JIDE Grids Developer Guide

Table of Contents

Purpose of This Document

Welcome to the *JIDE Grids*, the JTable extension product in JIDE Software's product line.

This document is for developers who want to develop applications using *JIDE Grids* .

What is JIDE Grids

Believe it or not, JTable is probably one of the most commonly used Swing components in most Swing applications.

Many people complained about the design of JTable. Every design has its pros and cons - so does JTable. People have so many various kinds of requirements, so it's really hard to design such a complex component as JTable satisfying everybody's needs. In our opinion, it's not the design of JTable is not good but it left out many important features that a table should have by default. Good news is JTable does leave many extension points so that you can enhance it to meet your needs. So as long as we keep improving it, it will get better and better - *JIDE Grids* is one step toward this goal. All components in *JIDE Grids* are related to JTable and are fully compatible with JTable.

In addition to JTable related features, we also included many features related to JList and JTree.

Packages

The table below lists the packages in the *JIDE Grids* product.

Packages	Description
com.jidesoft.grid	All the JTable related components are in this package, including PropertyTable, SortableTable, CellSpanTable, CellStyleTable, TreeTable, HierarchicalTable, SortableTableModel, and FilterableTableModel etc.
com.jidesoft.converter[1]	Converters that can convert from String to Object and from Object to String.
com.jidesoft.comparator[2]	Comparators
com.jidesoft.grouper[3]	ObjectGroupers that can group many values into one group

[1] This package is moved to jide-common.jar as other products also need converters.

[2] This package is moved to jide-common.jar as other products also need comparators.

	to reduce the number of distinct values.
com.jidesoft.combobox	ComboBox enhancement, such as DateExComboBox and ColorExComboBox, etc. It is also possible to create your own ComboBox
com.jidesoft.list	SortableListModel, FilterableListModel and other classes related to JList
com.jidesoft.tree	SortableTreeModel, FilterableTreeModel and other classes related to JTree
com.jidesoft.filter	Filter related classes
com.jidesoft.lucene	Filter related classes using Lucene

Class Hierarchy of All the JIDE Tables

Before we discuss each table component in detail, it'd be better to give you an overview of them. See below for a class hierarchy of all the table components we have in JIDE Grids.

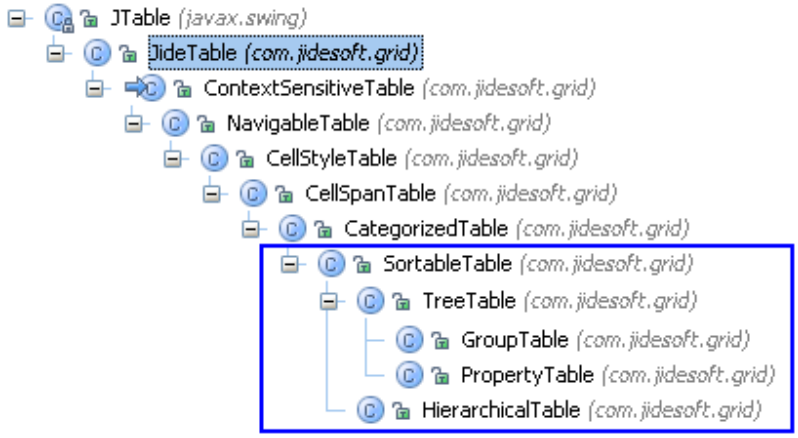


Figure 1 Class Hierarchy of Tables in JIDE Grids

As you can see, *JideTable* extends directly *JTable* since *JideTable* provides the features that are supposed to be in *JTable*. Those features include nested table column header, table/row/cell validation support, and automatic changing row height.

ContextSensitiveTable provides way to configure different cell renderers and cell editors for each cell. Then it comes the *NavigableTable* which provides a way to define how the navigation

[3] This package is moved to jide-common.jar as other products also need groupers.

keys work in a table. Then it comes to *CellStyleTable* and *CellSpanTable* which provide two commonly used features as the names indicated. Next is *CategorizedTable*. We will not cover this table at all in this developer guide. The reason is we are not ready to expose it as public API yet. Simply speaking, it provides access to the expand/collapse icon since both tree table and hierarchical table need it.

After *CategorizedTable*, it's *SortableTable* which supports multiple column sorting.

Till now, it's still one line of hierarchy. After *SortableTable*, it divides into two types of distinct tables. Each of them has its own special usage. One is *TreeTable*. *PropertyTable* is actually a special use case of *TreeTable*. *GroupTable* is also a *TreeTable*. The other kind of table is *HierarchicalTable* which is quite a unique table that is different from all other tables.

Generically speaking, you should make you table extending one of the last five tables (*SortableTable*, *HierarchicalTable*, *TreeTable*, GroupTable or *PropertyTable*) in the class hierarchy tree which are marked in a blue rectangle. However nothing prevents you from using any other tables as long as you know exactly what features each table provides.

JideTable

Let's start with *JideTable* which is the base class of all table classes in JIDE Grids. *JideTable* is an extended version of *JTable*. The additional features we added are:

First, we enhanced *CellEditorListener* support. You can add a *JideCellEditorListener* to *JideTable*. *JideCellEditorListener* extends *CellEditorListener* which is a Swing interface and adds several methods. They are

```
editingStarting(ChangeEvent)
editingStopping(ChangeEvent)
editingStopped(ChangeEvent)
```

With these three methods, you can now do things like preventing cell from starting edit or preventing cell from stopping edit.

The second feature is to support *Validator*[4]. You can add a *Validator* to *JideTable*. The validating() method in *Validator* will be called before cell stops editing. If the validation failed, the cell editor won't be removed. Please refer to Table Validation section for more information.

The third feature added to *JideTable* is the support of the listener for row height changes when rows have various heights. You can add a listener by calling *getRowHeights().*

[4] Validator and related classes are in package com.jidesoft.validation of jide-common.jar. Right now it is only used in JideTable. However this is part of an infrastructure we will build that will cover all other components which need validation.

addRowHeightChangeListener(listener) A *RowHeightChangeEvent* will be fired whenever *setRowHeight(int row, int rowHeight)* is called.

The fourth feature is the *rowAutoResizes* feature. By default, *JTable*'s row height is determined explicitly. It wouldn't consider the cell content preferred height. There is a problem here if a cell renderer can support multiple lines. So we added a new attribute called *rowAutoResizes*. By default, it's false which is exactly the same behavior as JTable. If you set to true, the table row will resize automatically when cell renderer's preferred height changes. Please note there is a performance hit if you turned it on as it has to check all cells to find out the preferred row height. So only use it when it's really necessary.

The fifth feature is what we called nested table column. See a picture below which shows a nested table header on Windows 7.

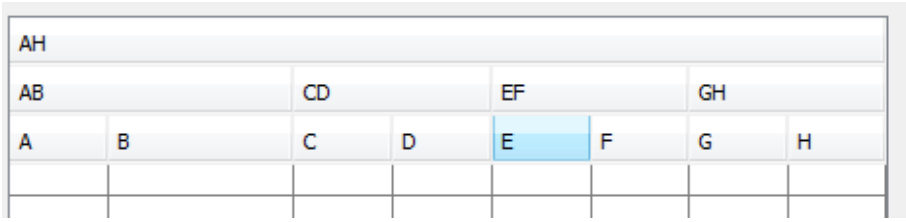
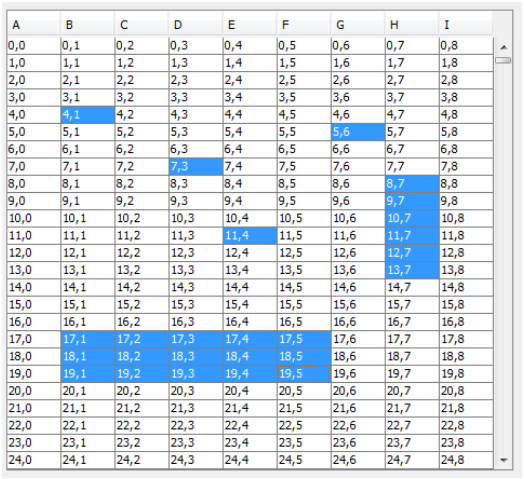


Figure 2 Nested table columns

Here is the code to create such a nested table column.

```
// create nested table columns
TableColumnModel cm = table.getColumnModel();
TableColumnGroup first = new TableColumnGroup("Sum 1 - 4");
first.add(cm.getColumn(0));
first.add(cm.getColumn(1));
first.add(cm.getColumn(2));
first.add(cm.getColumn(3));
TableColumnGroup second = new TableColumnGroup("Sum 5 - 9");
second.add(cm.getColumn(4));
second.add(cm.getColumn(5));
second.add(cm.getColumn(6));
second.add(cm.getColumn(7));
second.add(cm.getColumn(8));
TableColumnGroup all = new TableColumnGroup("Sum 1 - 9");
all.add(first);
all.add(second);
NestedTableHeader header = (NestedTableHeader) table.getTableHeader();
header.addColumnGroup(all);
```

The sixth feature is non-contiguous cell selection. This is probably one of the oldest bugs[5] that were reported to Sun Java back in 1998. In fact, it's not that difficult to implement a selection model that supports non-contiguous cell selection. We added the feature to *JideTable*. To use it, you just call *table.setNonContiguousCellSelection(true)*. Once you turn non-contiguous cell selection on, you will have to use *jideTable.getTableSelectionModel()* to get a selection model that keeps the selection. The old JTable's *getSelectionModel()* is not used anymore in this case.



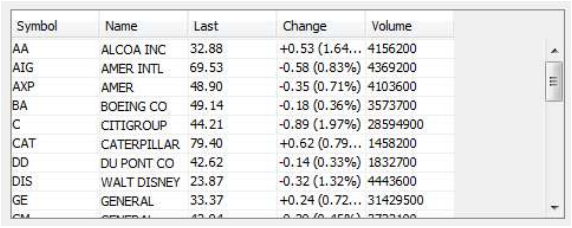
A	B	C	D	E	F	G	H	I
0,0	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8
1,0	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8
2,0	2,1	2,2	2,3	2,4	2,5	2,6	2,7	2,8
3,0	3,1	3,2	3,3	3,4	3,5	3,6	3,7	3,8
4,0	4,1	4,2	4,3	4,4	4,5	4,6	4,7	4,8
5,0	5,1	5,2	5,3	5,4	5,5	5,6	5,7	5,8
6,0	6,1	6,2	6,3	6,4	6,5	6,6	6,7	6,8
7,0	7,1	7,2	7,3	7,4	7,5	7,6	7,7	7,8
8,0	8,1	8,2	8,3	8,4	8,5	8,6	8,7	8,8
9,0	9,1	9,2	9,3	9,4	9,5	9,6	9,7	9,8
10,0	10,1	10,2	10,3	10,4	10,5	10,6	10,7	10,8
11,0	11,1	11,2	11,3	11,4	11,5	11,6	11,7	11,8
12,0	12,1	12,2	12,3	12,4	12,5	12,6	12,7	12,8
13,0	13,1	13,2	13,3	13,4	13,5	13,6	13,7	13,8
14,0	14,1	14,2	14,3	14,4	14,5	14,6	14,7	14,8
15,0	15,1	15,2	15,3	15,4	15,5	15,6	15,7	15,8
16,0	16,1	16,2	16,3	16,4	16,5	16,6	16,7	16,8
17,0	17,1	17,2	17,3	17,4	17,5	17,6	17,7	17,8
18,0	18,1	18,2	18,3	18,4	18,5	18,6	18,7	18,8
19,0	19,1	19,2	19,3	19,4	19,5	19,6	19,7	19,8
20,0	20,1	20,2	20,3	20,4	20,5	20,6	20,7	20,8
21,0	21,1	21,2	21,3	21,4	21,5	21,6	21,7	21,8
22,0	22,1	22,2	22,3	22,4	22,5	22,6	22,7	22,8
23,0	23,1	23,2	23,3	23,4	23,5	23,6	23,7	23,8
24,0	24,1	24,2	24,3	24,4	24,5	24,6	24,7	24,8

Figure 3 NonConfiguousCellSelection

The seventh feature is the column auto-fit feature.

On Windows, if you double click on the gap between table header, the column will be automatically resize to fit in the widest content in previous cell. JTable doesn't have this feature. So we added this to JideTable. You can call *setColumnAutoResizable(true)* to enable it. Similar to this feature, we also added a function to *TableUtils* called *autoResizeAllColumns(JTable table)*. This method will automatically resize all columns to fit in the content in the cells. Good news about this method is that it works for all *JTable*, not just *JideTable*.

From the screenshot below, you can see the Name column is narrow while Symbol etc. columns are too wide.



Symbol	Name	Last	Change	Volume
AA	ALCOA INC	32.88	+0.53 (1.64...	4156200
AIG	AMER INTL	69.53	-0.58 (0.83%)	4369200
AXP	AMER	48.90	-0.35 (0.71%)	4103600
BA	BOEING CO	49.14	-0.18 (0.36%)	3573700
C	CITIGROUP	44.21	-0.89 (1.97%)	28594900
CAT	CATERPILLAR	79.40	+0.62 (0.79...	1458200
DD	DU PONT CO	42.62	-0.14 (0.33%)	1832700
DIS	WALT DISNEY	23.87	-0.32 (1.32%)	4443600
GE	GENERAL	33.37	+0.24 (0.72...	31429500

[5] See bug report at http://bugs.sun.com/bugdatabase/view_bug.do?bug_id=4138111.

After double click on the table header gap between the "Name" and the "Last", here is what you will see. Please note the width of Name column is resized automatically to fit in the contents of all cells in that column.

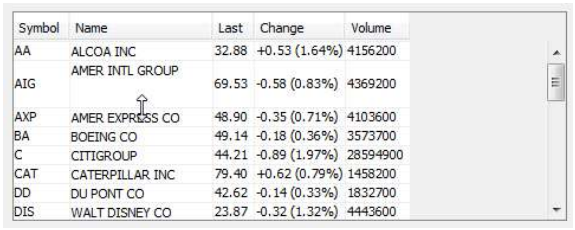
Symbol	Name	Last	Change	Volume
AA	ALCOA INC	32.88	+0.53 (1.64...	4156200
AIG	AMER INTL GROUP	69.53	-0.58 (0.83%)	4369200
AXP	AMER EXPRESS CO	48.90	-0.35 (0.71%)	4103600
BA	BOEING CO	49.14	-0.18 (0.36%)	3573700
C	CITIGROUP	44.21	-0.89 (1.97%)	28594900
CAT	CATERPILLAR INC	79.40	+0.62 (0.79...	1458200
DD	DU PONT CO	42.62	-0.14 (0.33%)	1832700
DIS	WALT DISNEY CO	23.87	-0.32 (1.32%)	4443600
GE	GENERAL ELEC CO	33.37	+0.24 (0.72...	31429500

You can also resize all columns so that all columns are resized properly. See below.

Symbol	Name	Last	Change	Volume
AA	ALCOA INC	32.88	+0.53 (1.64%)	4156200
AIG	AMER INTL GROUP	69.53	-0.58 (0.83%)	4369200
AXP	AMER EXPRESS CO	48.90	-0.35 (0.71%)	4103600
BA	BOEING CO	49.14	-0.18 (0.36%)	3573700
C	CITIGROUP	44.21	-0.89 (1.97%)	28594900
CAT	CATERPILLAR INC	79.40	+0.62 (0.79%)	1458200
DD	DU PONT CO	42.62	-0.14 (0.33%)	1832700
DIS	WALT DISNEY CO	23.87	-0.32 (1.32%)	4443600
GE	GENERAL ELEC CO	33.37	+0.24 (0.72%)	31429500

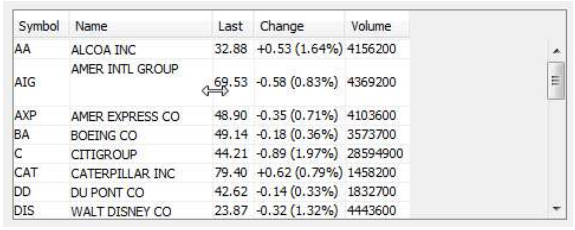
The eighth feature is row resize and column resize. As you know, JTable supports column resize only by dragging the table column header. And it doesn't support row resize at all. It would be nice if it can support resizing at the grid line. JideTable can support it. You just need to call *setColumnResizable(true)* and *setRowResizable(true)* to enable column resizing and row resizing respectively.

Here is how row resizing works.



Symbol	Name	Last	Change	Volume
AA	ALCOA INC	32.88	+0.53 (1.64%)	4156200
AIG	AMER INTL GROUP	69.53	-0.58 (0.83%)	4369200
AXP	AMER EXPRESS CO	48.90	-0.35 (0.71%)	4103600
BA	BOEING CO	49.14	-0.18 (0.36%)	3573700
C	CITIGROUP	44.21	-0.89 (1.97%)	28594900
CAT	CATERPILLAR INC	79.40	+0.62 (0.79%)	1458200
DD	DU PONT CO	42.62	-0.14 (0.33%)	1832700
DIS	WALT DISNEY CO	23.87	-0.32 (1.32%)	4443600

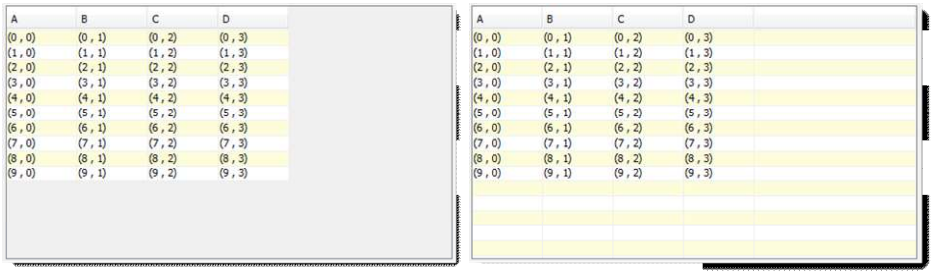
Here is how column resizing works.



Symbol	Name	Last	Change	Volume
AA	ALCOA INC	32.88	+0.53 (1.64%)	4156200
AIG	AMER INTL GROUP	69.53	-0.58 (0.83%)	4369200
AXP	AMER EXPRESS CO	48.90	-0.35 (0.71%)	4103600
BA	BOEING CO	49.14	-0.18 (0.36%)	3573700
C	CITIGROUP	44.21	-0.89 (1.97%)	28594900
CAT	CATERPILLAR INC	79.40	+0.62 (0.79%)	1458200
DD	DU PONT CO	42.62	-0.14 (0.33%)	1832700
DIS	WALT DISNEY CO	23.87	-0.32 (1.32%)	4443600

The ninth feature is a new *AutoResizeMode* called AUTO_RESIZE_FILL. In this mode, you won't see a blank area on the header area as the pictures below. The left picture is on

AUTO_RESIZE_OFF mode and the right picture is on AUTO_RESIZE_FILL mode along with *setFillRight(true)*, *setFillBottom(true)* and *setFillsViewportWithStripe(true)*.



There are a few more small features in *JideTable* and we are also adding more when needed. All these features should probably in *JTable* at the first place. That's why we add them to *JideTable* so that all JIDE tables can take advantage of them.

Validation Support in JideTable

JideTable has built-in validation support. The support is done on three different levels – cell, row and table. You should decide which level to implement your validation logic depending on your actual situation. Here are the details of three levels of validations.

Cell Level Validation

If the validation only depends on the cell value, such as if the number should be a positive integer, or the string must have less than 10 chars, you should implement the validation on the cell editor level. The *JideCellEditor* is an interface that has only one *validate* method (see below). All cell editors provided in JIDE Grids implement this interface.

```
public interface JideCellEditor extends CellEditor {
   ValidationResult validate(Object oldValue, Object newValue);
}
```

Depending on what validation you need to perform, you can subclass the correct cell editor and override this *validate* method to do the validation.

```
public class PositiveOnlyCellEditor extends NumberCellEditor {
   ValidationResult validate(Object oldValue, Object newValue) {
      if(newValue instanceof Integer && ((Integer) newValue).intValue > 0) {
         return ValidationResult.OK;
      }
      else {
         return new ValidationResult(false, "The number must be positive");
      }
```

```
    }
}
```

Once you register this cell editor above on a cell (using either the old JTable way or *CellEditorManger* way we described earlier), the cell will only accept positive integers.

Please note, the cell level validation can be used only when the validation logic doesn't need the values on other cells of this table. What if you do need? That's where you need a table level validation.

Table Level Validation

JideTable has *addValidator(Validator)* method to provide the validation logic on the table level. You can add multiple *Validator*s to the table. Those *Validator*s will be called for all cells when they stop editing. Just like Swing listener mechanism, those Validators are called in the opposite order of they were added (that is, the first added Validator will be called at the last). However different from listeners which will continue for all the listeners, if any of the *Validators* retuned neither a *null* nor a *ValidationResult.OK*, the validation process will stop right there and no more *Validators* will be called.

The only method on the *Validator* interface is the *validating* method. See below.

```
public interface Validator extends EventListener {
    ValidationResult validating(ValidationObject vo);
}
```

This is an interface shared by other JIDE components. But in the case of *JideTable*, the *ValidationObject* is an instance of *TableValidationObject*. *TableValidationObject* has methods such as *getRow* and *getColumn* so you know which cell it is for. The *TableValidationObject#getSource()* will always be the *JideTable* instance. So in case your validation logic needs to know the values from other cells, you have access to it in the *validating* method. This is something you can't do if you do validation on the cell level.

Row Level Validation

The last level of the validation is between the cell and the table – the row. In fact, in the design of JTable, there is no row editing concept. There are events when cell stops editing, but no specific events are fired for the row when user finishes editing a row. However, this is very useful feature when user tries to edit a database record using a table where they submit and validate once when the row editing (representing a record) is done. In *JideTable*, we added the support for the row validation through an interface called *RowValidator*. All you need to do is to call *JideTable#addRowValidator(RowValidator)*. *RowValidator* is again an interface just like *Validator*, which has only one *validating* method.

```
public interface RowValidator extends EventListener {
    ValidationResult validating(RowValidationObject vo);
}
```

RowValidator will be called when user stops editing a cell and jumps to another row or focuses out the table. If user is still in the same row after stopping the cell editing, *RowValidator* will not be triggered as the row editing is not done yet.

You can add multiple *RowValidator*s and they will be called for all rows. The *RowValiudationObject* has *getRowIndex* method which will tell you which row it is validating.

ValidationResult

No matter which level of validation it is, all the *validating* methods return *ValidationResult*. *ValidationResult* contains four fields.

```
    private boolean _valid;
    private int _failBehavior = FAIL_BEHAVIOR_REVERT;
    private int _id;
    private String _message;
```

The first one is a *boolean* to indicate whether the validation passed or not. True means the validation is OK. If so, you usually don't need to worry about other fields. You could either return a predefined *ValidationResult.OK* or simply return null in this case.

The second one is the *failBehavior*. If the *valid* flag is false, it means the validation failed. If so, you also need to tell the table what to do using this *failBehavior* field. There are three values for it.

```
    /**
     * When validation fails, reverts back to the previous valid value.
     */
    public final static int FAIL_BEHAVIOR_REVERT = 0;

    /**
     * When validation fails, do not stop cell editing until user enters a valid value or press
ESCAPE to cancel the editing.
     */
    public final static int FAIL_BEHAVIOR_PERSIST = 1;

    /**
     * When validation fails, reset the value to null.
```

```
     */
    public final static int FAIL_BEHAVIOR_RESET = 2;
```

While the other two values are obvious, the only one worth noting is the *FAIL_BEHAVIOR_PERSIST*. If you return this value as the *failBahavior*, you will get a stack trace like this when you run it and make the validation fail.

```
  Exception in thread "AWT-EventQueue-0"
com.jidesoft.grid.EditingNotStoppedException
        at com.jidesoft.grid.JideTable.editingStopped(JideTable.java:597)
        at
javax.swing.AbstractCellEditor.fireEditingStopped(AbstractCellEditor.java:125)
        at
javax.swing.DefaultCellEditor$EditorDelegate.stopCellEditing(DefaultCellEditor.java:350)
        at javax.swing.DefaultCellEditor.stopCellEditing(DefaultCellEditor.java:215)
        at javax.swing.JTable$GenericEditor.stopCellEditing(JTable.java:5444)
  …
```

Don't panic as this is expected. This is probably the only place in JIDE that we use an exception for a non-exception case. We didn't catch it but leave it to you do catch and handle it. The code below is the recommended way to handle it. You can display a message box or a message on the status bar to tell your users what is wrong and how to correct the errors. We did it this way is because we want to allow you to handle all validation errors at one place, no matter it is cell-level, row-level or table-level validations. Internally, this exception also gives us a chance to break out from JTable's stop cell editing process so that the cell editor won't be removed.

```
    JTable table = new JideTable(model) {
        @Override
        public void editingStopped(ChangeEvent e) {
            try {
                super.editingStopped(e);
            }
            catch (EditingNotStoppedException ex) {
                // ValidationResult vr = ex.getValidationResult();
                // handle it
            }
        }
    };
```

The third and the last one are an integer id and a message. This is something for you to define for your application as we don't read the values for these two fields inside our code at all. You can use them along with your logging system or error/warning system. Using them is optional.

Undo Support in JideTable

Swing provides *UndoManager*, *UndoableEdit* etc. classes related to the undo/redo. However the only component that has built-in undo support is the *JTextComponent* and its subclasses which uses *AbstractDocument*. *JTable*, *JList*, *JTree*, although they can also be edited, don't support undo by default.

In this section, we will discuss how to enable the undo support in a *JideTable*.

DefaultUndoableTableModel and AbstractUndoableTableModel

Most likely you already had a table implemented in your application when you decide to add the undo support. So when we design the undo feature, we want the least change to your existing code. If you are using *DefaultTableModel*, all you need to do is to replace it with *DefaultUndoableTableModel*. If you are using an *AbstractTableModel*, replace it with Abstract*UndoableTableModel*. Of course you also need to use a *JideTable* or one of its subclass such as *SortableTable* as your table class.

Both *DefaultUndoableTableModel* and Abstract*UndoableTableModel* implements *TableUndoableSupport*. If for whatever reason you can't use the default or the abstract implementation, you can also implement *TableUndoableSupport* interface directly and borrow some code from *AbstractUndoableTableModel*.

JideTable provides a collection of undo related methods. They are

```
public void addUndoableEditListener(UndoableEditListener listener);
public void removeUndoableEditListener(UndoableEditListener listener);
public UndoManager getUndoManager();
```

Please note, these undo related methods won't work (returns null or does nothing) unless the inner table model is an instance of *TableUndoableSupport*.

Keystrokes for Undo and Redo

By default, there is no keystroke for the undo and redo action because we don't know what keystroke to you. But to enable keystrokes is very easy.

```
InputMap map =
table.getInputMap(JComponent.WHEN_ANCESTOR_OF_FOCUSED_COMPONENT);
map.put(KeyStroke.getKeyStroke("control Z"), "undo");
```

```
map.put(KeyStroke.getKeyStroke("control shift Z"), "redo");
```

Note that we use "undo" and "redo" as the action names. That's because we already registered both actions on *JideTable*'s ActionMap. All you need to do is to map the keystroke to the action on the InputMap.

TransferHandler Enhancement in JideTable

TransferHandler provides the data transfer from and to a Swing component. By default, JTable provides a TransferHandler that only supports copy. In the other word, you can select a range of cells and copy the content to the clipboard. But you can't paste the content.

