Developers Guide

Authors

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Introduction

Codename One is a set of tools for mobile application development that derive a great deal of its architecture from Java. It stands both as the name of the startup that created the set of tools and as a prefix to the distinct tools that make up the Codename One product.

The goal of the Codename One project is to take the complex and fragmented task of mobile device programming and unify it under a single set of tools, APIs and services to create a more manageable approach to mobile application development without sacrificing development power/control.

History

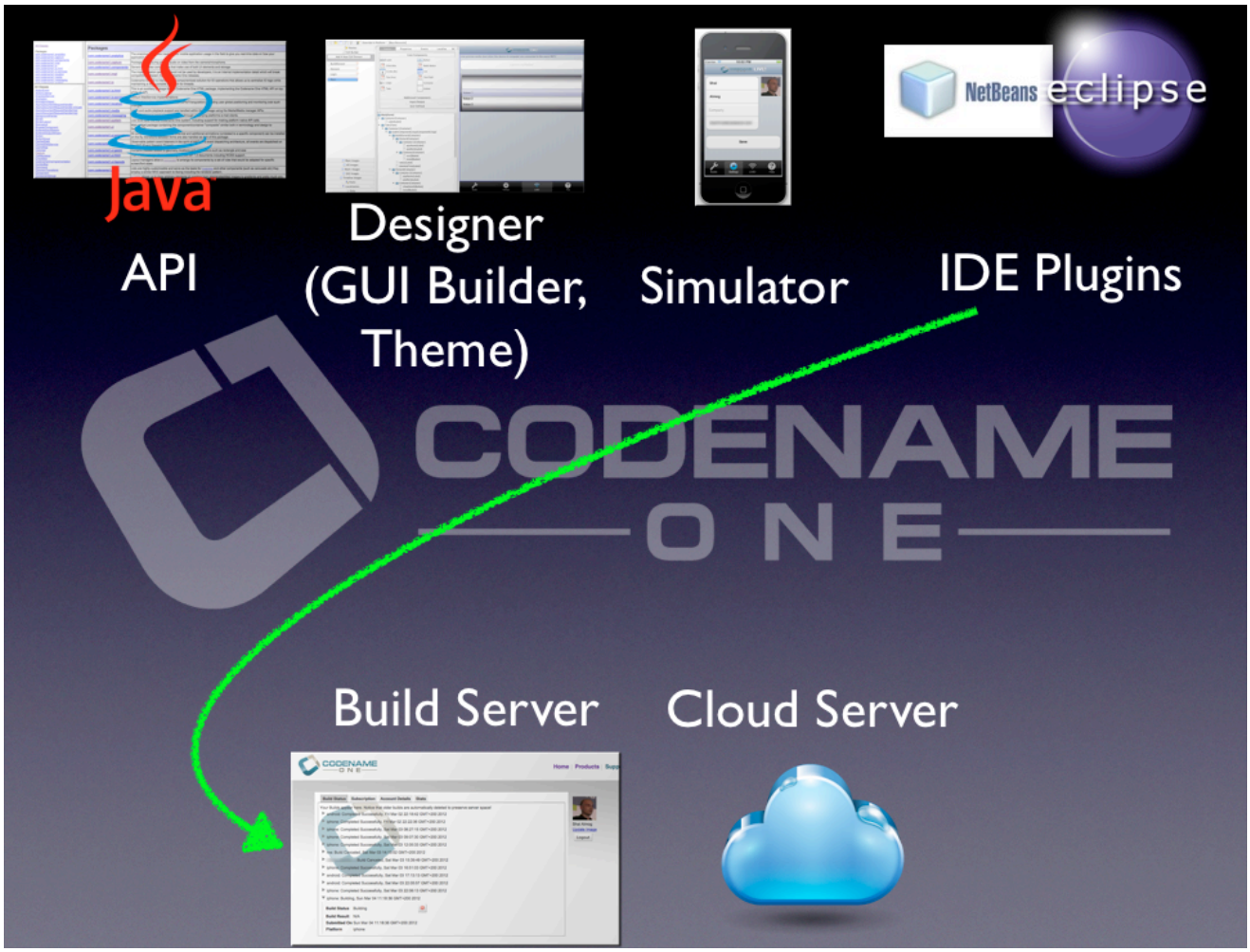
Codename One was started by Chen Fishbein & Shai Almog who authored the Open Source LWUIT[1] project at Sun Microsystems starting at 2007. The LWUIT project aimed at solving the fragmentation within J2ME/Blackberry devices by targeting a higher standard of user interface than the common baseline at the time. LWUIT received critical acclaim and traction within multiple industries but was limited by the declining feature phone market. In 2012 the Codename One project has taken many of the basic concepts developed within the LWUIT project and adapted them to the smartphone world which is experiencing similar issues to the device fragmentation of the old J2ME phones.

How Does It Work

Codename One has 4 major parts: API, Designer, Simulator, Build/Cloud server.

- API - abstracts platform specific functionality
- Designer - allows developers/designers to design the GUI/theme and package various resources required by the application
- Simulator - allows previewing and debugging applications within the IDE
- Build/Cloud server - the server performs the build of the native application, removing the need to install additional software stacks.

[1] See http://lwuit.blogspot.com/ http://lwuit.java.net/



Codename One unifies the pieces illustrated above allowing developers to use them as a single coherent product. When building the final native application the build server produces the actual native application removing the need for a dedicated machine/installation.

Lightweight UI

The biggest differentiation for Codename One is the lightweight architecture which allows for a great deal of the capabilities within Codename One. A Lightweight component is a component which is written entirely in Java, it draws its own interface and handles its own events/states. This has huge portability advantages since the same code executes on all platforms, but it carries many additional advantages.

The components are infinitely customizable just by using standard inheritance and overriding paint/event handling. Theming and the GUI builder allow for live preview and accurate reproduction across platforms since the same code executes everywhere.

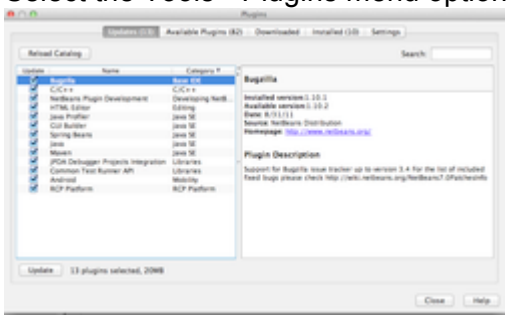
Installation

Installing Codename One In NetBeans

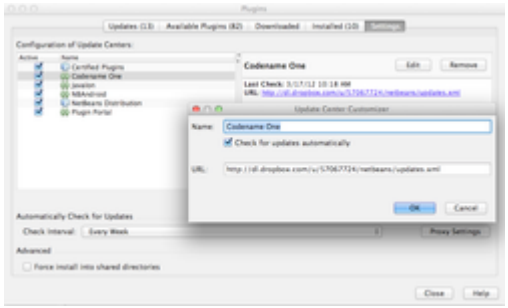
For the purpose of this document we will focus mostly on the NetBeans IDE for development, however most operations are almost identical in the Eclipse IDE as well. For instructions specific for Eclipse please go to the following section.

These instructions assume you have downloaded NetBeans 7.x,installed and launchedit.

Select the Tools->Plugins menu option & select the Settings tab

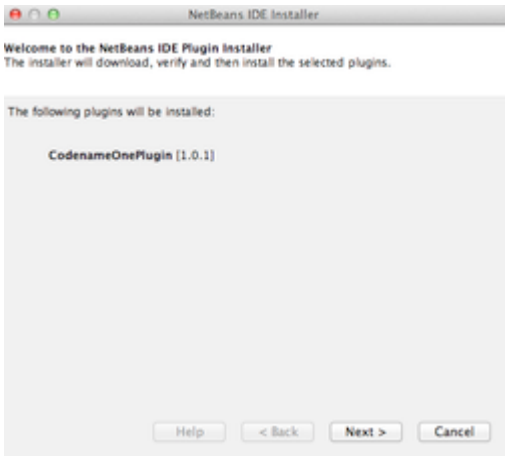


Click the "Add" button & enter the details below



For the name enter: Codename One
For the URL enter: http://dl.dropbox.com/u/57067724/netbeans/updates.xml

In The Available Plugins Tab Click "Reload Catalog" Then Check The CodenameOne Plugin

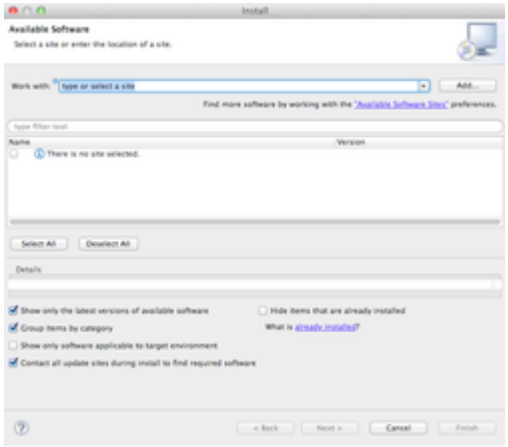


After that click the install button bellow. Follow the Wizard instructions to install the plugin

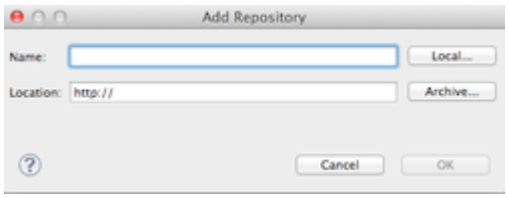
You will be informed that the plugin is unsigned which is indeed true, you just continue anyway.

Installing Codename One In Eclipse

Startup Eclipse and click Help->Install New Software. You should get this dialog

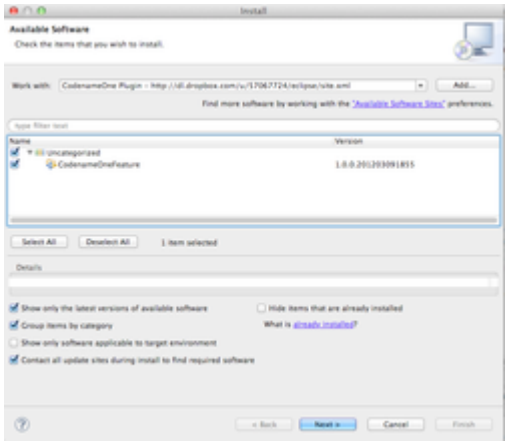


Click the Add button on the right side & fill out the entries



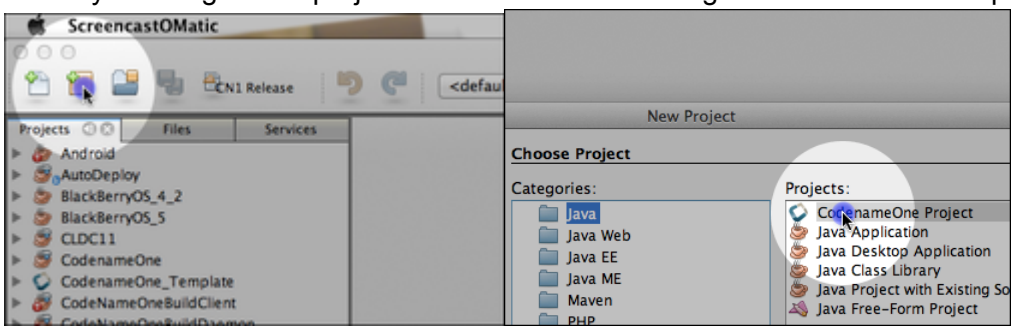
Enter Codename One for the name & http://dl.dropbox.com/u/57067724/eclipse/site.xml for the location.

Select the entries & follow the wizard to install

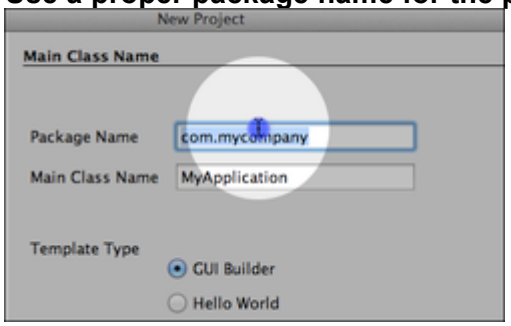


GUI Builder Hello World

Start by creating a new project in the IDE and selecting the Codename One project.

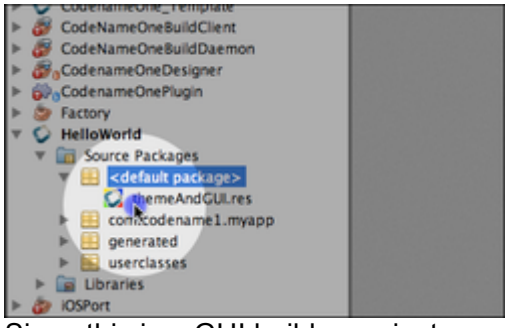


Use a proper package name for the project!

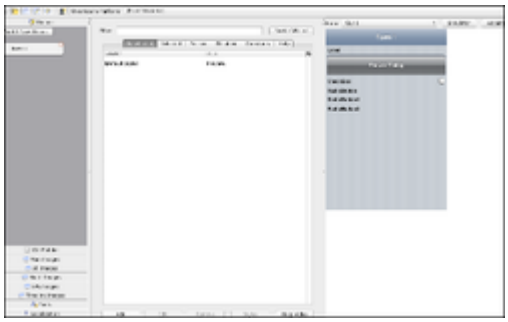


It is important to use proper package names for the project since platforms such as iOS & Android rely on these names for future updates. They are thus painful to change! The convention is the common Java convention of reverse domain names (e.g. com.codenameone for the owner of codenameone.com etc.).

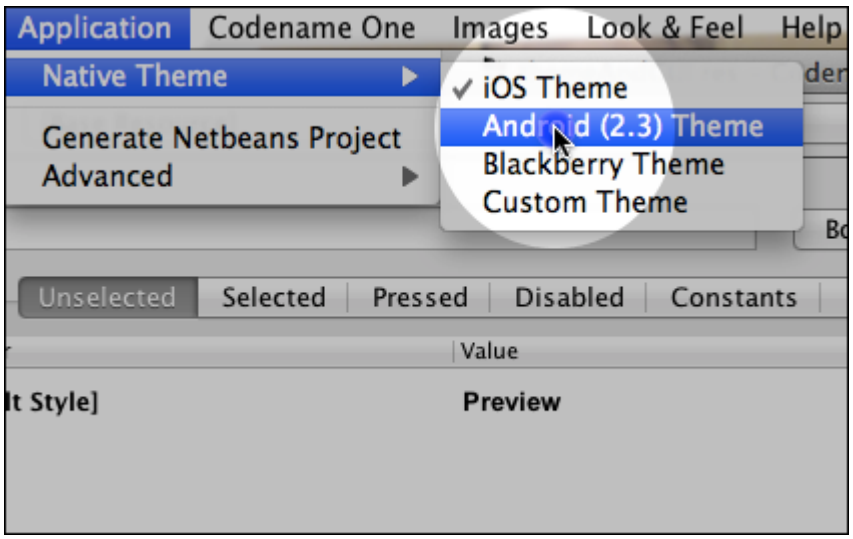
By default a GUI builder project is created, we will maintain this default for the purpose of this hello world.



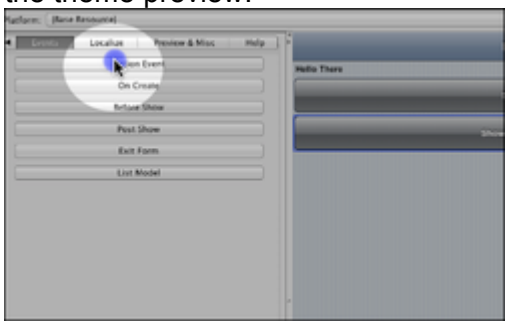
Since this is a GUI builder project you can open the Codename One Designer with the content of the themeAndGUI.res file by double clicking the file. FYI: If you choose to rename this file in the future it is important to update the resource file name in the project properties settings.



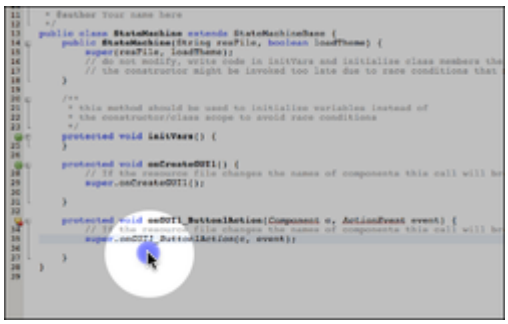
Within the Codename One Designer we can see several categories the most interesting of which are theme & GUI. We will start by opening the theme section and clicking the entry there. The default Codename One theme, derives from the platform native theme. We can easily change the "base theme" in the preview to see how the theme will act in different devices by clicking the native theme option in the application menu as such.



