DockingFrames

Insights of version BETA 1.0.1 (Release Candidate 2)

by Beni

dock.javaforge.com

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1 Basics

This chapter will present concepts that are needed to use DF as client.

1.1 The tree

DF is roughly organized as a tree. Clients have to create the elements of the tree (root, nodes, leafs), and users will be able to change the layout of the tree by simple drag&drop operations.

Some of the elements of the tree are part of the graphical user interface, others are not.

1.1.1 Leaf: Dockable

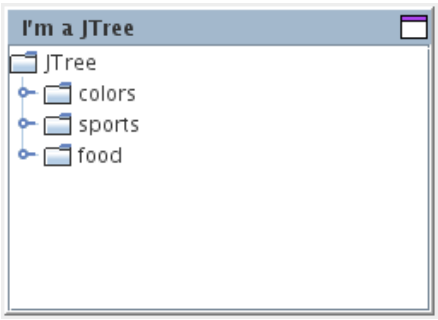
A Dockable is a graphical component like a JPanel, and a set of properties like an icon or title-text.

Clients will normally instantiate a DefaultDockable, and use its “content pane” to add their content to the graphical user interface.

A small example might look like this:

```
1: DefaultDockable dockable = new DefaultDockable();
2: dockable.setTitleText( "I'm a JTree" );
3: dockable.getContentPane().setLayout( new GridLayout( 1, 1 ) );
4: dockable.getContentPane().add( new JScrollPane( new JTree() ) );
```

The result would then be a Dockable of this form:



1.1.2 Node: DockStation

A Dockable alone is as usefull as a JButton without a Window to show it. Every Dockable needs a DockStation as parent. The DockStation knows where and how to show its children. A DockStation can be a Dockable by itself, so a tree of DockStations and Dockables can be built.

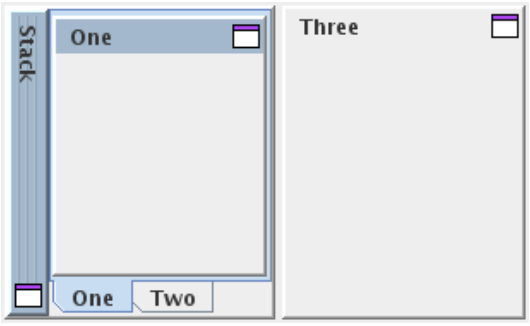
This codesnippet shows how some specific implementations of Dockable and DockStation can be combined.

```
1: SplitDockStation split = new SplitDockStation();
2: StackDockStation stack = new StackDockStation();
3:
4: stack.setTitleText( "Stack" );
5: stack.drop( new DefaultDockable( "One" ) );
6: stack.drop( new DefaultDockable( "Two" ) );
7:
8: split.drop( stack, SplitDockProperty.WEST );
9: split.drop( new DefaultDockable( "Three" ), SplitDockProperty.EAST );
```

What happens here?
In line 1 and 2, two DockStations are created.

A StackDockStation is also a Dockable, so in line 4 we set the title, and in line 9 we set the parent of the station.
In line 5 and 6, we add some children to the StackDockStation.
In line 8 and 9, we add some children to the SplitDockStation. The constants WEST and EAST are a hint for the SplitDockStation, where to put the new children.

The result of this code will produce this layout:



There are different DockStations:

- StackDockStation: organizes its children in a stack, like a JTabbedPane
- SplitDockStation: all children are put alongside with each other. A gap between the children allows the user to change the sizes of the children.
- FlapDockStation: shows a set of buttons, one for each child. The user can press one of the buttons, and a window will open showing the selected child.
- ScreenDockStation: creates a new window for each child. These windows float above the main application window.

1.1.3 Root: DockController

The DockController is the center of DF. He is responsible for “global” actions. The DockController seldomly does something by himself, but he knows where to find an object that can do its work. Every DockController has its own realm. There can be many DockControllers in one application, however they can't interact with each other. Normal applications will need only one DockController.

There is one method that needs to be mentioned: “setSingleParentRemove”. Clients can activate a mechanism that will cut out unnecessary nodes from the tree. This mechanism is per default offline, because in some applications removing nodes without asking would lead to a very strange behaviour.

