
JGraph Updating Guide

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1. Introduction

This guide should help you to update existing code to the latest JGraph versions. We try and keep the impact of new versions as minimal as possible, some bug fixes and extensions still require API changes. We will use deprecation where possible and explain the motivation of all changes and how to migrate your code in this guide.

Feel free to contact support@jgraph.com if you feel a change is missing or to request additional information for a change. (Please provide your order number when contacting support.)

2. JGraph 5.12

2.1. Painting changes

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JGraph 5.12 extends the double buffering idea introduced in JGraph 5.10. In 5.12 efforts have been made to repaint the absolute minimum of the double buffer. The JGraph class has a new dirty region rectangle storage which accumulates dirty rectangles and repaints the buffer in the union of those accumulated. If you use insert, remove or edit calls to alter the graph this will be done for you. The GraphLayoutCacheEvent was been altered to store a dirty region (see GraphLayoutCacheEvent API change below). The event determines the dirty region prior to the change on the fly and passes it the handlers in the BasicGraphUI. In these handlers the new dirty region is calculated and the union of the two is set as the graph dirty region. If you require in-place changes for functionality such as overlays, you should explicitly call JGraph.addDirtyRegion(Rectangle2D) if you are using double buffering passing all the area requiring repainting.

The GraphLayoutCacheEvent interface has changed to include accessors for the dirty region store. getDirtyRegion() and setDirtyRegion(Rectangle2D dirty) need to be offered in all GraphLayoutCacheEvent and GraphModelEvent subclasses. In the vast majority of cases these may be implemented as stubs. If you override the model, graph layout cache, or selection handlers in BasicGraphUI and do not call the

superclass method, or if the handlers are replaced entirely, the best course of action is to diff the changes between JGraph 5.11.0.1 and JGraph 5.12.0.0 (or later if bug fixes applied) and copy the changes over.

Previously, a list was used in the the DefaultSelectionModel class. This meant that certain operations (contains and remove) that were quadratic in performance to the number of elements. To obtain linear performance, the ArrayList has been replaced with a LinkedHashSet. Any overridden selection models will need some of their method signatures to be altered to reflect the change of collection class used.

3. JGraph 5.10

3.1. Painting changes

3.1. Painting changes

3.1. Painting changes

In JGraph 5.9 changes were made to reuse the offscreen buffer in the various handles available. This has been extended so the offscreen buffer persists constantly, except when it needs to resize. This means the painting engine draws the graph onto the offscreen buffer and paints the buffer onto the screen. This makes it possible to scroll around the graph much faster since the graph does not have to be re-drawn. If you have overridden any of the painting code in BasicGraphUI it is worth asking through your support channel or on the forum how best to port your code over.

The update() and refresh() method in cell view now have an additional parameter, a GraphLayoutCache. The reason for this is that the routing classes were unable to perform global routing without some high level view of the graph. Any overridden cell views or routing classes may need to be updated to reflect this new parameter.

Previously, a list was used in the the DefaultSelectionModel class. This meant that certain operations (contains and remove) that were quadratic in performance to the number of elements. To obtain linear performance, the ArrayList has been replaced with a LinkedHashSet. Any overridden selection models will need some of their method signatures to be altered to reflect the change of collection class used.

4. JGraph 5.9

4. JGraph 5.9

4.1. Off screen buffer moved to JGraph class

Double buffering in JGraph previously consisted of off screen buffers created in the root handles and size handles to buffer drag and resize previews on a per-case basis. However, the preview buffered the entire graph image and so recreating the buffer on each operation was expensive in CPU terms. The off screen buffer and off graphics that is the graphics object of the buffer have been moved to the JGraph class. The initOffscreen() methods of RootHandle and EdgeHandle now obtain the off graphics from the graph instance using the getOffgraphics() method. This method returns the same buffer as long the graph bounds does not change, thus sharing the buffer between handles and between drag operations. This mechanism does require that setPaintMode() is called on the graphics object before use, since XOR mode will generally have been enabled.

The root and size handles still maintain a reference to the graphics object since the mouseDragged methods need to still use it. The mouseDragged method also used to check the off screen image for being null as a means of determining whether or not off screen buffering is being used. These checks can be re-

placed with checking the offgraphics references for null, the effect is the same. The mouseDragged methods also used to perform a Graphics.drawImage() call to update the preview. Since this call required the off screen buffer and the JGraph instance a utility method called drawImage has been added to JGraph, which holds the necessary objects for this operation. If you did not want the off screen buffer to be retained between handle operations, override getOffgraphics() in your JGraph subclass and remove the if check.