In *JideTable*, we created *JideTableTransferHandler* class which can handle both copy and paste. The copy and paste can be done between a *JideTable* and Microsoft Excel or any other applications. Drag and drop works too as it is using the same *TransferHandler*.

The *TransferHandler* enhancement works with the undo feature. When you copy and paste causing the table model change, you can undo the change as long as you are using a *DefaultUndoableTableModel* or *AbstractUndoableTableModel*.

Converter

Before we introduce the next table – *ContextSensitiveTable*, we have to cover some basic modules that most tables would need.

As we all know, *JTable* follows MVC design pattern. The **M**odel is the TableModel. The **V**iew is the *JTable*. There could be any type of the data in the *TableModel*. Unless you use custom cell renderers that can display data in a more fancy way, the default cell renderer only displays String. It means we need some kinds of conversion that converts from any types of data to String so that it can be displayed in the table cells. Editing table is the opposite. It needs a converter that converts from String to any data type. Here comes the *ObjectConverter*.

Below is the interface of *ObjectConverter*. All converters implement this interface.

```
public interface ObjectConverter {
  /**
   * Converts from object to String based on current locale.
   * @param object object to be converted
   * @return the String
   */
  abstract String toString(Object object, ConverterContext context);

  /**
```

```
     * If it supports toString method.
     * @return true if supports toString
     */
    abstract boolean supportToString(Object object, ConverterContext context);

    /**
     * Converts from String to an object.
     * @param string the string
     * @return the object converted from string
     */
    abstract Object fromString(String string, ConverterContext context);

    /**
     * If it supports fromString.
     * @return true if it supports
     */
    abstract boolean supportFromString(String string, ConverterContext context);
}
```

As an example, assume you are dealing with a Rectangle object, specified as (10, 20, 100, 200). If you represent this Rectangle as the string “10; 20; 100; 200” then 80% of users will probably understand it as a Rectangle with x equals 10, y equals 20, width equals 100 and height equals 200. However, what about the other 20% of the people? Well, they might think it is an int array of four numbers. That’s fine. Users can generally learn by experience: as long as you are consistent across your application, users will get used to it. What is more important is you use the converter consistently across your whole application. If you decide to use “;” as the separator, do not also use “,”.

The situation is slightly more complicated in the case of Color. If we consider the string “0, 100, 200” - if people understand the RGB view of Color then 90% of them will treat as 0 as red, 100 as blue and 200 as green. However, since Color can also be represented in HSL color space (Hue, Saturation, and Lightness), some people may consider it as hue equal 0, saturation equals 100 and lightness equals 200. Another way to represent the color is to use the HTML color name such as “#00FFFF”. If your application is an html editor, you probably should use a converter to convert color to “#00FFFF” instead of “0, 255, 255”. What this means is that, based on your users’ background, you should consider adding more help information if ambiguity may arise.

We also need to consider internationalization, since the string representation of any object may be different under different locales.

In conclusion, we need a series of converters that convert objects so that we can display them as string and convert them back from string. However in different applications, different converters are required.

Although we have already built some converters and will add more over time, it is probably true that there will never be enough. Therefore, please be prepared to create your own converters whenever you need one.

The list below shows all the converters that we currently provide.

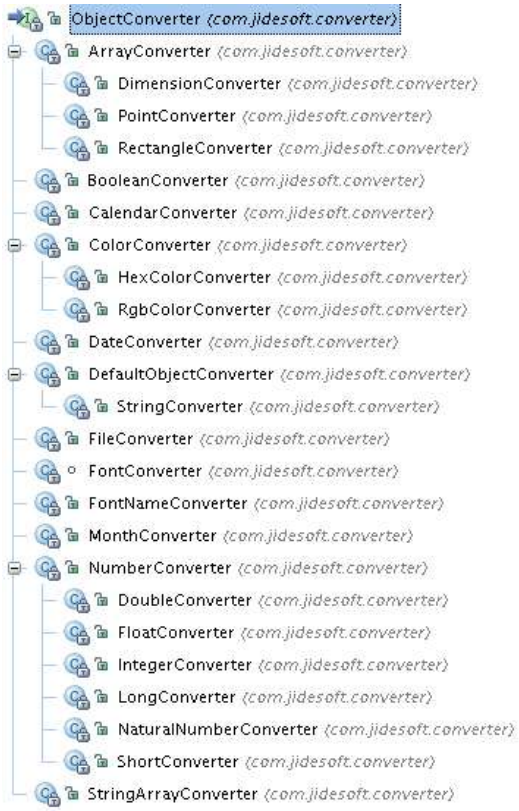


Figure 4 Existing converters

If you want to add your own converters then you can create one quite easily, by implementing a class that extends the *ObjectConverter* interface (i.e. the four methods in this interface). Before you use it, you must register it with *ObjectConverterManager*, which maps from a Class to a converter or several converters. If you want to register several converters for the same object then you can use *ConverterContext* to differentiate them.

There are two static methods on *ObjectConverterManager* that are used to register a converter:

```
void registerConverter(Class, ObjectConverter).
```

```
void registerConverter(Class, ObjectConverter, ConverterContext).
```

To help users adding their own classes that support *ConverterContex*, we provide an interface called *ConverterContextSupport* (all of our *CellEditor* and *CellRenders* implement this interface).

We didn't automatically register the existing converters with the *ObjectConverterManager*. However, we do provide a method *initDefaultConverter()* which you can call to register the default converters (as shown below). In addition to converters, this will register the default CellEditors and CellRenderers that we have provided. If you wish to make use of this facility then make sure that you call the *initDefaultConverter()* method when your application is started.

```
ObjectConverterManager.initDefaultConverter();
```

CellEditors and CellRenderers

The usage of *CellEditor* and *CellRenderer* is probably one of the most interesting aspects of the original *JTable* design.

First, let's review how *JTable* handles customization of cell editors and cell renderers.

1. You can set a *CellRenderer* and *CellEditor* per column using *TableColumn*'s *setCellRenderer* and *setCellEditor* methods respectively.
2. You can set a default *CellRenderer* and *CellEditor* per data type using *setDefaultRenderer(Class, TableCellRenderer)* and *setDefaultEditor(Class, TableCellEditor)* respectively.
3. The cell renderer or editor set in the first case has a higher priority than it in the second one.

From above, you can see a *JTable* assumes that each column has the same type of value, and that each data type will use the same type of cell editor. Unfortunately, neither of these assumptions is true in some cases (such as *PropertyTable* which we will cover later). Fortunately enough, *JTable* does allow us to add extensions to meet our requirements.

In the case of *PropertyTable*, each row in the value column may have different types of value, requiring different editors - even when the same underlying data type is being used. In order to support this requirement we have created two new classes: *CellEditorManager* and *CellRendererManager*, using an approach similar to the *ObjectConverterManager*.

If we first consider the *CellEditorManager*, this allows you to register any cell editor with a given data type, as defined by its class. You can also register a different cell editor to the same type using different contexts. Different from *CellRendererManager*, *CellEditorManager* takes *CellEditorFactory* to make sure an unique cell editor is used for each cell editing.

```
public static void registerEditor(Class clazz, CellEditorFactory editorFactory,
EditorContext context)
public static void registerEditor(Class clazz, CellEditorFactory editorFactory)
```

As an example, the String class is generally associated with a *StringCellEditor*. However, if the String is actually a font name then we associate it with a *FontNameCellEditor* in the context of *FontNameCellEditor.CONTEXT*. If you still remember the definition of *Property*, you will recall that the *Property* class has a field called *EditorContext*. This means that if you set the *EditorContext* of a *Property* to *FontNameEditor.CONTEXT* then a *FontNameCellEditor* will be used to edit cells of that type.

```
registerEditor(String.class, new CellEditorFactory() {
   public CellEditor create() {
      return new StringCellEditor();
   }
});
registerEditor(String.class, new CellEditorFactory() {
   public CellEditor create() {
      return new FontNameCellEditor();
   }
}, FontNameCellEditor.CONTEXT);
```

The Renderer framework works in a virtually identical manner to the Editor framework.

Both *CellRendererManager* and *CellEditorManager* have a method to initialize default editors or renderers, called *initDefaultRenderer()* and *initDefaultEditor()*, respectively. Please note that these methods are *not* called automatically (except in our demo code). This means that if you want to use our default editors and renderers then you must make sure to initialize them yourself before you can use the related classes.

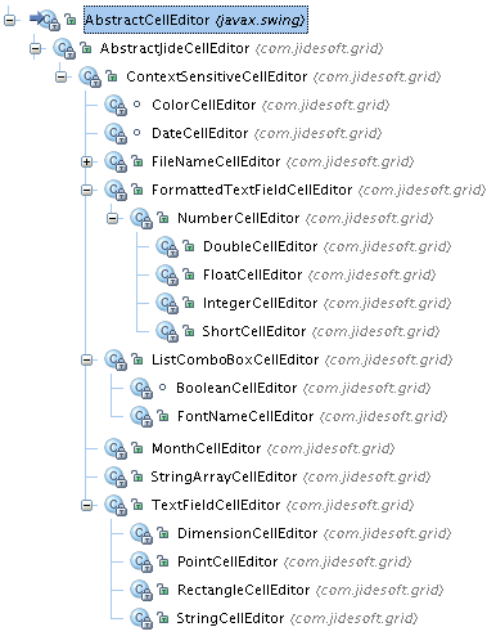


Figure 5 Existing CellEditors and their hierarchy

Here is the code to register default editors and renderers.

```
CellEditorManager.initDefaultEditor();
CellRendererManager.initDefaultRenderer();
```

In fact, in *JIDE Grids*, not just *ProperyTable* uses *CellEditorManager* and *CellRendererManager*. *ContextSensitiveTable* is the table class that starts to use it. If you remember the table hierarchy at the "Class Hierarchy of All the Tables" section, you will see all tables provided in *JIDE Grids* extend *ContextSensitiveTable* except *JideTable*. It means tables such as *SortableTable*, *TreeTable*, *HierarchicalTable*, *CellSpan/StyleTable* all can use *CellEditor/RendererManager*.

ContextSensitiveTable uses a table model called *ContextSensitiveTableModel*. *ContextSensitiveTableModel* extends *TableModel* interface and added three more methods. See below.

```
/**
 * Gets the converter context at cell (row, column).
 *
 * @param row
 * @param column
 * @return converter context
 */
```

```
    ConverterContext getConverterContextAt(int row, int column);

    /**
     * Gets the editor context at cell (row, column).
     *
     * @param row
     * @param column
     * @return editor context
     */
    EditorContext getEditorContextAt(int row, int column);

    /**
     * Gets the type at cell (row, column).
     *
     * @param row
     * @param column
     * @return type
     */
    Class getCellClassAt(int row, int column);
```

getCellClassAt returns the data type for a cell. If you need different cell renderer or editor for the same data type, returns a different *EditorContext* in *getEditorContextAt()* for those cells. Please note, both *CellRendererManager* and *CellEditorManager* use *EditorContext* to look up alought the name of *EditorContext* has "editor" in it.

The *getConverterContextAt* method can be used if you want to use the same default cell renderer but want to display the data differently. The converter context is used to find the correct *ObjectConverter* that can convert from a data type to/from a string so that the default cell renderer can display it. By using this feature, you save the effort of creating a new cell renderer for each data type because in most cases, a data type can be converted to a string.

In addition, we also added *setDefaultCellRenderer* method to *ContextSensitiveTable* will allow you to set a cell renderer that will be used for all cells.

Let's see after this enhancement, how cell renderer can be customized.

1. *setDefaultCellRenderer* to set the same cell renderer for all cells in a table.
2. You can still set a *TableCellRenderer* per column using *TableColumn*'s *setCellRenderer* methods respectively. This is just like before.
3. You can set your cell renderers to *CellRendererManager*. Then implement a table model that implementing *ContextSensitiveTableModel*. The cell renderers will be looked up from *CellRendererManager* and used.

   a. There is a special case. If you are OK to use *ContextSensitiveCellRenderer* to display your data as string, you can return a different *ConverterContext* in *ContextSensitiveTableModel. ContextSensitiveCellRenderer* will use the *ObjectConverter* it finds to convert your data into string.

4. You can still set a default *CellRenderer* per data type using *setDefaultRenderer(Class, TableCellRenderer)*. This is again just like before. But if will only happen if either you called *setCellRendererManagerEnabled(false)* or you didn't implement *ContextSensitiveTableModel* in your table model.
5. The first case has a higher priority than the second one and so on.

How about cell editor?

1. You can still set a *TableCellEditor* per column using *TableColumn*'s *setCellEditor* methods respectively. This is just like before.
2. You can set your cell editors to *CellEditorManager*. Then implement a table model that implementing *ContextSensitiveTableModel*. The cell editors will be looked up from *CellEditorManager* and used.
3. You can still set a default *CellEditor* per data type using *setDefaultEditor(Class, TableCellEditor)*. This is again just like before. But if will only happen if either you called *setCellEditorManagerEnabled(false)* or you didn't implement *ContextSensitiveTableModel* in your table model.
4. The first case has a higher priority than the second one and so on.

We prepared G26. ContextSensitiveTableDemo in the examples folder, which shows you how to use this feature.

NavigableModel and NavigableTable

Table is very data intensive. For frequent table users (i.e. Excel users), they prefer use keyboard to edit the whole table without ever touching the mouse to slow them down. So it is very important to optimize the cell navigation for those keyboard users.

In JTable, TAB key will navigate to the next cell, SHIFT-TAB will go to the previous cell and ENTER key will go to the cell of the next row. If user is editing the table, one thing we know for sure is if the next cell is not editable, most likely user wants to skip the cell when he/she presses the TAB. Or sometimes user wants to skip all the way to the next empty cell. In the other word, even though the next cell is editable but it is already filled with data, so no need to navigate to it. The actual requirement for this navigation could be more complex than the two simple examples. That's the reason we decide to introduce *NavigableModel* to allow you to customize the navigation behavior.

See below for the interface of NavigableModel. If you read *SpanModel* and *StyleModel*, you will find this interface is familiar. In fact, it's not just the interface is similar, so is the usage.

```
public interface NavigableModel {
```

```
    /**
     * Returns if the cell at the given coordinates can be navigated or
     * not.
     *
     * @param rowIndex    The row index
     * @param columnIndex The column index
     * @return <code>true</code> if navigable, <code>false</code> otherwise
     */
    boolean isNavigableAt(int rowIndex, int columnIndex);

    /**
     * Checks if the navigation is on. If off, {@link #isNavigableAt(int,int)}
     * should always return <code>true</code> for valid indexes.
     *
     * @return <code>true</code> if on, <code>false</code> otherwise
     */
    boolean isNavigationOn();

}
```

You can implement this *NavigableModel* on any table model. You will implement the *isNavigableAt* method to decide if this cell is navigable when user presses TAB, SHIFT-TAB or ENTER key.

We also create *NavigableTable* class to use *NavigableModel*. However you don't have to use it explicitly as most other JIDE tables such as *SortableTable*, *PropertyTable*, and *TreeTable* extend it.

Customize the navigation keys

We mentioned TAB, SHIFT-TAB or ENTER keys as the default navigation keys. In fact, JTable also supports all the arrow keys such as LEFT, RIGHT, UP, DOWN, PGUP, PGDN, HOME and END. By default, those keys will obey use NavigableModel. If you want some of the keys to use NavigableModel, you can override this method to do it. Just return true if you want to treat them as navigable keys.

```
protected boolean isNavigationKey(KeyStroke ks)
```

CellSpanTable

The next table is the CellSpanTable which one cell can span several rows or columns or both. To know what it is, we need to understand *CellSpan* first.

CellSpan defines how a cell spanning across several rows or/and columns. *CellSpan* has four fields. They are *row*, *column*, *rowSpan*, *columnSpan*. All are int type. The (row, column) is actually the anchor cell of the cell span. *rowSpan* tells how many rows the cell will span. *columnSpan* tells how many columns the cell will span. You can view them as Rectangle's y, x, height and width respectively.

Let's use the following table as an example. The cell marked as light green is a cell span. The cell span is defined as row = 1, column = 1, rowSpan = 2, and columnSpan = 3.

<table>
<tr><td>(0, 0)</td><td>(0, 1)</td><td>(0, 2)</td><td>(0, 3)</td></tr>
<tr><td>(1, 0)</td><td colspan="3" rowspan="2">CellSpan (1, 1, 2, 3)</td></tr>
<tr><td>(2, 0)</td></tr>
<tr><td>(3, 0)</td><td>(3, 1)</td><td>(3, 2)</td><td>(3, 3)</td></tr>
</table>

Now you know how to define a cell span. But how to pass the cell span information to table so that it knows how to paint the cells correctly? Instead of introducing a whole separate model, we decided to use *TableModel*. First we defined *SpanModel* as an interface and then *SpanTableModel* which combines *SpanModel* and *SpanTableModel* together. See below.

```
public interface SpanModel {
    /**
     * Gets the cell span at the specified row and column.
     * @param rowIndex
     * @param columnIndex
     * @return CellSpan object.
     */
    CellSpan getCellSpanAt(int rowIndex, int columnIndex);

    /**
     * Checks if the span is on. There are two meanings if it returns false.
     * It could be getCellSpanAt() return a valid value but
     * It could also be the span model is empty which means getCellSpanAt() always
return null.
     * @return true if span is on. Otherwise false.
     */
    boolean isCellSpanOn();
}

/**
```

```
   * <code>SpanTableModel</code> interface combines <code>TableModel</code> and
<code>SpanModel</code>.
   */
   public interface SpanTableModel extends TableModel, SpanModel {
   }
```

When you define your table model which you have to do it anyway, you can define what *SpanModel* is. Let's see some real examples.

This is a table with every third row spanning across the whole table width. The code to do it is very simple at the *getCellSpanAt(rowIndex, columnIndex)* method. Every third row translated to if(rowIndex % 3 == 0). So if rowIndex can be divided by 3, returns a cell span that anchor cell is at the first cell in that row and columnSpan is column count.

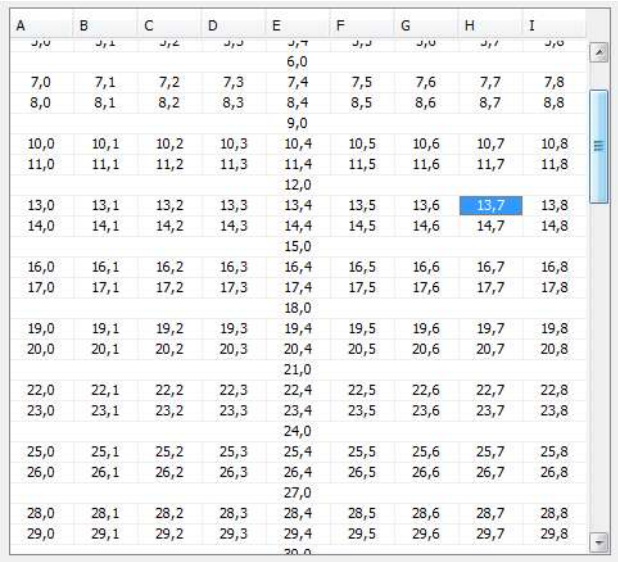
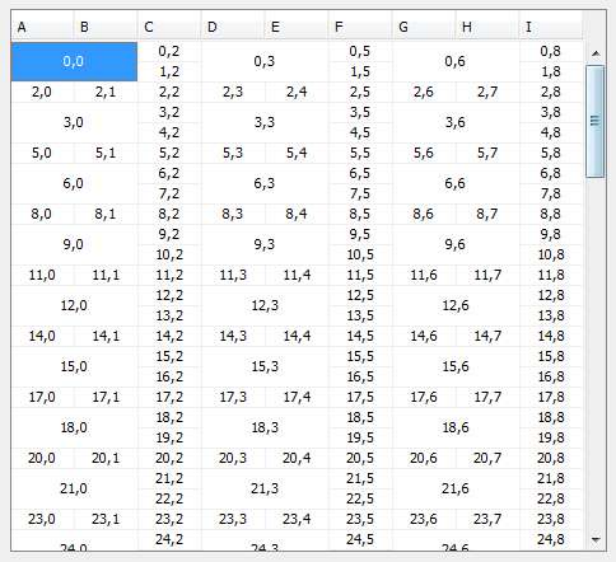


Figure 6 CellSpanTable

```
class SpanTableTableModel extends AbstractSpanTableModel {
   public int getRowCount() {
      return 10000;
   }

   public int getColumnCount() {
      return 9;
   }

   public boolean isCellEditable(int rowIndex, int columnIndex) {
```

```
        return false;
    }

    public Object getValueAt(int rowIndex, int columnIndex) {
        return "" + rowIndex + "," + columnIndex;
    }

    public CellSpan getCellSpanAt(int rowIndex, int columnIndex) {
        if (rowIndex % 3 == 0 ) {
            return new CellSpan(rowIndex, 0, 1, getColumnCount());
        }
        return null;
    }

    public boolean isCellSpanOn() {
        return true;
    }
}
```

Here is another more complex example. You can read the code to figure out how it works.



A	B	C	D	E	F	G	H	I
0,0		0,2	0,3		0,5	0,6		0,8
		1,2			1,5			1,8
2,0	2,1	2,2	2,3	2,4	2,5	2,6	2,7	2,8
3,0		3,2	3,3		3,5	3,6		3,8
		4,2			4,5			4,8
5,0	5,1	5,2	5,3	5,4	5,5	5,6	5,7	5,8
6,0		6,2	6,3		6,5	6,6		6,8
		7,2			7,5			7,8
8,0	8,1	8,2	8,3	8,4	8,5	8,6	8,7	8,8
9,0		9,2	9,3		9,5	9,6		9,8
		10,2			10,5			10,8
11,0	11,1	11,2	11,3	11,4	11,5	11,6	11,7	11,8
12,0		12,2	12,3		12,5	12,6		12,8
		13,2			13,5			13,8
14,0	14,1	14,2	14,3	14,4	14,5	14,6	14,7	14,8
15,0		15,2	15,3		15,5	15,6		15,8
		16,2			16,5			16,8
17,0	17,1	17,2	17,3	17,4	17,5	17,6	17,7	17,8
18,0		18,2	18,3		18,5	18,6		18,8
		19,2			19,5			19,8
20,0	20,1	20,2	20,3	20,4	20,5	20,6	20,7	20,8
21,0		21,2	21,3		21,5	21,6		21,8
		22,2			22,5			22,8
23,0	23,1	23,2	23,3	23,4	23,5	23,6	23,7	23,8
24,0		24,2	24,3		24,5	24,6		24,8

Figure 7 CellSpanTable

```
class SpanTableTableModel extends AbstractSpanTableModel {
    public int getRowCount() {
```

```
        return 10000;
    }

    public int getColumnCount() {
        return 9;
    }

    public boolean isCellEditable(int rowIndex, int columnIndex) {
        return false;
    }

    public Object getValueAt(int rowIndex, int columnIndex) {
        return "" + rowIndex + "," + columnIndex;
    }

    public CellSpan getCellSpanAt(int rowIndex, int columnIndex) {
        if ((rowIndex % 3) != 2 && (columnIndex % 3) != 2) {
            return new CellSpan(rowIndex  - rowIndex % 3, columnIndex - columnIndex %
3, 2, 2);
        }
        return super.getCellSpanAt(rowIndex, columnIndex);
    }

    public boolean isCellSpanOn() {
        return true;
    }
}
```

You probably already noticed we used *AbstractSpanTableModel* in the examples above which we haven't introduced. *AbstractSpanTableModel* extends *AbstractTableModel* and implements *SpanTableModel* and provides default implementation onto the two methods defined in *SpanModel*. Please note, it returns false in *isCellSpanOn()* which means if you want to see cell span, you have to override it and return true. The reason we did is because there are other table components that extends *CellSpanTable*. We don't want cell span is turned on by mistake.

AbstractSpanTableModel also provides support for *SpanModelListener* and *SpanModelEvent*.

```
abstract public class AbstractSpanTableModel extends AbstractTableModel implements
SpanTableModel {
```

```
    public CellSpan getCellSpanAt(int rowIndex, int columnIndex) {
      return null;
    }

    public boolean isCellSpanOn() {
      return false;
    }
    .....
}
```

There is another table model called *DefaultSpanTableModel.* It extends *DefaultTableModel* and implements *SpanTableModel*. In this model, you get additional methods such as *addCellSpan*, *removeCellSpan*.

Once we understand the *SpanTableModel* and different subclasses, *CellSpanTable* is very simple to use. There is no additional method on it except three methods starting with "orginal". They are originalRowAtPoint, originalColumnAtPoint and originalGetCellRect. They are handy when you need to get the old cell rectangle, row and column without considering the cell spans but in most cases you won't need them.

In general, *CellSpanTable* is very fast. In the example above, we have 10000 rows in the table and fairly complex cell spans, we couldn't even notice any difference when scrolling up and down quickly. However since it's user's responsibility to implement *getCellSpanAt()* method, how complex this method is does affect the speed of *CellSpanTable*. So when you implement this method, please make sure you optimize it as much as you can. We suggest you to use the same *CellSpan* instance over and over again[6] so that it will increase the memory usage in a short period of time (although it will be garbage collected later). The other performance tuning technique you can use in this case is to cache the cell span if the cell span is very difficult to calculate. Of course then you have to deal invalidating the cache when table data changes.

Since Java doesn't support multiple inherent, we have to put *CellSpanTable* at a lower level. Most table components in JIDE Grids are actually *CellSpanTable* such as *TreeTable*, *PropertyTable*, *HierarchicalTable*, *SortableTable* etc. There is one reason why we added *isCellSpanOn()* method to *SpanModel*. If your table model is not an instance *SpanModel* or it is but *isCellStyleOn()* returns false, there is no performance hit at all even if your table extends *CellSpanTable*.

---

[6] Please note, we didn't use the same *CellSpan* instance in the two examples above as it will make the code a little harder to read. However for you it's very simple to change it to reuse the same instance. All you need is to create a field of type *CellSpan* and set different row, column, rowSpan and columnSpan value on it and return the same thing. If there is no cell span, still return null.

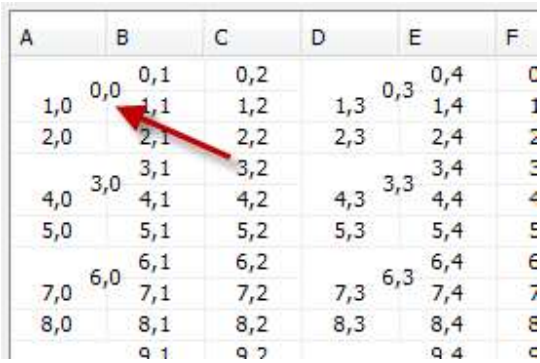


Figure 8 Corrupted Cell Span Display

One of the common mistakes when defining a span table model is the span definition inconsistence. The span definition inconsistence refers to a definition error in getCellSpanAt method when the cells in the same cell span return different CellSpans. The result is the display conrruption as shown on the screenshot above. The display conrruption is intermitten and the result may not be the same all the time, which make it hard to identify. The best way to detect this error is to use a static verifyCellSpan method on CellSpanTable. If there are errors, this method will print out something like below.

```
Cell at (0, 1) has a different cell span from that of the anchor cell (0, 0)
        (0, 0)-> CellSpan(0, 0, 2, 2)
        (0, 1)-> CellSpan(0, 1, 1, 1)
Cell at (1, 0) has a different cell span from that of the anchor cell (0, 0)
        (0, 0)-> CellSpan(0, 0, 2, 2)
        (1, 0)-> CellSpan(1, 0, 1, 1)
Cell at (1, 1) has a different cell span from that of the anchor cell (0, 0)
        (0, 0)-> CellSpan(0, 0, 2, 2)
        (1, 1)-> CellSpan(1, 1, 1, 1)
...
```

The message above simply tells you that the cell span at (0, 1), (1, 0) and (1, 1) should all be the same which should be CellSpan(0, 0, 2, 2).