Now follows a fully functional application showing how the whole tree is built:

```
1: public static void main( String[] args ){
2:     DockController controller = new DockController();
3:     controller.setSingleParentRemove( true );
4:
5:     SplitDockStation station = new SplitDockStation();
6:     controller.add( station );
7:
8:     station.drop( new DefaultDockable( "One" ) );
9:     station.drop( new DefaultDockable( "Two" ), SplitDockProperty.NORTH );
10:    station.drop( new DefaultDockable( "Three" ), SplitDockProperty.EAST );
11:
12:    JFrame frame = new JFrame();
13:    frame.add( station.getComponent() );
14:
15:    frame.setDefaultCloseOperation( JFrame.EXIT_ON_CLOSE );
16:    frame.setBounds( 20, 20, 400, 400 );
17:    frame.setVisible( true );
```

```
18: }
```

What happens here?

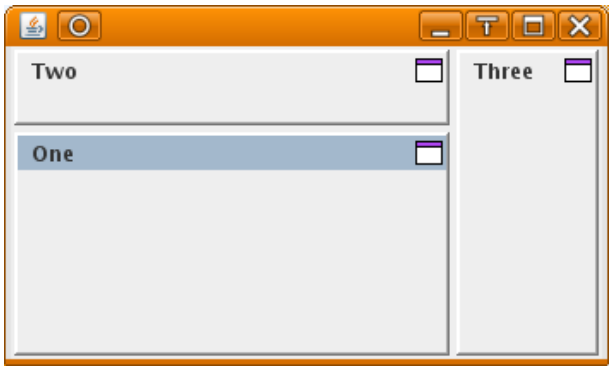
In line 1 and 2, the DockController is created and its properties set.

In line 5 and 6, a DockStation is instantiated, and added to the DockController. It's imperative to register the root-DockStations to the DockController, otherwise the tree could not be completed.

In lines 8 to 10, some Dockables are added to the DockStation.

In line 13 is the graphical representation of the DockStation added to a JFrame.

The resulting application will look like this:



1.2 Making life simple: DockFrontend

Instead of using a DockController, clients can also use a DockFrontend. The DockFrontend has the ability to do some of the common tasks which almost every application would like to do.

Clients can register the root-DockStations through the “addRoot”-method. They have to provide a unique name for every DockStation.

Also some Dockables can be registered through the “add”-method. Registered Dockables will then have a little button in their title, with which the user can close (or “hide”) the Dockable.

Another nice abbility of DockFrontend is, to read or write the whole layout of the application from or into a DataInput/OuputStream (see the methods “read”, “write”, “save” and “load”).

2 Load & Save

DF has tools to save and load the layout (the structure of the tree, the location and size of the Dockables, etc.).

2.1 Local layout: DockableProperty

Local layout means the location of exactly one element of the tree. Local information is very independent from the rest of the tree, however local information is never complet. So sometimes there is not enough information to recreate a layout later on.

Local information can be usefull to store the location of a Dockable before it is removed from the tree, and than later to add it again to the tree. Local information can't be used to store the location of all Dockables, then close the application and later restart the application.

DF can provide local information through a DockableProperty. The following example shows how

the DockableProperty can be read, and applied:

```
1: DockStation root = DockUtilities.getRoot( dockable );
2: DockableProperty location = DockUtilities.getPropertyChain( root, dockable );
3:
4: dockable.getDockParent().drag( dockable );
5:
6: root.drop( dockable, location );
```

In line 1 we get the root of the subtree containing a Dockable “dockable”.
In line 2 the location of “dockable” is read.
Then in line 4 the Dockable is removed from the tree.
And in line 6 it is reinserted into the tree hopefully at the same location.
Note that the method “drop” returns a boolean indicating whether the operation was a success or not.

DockableProperties can be stored using a PropertyTransformer.

2.2 Global layout: DockSituation

Global layout means the complete layout of a whole tree.

The class DockSituation can be used to store the global layout. It has a method named “write” which requests a map containing all root-DockStations and a stream to write into. The DockSituation will use a DockFactory to store the elements of the tree. Every element has a property “factoryID” which will be used to identifiy the appropriate factory.

The method “read” is the exact reverse of “write”. The method does creates a new instance of every element in the tree.

