

Automator Programming Guide

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Introduction to Automator Programming Guide

Automator is an application from Apple that automates repetitive procedures performed on a computer. With Automator users can construct arbitrarily complex workflows from modular units called actions. An action performs a discrete task, such as opening a file, cropping an image, or sending a message. A workflow is a number of actions in a particular sequence; when the workflow executes, data is piped from one action to the next until the desired result is achieved.

Apple includes a suite of ready-made actions with Automator, but developers are encouraged to contribute their own actions. You can create actions—which are implemented as loadable bundles—using either AppleScript, Objective-C, or a combination of the two languages. You can also create actions using shell scripts or other scripting languages such as Perl and Python.

Automator was introduced in OS X version 10.4. It does not run on earlier systems. The development features of Automator were introduced with Xcode 2.0. Additional development features have been added in Xcode 2.1. This document notes these newer features when it mentions them.

Who Should Read This Document

Any developer can create actions for Automator, as indeed can system administrators or “power users” who are familiar with AppleScript. But application developers have a particular motivation for developing actions. They can create actions that access the features of their applications, and then install these actions along with their applications. Users of Automator can then become aware of the applications and what they have to offer.

Developers can also contribute to Automator by making their applications scriptable or by providing a programmatic interface (via a framework) that developers use to create their actions.

Organization of This Document

Automator Programming Guide consists of the following articles:

- [Automator and the Developer](#) (page 11) describes what Automator can do and discusses the characteristics and types of actions,
- [How Automator Works](#) (page 17) gives an overview of the loadable-bundle architecture of Automator and the Objective-C classes of the Automator framework.

- [Design Guidelines for Actions](#) (page 26) lists guidelines for action development, including recommendations regarding I/O, naming, and the user interface.
- [Developing an Action](#) (page 29) guides you through the major steps required to develop an action.
- [Show When Run](#) (page 56) describes the Show When Run feature of actions and explains how you can customize it.
- [Implementing an AppleScript Action](#) (page 64) states the requirements for developing an action using AppleScript, suggests approaches you might take, and discusses hybrid actions—that is, actions based on both AppleScript and Objective-C code.
- [Implementing an Objective-C Action](#) (page 72) explains how to create an action implemented with Objective-C code.
- [Creating Shell Script Actions](#) (page 82) describes the steps required to create an action using a shell script or a scripting language such as Perl or Python.
- [Creating a Conversion Action](#) (page 95) describes what is required to create actions whose only purpose is to convert between types of input and output data.
- [Defining Your Own Data Types](#) (page 98) discusses custom data types and explains when and how you should define them.
- [Automator Action Property Reference](#) (page 108) defines the types and expected values for the Automator properties specified in an action’s information property list (`Info.plist`).

See Also

- [Automator Framework Reference](#) provides an overview of the reference material available for developing with Automator, with links to specific class reference and constants documents.
- [Automator Constants Reference](#) describes Automator programming constants.
- [Mac Technology Overview](#) presents an overview of the Xcode integrated development environment.
- [AppleScript Overview](#) introduces the technology for creating and controlling scriptable applications.
- [The Objective-C Programming Language](#) describes the Objective-C programming language and how you use it to create object-oriented programs.
- [Cocoa Bindings Programming Topics](#) discusses the Cocoa bindings mechanism and how you can incorporate it in your programs.

Automator and the Developer

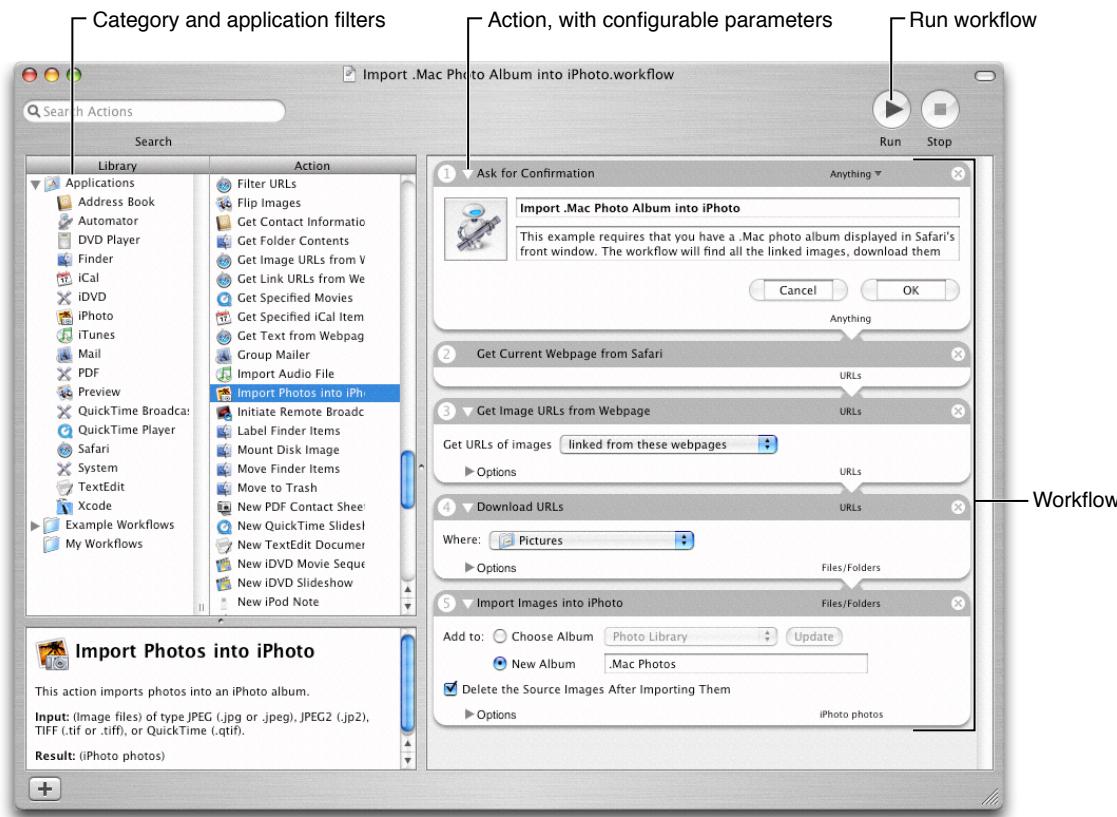
Automator is an Apple application that lets users automate repetitive procedures performed on a computer. With Automator, users can quickly construct arbitrarily complex sequences of configurable tasks that they can set in motion with a click of a button. And they do not need to write a single line of code to do so.