The cachedLabelBounds and cachedExtraLabelBounds variables in EdgeView were never set since getLabelBounds() and getExtraLabelBounds() were never called. If you were using these method or variable, you should find no difference just removing the calls. The label bounds are always worked out on the fly in the renderer now.

5. JGraph 5.8

5.1. Edge Renderer graph reference made weak reference

The graph variable in the EdgeRenderer has been replaced with a weak reference. Previously, in the vertex and port renderer, the graph variable was removed as, since the renderers have one static instance, the graph object instance could outlive its intended lifespan. Removing the graph instance in the edge renderer is not possible under the current architecture and so a weak reference is now used instead. It is recommended that if you sub-class EdgeRenderer and require an attribute of the graph, that you create a local renderer attribute and copy the value over in getRendererComponent(). See highlightColor in getRendererComponent() of EdgeRenderer as an example. This local variable is then used instead of the direct value from the graph.

Note that this issue did not cause a memory leak, as such. It is more a static memory footprint. This meant that one graph instance would exist until another was created and if the graph instance referenced a large number of cells with large user objects, this could waste excessive memory. The version number has had to go to 5.8 to indicate that a few users might not have binary compatibility, but the changes required, if any, are trivial.

6. JGraph 5.7

6.1. Loop routing seperated from general routing

The Routing interface still requires the implementation of the route() method. route() returns the result of one of the routing methods in the router. The basic implementation checks if the edge is a loop and calls the loop routing method, otherwise it calls the general routing method. routeLoop() routes edges that start and ends at the same vertex and routeEdge() is intended for non self-loop edges. The default loop implementation is provided by LoopRouting. Extending LoopRouting for your own routers is recommended if your router does not currently provide any self-looping. The default router, DefaultRouter, inherits from LoopRouting and adds routing for general edges.

6.2. Edgeview now keeps manual control points

Edgeviews with manual control points that have routing applied revert to their old manual control points when the routing is removed.

7. JGraph 5.6.3

7.1. Port and vertex renderers no longer have graph reference.

Renderers are generally static instances even when you delete a JGraph these renderers stop the JGraph from being garbage collected. This only happens for one JGraph instance and is more of a static memory footprint than a memory leak. We've removed the references in the port and vertex in this release and will do the edge renderer shortly. If you were relying on having the graph instance available the idea is to create extra variables in the renderer and set the specific variables in `getRendererComponent`. So if you were using the graph reference to get the color, for example, in `paint()`, instead create a variable to hold the color in the renderer and set it in `getRendererComponent` using the graph instance available there. In `paint` then use that local color variable instead.

8. JGraph 5.6.1

8.1. `getSelectionCellAt` added to JGraph

`getSelectionCellAt` takes a `Point2D` as its parameter and returns the first selected cell whose bounds the point lies within. This is useful if you have a mouse operation that doesn't perform a selection and you want the operation to act only on selected cells. A right mouse button press to bring up a popup menu is such an example.

8.2. Moves into group checks for full intersection

Previously, whether or not a cell that was dragged into a group was made part of that group (assuming the move into groups option is enabled) was based on the mouse position when released. This has been corrected to be based on whether the cells bounds is fully within the bounds of the group cell instead.

8.3. Inserting/Removing extra labels in edge handle

When extra labels are selected and dragged with the control key depressed, a clone of the extra label is made upon release. Also, if a press occurs on an extra label with the shift key depressed, the extra label is removed.

8.4. Bounds cloning bug in `JGraph.getCellBounds`

An intermittent bounds cloning bug was fixed in `JGraph.getCellBounds(Object[])`. This meant occasionally it was possible for a cell to become very high since it was using the bounds value from a previously processed cell.

8.5. `EdgeView.getPerimeterPoint` returns edge center

This means that edges connecting to other edges will point to the center of the connected-to edge if the port attached to the connected-to edge is floating.

9. JGraph 5.6

9.1. Expand/Collapse Functionality

The expand and collapse functionality has been improved in the `GraphLayoutCache`. When a group is collapsed, edges connecting to vertices that have been hidden are shown to attach to the perimeter point of their first visible parent view. Note that no model changes are made. When the group is expanded

again the edges are shown connected to their original vertices.