Of course there are some drawbacks. For one, every Dockable with different content needs its own factory. And creating new instances of elements is counterintuitive for elements that should only exist once.

So there is another class named “PredefinedDockSituation”. This class has a method called “put” which requests an element of the tree and optionally a unique id for the element. Later on, these elements will be used instead of instantiating new elements. Note that clients do not have to register factories for the elements which were “put” to the PredefinedDockSituation.

In the case that not all elements should be stored, a DockSituationIgnore can be applied to a DockSituation (using the method “setIgnore”). The DockSituationIgnore will filter out those elements which are not to be stored.

2.3 DockFrontend

Developers using a DockFrontend might have a look at the “read”, “write”, “load” and “save”-methods.

3 Drag & Drop

3.1 The default behavior

The drag & drop operation normally is handled by the DockRelocator (which is created by the DockController).

The DefaultDockRelocator registers Mouse- and MouseMotionListeners to several Components, most importantly to the titles of the Dockables.

When the user initiates a mouse-drag operation, the DefaultDockRelocator first shows a window containing the title of the Dockable. Then he uses the knowledge of the DockController to find a DockStation which might become the parent of the dragged Dockable. The methods “prepareMove” or “prepareDrop” of DockStation are used for that.

When the user releases the mouse, the methods “drop” or “move” of the next parent is called. Then the operation is finished.

3.2 Invoking the mechanism

There is a possibility to remotelly steer a drag & drop operation. Clients can use the methods “createRemote” or “createDirectRemote” of DockRelocator to get an object which can controll the DockRelocator.

The RemoteRelocator (result of “createRemote”) is intended for a connection with a Mouse-/MouseMotionListener.

On the other hand, the DirectRemoteRelocator is intended for a usage that has no connection to the (real) mouse.

3.3 Merging two Dockables

When the user lays two Dockables above each other, they are merged. Most DockStations will use a Combiner to create a new Dockable consisting of the old ones. If not told otherwise, the DockStation will ask the DockTheme (using “getTheme” of DockController) of its DockController to provide a Combiner (using “getCombiner” of DockTheme).

Clients might exchange the Combiner of the DockStation itself, or of the DockTheme, in order to create new effects when merging occurs.

3.4 Constraints for combinations

Not every relationship is a good one. Sometimes a Dockable just should not be a child of some DockStation.

There are several mechanism to prevent unhealthy relationships:

- Every Dockable has a methods called “accept”.
- Every DockStation has a method “accept”.
- And finally, the DockController can carry a whole set of DockAcceptances (see “addAcceptance” in DockController). Every DockAcceptance has methods called “accept”.

Whenever a drag&drop operation is about to end, all these “accept”-methods must agree to the new relationship.

4 Decorations

DF is part of a graphical user interface, so there have to be some thoughts about eye-candy. The look of the DF depends on several properties, factories and algorithms which are all collected by a DockTheme. This chapter will first describe some of the components of a DockTheme and later on look at some themes.

4.1 Title

A DockTitle is a component linked to exactly one Dockable, showing some properties of its Dockable.

The default-behaviour would be to show the icon, the text and the DockActions of the linked Dockable, but various implementations can show whatever they like.

4.1.1 Instantiating a DockTitle

Every Dockable has a method “getDockTitle”. A client should use that method to create a new DockTitle when necessary. Since there are different versions of DockTitles for different purposes, the method “getDockTitle” needs a DockTitleVersion.

A DockTitleVersion is a unique identifier telling which kind of DockTitle a method should produce. DockTitleVersions should be created by the DockTitleManager (see “getTitleManager” of DockController), using one of the “register”-methods.

The “register”-methods of DockTitleManager need a string which is a unique id, and a DockTitleFactory. A DockTitleFactory simply creates DockTitles. There are different “register”-methods, each representing another priority for the factory. If two factories are registered under the same key, then the one with the higher priority will be used. The highest priority is “client”, the lowest “default”, and “theme” is in the middle.

By the way, there is a special DockTitleFactory called “ControllerTitleFactory”. This factory forwards every call to the default-factory provided by the DockTheme (see “getTheme” of DockController and “getTitleFactory” of DockTheme). This factory should be used, whenever the very basic DockTitle is needed.