CellStyleTable

What is cell style? Usually all the cells in the same table has the same color, same font, same alignment (at least in the same column). However there are many cases we want to have different styles on each cell to highlight certain cells or archive the strips effect. In a regular JTable, we usually use cell renderers to do it. You will end up with creating several cell renderers

to do various cell styles. *CellStyleTable* provides a better and easier way to archive this and more.

Cell styles include the foreground, the background, the font, the alignments (horizontal and vertical), the border, the icon, etc. If you think there are other styles that should be added, just let us know. It's very simple to introduce new styles.

The design of *CellStyleTable* is almost the same as *CellSpanTable*. Instead of *CellSpan*, we got *CellStyle* class. *CellStyle* is just a collection of the styles we mentioned above. Then we got *StyleModel* and *StyleTableModel*.

```
public interface StyleModel {
    /**
     * Gets the cell style at the specified row and column.
     * @param rowIndex
     * @param columnIndex
     * @return CellStyle object.
     */
    CellStyle getCellStyleAt(int rowIndex, int columnIndex);

    /**
     * Checks if the style is on. There are two meanings if it returns false. It could be
     * getCellStyleAt() return a valid value but it could also be the style model is empty
which
     * means getCellStyleAt() always return null.
     * @return true if style is on. Otherwise false.
     */
    boolean isCellStyleOn();
}
/**
 * <code>StyleTableModel</code> interface combines <code>TableModel</code> and
<code>StyleModel</code>.
 */
public interface StyleTableModel extends TableModel, StyleModel {
}
```

If you read *SpanTableModel* section, you will see this *StyleTableModel* is almost a copy of it except changing from "Span" to "Style". We intentionally did it this way so that you can get familiar with those interfaces easily. When you implement *StyleModel*, all you need to do is to return a desired *CellStyle* at *getCellStyleAt(int rowIndex, int columnIndex)* method.

Available CellStyles

There are many cell styles that can be used in various situations to make your table more interesting.

Style Name	Data Type	Renderer Component Type	Notes
background	Color	Any Components	
foreground	Color	Any Components	
selectionBackground	Color	Any Components	
selectionForeground	Color	Any Components	
font	Font	Any Components	
fontStyle	int	Any Components	
icon	Icon	JLabel, AbstractButton	
verticalAlignment	int	JLabel, AbstractButton AbstractComboBox	
horizontalAlignment	int	JLabel, AbstractButton, JTextField, AbstractComboBox	
verticalTextPosition	int	JLabel, AbstractButton	
horizontalTextPosition	int	JLabel, AbstractButton	
text	String	JLabel, AbstractButton, JTextField	The text style allows you to display a specified text instead of the actual value of the cell.
toolTipText	String	Any JComponents	
border	Border	Any JComponents	The border style is set to the renderer component
overlayBorder	Border	Any Components	The overlay border style is painted over the cell renderer, unlike the border style which actually sets the border
overlayCellPainter	CellPainter	Any Components	The overlay CellPainter is painted after the cell content is painted
underlayCellPainter	CellPainter	Any Components	The underlay CellPainter is painted before the cell content is painted

Where to Define CellStyle

There are two kinds of cell styles. One is the style depending on the data of the cell. For example, showing red background if the value is negative, displaying an up or down icon if the data (representing stock price change maybe) is positive or negative. The other case is the style that is not depending on the data. For example, the row stripes, the column strips etc.

For the first case, you should define *StyleModel* on the table model and return *CellStyle* from the *getCellStyleAt* method. For the second case, the best way is to define it on *CellStyleTable* using *setTableStyleProvider*.

As row/column stripes is so popular, we even created *RowStripeTableStyleProvider* and *ColumnStripeTableStyleProvider*, you can use it simply by calling

```
CellStyleTable table = …;
table.setTableStyleProvider(new RowStripeTableStyleProvider(new Color[]{…}); // pass in the alternative colors here
```

CellStyle Merging

When there is a pipe of several table models, *StyleModel* can be implemented at any of the table models. *TableStyleProvider* also provides a cell style. Sometimes, the style depends on the actual table data. If so, you probably should implement the *StyleModel* on the actual table model level to avoid index conversion. Sometimes, the style depends on the row position in the view, such as alternative row stripes. In this case, you will use *CellStyleTable*'s *TableStyleProvider*. We allow you to define *CellStyle* at the appropriate *TableModel* and we will merge the styles for you. When there are conflicts in the styles, we allow you to define the priority using *CellStyle#setPriority(int)*. By default, if prioritys for all cell styles are the same, the inner model has the highest priority and *TableStyleProvider* on *CellStyleTable* has the lowest priority.

SortableTable

Comparator

Before we introduce *SortableTable*, we first have to introduce the *ObjectComparatorManager*. This works in a similar manner to the *ObjectConverterManager* which we have already discussed, with the difference being that *ObjectComparatorManager* is a central place for managing comparators. Registration of comparator can be done using the following two methods on *ObjectComparatorManager*.

```
public static void registerComparator(Class clazz, Comparator comparator);
public static void unregisterComparator(Class clazz);
```

The figure to the right shows the standard comparators that we provide. If an object type implements Comparable then you can use *ComparableComparator*. If the object can be compared as a string (based on the value of toString()) then you can use *DefaultComparator*. We also provide several comparators for existing data types such as *NumberComparator* for any Number, *BooleanComparator* for Boolean and *CalendarComparator* for Calendars. Alternatively, you can write your own comparator and register it with *ObjectComparatorManager*.

Sortable Table

A *SortableTable*, as the name indicates, is a table that can sort on each column. Usually a *SortableTable* can only sort on one column. However this *SortableTable* can sort on multiple columns, as shown below:

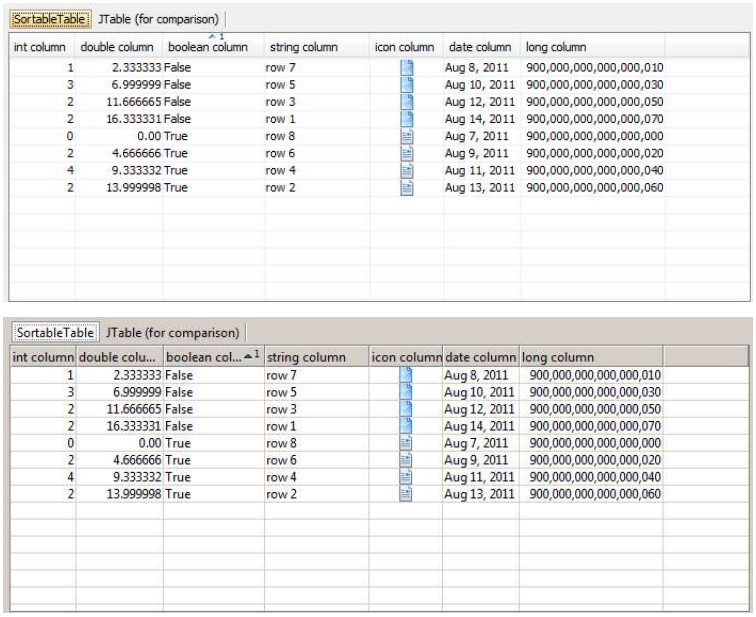


Figure 9 SortableTable under different L&F

In a *SortableTable*, clicking on table column header will sort the column: the first click will sort ascending; the second click descending; the third click will reset the data to the original order. To sort on multiple columns, you just press CTRL key and hold while clicking on the other columns. A number is displayed in the header to indicate the rank amongst the sorted columns. As an example, in the screen shot above, the table is sorted first by “boolean column”, then by “double column” and then by “string column”.

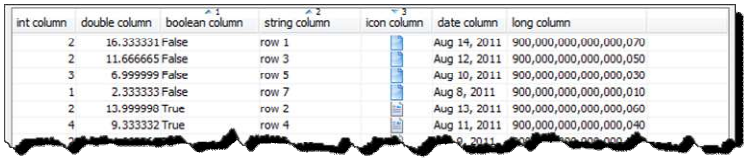


Figure 10 Multiple Column Sorting

SortableTableModel

The core part of *SortableTable* is not the table itself but the *SortableTableModel*. This can take any standard table model and convert to a suitable table model for use by *SortableTable*. Note that we wrap up the underlying table model, which means that when you sort a column, the original table model is unchanged (you can always call *getActualModel()* to get the original table model).

As a developer, how do I use it

It's very easy to use *SortableTable* in your application. Just create your table model as usual, but instead of setting the model to *JTable*, set it to *SortableTable*. If you have your own *JTable* class which extends *JTable* then you will need to change it to extend *SortableTable*.

```
TableModel model = new SampleTableModel();
SortableTable sortableTable = new SortableTable(model);
```

In the example above, *SampleTableModel* is just a normal table model. When you pass the model to *SortableTable*, *SortableTable* will create a *SortableTableModel* internally. This means that when you call *sortableTable.getModel()*, it will return you the *SortableTableModel*, not the *SampleTableModel*. However if you cast the table model you get to *TableModelWraper* and then call *getActualModel()* on the table model, the *SampleTableModel* will be returned. If you use several levels of *TableModelWrapper*s such as *FitlerableTableModel*, you may want to use *TableModelWrapperUtils#getActualTableModel(TableModel,Class)* to find the inner most table model.

Sometimes, you need to know the actual row since it's different visually. For example, although the first row may appear to be selected, since the table could be sorted, this may not be the first row in the actual table model. Here are the two methods you need to know: *getActualRowAt(int row)* and *getSortedRowAt(int row)*. The first one will return you the actual row in the actual table model by passing the row index on the screen; the second one does the opposite mapping. In fact, we suggest you to use *TableModelWrapperUtils*' *getActualRowAt* and *getRowAt* to do the index conversion once you start to use *FilterableTableModel* along with *SortableTableModel*. We will cover *FilterableTableModel* later. In short, both *FilterableTableModel* and *SortableTableModel* are table model wrappers. Once there are several models that one wraps the other. *TableModeWrapperUtils* will allow you to find the row index at any table model level, v.s. the two methods on *SortableTableModel* only allows you to find one level at a time.

There are several options you can use to control SortableTable. For example, setMultiColumnSortable(Boolean) allows you to enable/disable multiple column sort. Similarly, if you have better icons for showing the ascending/decending option on the table header, then you can call *setAscendingIcon(ImageIcon)* to *setDescendingIcon(ImageIcon)* to replace the standard icons.

As has already been explained, the user can click the column header to sort a column. In addition you can call *sortColumn()* to sort a column programmatically. You can sort either by column index, or by column name. The interface for sorting on *SortableTable* is really simple. If you want to sort by multiple columns programmatically, you will have to use *SortableTableModel* to do it. This provides more methods will allow you to sort several columns or even un-sort a sorted column.

How to Compare

You may think we use Comparator all the time to compare two values. However that's not the case by default. The actual comparison is done in this method of *SortableTableModel*.

```
protected int compare(Object o1, Object o2, int column)
```

We will first to see if the two objects are String. If yes, we use String's *compareToIgnoreCase* method to compare. Then we will see if the two objects are *Comparable*. If yes and they are type compatible, we will use either *o1.compareTo(o2)* or *o2.compareTo(o1)* to compare the two values. *compareTo(…)* is the method on *Comparable* interface. If none of the above is true, we will finally use *Comparator* to compare. *Comparator* is looked up from *ObjectComparatorManager* using the type returned *getColumnClass* as the primary key and the context returned from *getComparatorContext* as the second key. The main reason we did it this way is because we found people always forgot to override *getColumnClass()* method then complained to us why sorting is not working as expected. By using *compareTo* method, it will work in most cases without depending on *getColumnClass()*. Saying that, there are cases you have to use *Comparator* because, for example, you provide some customized compare logic in it. If so, you can call *SortableTableModel*'s setAlwaysUseComparators(true) so that we will always use *Comparator* to compare without even checking if the objects are *Comparable*.

The performance of SortableTableModel

We tried to optimize the performance of *SortableTableModel*. The basic strategy is if the table is completely unsort, we will sort the whole table model which could be slow if the table is huge. If the table is sorted already and a new row is added/deleted/updated, we will do incremental sorting. For example, insert the new row to the correct position directly.

As we have no idea of what the data might look like, we have to use a generic sorting algorithm. In our case, we used shuttle sort. It's a very fast algorithm comparing to others. However depending on how large the table model is, it could potentially take a long time on a large table model. In the actual use cases, user knows very well about the data. So they could develop a sorting algorithm that is customized to the particular data.

When the table is sorted, a new row is added or deleted or some values are updated in the underlying table model, we won't resort the whole table again. We will listen to the table model event from underlying table model and do incremental sort. Binary search is used by default as the table is sorted already. In this case, as user of SortableTableModel, you need to fire the exact table model event to tell SortableTableModel what happened in underlying table model. If you use *DefaultTableModel*, all those are done automatically. If you implement your own underlying table model basing on *AbstractTableModel*, you need to fire the table model event. You can refer to the source code of *DefaultTableModel* to figure out what event to fire. If an incorrect event is fired, the sorting result will be unpredictable.

Generic speaking, in our testing environment, the performance of *SortableTableModel* is good enough. You can try in using LargeSortableTableDemo we included in our examples.

However if you have an even better algorithm or as I said you know your data very well so that you can play some tricks to make sorting faster, we allow you to do so.

First, you need to extend SortableTableModel. There are three methods you need to know in order to plug in your own algorithm. They are

protected void sort(int from[], int to[], int low, int high);

protected int search(int[] indexes, int row);

protected int compare(int row1, int row2);

When the table model is completely unsorted, sort() will be used to sort the whole table model. If the table is sorted already, search() will be called to find out where a new row to be added or an existing row to be deleted. So method sort can be overwritten if you want to use your own sort algorithm. Method search can be overwritten if you want to use your own search algorithm.

In either sort() or search(), if you want to compare two rows, using the compare() method. Usually you don't need to overwrite it. To make it easier to understand, here is the source code we used to do the search and sort for your reference.

Search algorithm:

```
protected int search(int[] indexes, int row) {
   return binarySearch(indexes, row);
}

private int binarySearch(int[] indexes, int row) {
   // use binary search to find the place to insert
   int low = 0;
   int high = indexes.length - 1;
   int returnRow = high;

   boolean found = false;
   while (low <= high) {
      int mid = (low + high) >> 1;
      int result = compare(indexes[mid], row);
      if (result < 0)
         low = mid + 1;
      else if (result > 0)
         high = mid - 1;
      else {
         returnRow = mid; // key found
         found = true;
         break;
```

```
        }
      }
      if (!found) {
        returnRow = low;
      }
      return returnRow;
    }
```

Sort algorithm:

```
    protected void sort(int from[], int to[], int low, int high) {
      shuttlesort(from, to, low, high);
    }

    private void shuttlesort(int from[], int to[], int low, int high) {
      if (high - low < 2)
        return;

      int middle = (low + high) / 2;
      shuttlesort(to, from, low, middle);
      shuttlesort(to, from, middle, high);

      int p = low;
      int q = middle;

      if (high - low >= 4 && compare(from[middle - 1], from[middle]) <= 0) {
        for (int i = low; i < high; i++)
          to[i] = from[i];
        return;
      }

      for (int i = low; i < high; i++) {
        if (q >= high || (p < middle && compare(from[p], from[q]) <= 0))
          to[i] = from[p++];
        else
          to[i] = from[q++];
      }
```

```
}
```

Filter and FilterableTableModel

Table is used to display data. Sometimes users are only interested in some important rows, so they would like to filter other rows away. This is why we need a component which can do filter on the table model.

Filter is an interface which is used to filter data. The main method is *isValueFiltered(Object value)*. If a value should be filtered, this method should return true. Otherwise, returns false. It also defined other methods such as setters and getters for name, enabled as well as methods to add/remove *FilterListener*. *AbstractFilter* is the default implement of *Filter* interface. It implements most of the methods in *Filter* except *isValueFiltered()*. Subclasses should implement this method to do the right filtering.

There is no class called *FilterTable* because the filtering happens on the table model portion. There is no code need to be added to the table portion to do the filtering. There is a *FilterableTableModel*. It's also a table model wrapper just like *SortableTableModel*. *FilterableTableModel* allows you to add filter for each column or to the whole table. It will use those *Filter* and call *isValueFiltered()* to decide which value to be filtered.

In most cases, you can use *Filter* interface or *AbstractFilter* as the filters. But if the filter logic depends on the row index and column index, you may need to use *TableFilter* or *AbstractTableFilter*. *TableFilter* has *getRowIndex* and *getColumnIndex* methods which you can use to get the row and column index.

AutoFilterTableHeader

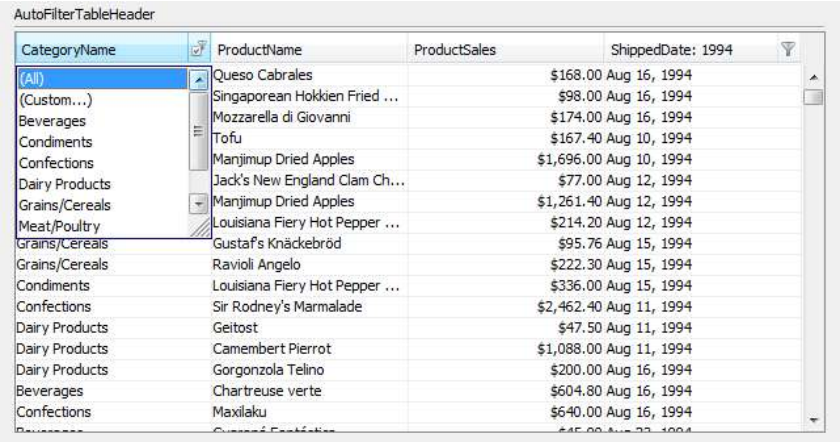


Figure 11 AutoFilterTableHeader

AutoFilterTableHeader implements auto-filter feature on the table header. Each column header has a combobox-like control to allow user selecting certain value(s) to be filtered from the list. The list contains the possible values for that column as well as other customized items. Each item represents a Filter class that will be added to *FilterableTableModel* when selected.

Since JIDE 3.0 release, we redesigned the *AutoFilterTableHeader* so that it will only show the filter drop down button when the mouse is over the column. It means by default, *AutoFilterTableHeader* will look just like a regular JTableHeader.

AutoFilterTableHeader works with any *FilterableTableModel*. If the table passed to the constructor of *AutoFilterTableHeader* already defined a *FilterableTableModel*, it will use that *FilterableTableModel*. Otherwise, it will create a new *FilterableTableModel*, wrapping the current table's table model and reset the table's table model to the newly created *FilterableTableModel*.

Among the drop down list, there is a “Custom…” entry. If you click on it, it will bring up a dialog that can define customer filters.

User can choose all kinds of built-in filters from this dialog. We will cover more information in the *CustomFilterEditor* section below.

AutoFilterTableHeader also supports multiple filter values. See below. We will use a *CheckBoxList* to allow you to select multiple values.

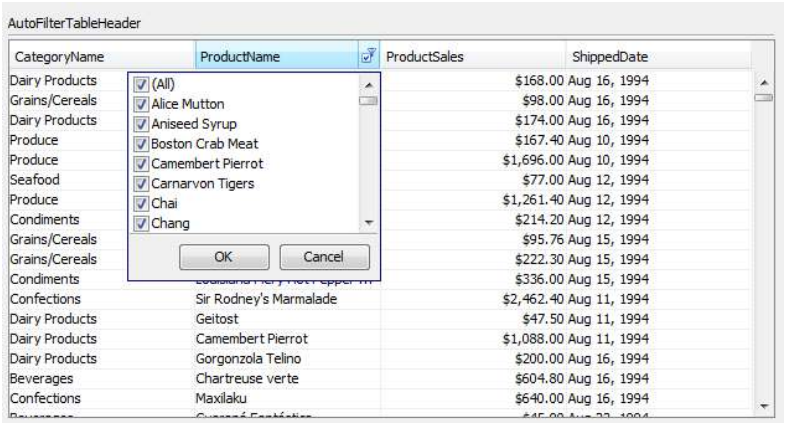


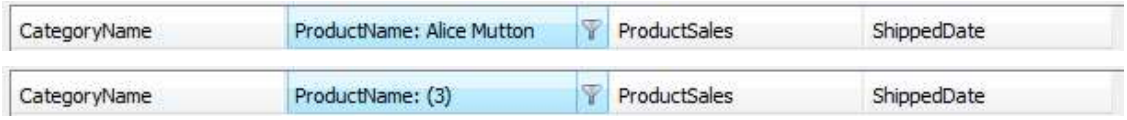
Figure 12 Multiple Values as Filter

There are three kinds of Filters *AutoFilterTableHeader* will use. They are *SingleValueFilter*, *MultipleValuesFilter* and *DynamicTableFilter*. When *isAllowMultipleValues()* returns false and user selects a value from *AutoFilterTableHeader*'s drop down value list, *SingleValueFilter* will be created and added to that column as the filter. *DynamicTableFilter* could also be used in this case when you call *AutoFilterBox#addDynamicTableFilter(DynamicTableFilter)*. This method call will add new custom filter to the header which will appear as a new item under "All" item in the

drop down value list. If *isAllowMultipleValues()* returns true, *MultipleValuesFilter* will be the only filter that is used to allow multiple values as the filter values.

AutoFilterTableHeader also detects filters added outside *AutoFilterTableHeader*. For example, if *isAllowMultipleValues* returns false, you can add a *SingleValueFilter* to the column, or if *isAllowMultipleValues* returns true, you can add a *MultipleValuesFilter*. After you did it, AutoFilterTableHeader will automatically update the display to show a filter name or filter name to indicate the column has a filter.

AutoFilterTableHeader also supports the filter indicator on the header. It can be icon only, filter value(s) only, or both. In the case of *isAllowMultipleValues* is true, we will display the number of values instead of the actual values as there could a lot of them.

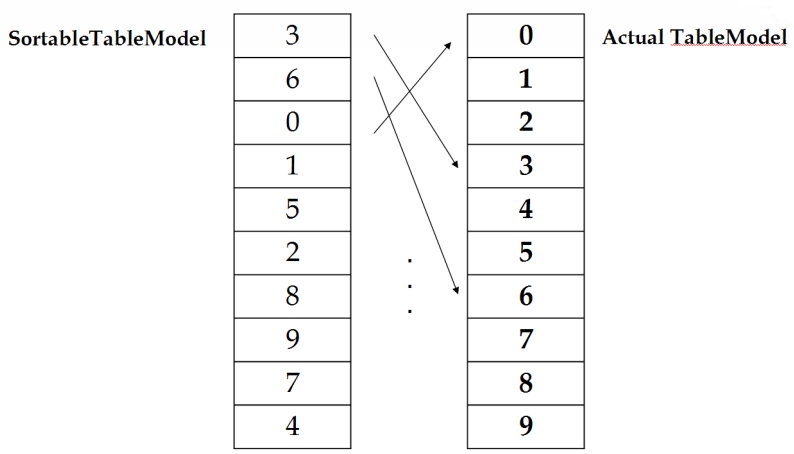


TableModelWrapper

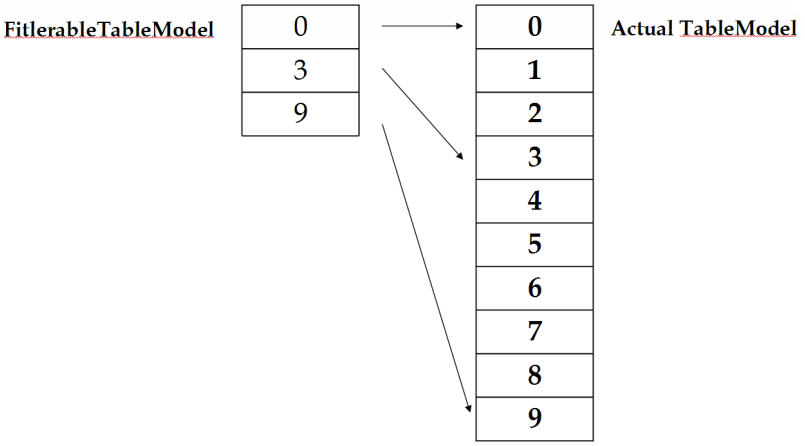
We just talked about *SortableTableModel* and *FilterableTableModel*. In fact, both implements *TableModelWrapper* interface.

```
/**
 * <code>TableModelWrapper</code> is a wrapper around table model which is
referred
 * as the actual table model or underlying table model. It can be used to provide a
 * different view to the actual model. A typical use case is SortableTableModel.
 */
public interface TableModelWrapper {
  /**
   * Gets the underlying table model.
   *
   * @return the underlying table model.
   */
  TableModel getActualModel();
}
```

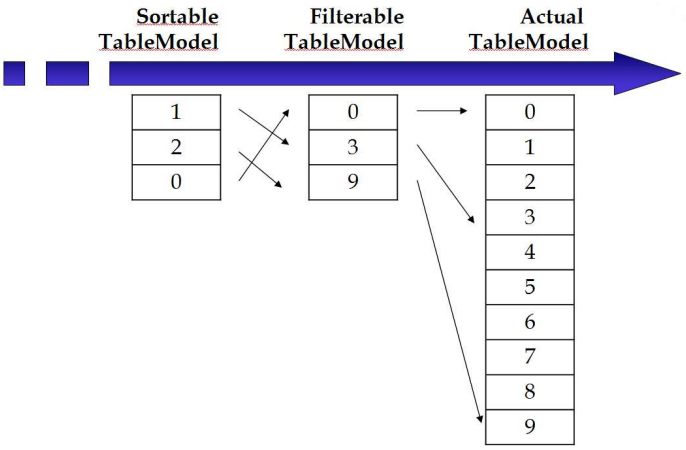
On top of *TableModelWrapper*, we also have *RowTableModelWrapper* and *ColumnTableModelWrapper*. Let's look at an example of how we use RowTableModelWrapper to implement sorting. Instead of modifying the actual table model, we just provide a row index mapping. The first row after sorting is actually the 4th row in the actual model. So all we need is to put 3 at the first index in the mapping, and so on.



For FilterableTableModel, it is the same thing. We just remove the row indices that are not satisfy the filter condition.



Since both FilterableTableModel and SortableTableModel are table model wrappers, you can connect them to for a “pipe”.



That's how you implement both sorting and filtering feature in JIDE Grids.

We also provide *TableModelWrapperUtils* which has a bunch of methods to allow you to convert the row index. For example, if you know the first row is selected in the table, you need to find out the actual row index in the actual table model, *TableModelWrapperUtils*' *getActualRowAt* is the one to use.

CompoundTableModelEvent

In the case TableModelWrappers, events are passed from model to model. In some cases, the event could change its meaning. A row deleted event will not be fired on an outer model because the model is a FilterableTableModel and the deleted row is already filtered. A continuous rows deleted event may become several discontinued row deleted event because SortableTableModel changed the row order. It will cause some problems.