There is a new method in `GraphLayoutCache`, `setCollapsedState` that accepts arrays of the cells to be collapsed and those to be expanded, so the two operations can be performed at the same time.

A new attribute, `groupOpaque`, was added. This enables transparent groups which are opaque when collapsed, i.e. the group cell is not visible if it is expanded but is visible if it is collapsed.

The `showsChangedConnections` switch was added to the `GraphLayoutCache`. This indicates whether connections should be made visible when reconnected and their source and target ports (or one of their parents) are visible.

9.2. Adds `getPerimeterPoint` to `CellView` interface

This method was previously in `VertexView`, this change enables edge to edge connections. The method also now requires an `EdgeView` parameter of the edge connecting with the perimeter of the vertex. null will work correctly for this parameter initially. The old method has been deprecated.

9.3. Moves `getCenterPoint` as static method to `AbstractCellView`

The old method in `VertexView` is deprecated. `vertex.getCenterPoint()` needs to be changed to `AbstractCellView.getCenterPoint(vertex)`;

9.4. Adds `getCells` to `GraphLayoutCache`

This new helper methods allows to get cells based on their type and current state in the layout cache. For example, to get all vertices (ie. all cells for which `model.isEdge(cell)` and `model.isPort(cell)` returns null and that appear as leafs in the layout cache), the following code may be used:

```
graph.getGraphLayoutCache().getCells(false, true, false, false);
```

In order to find all selected edges, the following code is used (using the new `getSelectionCells(Object[])` in `JGraph`):

```
graph.getSelectionCells(
    graph.getGraphLayoutCache().getCells(false, false, false, true));
```

9.5. Other Changes

- `getSelectionCells(Object[] cells)` was added to the `JGraph` class. This returns an `Object` array with cells that are selected from the `Object` array parameter passed in.
- The type of extra edge labels in `GraphConstants` was changed to a `Point2D`. This was a bug, please update your types accordingly.
- The moves cells out of groups functionality was changed so that the cell is judged to have left the group with there is no intersection between its bounds and the group bounds. Previously, this was worked out from the mouse position, which was a bug.

- Bean properties for `gridColor`, `(locked)handleColor` and `handleSize` have been added.

10. JGraph 5.5.3

10.1. Move In/Out Groups Functionality

The `JGraph` class has switches named `moveIntoGroups` and `moveOutOfGroups`. `moveIntoGroups` controls whether or not to automatically insert cells into group cells if they are dragged and dropped into the bounds of that group. Likewise, dragging and dropping a cell out of a group cell is possible with `moveOutOfGroups` enabled.

10.2. **Deprecated** `DefaultGraphModel.getUserObject(Object)`

This static method is replaced with the member method `getValue(Object)`.

10.3. Other Changes

- `EdgeHandle` checks for the edge being disconnectable in `mouseDragged` instead of `mousePressed`. The `processNestedMap` has been added for subclasses to modify the nested map that represents the change.

11. JGraph 5.5.1

11.1. New Hooks in `AbstractCellView`

In order to avoid creation of unused attribute maps in the cell views, and to avoid or change the retrieval and cloning of the cell's attributes in the `CellView.refresh`, the `AbstractCellView` provides two hooks: `createAttributeMap` is called at construction time to create the `allAttributes` and `attributes` (same instance until the first refresh call) and `getCellAttributes` is called from refresh to retrieve and clone the cell attributes from the model.

These hooks may be used to reduce the memory footprint for large graphs. Please have a look at the `FastGraph` example.

11.2. **Deprecated** `GraphCell.changeAttributes`

The default values for points and the label position in edges is not required to be ensured in the `DefaultEdge` (ie on cell-level). Rather, the `EdgeView`'s update method should check whether these values exist, and create them on the fly if they are missing. (In analogy to the bounds-check in `VertexView`.) Thanks to this, it is no longer required to change the attributes of a cell *via* the cell instance using `changeAttributes`, the attributes can be changed directly using the following code (where `change` is a `Map` and `cell` is an `Object`):

```
AttributeMap undo = graph.getModel().getAttributes(cell).applyMap(change);
```

11.3. Other Changes

- Various performance and memory improvements in edges and edge rendering and -hit detection
- Stores default values in allAttributes in VertexView.update
- Adds new examples to the commercial distribution
- Removes unnessesary calls to AttributeMap.createPoint

12. JGraph 5.5

12.1. GraphModel.valueForCellChanged

Sometimes it is required that a value for a cell be changed without knowing the actual cell- or graph model class, and without adding the change to the command history. Therefore, a new method has been added to the GraphModel interface which allows a client to change the value (aka. user object) of a cell without making any typecasts or adding the change to the command history.