This rather complex way of creating a DockTitle allows developers to create either indiviual DockTitles for each Dockable (by overriding “getDockTitle” of Dockable) or to make global changes (by registering new DockTitleFactories at the DockTitleManager).

The one object that asked for the DockTitle needs to call the “bind”-method of Dockable in order to connect the DockTitle with its Dockable. The method “unbind” should be called when a DockTitle is no longer used. This gives the DockTitle the opportunity to remove listeners.

Let's write down the steps necessary to use a DockTitle again:

- Get a DockTitleVersion from the DockTitleManager as early as possible. Use the appropriate “register”-method, normally it would be “registerDefault”.
- Call “getDockTitle” of Dockable to create a new DockTitle. Use the DockTitleVersion of the last step.
- Use the method “bind” of Dockable to connect the DockTitle to its Dockable.
- Use the method “unbind” of Dockable to remove the connection of the last step.

Note: never ever invoke “bind” or “unbind” of DockTitle directly, these methods are intended to be used by the DockController only.

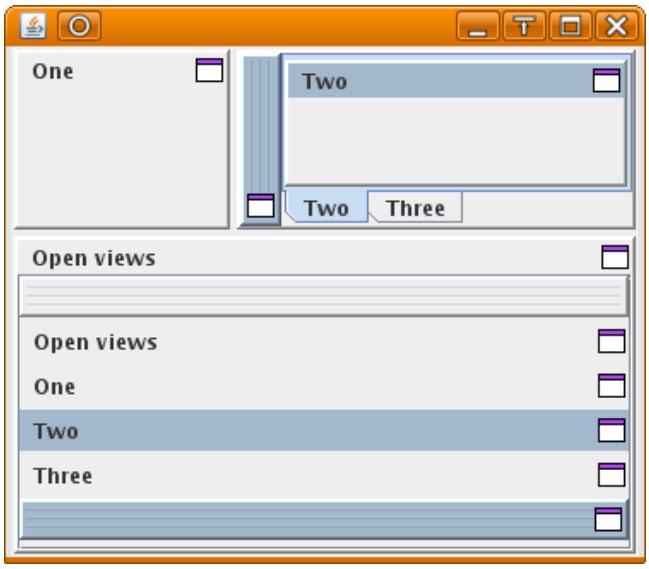
Let's have a look at this example:

```
1: public class OpenViewList extends DefaultDockable{
2:    private JPanel panel = new JPanel();
3:    private Map<Dockable, DockTitle> titles =
4:          new HashMap<Dockable, DockTitle>();
5:    private DockTitleVersion version;
6:
7:    public OpenViewList( DockController controller ){
8:          setTitleText( "Open views" );
9:          version = controller.getDockTitleManager().registerDefault(
10:               "open view", new ControllerTitleFactory() );
11:
12:         getContentPane().setLayout( new GridLayout( 1, 1 ) );
13:         getContentPane().add( new JScrollPane( panel ) );
```

```
14:
15:         controller.getRegister().addDockRegisterListener( new DockAdapter(){
16:               @Override
17:               public void dockableRegistered(
18:                     DockController controller, Dockable dockable ){
19:
20:                     DockTitle title = dockable.getDockTitle( version );
21:                     if( title != null ){
22:                           title.setOrientation(
23:                                 Orientation.FREE_HORIZONTAL );
24:                           dockable.bind( title );
25:                           titles.put( dockable, title );
26:                           panel.add( title.getComponent() );
27:                           panel.setLayout( new GridLayout(
28:                                 panel.getComponentCount(), 1, 2, 2 ) );
29:                           panel.revalidate();
30:                     }
31:               }
32:
33:               @Override
34:               public void dockableUnregistered(
35:                     DockController controller, Dockable dockable ){
36:
37:                     DockTitle title = titles.remove( dockable );
38:                     if( title != null ){
39:                           dockable.unbind( title );
40:                           panel.remove( title.getComponent() );
41:                           panel.setLayout( new GridLayout(
42:                                 panel.getComponentCount(), 1, 2, 2 ) );
43:                           panel.revalidate();
44:                     }
45:               }
46:         });
47:    }
48:}
```

What's happening here? This is a Dockable showing a DockTitle for each Dockable that was added to the tree after it was instantiated.
On line 9, the DockTitleVersion is created.
In lines 20 to 29 a DockTitle is added, in line 20 the DockTitle is created, in line 24 the DockTitle is connected to its Dockable.
In lines 35 to 43 a DockTitle is removed, in line 39 the connection between the DockTitle and its Dockable is broken.