All kinds of OS X users, including system administrators and developers, can derive huge benefits from Automator. It enables them to accomplish in a few seconds a complex or tedious procedure that manually might take many minutes. Developers can contribute to what Automator offers users in two ways: by making their applications scriptable and by creating loadable bundles specifically designed for Automator.

Constructing Workflows With Automator

As a developer, you can best appreciate how to integrate your software products with Automator by understanding how users might use the application, which is located in /Applications. Figure 1 shows a typical Automator workflow.

Figure 1 A typical Automator workflow



A workflow in Automator consists of a sequence of discrete tasks called actions. An Automator action is a kind of functional building block. An Automator workflow hooks the actions together so that—in most cases—the output of one action is the input of the subsequent action. Clicking the run button in the upper-right corner of the window causes Automator to invoke each action of the workflow in turn, passing it (usually) the output of the previous action.

To create a workflow, users choose each action they want from the browser on the left side of the application window and drag it into the layout view in the right side of the window. They can search for specific actions by application, category, or keyword. Once dropped, an action presents a view which, in almost all cases, contains text fields, buttons, and other user-interface elements for configuring the action. In addition to configuring each action, users can move actions around in the workflow to put them in the desired sequence. They can then save the workflow as a document that can be run again and again in Automator.

Actions can be virtually anything that you can do on an OS X system (version 10.4 and later). You can have an action that copies files, an action that crops an image, an action that burns a DVD, or an action that builds a project in Xcode. Actions can either interact with applications or draw on system resources to get their work done. By stringing actions together in a meaningful sequence—that is, in a workflow—a user can accomplish complex and highly customized procedures with a click of a button. Apple provides dozens of actions for use in Automator (OS X version 10.4 and later).

Workflow Scenarios

A general description of Automator and its actions and workflows goes only so far to convey the power and flexibility of the application. To better appreciate what users can do with Automator—and how your actions can play a part in it—consider the following workflow scenarios:

- Workflow 1—Copies the content of all messages flagged in the currently displayed mailbox to a TextEdit document. This workflow consists of the following actions:
 1. Find Messages in Mail (Mail), configured to find messages whose flagged status is true
 2. Display Messages (Mail)
 3. Combine Messages (Mail)
 4. New TextEdit Document (TextEdit)
- Workflow 2—Imports images on a webpage (such as .Mac photo album) into iPhoto:

This workflow requires users to go to the webpage in Safari before running the workflow.

 1. Get Current Webpage from Safari
 2. Get Image URLs from Webpage, configured to get the URLs linked from this webpage
 3. Download URLs, configured to a specified location on the local computer
 4. Import Images into iPhoto, configured to put them in a new or existing album
- Workflow 3—Finds people with birthdays in the current month and creates an iCal event for each person:
 1. Find People with Birthdays (Address Book), configured to this month.
 2. New iCal Event, configured to create one event for each person received. It is also configured with any relevant event information, such as calendar and alarm.

Developing for Automator

Given an automation tool as powerful and flexible as Automator, it's clear that any action you develop for it benefits both you and the user, especially if that action accesses what your application has to offer. Users have an additional path to the features and services that make your products unique, and this in turn enhances the visibility and reputation of your products.

You don't even have to be a programmer (in the traditional sense) to develop actions for Automator. You can write an action in AppleScript as well as in Objective-C (and AppleScript actions have full access to such things as Standard Additions). You can also mix AppleScript scripts and Objective-C code when you develop an action; the script can invoke Objective-C methods implemented for the action. AppleScript has the advantage of being easier to learn, but it requires that applications that are the targets of commands be scriptable. As an object-oriented superset of ANSI C, Objective-C is a full-fledged programming language, which makes it harder to master than AppleScript but allows you to take full advantage of the Cocoa Objective-C frameworks—as well as all C-based frameworks.

If you have experience in UNIX environments, you can also write shell scripts, Perl scripts, or Python scripts to drive the behavior of actions. These kinds of actions are known as shell script actions. The scripts in these actions can also work together with AppleScript scripts and Objective-C classes in an action project.

In light of these language alternatives, there are three general types of Automator actions:

- An action that controls an application to get something done. AppleScript-based actions can do this if the application is scriptable. Objective-C actions can do this if the application has a public programmatic interface (as do, for example, Address Book and iChat).
- An action that uses system frameworks and other system resources to get something done. Actions that are strictly based on AppleScript cannot do this, but Objective-C actions—and actions that are a mixture of AppleScript and Objective-C—can. An Objective-C action, for example, could use the network-services classes NSNetService and NSNetServiceBrowser to implement an action that offers dynamic printer discovery. Shell script actions also fall into this category, because they have hundreds of BSD command-line tools at their disposal.
- An action that performs some small but necessary “bridge” function such as prompting the user for input, writing output to disk, or informing the user of progress. You can create these types of actions using AppleScript, Objective-C, and shell scripts (including Perl or Python).

Important: Consider making your applications accessible to actions even if you do not provide any Automator actions of your own. For AppleScript-based actions, that means making your applications scriptable—that is, responsive to AppleScript commands. For Objective-C based actions, that means publishing a programmatic interface. Other developers may decide to create actions that access your application’s services. See *AppleScript Overview* for information on making applications scriptable.