Without this method a client that didn't want to affect the command history while changing the value of a cell was forced to either cast to the custom graph model or to the custom cell type in order to change the value.

The advantage of this change is that it is now possible to change the value of a cell (eg. prior to insertion) without knowing the custom model or custom types it contains. This is useful for functionalities that create new cells (such as group actions, mouse tools and import routines), because these are typically unaware of the concrete graph model or cell types, or there may be more than one model or cell type throughout the lifecycle of these objects.

In such a setup, the cell passed to the functionality is referred to as a "prototype" and is prepared (cloned and updated) for use in a new model with the following lines of code:

```
GraphModel model = graph.getModel();
Object newCell = DefaultGraphModel.cloneCell(model, prototype);
model.valueForCellChanged(cell, "Hello, world!");
```

Note that in this example, the prototype is an Object and no typecast is required to change the cell value. The value does not need to be a String, it can be any object.

12.1.1. How to migrate?

Developers of custom models and custom graph cells do only need to change the modifier of the existing valueForCellChanged method. This method has been there before, but was not part of the graph model interface. Instead it was used internally by the handleAttributes method to encapsulate the actual changing of the value, so that it could be overridden by subclassers to handle custom user objects. This is still the same, but with the new interface the method can be called by external parties as well, which means the visibility must be changed from protected to public.

12.2. EdgeView.getEdgeRenderer

This method does a cast to EdgeRenderer on the value returned by getRenderer, and may therefore cause exceptions for subclassers that do not inherit from EdgeRenderer to implement their edge rendering. We have fixed this so that the invocations of this method are limited to the EdgeView class, so that a subclasser can safely assume that no other invocations to this method will be made. It is therefore required to override all methods which rely on this method within the EdgeView class, namely:

- `getShape`
- `getLabelBounds`
- `getExtraLabelBounds`
- `intersects`
- `getBounds`

The reason for closely coupling the `EdgeView` and `EdgeRenderer` is due to caching and separation of concerns between the `EdgeRenderer` and the `EdgeView`. For example: The `EdgeRenderer` is in charge of finding the actual bounds of the edge, whereas the `EdgeView` is in charge of caching these bounds until they need to be updated.

When implementing a custom edge renderer that does not inherit from `EdgeRenderer` then you need to make sure that these collaborations are clearly defined and then override the above methods with your custom code.

Note that there was one additional call to this method from within the `BasicGraphUI` (which was used to position the in-place editor). This call was fixed to use `getRenderer` and perform a typecast, using the top-left corner of the edge's bounding box as a default. You may want to override that `getEditorLocation` method to change this for a custom edge renderer.

12.3. Labels for Self-References (aka Loops)

The labels for self-references with no additional control points have been made moveable. The underlying functionality interprets the label position as an absolute vector in pixel coordinates in this special case, because one cannot use the normalized vector between to the end points of such loops (as they are at the same location and thus the resulting vector is 0).

The advantage of this change is that it is now possible to move labels on loops that have no control points. On the downside the labels will "jump" (because of the special coordinate system) once the loop is changed to become a link between two different ports.

12.4. Other Changes

- Avoids cropping of edge label (and in-place editing) in `EdgeRenderer`

13. JGraph 5.4.4

13.1. BasicMarqueeHandler

The `paint` and `overlay` methods have been changed to include the current graph. Since these methods are always called in the context of a specific event, the graph is part of the caller's state, not the callee. To migrate your code, simply change the subclasses method signature to match that of the parent class, namely by inserting an argument in `paint` and `overlay` as in:

```
public void paint(JGraph graph, Graphics g);  
public void overlay(JGraph graph, Graphics g, boolean clear);
```

13.2. BasicGraphUI.MouseHandler.handleEditTrigger

The handleEditTrigger returns a boolean value to indicate whether the editing has actually started. This is a fix for events that are outside the cell editor's hit region, in which case the cell is not selected when the edit click count is set to 1. This bug still exists in various Swing components. (Thanks to Timothy Wall from the Abbott project for this fix!)