To edit the UI for the application we need to select the GUI section and click “GUI 1” within that section. We are then faced with a drag and drop interface to manipulate the GUI of the application we saw within the theme preview. All changes made here are reflected instantly to the theme preview.

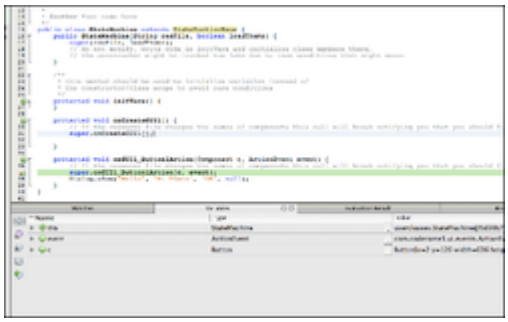


The GUI builder allows us to bind events, we will drag a new button into the GUI and use this functionality to select the button from the GUI and then add an action event to a button listener to a button..

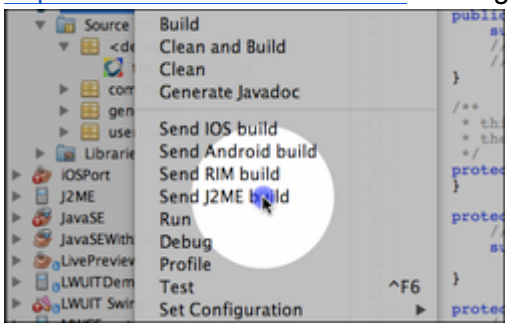


Clicking the action event button creates a new method within the IDE which we can can use to bind functionality to the button. Within the code we show a dialog by adding the code:
Dialog.show("Hello", "Hi There", "OK", null);

If we inspect the Codename One project to some degree we will notice that it is pretty close to a standard Java project hence it can be modified/used in very similar ways. You can use the debugger and most refactoring functionality as usual. **Notice** that you should not change the classpath settings for the project since library support is a more complex issue than just modifying the classpath!
Furthermore, if you change package/class names for some of the core classes you will need to update the project settings accordingly.



In order to get a native application for the devices you need to send a build to the build server. Before you get started you will probably need to read the signing section of this guide in order to produce an actual working application. Right click the project and select the device type for which you wish to build. If you haven't registered in the build server just visit http://www.codenameone.com/ and signup for free to get an account there!



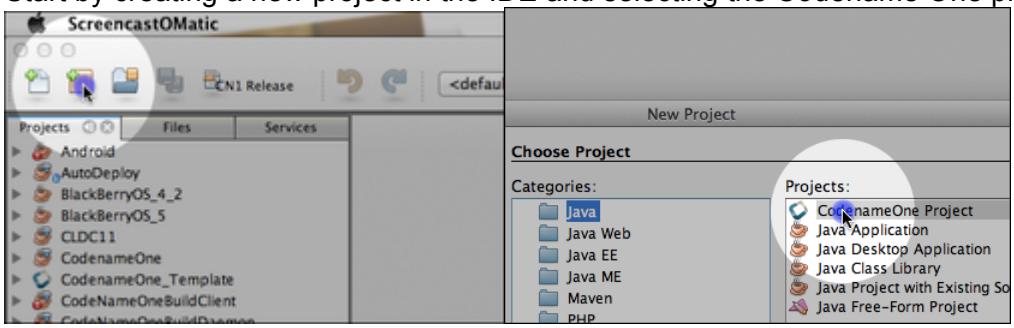
Within the build server at http://www.codenameone.com/ you can follow the status of your current build.

In the build server we can follow the progress of the build and the results for the current build. We can email a link to the deployment files, download them or use a QR reader to install them to the phone. The Codename One LIVE! application allows following the status and installing applications directly from the build server.

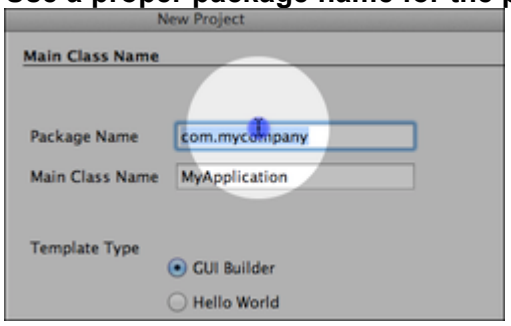
Manual Hello World

Some developers prefer writing all their code and avoiding the GUI builder like a plague, for them this tutorial covers the creation of a hello world application without the GUI builder.

Start by creating a new project in the IDE and selecting the Codename One project.



Use a proper package name for the project!



It is important to use proper package names for the project since platforms such as iOS & Android rely on these names for future updates. They are thus painful to change! The convention is the common Java convention of reverse domain names (e.g. com.codenameone for the owner of codenameone.com etc.).

Make sure to select the Hello World project and NOT the GUI Builder project!

Within your project main class you will see a start method that contains the code:

```
Form f = new Form("Hello World");
```

to add a button to the form that will show a dialog add the following:

```
Button d = new Button(“Show Dialog”);
f.addComponent(d);
d.addActionListener(new ActionListener() {
    public void ActionPerformed(ActionEvent ev) {
        Dialog.show("Hello", "Hi There", "OK", null);
    }
});
```

This will show a dialog when the user clicks the button. You can use the play button in the IDE to run the application.

Basics: Themes, Styles, Components & Layouts

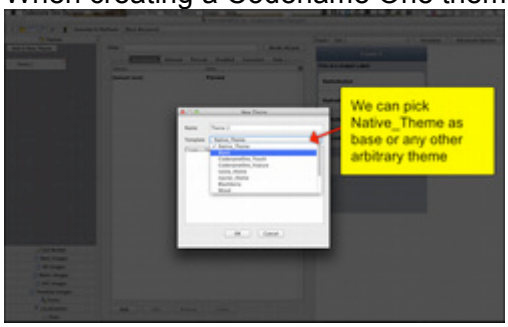
This chapter covers the basic ideas underlying a Codename One application. It focuses mostly on the issues related to UI.

What Is A Theme, What Is A Style & What Is a Component?

Every visual element within Codename One is is a component, the button on the screen is a Component and so is the Form in which it is placed. This is all represented within the Component class which is probably the most central class in Codename One.
The appearance of the component is determined by several style objects, every component has 4 style objects associated with it: Selected, Unselected, Disabled & Pressed.
Only one style is applicable at any given time and it can be queried via the getStyle() method. A style contains the colors, fonts, border, spacing information relating to how the component is presented to the user.
A theme allows the designer to define the styles externally via a set of UIID's (User Interface ID's), the themes are created via the Codename One Designer tool and allow developers to separate the look of the component from the application logic.

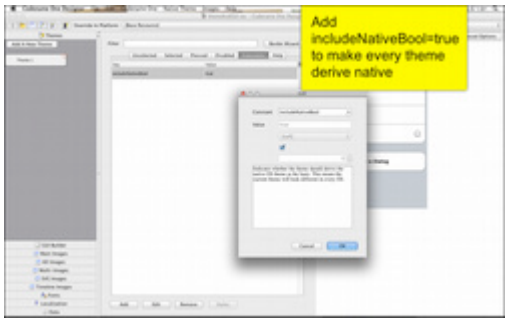
Creating A Native Theme

When creating a Codename One theme the default uses the platform native theme



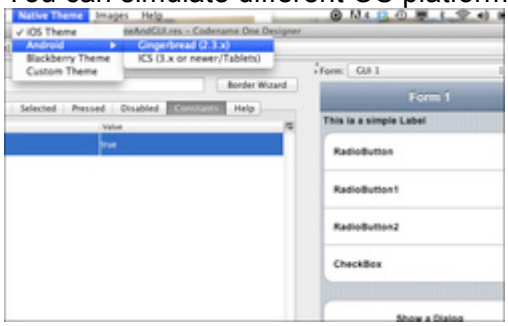
You can easily create a theme with any look you desire or you can "inherit" the platform native theme and start from that point. When adding a new theme you are given the option.

Any theme can be configured to derive a native theme



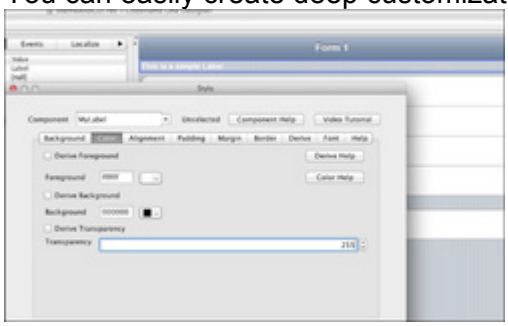
Codename One uses a theme constant called "includeNativeBool", when that constant is set to true Codename One starts by loading the native theme first and then applying all the theme settings. This effectively means your theme "derives" the style of the native theme first, similar to the cascading effect of CSS.

By avoiding this flag you can create themes that look EXACTLY the same on all platforms. You can simulate different OS platforms by using the native theme menu option



Developers can pick the platform of their liking and see how the theme will appear in that particular platform by selecting it and having the preview update on the fly.

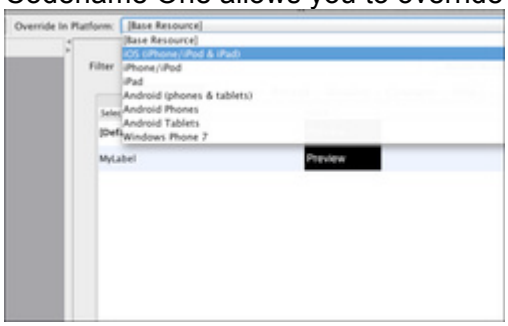
You can easily create deep customizations that span across all themes



In this case we just customized the UIID of a label and created a style for the new UIID. When deriving a native theme its important to check the various platform options to make sure that basic assumptions aren't violated. E.g. labels might be transparent on one platform but opaque

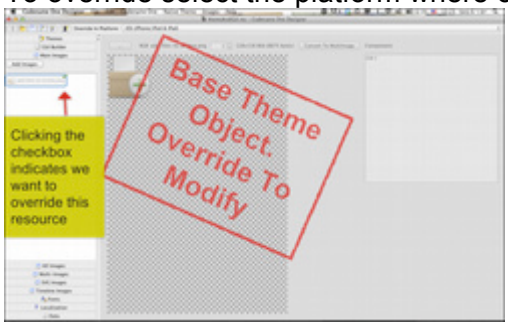
on others. Or labels might look good in a dialog in Android but look horrible in an iOS dialog (hint: use the DialogBody UIID for text content within a dialog).

Codename One allows you to override a resource for a specific platform



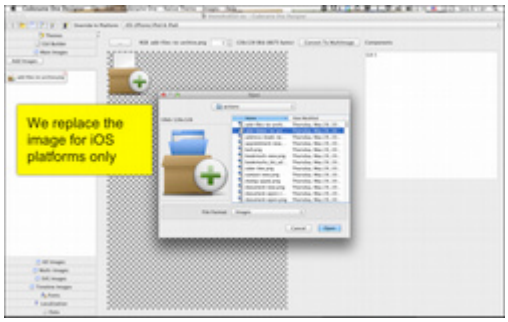
A common case we run into when adapting for platform specific looks is that a specific resource should be different to match the platform conventions. The Override feature allows us to define resources that are specific to a given platform combination. Override resources take precedence over embedded resources thus allowing us to change the look or even behavior (when overriding a GUI builder element) for a specific platform/OS.

To override select the platform where overriding is applicable



Then click the green checkbox to define that this resource is specific to this platform. All resources added at this point will only apply to the given platform. If you change your mind and are no longer interested in a particular override just delete it in the override mode and it will no longer be overridden.

In this case we just select a new image object applicable to this platform



This is easily done by selecting the "..." button. We can easily do the same in the GUI builder although this is a dangerous road to start following since it might end up with a great deal of fragmentation.

Layout Managers

Codename One handles

Layout Animations

To understand animations you need to understand a couple of things about Codename One components. When we add a component to a container its generally just added but not positioned anywhere. A novice might notice the setX/Y/Width/Height methods on a component and just try to position it absolutely.

This won't work since these methods are meant for the layout manager which it implicitly invoked when a form is shown (internally in Codename One) and the layout manager uses these methods to position the components as it sees fit.

However, if you add components to a Codename One Form that is already shown it is your responsibility to invoke revalidate (or layoutContainer) to arrange the newly added components. Codename One doesn't "reflow" implicitly since that would be hugely expensive, imagine doing the layout calculations for every component added to the container the cost would be closer to a factorial of the original cost of adding a component.

The animateLayout() is simply a fancy form of revalidate. After changing the layout when you invoke this method it will animation the components to their new sizes and positions seamlessly.

The first example in the tipster demo shows an "interlace" effect where the components each slide from a separate direction into the screen. This is the code I used before showing the form:

```
f.revalidate();
 for(int iter = 0 ; iter < c.getComponentCount() ; iter++) {
    Component current = c.getComponentAt(iter);
```

```
            if(iter % 2 == 0) {
                current.setX(-current.getWidth());
            } else {
                current.setX(current.getWidth());
            }
        }
        c.setShouldCalcPreferredSize(true);
        c.animateLayout(1000);
```

Lets go over this line by line:

```
f.revalidate();
```

I make sure the layout is valid so I can start from the correct component positions.

```
            if(iter % 2 == 0) {
                current.setX(-current.getWidth());
            } else {
                current.setX(current.getWidth());
            }
```

I manually position every component outside of the screen, if they are odd I place them to the right and if they are even I place them to the left.

```
c.setShouldCalcPreferredSize(true);
```

I mark the UI as needing layout. This is crucial since I validated the UI earlier (by calling revalidate). Changing the X/Y/Width/Height doesn't trigger a validation! Codename One doesn't know I made that change!
By calling setShouldCalcPreferredSize I'm explicitly telling Codename One that I changed something in the UI and I want it to validate, normally this method is implicitly invoked by Codename One.

```
c.animateLayout(1000);
```

Perform the animation over the length of a second, this might seem like much but the animation starts before the form entry transition so it isn't that much.

The other animations are even simpler than this one and all follow the same basic rules, place the components wherever you want either manually (or by changing the layout) and use animateLayout() to automatically rearrange them to the new position.

Signing, Certificates & Provisioning

While Codename One can simplify allot of the grunt work in creating cross platform mobile applications, signing is not something that can be significantly simplified since it represents the developers individual identity in the markets. In this section we attempt to explain how to acquire certificates for the various platforms and how to set them up.

The good news is that this is usually a "one time issue" and once its done the work becomes easier (except for the case of iOS where a provisioning profile should be maintained).

iOS (iPhone/iPad)

iOS signing has two distinct modes: App Store signing which is only valid for distribution via iTunes (you won't be able to run the resulting application without submitting it to Apple) and development mode signing.

You have two major files to keep track of:
Certificate - your signature
Provisioning Profile - details about the application and who is allowed to execute it

You need two versions of each file (4 total files) one pair is for development and the other pair is for uploading to the itunes App Store.

Adobe wrote a pretty decent signing tutorial on this subject for Air which you can pretty much follow to get the files we need (p12 and mobileprovision). Adobe also covers the certificate to p12 conversion process which might be harder if you don't have a Mac.

The first step you need to accomplish is signing up as a developer to Apple's iOS development program, even for testing on a device this is required! This step requires that you pay Apple 99 USD on a yearly basis.

The Apple website will guide you through the process of applying for a certificate at the end of this process you should have a distribution and development certificate pair. After that point you can login to the iOS provisioning portal where there are plenty of videos and tutorials to guide you through the process. Within the iOS provisioning portal you need to create an application ID and register your development devices.

You then create a provisioning profile which comes in two flavors: distribution (for building the release version of your application) and development. The development provisioning profile needs to contain the devices on which you want to test.

You can then configure the 4 files in the IDE and start sending builds to the Codename One cloud.