The screenshot shows how an application using three normal Dockables and the OpenViewList might look like. The first, empty DockTitle belongs to the SplitDockStation which is the root of the subtree containing visible elements.



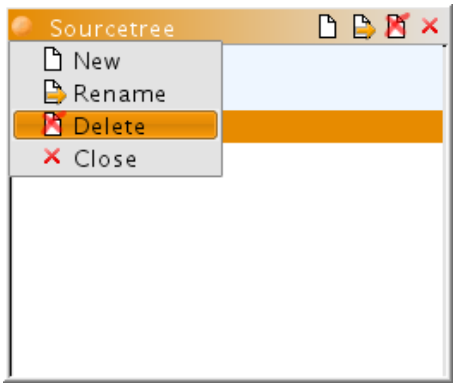
4.2 Actions

A DockAction is something that has a graphical representation, and reacts somehow when the user clicks onto this representation.

Every Dockable has a set of DockActions, some of them can be set by the developer, others are added by DF.

DockActions are normally shown on a DockTitle, but other locations are possible, like a drop-down-menu.

Have a look at the image. There are four DockActions associated with the Dockable “Sourcetree”. The DockActions are shown as buttons in the top right corner, and as menu-items in the JMenu at the top left corner.



There are different types of DockActions, and there are different views:

A ActionType describes how a DockAction works, a ViewTarget where the DockAction will be shown. An ActionType might be something like “BUTTON”, describing a DockAction which always does the same action when triggered. A ViewTarget might be something like “MENU” to tell that a DockAction is shown as menu-item in a menu.

ActionTypes and ViewTargets create a table where each cell tells how to create the graphical representation of a specific type of DockAction to be displayed on a specific target.

This table is known as the ActionViewConverter (see “getActionViewConverter” of DockController). Clients might introduce new ActionTypes or ViewTargets using this converter.

4.2.1 Types of actions and their use

The interface “DockAction” is rather simple and only contains a method to create a view of the DockAction for a specific ViewTarget.

Clients surely can implement this interface, but then they have to create their own views. It's better to use one of the existing sub-interfaces, since there are already views for them. All of these DockActions have icons, text and tooltips:

- **ButtonDockAction**: represents a button. The user clicks onto a button, and the action always executes the same piece of code.
- **MenuDockAction**: A very simple menu, the content of the menu is a DockActionSource, containing other DockActions. Normally the user can click onto a button, and a drop down menu opens where he can choose which other DockAction to execute.
- **DropDownAction**: A more sophisticated menu. The behavior is almost the same as MenuDockAction, but the content (icon, text, ...) of the last invoked DockAction is shown as content of the DropDownAction.
- **SelectableDockAction**: A DockAction which has two states, “selected” and “not selected”. Clicking on the graphical representation might change this state. There are often two implementations of this DockAction, either as “CHECK” (state changes always when clicking) or as “RADIO” (state changes to “selected” when clicking, but has to be deselected by another action).

There are two sets of classes implementing the above interfaces.

- **SimpleButtonAction, SimpleMenuAction, SimpleDropDownAction, SimpleSelectableAction.Check, SimpleSelectableAction.Radio**:
  These classes provide a single property for icon, text, etc. Several Dockable can share one of these DockAction, and the user will always experience the same behavior.
  SimpleDockActions are enough for most applications.
- **GroupedButtonAction, GroupedSelectableAction.Check, GroupedSelectableAction.Radio**:
  These classes provide a map for each property. Every Dockable is then mapped to a key, which is used to read the informations from the maps. Different Dockables may share a key, and the key for a Dockable can be changed at any time.
  In the end, it's like having several SimpleDockActions, and exchanging them whenever the key is exchanged.

4.2.2 How to apply a DockAction

The question remains, how a DockAction can be injected into the framework.