13.3. New Helper Methods

- `GraphLayoutCache.getEdges`: Returns all visible, connected edges for a cell (with various switches)
- `GraphLayoutCache.edit(Map)`: Shortcut method to avoid passing null parameters
- `GraphLayoutCache.editCell(Object, Map)`: Changes a single cell (no nested map required)
- `GraphLayoutCache.getNeighbours`: Returns the neighbours of a cell (with various switches)
- `GraphConstants.merge(Map, Map)`: Merges two nested maps

13.4. Other Changes

- Changes `GraphLayoutCache.setAllAttributeLocal` to `setAllAttributesLocal`
- Replaced certain `setViews` calls in `EdgeRenderer` with assignment of view where `setView` is called directly afterwards for performance reasons
- Adds `createGraph` method, graph accessors, static inner classes in `GraphEd`
- Fixes `GraphEd.connect` to check against `acceptsSource` and `acceptsSource`

14. JGraph 5.4.3

14.1. Edge Labels

We use a new positioning for edge labels, and fixed moving of them with the mouse.

- X-coordinate: the percentual position on the length of the edge in direction of the edge
- Y-coordinate: the absolute offset, orthogonally to the edge

Note that this requires to change the position of the default label from $(u/2, u/2)$ to $(u/2, 0)$, meaning 50% (in the center of the edge) with 0 px offset. For a label at the end of an edge with some 20 px offset you would use $(u, 20)$, and for a label at the start of the edge at the other side of it you would use $(0, -20)$ - eg. for multiplicities, where $u = \text{GraphConstants.PERMILLE}$.

15. JGraph 5.4.1

15.1. AskLocalAttributes

The `isAskLocalAttributes` field has been removed from `GraphLayoutCache`. The switch was used to control if the local attributes should be ignored. This switch was never used since the existence of local attributes normally also implies that they should be used.

15.2. AllAttributesLocal

As a "replacement" of the above, a `allAttributesLocal` switch was added to `GraphLayoutCache`. The switch controls if all attributes should be considered local. This is allows to control attributes without actually knowing them, and is useful in the context of "view-local" geometries.

15.3. Performance Improvements

The performance improvements are technically simple but quite considerable in wrt time consumption (eg. 5 times faster for inserting 10'000 nodes). They consist of removing `model.contains` calls in `GraphLayoutCache` and `DefaultGraphModel`.

15.4. Insets

The inset attribute is used in `BasicGraphUI.getPreferredSize` to add an inset to the default size returned by the respective renderer. The inset attribute now has a non-final default value in `GraphConstants.DEFAULTINSET`. Note that changing this value affects all graph instances.

15.5. Other Changes

- A method to snap a `Rectangle2D` to the grid (if it is active) has been added to `JGraph`.
- The `GraphLayoutCache` constructor adds a `hiddenSet` parameter.
- The `AttributeMap` does no longer contain default bounds.
- A `HugeGraphTest` example has been added.
- New hooks have been added to `GraphEd` (example): `createEdgeAttributes`, `createGroupCell`, `createDefaultGraphEdge`. In addition, the `createDefaultGraphCell` adds the port to the cell, not the calling method.

16. JGraph 5.4

16.1. Event Notification in GraphLayoutCache

The `GraphLayoutCache` does no longer implement the `Observable` interface, it now has a full-featured event notification mechanism. The listener should implement the `GraphLayoutCacheListener` interface and add the instance using the `addGraphLayoutCacheListener` method on the layout cache. The layout cache delivers `GraphLayoutCacheEvents` from which you can retrieve the new and the previous attributes. (Note: This will be required to optimize repaint upon changes.) The `getInserted` and `getRemoved` methods return the cells that have been shown or hidden.

16.1.1. How to migrate?

For code migration all existing observers should now implement the above interface with the respective method and remove the observer's update method:

```
class ACacheListener implements GraphLayoutCacheListener {
    public void graphLayoutCacheChanged(GraphLayoutCacheEvent e) {
        ...
    }
}
```

16.2. AttributeMap Does Not Store User Object

This fundamental change has the following advantages:

- No custom storage map injection at cell creation time, i.e. so no `setAttributeMap()` call required
- Graphcells must no longer keep the user object and the attribute map in sync
- No double-referencing of the same user object from graphcell and attribute map

On the downside this adds another control attribute, in other words: You can not use attributes with the name value in a storage map.