Since 3.0 release, we introduced this CompoundTableEvent to handle some of those complicated scenarios. For example, if a sorted SortableTableModel receives a row updated event from its underlying table model, the updated row could change its position. In this case, SortableTable needs to get a tableRowsDeleted event for the original position and another tableRowsInserted event for the updated position. However, it's not appropriate to fire two separate events for one action. It will also impact the performance if we simply fire tableDataChanged event. That's why we introduce this class.

Basically, JIDE fires this CompoundTableModelEvent only if there are two or more child events embedded in. The event itself will represent as a tableDataChanged event. That means, if you don't try to distinguish it with regular TableModelEvents, it will fall into the branch you handle tableDataChanged event. However, it doesn't mean that CompoundTableModelEvent has to be a tableDataChanged event. You could fire whichever event you want following the instruction of TableModelEvent.

You could invoke getEvents() to get the embedded child events inside the event. The order of those child events inside the CompoundTableModelEvent matters. The listener is expected to handle the embedded event one by one.

For example, if a CompoundTableModelEvent contains two events, the first one is row insertion at 2 while the other one is row deletion at 5, you need insert first then delete. Otherwise, you may get a wrong result.

Sortable/Filterable List and Tree

We just talked about *SortableTableModel* and *FilterableTableModel*. In you still remember, both models are actually table model wrappers. The same technique can be applied to *ListModel* and *TreeModel* as well.

Corresponding to T*ableModelWrapper*, there are *ListModelWrapper* and *TreeModelWrapper*. Each of them has corresponding sortable and filterable implementations. See below.

SortableListModel and SortableTreeModel

Different from SortableTable, there is no SortableList or SortableTree. The reason is SortableTable doesn't really do the sorting. It's the SortableTableModel who does the sorting. SortableTable just provides a special table header which can accept mouse clicks. It still delegates to SortableTableModel to sort the data. In the case of JList and JTree, there is no header. In fact, there is no uniform way on the UI to make JList or JTree sortable. So there is no need for SortableList and SortableTree. To make JList sortable,

```
SortableListModel sortableListModel = new SortableListModel(listModel);
JList sortableList = new JList(sortableListModel);
```

To sort the list, you just call

```
sortableListModel.sort(); // or sort(SortableListModel.SORT_DESCENDING) to sort descending.
```

Usually you can hook up this action with a button somewhere near the JList or on a local toolbar.

It's exactly the same way to make JTree sortable.

FilterableListModel and FilterableTreeModel

FilterableListModel is a list model wrapper which wraps another list model so that user can apply filters on it. You can use *addFilter(Filter)* to a filter to the ListModel. By default, filters won't take effect immediately. You need to call setFiltersApplied(true) to apply those filters. If filtersApplied flag is true already, you just need to call refresh(). We don't refresh automatically because you might have several filters to add. You can add all of them, then only call refresh once.

setFiltersApplied(boolean) controls all the filters. Each filter has its own enabled flag which will control each individual filter.

By default, if you have more than one filters, all filters will be used in AND mode. You can see javadoc of *setAndMode(boolean)* to find more information.

Again, *FilterableTreeModel* works exactly the same way.

More Filters and CustomFilterEditor

From Filter interface, we created many built-in filters.

Filter	Description
EqualFilter	Equal
NotEqualFilter	Not equal
GreaterThanFilter	Greater than
LessThanFilter	Less than
GreaterOrEqualFilter	Greater than or equal
LessOrEqualFilter	Less than or equal
BetweenFilter	Between an inclusive range
NotBetweenFilter	Not between an inclusive range
LikeFilter	Search for a pattern. % is the wildcard for any chars and _ is the wildcard for one char, similar to SQL LIKE statement
NotLikeFilter	Search for opposite of a pattern
WildcardFilter	Search for a pattern based using wildcards
RegexFilter	Search for a pattern based on regular expression
InFilter	If you know the exact value you want to return for at least one of the columns
NotInFilter	If you know the exact values you want to exclude
DateOrCalendarFilter	An abstract Filter for Date or Calendar filters
TodayFilter	Filter all other dates except today's date
YesterdayFilter	Filter all other dates except yesterday's date
TomorrowFilter	Filter all other dates except tomorrow's date
ThisWeekFilter	Filter all other dates except it is this week
LastWeekFilter	Filter all other dates except it is in the last week
NextWeekFilter	Filter all other dates except it is in the next week
ThisMonthFilter	Filter all other dates except it is this month
LastMonthFilter	Filter all other dates except it is in the last month
NextMonthFilter	Filter all other dates except it is in the next month
ThisQuarterFilter	Filter all other dates except it is in this quarter
LastQuarterFilter	Filter all other dates except it is in the last quarter
NextQuarterFilter	Filter all other dates except it is in the next quarter
ThisYearFilter	Filter all other dates except it is in this year
LastYearFilter	Filter all other dates except it is in the last year
NextYearFilter	Filter all other dates except it is in the next year
MonthFilter	Filter all other dates except the specified month of any year
QuarterFilter	Filter all other dates except the specified quarter of any year
YearFilter	Filter all other dates except the specified year

As a developer, you can always create those filters using code and add them to *FilterableTableModel*, *FilterableListModel* or *FilterableTreeModel* and use them. To make it easy to be used by end users, we create an editor to create filters.

FilterFactoryManager

Different data type support different filters. In order to support this feature, we created *FilterFactoryManager* to make it possible. The main method on this class is:

```
public void registerFilterFactory(Class type, FilterFactory filter)
```

FilterFactory defines three methods.

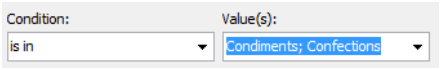
```
public interface FilterFactory {
   Filter createFilter(Object... objects);
   String getConditionString(Locale locale);
   String getName();
   Class[] getExpectedDataTypes();
}
```

The first *createFilter* method is to create the filter. The other two methods are there so that the filter can be created interactively from a user interface. The user interface is *CustomFilterEditor*.

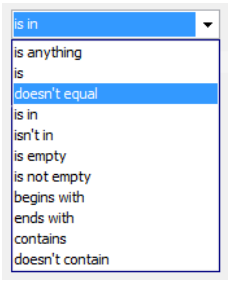
We registered four categories of *FilterFactory* to *FilterFactoryManager*. They are for number, string, date/calendar and boolean.

CustomFilterEditor

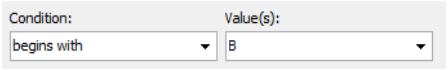
CustomFilterEditor provides an interface to create a filter based on the data type.



For the string data type, we defined the following filters.

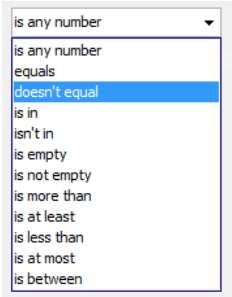


User can select one from the drop down list above and then input the value for the filter. For example, the selection below will create *WildcardFilter* same as the code below.

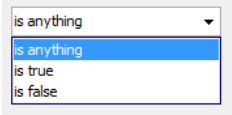


```
WildcardFilter filter = new WildcardFilter();
filter.setBeginWith(true);
filter.setEndWith(false);
return filter;
```

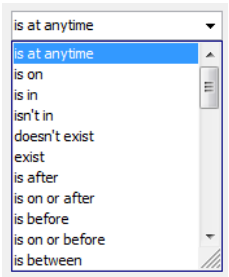
For numbers (any objects extends Number and the primitives), we predefined the following filters.



For booleans, we defined the following filters.



For Date or Calendar, we defined the following filters.



Those four data types should be good enough to cover most use cases. If you have other data type that you want to add, you just need to register them to *FilterFactoryManager*. For example, here is the code to register the "begin with" filter on String.

```
FilterFactoryManager.registerFilterFactory(String.class, new FilterFactory() {
   public Filter createFilter(Object... objects) {
      WildcardFilter beginWith = new WildcardFilter((String) objects[0]);
      beginWith.setBeginWith(true);
      beginWith.setEndWith(false);
      return beginWith;
   }
```

```
    public Class[] getExpectedDataTypes() {
      return new Class[]{String.class};
    }

    public String getConditionString(Locale locale) {
      return AbstractFilter.getConditionString(locale, “string”, "beginWith");
    }
  });
```

The *getExpectedDataTypes()* return an array of data types that this filter needs in order to define the filter. Please note, in the current release, the *CustomFilterEditor* only supports two values. This method returns an array of one class, or two classes. Or it can return a class array if the Filter expects an array of Objects of the same type, such as

```
return new Class[]{String[].class};
```

The *getConditionString(Locale)* returns the string that will appear in the drop down list. Since it is a localized string, we use a helper method in *AbstractFilter* to get it. We defined an entry like this in filter.properties. The “beginWith” example above will return this entry.

```
FilterCondition.beginWith.string=begins with
```

You can follow this pattern to define your own properties if you register your own *FilterFactory*.

CustomFilterEditor also has *setFilter* and *getFilter* methods. The *getFilter* method will return a filter created from the *FilterFactory* that user selects. The *setFilter* method will change the *CustomFilterEditor* to select the *FilterFactory* that creates the *Filter*. Please note, only Filter created from *CustomFilterEditor* can be set. Other filters won’t work.

TableCustomFilterEditor

TableCustomFilterEditor is one level above *CustomFilterEditor*. There are two styles. You can see both below.

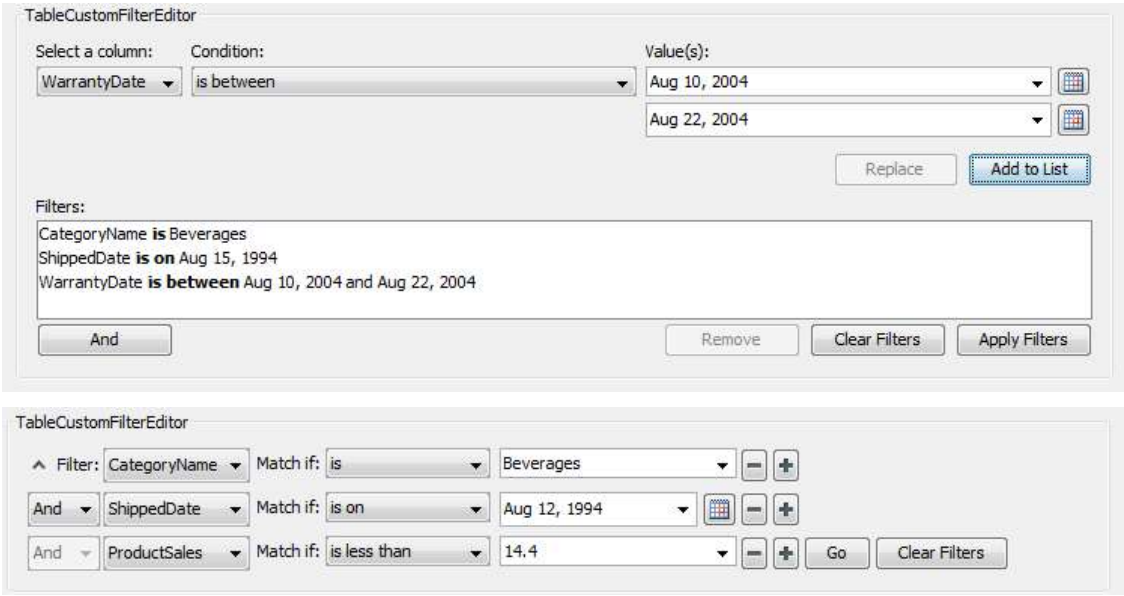


Figure 13 TableCustomFilterEditor (two different styles)

As you can see from the screenshots above, *CustomFilterEditor* is used as a part of the user interface. *CustomFilterEditor* creates one *Filter*. *TableCustomFilterEditor* adds additional controls to create a list of *FilterItem*s and they can be added to *FilterableTableModel*. To get the list of *FilterItem*s, you can call *getFilterItems()* method.

Property Pane

In an Object Oriented Design, every object is composed of a combination of data and function. In Java, we sometimes refer to this data as the 'properties' of the object. If you follow the JavaBean pattern then all properties are exposed via getter and setter methods. If an application needs to deal with an object's properties then this can be done by displaying the name of each property, along with its value. This is the purpose of the *PropertyPane*, which displays this information in table form.

Below are two examples of Property Panes, from NetBeans and JBuilder respectively. Both graphs show the properties of a JButton. As you can see, the JButton has many properties, such as its background color, foreground color, font, icon, text etc. As you can see, it's quite intuitive to display them in a table like this with the property name on the left side and the corresponding value on the right side.

name	jTextPane1
constraints	Center
actionMap	
alignmentX	0.5
alignmentY	0.5
background	White
border	custom
caretColor	Black
caretPosition	10
contentType	text/plain
debugGraphicsOptions	<default>
disabledTextColor	153, 153, 153
document	
doubleBuffered	False
editable	True
editorKit	
enabled	True
focusAccelerator	
font	"Dialog", 0, 12
foreground	Black
inputVerifier	
logicalStyle	
margin	3, 3, 3, 3
maximumSize	2147483647, 2147483647
minimumSize	6, 22
nextFocusableComponent	

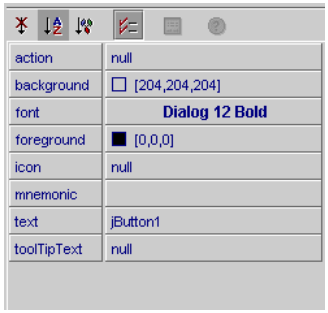


Figure 14 NetBeans PropertyPane (Above)

Figure 15 JBuilder 9 PropertyPane (Right)

What does a PropertyPane look like?

The picture below shows an example of a property pane, using our *PropertyPane* class. The *PropertyPane* consists of three main parts. The top portion is a toolbar that has buttons which provide convenient access to some features of the *PropertyPane*. The middle portion is the *PropertyTable*, which displays the name of each property, along with its value. The bottom portion is the description area, which can be used to provide a more detailed description of each property.

Since the name of each property is usually very concise, the description area can very helpful (especially for new users). However, the description area can be hidden when the user becomes familiar with the properties

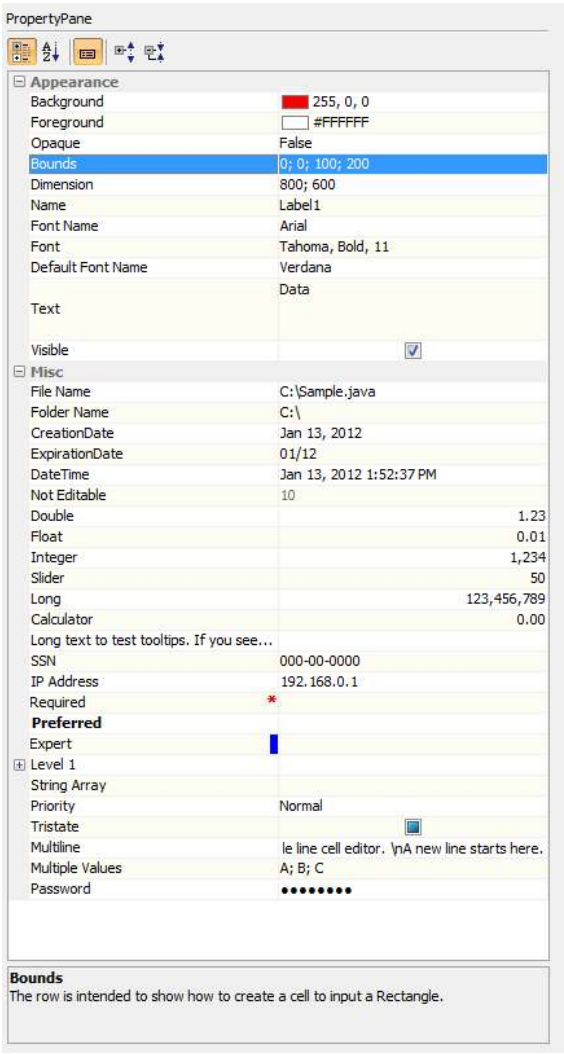


Figure 16 JIDE PropertyPane

The *PropertyTable* is a two-column table, the first column of which is the name of the property and the second column is the value of the property. If you wish, you can group sets of properties into *categories*, where each category appears as gray bold text, as shown in the example above. You can collapse categories, which you are not interested in, so that only properties you are interested in will be shown. You can also have different levels of properties, as shown in the last row in the example above.

If you have a large number of properties, which makes it hard to find a specific entry, then you can click on the alphabetic button in the *PropertyPane* toolbar, so that the properties will be listed in alphabetic order.

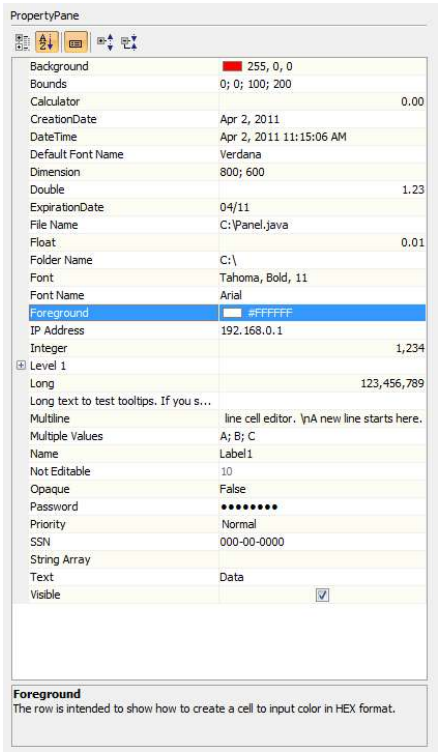


Figure 17 PropertyPane (Alphabetic Order)

As a user, how do I use it?

When you click the mouse on the name column, the row will be selected and the value column will go into editing mode automatically. The type of editor that is displayed may vary depending on the type of the data that is being edited. There are basically three types of editors.

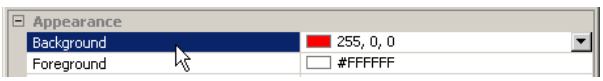
TextField editor – For very simple types such as name, number etc.

Dropdown Popup – Rather than letting the user type free-format text, this uses a popup to help the user select the required value. Usually the popup only needs a single selecting action. Examples include the Color and Date input editor.

Dialog Popup – If the popup needs multiple selection actions then you should consider using a Dialog Popup rather than a Dropdown Popup. In addition, you should use the Dialog Popup if there is an existing dialog that you can leverage. Examples include Font, File and Multiple Line Description.

TextField editor is very simple and so will not be discussed any further.

Below is an example of a Dropdown Popup, for selecting a color, using a combo-box-like editor. If you click on the drop down button then the popup will be displayed.



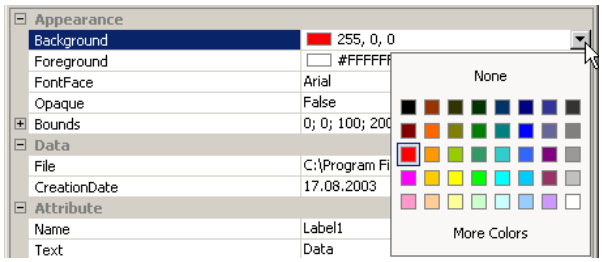
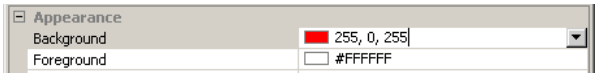
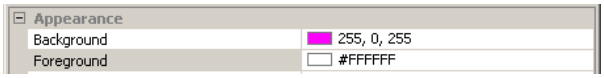


Figure 18 Dropdown Cell Editor

You can also choose a value without going through the popup. Just type in the value you want in the text field…



…and then press enter. You can see the value is set as you entered it. You should see that the converter module has been used here to convert the string "255, 0, 255" into a Color value.



Below is an example of a Dialog Popup. Instead of the down arrow button that is used in a Dropdown popup, a "…" button is displayed. Clicking on this will cause dialog to appear to help you select a value.

The example below is a file chooser - clicking on the "…" will cause a FileChooser dialog to pop up.

Figure 19 Dialog Cell Editor

As a developer, how do I use it?

If you are following the standard object bean pattern then it is quite easy to use the *PropertyTable* control. However, in the real world, not all objects are compliant with the standard bean pattern. Furthermore, in many cases we find that we are dealing with a property which does not exist as an attribute of any single object, but which is instead calculated 'on the fly', based on the values of a number of attributes. Based on our experience of dealing with this sort of situation, we created a class called *Property* - not surprisingly, it is an abstract class.

Property defines the following methods as abstract, so you need to write your own Property class that extends *Property* and implement these three methods:

```
public abstract void setValue(Object value);
public abstract Object getValue();
public abstract boolean hasValue();
```

Things become much easier once you have created a concrete descendant of the *Property* class. Then, all you need to do is to create a list of your *Property* objects, as an *ArrayList* and use this *ArrayList* to create a *PropertyTableModel*.

```
ArrayList list = new ArrayList();
Property property = new ….. // create property
list.add(property);

// add more properties

PropertyTableModel model = new PropertyTableModel(list);
PropertyTable table = new PropertyTable(model);
```

BeanProperty and BeanIntrospector

The *Property* class provides an abstract implementation. If you want to use *PropertyTable* to display JavaBean properties, it will be too tedious to create a list of properties manually. To address this requirement, we introduced a concrete class called *BeanProperty*. *BeanProperty* implements *Property* on top of *PropertyDescriptor* which is part of JDK JavaBean implementation.

We introduced another class call *BeanIntrospector* to help you introspect JavaBean. *BeanIntrospector*, will create a list of *properties* which can be used by *PropertyTableModel*.

There are four different ways to create a *BeanIntrospector*.

1. Given an object, if it's fully JavaBean compatible and there is corresponding *BeanInfo* class, you can use *BeanIntrospector(Class clazz, BeanInfo beanInfo)* to create a *BeanIntrospector*.
2. If you know exactly the list of property names of the object but you don't want to create a BeanInfo, you can use *BeanIntrospector(Class clazz, String[] properties)* and give introspector the information of the properties. The array of *properties* is in the format of

```
new String[] {
        "propertyName1", "propertyDescription1", "propertyCategory1",
        "propertyName2", "propertyDescription2", "propertyCategory2",
        ...
};
```

   So if you have *n* properties, the array length should be have *3*n*. This array will tell *BeanIntrospector* what the properties are as well as the description and category which are both part of *Property*.
3. In this case, you know exactly the list of property names, just like in case 2. However you don't want to hard code the property name into source code. We provide a way to load the property definition from XML file. The XML file looks like this.

```
<Properties>
  <Property name="..." displayName="..." description="..." category="..."/>
  <Property name="..." displayName="..." description="..." category="..."/>
   ...
</Properties>
```

Possible attributes for Property element in the XML are "name", "displayName", "value", "type", "description", "dependingProperties", "category", "converterContext", "editorContext", "editable", and "autoIntrospect".

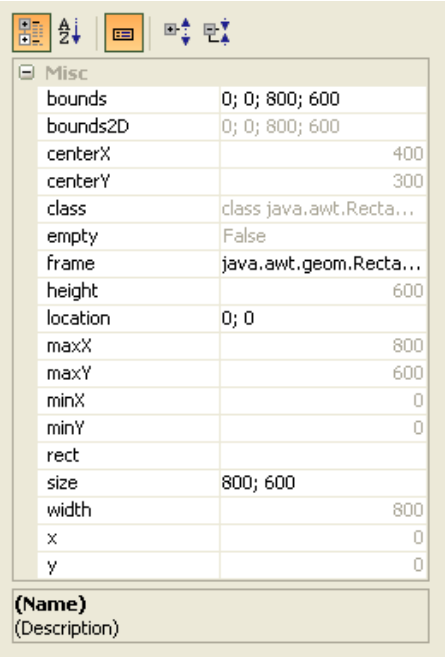
The XML file could be at any place where the code can access. However we suggest you put it at the same package of the object class definition and copy it as resource file to class output directory so that you can use class loader to load it. There are two constructors for this case, *BeanIntrospector(Class clazz, String fileName)* and *BeanIntrospector(Class clazz, InputStream in)*. The first one used to load property XML as a file. The second one is to load it using class loader.

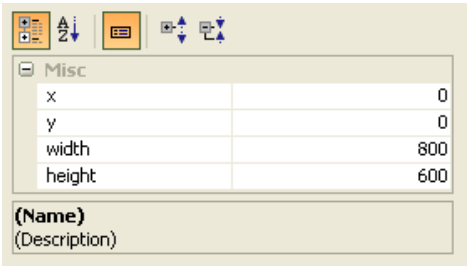
4. The last case is you want to completely depend on Java reflection to find all properties. You can use constructor *BeanIntrospector(Class clazz)* in this case. If using this way, it will find a lot more properties than you need. Typically you don't want to use this way. However it is not a bad idea to use this in development phase to get the complete list of properties, and then go through each one and determine which ones you want. In production phase, you should use the first three ways and only show the properties you want.

   For example, if you use reflection to introspect Rectangle.class, you will get 18 properties. Most of them are useless. See the first picture below. In fact, you just need to have a string array as below.

```
public static final String[] RECTANGLE_PROPERTIES = new String[]{
  "x", "x", "",
  "y", "y", "",
  "width", "width", "",
  "height", "height", ""
};
```

And use the second way to create the introspector, and you got the property table like in the second picture.





After you create the *BeanIntrospector*, you can further customize it by calling *getProperty(String name)* to get the *BeanProperty* and then call *setConverterContext()* and *setEditorContext()* etc.

BeanIntropector has a method called *createPropertyTableModel(Object object)*. It will create a *PropertyTableModel* that can be used by *PropertyTable*.

Now let's go through a real example to create and configure *BeanIntrospector* to inspect the properties of *DockableFrame*.

First, let's use constructor *BeanIntrospector(DockableFrame.class)* to create an introspector first, then call *createPropertyTableModel* and set the model on *PropertyTable*. Here is what you will see.

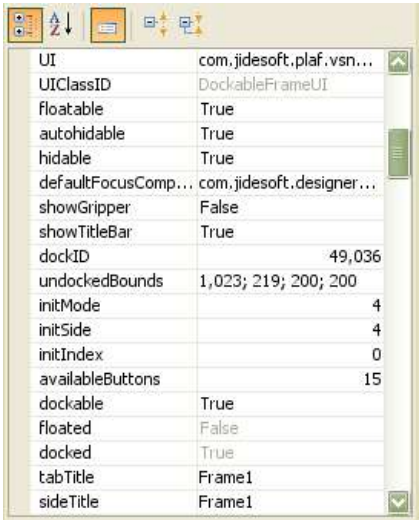


Figure 20 BeanInstrospector on DockableFrame.class

There are more than 140 properties when we tried the first time. It's too many if we show all of them so we just take part of them as an example and show it above. After looking through each of them, we come up with a list of properties we want to expose. Then we create a String array of the properties we want and use constructor *BeanIntrospector(Class clazz, String[] properties)* to create an introspector. See below. As you can see, there are only 22 properties. And they are properly categorized.