Android

Its really easy to sign Android applications if you have the JDK installed. Find the keytool executable (it should be under the JDK's bin directory) and execute the following command:
keytool -genkey -keystore Keystore.ks -alias [alias_name] -keyalg RSA -keysize 2048 -validity 15000 -dname "CN=[full name], OU=[ou], O=[comp], L=[City], S=[State], C=[Country Code]" -storepass [password] -keypass [password]

The elements in the brackets should be filled up based on this:
Alias: [alias_name] (just use your name/company name without spaces)
Full name: [full name]
Organizational Unit: [ou]
Company: [comp]
City: [City]
State: [State]
CountryCode: [Country Code]
Password: [password] (we expect both passwords to be identical)

Executing the command will produce a Keystore.ks file in that directory which you need to keep since if you lose it you will no longer be able to upgrade your applications! Fill in the appropriate details in the project properties or in the CodenameOne section in the Netbeans preferences dialog.

For more details see http://developer.android.com/guide/publishing/app-signing.html

RIM/BlackBerry

You can now get signing keys for free from RIM by going here. After obtaining the certificates and installing them on your machine (you will need the RIM development environment for this). You will have two files: sigtool.db and sigtool.csk on your machine (within the JDE directory hierarchy). We need them and their associated password to perform the signed build for Blackberry application.

J2ME

Currently signing J2ME application's isn't supported. You can use tools such as the Sprint WTK to sign the resulting jad/jar produced by Codename One.

Advanced Theming

This chapter covers the advanced concepts of theming as well as deeper understanding of how to build/design a Codename One Theme

Working With UIID

[TODO]

Colors

[TODO]

Backgrounds

[TODO]

Fonts

[TODO]

Borders

[TODO]

Inheritance

[TODO]

Theme Constants

The Codename One Designer has a tab for creating constants which can be used to add global values of various types and behavior hints to Codename One and its compoennts. Constants are always strings, they have some conventions where a constant ending with Bool is treated as a boolean true/false value and a constant ending with Int or Image (for image the string name of the image is stored but the image instance will be returned).

To use a constant one can use the UIManager's methods to get the appropriate constant type specifically:
getThemeConstant
isThemeConstant

getThemeImageConstant

Internally Codename One has several built in constants and the list is constantly growing as we add features to Codename One, we will try to keep this list up to date when possible.

alwaysTensileBool Enables tensile drag even when there is no scrolling in the container (only for scrollable containers though)
centeredPopupBool Popup of the combo box will appear in the center of the screen
checkBoxCheckDisImage CheckBox image to use instead of Codename One drawing it on its own
checkBoxCheckedImage CheckBox image to use instead of Codename One drawing it on its own
checkBoxUncheckDisImage CheckBox image to use instead of Codename One drawing it on its own
checkBoxUncheckedImage CheckBox image to use instead of Codename One drawing it on its own
comboImage Combo image to use instead of Codename One drawing it on its own
commandBehavior Indicates how commands should act, as a touch menu, native menu etc. Possible values: SoftKey, Touch, Bar, Title, Right, Native
ComponentGroupBool Enables component group which allows components to be logically grouped together so the UIID's of components would be modified based on their group placement. This allows for some unique styling effects where the first/last elements have different styles from the rest of the elements. Its disabled by default thus leaving its usage up to the designer.
defaultCommandImage Image to give a command with no icon
dialogButtonCommandsBool Place commands in the dialogs as buttons
dialogPosition Place the dialog in an arbitrary border layout position (e.g. North, South, Center etc.)
dialogTransitionIn Default transition for dialog
dialogTransitionInImage Default transition Image for dialog, causes a Timeline transition effect
dialogTransitionOut Default transition for dialog
dialogTransitionOutImage Default transition Image for dialog, causes a Timeline transition effect
disabledColor Color to use when disabling entries by default
dlgCommandButtonSizeInt Minimum size to give to command buttons in the dialog
dlgCommandGridBool Places the dialog commands in a grid for uniform sizes
dlgSlideDirection Slide hints
dlgSlideInDirBool Slide hints
dlgSlideOutDirBool Slide hints
fadeScrollBarBool Fade transition hints
fadeScrollEdgeBool Fade transition hints
fadeScrollEdgeInt Fade transition hints
firstCharRTLBool Indicates the GenericListCellRenderer should determine RTL status based on the first character in the sentence
fixedSelectionInt Number corresponding to the fixed selection constants in List
formTransitionIn Default transition for form

formTransitionInImage Default transition Image for form, causes a Timeline transition effect
formTransitionOut Default transition for form
formTransitionOutImage Default transition Image for form, causes a Timeline transition effect
hideEmptyTitleBool Indicates that a title with no content should be hidden even if the border for the title occupies space
ignorListFocusBool Hide the focus component of the list when the list doesn't have focus
listItemGapInt Builtin item gap in the list, this defaults to 2 which predated padding/margin in Codename One
menuHeightPercent Allows positioning and sizing the menu
menuPrefSizeBool Allows positioning and sizing the menu
menuSlideDirection Defines menu entrance effect
menuSlideInDirBool Defines menu entrance effect
menuSlideOutDirBool Defines menu entrance effect
menuTransitionIn Defines menu entrance effect
menuTransitionInImage Defines menu entrance effect
menuTransitionOut Defines menu entrance effect
menuTransitionOutImage Defines menu entrance effect
menuWidthPercent Allows positioning and sizing the menu
otherPopupRendererBool Indicates that a separate renderer UIID/instance should be used to the list within the combo box popup
PackTouchMenuBool Enables preferred sized packing of the touch menu (true by default), when set to false this allows manually determining the touch menu size using percentages
popupCancelBodyBool Indicates that a cancel button should appear within the combo box popup
popupTitleBool Indicates that a title should appear within the combo box popup
pureTouchBool Indicates the pure touch mode
radioSelectedDisImage Radio button image
radioSelectedImage Radio button image
radioUnselectedDisImage Radio button image
radioUnselectedImage Radio button image
rendererShowsNumbersBool Indicates whether renderers should render the entry number
reverseSoftButtonsBool Swaps the softbutton positions
slideDirection Default slide transition settings
slideInDirBool Default slide transition settings
slideOutDirBool Default slide transition settings
snapGridBool Snap to grid toggle
tabPlacementInt The placement of the tabs in the Tabs component: TOP = 0, BOTTOM = 2, LEFT = 1, RIGHT = 3
tabsFillRowsBool Indicates if the tabs should fill the row using flow layout
tabsGridBool Indicates whether tabs should use a grid layout thus forcing all tabs to have identical sizes
textCmpVAlignInt The vertical alignment of the text component: TOP = 0, CENTER = 4, BOTTOM = 2
textFieldCursorColorInt The color of the cursor as an integer (not hex)
tickerSpeedInt The speed of label/button etc. tickering in ms.
tintColor The aarrggbb hex color to tint the screen when a dialog is shown

touchCommandFillBool Indicates how the touch menu should layout the commands within
touchCommandFlowBool Indicates how the touch menu should layout the commands within
transitionSpeedInt Indicates the default speed for transitions

One "odd" behavior of constants is that once they are set by a theme they don't get "lost" when replacing the theme. E.g. if one would set the comboImage constant to a specific value in theme A and then switch to theme B that doesn't define the comboImage, the original theme A comboImage might remain. The reason for this is simple, when extracting the constant values components keep the values in cache locally and just don't track the change in value. Furthermore, since the components allow manually setting values its impractical for them to track whether a value was set by a constant or explicitly by the user.
The solution for this is to either manually reset undesired values before replacing a theme (e.g. for the case above by calling the default look and feel method for setting the combo image with a null value) or defining a constant value to replace the existing value.

How Does A Theme Work

[TODO]

Working With The GUI Builder

Basic Concepts

The basic premise is this: the designer creates a UI version and names GUI components, he can create commands as well including navigation commands, exit, minimize. He can also define a long running command which will by default trigger a thread to execute...

All UI elements can be loaded using the UIBuilder class. Why not just use the Resources API?

Since the Resources class is essential for using Codename One, adding the UIBuilder as an import would cause any application (even those that don't use the UIBuilder) to increase in size! We don't want people who aren't using the feature to pay the penalty for its existence!

The UI Builder is designed for use as a state machine carrying out the current state of the application so when any event occurs a subclass of the UIBuilder can just process it. The simplest way and most robust way for changes is to use the Codename One Designer to generate some code for you (yes we know its not a code generation tool but there is a hack...).

When using a GUI builder project it will constantly regenerate the state machine base class which is a UIBuilder subclass containing most of what you need...
The trick is not to touch that code! DO NOT CHANGE THAT CODE!

Sure you can change it and everything will be just fine, however it you will make changes to the GUI regenerating that file will obviously lose all those changes which is not something you want! To solve it you need to write your code within the State machine class which is a subclass of the state machine base class and just override the appropriate methods, then when the UI changes the GUI builder just safely overwrites the base class since you didn't change anything there...

The Components Of Codename One

This chapter covers the components of Codename One, not all are covered but it tries to go deeper than the JavaDocs.

Container

[TODO]

Form

[TODO]

Dialog

[TODO]

Label

[TODO]

Button

[TODO]

CheckBox/Radio Button

[TODO]

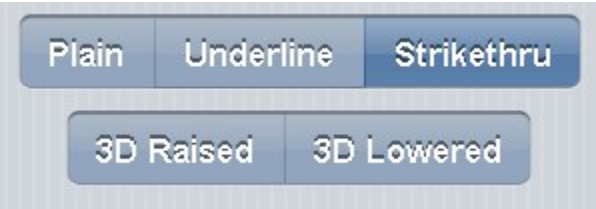
Multi-Button

[TODO]

TextField/TextArea

[TODO]

Toggle Button



A toggle button is a button that is pressed and then stays pressed, when pressed again it's released. Hence the button has a selected state to indicate if it's pressed or not. Just like the radio button or checkbox components in Codename One. So Codename One's new toggle buttons are really any button (checkbox & radio buttons derive from Button) that has the setToggle() method invoked with true. It thus paints itself with the toggle button style unless explicitly defined otherwise (note that the UIID will be implicitly changed to "ToggleButton").

The cool thing about this is that you can effectively take your knowledge about checkboxes & radio buttons and apply it to toggle buttons.

That's half the story though, to get the full effect of some cool toggle button UI's we would like to assign the buttons on the edges with a rounded feel like some platforms choose to do... That's pretty easy, you can just assign a different UIID to the first/last buttons and be over with it.

But what if you want your code to be generic? After all you might add/remove a button in runtime based on application state and you would like it to have the right style.

To solve this we introduced the ComponentGroup.

The ComponentGroup is a special container that can be either horizontal or vertical (Box X or Y respectively), it also does nothing else. You need to explicitly activate it in the theme by setting a theme property to true (by default you need to set ComponentGroupBool to true).

When ComponentGroupBool is set to true the component group will modify the styles of all components placed within it to match the element UIID given to it (by default GroupElement) with special caveats to the first/last/only elements. E.g.
1. If I have one element within a component group it will have the UIID: GroupElementOnly
2. If I have two elements within a component group they will have the UIID's GroupElementFirst, GroupElementLast
3. If I have three elements within a component group they will have the UIID's GroupElementFirst, GroupElement, GroupElementLast
4. If I have four elements within a component group they will have the UIID's GroupElementFirst, GroupElement, GroupElement, GroupElementLast

You get the picture... This allows you to define special styles for the sides (don't forget to use the derive attribute to generalize your theme) and provide toggle buttons that include special effects simply by placing them into this group.
You can customize the UIID set by the component group by calling setElementUIID in the component group e.g. setElementUIID("ToggleButton") for the picture above will result in: ToggleButtonFirst, ToggleButton, ToggleButtonLast

This is a short sample:

```
ComponentGroup buttons = new ComponentGroup();
buttons.setElementUIID("ToggleButton");
buttons.setHorizontal(true);
RadioButton plain = new RadioButton("Plain");
RadioButton underline = new RadioButton("Underline");
RadioButton strikeout = new RadioButton("Strikethru");
ButtonGroup bg = new ButtonGroup();
initRb(bg, buttons, listener, plain);
initRb(bg, buttons, listener, underline);
initRb(bg, buttons, listener, strikeout);
Container centerFlow = new Container(new FlowLayout(Component.CENTER));
f.addComponent(centerFlow);
centerFlow.addComponent(buttons);

private void initRb(ButtonGroup bg, Container buttons, ActionListener listener, RadioButton rb)
{
  bg.add(rb);
  rb.setToggle(true);
  buttons.addComponent(rb);
  rb.addActionListener(listener);
}
```

List, ContainerList, Renderers & Models

A Codename One list doesn't contain components but rather arbitrary data, this seems odd at first but makes perfect sense... If you want a list to contain components just use a Container. The advantage of using a List in this way is that we can display it in many ways (e.g. fixed focus positions, horizontally etc.) and that we can have more than a million entries without performance overhead. We can also do some pretty nifty things like filter the list on the fly or fetch it dynamically from the internet as the user scrolls down the list.

To achieve these things the list uses two interfaces: ListModel and ListCellRenderer.

List model represents the data, its responsibility is to return the arbitrary object within the list at a given offset. Its second responsibility is to notify the list when the data changes so the list can refresh, think of it as an array of objects that can notify you when you get changes.

The list renderer is like a rubber stamp that knows how to draw an object from the model, its called many times per entry in an animated list and must be very fast. Unlike standard LWUIT components it is only used to draw the entry in the model and immediately discarded hence it has no memory overhead but if it takes too long to process a model value it can be a big bottleneck!

This is all very generic but a bit too much for most, doing a list "properly" requires some understanding. The main source of confusion for developers is the stateless nature of the list and transfer of state to the model (e.g. a checkbox list needs to listen to action events on the list and update the model in order for the renderer to display that state... Once you understand that it’s easy).

Understanding MVC

Lets recap, what is MVC:

Model - Represents the data for the component (list), the model can tell us exactly how many items are in it and which item resides at a given offset within the model. This differs from a simple Vector (or array) since all access to the model is controlled (the interface is simpler) and unlike a Vector/Array the model can notify us of changes that occur within it.

View - The view draws the content of the model. It is a "dumb" layer that has no notion of what is displayed and only knows how to draw. It tracks changes in the model (the model sends events) and redraws itself when it changes.

Controller - The controller accepts user input and performs changes to model which in turn cause the view to refresh.

Codename One's List component uses the MVC paradigm to separate its implementation. List itself is the Controller (with a bit of View mixed in). The ListCellRenderer interface is a View and the ListModel is (you guessed it by now) the model.

When the list is painted it iterates over the visible elements in the model and asks for them, it then draws them using the renderer.

Why is this useful?

Since the model is a lightweight interface it can be implemented by you and replaced in runtime if so desired, this allows several very cool use cases:

1. A list can contain thousands of entries but only load the portion visible to the user. Since the model will only be queried for the elements that are visible to the user it won't need to load into memory a very large data set until the user starts scrolling down (at which point other elements may be offloaded from memory).

2. A list can cache efficiently. E.g. a list can mirror data from the server into local RAM without actually downloading all the data. Data can also be mirrored from RMS for better performance and discarded for better memory utilization.

3. No need for state copying. Since renderers allow us to display any object type, the list model interface can be implemented by the applications data structures (e.g. persistence/network engine) which would return internal application data structures saving you the need of copying application state into a list specific data structure.

4. Using the proxy pattern (as explained in a previous post) we can layer logic such as filtering, sorting, caching etc. on top of existing models without changing the model source code.

5. We can reuse generic models for several views e.g. a model that fetches data from the server can be initialized with different arguments to fetch different data for different views. View objects in different Form's can display the same model instance in different view instances thus they would update automatically when we change one global model.

Most of these use cases work best for lists that grow to a larger size or represent complex data which is what the list object is designed to do.

List Cell Renderer

List is one of the most important widgets in Codename One, unfortunately it is also one of the most difficult widgets to understand.

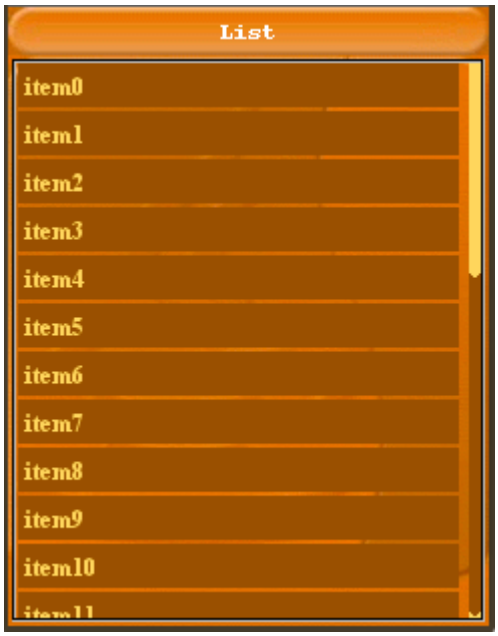
The List component uses the MVC model inspired from Swing (which was inspired from SmallTalk), we created a data model to encapsulate the data and a renderer to display the data items on the screen.

