed to a variety of statistical methods (for example, a method that calculates frequency distributions, returning an appropriate dataset for constructing a histogram). More work to be done...

13.37 Week
13.37.1 Overview
A subclass of TimePeriod that represents one week in a particular year. This class is designed to be used with the BasicTimeSeries class, but (hopefully) is general enough to be used in other situations.

13.37.2 Constructors
To construct a Week instance:

```java
public Week(int week, Year year);
Creates a new Week instance. The week argument should be in the range 1 to 52.
```

```java
public Week(int week, int year);
Creates a new Week instance.
```

To construct a Week instance based on a java.util.Date:

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public Week(Date time);  
Creates a new Week instance.

A default constructor is provided:

public Week();  
Creates a new Week instance based on the current system time.

13.37.3 Methods

To access the week:

public int getWeek();  
Returns the week (in the range 1 to 52).

To access the year:

public Year getYear();  
Returns the year.

There is no method to set the week or the year, because this class is immutable.

Given a Week object, you can create an instance representing the previous week or the next week:

public TimePeriod previous();  
Returns the previous week, or null if the lower limit of the range is reached.

public TimePeriod next();  
Returns the next week, or null if the upper limit of the range is reached.

To convert a Week object to a String object:

public String toString();  
Returns a string representing the week.

13.37.4 Notes

In the current implementation, the year can be in the range 1900 to 9999.

The Week class is immutable. This is a requirement for all TimePeriod subclasses.

See Also:  
TimePeriod, BasicTimeSeries, Year.

13.38 XYDatapair

Associates a numerical value with another numerical value. This class is analogous to the TimeSeriesDataPair class.

13.39 XYDataset

13.39.1 Overview

An interface that defines a collection of data in the form of \((x, y)\) values. The dataset can consist of zero, one or many data series. Each series can have \((x, y)\) values that are completely independent of the other series in the dataset.
13.39.2 Methods

The methods in the interface are:

- `public int getItemCount(int series);` Returns the number of data items in a series.
- `public Number getXValue(int series, int item);` Returns an x-value for a series.
- `public Number getYValue(int series, int item);` Returns a y-value for a series (possibly null).

13.39.3 Notes

JFreeChart uses this interface to obtain data for drawing charts.

See Also:
SeriesDataset, DefaultXYDataset, IntervalXYDataset.

13.40 XYSeries

A series of (x, y) data items. Analogous to the TimeSeries class.

13.41 XYSeriesCollection

A collection of XYSeries objects. This class implements the XYDataset interface, so can be used very conveniently with JFreeChart.

13.42 XYZDataset

A natural extension of the XYDataset interface.

13.43 Year

13.43.1 Overview

A subclass of TimePeriod that represents one year. This class is designed to be used with the TimeSeries class, but is (hopefully) general enough to be used in other situations.

13.43.2 Constructors

To construct a Year instance:

- `public Year(int year);` Creates a new Year instance. The year argument should be in the range 1900 to 9999.

To construct a Year instance based on a java.util.Date:

- `public Year(Date time);` Creates a new Year instance.

A default constructor is provided:
public Year();
Creates a new Year instance based on the current system time.

13.43.3 Methods
To access the year:

    public int getYear();
    Returns the year.

There is no method to set the year, because this class is immutable.
Given a Year object, you can create an instance representing the previous year or the next year:

    public TimePeriod previous();
    Returns the previous year, or null if the lower limit of the range is reached.

    public TimePeriod next();
    Returns the next year, or null if the upper limit of the range is reached.

To convert a Year object to a String object, or vice versa:

    public String toString();
    Returns a string representing the year.

    public static Year parseYear(String s) throws TimePeriodFormatException;
    Parses the string and, if possible, returns a Year object.

13.43.4 Notes
In the current implementation, the year can be in the range 1900 to 9999.
The Year class is immutable. This is a requirement for all TimePeriod sub-
classes.

See Also:
    TimePeriod, TimeSeries.
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