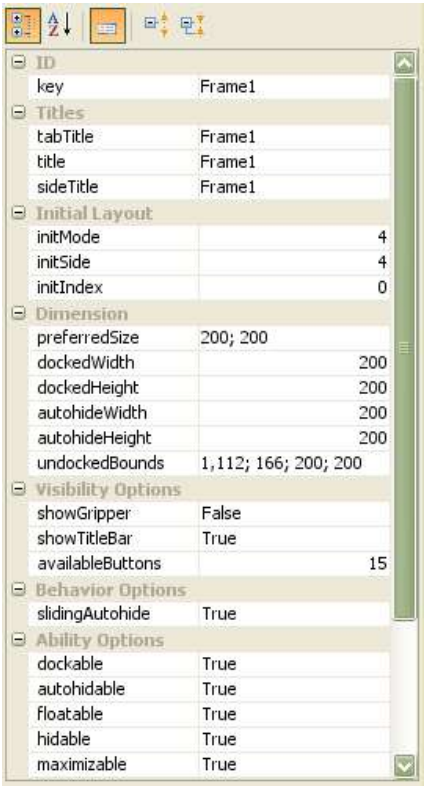


Figure 21 BeanInstrospector on DockableFrame.class with proper categories

It's much better but there are still a few issues. For example, *initMode* property is shown as a regular integer cell. Yes, the type of the property is indeed int.class but the valid values are defined in *DockContext* such as hidden, floating, docked or autohidden etc. It will be very unusable if let you remember the mapping. It's very easy to solve. All you need is to create an *EnumConverter* that maps correctly from int value to a string value as well as corresponding *EnumCellRenderer/Editor*.

```
EnumConverter dockModeConverter = new EnumConverter("DockMode-
DockableFrame", int.class,
            new Object[]{
              new Integer(DockContext.STATE_HIDDEN),
              new Integer(DockContext.STATE_FLOATING),
              new Integer(DockContext.STATE_AUTOHIDE),
              new Integer(DockContext.STATE_AUTOHIDE_SHOWING),
              new Integer(DockContext.STATE_FRAMEDOCKED)
            },
            new String[]{
              "Hidden",
              "Floating",
```

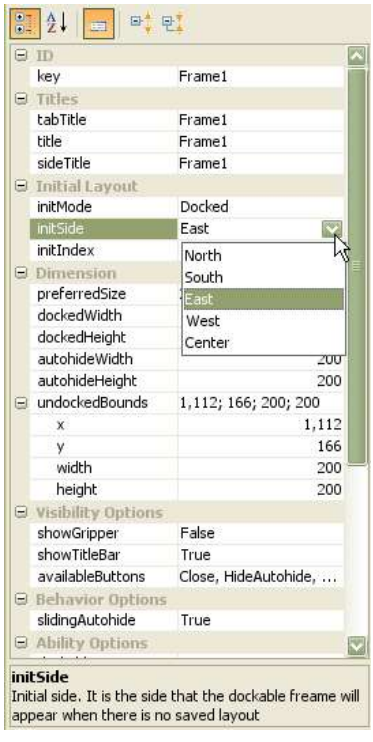
```
                "Autohidden",
                "Autohidden (showing)",
                "Docked"},
            new Integer(DockContext.STATE_HIDDEN));
    ObjectConverterManager.registerConverter(dockModeConverter.getType(),
dockModeConverter, dockModeConverter.getContext());
    EnumCellRenderer dockModeRenderer = new EnumCellRenderer(dockModeConverter);
    EnumCellEditor dockModeEditor = new EnumCellEditor(dockModeConverter);
    CellRendererManager.registerRenderer(dockModeConverter.getType(),
dockModeRenderer, dockModeRenderer.getContext());
    CellEditorManager.registerEditor(dockModeConverter.getType(), dockModeEditor,
dockModeEditor.getContext());


DOCKABLE_FRAME_INTROSPECTOR.getProperty("InitMode").setConverterContext(dockM
odeConverter.getContext());
    DOCKABLE_FRAME_INTROSPECTOR.getProperty("InitMode").setEditorContext(dockMo
deEditor.getContext());
```

The same thing applies *initSide* property.

The next thing we noticed is the *undockedBounds* property. The type is *Rectangle.class*. Since we have *RectangleConverter*, the rectangle value is converted to a semi-colon delimited string. The values are in the order of x, y, width and height. If user types in that format, it will be converted to rectangle. However it's not user-friendly. A better approach is to make *undockedBounds* expandable so that the value of x, y, width, height can be modified in child properties. To make it happen, you need to call the following.

```
    DOCKABLE_FRAME_INTROSPECTOR.getProperty(DockableFra
me.PROPERTY_UNDOCKED_BOUNDS).setAutoIntrospect(true);
```

After a few customizations, we got the screen shot on your right. As you can see, *initMode* and *initSide* properties are now combobox. User can choose the meaningful value directly from the list. The *undockedBounds* property has child properties so that user can change the x, y, width or height directly.



We provide many built-in cell editors in JIDE Grids product as you will see in the following sections. However there is no way we can cover all your need. When you have a custom data type, you may need to write your own cell editor/cell

renderer/converter in order to allow user editing that certain type in *PropertyTable*.

Color Related Components

ColorChooserPanel

ColorChooserPanel is a panel that has many color buttons that the user can click on to select the required color. This class supports the *ItemListener.* An *itemStateChanged* event will be fired whenever a color is selected.

We support several color sets, including the 15 basic RGB colors, 40 basic colors and 215 web colors.

Figure 22 ColorChooserPanel (15 colors)

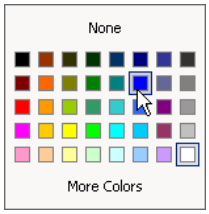


Figure 23 ColorChooserPanel (40 colors)

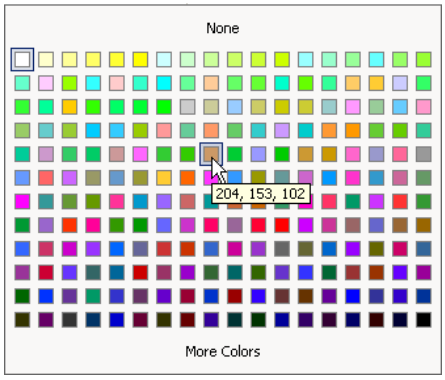


Figure 24 ColorChooserPanel (215 web-safe colors)

In additional to color choosers, we also support gray scale - from 16 gray scales, 102 gray scales and 256 gray scales.

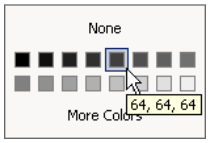


Figure 25 ColorChooserPanel (16 gray scale)

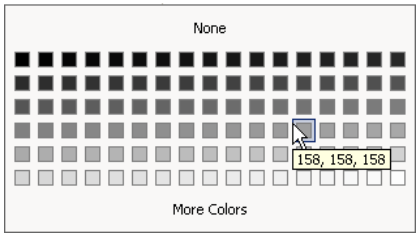


Figure 26 ColorChooserPanel (102 gray scales)

Color(Ex)ComboBox

Unsurprisingly, the *Color(Ex)ComboBox* is a combo box that can choose colors. It uses *ColorChooserPanel* as dropdown popup, as shown below:

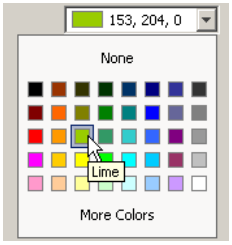


Figure 27 ColorComboBox

Keyboard Support

Color(Ex)ComboBox and ColorChooserPanel supports keyboard-only environment.

When Popup is hidden	
ALT + DOWN	To Bring up the popup
When Popup is visible	
ESC	Hide the popup without changing the selection
LEFT	Previous color to the same row. If at the beginning of a row, go to last color of previous row

RIGHT	Next color to the same row. If at the end of a row, go to first color of next row.
UP	Color at the same column of the previous row
DOWN	Color at the same column of the next row
HOME	First color
END	Last color
ENTER	Select the highlighted color and hide popup

Date Related Component

DateChooserPanel

Similarly to the *ColorChooserPanel*, the *DateChooserPanel* is also a popup panel, which allows the user to choose a Date value (again, providing *ItemListener* events, as appropriate).

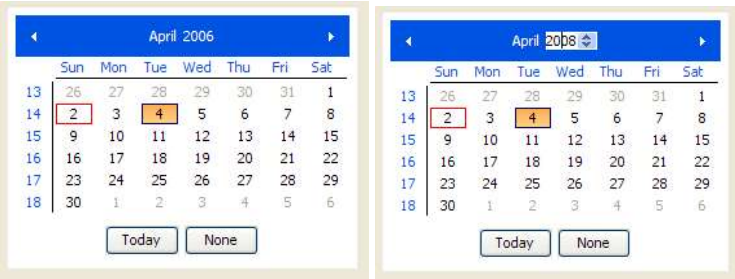


Figure 28 DateChooserPanel / Choosing Year

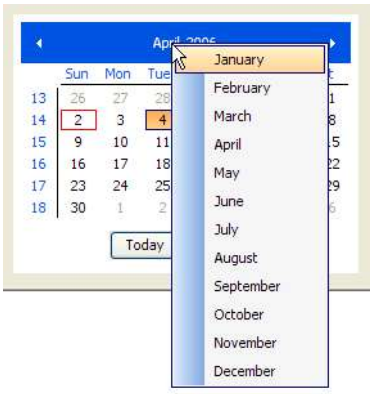


Figure 29 DateChooserPanel (Choosing Month)

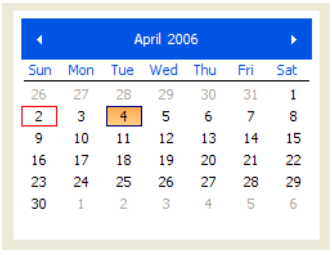


Figure 30 DateChooserPanel
(hide week of year panel, "Today" and "None" button which are all optional)

```
DateChooserPanel dateChooserPanel = new DateChooserPanel();
dateChooserPanel.setShowWeekNumbers(true/false);
dateChooserPanel.setShowTodayButton (true/false);
dateChooserPanel.setShowNoneButton(true/false);
```

Figure 31 DateChooserPanel (all dates after Aug 13, 2003 are disabled)

```
// create a DateModel first
DefaultDateModel model = new DefaultDateModel();

// setMaxDate of DateModel to Aug 13, 2003
Calendar calendar = Calendar.getInstance();
calendar.set(Calendar.YEAR, 2003);
calendar.set(Calendar.MONTH, Calendar.AUGUST);
calendar.set(Calendar.DAY_OF_MONTH, 13);
model.setMaxDate(calendar);

// create DateChooserPanel with that model.
DateChooserPanel dateChooserPanel = new DateChooserPanel(model);
```

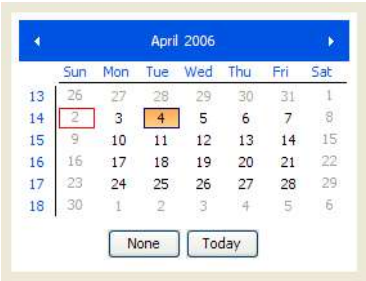


Figure 32 DateChooserPanel (any weekends are disabled)

```
// create a DateModel first
DefaultDateModel model = new DefaultDateModel();

// add DateFilter to allow WEEKDAY_ONLY
```

```
model.addDateFilter(DefaultDateModel.WEEKDAY_ONLY);

// create DateChooserPanel with that model.
DateChooserPanel dateChooserPanel = new DateChooserPanel(model);
```

Figure 33 DateChooserPanel (Localized Version de)

DateChooserPanel supports multiple selections. There are three selection modes. The first is *SINGLE_SELECTION*, meaning only one date can be selected at one time. This is the default mode. Since JIDE v1.9.1 release, we introduced two new selection modes - *SINGLE_INTERVAL* and *MULTIPLE_INTERVAL*. *SINGLE_INTERVAL* is perfect to choose a data range. See a screenshot below.

Figure 34 SINGLE_INTERVAL Selection Mode

MULTIPLE_INTERVAL mode allows user to choose multiple data ranges. See a screenshot below. You can use this mode to display things like all holidays within current year, an employee's vacation days etc.

Figure 35 MULTIPLE_INTERVAL Selection Mode

User can use keyboard or mouse with the help of CTRL (or Command key on Mac OS X) and SHITF key to do multiple selections. The way to use it is the same as using multiple selections in JList.

When *DateChooserPanel* is in single selection mode, you can use *setSelectedDate()* and *getSelectedDate()* to set and get the selection. However in multiple selection mode (including both single interval or multiple interval), you need *getSelectionModel()* to get the *DateSelectionModel* first, then call *getSelectedDates()* or *setSelectedDates(Date[] dates)* or other methods to get or change the selections.

There is also a view-only mode *DateChooserPanel*, as shown here. In view-only mode, although *setDisplayedMonth()* can be used to select which month you want to display. There is no next month or previous month button so the user will not be able to change it. User cannot select any date either.

Figure 36 View-only Mode

You can also customize the date label, day of week label, and the month and year labels to show some special effect. To do so, simply create a class extending *DateChooserPanel*, overriding the appropriate methods to get the visual effect that you want.

To the right is a simple example that makes each cell bigger, grays the weekends, and shows an example icon on the “Today” date.

Figure 37 Customized Label in View-only Mode

The methods you can override are: *createDateLabel*, *updateDateLabel*, *createDayOfWeekLabel*, *updateDayOfWeekLabel*, *createMonthLabel*, *updateMonthLabel*, *createYearLabel* and *updateYearLabel*. The default create methods will simply create a standard *JideButton*. Your implementations can override this behavior to create whatever *JComponent* you want. The update methods will update the actual value of the labels. Since the date is passed in as parameter to all update methods, so you can check the date and do whatever you

want to the labels. For example you could look up in a database and find out if there are any historic events on that date and add a special icon if so (perhaps adding a *MouseListener* to trigger some other behavior).

Date(Ex)ComboBox

A *Date(Ex)ComboBox* is a combo box that can choose a date, using a *DateChooserPanel* as a dropdown popup.

Figure 38 DateComboBox

Keyboard Support

Date(Ex)ComboBox and *DateChooserPanel* supports a keyboard-only environment.

When Popup is hidden	
ALT + DOWN	To Bring up the popup
When Popup is visible	
ESC	Hide the popup without changing the selection
LEFT	Previous day of the selected day
RIGHT	Next day of the selected day
UP	Same day of the last week
DOWN	Same day of the next week
HOME	First day of this month
END	Last day of this month
PAGE_UP	Same day of the last month

PAGE_DOWN	Same day of the next month
CTRL + PAGE_UP	Same day of the last year
CTRL+ PAGE_DOWN	Same day of the next year
ENTER	Select the highlighted date and hide popup

CalendarViewer

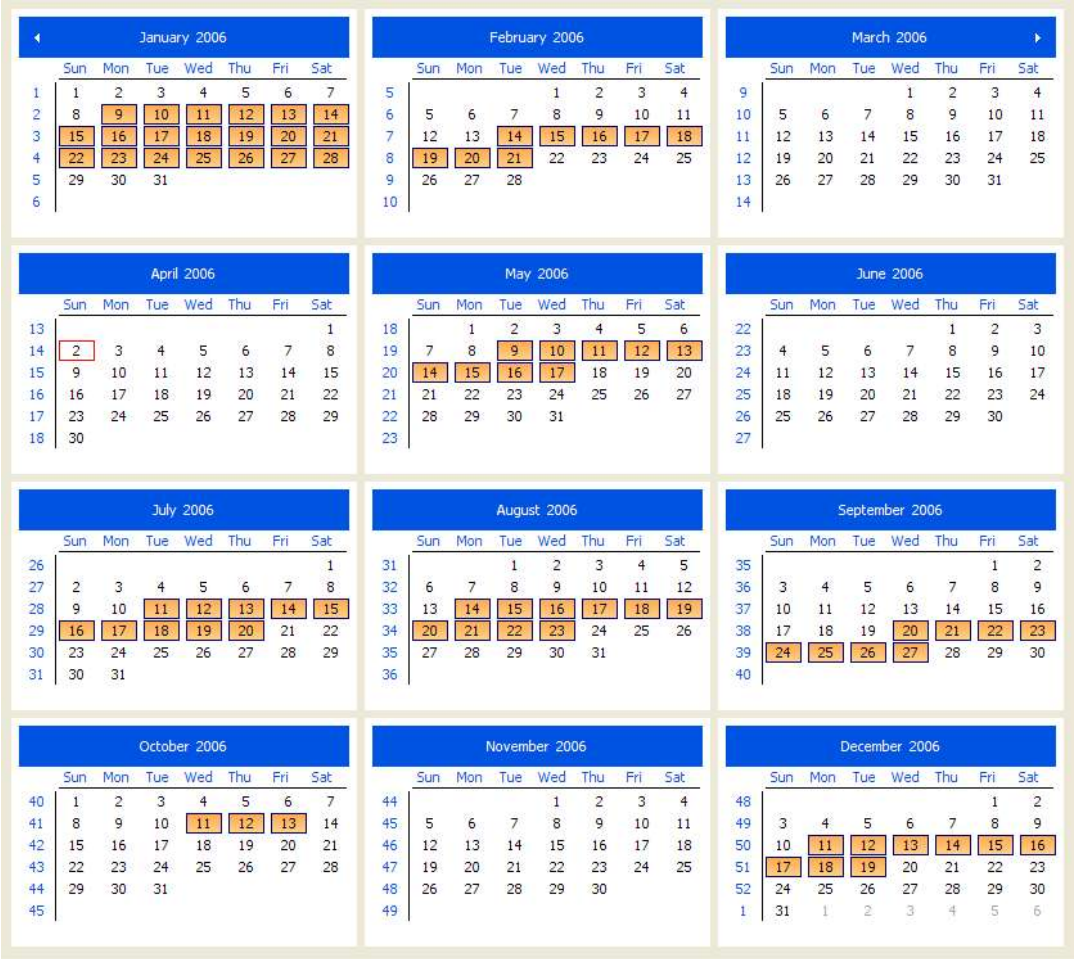


Figure 39 CalendarViewer of 12 month view with multiple selection

CalendarViewer uses several *DateChooserPanel*s to create a Calendar view. You can choose how many months you want to view. It also supports multiple selections just like *DateChooserPanel*. *CalendarViewer* uses *DateSelectionModel* to keep track of selection, which is same as *DateChooserPanel*.

Figure 40 CalendarViewer with three month view

ComboBox Extension

JComboBox is a very useful component. However, it is very limited as you can only use it to choose a value from a JList. People always wants a more customizable dropdown. To solve this limitation, we tried two different approaches. Due the limitation of Swing itself, each approach has its own pros and cons. The table below shows a comparison overview.

	AbstractComboBox	ExComboBox
Visual Appearance	Similar to JComboBox but not always the same.	Always the same as JComboBox
Built-in support for L&Fs	Most L&Fs even some 3rd parties L&Fs but doesn't look identical to the JComboBox on those L&Fs; not look good on Aqua L&F	Out-of-box support for Windows, Metal, Aqua, Synthetica etc. L&F perfectly. For other 3rd party L&F, UI class needs to be implemented. Once implemented, it will support perfectly
Extensible	Yes	Yes but not as great as AbstractComboBox
Compatibility	Incompatible with JComboBox although most methods on JComboBox are also available on it	Extend JComboBox so it is fully compatible with JComboBox

AbstractComboBox basically creates a brand new component and tried to mimic what *JComboBox* does. It doesn't extend *JComboBox*. Since it is a new component, we literally can do whatever we want to it. For example, you can choose your own button for the combobox's drop down button. You can have your own editor for the editor part of the combobox. However, it is very difficult to keep the same look and behavior as *JComboBox*. We managed to do it for Windows L&F and some other L&Fs but for Aqua L&F, it is almost impossible to make it look identical to Aqua's *JComboBox*.

ExComboBox took a different approach. It extends *JComboBox* and provides several UI classes extend *BasicComboBoxUI*, *WindowsComboBoxUI*, *AquaComboBoxUI* respectively to provide the additional features we want. Since the same UI is used, we get the same look and behavior as *JComboBox*. The main downside is you have to subclass the corresponding *ComboBoxUI* for that L&F in order to support the new L&F. It is also not easy to customize the editor area as *AbstractComboBox* can.

A ComboBox has three parts – a text field editor, a button, and popup that appears when the button is pressed. The *AbstractComboBox* will allow you to customize all three parts.

ExComboBox only allows you to customize the button and the popup. Since in most cases, the popup is the main part that needs customization, both approaches will work.

Both *AbstractComboBox* and *ExComboBox* have these two methods that you can implement or override when extending.

```
    /**
     * Subclass should implement this method to create the actual popup component.
     * @return the popup component
     */
    abstract public PopupPanel createPopupComponent();

    /**
     * Subclass should override this method to create the actual button component.
     * If subclass doesn't implement or it returns null, a default button will be created. If
type is DROPDOWN,
     * down arrow button will be used. If type is DIALOG, "..." button will be used.
     * @return the button component
     */
    public AbstractButton createButtonComponent() {
        return null;
    }
```

AbstractComboBox has an addition method.

```
  /**
     * Subclass should implement this method to create the actual editor component.
     * @return the editor component
     */
    public abstract EditorComponent createEditorComponent();
```

The ComboBox's dropdown popup is handled by *PopupPanel*. All dropdown popup must extend *PopupPanel*. For *JComboBox*, we create *List(Ex)ComboBox* which uses *ListChooserPanel* (extending *PopupPanel*) as the popup. Likewise, in the case of *Color(Ex)ComboBox*, it's a *ColorChooserPanel*. Usually people use popup to select things, so the *PopupPanel* contains common methods for all pop ups, such as knowing how to select an item and how to fire an item event when the selection changes. Please note that although *PopupPanel* is usually used as a DropDown popup, it can also be used in a dialog (a *FileChooserPanel* for example). In the other word, when clicking on the dropdown button on a combobox, a dialog pops up. Note also that you do have the choice of using DROPDOWN and DIALOG when using *AbstractComboBox* or *ExComboBox*.

The Button part of ComboBox is used to trigger the popup. By default, if it is a drop down popup then we use a button with a down arrow. Conversely, if it is a dialog popup then we use a button with "…" as the text of the button, or if you want, you can use "open" as the text. However in the default cases, we don't change the button because it doesn't look very consistent on some L&Fs if changing the text or the look.

For *AbstractComboBox*, the *EditorComponent* is the text field editor (actually a *JPanel*). If you replace this with a *JTextField* then it becomes normal *JComboBox*. Although you can create your own *EditorComponent* you must make sure that it extends an *EditorComponent* and that it implements *getValue* and *setValue* (so that *AbstractComboBox* knows how to set and get values).

Below shows an example code of a custom ComboBox – StringArrayComboBox.

```
public class StringArrayComboBox extends AbstractComboBox {
    public StringArrayComboBox() {
        super(DIALOG);
        setType(String[].class);
        initComponent(); // it is very important to call this method in your constructor
    }

    @Override
    public EditorComponent createEditorComponent() {
        if (isEditable()) {
            return new DefaultTextFieldEditorComponent(getType());
        }
        else {
            return new DefaultRendererComponent(getType());
        }
    }

    @Override
    public PopupPanel createPopupComponent() {
        return new
StringArrayPopupPanel(Resource.getResourceBundle(Locale.getDefault()).getString("Com
boBox.stringArrayTitle"));
    }
```

If you want to an ExComboBox, it is even simpler.

```
public class StringArrayExComboBox extends ExComboBox {
```

```
    public StringArrayExComboBox() {
        super(DIALOG);
        setType(String[].class);
    }

    @Override
    public PopupPanel createPopupComponent() {
        return new
StringArrayPopupPanel(Resource.getResourceBundle(Locale.getDefault()).getString("Com
boBox.stringArrayTitle"));
    }
```

The main difference is you don't need to *createEditorComponent* in *ExComboBox* because, as it mentioned before, *ExComboBox* doesn't allow you to change editor component.

Both classes use the same *StringArrayPopupPanel*. This is the main place you need to create a panel that knows how to edit a String array. In our case, we used a simple JTextArea to do it. See below.

```
/**
 * A popup panel for String array.
 */
public class StringArrayPopupPanel extends PopupPanel {
    JTextArea _textArea = new JTextArea();

    public StringArrayPopupPanel() {
        this("");
    }

    public StringArrayPopupPanel(String title) {
        JScrollPane scrollPane = new JScrollPane(_textArea);
        scrollPane.setVerticalScrollBarPolicy(JScrollPane.VERTICAL_SCROLLBAR_ALWAYS);
        scrollPane.setAutoscrolls(true);
        scrollPane.setPreferredSize(new Dimension(300, 200));
        setBorder(BorderFactory.createEmptyBorder(10, 5, 5, 5));
        setLayout(new BorderLayout());
        add(scrollPane, BorderLayout.CENTER);
        setTitle(title);
        setDefaultFocusComponent(_textArea);
```

```
    }

    @Override
    public Object getSelectedObject() {
      String text = _textArea.getText();
      return text.split("\n");
    }

    @Override
    public void setSelectedObject(Object selected) {
      if (selected != null && selected.getClass().isArray()) {
        if (((Object[]) selected).length == 0) {
          _textArea.setText("");
          return;
        }
        String[] list = (String[]) selected;
        StringBuffer buf = new StringBuffer();
        for (int i = 0; i < list.length; i++) {
          if (i > 0)
            buf.append("\n");
          buf.append(list[i]);
        }
        _textArea.setText(buf.toString());
      }
    }
  }
```

Available ExComboBoxes

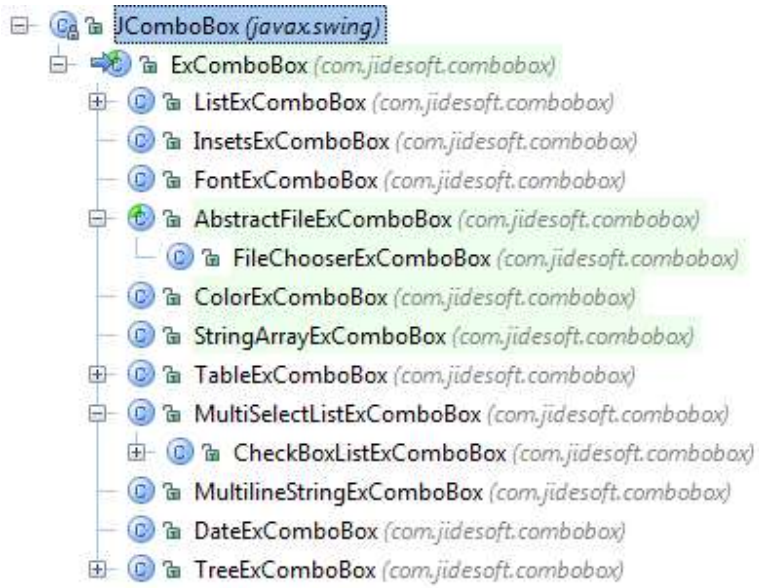
See below for a list of available ExComboBoxes. If we categorized them by the component on the popup, there are

1. JList (ListExComboBox or MultiSelectListExComboBox which supports multiple selects)
2. JTable (TableExComboBox)
3. JTree (TreeExComboBox).
4. CheckBoxList (CheckBoxListExComboBox)

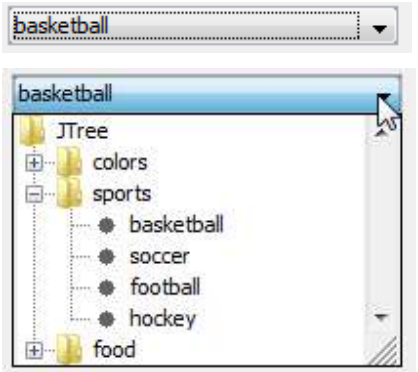
If we categorized by the data type of the combo box's selected item, they are

1. Date.class (DateExComboBox or MonthExComboBox)

2. Color.class (ColorExComboBox)
3. Font.class (FontExComboBox)
4. Insets.class (InsetsExComboBox)
5. File.class (FileChooserExComboBox)
6. String.class but the String is a file name (FileNameChooserExComboBox)
7. String[].class - String Array (StringArrayExComboBox)
8. String.class but it is a multiple line string (MultilineStringExComboBox)



See below for a screenshot of a Tree(Ex)ComboBox.