Whenever some view wants to show the DockActions for a Dockable, the view calls the method “listActionOffers” of DockController. This method collects the DockActions from various sources:

- The Dockable itself
- All the parent DockStations of the Dockable
- The ActionGuards
- The ActionOffers

4.2.2.1 Dockable

Since DockActions are bound to a Dockable, its natural that every Dockable contains a list (a

DockActionSource) of DockActions. Clients should set their own list of DockAction when a new Dockable is created. Replacing the list later on will not have any effect, however changing the content of the list will be noted immediately.

This codesnipet shows how a DockAction can be assigned to a DefaultDockable:

```
1: DefaultDockable dockable = new DefaultDockable( "One" );
2:
3: DefaultDockActionSource source = new DefaultDockActionSource();
4: dockable.setActionOffers( source );
5:
6: SimpleButtonAction action = new SimpleButtonAction();
7: source.add( action );
8: action.setIcon( ... );
9: action.setText( ... );
```

In line 1, a new Dockable is created.

In lines 3 and 4, the list of DockActions is created and assigned.

In lines 6 to 9, a new DockAction is created, added to the list of DockActions, and some properties of the DockAction are changed.

4.2.2.2 ActionGuard

If a more “global approach” is necessary, an ActionGuard can be used. An ActionGuard is added to the DockController (see “addActionGuard” of DockController), and asked for a list of DockActions whenever someone wants to show the DockActions of a Dockable.

This is an example how an ActionGuard might look like.

```
1: public class Guard implements ActionGuard{
2:    public boolean react( Dockable dockable ) {
3:          return "One".equals( dockable.getTitleText() );
4:    }
5:
6:    public DockActionSource getSource( Dockable dockable ) {
7:          DefaultDockActionSource source = new DefaultDockActionSource();
8:          source.setHint( new LocationHint(
9:                LocationHint.ACTION_GUARD, LocationHint.MIDDLE ) );
10:         source.add( ... );
11:         return source;
12:   }
13: }
```

The method “react” in line 2 to 4 tells whether a Dockable should receive DockActions from this guard or not. In this case, only Dockables with a title “One” should get new DockActions.

The method “getSource” in lines 6 to 12 then creates a list of DockActions for those Dockables which were selected by “react”.

The LocationHint created in lines 8 and 9 tells the views which show more then just one DockActionSource, where the list should be placed relatively to the other lists.

4.2.2.3 ActionOffer

Yet another way is using an ActionOffer. An ActionOffer is responsible to collect the DockActions for a Dockable from various sources. Of course, an ActionOffer could insert its own DockActions while doing that. ActionOffers are added to the DockController through “addActionOffer”, and only one ActionOffer can serve a Dockable.

4.2.2.4 parent DockStations

Last but not least, every DockStation has methods “getDirectActionOffers” and “getIndirectActionOffers”. These methods return DockActions either for the direct or for all children of the DockStation.

4.3 Displayer

The “DockableDisplayer” is a Component that lies between a Dockable and its parent DockStation. The DockableDisplayer is responsible to place the DockTitle and to paint the border around the Dockable.

DockableDisplayer are created by the DisplayerFactory, and that factory is provided by the method “getDisplayerFactory” of DockTheme. Clients can override the DockTheme and return some own factory.

4.4 Paint

During a drag and drop operation, some markings are painted onto affected DockStations. A “StationPaint”-object is used to paint these markings. The StationPaint is provided by the method “getPaint” of DockTheme. Clients can override the DockTheme and return some own painting code.

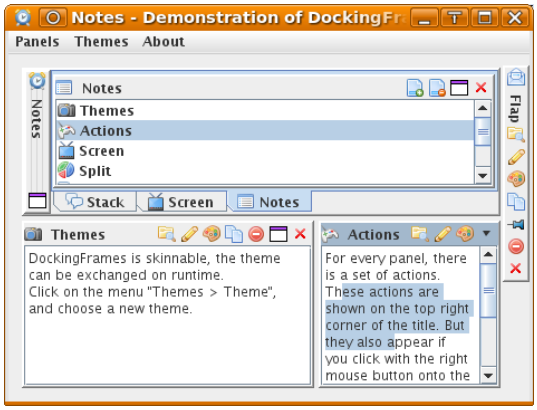
4.5 Theme

A DockTheme is a whole set of icons, colors, titles, borders and other things. A DockTheme for DockingFrames is like a LookAndFeel for Swing. The theme can be replaced at any time using “setTheme” of “DockController”.

```
1:    DockTheme theme = new BasicTheme();
2:    controller.setTheme( theme );
```

Currently 6 different themes are included in the framework, clients can use “getThemes” of “DockUI” to get a list of all available themes.