16.2.1. How to migrate?

If you are using custom user objects then you should have implemented a custom attribute map with at least a `valueChanged` and `clone` method to take care of your custom user objects. If the attribute map only contains these two methods it is no longer required. Instead, you should create or use the custom graph model and override the following two methods:

```
public class GPGraphModel extends DefaultGraphModel {
    protected Object cloneUserObject(Object userObject) {
        ...
    }
    protected Object valueForCellChanged(Object cell, Object newValue) {
        ...
    }
}
```

If the attribute map is no longer required then all calls to `cell.setAttributes` that were used to inject the map may also be removed. (See `GPGraphModel` in the `JGraphpad` project for an example.)

16.3. New Methods

3 useful static helper methods have been added to the `DefaultGraphModel`:

- `DefaultGraphModel.setSource/Target`: Sets the source or target of an edge
- `DefaultGraphModel.getUserObject`: Gets the user object from a graph cell

In the `GraphModelChange` the `getConnectionSet` and `getParentMap` methods have been added.

16.4. Other Changes

3 new attributes are available to control cell behaviour, 1 attribute has been renamed:

- selectable/childrenSelectable: Enable/disable selection of cells and children
- constrained: Forces constrained sizing on a cell
- groupBorder attribute is now called inset

The `JGraph.convertValueToString` method has been changed to no longer map the cell. Instead, it uses the cell's `toString` method to determine the value. The method still handles view-local values though. See source code and javadocs for more details on the implementation.

16.5. Abbott Tests

Timothy Wall has contributed test code for the Abbot testing framework. Please see the test directory. You must download the latest version of Abbot to compile and run the tests.

17. JGraph 5.3

17.1. Automatic Selection

The graph layout cache offers the `setSelectsLocalInsertedCells` and `setSelectsAllInsertedCells` methods for automatic selection. The first method will select all cells which are inserted through the local cache, while the latter will select all inserted cells that are visible. (Therefore it is not possible to select cells in all but the local layout cache.)

17.2. Attribute Maps

The `AttributeMap` had quite some changes over time. For migration it is important to understand that we have split the use of such maps into transport and storage. The transport objects are normal maps, as they do not need to override certain methods. The storage maps are `AttributeMaps`, which are no longer created with a static or non-static hook. The storage maps are only used when replacing the cell's or cellview's `attributes` field, otherwise one should use a transport map, such as a `Hashtable`.

17.3. Storage Maps

Here is how to set a storage map for a cell:

```
DefaultGraphCell cell = new DefaultGraphCell();
cell.setAttributes(new MyAttributeMap());
```

17.4. Transport Maps

This changes the vertex background color to blue:

```
Hashtable map = new Hashtable();
GraphConstants.setBackground(map, Color.BLUE);
graph.getGraphLayoutCache().edit(new Object[]{vertex}, map);
```

Note that by using the `edit(Object[], Map)` method we do no longer require a nested map.

17.5. New Methods

Many of the methods found in JGraphUtilities (JGraphAddons) have been moved to the DefaultGraphModel and GraphLayoutCache including:

- GraphLayoutCache.insertEdge: Inserts an edge
- GraphLayoutCache.insertVertex: Inserts a vertex
- GraphLayoutCache.insertGroup: Inserts a group

18. JGraph 5.2

18.1. JGraph.setSelectNewCells

This method was replaced by setSelectClonedCells, which uses the following pattern when cloning cells. The actual functionality of selecting newly inserted cells was removed from the core. Use the following pattern instead:

```
graph.getGraphLayoutCache().insert(cells, ...);  
graph.setSelectionCells(cells);
```

18.2. DefaultCellViewFactory

JGraph is no longer a cell view factory. Instead, the cell view factory is a standalone object that is referenced from the layout cache. Also, the cell view factory is no longer in charge of updating the auto size, this is done in the basic graph ui. Use the following code to create custom cell views:

```
graph.getGraphLayoutCache().setFactory(new DefaultCellViewFactory() {  
    public CellView createView(GraphModel model, Object cell) {  
        ...  
    }  
})
```

18.3. Extended Observer Pattern

The layout cache does now provide a getChanged method to indicate the changed cell views to its observers. The changed cell views are collected using addChanged before the call to notifyObservers. You must still call setChanged to notify the observers. The changed cell views are cleared when clearChanged is called.

18.4. Standalone GraphLayoutCache and Cell Views

For the cell views, the constructor now only takes the cell. The refresh method is used to refresh on a model-level change, and adds the graph model as a parameter. The layout cache is no longer in charge of auto-sizing and selection of new cells. Constructors have been changed to take a model and a factory. This change allows to use GraphLayoutCache and contained cell views in more than one JGraph instance.