Let's have a closer look at the List Renderer, the Renderer is a simple interface with 2 methods:

```
public interface ListCellRenderer {
//This method is called by the List for each item, when the List paints itself.
public Component getListCellRendererComponent(List list, Object value, int index, boolean isSelected);

//This method returns the List animated focus which is animated when list selection changes
public Component getListFocusComponent(List list);

}
```

Let's try to implement our own renderer.
The most simple/naive implementation may choose to implement the renderer as follows:

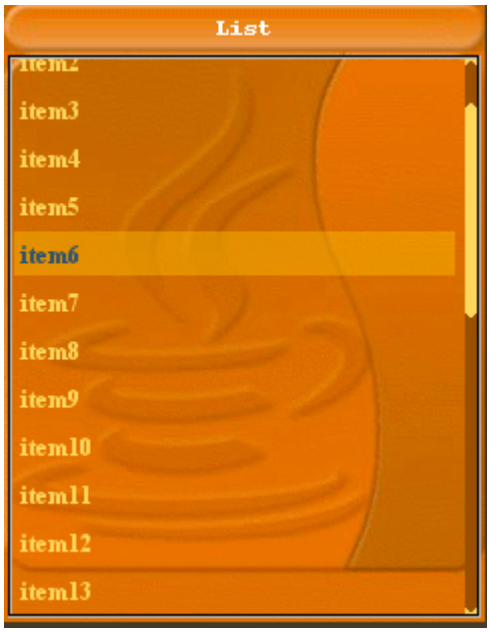
```
public Component getListCellRendererComponent(List list, Object value, int index, boolean isSelected){
return new Label(value.toString());
}

public Component getListFocusComponent(List list){
return null;
}
```



This will compile and work, but won't give you much, notice that you won't see the List selection move on the List, this is just because the renderer returns a Label with the same style regardless if it's being selected or not.

Now Let's try to make it a bit more useful.

```
public Component getListCellRendererComponent(List list, Object value, int index, boolean
isSelected){
    Label l = new Label(value.toString());
if (isSelected) {
        l.setFocus(true);
        l.getStyle().setBgTransparency(100);
     } else {
        l.setFocus(false);
        l.getStyle().setBgTransparency(0);
     }
     return l;
}  public Component getListFocusComponent(List list){
    return null;
}
```



In this renderer we set the Label.setFocus(true) if it's selected, calling to this method doesn't really gives the focus to the Label, it simply indicates to the LookAndFeel to draw the Label with fgSelectionColor and bgSelectionColor instead of fgColor and bgColor.
Then we call to Label.getStyle().setBgTransparency(100) to give the selection semi transparency and 0 for full transparency if not selected.
OK that's a bit more functional, but not very efficient that's because we create a new Label each time the method is called.

To make it more device friendly keep a reference to the Component or extend the Widget.

```
class MyRenderer extends Label implements ListCellRenderer {

public Component getListCellRendererComponent(List list, Object value, int index, boolean
isSelected){
setText(value.toString());
if (isSelected) {
  setFocus(true);
  getStyle().setBgTransparency(100);
} else {
setFocus(false);
  getStyle().setBgTransparency(0);
}
return this;
}
}
}
```

Now Let's have a look at a more advanced Renderer

```
class ContactsRenderer extends Container implements ListCellRenderer {

 private Label name = new Label("");
 private Label email = new Label("");
 private Label pic = new Label("");

 private Label focus = new Label("");

 public ContactsRenderer() {
    setLayout(new BorderLayout());
    addComponent(BorderLayout.WEST, pic);
    Container cnt = new Container(new BoxLayout(BoxLayout.Y_AXIS));
    name.getStyle().setBgTransparency(0);
    name.getStyle().setFont(Font.createSystemFont(Font.FACE_SYSTEM, Font.STYLE_BOLD,
Font.SIZE_MEDIUM));
    email.getStyle().setBgTransparency(0);
    cnt.addComponent(name);
    cnt.addComponent(email);
    addComponent(BorderLayout.CENTER, cnt);

    focus.getStyle().setBgTransparency(100);
 }

 public Component getListCellRendererComponent(List list, Object value, int index, boolean
isSelected) {

    Contact person = (Contact) value;
    name.setText(person.getName());
    email.setText(person.getEmail());
    pic.setIcon(person.getPic());
    return this;
 }

 public Component getListFocusComponent(List list) {
    return focus;
 }
}
```

In this renderer we want to renderer a Contact Object to the Screen, we build the Component in the constructor and in the getListCellRendererComponent we simply updates the Labels texts according to the Contact Object.
Notice that in this renderer I return a focus Label with semi transparency, as mentioned before the focus component can be modified by using this method.

For example I can modify the focus Component to have an icon.

```
   focus.getStyle().setBgTransparency(100);
try {
  focus.setIcon(Image.createImage("/duke.png"));
  focus.setAlignment(Component.RIGHT);
} catch (IOException ex) {
    ex.printStackTrace();
}
```

Generic List Cell Renderer

Codename One is really powerful and flexible, we took the power and flexibility of Swing and went even further (styles, painters) and one such power is the cell renderer. This is a concept we derived from Swing which is both remarkably powerful and pretty hard for newbies to figure out, frankly it's pretty hard for everyone...

As part of the GUI builder work we needed a way to customize rendering for a List but the renderer/model approach seemed impossible to adapt to a GUI builder (it seems the Swing GUI builders had a similar issue). Our solution was to introduce the GenericListCellRenderer which while introducing limitations and implementation requirements still manages to make life easier both in the GUI builder and outside of it.

GenericListCellRenderer is a renderer designed to be as simple to use as a Component-Container hierarchy, we effectively crammed most of the common renderer use cases into one class. To enable that we need to know the content of the objects within the model, so the GenericListCellRenderer assumes the model contains only Hashtable objects. Since Hashtable's can contain arbitrary data the list model is still quite generic and allows storing

application specific data, furthermore a Hashtable can still be derived and extended to provide domain specific business logic.
The GenericListCellRenderer accepts two container instances (more later on why at least two and not one) which it maps to individual Hashtable entries within the model by finding the appropriate components within the given container hierarchy. Components are mapped to the Hashtable entries based on the name property of the component (get/setName) and the key value within the Hashtable e.g.:
For a model that contains a Hashtable entry like this:
"Foo": "Bar"
"X": "Y"
"Not": "Applicable"
"Number": Integer(1)

A renderer will loop over the component hierarchy in the container searching for component's whose name matches Foo, X, Not and Number and assign to them the appropriate value. Notice that you can also use image objects as values and they will be assigned to labels as expected. However, you can't assign both an image and a text to a single label since the key will be taken. That isn't a big problem since two labels can be used quite easily in such a renderer.
To make matters even more attractive the renderer seamlessly supports list tickering when appropriate and if a CheckBox appears within the renderer it will toggle a boolean flag within the Hashtable seamlessly.
One issue that crops up with this approach is that if a value is missing from the hashtable it is treated as empty and the component is reset, this can pose an issue if we hardcode an image or text within the renderer and we don't want them replace (e.g. an arrow graphic). The solution for this is to name the component with Fixed in the end of the name e.g.: HardcodedIconFixed. Naming a component within the renderer with $number will automatically set it as a counter component for the offset of the component within the list.

Styling the GenericListCellRenderer is slightly different, the renderer uses the UIID of the container passed to the generic list cell renderer and the background focus uses that same UIID with the word "Focus" appended.
It is important to notice that the generic list cell renderer will grant focus to the child components of the selected entry if they are focusable thus changing the style of said entries. E.g. a Container might have a child label that has one style when the parent container is unselected and another when its selected (focused), this can be easily achieved by defining the label as focusable. Notice that the component will never receive direct focus since it is still a par of a renderer.

Last but not least, the generic list cell renderer accepts two or four instances of a Container rather than the obvious choice of accepting only one instance. This allows the renderer to treat the selected entry differently which is especially important to tickering although its also useful for fisheye. Since it might not be practical to seamlessly clone the Container for the renderer's needs Codename One expects the developer to provide two separate instances, they can be identical in all respects but they must be separate instances for tickering to work. The renderer also allows for a fisheye effect where the selected entry is actually different from the unselected

entry in its structure, it also allows for a pinstripe effect where odd/even rows have different styles (this is accomplished by providing 4 instances of the containers selected/unselected for odd/even).

The best way to learn about the generic list cell renderer and the hashtable model is by playing with them in the GUI builder, however they can be used in code without any dependency on the GUI builder and can be quite useful at that.

Here is a simple sample for a list with checkboxes that get updated automatically:

```
List list = new List(createGenericListCellRendererModelData());
list.setRenderer(new GenericListCellRenderer(createGenericRendererContainer(),
createGenericRendererContainer()));


private Container createGenericRendererContainer() {
    Container c = new Container(new BorderLayout());
    c.setUIID("ListRenderer");
    Label name = new Label();
    name.setFocusable(true);
    name.setName("Name");
    c.addComponent(BorderLayout.CENTER, name);
    Label surname = new Label();
    surname.setFocusable(true);
    surname.setName("Surname");
    c.addComponent(BorderLayout.SOUTH, surname);
    CheckBox selected = new CheckBox();
    selected.setName("Selected");
    selected.setFocusable(true);
    c.addComponent(BorderLayout.WEST, selected);
    return c;
}

private Hashtable[] createGenericListCellRendererModelData() {
    Hashtable[] data = new Hashtable[5];
    data[0] = new Hashtable();
    data[0].put("Name", "Shai");
    data[0].put("Surname", "Almog");
    data[0].put("Selected", Boolean.TRUE);
    data[1] = new Hashtable();
    data[1].put("Name", "Chen");
    data[1].put("Surname", "Fishbein");
    data[1].put("Selected", Boolean.TRUE);
    data[2] = new Hashtable();
    data[2].put("Name", "Ofir");
    data[2].put("Surname", "Leitner");
```

```
    data[3] = new Hashtable();
    data[3].put("Name", "Yaniv");
    data[3].put("Surname", "Vakarat");
    data[4] = new Hashtable();
    data[4].put("Name", "Meirav");
    data[4].put("Surname", "Nachmanovitch");
    return data;
}
```

The List Model

Swing's approach to MVC is one of the hardest concepts for people to fully grasp, which is a real shame as it is probably the most important and powerful feature in Swing. Codename One copied Swing's approach to MVC almost entirely but on a smaller scale.

To show off the power of the list model we create a list with one million entries... What I am trying to prove here is that a list and a model have a very low overhead when used properly. Most of the overhead for rendering a list is in the renderer and the model implementation, both of which you can optimize to your hearts content. This is a very small price to pay for something as flexible, powerful and customizable as the Codename One list!

```
class Contact {
 private String name;
 private String email;
 private Image pic;

 public Contact(String name, String email, Image pic) {
    this.name = name;
    this.email = email;
    this.pic = pic;
 }

 public String getName() {
    return name;
 }

 public String getEmail() {
    return email;
 }

 public Image getPic() {
    return pic;
 }
}

class ContactsRenderer extends Container implements ListCellRenderer {
```

```
 private Label name = new Label("");
 private Label email = new Label("");
 private Label pic = new Label("");

 private Label focus = new Label("");

 public ContactsRenderer() {
    setLayout(new BorderLayout());
    addComponent(BorderLayout.WEST, pic);
    Container cnt = new Container(new BoxLayout(BoxLayout.Y_AXIS));
    name.getStyle().setBgTransparency(0);
    email.getStyle().setBgTransparency(0);
    cnt.addComponent(name);
    cnt.addComponent(email);
    addComponent(BorderLayout.CENTER, cnt);
 }

 public Component getListCellRendererComponent(List list, Object value, int index, boolean
isSelected) {
    Contact person = (Contact) value;
    name.setText(index + ": " + person.getName());
    email.setText(person.getEmail());
    pic.setIcon(person.getPic());
    return this;
 }

 public Component getListFocusComponent(List list) {
    return focus;
 }
}
String[][] CONTACTS_INFO = {
 {"Nir V.","Nir.Vazana@Sun.COM"},
 {"Tidhar G.","Tidhar.Gilor@Sun.COM"},
 {"Iddo A.","Iddo.Arie@Sun.COM"},
 {"Ari S.","Ari.Shapiro@Sun.COM"},
 {"Chen F.","Chen.Fishbein@Sun.COM"},
 {"Yoav B.","Yoav.Barel@Sun.COM"},
 {"Moshe S.","Moshe.Sambol@Sun.COM"},
 {"Keren S.","Keren.Strul@Sun.COM"},
 {"Amit H.","Amit.Harel@Sun.COM"},
 {"Arkady N.","Arcadi.Novosiolok@Sun.COM"},
 {"Shai A.","Shai.Almog@Sun.COM"},
 {"Elina K.","Elina.Kleyman@Sun.COM"},
 {"Yaniv V.","Yaniv.Vakrat@Sun.COM"},
 {"Nadav B.","Nadav.Benedek@Sun.COM"},
 {"Martin L.","Martin.Lichtbrun@Sun.COM"},
```

```
{"Tamir S.","Tamir.Shabat@Sun.COM"},
{"Nir S.","Nir.Shabi@Sun.COM"},
{"Eran K.","Eran.Katz@Sun.COM"}
};

int contactWidth= 36;
int contactHeight= 48;
int cols = 4;
Resources images = Resources.open("/images.res");
Image contacts = images.getImage("people.jpg");
Image[] persons = new Image[CONTACTS_INFO.length];
for(int i = 0; i < persons.length ; i++){
 persons[i] = contacts.subImage((i%cols)*contactWidth, (i/cols)*contactHeight, contactWidth,
contactHeight, true);
}

final Contact[] contactArray = new Contact[persons.length];
for (int i = 0; i < contactArray.length; i++) {
 int pos = i % CONTACTS_INFO.length;
 contactArray[i] = new Contact(CONTACTS_INFO[pos][0], CONTACTS_INFO[pos][1],
persons[pos]);
}

Form millionList = new Form("Million");
millionList.setScrollable(false);
List l = new List(new ListModel() {
 private int selection;
 public Object getItemAt(int index) {
    return contactArray[index % contactArray.length];
 }

 public int getSize() {
    return 1000000;
 }

 public int getSelectedIndex() {
    return selection;
 }

 public void setSelectedIndex(int index) {
    selection = index;
 }

 public void addDataChangedListener(DataChangedListener l) {
 }
```

```
 public void removeDataChangedListener(DataChangedListener l) {
 }

 public void addSelectionListener(SelectionListener l) {
 }

 public void removeSelectionListener(SelectionListener l) {
 }

 public void addItem(Object item) {
 }

 public void removeItem(int index) {
 }
});
l.setListCellRenderer(new ContactsRenderer());
l.setFixedSelection(List.FIXED_NONE_CYCLIC);
millionList.setLayout(new BorderLayout());
millionList.addComponent(BorderLayout.CENTER, l);
millionList.show();
```

Slider

[TODO]

Ads

[TODO]

Table

Unlike list the table is a composite component, which means it is really a subclass of a Container and is effectively built from multiple components. The general thought process is that Table is an elaborate component and should include complex editing, while the list is more of a selection component designed for scalability.

Here is a minor sample of using the standard table component, it should be pretty self explanatory:

```
final Form f = new Form("Table Test");
TableModel model = new DefaultTableModel(new String[] {"Col 1", "Col 2", "Col 3"}, new
Object[][] {
{"Row 1", "Row A", "Row X"},
{"Row 2", "Row B", "Row Y"},
```

```
{"Row 3", "Row C", "Row Z"},
{"Row 4", "Row D", "Row K"},
}) {
public boolean isCellEditable(int row, int col) {
    return col != 0;
}
};
Table table = new Table(model);
table.setScrollableX(true);
f.setLayout(new BorderLayout());
f.addComponent(BorderLayout.CENTER, table);
f.show();
```

However, the more "interesting" aspect of the table is the table layout and its ability to create rather unique layouts relatively easily similarly to HTML's tables. You can use the layout constraints (also exposed in the table class) to create spanning and elaborate UI's.
In order to customize the table cell behavior you can now derive the table to create a "renderer like" widget, however unlike the list this component is "kept" and used as is. This means you can bind listeners to this component and work with it as you would with any other component in Codename One.