The next list shows the four most important themes:

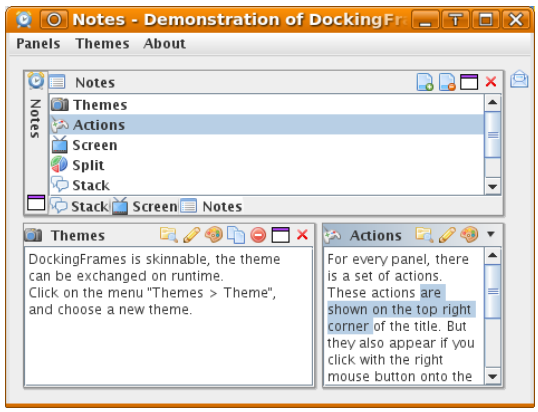


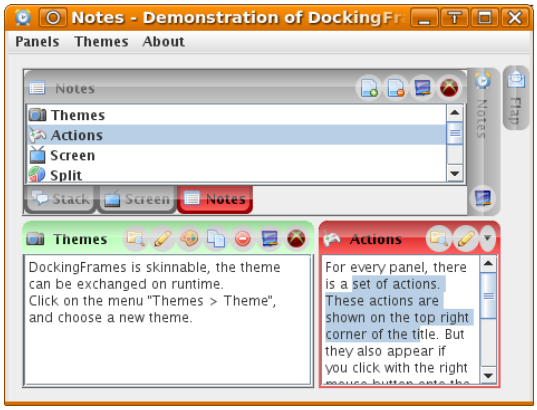
BasicTheme

A simple but robust theme. Most of the other themes are built up on the BasicTheme.

This theme might not look very nice, but it shows clearly how the elements were combined. Use this theme when debugging.

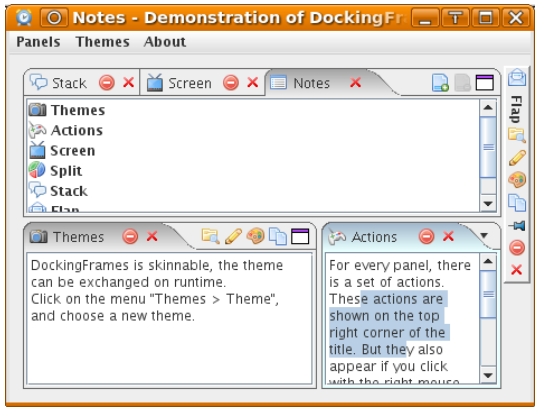
FlatTheme
This theme was written with the goal to use as less borders as possible.





BubbleTheme
A theme that brings some life. All titles and buttons are animated, changing their color whenever the mouse touches them.

EclipseTheme
This theme tries to imitate the famous Eclipse-IDE.
Clients can use the annotation “EclipseTabDockAction” to designate DockActions which will be shown on the tabs.



4.5.1 How to extend a theme: BasicTheme

Writing an own theme is possible, and the simplest way to start is to write a new class extending BasicTheme.

The most important settings can be changed by the “set”-methods of BasicTheme. Please note that calling such a method will not have any effect until the changed property is read from within the framework. That happens on drag&drop events, or when the theme is replaced (through the method “setTheme” of “DockController”).

Settings of minor importance can be changed in the “install”-Methode of DockTheme. Don't forget to undo the changes in “uninstall”, otherwise the user might experience some interesting failures when the theme is exchanged.

4.5.2 The EclipseTheme

The “EclipseTheme” is not so easy to use, therefore some aspects need more explanation.

The EclipseTheme paints a single “tab” for every Dockable, but these tabs are (normally) no instances of DockTitle. Every tab shows a subset of the DockActions which are assigned to a Dockable, the actions that are not on the tab are only visible when the tab is selected.

The location of a DockAction depends whether the action has the annotation “EclipseTabDockAction” or not. That might look like this:

```
1: @EclipseTabDockAction
2: public class CloseAction extends SimpleButtonAction{
3:    ...
4: }
```

Clients might replace the “EclipseThemeConnector” (see “Wiring”) to change the algorithm that determines the location of the actions.