From a developer’s perspective, actions have a common programmatic interface and a common set of properties. The programmatic interface is defined by four classes: `AMAction`, `AMBUNDLEAction`, `AMAppleScriptAction`, and `AMShellScriptAction` (discussed in [How Automator Works](#) (page 17)). Action properties, which are specified in an action bundle’s information property list (`Info.plist`), define characteristics such as:

- The types of data the action accepts and provides
- The application the action is associated with and the category of task it performs
- Other keywords to identify the action in searches
- The default parameters of the action
- Warnings given to users if the action, as configured, might result in loss of data

See [Automator Action Property Reference](#) (page 108) for further information on Automator action properties.

The Apple integrated development environment, Xcode, provides support for Automator action developers. There are Xcode project types for AppleScript, Objective-C, and shell script actions. Included in these project types are all required files and templates. For example, the default nib file (`main.nib`) contains an initial user interface, an instance of `NSObjectController` for establishing bindings, and File’s Owner already set up to be your action object. For more on the Automator action project types see [Developing an Action](#) (page 29).

If you install actions as part of your product, be sure to install them in `/Library/Automator` (if they are to be available to all users of a system) or in `~/Library/Automator` (if they are to be available only to the current user). `/System/Library/Automator` is reserved for Apple-developed actions. You can also install actions in the bundle of the application that uses them. Automator also looks for actions in application bundles. If you provide actions, you may want to advertise them to your users so they can look forward to using them in new workflows.

Automator Actions as Universal Binaries

A universal binary is executable code that can run on either PowerPC-based or Intel-based Macintosh computers. To move a PowerPC-only project to a universal-binary project may require work involving such programming details as endianness, alignment, and calling conventions. The amount of work generally depends on the level of the source code; lower-level source code (for example, the kernel) requires more work than higher-level code (for example, an application based on Carbon).

The need to make an Automator action a universal binary depends on the language used:

- AppleScript actions are platform-independent and do not require any changes to run on Intel processors.
- An action that contains Objective-C code, whether a Cocoa-only action or an action that contains a mix of Objective-C and AppleScript, must be built as a universal binary to run correctly on both Intel and PowerPC processors.

For information on making universal binaries, see *Universal Binary Programming Guidelines, Second Edition*.

How Automator Works

The following sections describe the development environment, runtime architecture, and class hierarchy for Automator actions.

The Development Components of Automator

The Xcode development environment integrates a number of technologies to make action programming as efficient as possible:

- Xcode project templates—Apple defines a project type for each of the languages used to implement actions: AppleScript, Objective-C, and shell script. Each project type contains all required files and resources, and supplies placeholder code and default configurations for the action-bundle project.
- AppleScript Studio—A powerful tool that helps you to create Mac apps that support the Aqua user interface guidelines and that can execute AppleScript scripts.
- Interface Builder—A tool for creating graphical user interfaces from palettes of standard objects. Automator supplies its own palette (Cocoa-Automator) containing pop-up menus for files and folders. The action project template includes a preconfigured nib file.
- Cocoa bindings—Actions by default are designed to use the Cocoa bindings mechanism to communicate data automatically between an action’s view and its internal parameters; an action’s nib file is configured to support bindings.
- Objective-C frameworks—Support for Automator actions is implemented in Objective-C. Consequently, the Foundation, Application Kit, and Automator frameworks—all Objective-C frameworks—are automatically imported into and linked with action projects.

The final product of all these components, when an action is built, is a loadable bundle.

Loadable Bundle Architecture

The Automator application is based on a loadable bundle architecture. It loads loadable bundles called actions and executes the code they contain in the sequence determined by the current workflow, piping the flow of data from one action to the next.

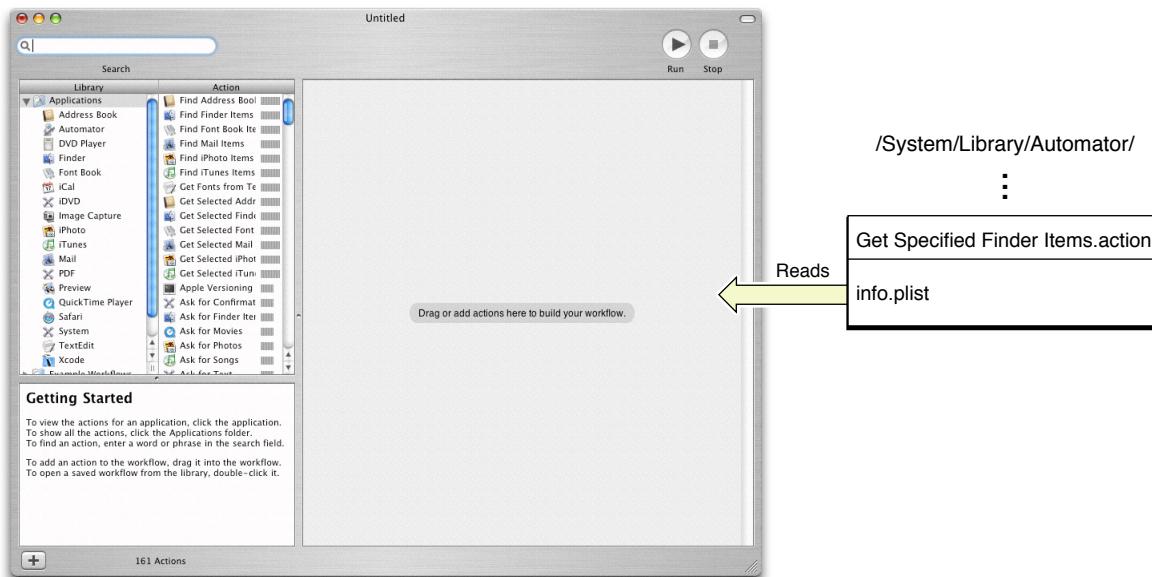
Each action is packaged as a loadable bundle—or in the case of AppleScript-based actions, a potentially loadable bundle. A loadable bundle contains resources of various kinds and usually binary code, but it is not capable of executing that code on its own. The internal structure of a Cocoa bundle is in a form that an NSBundle object “understands.” Using an NSBundle object, an application or framework can load the resources and code of a loadable bundle at runtime and integrate them with what it already contains. Loadable bundles are essentially a plug-in architecture.