Tree

[TODO]

Share Button

[TODO]

Progress

[TODO]

Tabs

[TODO]

MediaPlayer

[TODO]

WebBrowser

[TODO]

Embedded Container

EmbeddedContainer solves a problem that exists only within the GUI builder and the class makes no sense outside of the context of the GUI builder.
The necessity for EmbeddedContainer came about due to iPhone inspired designs that relied on tabs (iPhone style tabs at the bottom of the screen) where different features of the application are within a different tab.

This didn't mesh well with the GUI builder navigation logic and so we needed to rethink some of it. We wanted to reuse GUI as much as possible while still enjoying the advantage of navigation being completely managed for me.
Android does this with Activities and the iPhone itself has a view controller, we don't like both approaches and think they both suck. The problem is that you have what is effectively two incompatible hierarchies to mix and match which is why Android needed to "invent" fragments and Apple can't mix view controllers within a single application.

The Component/Container heirarchy is powerful enough to represent such a UI but we needed a "marker" to indicate to the UIBuilder where a "root" component exists so navigation occurs only within the given "root". Here EmbeddedContainer comes into play, its a simple container that can only contain another GUI from the GUI builder. Nothing else. So we can place it in any form of UI and effectively have the UI change appropriately and navigation would default to "sensible values".

Navigation replaces the content of the embedded container, it finds the embedded container based on the component that broadcast the event. If you want to navigate manually just use the showContainer() method which accepts a component, you can give any component that is under the EmbeddedContainer you want to replace and Codename One will be smart enough to replace only that component.

The nice part about using the EmbeddedContainer is that the resulting UI can be very easily refactored to provide a more traditional form based UI without duplicating effort and can be easily adapted to a more tablet oriented UI (with a side bar) again without much effort.

The Map Component

The MapComponent uses the OpenStreetMap webservice by default to display a navigatable map.
The code was contributed by Roman Kamyk and was originally used for a LWUIT application.

The screenshot above was produced using the following code:

```
Form map = new Form("Map");
 map.setLayout(new BorderLayout());
 map.setScrollable(false);
 final MapComponent mc = new MapComponent();

 try {
    //get the current location from the Location API
    Location loc = LocationManager.getLocationManager().getCurrentLocation();

   Coord lastLocation = new Coord(loc.getLatitude(), loc.getLongtitude());
    Image i = Image.createImage("/blue_pin.png");
    PointsLayer pl = new PointsLayer();
    pl.setPointIcon(i);
    PointLayer p = new PointLayer(lastLocation, "You Are Here", i);
    p.setDisplayName(true);
    pl.addPoint(p);
    mc.addLayer(pl);
 } catch (IOException ex) {
```

```
        ex.printStackTrace();
    }
    mc.zoomToLayers();

    map.addComponent(BorderLayout.CENTER, mc);
    map.addCommand(new BackCommand());
    map.setBackCommand(new BackCommand());
    map.show();
```

The example below shows how to integrate the MapComponent with the Google Location API. make sure to obtain your secret api key from the Google Location data API at: https://developers.google.com/maps/documentation/places/


```
final Form map = new Form("Map");
 map.setLayout(new BorderLayout());
 map.setScrollable(false);
 final MapComponent mc = new MapComponent();
 Location loc = LocationManager.getLocationManager().getCurrentLocation();
 //use the code from above to show you on the map
 putMeOnMap(mc);
```

```
        map.addComponent(BorderLayout.CENTER, mc);
        map.addCommand(new BackCommand());
        map.setBackCommand(new BackCommand());

        ConnectionRequest req = new ConnectionRequest() {

            protected void readResponse(InputStream input) throws IOException {
                JSONParser p = new JSONParser();
                Hashtable h = p.parse(new InputStreamReader(input));
                // "status" : "REQUEST_DENIED"
                String response = (String)h.get("status");
                if(response.equals("REQUEST_DENIED")){
                    System.out.println("make sure to obtain a key from "
                            + "https://developers.google.com/maps/documentation/places/");
                    progress.dispose();
                    Dialog.show("Info", "make sure to obtain an application key from "
                            + "google places api's"
                            , "Ok", null);
                    return;
                }

                final Vector v = (Vector) h.get("results");

                Image im = Image.createImage("/red_pin.png");
                PointsLayer pl = new PointsLayer();
                pl.setPointIcon(im);
                pl.addActionListener(new ActionListener() {

                    public void actionPerformed(ActionEvent evt) {
                        PointLayer p = (PointLayer) evt.getSource();
                        System.out.println("pressed " + p);

                        Dialog.show("Details", "" + p.getName(), "Ok", null);
                    }
                });

                for (int i = 0; i < v.size(); i++) {
                    Hashtable entry = (Hashtable) v.elementAt(i);
                    Hashtable geo = (Hashtable) entry.get("geometry");
                    Hashtable loc = (Hashtable) geo.get("location");
                    Double lat = (Double) loc.get("lat");
                    Double lng = (Double) loc.get("lng");
                    PointLayer point = new PointLayer(new Coord(lat.doubleValue(),
lng.doubleValue()),
                            (String) entry.get("name"), null);
                    pl.addPoint(point);
```

```
            }
            progress.dispose();

            mc.addLayer(pl);
            map.show();
            mc.zoomToLayers();

        }
      };
      req.setUrl("https://maps.googleapis.com/maps/api/place/search/json");
      req.setPost(false);
      req.addArgument("location", "" + loc.getLatitude() + "," + loc.getLongtitude());
      req.addArgument("radius", "500");
      req.addArgument("types", "food");
      req.addArgument("sensor", "false");

      //get your own key from https://developers.google.com/maps/documentation/places/
      //and replace it here.
      String key = "yourAPIKey";

      req.addArgument("key", key);

      NetworkManager.getInstance().addToQueue(req);
    }
    catch (IOException ex) {
      ex.printStackTrace();
    }
}
```

Events

Covers the event dispatch mechanism and the events sent by Codename One

Animations & Transitions

Covers the basics of using/authoring transitions and animations

The EDT - Event Dispatch Thread

This chapter covers the basic concepts of the EDT

Invoke And Block

Codename One has some nifty threading tools inspired by Foxtrot, which is a remarkably powerful tool most Swing developers don't know enough about.

When people talk about dialog modality they often mean two separate things, the first indicates that the dialog intercepts all input and blocks the background form/window which is the true definition of modality. However, there is another aspect often associated with modality that is really important from a programmers perspective and simplified our code considerably:

```
public void actionPerformed(ActionEvent ev) {
  // will return true if the user clicks "OK"
  if(!Dialog.show("Question", "How Are You", "OK", "Not OK")) {
  // ask what went wrong...
  }
}
```

Notice that the dialog show method will block the calling thread until the user clicks OK or Not OK...
If you read a bit about Codename One you would notice that we are blocking the EDT (Event Dispatch Thread) which is also responsible for painting, how does the dialog paint itself or handle events?

The secret is invokeAndBlock, it allows us to "block" the EDT and resume it while keeping a "nested" EDT functioning. The semantics of this logic are a bit hairy so I won't try to explain them further, this functionality is also available in Swing which has the exact same modality feature however Swing doesn't expose the "engine" to developers. Foxtrot, exposes this undocumented engine to Swing developers, in Codename One we chose to expose the ability to block the EDT (without "really" blocking it) as a simple API: invokeAndBlock.

The best way to explain this is by example:

```
public void actionPerformed(ActionEvent ev) {
  label.setText("Initiating IO, please wait...");
  Display.getInstance().invokeAndBlock(new Runnable() {
      public void run() {
          // perform IO operation...
      }
  });
  label.setText("IO completed!");
```

```
  // update UI...
}
```

Notice that the behavior here is similar to the modal dialog, invokeAndBlock "blocked" the current thread despite the fact that it is the EDT and performed the run() method in a separate thread. When run() completes the EDT is resumed. All the while repaints and events occur as usual, you can have invokeAndBlock calls occurring while another invokeAndBlock is still pending there are no limitations here although we would recommend against it since invokeAndBlock does carry some overhead.

As you can see this is a very simple approach for thread programming in UI, you don't need to block your flow and track the UI thread. You can just program in a way that seems sequential (top to bottom) but really uses multi-threading correctly without blocking the EDT.

Graphics, Drawing & Images

This chapter covers the basics of drawing manually using the Codename One API, notice that drawing is considered a low level API which might introduce some platform fragmentation.

Basics - Where & How Do I Draw Manually?

The Graphics class is responsible for drawing basics, shapes, images and text, it is never instantiated by the developer and is always passed on by the Codename One API.
You can gain access to a Graphics object by doing one of the following:

- Derive Component or a subclass of Component - within Component there are several methods that allow developers to modify the drawing behavior, notice that Form is a subclass of component and thus features all of these methods. These can be overridden to change the way the component is drawn:
    - paint(Graphics) - invoked to draw the component, this can be overridden to draw the component from scratch.
    - paintBackground(Graphics)/paintBackgrounds(Graphics) - these allow overriding the way the component background is painted although you would probably be better off implementing a painter (see below).
    - paintBorder(Graphics) - allows overriding the process of drawing a border, notice that border drawing might differ based on the style of the component.
    - paintComponent(Graphics) - allows painting only the components contents while leaving the default paint behavior to the style.
    - paintScrollbars(Graphics),paintScrollbarX(Graphics),paintScrollbarY(Graphics) - allows overriding the behavior of scrollbar painting.
- Implement the painter interface, this interface can be used as a GlassPane or a background painter.
  The painter interface is a simple interface that includes 1 paint method, this is a useful way to allow developers to perform custom painting without subclassing component. Painters can be chained together to create elaborate paint behavior by using the PainterChain class.
    - Glass pane - a glass pane allows developers to paint on top of the form painting. This allows an overlay effect on top of a form.
      For a novice it might seem that a glass pane is similar to overriding the Form's paint method and drawing after super.paint(g) completed. This isn't the case. When a component repaints (by invoking the repaint() method) only that component is drawn and Form's paint() method wouldn't be invoked. However, the glass pane painter is invoked for such cases and would work exactly as expected.
      Container has a glass pane method called paintGlass(Graphics), which can be overridden to provide a similar effect on a Container level. This is especially

useful for complex containers such as Table which draws its lines using such a methodology.
- Background painter - the background painter is installed via the style, by default Codename installs a custom background painter of its own. Installing a custom painter allows a developer to completely define how the background of the component is drawn.

A paint method can be implemented by deriving a Form as such:

```
public MyForm {
  public void paint(Graphics g) {
      // red color
      g.setColor(0xff0000);

      // paint the screen in red
      g.fillRect(getX(), getY(), getWidth(), getHeight());

      // draw hi world in white text at the top left corner of the screen
      g.setColor(0xffffff);
      g.drawString("Hi World", getX(), getY());
  }
}
```

Images

Codename One has quite a few image types: loaded, RGB (builtin), RGB (Codename One), Mutable, EncodedImage,SVG, Multi-Image & Timeline. There are also FileEncodedImage, FileEncodedImageAsync, StorageEncodedImage/Async which will be covered in the IO section.

Here are the pros/cons and logic behind every image type and how its created:

- Loaded Image - this is the basic image you get when loading an image from the jar or network using Image.createImage(String)/Image.createImage(InputStream)/Image.createImage(byte[], int, int).
  In some platforms (e.g. MIDP) calling getGraphics() on an image like this will throw an exception (its immutable in MIDP terms), this is true for almost all other images as well. This restriction might not apply for all platforms.
  The image is encoded based on device logic and should be reasonably efficient.

- RGB Image (internal) - close cousin of the loaded image. This image is created using the method Image.createImage(int[], int, int) and receives ARGB data forming the image. It is usually (although not always) a high color image. Its more efficient than the Codename One RGB image but can't be modified, at least not on the pixel level.

- RGBImage (Codenme One) - constructed via the RGBImage constructors this image is effectively an ARGB array that can be drawn by Codename One. On many platforms this

is quite inefficient but for some pixel level manipulations there is just no other way.

- EncodedImage - created via the encoded image static methods, the encoded image is effectively a loaded image that is "hidden". When creating an encoded image only the PNG (or jpeg etc.) is loaded to an array in RAM. Normally such images are very small relatively so they can be kept in memory without much effect. When image information is needed (e.g. pixels, dimension etc.) the image is decoded into RAM and kept in a weak/sort reference.
  This allows the image to be cached for performance and allows the garbage collector to reclaim it when the memory becomes scarce.
  Encoded image is not final and can be derived to produce complex image fetching strategies such as lazily loading an image from the filesystem (read more about it in the IO section).

- SVG - SVG's can be loaded directly via Image.createSVG() if Image.isSVGSupported() returns true. When adding SVG's via the Codename One Designer fallback images are produced for devices that do not support SVG. The fallback images are effectively multi-images.

- Multi-Image - The multi-image is seamless to developers it is strictly a design time feature, during runtime an EncodedImage is returned whenever a multi-image is used. In the Codename One Designer one can add several images based on the DPI of the device (one of several predefined ranges). When loading the resource file irrelevant images are skipped thus saving the additional memory.
  Multi-images are ideal for icons or small artifacts that are hard to scale properly. They are not meant to replace things such as 9-image borders etc. since adapting them to every resolution or to device rotation isn't practical.
  9-image borders use multi-images by default internally to keep their appearance more refined on the different DPI's.

- Timeline - Timeline's allow rudimentary animation and enable GIF importing using the Codename One Designer. Effectively a timeline is a set of images that can be moved rotated, scaled & blended to provide interesting animation effects. It can be created manually using the Timeline class.

All image types are mostly seamless to use and will just work with drawImage and various image related image API's for the most part with caveats on performance etc. For animation images the code must invoke images animate() method (this is done automatically by Codename One when placing the image as a background or as an icon! You only need to do it if you invoke drawImage in code rather than use a builtin component).
All images might also be animated in theory e.g. my gif implementation returned animated gifs from the standard Loaded Image methods and this worked pretty seamlessly (since Icons's and backgrounds just work). To find out if an image is animated you need to use the isAnimation() method, currently SVG images are animated in MIDP but most of our ports don't support GIF animations by default (although it should be easy to add to some of them).

Performance and memory wise you should read the above carefully and be aware of the image types you use. The Codename One designer tries to conserve memory and be "clever" by using only encoded images, while these are great for low memory they are not as efficient as loaded images in terms of speed. Also when scaled these images have much larger overhead since they need to be converted to RGB, scaled and then a new image is created. Keeping all these things in mind when optimizing a specific UI is very important.

Glass Pane

The GlassPane in Codename One is inspired by the Swing GlassPane & layered pane with quite a few twists. We tried to imagine how Swing developers would have implemented the glass pane knowing what they do now about painters and Swings learning curve. But I'm getting ahead of myself, what is the glass pane?

A typical Codename One application is essentially composed of 3 layers (this is a gross simplification though), the bg painters are responsible for drawing the background of all components including the main form. The component draws its own content which might overrule the painter and the glass pane paints last...

Essentially the glass pane is a painter that allows us to draw an overlay on top of the Codename One application. Initially we didn't think we need a glass pane, we used to suggest that people should override the form's paint() method to reach the same result. Feel free to try and guess why this failed before reading the explanation in the next paragraph.

Overriding the paint method of a form worked initially, when you enter a form this behaves just as you would expect. However, when modifying an element within the form only that element gets repainted not the entire form! So if I had a form with a Button and text drawn on top using the Form's paint method it would get erased whenever the button got focus.

Thats good for the forms paint method, calling the forms paint method would be REALLY expensive for every little thing that occurs in Codename One. However, we do want overlays for some things and we don't need to repaint every component in the screen to get them. The glass pane is called whenever a component gets painted, it only paints within the clipping region of the component hence it won't break the rest of the glass pane.

The painter chain is a tool that allows us to chain several painters together to perform different logistical tasks such as a validation painter coupled with a fade out painter. The sample below shows a crude validation panel that allows us to draw error icons next to components while exceeding their physical bounds as is common in many user interfaces

```
public class ValidationPane implements Painter {
 private Vector components = new Vector();
 private static Image error;
 public ValidationPane(Form parentForm) {
    try {
```

```
        if(error == null) {
            error = Image.createImage("/error.png");
        }
    } catch (IOException ex) {
        ex.printStackTrace();
    }
PainterChain.installGlassPane(parentForm, this);
}

public void paint(Graphics g, Rectangle rect) {
    for(int iter = 0 ; iter < components.size() ; iter++) {
        Component c = (Component) components.elementAt(iter);
        if(c == null) {
            components.removeElementAt(iter);
            continue;
        }
        Object p = c.getClientProperty(VALIDATION_PROP);
        int x = c.getAbsoluteX();
        int y = c.getAbsoluteY();
        x -= error.getWidth() / 2;
        y += c.getHeight() - error.getHeight() / 2;
        g.drawImage(error, x, y);
    }
}

public void addInvalid(Component c) {
    components.addElement(c);
}

public void removeInvalid(Component c) {
    components.removeElement(c);
}
}
```

Layout Managers

The layout managers allow positioning components in a portable way, this chapter covers the subjects of using and authoring layout managers.