Tree(Ex)ComboBox uses JTree as the component on the popup. The usage of *TreeComboBox* is very intuitive. There are only two points that worth mentioning.

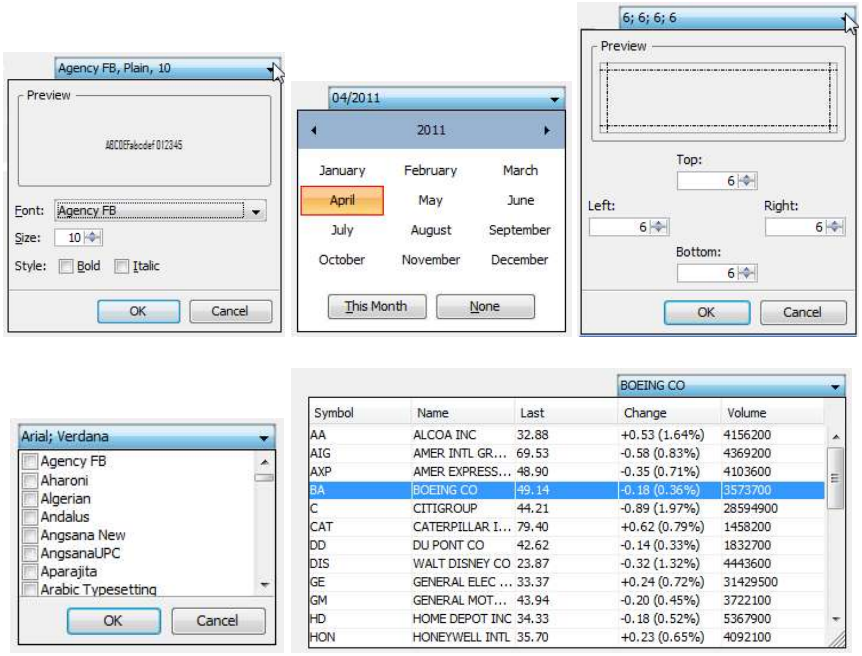
First, different from JList, not all tree nodes in a tree are valid selection. In many cases, you only want the leaf node to be selected. So *Tree(Ex)ComboBox* allows you to add your own code to determine if a *TreePath* is valid selection. All you need to do is to overwrite *isValidSelection(TreePath path)*. By default, it always returns true, meaning all tree nodes are valid selections. If you want only leaf node to be selectable, you can write something like this in subclass.

```
protected boolean isValidSelection(TreePath path) {
  TreeNode treeNode = (TreeNode) path.getLastPathComponent();
  return treeNode.isLeaf();
}
```

The second point is the conversion from *TreePath* to *String*. You need to provide an algorithm to convert from the selected *TreePath* to a string so that the string can be displayed in the text field of *ComboBox*. The algorithm is in a method called *converElementToString()*. Below is the default implementation of this method in *TreeComboBox*. You can see it simply uses toString to convert the tree node to string. Subclass can overwrite this method to do your own conversion. For example, you can convert the selected path in the screenshot above to "JTree -> sports -> football" if it makes sense in your application.

```
protected String convertElementToString(Object object) {
  if (object instanceof TreePath) {
    Object treeNode = ((TreePath) object).getLastPathComponent();
    return treeNode.toString();
  }
  else if (object != null) {
    return object.toString();
  }
  else {
    return "";
  }
}
```

More Screenshots. They are *FontExComboBox*, *MonthExComboBox*, *InsetsExComboBox*, *CheckBoxListExComboBox* and *TableExComboBox* respectively.



Supporting 3rd Party L&F for ExComboBox

ExComboBox has its own Combobox UI that extends the corresponding ComboBoxUI of the L&F. For example we have WindowsExComboBoxUI extends WindowsComboBoxUI. That's how it supports Windows L&F. We also have AquaExComboBoxUI, MetalExComboBoxUI, SynthExComboBox etc. to support other JDK L&Fs. However, if you want to use ExComboBox with other 3rd party L&Fs, you need to provide a UI for it.

I included the full source code for PlasticExComboBoxUI below as an example. Then make sure you call *UIManager.put("ExComboBoxUI", " com.jidesoft.plaf.plastic.PasticExComboBoxUI")* after you set the Plastic L&F. You may need to tweak to the source code if the UI class you are extending override some methods we also override but it shouldn't be too hard to figure out.

```
package com.jidesoft.plaf.plastic;

import com.jgoodies.looks.plastic.PlasticComboBoxUI;
import com.jidesoft.combobox.ExComboBox;
import com.jidesoft.combobox.PopupPanel;
import com.jidesoft.plaf.ExComboBoxUI;
import com.jidesoft.plaf.basic.ExComboBoxEditor;
import com.jidesoft.plaf.basic.ExComboBoxFocusListener;
```

```
import com.jidesoft.plaf.basic.ExComboBoxPopup;
import com.jidesoft.plaf.basic.ExComboBoxRenderer;

import javax.swing.*;
import javax.swing.plaf.ComponentUI;
import javax.swing.plaf.basic.ComboPopup;
import java.awt.event.FocusListener;

public class PlasticExComboBoxUI extends PlasticComboBoxUI implements
ExComboBoxUI {
    public static ComponentUI createUI(JComponent c) {
        return new PlasticExComboBoxUI();
    }

    protected ExComboBox _comboBox;

    @Override
    public void installUI(JComponent c) {
        if (c instanceof ExComboBox) {
            _comboBox = ((ExComboBox) c);
        }
        super.installUI(c);
    }

    @Override
    protected JButton createArrowButton() {
        if (_comboBox != null) {
            AbstractButton button = _comboBox.createButtonComponent();
            if (button instanceof JButton) {
                return (JButton) button;
            }
        }
        JButton button = super.createArrowButton();
        comboBox.putClientProperty("doNotCancelPopup",
button.getClientProperty("doNotCancelPopup"));
        return button;
    }

    @Override
    protected ComboPopup createPopup() {
```

```
        return new ExComboBoxPopup(_comboBox);
    }

    @Override
    protected ListCellRenderer createRenderer() {
        return new ExComboBoxRenderer(super.createRenderer(), _comboBox);
    }

    @Override
    protected ComboBoxEditor createEditor() {
        return new ExComboBoxEditor(super.createEditor(), _comboBox);
    }

    public PopupPanel getPopupPanel() {
        return ((ExComboBoxPopup) popup).getPopupPanel();
    }

    @Override
    public void configureEditor() {
        super.configureEditor();
        FocusListener[] focusListeners = editor.getFocusListeners();
        for (FocusListener listener : focusListeners) {
            if (listener.getClass().getName().indexOf("BasicComboBoxUI") != -1) {
                editor.removeFocusListener(listener);
            }
        }
    }

    @Override
    protected FocusListener createFocusListener() {
        return new ExComboBoxFocusListener(_comboBox, super.createFocusListener());
    }
}
```

How to create your own Cell Renderer and Cell Editor

In this section, we will use *FontNameCellEditor* as an example to illustrate how to create your own cell renderer and cell editor that is compatible with the rest of *JIDE Grids*.

First of all, we need to decide what the type of this property is. In the case of font face name, the type is String. However not all strings are valid font face name. That's why we need a converter for it. See below. In *fromString()* method, we enumerate all available font names in current environment. If the String is one of the known font names, we return the String. Or else, return null because the String is not valid font name.

```
public class FontNameConverter implements ObjectConverter {
    /**
     * ConverterContext for a font name.
     */
    public static ConverterContext CONTEXT = new ConverterContext("FontName");

    public String toString(Object object, ConverterContext context) {
        if (object == null || !(object instanceof String)) {
            return null;
        }
        else {
            return (String) object;
        }
    }

    public boolean supportToString(Object object, ConverterContext context) {
        return true;
    }

    public Object fromString(String string, ConverterContext context) {
        if (string.length() == 0) {
            return null;
        }
        else {
            String[] font_names =
GraphicsEnvironment.getLocalGraphicsEnvironment().getAvailableFontFamilyNames();
            for (int i = 0; i < font_names.length; i++) { // check font if it is available
                String font_name = font_names[i];
                if (font_name.equals(string)) {
                    return string;
                }
            }
            return null;
        }
    }
```

```
    public boolean supportFromString(String string, ConverterContext context) {
        return true;
    }
}
```

Next, we need to create a cell editor. We use *ListComboBoxCellEditor* as the base class. Please note, you can also extend *AbstractComboBoxCellEditor* or *TextFieldCellEditor*, depending what you need from the base class.

```
/**
 * CellEditor for FontFace.
 */
public class FontNameCellEditor extends ListComboBoxCellEditor {

    public final static EditorContext CONTEXT = new EditorContext("FontName");

    /**
     * Creates FontNameCellEditor.
     */
    public FontNameCellEditor() {
        super(new FontNameComboBoxModel());
    }

    /**
     * Model for the font style drop down.
     */
    private static class FontNameComboBoxModel extends AbstractListModel
implements ComboBoxModel {

        /** An array of the names of all the available fonts. */
        private String[] _fontNames = null;

        /** The currently selected item. */
        private Object _selectedFontName;

        /**
         * Create a custom data model for a JComboBox.
         */
```

```
        protected FontNameComboBoxModel() {
            _fontNames =
GraphicsEnvironment.getLocalGraphicsEnvironment().getAvailableFontFamilyNames();
        }

        public void setSelectedItem(Object selection) {
            this._selectedFontName = selection;
            fireContentsChanged(this, -1, -1);
        }

        /**
         * Chooses a Font from the available list.
         * @param font The font to make current
         */
        public void setSelectedFont(Font font) {
            for (int i = 0; i < _fontNames.length; i++) {
                if (font.getFontName().equals(_fontNames[i])) {
                    setSelectedItem(getElementAt(i));
                }
            }

            fireContentsChanged(this, -1, -1);
        }

        public Object getSelectedItem() {
            return _selectedFontName;
        }

        public int getSize() {
            return _fontNames.length;
        }

        public Object getElementAt(int index) {
            return _fontNames[index];
        }
    }
}
```

Please note, in both converter and cell editor, we have a context object. We need them because the type is String type which has been taken to register *StringConverter* and *StringCellEditor*. We will need the context object to register with our own converter and cell editor with ObjectConverterManager and CellEditorManager. So here is the last thing you need to do.

```
ObjectConverterManager.registerConverter(String.class, new FontNameConverter(),
FontNameConverter.CONTEXT);
CellEditorManager.registerEditor(String.class, new FontNameCellEditor(),
FontNameCellEditor.CONTEXT);
```

To try it out, you just need to create a Property which type is String.class, converter context is FontNameConverter.CONTEXT and editor context is FontNameCellEditor.CONTEXT. If you add this property to PropertyTableModel, PropertyTable will automatically use FontNameCellEditor to edit this Property and use FontNameConverter to validate the font name.

Below is another example of custom CellEditor. It continues from the StringArrayComboBox example above. Now we will make it a CellEditor.

```
/**
 * A String array cell editor.
 */
public class StringArrayCellEditor extends ContextSensitiveCellEditor implements
TableCellEditor {

    private StringArrayComboBox _comboBox;

    /**
     * Creates a FileNameCellEditor.
     */
    public StringArrayCellEditor() {
        _comboBox = new StringArrayComboBox();
        _comboBox.setBorder(BorderFactory.createEmptyBorder());
    }

    /**
     * Gets the value of the cell editor.
     *
     * @return the value in this cell editor.
     */
    public Object getCellEditorValue() {
        _comboBox.setSelectedItem(_comboBox.getEditor().getItem());
```

```
        return _comboBox.getArray();
    }

    public Component getTableCellEditorComponent(JTable table, Object value,
                                                 boolean isSelected,
                                                 int row, int column) {
        if (table != null) {
            JideSwingUtilities.installColorsAndFont(_comboBox, table.getBackground(),
table.getForeground(), table.getFont());
        }
        _comboBox.setArray((String[]) value);
        _comboBox.setConverterContext(getConverterContext());
        return _comboBox;
    }

    public boolean stopCellEditing() {
        _comboBox.setPopupVisible(false);
        return super.stopCellEditing();
    }
}
```

Hierarchical Table

HierarchicalTable is special type of table which can display any components hierarchically inside the table itself. (*TreeTable* can also display hierarchical information, but the information in *TreeTable* is limited to all rows being the same format. In HierarchicalTable, you can display any components.)

See below for three examples of hierarchical tables. They look quite different from each other, but they are all done using *HierarchicalTable*.

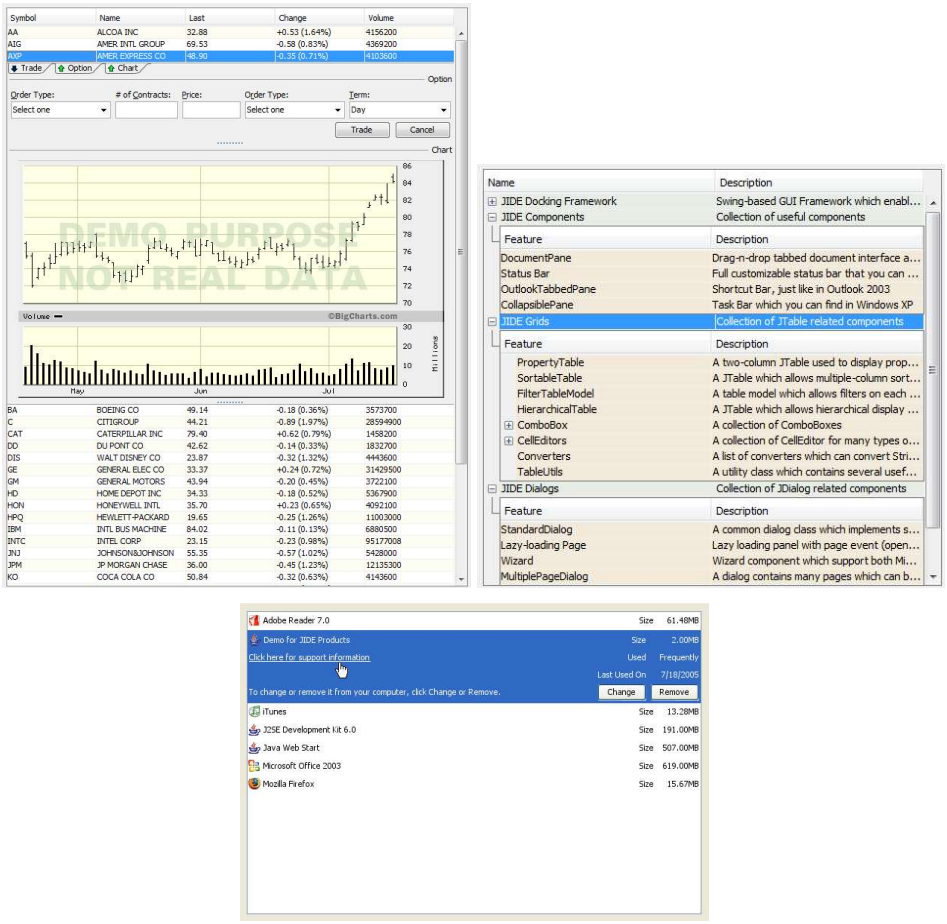


Figure 41 Examples of Hierarchical Tables

From the screenshots, you probably are surprised by what *HierarchicalTable* can do. The child component of each row is not limited to table. It could be anything. That's the power of *HierarchicalTable*.

There are actual three tables in the second example. Each has different background colors. The top level has four rows; each row is a JIDE product. You can further expand each row to display components or features in that product. Furthermore, for each features, you can see further details. Now three tables are organized in a hierarchical way, this is also why it is called *HierarchicalTable*.

The last one is the famous user interface of Windows Control Panel's Add/Remove Program dialog. People ask us how to do it but didn't realize *HierarchicalTable* provides build-in support for. The trick is the child component will cover the parent row if it returns false in *isHierarchical(int row)* method of *HierarchicalTableModel*.

HierarchicalTableModel

There are only two major classes in *HierarchicalTable* component. One is very obvious, the *HierarchicalTable*. The other one is called *HierarchicalTableModel*. *HierarchicalTableModel* is an

interface but it doesn't extend *TableModel*. We named it *XxxTableModel* because we expect you always use it with either *TableModel*, or *AbstractTableModel* or *DefaultTableModel*. There are three methods in this interface; see below.

```
    /**
     * Checks if the row has child.
     *
     * @param row the row index
     * @return true if the row has child. Otherwise false.
     */
    boolean hasChild(int row);

    /**
     * Returns true if the child component will be shown in a new row. Returns false is the
child
     * component will replace the current row.
     *
     * @param row
     * @return true if the child component will be shown in a new row. Otherwise false
which means the child
     * component will replace the current row when displaying.
     */
    boolean isHierarchical(int row);

    /**
     * Gets the child object value associated with the row at row index.
     *
     * @param row
     * @return the value. If child components are the same except the displaying is
different, it's better to
     * return a value using this method. Then the component factory can create the same
component and only
     * load a different value to that component. You can also return null in this method. If
so,
     * the component factory can look up in the table model on fly and find out how to
create the child component.
     */
    Object getChildValueAt(int row);

    /**
     * Returns true if the row is expandable. This only makes sense when hasChild() return
true. If there is child and
```

```
     * but not expandable, you will see a gray "+" icon but click on it does nothing.
     *
     * @param row
     * @return true if the row is expandable.
     */
    boolean isExpandable(int row);
```

Here are two typical usages of *HierarchicalTableModel*.

```
  class ProductTableModel extends DefaultTableModel implements
HierarchicalTableModel {
    ……
  }
```

or

```
  class ProductTableModel extends AbstractTableModel implements
HierarchicalTableModel {
    ……
  }
```

So in addition to implement methods defined in *TableModel*, you also need to implement the three methods defined in *HierarchicalTableModel*.

HierarchicalTable

As you probably noticed, *HierarchicalTableModel* only returns a value and doesn't have code to create a component to be display in *HierarchicalTable*. We added a new method to *HierarchicalTable* called *setComponentFactory*. You can use this method to associate a *HierarchicalTableComponentFactory* object with *HierarchicalTable*. It's *HierarchicalTableComponentFactory*'s responsibility to create components and destroy components.

HierarchicalTable extends *SortableTable*, which indicates our *HierarchicalTable* can be sorted. In case you don't want it to be sortable, just call *setSortable(false)*.

In addition to methods defined in JTable and SortableTable, *HierarchicalTable* defined several of its own methods.

HierarchicalTable has one special column called the hierarchical column. If a column is the hierarchical column, there will be an expand/collapse icon on the left side of any cells in that column. Clicking on that button will expand/collapse. By default, the first column is the hierarchical column. If you want to control when to expand/collapse all by yourself, you can call *setHierarchicalColumn(-1)*. For example, at the screenshot below, the hierarchical column is 1 (the 2nd column since the column index is starting from 0).

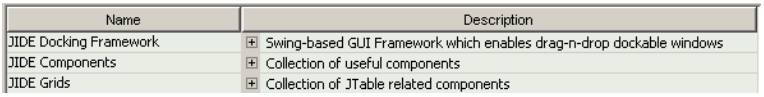


Figure 42 HierarchicalTable when the hierarchical column is 1

There is another attribute called *singleExpansion*. Typically when user expands a row, and then expands another row, the first expanded row will remain expanded. However there are case user wants only one row to be expanded at a time. The attribute *singleExpansion* can be used in this case. True means only one row can expanded at a time. Default is false.

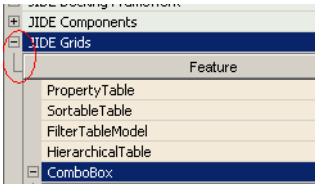
Container for Child Component

Among the four methods of *HierarchicalTableModel*, the most important method is *getChildValueAt(int row)*. Basically for each row, you can associate a value with it. This value can be used in *HierarchicalTableComponentFactory* to create a child component for each row when the row is expanded. How you write this component is completely up to you. As usual, we created several classes you can leverage. They are *HierarchicalPanel* and *TreeLikeHierarchicalPanel*.

HierarchicalPanel is a special *JPanel* which will always respect the preferred height of the component it contains. So instead of returning the child component directly in *getChildComponent(int row)*, wrap it in *HierarchicalPanel* and return the *HierarchicalPanel*. That way, when the child component height changes, *HierarchicalPanel*'s height will adjust to the new height automatically. This may be a little hard to understand, but if you try to expand a child component, one with *HierarchicalPanel* and the other with regular *JPanel*, you will notice the difference.

HierarchicalPanel also has a border of BorderFactory.createEmptyBorder(0, 14, 1, 0), which will match with the margin of the expand/collapse icon when the expandable column is 0. However you can pass in any border to *HierarchicalPanel*.

To make *HierarchicalTable* more like a tree, we also prepared *TreeLikeHierarchicalPanel*. It'll draw a hash line on the left margin, just like in JTree. See the red circled area in the left screenshot. You can tell from the name of *TreeLikeHierarchicalPanel* that it extends *HierarchicalPanel*. If you plan to create your own style of *HierarchicalPanel*, we suggest you also make it extend *HierarchicalPanel.*



Maintaining single selection

When the child components in *HierarchicalTable* are also tables, sometimes you want to keep one selection at a time. However since those are different table components and have their own *ListSelectionModel*s, you will end up with each table has its own row selected. To address this issue, we created a class called *ListSelectionModelGroup*. The name comes from *ButtonGroup* which keeps an exclusive selection for a group of buttons. *ListSelectionModelGroup* will keep exclusive selection for a group of *ListSelectonModel*. To add a *ListSelectionModel* to the group, you just call *add()* method. After the *ListSelectionModel* is gone, call *remove()* method. This matches perfectly with *HierarchicalTable*'s *HierarchicalTableComponentFactory*'s *createChildComponent()* and *destroyChildComponent()* methods. Basically, when a child component is created and if it's a table, call *group.add(table.getSelectionModel())*. When the table is destroyed, call *group.remove(table.getSelectionModel())*. G8.1 HierarchicalTableDemo is an example to show you how to use this.

Migration from Hierarchical Table Beta version

If you use *HierarchicalTable* for the first time, you can skip this section. If you used *HierarchicalTable* beta version, you should read this to find out how to migrate from your old code to the new one.

The main changes are in interface *HierarchicalTableModel*. Here are the details of interface changes.

Old method	New method
boolean hasChildComponent(int row)	boolean hasChild(int row)
boolean isHierarchical(int row)	the same
Component getChildComponent(int row)	Object getChildValueAt(int row)

The reason for this change is to separate the model from view. The old interface gave people the impression that we are mixing model and view. So the new interface is only about data. To convert the data to a component, you need to use *HierarchicalTableComponentFactory* defined on *HierarchicalTable*.

HierarchicalTableComponentFactory has two methods

```
Component createChildComponent(HierarchicalTable table, Object value, int row);
void destroyChildComponent(HierarchicalTable table, Component component, int row);
```

For the *createChildComponent()* method, the value argument is the value that's returned from the *getChildValueAt()* method in *HierarchicalTableModel*. The row is the same row as in *getChildValueAt(int row)*. You have two choices here: You can either always return null in

getChildValueAt(int row) method and completely let *createChildComponent()* figure out how to create the component. Or you can return a value in the *getChildValueAt(int row)* method and let *createChildComponent()* create the component, and then associate the component with the value. If you're migrating from beta version, it's easier to use the first way. You can simply return null from *getChildValueAt(int row)*, and pretty much copy the old code in the *getChildComponent(int row)* method and put it into *createChildComponent()*. However, if your child components are using the same component with different data, you might think about changing to the second way. For example, if your child component is always a table, you can return a table model in *getChildValueAt(int row)* - and in *createChildComponent()*, just set the table model to the table. You can even use a table pool to contain all instances of table and reuse them.

TreeTable

TreeTable is another kind of table component that can display hierarchical data using a table.

TreeTable is a combination of a tree and a table -- a component capable of expanding and collapsing rows, as well as showing multiple columns of the same row. Tree and table work on different data structure. The former is used to display hierarchical data. The latter is used to display a flat tabular data. So in order to make the data works in *TreeTable*, we need to "hierarchize" the flat tabular data. To make the design simple, we make the following assumption

If the data can be used in TreeTable, it must be row-oriented.

Row-oriented means one dimension of the two dimension tabular data can be represented as **row**. Then each row will provide data for the second dimension. Based on this assumption, we introduce several concepts (they are all Interfaces) to make *TreeTable* possible.

Node: represent a node in tree data structure

Expandable: represent something can be expanded such as tree node with children.

Row: represent a row in table data structure – it is also the first dimension of the two dimension tabular table data.

ExpandableRow: represent a row that can have children rows.

It will be simple to understand this using an example. A typical *TreeTable* example is the file system. In file system, there are files and folders. Using the concepts above, each file will be a Row; each folder will be an *ExpandableRow*. Folder (the *ExpandableRow*) can have children which can be either files (the *Row*) or other folders (the *ExpandableRow*). See screenshot of a *TreeTable*.

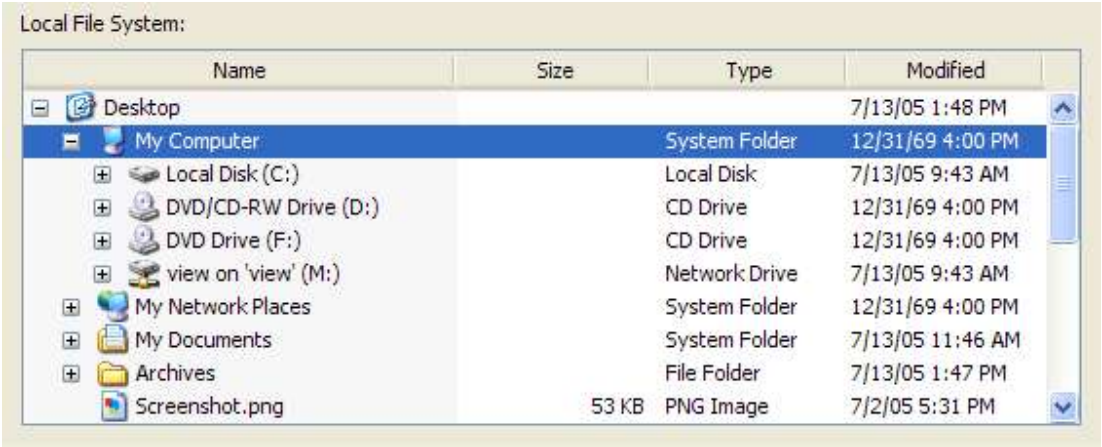


Figure 43 FileSystem TreeTable

The table model used by *TreeTable* is *TreeTableModel*. It extends *AbstractTableModel*. However it's essentially a list of *ExpandableRows* or *Rows*. TreeTableModel is an abstract class. The only method you has to implement is *getColumnCount()*. You might want to override *getColumnName(int)*. Otherwise, it will use "A", "B" etc as default names. You also need to make the columns match with the value you returned in *Row#getValueAt(int)*. Please be noted that JIDE will create a root by default in *TreeTableModel* to make sure the update on the rows you passed into *TreeTableModel* will be reflected in UI by firing table model events. You may override *createRoot()* to create your own root rows although it is actually not visible.