4.5.2.1 Tabs

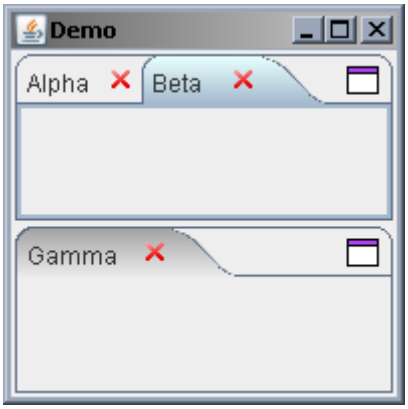
Tabs are exchanged throught the “DockProperties”. The key is “TAB_PAINTER”, and the value is an instance of “TabPainter”.

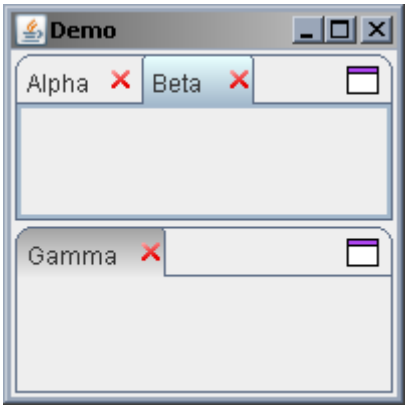
```
1: DockProperties properties = controller.getProperties();
2: properties.set( EclipseTheme.TAB_PAINTER, RectGradientPainter.FACTORY );
```

Several TabPainters are already in the library:

The default-TabPainter is the “ShapedGradientPainter”, it can be set through

```
1: properties.set(
     EclipseTheme.TAB_PAINTER,
     ShapedGradientPainter.FACTORY );
```

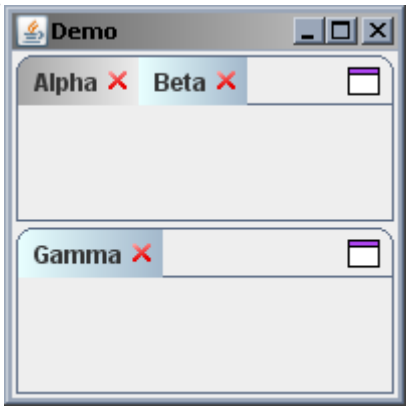




The “RectGradientPainter” needs a little less space.

```
1: properties.set(
     EclipseTheme.TAB_PAINTER,
     RectGradientPainter.FACTORY );
```

The “DockTitleTab” uses real DockTitles to display the tabs.




```
1: properties.set(
     EclipseTheme.TAB_PAINTER,
     ShapedGradientPainter.FACTORY );
```

The factory which creates the titles can be replaced through the “DockTitleManager”.

```
1: DockTitleManager titleManager =
     controller.getDockTitleManager();
2: titleManager.registerTheme(
     EclipseTheme.TAB_DOCK_TITLE,
     newFactory );
```

Since a tab does not show all DockAtions of its Dockable, all DockTitles that are used by the DockTitleTab should use the “EclipseDockActionSource” to filter those actions which are not visible. The next line of code belongs to a DockTitle which inherits from “BasicDockTitle”, and exchanges the list of actions:

```
1: protected DockActionSource getActionSourceFor( Dockable dockable ) {
2:     return new EclipseDockActionSource(
           theme, super.getActionSourceFor( dockable ), dockable, true );
3: }
```

4.5.2.2 Wiring

To determine which actions to show on a tab, and whether to show a tab at all, the EclipseTheme uses a “EclipseThemeConnector”. This connector is stored in the DockProperties.

```
1: properties.set( EclipseTheme.THEME_CONNECTOR, new EclipseThemeConnector(){
1:   public TitleBar getTitleBarKind( Dockable dockable ) {
1:     return TitleBar.ECLIPSE;
1:   }
1:   public boolean isTabAction( Dockable dockable, DockAction action ) {
1:     return true;
1:   }
1: });
```

The method “getTitleBarKind” tells what will happen when the “dockable” is alone. Normally a lonely tab would be painted, but it is possible to do other things – like painting the ordinary DockTitle.

The method “isTabAction” simply decides where to put an action.