When it launches, Automator immediately scans the currently installed action bundles and extracts from each bundle’s information property list (`Info.plist`) the information necessary to display it and prepare it for use (see Figure 1). Automator actions (in the form of loadable bundles) are stored in standard file-system locations:

- /System/Library/Automator — Apple-provided actions
- /Library/Automator — third-party actions, general use
- ~/Library/Automator — third-party actions, private use

Automator also looks for actions that are stored inside the bundles of any registered applications. See [Testing, Debugging, and Installing the Action](#) (page 51) for information on installing actions in the bundles of their related applications.

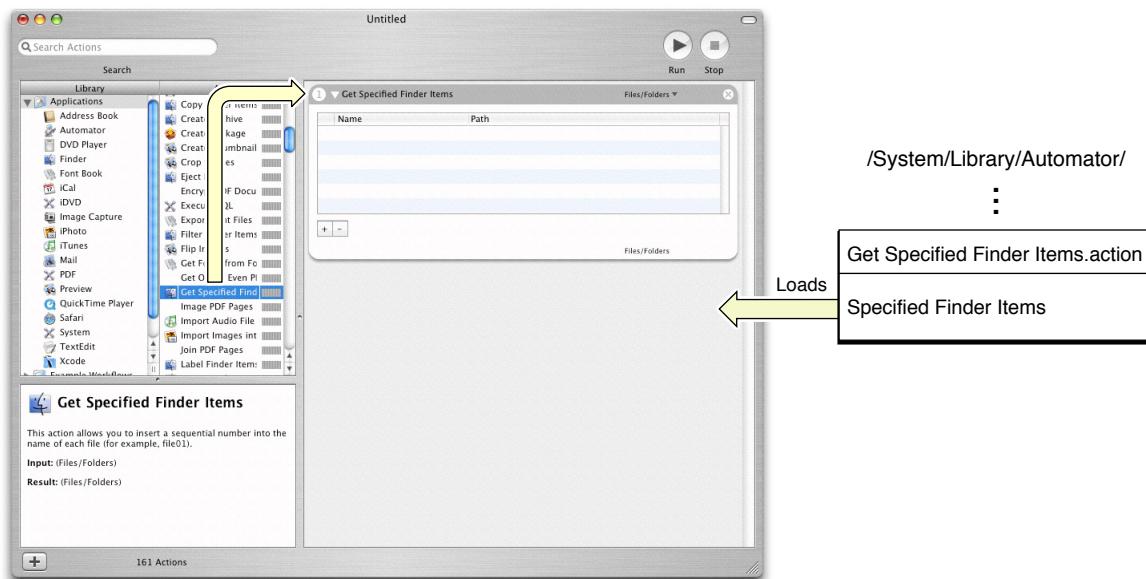
Figure 1 When launched, Automator gets information about available actions



When it launches, Automator also loads any Mach-O code it finds in action bundles—which in this case are Objective-C actions only—resolving external references in the process. If the action is based on Objective-C, an instance of `AMB(Bundle)Action` (or a subclass of that class) is unarchived from the nib. However, if an action is entirely driven by AppleScript or a shell script, Automator instead retains a reference to the bundle since

there is no Mach-O code to load. When a user drags such an action into Automator's workflow area for the first time, the application loads the action, unarchiving its nib file, and displays the action's view (see Figure 2).

Figure 2 When user drags AppleScript-based action into workflow, Automator loads bundle



Note: An action bundle is loaded when the action is first used when Automator launches. Thereafter, the action remains loaded until the user quits Automator.

The architectural details hereafter differ slightly based on whether the workflow is created for the first time or is unarchived.

A New Workflow

When the user creates a new workflow by dragging one or more actions into the workflow layout view, Automator does a couple of things:

- If the action is AppleScript-based it creates an instance of `AMAppleScriptAction` as the owner of the bundle; it also loads the script so AppleScript Studio can perform some initialization. If the action is based on a shell script, Automator creates an instance of `AMShellScriptAction` instead.
- It gets the content view contained in the action's bundle and displays it within an action view in the workflow area, setting the default values of text fields and controls as defined by the action's `AMDefaultParameters` property.

Users modify the parameters of an action by choosing pop-up items, clicking buttons, entering text into text fields, and so on. When the workflow is ready, they click the run button to execute the workflow. With Automator acting as a coordinator, the application and each action perform the following steps in the workflow sequence:

- Automator invokes the `runWithInput:fromAction:error:` method of the action, passing it the output of the previous action as input.
The `AMAppleScriptAction` and `AMShellScriptAction` classes provide default implementation of this method for script-based actions. The `AMAppleScriptAction` implementation calls the `on run` AppleScript handler.
- The settings made in the user interface of the action are propagated as parameters to the action object via Cocoa bindings.
- The action object (in most cases) takes the input and, based on the parameters, transforms it or does whatever its stated role is (such as importing it into an application or displaying output).
- As its last step, the action returns the result of its work (its output). If it does not affect the data passed it as input, it simply returns it unchanged.

While each action is busy, Automator displays a spinning progress indicator in the action view. If an error occurs in an action, the action view displays a red "X" and may display an error message. If the action successfully completes, its view displays a green check mark. When the last action has finished its task, the workflow execution is over.

An Unarchived Workflow

When users save a workflow or copy one via the pasteboard (clipboard), the workflow and all of its actions are archived. Automator invokes the `writeToDictionary:` method of each of the actions in the workflow, passing in a mutable dictionary of the action's parameters and other information. The action may choose to modify the contents of the dictionary before returning from `writeToDictionary:`. Then the combined dictionaries of each action of the workflow are encoded and archived.