Once we create a java.util.List of the *Rows*, you call

```
TreeTableModel model = new MyTreeTableModel(list);
TreeTable table = new TreeTable(model);
```

Now you get a *TreeTable* instance.

TreeTable uses a special cell renderer on the first column to paint +/- icon as well as tree line. If the row is expandable, you will see +/- icon. Clicking on it will expand the row. Clicking again will collapse it. You can also use keyboard to expand/collapse a row. Right arrow key will expand the selected row and left arrow key will collapse it. If the selected row doesn't have children or it is collapsed already, it will change the selection to its parent. If you try it, you will find it is very convenient to navigate in the tree table using arrow keys.

We used the same +/- icons used in a regular *JTree* so it will change based on different LookAndFeels. The tree lines can be turn on or off using *setShowTreeLines(boolean)*. The line color can be set by *setTreeLineColor(Color)*. By default, it will use the *JTree's* tree line color which is *UIManager.getColor("Tree.hash")*.

Please note, in our *TreeTable* design, there are not usage of *JTree* or *TreeModel* or *TreeNode* as defined in Swing. *TreeTable* extends *JTable* eventually and it has nothing to do with *JTree*.

Comparison between TreeTable and HierarchicalTable

Many people wonder when they should use *TreeTable* and when to use *HierarchicalTable*. The following table will help you to understand and make you decision.

	HierarchicalTable	TreeTable
Data format of top level	A regular tabular data just like *JTable*	A list of rows with hierarchical information built in the data
Data format of child levels	Any data.	Same data as the top level data
Nested components	Any components	There are no nested components in tree table. They are part of the *TreeTable*.
Scalability	Bad in the sense that each children component is a real	Good. There is only one table no matter how many nested

	component. So if you have a table with 100 rows all expanded with a children table, you will have 101 table instances.	levels.
Level of hierarchies (exclude the top level)	One. However you can archive many levels by nested *HierarchicalTable* inside another *HierarchicalTable*.	As many as you want

From the table above, you can see which table to use is totally depending on what kind of data you have. If the data on each child level can all be represent as table, it's better to use *TreeTable*. If not, you should use *HierarchicalTable*.

GroupTable

GroupTable is a special *TreeTable* that can group rows who has the same value in certain column into a group. It is an implementation that is very similar to the table used in Microsoft Outlook Inbox.

GroupableTableModel

GroupableTableModel, just like *ContextSensitiveTableModel* is an interface that you can implement it at any table model. It only has one method called *getGrouperContext()*. We use the same design pattern here as *ContextSensitiveTableModel.* Just like *ContextSensitiveTableModel* uses *CellEditorManager* and *CellRendererManager* to find the cell renderers and cell editors, *GroupableTableModel* uses *ObjectGrouperManager* to find the *ObjectGrouper* which will be used to group values.

Please note *GroupableTableModel* is totally optional. If the values in the table do not need any special value grouping, you don't need to implement this interface.

DefaultGroupTableModel

As we mentioned earlier, the *GroupableTableModel* is just a table model that can be grouped. The one who actually does the grouping is the *DefaultGroupTableModel*. *DefaultGroupTableModel* is a *TreeTableModel* that implements *TableModelWrapper*. It wraps any *TableModel* or *GroupableTableModel* if special value grouping is needed.

DefaultGroupTableModel's constructor takes any table model. You can then call *addGroupColumn* to add the column that you want to group or *setGroupColumns* to set all group columns at once. When you change the group columns, you call *groupAndRefresh* to push the change to the screen.

Now let's look at an example. There is a *JTable*. It has five columns. If you look at carefully, you will see the value in source and destination column repeats. In this case, it would make sense if we group by those two columns.

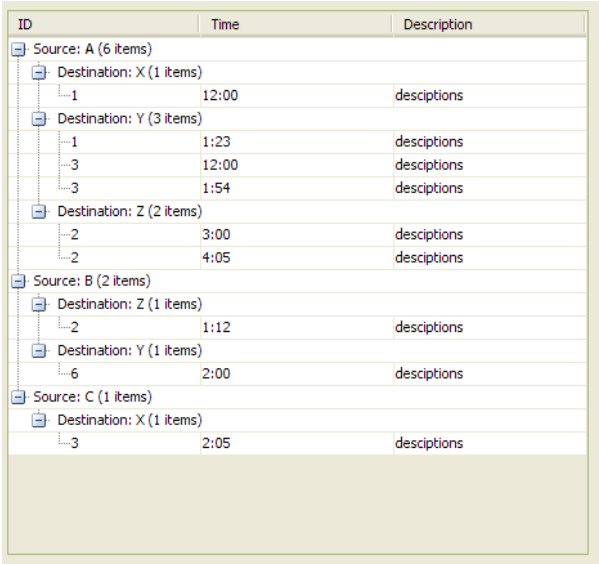
ID	Time	Source	Destination	Description
1	12:00	A	X	desciptions
2	1:12	B	Z	desciptions
1	1:23	A	Y	desciptions
3	12:00	A	Y	desciptions
2	3:00	A	Z	desciptions
2	4:05	A	Z	desciptions
6	2:00	B	Y	desciptions
3	1:54	A	Y	desciptions
3	2:05	C	X	desciptions

So you do something like this.

```
DefaultGroupTableModel groupTableModel = new
DefaultGroupTableModel(tableModel);
groupTableModel.addGroupColumn(2);
```

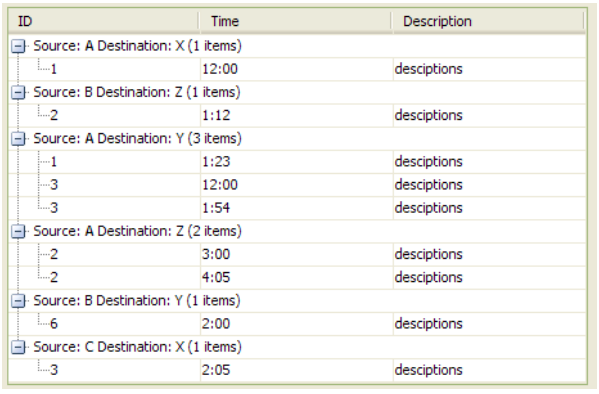
```
groupTableModel.addGroupColumn(3);
groupTableModel.groupAndRefresh();
```

Here is the result.



As you can see, there is actually a *TreeTable*. It will group by the source column first. Then understand each group, it will group by destination column. You can independently expand or collapse each group. Comparing with the flat table originally, this hierarchical view obviously offers more information to the user. For example, your user can easily see how many items are from source A, B and C.

We also have an option to flat down the group level. See the screenshot below. We still have two group-by columns but we flat it down into one level so there are fewer hierarchies.



In the example, we didn't use *GroupableTableModel* because there is no need to group the values. See below for another example where you use an ObjectGrouper to group the value. It's

a product table which has a sales column. The sales column is a dollar amount. We want to group them into several groups.

First, we need an ObjectGrouper. If the value is less than $100, we put them into group 1. If less than $1000 but greater than $100, we put into group 2. And so on.

```
private static class SalesObjectGrouper extends DefaultObjectGrouper {
  public final static GrouperContext CONTEXT = new GrouperContext("Sales");

  public Object getValue(Object value) {
    if (value instanceof Number) {
      double v = ((Number) value).doubleValue();
      if (v < 100) {
        return new Integer(0);
      }
      else if (v < 1000) {
        return new Integer(1);
      }
      else if (v < 10000) {
        return new Integer(2);
      }
      else {
        return new Integer(3);
      }
    }
    return null;
  }

  public Class getType() {
    return int.class;
  }

  public ConverterContext getConverterContext() {
    return SalesConverter.CONTEXT;
  }
}
```

We certainly don't want to display 0, 1, 2 and 3 to users so we need an ObjectConverter to convert the integer to some meaningful texts.

```
private static class SalesConverter extends DefaultObjectConverter {
```

```
    public static ConverterContext CONTEXT = new ConverterContext("Sales");

    public String toString(Object object, ConverterContext context) {
      if (object instanceof Integer) {
        int value = ((Integer) object).intValue();
        switch (value) {
          case 0:
            return "From 0 to 100";
          case 1:
            return "From 100 to 1000";
          case 2:
            return "From 1000 to 10000";
          case 3:
            return "Greater than 10000";
        }
      }
      return null;
    }

    public boolean supportFromString(String string, ConverterContext context) {
      return false;
    }
  }
```

Now if you apply *DefaultGroupTableModel* to this *GroupableTableModel*, you will get something like this screenshot. As you can see, we used the *ObjectGrouper* to decide the group and we even display the group nicely using the converter.

You can optional use GroupTableHeader so that user can drag the columns to decide how to group the table. See below.

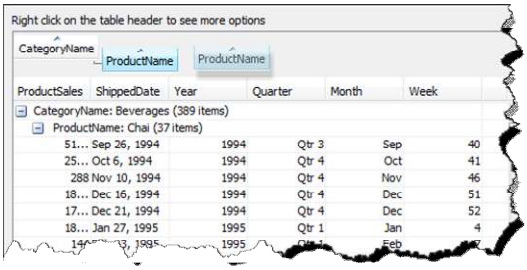
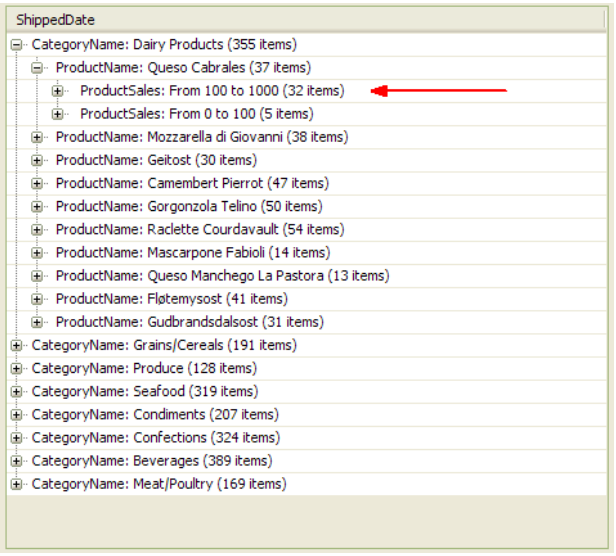


Figure 44 Draggable GroupTableHeader

GroupList

GroupList is a *JList* that supports the grouping of items. When there is large number of items in a *JList* and you need to organize them in several categories, this is where you can use *GroupList*. Each group header appears slightly different from other regular rows as it uses a different cell renderer you can set by yourself.



GroupableListModel

The most important part of *GroupList* is the *GroupableListModel*. *GroupableListModel* extends *ListModel* and adds the following methods.

```
Object getGroupAt(int index);
Object[] getGroups();
void addListGroupChangeListener(ListGroupChangeListener listener);
void removeListGroupChangeListener(ListGroupChangeListener listener);
```

The *getGroupAt(int index)* method provides the group information for each row in the list model. It returns an object that identifies the group. It is normally a String. However you can use any object type as long as you have cell renderer knows how to renderer it on UI. All rows that belong to the same group should return the same object instance or those objects equal (based on *equals* method).

The *getGroups()* method return a list of groups you ever return in *getGroupAt* method. The main purpose of this method is to allow you to specify the order of the groups. You could return less groups than they are actually used in getGroupAt(). In this case, the groups that are not defined in *getGroups()* will be appended at the end of the list.

On top of *GroupableListModel*, we have two implementations - *AbstractGroupableListModel* and *DefaultGroupableListModel*. The abstract version just implements the support for *ListGroupChangeListener* and leave everything else related to grouping to you. The default one extends DefaultListModel and add method such as *setGroupAt*, *setGroups(), renameGroup()* etc methods allowing you to change the group information. If you already have a *DefaultListModel*, you can replace it with *DefaultGroupableListModel* without any code change. Then later on, you call setters to add group information. If you were using *AbstractListModel*, you can also replace it with *AbstractGroupableListModel* without any code change. However, you still need to override *getGroupAt()* and *getGroups()* in order to have any groups.

LayoutOrientation

JList supports three layout orientations. They are

- VERTICAL: a vertical layout of cells, in a single column
- VERTICAL_WRAP: a "newspaper style" layout with cells flowing vertically then horizontally when it reaches the list height.
- HORIZONTAL_WRAP: a "newspaper style" layout with cells flowing horizontally then vertically when it reaches the list width.

GroupList supports all three layout orientations. However, since GroupList brings the concept of grouping, it has to change the meaning of the layout orientation. First of all, the group rows are not part of the layout. It always covers the whole list width. The layout of cells only applies to the cell within the same group. In the case of VERTICAL layout, there isn't much difference with or without grouping. But in the case of two wrap layouts, it is quite different. We had to introduce one property to *GroupList* called *preferredColumnCount*. In horizontal wrap mode, we will wrap the cells when it reaches the *preferredColumnCount*. In the case of vertical wrap, it will calculate items in each group and find out how many rows it will need for each group and wrap when it reaches the row count vertically. For example, if there are 20 items in the group and the preferred column count is 8, 20 divided 8 is 2 remaining 4, which means it needs at least 3 rows to display all the cells. So we will layout three cells vertically and then wrap and so on.

Careful readers might notice *JList* misses the fourth layout – HORIZONTAL. The reason I guess is because the *JList* will be way too wide (although I can still argue that it could be useful in some cases). In the case of *GroupList*, it is less a problem to support it as all items are divided into groups so that each group has fewer items. So we added HORIZONTAL layout orientation into *GroupList*.

- HORIZONTAL: a horizontal layout of cells, in a single row with in the same group.

As the group rows are different from regular rows, we provide *setGroupCellRenderer* method to allow you to set your own cell renderer. The other method is *setGroupCellSelectable*. In most cases, user doesn't want to select the group cells. But if you want to select them, they can always call setGroupCellSelectable to make the group cell selectable.

TableScrollPane

TableScrollPane is a component that supports table row header, row footer, column header, and column footer. In fact, you can implement row header even without this component. You basically create a separate table and call setRowHeaderView() to set it to JScrollPane. Now you get a table with a row header. Sounds simple? Unfortunately it's more than that. What you can't do with JScrollPane is that it doesn't row footer and column footer. You also needed to create two separate table models – one for row header and the other for the table itself – which might be inconvenience. Of course, you also need to deal with keystrokes. As they are two tables, keeping pressing left arrow or tab key won't navigate from row header to the table. Don't forget the sorting. Sorting row header won't change the sort order of the table because, again, they are two tables. In fact, there are a lot of things you need to do in order to support row header. TableScrollPane is such a component that takes care of all those for you.

To simplify the usage, we also create an interface MultiTableModel to replace TableModel. Instead of using AbstractTableModel or DefaultTableModel, you can use AbstractMultiTableModel or DefaultMultiTableModel respectively. Interface MultiTableModel has a method called getColumnType(int column)[7]. By returning HEADER_COLUMN or FOOTER_COLUMN or REGULAR_COLUMN, you can use one table model to define a table which has header columns and footer columns.

Please see screenshot below for a typical use case of *TableScrollPane*. As you can see there are frozen rows and columns. The first row and the last row are frozen. The first column and the last two columns are frozen.

Year	Sales (million dollar)				After-tax Profits (million dollar)			Sales Total	After-tax Profits Total
	Q1	Q2	Q3	Q4	Q1	Q2	Q3		
2011	1,596,666.00				144,463.00			1,596,666.00	144,463.00
2000	1,119,619.00	1,127,677.00	1,143,982.00	1,122,837.00	77,113.00	69,331.00	71,194.00	4,514,115.00	270,345.00
2004	1,182,609.00	1,222,192.00	1,243,017.00	1,284,205.00	77,185.00	85,249.00	87,432.00	4,932,023.00	347,864.00
2009	1,241,294.00	1,226,253.00	1,289,095.00	1,353,997.00	36,559.00	49,946.00	95,282.00	5,110,639.00	286,404.00
2005	1,300,210.00	1,322,831.00	1,373,056.00	1,412,359.00	92,180.00	97,277.00	105,470.00	5,408,456.00	401,009.00
2010	1,398,695.00	1,430,276.00	1,447,157.00	1,490,965.00	110,934.00	107,759.00	124,032.00	5,767,093.00	477,877.00
2006	1,445,585.00	1,454,570.00	1,452,573.00	1,428,549.00	122,653.00	112,943.00	122,834.00	5,781,277.00	470,352.00
2007	1,456,498.00	1,494,618.00	1,521,356.00	1,585,911.00	120,354.00	126,496.00	76,348.00	6,058,383.00	442,884.00
2008	1,623,674.00	1,687,223.00	1,661,264.00	1,400,121.00	120,311.00	99,284.00	120,320.00	6,372,282.00	266,425.00
Average	1,273,518.36	1,289,206.91	1,305,328.73	1,300,067.91	76,552.18	77,032.18	81,883.82	5,168,121.91	306,847.00

Figure 45 TableScrollPane

[7] The interface has another method called getTableIndex(). In case you noticed it, this method is for TableSplitPane, the next component we will discuss. To use in TableScrollPane, you just need to return 0 inthat method.

The whole timesheet table is based on one MultiTableModel. To determine which column is row header or row footer, you just need to return different values in getColumnType. See below.

```
public int getColumnType(int column) {
  if (column < 4) {
    return HEADER_COLUMN;
  }
  else if (column < HEADER.length - 4) {
    return FOOTER_COLUMN;
  }
  else {
    return REGULAR_COLUMN;
  }
}
```

Even though header columns and footer columns are added as separate components, they will work just like in one table. For example, row selection is synchonized. Tab key or left/right arrows will navigate across all three tables. If you scroll vertically, all three tables will scroll together. If you resize columns in any table, even the last column of the header column table and the first column of footer column table. If you choose to have sortable table, sorting in one table will affect other tables. Only one column will be sorted at a time.

TableSplitPane

TableSplitPane is a special component that splits a large table into several smaller tables. There are dividers between tables so each table can be resized independently. However, as just like in *TableScrollPane*, all tables inside this component act just like one table. In short, this is an ideal candidate if you have a large table model which has a lot of columns and those columns can be divided into different categories.

TableSplitPane is built on top of *MultiTableModel* too. There is one more method on the *MultiTableModel* interface called *getTableIndex(int column)*. You can return any integer starting from 0. If the value is 0, the column will in the first table. If 1, it will be in the second table, and so on. *TableSplitPane* will look at the value returned from *getTableIndex()* and divider columns into several tables. Then for each table, it will look at the value returned from *getColumnType()* and divide them into header, regular or footer columns. As a result, you can use one table model to define multiple tables; each can have its own header and footer. See below for an example.

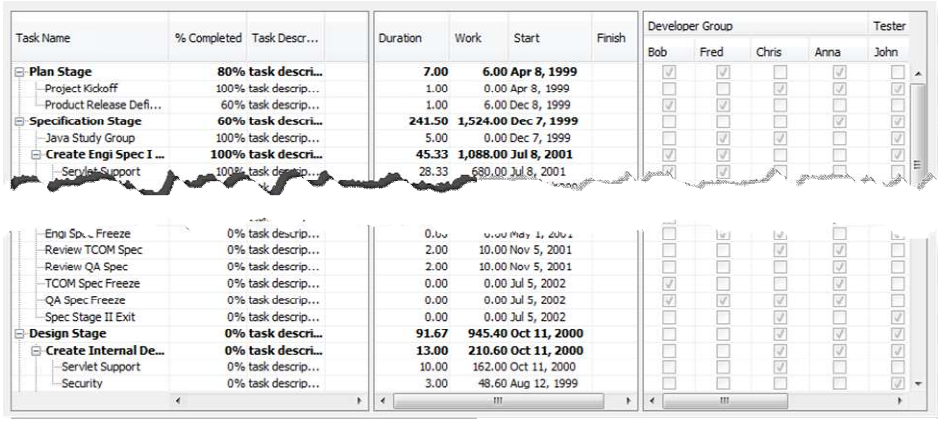


Figure 46 TableSplitPane

DualList

Features of DualList

DualList is a pane that contains two *JList*s and a bunch of buttons. The list on the left contains all the items. The list on the right contains the items that are selected.

DualList uses *DualListModel* which is the model of this component. *DualListModel* is nothing but a *ListModel* with additional methods to keep track of the selected item. If you want to implement a *DualListModel*, you just need to use one of the two *DualListModel*s we already defined - *AbstractDualListModel* or *DefaultDualListModel*. Implementing them is as easy as implementing *AbstractListModel* or *DefaultListModel* because we already implemented the additional methods *DualListModel* adds.

With the help of *DualListModel*, *DualList* supports three kinds of selection modes. This mode controls what to display in the right list when items are selected.

- REMOVE_SELECTION mode means the left list will remove the items if they are selected to the right list. This mode can prevent user from selecting the selected item again if it is not allowed in certain cases (see screenshot above on the left).
- DISABLE_SELECTION mode means the selected items will be shown as disabled. User cannot select them anymore but they can still see them in the right list to show user a complete unchanged list. (see screenshot above on the right)
- KEEP_SELECTION mode will not change the right list at all when items are selected. This is the only mode which can result duplicated items to be selected. If that's what you want in your situation, this mode is the one you should use.

Here is the list of features that *DualList* supports.

- Powerful selection feature. It allows single selection, multiple selection and multiple interval selection on either list.
- Powerful reorder feature. After selecting the items, you can rearrange them to the order you want though move up and move down actions. You can select multiple items and rearrange them all at once.
- Complete keyboard support.
    a. UP/DOWN/PAGE_UP/PAGE_DOWN keys to select items in either list.
    b. LEFT/RIGHT/ENTER keys to move items between the two lists.
    c. CTRL-UP/CTRL-DOWN keys to move selected items up and down in the selected item list. CTRL-HOME/CTRL-END keys to move selected items to the top or the bottom.
- Buttons to select and reorder the items. Each button can be shown or hidden independently.
- Complete API support to do everything you can do through the UI.
- Mode support. The same *DualListModel* instance can be set to two or more *DualList*s, and all the *DualList*s will be synchronized because they are using the same model.

Classes, Interfaces and Demos

Classes	
DualList (com.jidesoft.list)	The main class for this component.
DualListModel (com.jidesoft.list)	The model class for *DualList*.
AbstractDualListModel (com.jidesoft.list)	Abstract implementation of *DualListModel*.
DefaultDualListModel (com.jidesoft.list)	Default implementation of *DualListModel*.
Demos	
DualListDemo (examples\G31. DualList)	A demo to demonstrate the *DualList.* It selected from a list of countries.

Code Examples

1. To create a *DualList*. There is no difference from creating a regular *JList*.

```
DualList dualList = new DualList(Object[] or java.utils.List);
```

2. The call above will create a *AbstractDualListModel* internally. To create a DualList with your own DualListModel, do

```
DualList dualList = new DualList(DualListModel);
```

3. To select a few items using API. The code below will select the 2nd and 4th items from the original list model.

```
DualListModel model = dualList.getModel();
model.addSelectionInterval(1, 1);
model.addSelectionInterval(3, 3);
```

4. To move all items to the right list. In the other word, select all items.

```
dualList.moveRight();
```

5. To get the list of selected items.

```
Object[] items = dualList.getSelectedValues();
```

6. To change the selection mode. The selection mode can be REMOVE_SELECTION, KEEP_SELECTION or DISABLE_SELECTION.

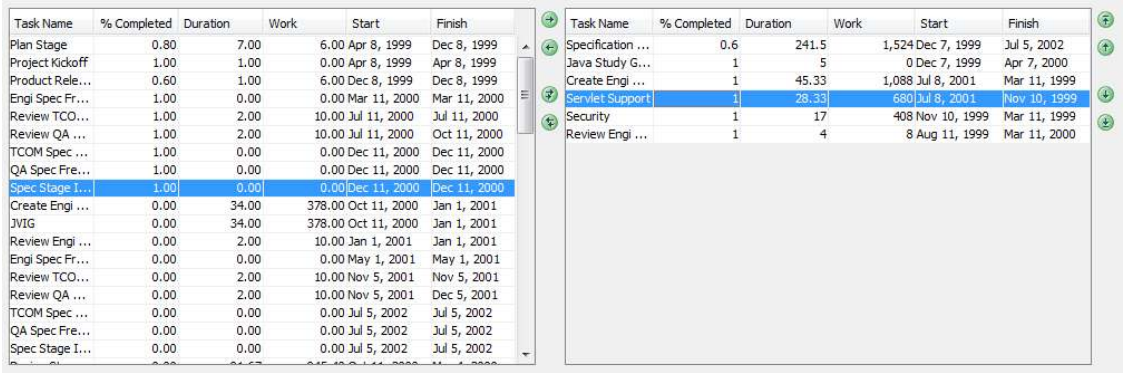
```
dualList.setSelectionMode(selectionMode);
// or
dualList.getModel().setSelectionMode(selectionMode);
```

7. To show or hide one of the buttons in the middle. The first parameter is the command name. They are all defined in *DualList* beginning with *COMMAND_*.

```
dualList.setButtonVisible(DualList.COMMAND_MOVE_ALL_RIGHT. true or false);
```

DualTable

Features of DualTable



Task Name	% Completed	Duration	Work	Start	Finish
Plan Stage	0.80	7.00	6.00	Apr 8, 1999	Dec 8, 1999
Project Kickoff	1.00	1.00	0.00	Apr 8, 1999	Apr 8, 1999
Product Rele...	0.60	1.00	6.00	Dec 8, 1999	Dec 8, 1999
Engi Spec Fr...	1.00	0.00	0.00	Mar 11, 2000	Mar 11, 2000
Review TCO...	1.00	2.00	10.00	Jul 11, 2000	Jul 11, 2000
Review QA ...	1.00	2.00	10.00	Jul 11, 2000	Oct 11, 2000
TCOM Spec ...	1.00	0.00	0.00	Dec 11, 2000	Dec 11, 2000
QA Spec Fre...	1.00	0.00	0.00	Dec 11, 2000	Dec 11, 2000
Spec Stage I...	1.00	0.00	0.00	Dec 11, 2000	Dec 11, 2000
Create Engi ...	0.00	34.00	378.00	Oct 11, 2000	Jan 1, 2001
JVIG	0.00	34.00	378.00	Oct 11, 2000	Jan 1, 2001
Review Engi ...	0.00	2.00	10.00	Jan 1, 2001	Jan 1, 2001
Engi Spec Fr...	0.00	0.00	0.00	May 1, 2001	May 1, 2001
Review TCO...	0.00	2.00	10.00	Nov 5, 2001	Nov 5, 2001
Review QA ...	0.00	2.00	10.00	Nov 5, 2001	Dec 5, 2001
TCOM Spec ...	0.00	0.00	0.00	Jul 5, 2002	Jul 5, 2002
QA Spec Fre...	0.00	0.00	0.00	Jul 5, 2002	Jul 5, 2002
Spec Stage I...	0.00	0.00	0.00	Jul 5, 2002	Jul 5, 2002

Task Name	% Completed	Duration	Work	Start	Finish
Specification ...	0.6	241.5	1,524	Dec 7, 1999	Jul 5, 2002
Java Study G...	1	5	0	Dec 7, 1999	Apr 7, 2000
Create Engi ...	1	45.33	1,088	Jul 8, 2001	Mar 11, 1999
Servlet Support	1	28.33	680	Jul 8, 2001	Nov 10, 1999
Security	1	17	408	Nov 10, 1999	Mar 11, 1999
Review Engi ...	1	4	8	Aug 11, 1999	Mar 11, 2000

DualTable is a pane that contains two *JTables* and a bunch of buttons. It looks just like DualList except it uses table instead of list. The table on the left contains all the items. The table on the right contains the items that are selected.