Border Layout

[TODO]

Flow Layout

[TODO]

Grid Layout

[TODO]

Box Layout

[TODO]

Layered Layout

[TODO]

Table Layout

The table layout is largely inspired by the HTML table tag and slightly by AWT's GridBagLayout. The table layout is a constraint based layout (similar to the border layout) this means that unlike other layout managers that expect components to be added on their own:

```
container.addComponent(component);
```

The table layout container expects something like this:

```
container.addComponent(tableConstraint, component);
```

Notice that this syntax is optional if omitting the constraint a default behavior will ensue of placing the component in the next available cell.

The table layout will automatically size components to the largest preferred size in the row/column until running out of space, if the table is not horizontally scrollable this will happen when the edge of the parent container is reached (close to the edge of the screen) and further components will be "crammed together". Notice that all cells in the table layout are sized to fit the entire cell always. To align, or margin cell's a developer can use the methods of the component/Style appropriately.

A developer can provide hints to the table layout to enable spanning and more detailed column/row sizes using the constraint argument to the addComponent method. The constraint argument is an instance of TableLayout.Constraint that **must not** be reused for more than one cell, this will cause an exception.

A constraint can specify the absolute row/column where the entry should fit as well as spanning between cell boundaries. Notice that in the picture the "First" cell is spanned vertically while the "Spanning" cell is spanned horizontally. This is immensely useful in creating elaborate UI's,

Constraints can also specify a height/width for a column/row that will override the default, this size is indicated in percentage of the total table layout size. In the picture you can see that the "First" label is sized to 50% width while the "Forth" label is sized to 20% height.

```
Form mainForm = new Form("Table Layout");
TableLayout layout = new TableLayout(4, 3);
mainForm.setLayout(layout);
TableLayout.Constraint constraint = layout.createConstraint();
constraint.setVerticalSpan(2);
constraint.setWidthPercentage(50);
mainForm.addComponent(constraint, new Label("First"));
mainForm.addComponent(new Label("Second"));
mainForm.addComponent(new Label("Third"));

constraint = layout.createConstraint();
constraint.setHeightPercentage(20);
mainForm.addComponent(constraint, new Label("Forth"));
mainForm.addComponent(new Label("Fifth"));
constraint = layout.createConstraint();
constraint.setHorizontalSpan(3);
Label span = new Label("Spanning");
span.getStyle().setBorder(Border.createLineBorder(2));
span.setAlignment(Component.CENTER);
mainForm.addComponent(constraint, span);
mainForm.show();
```

Building Your Own Layout Manager

Layout managers in Codename One are a remarkably powerful tool, I won't go into all the elaborate ways in which you can modify the layout in Codename One since this is covered rather well in the tutorial and developer guide. Instead I will try to show something that is a bit under documented, mostly because its almost exactly like its Swing/AWT equivalent: building a layout manager.

A layout manager contains all the logic for positioning Codename One components, it essentially traverses a Codename One container and positions components absolutely based on internal logic. When we build our own component we need to take padding into consideration, when we build the layout we need to take margin into consideration. Building a layout manager involves two simple methods: layoutContainer & getPreferredSize.

layoutContainer is invoked whenever Codename One decides the container needs rearranging, Codename One tries to avoid calling this method and only invokes it at the last possible moment. Since this method is generally very expensive (imagine the recursion with nested layouts...), Codename One just marks a flag indicating layout is "dirty" when something important changes and tries to avoid "reflows".

getPreferredSize allows the layout to determine the size desired for the container, this might be a difficult call to make for some layout managers that try to provide both flexibility and simplicity. Most of flow layout bugs stem from the fact that this method is just impossible to implement for flow layout. The size of the final layout won't necessarily match the requested size (it probably won't) but the requested size is taken into consideration, especially when scrolling and also when sizing parent containers.

This is a layout manager that just arranges components in a center column aligned to the middle:

```
/**
* Layout manager that arranges components in a center column
*
* @author Shai Almog
*/
public class CenterLayout extends Layout {
public void layoutContainer(Container parent) {
    int components = parent.getComponentCount();
    Style parentStyle = parent.getStyle();
    int centerPos = parent.getLayoutWidth() / 2 + parentStyle.getMargin(Component.LEFT);
    int y = parentStyle.getMargin(Component.TOP);
    for(int iter = 0 ; iter < components ; iter++) {
        Component current = parent.getComponentAt(iter);
        Dimension d = current.getPreferredSize();
        current.setSize(d);
        current.setX(centerPos - d.getWidth() / 2);
        Style currentStyle = current.getStyle();
        y += currentStyle.getMargin(Component.TOP);
```

```
        current.setY(y);
        y += d.getHeight() + currentStyle.getMargin(Component.BOTTOM);
    }
}

public Dimension getPreferredSize(Container parent) {
    int components = parent.getComponentCount();
    Style parentStyle = parent.getStyle();
    int height = parentStyle.getMargin(Component.TOP) +
parentStyle.getMargin(Component.BOTTOM);
    int marginX = parentStyle.getMargin(Component.RIGHT) +
parentStyle.getMargin(Component.LEFT);
    int width = marginX;
    for(int iter = 0 ; iter < components ; iter++) {
        Component current = parent.getComponentAt(iter);
        Dimension d = current.getPreferredSize();
        Style currentStyle = current.getStyle();
        width = Math.max(d.getWidth() + marginX + currentStyle.getMargin(Component.RIGHT)
                + currentStyle.getMargin(Component.LEFT), width);
        height += currentStyle.getMargin(Component.TOP) + d.getHeight() +
              currentStyle.getMargin(Component.BOTTOM);
    }
    Dimension size = new Dimension(width, height);
    return size;
}
}
```

Here is a simple example of using it:

```
Form f = new Form("Centered");
f.setLayout(new CenterLayout());
for(int iter = 1 ; iter < 20 ; iter++) {
    f.addComponent(new Button("Button: " + iter));
}
f.addComponent(new Button("Really Wide Button Text!!!"));
f.show();
```

File System, Storage, Network & Parsing

In this chapter we cover the IO frameworks which include everything from network to storage, filesystem and parsing.

Parsing: JSON, XML & CSV

Codename One has several built in parsers for JSON, XML & CSV formats which you can use to parse data from the internet or data that is shipping with your product. E.g. use the CSV data to setup default values for your application.

The parsers are all geared towards simplicity and small size, they don't validate and will fail in odd ways when faced with broken data.

CSV is probably the easiest to use, the "Comma Separated Values" format is just a list of values separated by commas (or some other character) with new lines to indicate another row in the table. These usually map well to an Excel spreadsheet or database table.

To parse a CSV just use the CSVParser class as such:

```
CSVParser parser = new CSVParser();
String[][] data = parser.read(stream);
```

The data array will contain a two dimensional array of the CSV data. You can change the delimiter character by using the CSVParser constructor that accepts a character.

The JSON "Java Script Object Notation" format is popular on the web for passing values to/from webservices since it works so well with JavaScript. Parsing JSON is just as easy but has two different variations. You can use the JSONParser class to build a tree of the JSON data as such:

```
JSONParser parser = new JSONParser();
Hashtable response = parser.parse(reader);
```

The response is a Hashtable containing a nested hierarchy of Vectors, Strings and numbers to represent the content of the submitted JSON. To extract the data from a specific path just iterate the Hashtable keys and recurs into it. Notice that there is a webservices demo as part of the kitchen sink showing the returned data as a Tree structure.

An alternative approach is to use the static data parse() method of the JSONParser class and implement a callback parser e.g.:

```
JSONParser.parse(reader, callback);
```

Notice that a static version of the method is used! The callback object is an instance of the JSONParseCallback interface which includes multiple methods. These will be invoked by the parser to indicate internal parser states in a similar way to a traditional XML SAX event based parser.

Advanced readers might want to dig deeper into the processing language contributed by Eric Coolman which allows for xpath like expressions when parsing JSON & XML. Read about it in Eric's blog.

Last but not least is the XML parser, to use it just create an instance of the XMLParser class and invoke parse:

```
XMLParser parser = new XMLParser();
Element elem = parser.parse(reader);
```

The element contains children and attributes and represents a tag element within the XML document or even the document itself. You can iterate over the XML tree to extract the data from within the XML file.

Miscellaneous Features

This chapter covers various features of Codename One that don't quite fit in any of the other chapters.

Analytics Integration

One of the features in Codename One is builtin support for analytic instrumentation. Currently Codename One has builtin support for Google Analytics which provides reasonable enough statistics of application usage.

The infrastructure is there to support any other form of analytics solution of your own choosing.

Analytics is pretty seamless for a GUI builder application since navigation occurs via the Codename One API and can be logged without developer interaction. However, to begin the instrumentation one needs to add the line:

```
AnalyticsService.init(agent, domain);
```

To get the value for the agent value just create a Google Analytics account and add a domain, then copy and paste the string that looks something like UA-99999999-8 from the console to the agent string. Once this is in place you should start receiving statistic events for the application.

If your application is not a GUI builder application or you would like to send more detailed data you can use the Analytics.visit() method to indicate that you are entering a specific page.

Performance & Size

Reducing Resource File Size

Its easy to lose track of size/performance when you are working within the comforts of a visual tool like the Codename One Designer. When optimizing resource files you need to keep in mind one thing: it's all about image sizes.
Images will take up 95-99% of the resource file size, everything else is peanuts in comparison.

Like every optimization the first rule is to reduce the size of the biggest images which will provide your biggest improvements, for this purpose I introduced the ability to see image sizes in KB (see the menu option Images -> Image Sizes (KB).
This produces a list of images sorted by size with the amount of KB each takes. Often the top entries will be multi-images which include HD resolution values that can be pretty large. These very high resolution images take up a significant amount of space! Just going to the multi-images, selecting the unnecessary resolutions & deleting these HUGE images (note you can see the size in KB at the top right side in the image viewer) saves a HUGE amount of space.

Next you should probably use the "Delete Unused Images" menu option (it's also under the Images menu). This tool allows detecting and deleting images that aren't used within the theme/GUI.

If you have a very large image that is opaque you might want to consider converting it to JPEG and replacing the built in PNG's. JPEG's work on most devices and are much smaller.

You can use the excellent OptiPng tool to optimize image files right from the Codename One designer. To use this feature you need to install OptiPng then select "Images -> Launch OptiPng" from the menu. Once you do that the tool will automatically optimize all your PNG's.

When faced with size issues make sure to check the size of your res file, if your JAR file is large open it with a tool such as 7-zip and sort elements by size. Start reviewing which elements justify the size overhead.

Advanced Topics/Under The Hood

This chapter covers the more advanced topics explaining how Codename One actually works.

The Architecture Of The GUI Builder

The Codename One GUI builder has several unique underlying concepts that aren't as common among such tools, in this article I will try to clarify some of these basic ideas.

Basic Concepts

The Codename One Designer isn't a standard code generator, the UI is saved within the resource file and can be designed without the source files available. This has several advantages:

1. No fragile generated code to break.
2. Designers who don't know Java can use the tool.
3. The "Codename One LIVE!" application can show a live preview of your design as you build it.
4. Images and theme settings can be integrated directly with the GUI without concern.
5. The tool is consistent since the file you save is the file you run.
6. GUI's/themes can be downloaded dynamically without replacing the application (this can reduce download size).
7. It allows for control over application flow. It allows preview within the tool without compilation.

This does present some disadvantages and oddities:

1. Its harder to integrate custom code into the GUI builder/designer tool.
2. The tool is somewhat opaque, there is no "code" you can inspect to see what was accomplished by the tool.
3. If the resource file grows too large it can significantly impact memory/performance of a running application.
4. Binding between code and GUI isn't as intuitive and is mostly centralized in a single class.

In theory you don't need to generate any code, you can load any resource file that contains a UI element as you would normally load a Resource file:

```
Resources r = Resources.open("/myFile.res");
```

Then you can just create a UI using the UIBuilder API:

```
UIBuilder u = new UIBuilder();
Container c = u.createContainer(r, "uiNameInResource");
```

(Notice that since Form & Dialog both derive from Container you can just downcast to the appropriate type).

This would work for any resource file and can work completely dynamically! E.g. you can download a resource file on the fly and just show the UI that is within the resource file... That is what Codename One LIVE! is doing internally.

IDE Bindings

While the option of creating a Resource file manually is powerful, its not nearly as convenient as modern GUI builders allow. Developers expect the ability to override events and basic behavior directly from the GUI builder and in mobile applications even the flow for some cases.

To facilitate IDE integration we decided on using a single Statemachine class, similar to the common controller pattern. We considered multiple classes for every form/dialog/container and eventually decided this would make code generation more cumbersome.

The designer effectively generates one class "StatemachineBase" which is a subclass of UIBuilder (you can change the name/package of the class in the Codename One properties file at the root of the project). StatemachineBase is generated every time the resource file is saved assuming that the resource file is within the src directory of a Codename One project. Since the state machine base class is always generated, all changes made into it will be overwritten without prompting the user.

User code is placed within the Statemachine class, which is a subclass of the Statemachine Base class. Hence it is a subclass of UIBuilder!

When the resource file is saved the designer generates 2 major types of methods into Statemachine base:
1. Finders - findX(Container c). A shortcut method to find a component instance within a hierarchy of containers. Effectively this is a shortcut syntax for UIBuilder.findByName(), its still useful since the method is type safe. Hence if a resource component name is changed the find() method will fail in subsequent compilations.

2. Callback events - these are various callback methods with common names e.g.: onCreateFormX(), beforeFormX() etc. These will be invoked when a particular event/behavior occurs.

Within the GUI builder, the event buttons would be enabled and the GUI builder provides a quick and dirty way to just override these methods. To prevent a future case in which the underlying resource file will be changed (e.g formX could be renamed to formY) a super method is invoked e.g. super.onCreateFormX();

This will probably be replaced with the @Override annotation when Java 5 features are integrated into Codename One.

Working With The Generated Code

The generated code is rather simplistic, e.g. the following code from the tzone demo adds a for the remove button toggle:

```
protected void onMainUI_RemoveModeButtonAction(Component c, ActionEvent event) {
  // If the resource file changes the names of components this call will break notifying you that
you should fix the code
  super.onMainUI_RemoveModeButtonAction(c, event);
  removeMode = !removeMode;
  Container friendRoot = findFriendsRoot(c.getParent());
  Dimension size = null;
  if(removeMode) {
    if(Display.getInstance().getDeviceDensity() > Display.DENSITY_LOW) {
      findRemoveModeButton(c.getParent()).setText("Finish");
    }
  } else {
    size = new Dimension(0, 0);
    if(Display.getInstance().getDeviceDensity() > Display.DENSITY_LOW) {
      findRemoveModeButton(c.getParent()).setText("Remove");
    }
  }
  for(int iter = 0 ; iter < friendRoot.getComponentCount() ; iter++) {
    Container currentFriend = (Container)friendRoot.getComponentAt(iter);
    currentFriend.setShouldCalcPreferredSize(true);
    currentFriend.setFocusable(!removeMode);
    findRemoveFriend(currentFriend).setPreferredSize(size);
    currentFriend.animateLayout(800);
  }
}
```

As you can see from the code above implementing some basic callbacks within the state machine is rather simple. The method findFriendsRoot(c.getParent()); is used to find the "FriendsRoot" component within the hierarchy, notice that we just pass the parent container to the finder method. If the finder method doesn't find the friend root under the parent it will find the "true" root component and search there.

The friends root is a container that contains the full list of our "friends" and within it we can just work with the components that were instantiated by the GUI builder.

Implementing Custom Components There are two basic approaches for custom components:

1. Override a specific type - e.g. make all Form's derive a common base class.
2. Replace a deployed instance.

The first uses a feature of UIBuilder which allows overriding component types, specifically override createComponentInstance to return an instance of your desired component e.g.:

```
protected Component createComponentInstance(String componentType, Class cls) {
  if(cls == Form.class) {
     return new MyForm();
  }
  return super.createComponentInstance(componentType, cls);
}
```

This code allows me to create a unified global form subclass. That's very useful when I want so global system level functionality that isn't supported by the designer normally.