When Automator reads a workflow archive from disk or the pasteboard, it sends a `initWithDefinition:fromArchive:` message to each action in the workflow. In the first parameter of the message is a dictionary from which the action can re-create its state, particularly the last-selected parameters. The second parameter tells the newly created action object whether its definition is coming from an archive.

Once all actions in the workflows have been reinitialized from the archive, the workflow is ready to use. Users can select parameters in actions and run the workflow. Things continue on at this point as described in [A New Workflow](#) (page 19).

Programming Implications of Loadable Bundles

The loadable bundle architecture of Automator has some implications for action programming, especially when the development language is Objective-C. These implications concern bundles, nib file unarchiving, and namespaces.

Bundle Access

One issue with bundles arises from a distinction between the main bundle of an application such as Automator and the bundles that are loaded by the application. If you ask for the main bundle in your action's code—for example:

```
NSBundle *theBundle = [NSBundle mainBundle];
```

you get the main bundle of the Automator application, not the bundle of the action calling `mainBundle`. For the action bundle, you must send a bundle message to the action object (which is usually `self` in the code implementing the action):

```
NSBundle *theBundle = [self bundle];
```

The `bundle` method is declared by the `AMBBundleAction` class, which all action objects inherit from, directly or indirectly (see [The Automator Classes](#) (page 23)).

Nib File Unarchiving

Cocoa programs frequently implement the `awakeFromNib` method (whose counterpart for AppleScript Studio programs is the `awake from nib` command handler). The `awakeFromNib` method is invoked when all objects in a program's nib file have been unarchived. It gives the program an opportunity to perform any initialization that requires the presence of all unarchived objects.

However, the `awakeFromNib` method is invoked in an action when Automator is launched. At this time Automator reads in any binary code of the actions in standard Automator locations and it directly unarchives objects in the nib files that it *directly* owns. However, these objects don't include the objects in the nib files of actions. The nib file of an action is not loaded and its objects are not unarchived until users drag the action into a workflow. If you want to perform initializations that require the presence of all objects and connections in an action's nib file, implement the `opened` method instead of `awakeFromNib`.

Namespaces

An Objective-C class defines a namespace for the methods and instance variables it declares. Because of this, identically named methods and instance variables in other classes do not cause conflicts within a process.

However the name of a class itself exists in a namespace occupied by all classes loaded by a process. In addition, all global symbols (such as functions and data types) share the same namespace within a process.

For Automator, with its loadable bundle (or plug-in) architecture, the potential for namespace collisions—and hence runtime exceptions—is significant. Automator can potentially load hundreds of actions from different sources and, for example, if two action classes have the same name or declare a string constant with the same name, there is the potential for namespace conflict when those actions are loaded by Automator.

To avoid namespace collisions, it is recommended that you assign prefixes to all classes and global types that are distinctive as possible. For example, if your company's name is Acme, you might name a class AC_FilterImages.

Threading Architecture

To improve runtime stability and give AppleScript-based actions access to resources such as Standard Additions, Automator has a threading architecture that puts different types of program activity on separate threads. Automator starts a workflow on a secondary thread (that is, a thread other than the main thread). But as it cycles through the actions of the workflow, it runs each action on a different thread depending on whether the action is based on AppleScript or Objective-C:

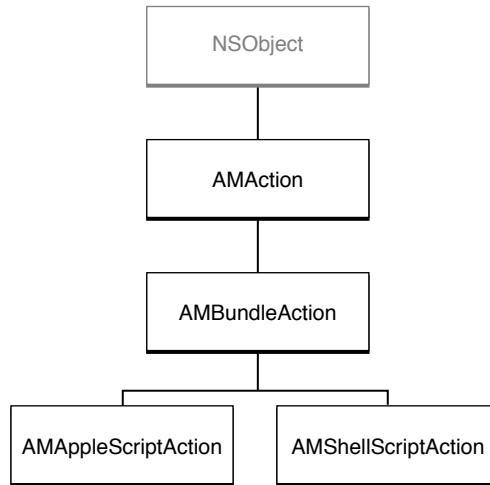
- If the action is based on AppleScript, it is executed on the main thread. The implementation permits users to cancel the execution of the action on this thread by clicking the stop button or pressing Command-period.
- If the action is based on Objective-C or a shell script, it is executed on the secondary thread.

This threading architecture imposes restrictions on both writers of AppleScript-based and Objective-C actions. If an AppleScript-based action uses the `do shell script` command, the user interface is rendered unresponsive until the script completes; the only way users can cancel execution is to press Command-period. If Objective-C actions are to display windows, they must do so on the main thread using a method such as `performSelectorOnMainThread:withObject:waitUntilDone:`.

The Automator Classes

Automator as a technology includes not only the application and its actions but the Automator framework (`Automator.framework`). The framework implements much of the common behavior of actions and also provides a public interface defined by four classes: `AMAction`, `AMBUNDLEAction`, `AMAppleScriptAction`, and `AMShellScriptAction`. These classes are hierarchically related (in terms of inheritance) as shown in Figure 3.

Figure 3 The Automator public classes



`AMAction` is an abstract class that specifies the interface and attributes essential to all actions. A major attribute of an action (as defined by `AMAction`) is its definition, a dictionary derived from the action properties specified in the bundle's information property list. The designated initializer of `AMAction` includes the action's definition in its signature: `initWithDefinition:fromArchive:`. The major method in an action's programmatic interface (as defined by `AMAction`) is `runWithInput:fromAction:error:`, which is briefly described in [Loadable Bundle Architecture](#) (page 17).

The `AMBUNDLEAction` class directly inherits from `AMAction` and provides a concrete implementation of it. `AMBUNDLEAction` defines the interface and common behavior of actions that are loadable bundles.