DualTable uses some model classes from *DualList*, for example, *DualListModel*. It uses TableModelAdapter interface to get multiple values from an item in the *DualListModel* so that they can be displayed in a table.

With the help of *DualListModel*, *DualTable* supports three kinds of selection modes. This mode controls what to display in the right table when items are selected.

- REMOVE_SELECTION mode means the left table will remove the items if they are selected to the right table. This mode can prevent user from selecting the selected item again if it is not allowed in certain cases (see screenshot above on the left).
- DISABLE_SELECTION mode means the selected items will be shown as disabled. User cannot select them anymore but they can still see them in the right table to show user a complete unchanged table (see screenshot above on the right).
- KEEP_SELECTION mode will not change the right table at all when items are selected. This is the only mode that can result in duplicated items to be selected. If that's what you want in your situation, this mode is the one you should use.

Here is the list of features that *DualTable* supports.

- Powerful selection feature. It allows single selection, multiple selection and multiple interval selection on either list.
- Powerful reorder feature. After selecting the items, you can rearrange them to the order you want though move up and move down actions. You can select multiple items and rearrange them all at once.
- Complete keyboard support.
    a. UP/DOWN/PAGE_UP/PAGE_DOWN keys to select items in either list.
    b. LEFT/RIGHT/ENTER keys to move items between the two lists.
    c. CTRL-UP/CTRL-DOWN keys to move selected items up and down in the selected item list. CTRL-HOME/CTRL-END keys to move selected items to the top or the bottom.
- Buttons to select and reorder the items. Each button can be shown or hidden independently.
- Complete API support to do everything you can do through the UI.
- Mode support. The same *DualListModel* instance can be set to two or more *DualList*s, and all the *DualList*s will be synchronized because they are using the same model.

Classes, Interfaces and Demos

Classes	
DualTable (com.jidesoft.grid)	The main class for this component.
DualListModel (com.jidesoft.list)	The model class for *DualList*, the same as in DualList
AbstractDualListModel	Abstract implementation of *DualListModel*.

(com.jidesoft.list)	
DefaultDualListModel (com.jidesoft.list)	Default implementation of *DualListModel*.
TableModelAdapter	An interface which can adapt a list model to a table model
Demos	
DualTableDemo (examples\G31. DualList)	A demo to demonstrate the *DualTable.* It selected from a table of tasks.

Code Examples

8. To create a *DualTable*.

```
DualTable dualTable = new DualTable(Object[] or java.utils.List, a TableModelAdapter);
```

9. The call above will create an *AbstractDualListModel* internally. To create a DualTable with your own DualListModel, do

```
DualTable dualTable = new DualTable (DualListModel, a TableModelAdapter);
```

10. To select a few items using API. The code below will select the 2nd and 4th items from the original list model.

```
DualListModel model = dualTable.getModel();
model.addSelectionInterval(1, 1);
model.addSelectionInterval(3, 3);
```

11. To move all items to the right table. In the other word, select all items.

```
dualTable.moveRight();
```

12. To get the list of selected items.

```
Object[] items = dualTable.getSelectedValues();
```

13. To change the selection mode. The selection mode can be REMOVE_SELECTION, KEEP_SELECTION or DISABLE_SELECTION.

```
dualTable.setSelectionMode(selectionMode);
```

or

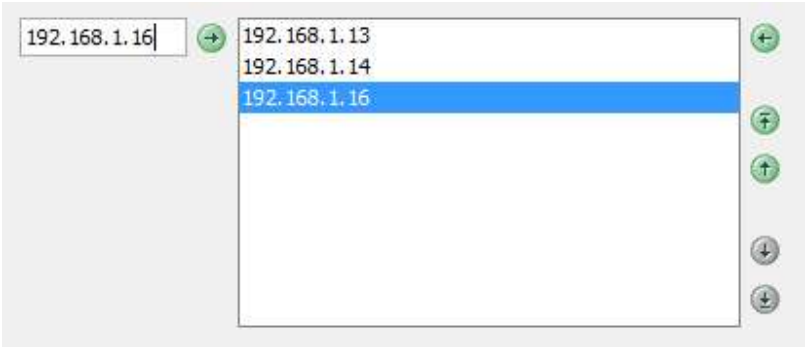
```
dualTable.getModel().setSelectionMode(selectionMode);
```

14. To show or hide one of the buttons in the middle. The first parameter is the command name. They are all defined in *DualList* beginning with *COMMAND_*.

```
dualTable.setButtonVisible(DualTable.COMMAND_MOVE_ALL_RIGHT. true or false);
```

TextFieldList

Features of TextFieldList



TextFieldList belongs to the same family of *DualList* and *DualTable* which tranfers object from one component to a list. It contains a *JTextField* on the left and a JList on the right and a bunch of buttons. The customer can input new items in the JTextField on the left and press the transfer button to move it to the list on the right.

You could override *isInputValid(String*) to control which kind of inputs are allowed to be transferred to the list.

Magin Area

Magin is a thin vertical stripe that can be added next to any component that can be tall. For example, any component with a vertical scroll bar such as JTable, JList, JTree, JTextArea, CodeEditor etc. Usually the content in margin area will scroll vertically along with the content in the component. A typical example is line/row number margin.

MarginArea is the container for margins. You can place a MarginArea to the left hand side of a tall component then add many margin components into this MarginArea using *addMarginComponent(Margin magin)*.

MarginSupport and RowMarginSupport

There are common things to JTable, JList, JTree, JTextArea and CodeEditor. All of them could be very tall and thus need a vertical scroll bar. This is the reason a margin could be useful. All of them also have a row concept. That's why they can use row-based margins. In order to provide the support for all of them without referring to the specific component in the margin code, we introduced two interfaces called *MarginSupport* and *RowMarginSupport*. *RowMarginSupport* extends *MarginSupport*. Further more, we created an implementation of *RowMarginSupport* for each component. See below.

Create your own margin

All margins must implement an interface called *Margin*. We provide *AbstractMargin* which implements most of the methods in *Margin*. We also provide AbstractRowMargin to make the implementation of row-based margin easier.

Margin should paint itself completely instead using any child components. You don't want to add child components to margin mainly because the margin will scroll along with the text in code editor and is usually very tall. You don't want to deal with any child components or layout manager for this particular component. Taking line number margin for example: say we have a code editor has 1000 lines and 100 lines are visible in the view port, you of course can create 1000 *JLabel*s and add them to the margin. Or you can paint the 100 strings on fly just for the visible 100 lines. Obviously the second approach is much more efficient. *Margin* has *paintMargin* method whichs you must implement in order to paint the margin.

There are two categories of margins – row margin or non-row margin. Sometimes we refer row as line which is more suitable for the case of CodeEditor or TextArea. But row or line are esseitnally basically the same thing.

The row margin paints its content row by row. A typical example in this category is the row or line number margin. Each painting code will just paint the rectangle area belong to that row. In this case, we created *AbstractRowMargin* to make it simple. You need to implement the *paintRowMargin* method in its subclass. Internally, we implemented the *paintMargin* method on *Margin* interface and delegate to *paintRowMargin* to paint line by line. As you can see below, all you need to do is to paint the content for a particular line at the specified rectangle. You should never paint it outside the rectangular area.

```
    public void paintRowMargin(Graphics g, Rectangle rect, int row) {
        int lineNumber = ((RowMarginSupport)
_marginSupport).visualRowToActualRow(row) + 1;
        if (lineNumber <= ((RowMarginSupport) _marginSupport).getRowCount()) {
            String s = "" + lineNumber;
            g.setColor(getForeground());
            g.setFont(getFont());
            g.drawString(s, rect.x + rect.width - getFontMetrics(getFont()).stringWidth(s) - 3,
rect.y + (rect.height + getFontMetrics(getFont()).getAscent() -
getFontMetrics(getFont()).getDescent()) / 2);
        }
    }
```

There are many margins in this category. Breakpoint margin and bookmark margin are two more such examples.

The non-row margin is the opposite of the first category. It is not limited by one row but ranges one or several rows. In this case you don't want to paint row by row but paint it across many row. A typical example is code folding margin in CodeEditor. As the code folding ranges from a start line to an end line, you just paint the whole range in one shot. For the margins in this category, you need to extend *AbstractMargin* directly and implements the *paintMargin* method. For performance reason, you should check the first visible line of the code editor and the total visible line count. If you know you will paint outside the visible area, just don't paint.

RowNumberMargin

Now let's cover look at an example. Here is the *RowNumberMagin*. Row*NumberMagin* extends *AbstractRowMargin* as you may expect.

Figure 47 RowNumberMargin

Here is the code to create the UI above.

```
RowMarginSupport marginSupport = new ListRowMarginSupport(list, listScrollPane);
MarginArea marginArea = new MarginArea();
marginArea.addMarginComponent(new RowNumberMargin(marginSupport));
```

The code is very simple. All we did is to create a *RowMarginSupport*, in this case, it is a *ListRowMarginSupport* as the component is a JList. Then we create a *RowNumberMargin* that takes any *RowMarginSupport*. Because of this *RowMarginSupport* interface, we can easily extend it to support many other components that have vertical scroll bar.

MarginPainter and LineMarginPainter

At the beginning, you most likely use one margin for one purpose. But sooner or later, you will find out that's a waste of screen space. You will start to think if you can combine several margins that are not very busy into one margin. See screenshot below for an example. What you see here is a brace matching margin over the code folding margin. Code folding margin could be very busy but brace matching is not because there is only one brace matching at one time. So it's a perfect use case to paint the brace matching over the code folding to save some space.

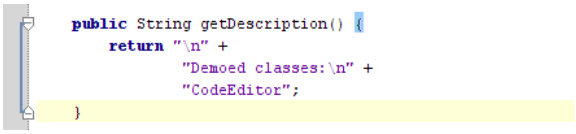


Figure 48 An example of MarginPainter

Now let's see how we do this. We added *addMarginPainter* method on *AbstractMargin*. Assuming you will extend *AbstractMargin* in your margin. If so, you can add your own *MarginPainter* to it.

MarginPainter is a painter interface which can paint the margin area. This painter is mainly used to add extra content to an existing margin. You can add many *MarginPainter*s to *AbstractMargin* In order to decide the order to paint them, each *MarginPainter* has layer index.

The lower the layer index is, the earlier it gets painted. In the other word, the painter has a higher index will overwrite those that have lower index. The default layer index is defined as *LAYER_DEFAULT_INDEX* in *MarginPainter* interface. The original content of the margin is painted on this layer. For example, in code folding margin, code folding information is painted on the layer of index *LAYER_DEFAULT_INDEX*. If you want to your painter painted before code folding information, use a layer index smaller than *LAYER_DEFAULT_INDEX*. If you want it painted after the code folding, use an index larger than *LAYER_DEFAULT_INDEX*.

Here is the code of how to adding a margin painter. The result is what the screenshot above shows.

```
CodeFoldingMargin margin = new CodeFoldingMargin();
margin.addMarginPainter(new BraceMatchingMarginPainter());
editor.getMarginArea().addMarginComponent(margin);
```

MarginPainter is mainly for non-line margin. For line margin, there is *addLineMarginPainter* on *AbstractLineMargin*. It is almost the same as *MarginPainter* except it just paints the rectangle area of a particular line.

CodeFoldingMargin

CodeFoldingMargin is a special margin that paints the code folding information. We mentioned it several times when we cover the basic of margin. Now let's say how to use it.

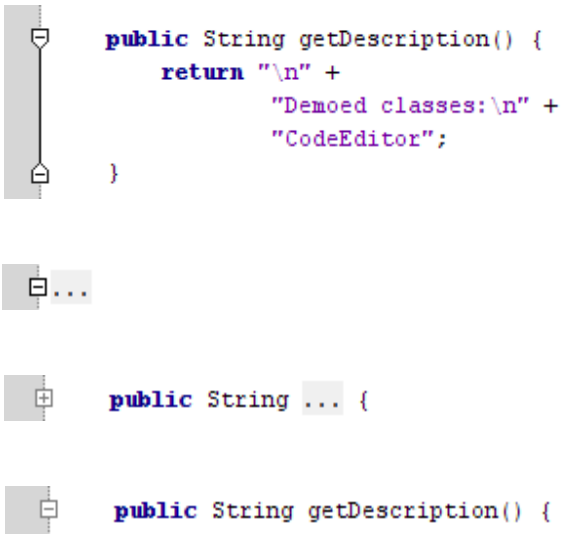


Figure 49 CodeFoldingMargin

As you can see from the screenshot above, each code folding has a start and an end (the 1st screenshot above). Then there is a line between them to connect them. When it is folded, there is just one icon to indicate where the folding is (the 2nd screenshot above), or when the code folding starts and ends on the same line, you will only see one icon when it either expanded or collapsed (the 3rd and 4th screenshots above).

In order to allow you to customize how the code folding is painted, we added *setCodeFoldingPainter* to allow you set a *CodeFoldingPainter*. *CodeFoldingPainter* has all methods you can implement in order to paint each part of the code folding. Here are a few examples after we set our own customized painter.

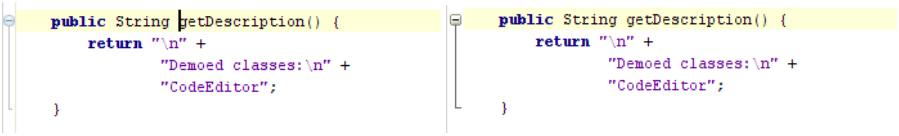


Figure 50 Different CodeFoldingPainter to mimic Eclipse and NetBeans

Marker Area

MarkerArea is a special area on the right side of a tall component, after the vertical scroll bar. See the picture on the right for an example. Since it appears outside the scroll bar, it doesn't scroll with the content. Both MarkerArea and MarginArea are for tall component that needs vertical scroll bar. However the MarkerArea doesn't change when scrolling v.s. the MarginArea will change content while scrolling.

The main usage of MarkerArea is to use limit vertical space to display a condense information for this tall component so that user has an overview of what's going on inside this tall component. For example, a table data is constantly updating (such as a table that displays real time data). If the updating rows are not in the viewport, you will miss them. In this case, you can use the MarkerArea to show a color line or color lines (called marker) to indicate a row or some rows are updating. Since the MarkerArea is not scrolling, you can always see the markers. Similar usages are highlights, errors, todo's. Users not only can see all of the makers of the table in one shot but also can click on the marker on the marker stripe and jump right to the row.

MarkerSupport

In order not to refer to a specific component in *MarkerArea*, we introduced two interfaces *MarkerSupport*, similar to what we did in the margin area. While *AbstractMarkerSupport* simply provdes a *MarkerModel* in the implementation, while *AbstractRowMarkerSupport* assumed the component has the same row height for all the rows so that it can implement indexToPoint and pointToIndexRange methods when giving the row height and the row count. We created an implementation of *MarkerSupport* for the specific component. See below.

Marker and MarkerModel

From data point of view, *Marker* represents a range of elements in the component and the status associated with the elements. It has a start offset and an end offset. By default, there are two types of markers - error and warning. But you can always define your own types of markers. You can also associate a tool tip with a marker. The tool tip will be shown when user mouse moves over the marker stripe.

MarkerModel is the model class that stores all the markers. You can use this class to add/remove/update markers. The change will be shown on the *MarkerArea* immediately.

Marker Eye and Marker Stripes

MarkerEye is at the top of the marker area. It indicates the inspecting status. The paint of *MarkerEye* is done by a class called *MarkerEyePainter*. By default, *DefaultMarkerEyePainter* is used. You can always set your own painter by calling *setPainter(MarkerEyePainter)*.

MarkerStripe is a panel below the *MarkerEye* to display all the markers in a marker model. The paint of each stripe is done by a class called *MarkerStripePainter*. By default, *DefaultMarkerStripePainter* is used. You can always set your own painter by calling *setPainter(MarkerStripePainter)*.

MarkerArea

MarkerArea is the component that displays the marker. It accepts any *MarkerSupport* in the constructor. Internally it will use *MarkerEye* and *MarkerStripe* to display the markers.

There are many methods on *MarkerArea*. Ideally you shouldn't call methods on *MarkerEye* and *MarkerStripe* directly as the *MarkerArea* should have the methods that delegate to these two sub-components.

Marker has different types. You can register the types with *MarkerArea* using *registerMarkerColor*. Please choose colors consistently inside your application. For example, if yellow means changes in your application, register yellow as the marker color for change markers. *DefaultMarkerStripePainter* will use the registered color to paint the marker. Of course if you set your stripe painters, you can do whatever you want for each marker type.

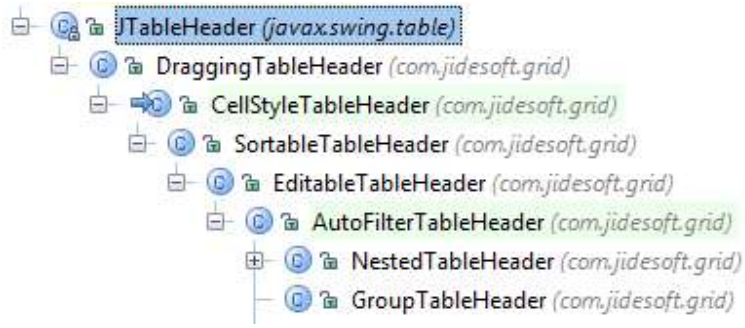
TableHeaders

JTableHeader is the Swing class for the header of a *JTable*. In order to support various features in JIDE Grids, we have to enhance the *JTableHeader*. For example, SortableTable needs to paint a sort arrow onto the header. AutoFilter feature needs a drop down button on the header. Nested table header requires a header that supports mutliple rows and the grouping. Then for the GroupTable, we need a header that supports drag-n-drop to group the columns. People also have requirements to show multiple line text or bold/italic text on the header. We gradually added some of the features mentioned above, i.e. using header cell renderer for the sort arrow and drop down button. However it has the limitation because usig cell renderer will

break the native look of the header on Windows and Mac OS X. These table headers will look different from the standard table header. We also couldn't support both nesting and auto filter feature, or both drag-n-drop grouping and auto filter feature on one table header. All those limitations forced us to look into a redesign. Since JIDE 3.x release, we overhauled the design of table header related features.

Table Header Hierarchy

This is the table header hierarchy. It is now a single hierarchy until the last level. As you can see, *NestedTableHeader* and *GroupTableHeader* is also an *AutoFilterTableHeader*.

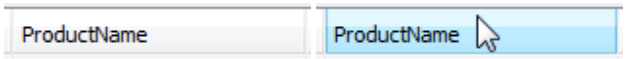


TableHeaderCellDecorator

Instead of using the cell renderer approach in the old design, we introduce a new approach which we haven't seen in any other projects. *TableHeaderCellDecorator* provides a way for users to paint over the margin of any table header's cells. You can use it on any table headers that is a *SortableTableHeader*. You just need to call addCellDecorator to add your own cell decorator. The added order of the cell decorator matters. The first cell decorator that is added will paint first. Because each cell decorator will reserve a margin from the cell rect for its painting, the next cell decorator will get a smaller cell rect.

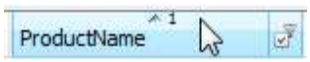
We used this cell decorator for both SortableTable's sorting arrow as well as the drop down button for the auto-filter feature.

For example, here is how the default table header looks like on Windows 7. The left one is the default state and the right one is the rollover state.



Our goal of the cell decorator is to keep the look exactly the same as the default one. And here is what it looks after we use cell decorator to add a filter icon to the header. As you can see, the look is very consistent.

Note that we can also painting both sort arrow and the filter icon which was not possible in the earlier design. See below.



Not only that we are using *TableHeaderCellDecorator*, but also it is a public API, which means you can also use this feature to decorate your table header.

Please take a look at the screenshot below which were taken under different OS and L&Fs.

Figure 51 TableHeader under different L&Fs and OS

StyledLabel Powered TableHeader

Since JIDE 3.2 release, we optionally use *StyledLabel* to paint the text for the table header. This is no API changing for this feature. It is hidden behind the column name as defined in *TableModel*'s *getColumnName(int column)*. You can use an annotated string that is available in *StyledLabelBuilder*. If you return a regular string without any annotation, *JLabel* is used to paint the cell. But if you use an annotated string that *StyledLabel* can recognize, *StyledLabel* is automatically used.

You can add a lot of interesting styles to your header. Here is a show-off example that has absolutely no real meaning. You can make it more meanful. For example, show a bold text on the header if the column is sorted.

Here is the code for it.

```
@Override
public String getColumnName(int column) {
  switch (column) {
    case 0:
      return "Java{TM:sp}";
    case 1:
      return "CO{2:sb}";
    case 2:
      return "{Waved:w}";
    case 3:
      return "{Red:f:red} {Blue:f:blue}";
    case 4:
      return "{Red:b:red} {Blue:b:blue}";
```

```
            case 5:
                return "{Bold:b} {Italic:i}";
            case 6:
                return "{Strike:s} {Double-strike:ds}";
        }
        return "";
    }
```

We also support text wrapping. You just need to enabled it using the global flag feature introduced to *StyledLabel*. For example, to enable text wrapping on column "this is a long text", you can return "this is a long text@r:2:1:4". Everything after "@" symbol is considered as global flags. You can have multiple flags separated by ",". "r:2:1:4" means it will do row wrapping, by default is 2 rows, minimum 1 rows and maximum 4 rows.

HeaderStyleModel and CellStyleTableHeader

Another way to bring style to the header is to use *HeaderStyleModel*. *HeaderStyleModel* uses a similar approach as *CellStyleModel*. You again implement *HeaderStyleModel* on your table model and you return the *CellStyle* you want in *getHeaderStyleAt* method.

Pretty much all styles available in *CellStyle* is available on *CellStyleTableHeader*. See below for an screenshot.

Figure 52 HeaderStyleModel

TableCellEditorRenderer

JTable uses something called cell renderer and cell editor for cell rendering and editing respectively. For the same cell, the renderer component is usually difference from the editor component. For example, most cell renderer components are *JLabel*. But to edit a cell, *JTextField* is usually used as the cell editor component. However, in some cases, maybe we want the same component to be used for both the renderer component and the editor component. That's why we introduced *TableCellEditorRenderer* so that you can use the same component for both renderer and editor.

Why do we want the same component use the same component as both editor and renderer? There are at least two reasons.

To better indicate the cell is editable

JTable renderers the cell using *JLabel* by default. Editable cells have no visual difference from non-editable cells. Users have to click or double click on the cell to figure out if the cell is editable. So some users will prefer to have a different way to renderer the cell to indicate it is editable. JIDE Grids provides cell style which is one way to make it happen as you can use CellStyle to make the editable cells having white background and non-editable cells gray background. Another way is to this *EditorRenderer* approach and use editors such as JTextField or JComboBox/ExComboBox as the renderer. If users see a drop down button on the cell, they know the cell will be editable without clicking on it.

To interactive with mouse events on the cell level

As you know already, *JTable* paints the cell, not places a real component on the cell. That's why it was called a cell renderer. When you moves your mouse over a cell, the mouse events will not interactive with the cell renderer component because it is just a painted image. For example, if you use as JButton as cell renderer and JButton, if placed in a JPanel, will a rollover effect, but the rollover effect will not work in *JTable*. Clicking on the button-based cell renderer will not trigger the button action either. Because of this, it was always a challenge to implement hyperlink type of features in *JTable*. The cell editor, on the other hand, is a real component that is placed on the cell. So it will interactive with mouse events. This is a hint. To implement hyperlink, we can use this *EditorRenderer* so that the renderer and the editor use the same hyperlink button. We can add a mouse listener to *JTable*. When JTable is over a cell, we automatically and silently enter cell editing mode. Since the renderer and the editor are the same, user won't even notice the cell is in editing mode when rollover.

Sounds easy? Right, except there is one minor issue. JTable only allows one cell to be editing at a time. So we start the cell editing automatically, the previous editing cell has to stop editing. It might not be a problem if the table doesn't contain any editable cells other than hyperlinks. But unfortunately in most cases, it is not true. You certainly don't want the cell stop editing automatically when user simply moves the mouse. To fix this issue, we introduced a new *rolloverCellAt* method to *JideTable*. This method works just like *editCellAt* except it doesn't involve with the existing cell editing mechanism. When you call *rolloverCellAt*, a cell editor will be created and placed over the cell. However the old cell editor, if it has one, will remain there. This way user can still do cell editing while having mouse interaction over other cells.

Hyperlink in Cell

This is probably one of the most asked features but so far we haven't seen anyone did it right. There was post at http://java-swing-tips.blogspot.com/2009/02/hyperlink-in-jtable-cell.html but it is a very bad example. It calls table.repaint() in mouseMoved method. Is it the reason people think Swing is slow? It is of course very tempting to copy an existing example from web but you really need to cautious about you are copying.

The approach we took for the hyperlink feature is to use both editor component and renderer component. We created a new class called *HyperlinkTableCellEditorRenderer*. It uses JideButton as the hyperlink component. The action listener can be set. We didn't use *CellRendererManager* in this case as this renderer/editor is probably will only be used for this

particular table because of the customized action listener thing. That's why we simply set it to *TableColumn*. Note that we set it for both the cell renderer and cell editor.

```
HyperlinkTableCellEditorRenderer renderer = new HyperlinkTableCellEditorRenderer();
renderer.setActionListener(new ActionListener() {
        @Override
        public void actionPerformed(ActionEvent e) {
          Object source = e.getSource();
          JOptionPane.showMessageDialog(table, ((JideButton) source).getText() + " is
clicked");
        }
});
table.getColumnModel().getColumn(0).setCellRenderer(renderer);
table.getColumnModel().getColumn(0).setCellEditor(renderer);
```

The next thing you need to do is to use a util class called *RolloverTableUtils*. This util has a install method which will add a mouse motion listener to the *JTable*. The listener will automatically force a cell to enter editing mode or the rollover mode when the mouse is over the cell. Once the cell is editing or rollover mode, the componet itself will reponse to mouse event thus you see the cursor change as well as clicking will trigger the action. editing.

```
RolloverTableUtils.install(table);
```

Here is what it looks like.

Figure 53 Hyperlink in JTable

This approach has absolutely no performance problem as the link above has. The only extra thing we did is to check if the cell should enter editing mode which is very fast. You can refer to the JavaDoc of *RolloverTableUtils* for more information.

You can also use JButtons in *JTable* that act like real buttons. by using ButtonTableCellEditorRenderer. The usage is exactly the same as the hyperlink example. If you want to have mutliple buttons in the same cell, that's also covered. The HyperlinkCellDemo has an example of it (refer to the second column in the table above which contains cells with two buttons in each cell).

Internationalization and Localization

We have fully considered i18n and l10n. All strings used by *JIDE Grids* have been put into properties files under each package. Some users contributed localized version of those files and we put those files inside jide-properties.jar. If you want to support languages other than those we provided, just extract those properties file, translated to the language you want, add the correct postfix and then jar them back into jide-properties jar. You are welcome to send the translated properties file back to us if you want to share it.