The second approach allows me to replace an existing component:

```
protected void beforeSplash(Form f) {
  super.beforeSplash(f);

  splashTitle = findTitleArea(f);

  // create a "slide in" effect for the title
  dummyTitle = new Label();
  dummyTitle.setPreferredSize(splashTitle.getPreferredSize());
  f.replace(splashTitle, dummyTitle, null);
}

protected void postSplash(Form f) {
  super.postSplash(f);

  f.replace(dummyTitle, splashTitle,
CommonTransitions.createSlide(CommonTransitions.SLIDE_VERTICAL, true, 1000));
  splashTitle = null;
  dummyTitle = null;
}
```

Notice that we replace the title with an empty label, in this case we do this so we can later replace it while animating the replace behavior thus creating a slide-in effect within the title. It can be replaced though, for every purpose including the purpose of a completely different custom made component. By using the replace method the existing layout constraints are automatically maintained.

Native Interfaces

Low level calls into the Codename One system, including support for making platform native API calls. Notice that when we say "native" we do not mean C/C++ always but rather the

platforms "native" environment. So in the case of J2ME the Java code will be invoked with full access to the J2ME API's, in case of iOS an Objective-C message would be sent and so forth. Native interfaces are designed to only allow primitive types, Strings, arrays (single dimension only!) of primitives and PeerComponent values. Any other type of parameter/return type is prohibited. However, once in the native layer the native code can act freely and query the Java layer for additional information.
Furthermore, native methods should avoid features such as overloading, varargs (or any Java 5+ feature for that matter) to allow portability for languages that do not support such features (e.g. C).
Important! Do not rely on pass by reference/value behavior since they vary between platforms.

Implementing a native layer effectively means:

1. Creating an interface that extends NativeInterface and only defines methods with the arguments/return values declared in the previous paragraph.
2. Creating the proper native implementation hierarchy based on the call conventions for every platform within the native directory

E.g. to create a simple hello world interface do something like:

```
package com.my.code;
public interface MyNative extends NativeInteface {
    String helloWorld(String hi);
}
```

Then to use that interface use MyNative my = (MyNative)NativeLookup.create(MyNative.class);
Notice that for this to work you must implement the native code on all supported platforms!
To implement the native code use the following convention. For Java based platforms (Android, RIM, J2ME):
Just create a Java class that resides in the same package as the NativeInterface you created and bares the same name with Impl appended e.g.: MyNativeImpl. So for these platforms the code would look something like this:

```
package com.my.code;
public class MyNativeImpl implements MyNative {
    public String helloWorld(String hi) {
        // code that can invoke Android/RIM/J2ME respectively
    }
}
```

Notice that this code will only be compiled on the server build and is not compiled on the client. These sources should be placed under the appropriate folder in the native directory and are sent to the server for compilation.
For Objective-C, one would need to define a class matching the name of the package and the class name combined where the "." elements are replaced by underscores. One would need to provide both a header and an "m" file following this convention e.g.:

```
@interface com_my_code_MyNative : NSObject {
}
- (id)init;
- (NSString*)helloWorld:(NSString *)param1;
@end
```

Notice that the parameters in Objective-C are named which has no equivalent in Java. That is why the native method in Objective-C MUST follow the convention of naming the parameters "param1", "param2" etc. for all the native method implementations. Java arrays are converted to NSData objects to allow features such as length indication.

PeerComponent return values are automatically translated to the platform native peer as an expected return value. E.g. for a native method such as this: PeerComponent createPeer();
Android native implementation would need: View createPeer();
While RIM would expect: Field createPeer()
The iphone would need to return a pointer to a view e.g.: - (UIView*)createPeer; J2ME doesn't support native peers hence any method that returns a native peer would always return null.

Drag & Drop

Unlike other platforms who tried to create overly generic catch all API's we tried to make things as simple as possible. We always drag a component and always drop it onto another component, if something else is dragged to some other place it must be wrapped in a component, the logic of actually performing the operation indicated by the drop is the responsibility of the person implementing the drop.

There is a minor sample of this in the KitchenSink demo whose drag and drop behavior is implemented using this API. However, the KitchenSink demo relies on built in drop behavior of container specifically designed for this purpose.

To enable dragging a component it must be flagged as draggable using setDraggable(true), to allow dropping the component onto another component you must first enable the drop target with setDropTarget(true) and override some methods (more on that later).

Notice that is a drop target is a container that has children, dropping a component on the child will automatically find the right drop target. You don't have to make "everything" into a drop target.

You can override these methods in the draggable components:
getDragImage - this generates an image preview of the component that will be dragged. This automatically generates a sensible default so you don't need to override it.
drawDraggedImage - this method will be invoked to draw the dragged image at a given location, it might be useful to override it if you want to display some drag related information such an additional icon based on location etc. (e.g. a move/copy icon).

In the drop target you can override the following methods:
draggingOver - returns true is a drop operation at this point is permitted. Otherwise releasing the component will have no effect.
dragEnter/Exit - useful to track and cleanup state related to draging over a specific component.
drop - the logic for dropping/moving the component must be implemented here!

Notice that the Container class has a simple sample drop implementation you can use to get started.

Physics - The Motion Class

[TODO]

BiDi/RTL Language Support

BiDi is the term referring to bi-directional language support, generally RTL languages (right to left). There is plenty of information about RTL languages (Arabic, Hebrew, Syriac, Thaana) on the internet but as a brief primer here is a minor summary.

Most western languages are written from left to right (LTR), however some languages are normally written from right to left (RTL) speakers of these languages expect the UI to flow in the opposite direction otherwise it seems weird just like reading this word would be to most English speakers: "drieW".

The problem posed by RTL languages is known as BiDi (Bi-directional) and not as RTL since the "true" problem isn't the reversal of the writing/UI but rather the mixing of RTL and LTR together. E.g. numbers are always written from left to right (just like in English) so in an RTL language the direction is from right to left and once we reach a number or English text embedded in the middle of the sentence (such as a name) the direction switches for a duration and is later restored.

Codename One's support for bidi includes the following components:

- Bidi algorithm - allows converting between logical to visual representation for rendering
- Globabl RTL flag - default flag for the entire application indicating the UI should flow from right to left
- Individual RTL flag - flag indicating that the specific component/container should be presented as an RTL/LTR component (e.g. for displaying English elements within a RTL UI).
- RTL text field input
- RTL bitmap font rendering

Most of Codename One's RTL support is under the hood, the LookAndFeel global RTL flag can be enabled using:

```
UIManager.getInstance().getLookAndFeel().setRTL(true);
```

(Notice that setting the RTL to true implicitly activates the bidi algorithm).

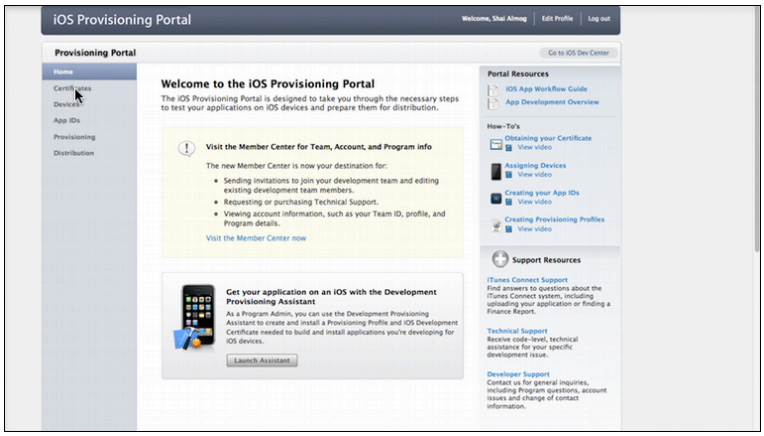
Once RTL is activated all positions in Codename One become reversed and the UI becomes a mirror of itself. E.g. A softkey placed on the left moves to the right, padding on the left becomes padding on the right, the scroll moves to the left etc.
This applies to the layout managers (except for group layout) and most components. Bidi is mostly seamless in Codename One but a developer still needs to be aware that his UI might be mirrored for these cases.

Appendix: Working With iOS

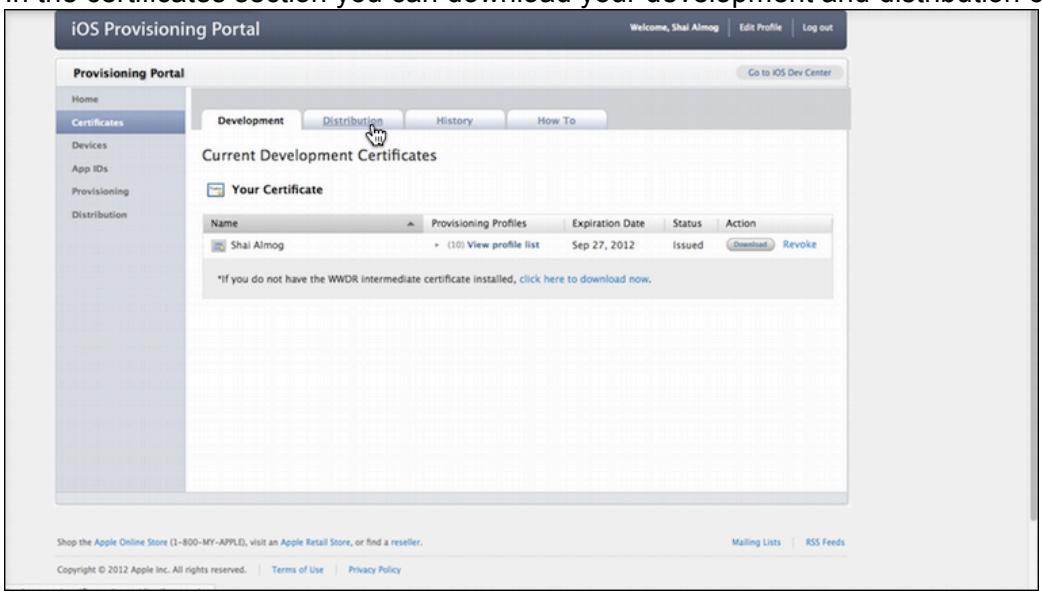
Provisioning Profile & Certificates

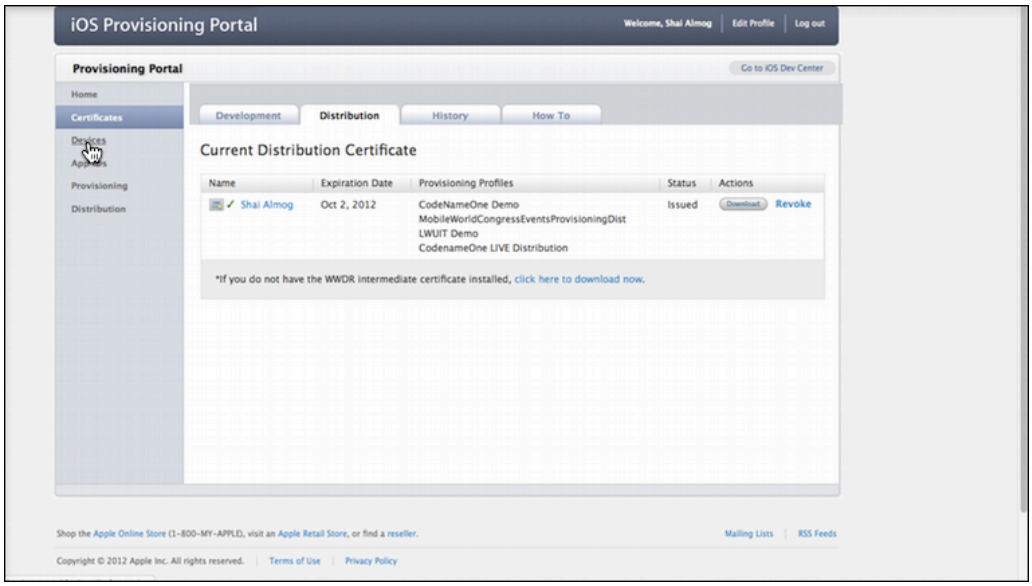
One of the hardest parts in developing for iOS is the total mess they made with their overly complex certificate/provisioning process. Relatively for the complexity the guys at Apple did a great job of hiding allot of the crude details but its still difficult to figure out where to start.

Start by logging in to the iOS provisioning portal

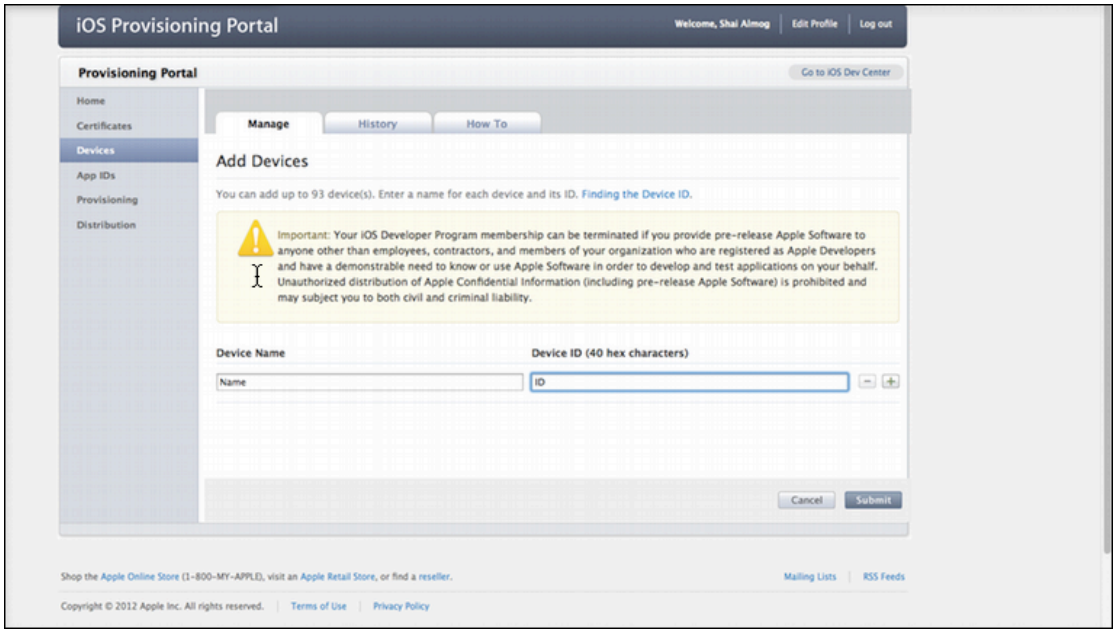


In the certificates section you can download your development and distribution certificates.