`AMBUNDLEAction` objects have three essential properties:

- An outlet connection to their associated view
- A reference to their bundle
- The parameters of the action—that is, the configuration choices users make in the action's user interface (stored in an `NSDictionary` object).

Bundled actions are designed to present a view, access the resources of the bundle, and access the parameters for the action. The implementation of the `AMBBundleAction` class makes it possible for actions to be copied, pasted, and encoded for archiving. Objective-C action objects are always instantiated from custom subclasses of `AMBBundleAction`.

`AMAppleScriptAction` and `AMShellScriptAction` are subclasses of `AMBBundleAction`. They extend loadable action bundles so that AppleScript scripts or shell scripts can drive the action's logic instead of Objective-C code (although AppleScript, Objective-C, and even shell script code can be mixed in the implementation of an action). The sole outlet of `AMAppleScriptAction` is an `OSAScript` object representing the script; by default, this outlet is set to an object representing `main.applescript`.

You can create your own subclasses at the last two levels of the Automator class hierarchy—that is, `AMBBundleAction` on down—to get objects with the characteristics and capabilities that you need. If you want to create loadable action bundles whose behavior is determined by scripting languages other than AppleScript, shell scripts, Perl, or Python, you would subclass `AMBBundleAction`.

Conceptually, the two fundamental external factors for an action are the input object passed it by the previous action (if any) and the parameters specified by users through the controls and text fields of the action's view. An instance of `AMBBundleAction` accesses the input object in its implementation of `runWithInput:fromAction:error:` and obtains parameters directly from the user interface through the

Cocoa bindings mechanism. For an AppleScript-based action (represented by an `AMAppleScriptAction` instance), the input object and parameters are even more explicit. They occur as the passed-in values in the `on run` handler, as shown in Figure 4.

Figure 4 A typical action script

```
on run {input, parameters}
    set output to input
    set filesToCopy to {}
    set toDirectory to |toDirectory| of parameters
    set replaceExisting to |replaceExisting| of parameters

    -- Check to see that we actually got some files to copy
    if (the class of input) is script then
        error my localized_string("No item references were passed to the Copy Files action.")
    end if

    -- Default the toDirectory to the desktop if one wasn't specified
    if the toDirectory is "" then
        set the toDirectory to "~/Desktop"
    end if

    -- Expand the toDirectory
    set toDirectory to «event appScalM» "stringByExpandingTildeInPath" given «class ps of»:toDirectory

    -- See if the path exists and that it is in fact a directory
    if not («event appScalM» "directoryExistsAtPath:" given «class of C»:"CopyFilesAction", «class witQ»:toDirectory)
        as boolean then
            error my localized_string("The chosen folder was not found on this computer.")
    end if

    -- Create an array of posix paths from the input
    repeat with i in input
        copy (POSIX path of i) to end of filesToCopy
    end repeat

    -- Do the actual copy
    set duplicatedFiles to «event appScalM» "copyFiles:toDirectory:replaceExisting:"
        given «class of C»:"CopyFilesAction", «class witP»:{filesToCopy, toDirectory, replaceExisting}

    set output to {}
    repeat with i in duplicatedFiles
        copy POSIX file (i) as alias to end of output
    end repeat

    return output
end run

on localized_string(key_string)
    return «event appSlocS» key_string given «class iBWI»:"com.apple.Automator.CopyFiles"
end localized_string
```

For information that clarifies aspects of this scripting code, see [Implementing an AppleScript Action](#) (page 64).

Design Guidelines for Actions

As with other parts of the human interface in OS X, actions should have a consistent look and feel so that users can easily use them. The following guidelines will help you achieve that consistent look and feel.

For concrete examples of well designed actions, look at the action project examples installed in /Developer/Examples/Automator .

What Makes a Good Action?

Perhaps the most important guideline is to keep your action as simple and focused as possible. An action should *not* attempt to do too much; by doing so it runs the risk of being too specialized to be useful in different contexts. An action should perform a narrowly defined task well. If an action you're working on seems like it's unwieldy, as if it's trying to do too much, consider breaking it into two or more actions. Small, discrete actions are better than large and complex actions that combine several different elements.

An action should inform the user what is going on, and if it encounters errors, it should tell users about any corrective steps that they might take. If an action takes a particularly long period to complete, consider displaying a determinate progress indicator. (Automator displays a circular indeterminate progress indicator when an action runs.)

You should provide an action in as many localizations as possible. See [Developing an Action](#) (page 29) for further information on internationalizing actions.

Action Input and Output

Interoperability is critical in the implementations of actions. An action's usefulness is limited by the types of data it can accept from other actions and give to other actions in a workflow. You specify these data types in the `AMAccepts` and `AMProvides` properties of actions using Uniform Type Identifiers (UTIs). The following guidelines apply to action input and output.

- Make the types of data the action provides and accepts as specific as possible. For example, if an image is coming from iPhoto, use `com.apple.iphoto.photo-object` as the UTI identifier instead of `public.image`.
- Specify multiple accepted and provided types, unless that is not appropriate for the action.

- Ideally, an action should accept and provide a list (or array) of the specified types.
- If your action doesn't require input and doesn't provide output (such as the Pause action), it should not list any input or output types. The framework will then route the flow of data around the action.
- Even if your action requires input it should still be prepared to handle gracefully the case where it doesn't get input.

For more on the `AMAccepts` and `AMProvides` properties and the supported UTIs, see [Automator Action Property Reference](#) (page 108).

Naming an Action

The following guidelines apply to the names of actions:

- Use long, fully descriptive names (for example, Add Attachments to Front Mail Message).
- Start the name with a verb that specifies what the action does.
- Use plural objects in the name—actions should be able to handle multiple items, whether that be URLs or `NSImage` objects.
 - However, you may use the singular form if the action accepts only a single object (for example Add Date to File Names, where there can be only one date).
- Don't use "(s)" to indicate one or more objects (for example, Add Attachment(s)). Use the plural form.