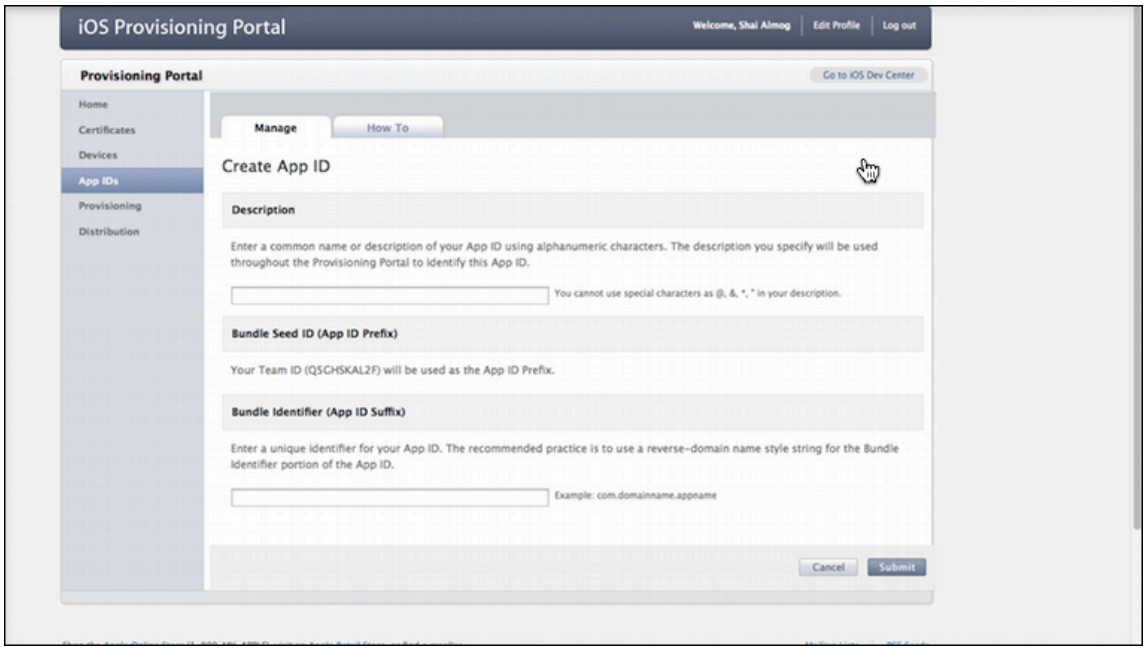




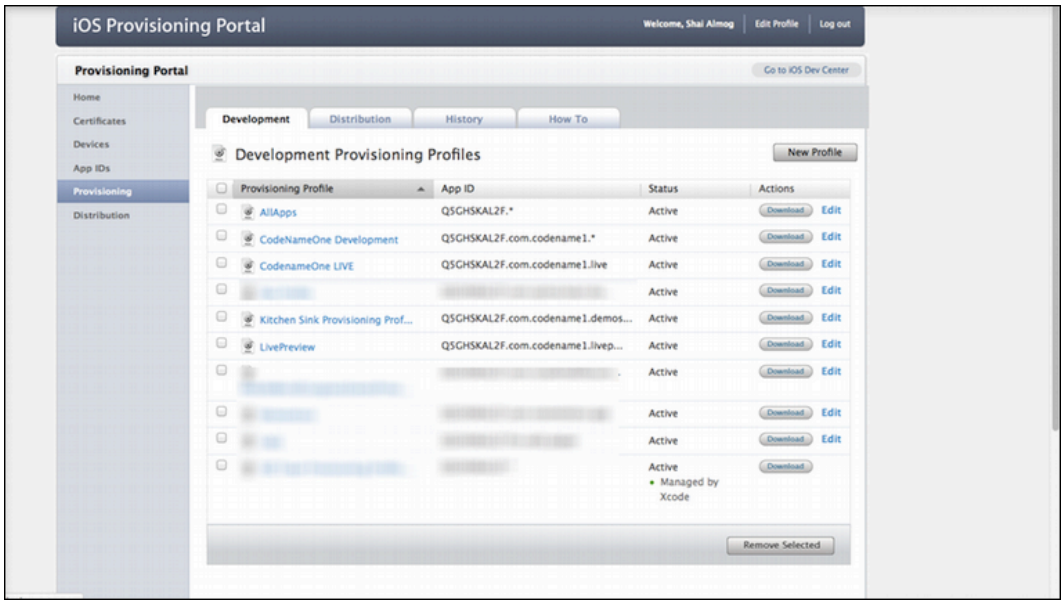
In the devices section add device id's for the development devices you want to support. Notice no more than 100 devices are supported!

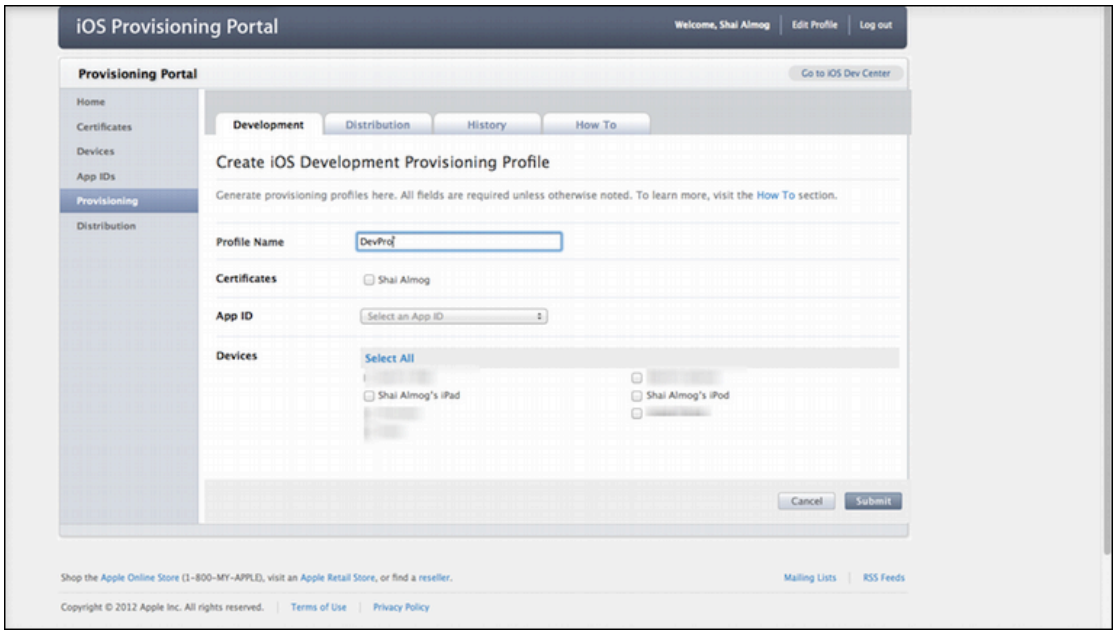


Create an application id, it should match the package identifier of your application perfectly!

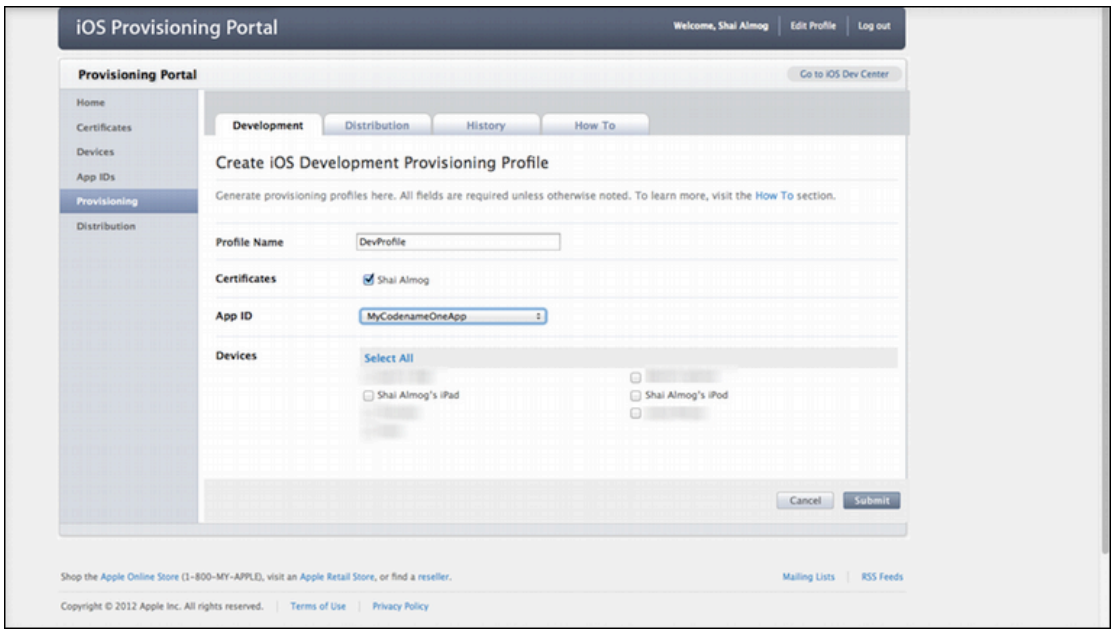


Create a provisioning profile for development, make sure to select the right app and make sure to add the devices you want to use during debug.

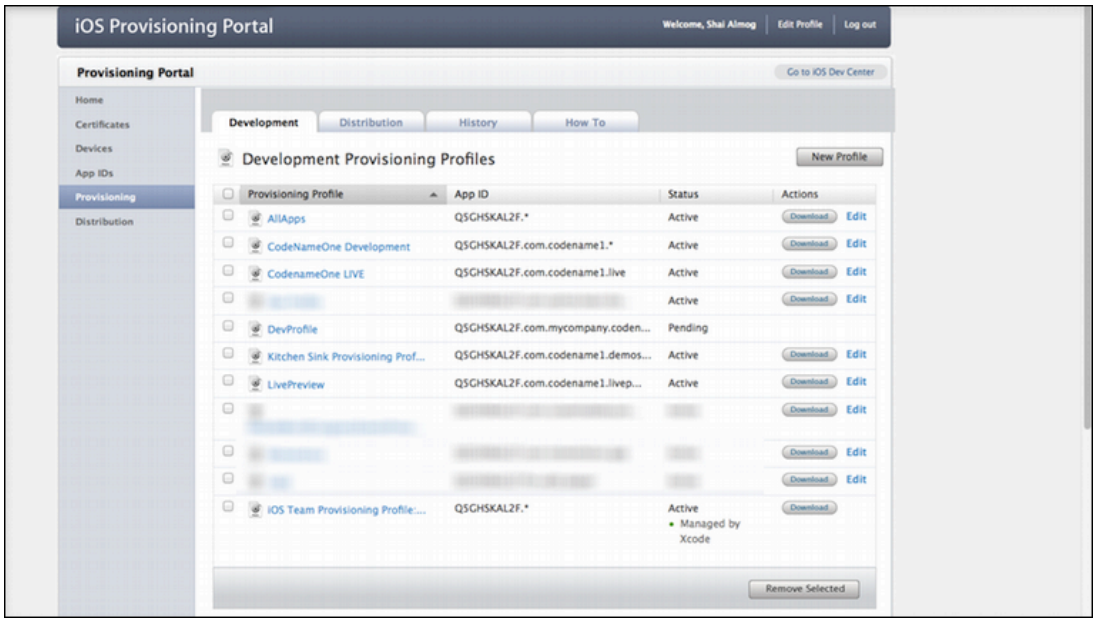




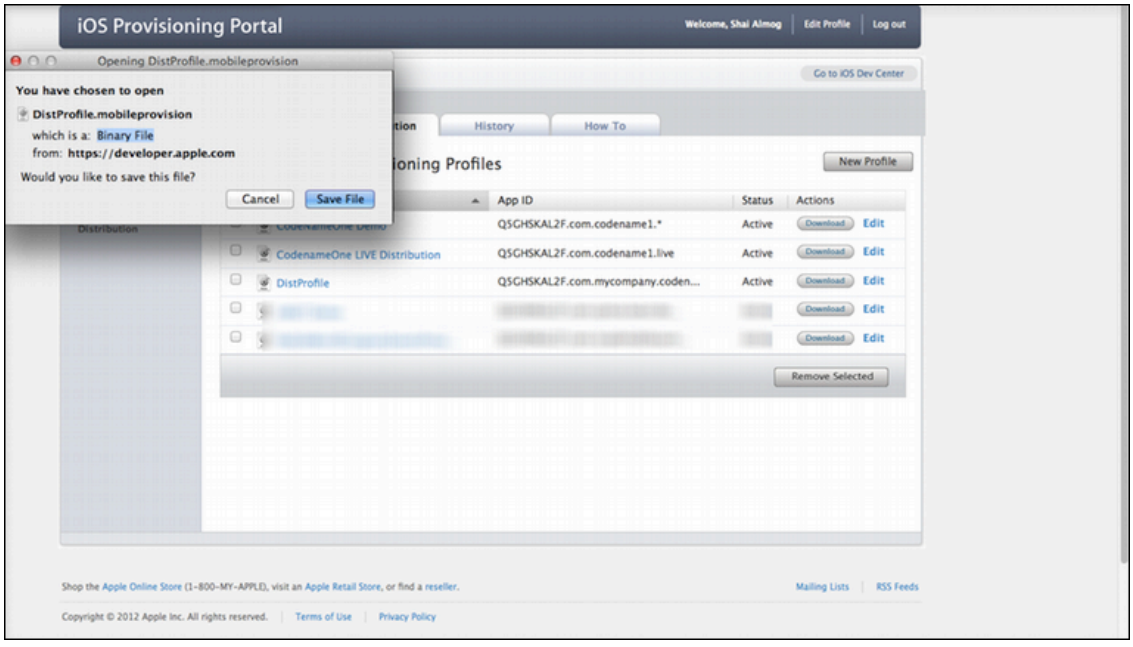
Refresh the screen to see the profile you just created and press the download button to download your development provisioning profile.



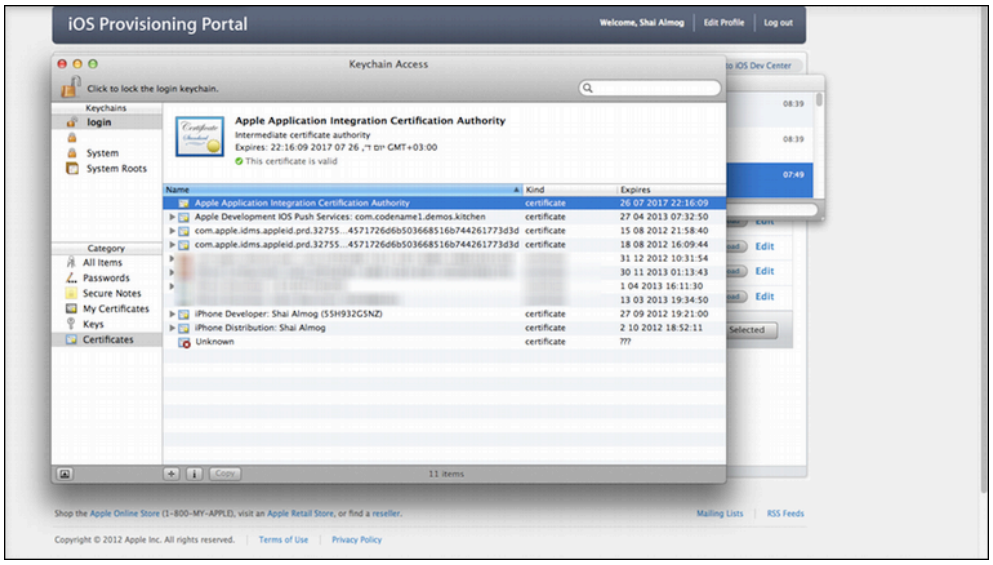
Create a distribution provisioning profile, it will be used when uploading to the app store. There is no need to specify devices here.



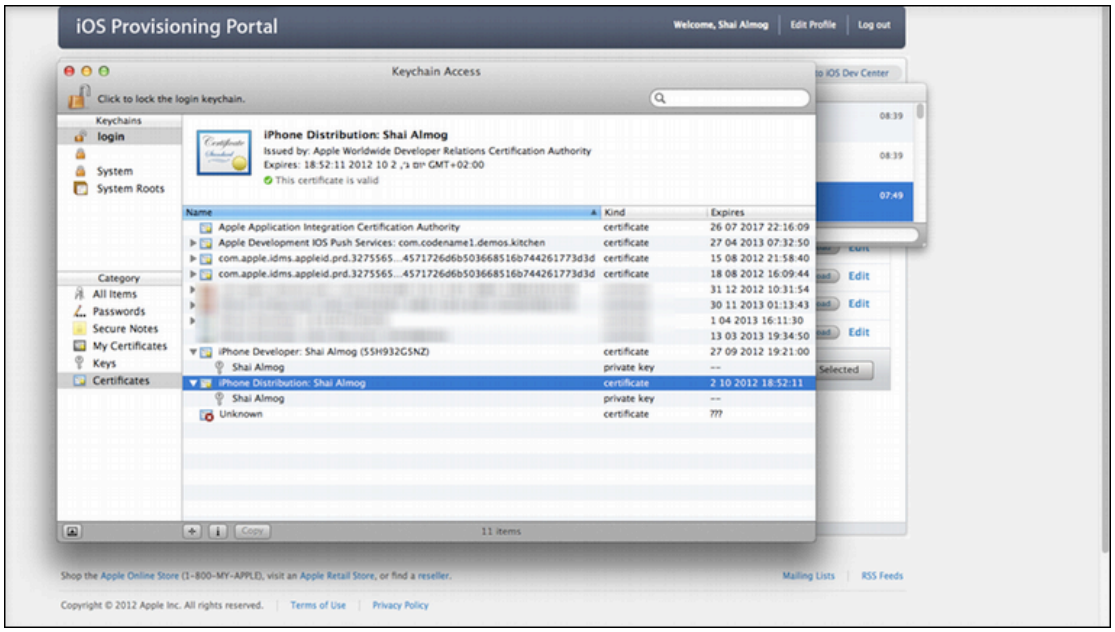
Download the distribution provisioning profile.



We can now import the cer files into the key chain tool on a Mac by double clicking the file, on Windows the process is slightly more elaborate



We can export the p12 files for the distribution and development profiles through the keychain tool



In the IDE we enter the project settings, configure our provisioning profile, the password we typed when exporting and the p12 certificates. It is now possible to send the build to the server.