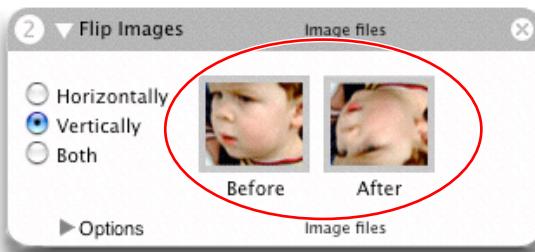
The User Interface of an Action

The user interface of an action should adhere to the following guidelines:

- Keep it simple:
 - Refrain from using boxes.
 - Minimize the use of vertical space; in particular, use pop-up menus instead of radio buttons even if there are only two choices.
 - Avoid tab views; instead, use hidden tab views to swap alternate sets of controls when users select a top-level choice.
 - Don't have labels repeat what's in the action title or description.
- Keep it small and consistent:
 - Use 10-pixel margins.
 - Use small controls and labels.

- Give buttons the standard Aqua “Push Button” style.
- Follow the Aqua guidelines (as suggested in Interface Builder).
- Implement behavior expected in a user interface—for example, tabbing between multiple text fields.
- Provide feedback and information to users:
 - Use determinate progress indicators when a user-interface element needs time to load its content; for example, an action that presents a list of current iCal calendars might need many seconds to load them.
 - Present examples of what the action will do where possible. For instance, the Make Sequential File Names action has an area of the view labeled “Example” that shows the effect of action options; the examples have the same font size and color as the rest of the action’s user interface. Figure 1 shows an action that uses images for its example.

Figure 1 An action that includes an example of its effect



- Streamline file and folder selection and display:
 - Insert a pop-up menu that includes standard file-system locations, such as Home, Startup Disk, Documents, Desktop, and so on.
 - The Cocoa-Automator palette includes pre-configured pop-up menus for selecting applications, directories, and files; use these objects where appropriate. See [Using the Cocoa-Automator Palette](#) (page 34) for details.

Developing an Action

It's easy to develop an Automator action. Because an action is a loadable bundle, its scope is limited and hence the amount of code you need to write is limited. Apple also eases the path to developing an action because of all the resources it places at your disposal. When you create an action project, the Xcode development environment provides you with all the necessary files and settings to build an action. You just need to follow certain steps—described in this document—to arrive at the final product.

The steps for developing an action don't necessarily have to happen in the order given below. For example, you can write an action description at any time and you can specify the Automator properties at any time.

Creating an Automator Action Project

To create an Automator action project, launch the Xcode application and choose New Project from the File Menu. From the first window of the New Project assistant, select one of the two Automator action projects, depending on your language choice:

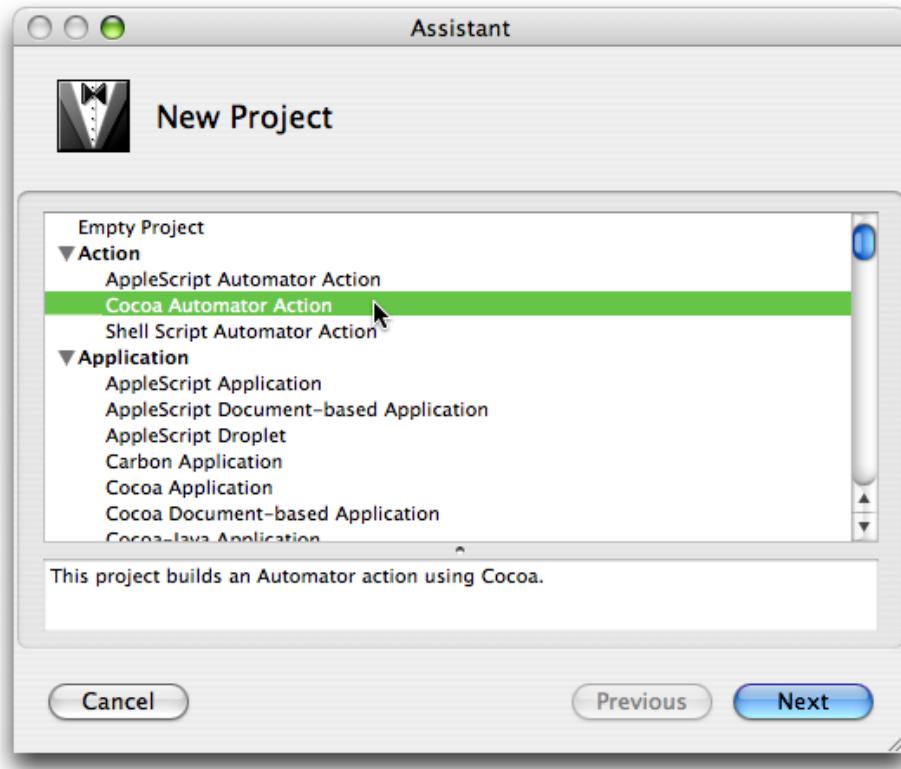
AppleScript Automator Action

Cocoa Automator Action

Shell Script Automator Action

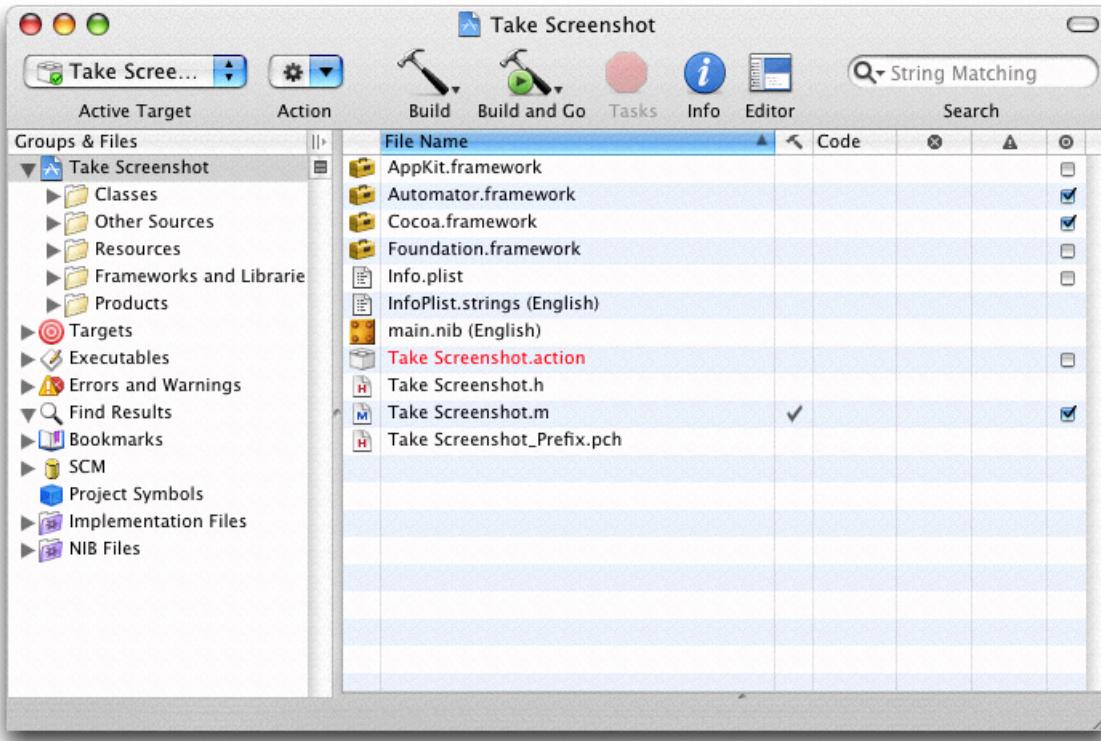
Figure 1 shows the selection of the Cocoa Automator action.

Figure 1 Choosing a Cocoa Automator Action project type in Xcode



Complete the remaining window of the New Project assistant as usual—specify a file-system location for the project and enter a project name. When you finish, an Xcode window similar to the one in Figure 2 is displayed.

Figure 2 Template files for a Cocoa Automator Action project



You'll become more familiar with many of the files and file wrappers displayed here in the sections that follow. But here is a summary of the more significant items:

- `Automator.framework`—The project automatically adds the Automator framework to the project.
- `Info.plist`—The information property list for the bundle includes the Automator properties; comments inserted in the value elements provide helpful hints. See [Specifying Action Properties](#) (page 41) for further information.
- `projectName.h` and `projectName.m`—A Cocoa action project includes header and implementation template files prepared for an `AMBundleAction` subclass (including a null implementation of `runWithInput:fromAction:error:`).

An AppleScript action project includes a template `main.applescript` file instead of Objective-C template files. A shell script action project includes a `main.command` file instead.

- `main.nib`—The bundle's nib file, partially prepared for the action. See [Constructing the User Interface](#) (page 32) for details.

Constructing the User Interface

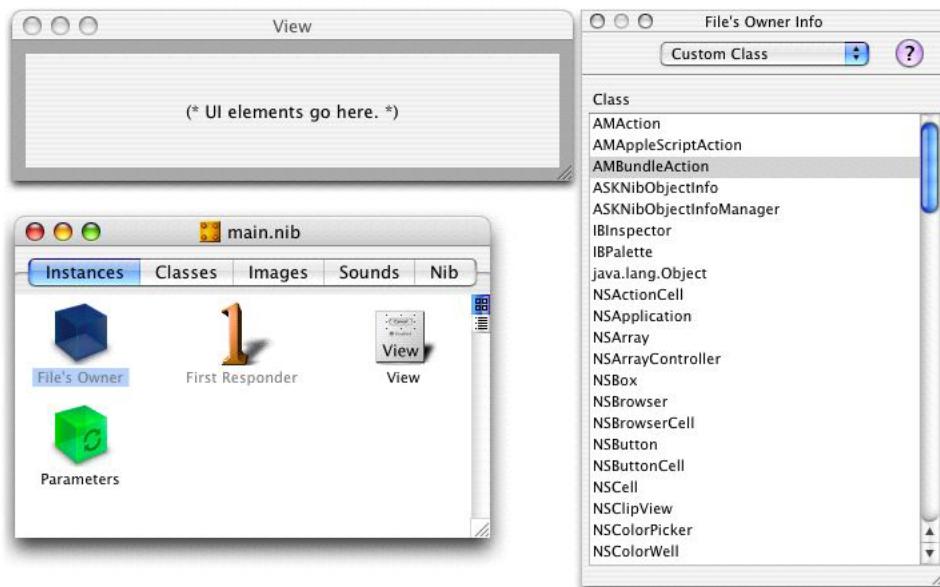
In the Xcode project browser, double-click `main.nib` to open the nib file of the action in Interface Builder. The nib file contains the usual File's Owner and First Responder instances, but it also contains two other items specific to actions:

- A blank NSView object (known as the content view of the action, or simply, action view) on which you set the controls, text fields, and other user-interface elements for setting the parameters of the action.
- An instance of the NSObjectController class named `Parameters`. The `Parameters` instance is used for establishing bindings between objects on the user interface and the action instance.
- For AppleScript-based actions, an AppleScript Info instance that AppleScript Studio uses to contain the names and event handlers for objects in the nib file.

Note: Some actions, such as the Connect to Server action, do not have a user interface because there is no possible setting the user can make. Yet these actions still appear in a workflow showing their titles and accepted and provided data types. If your action is not supposed to have a user interface, remove the action-view instance from the nib file window or remove main.nib from the project.

Several objects and relationships in main.nib are already initialized for you. For example, File's Owner is set in the Custom Class pane of the Info window to be an instance of the AMBundleAction class (as shown in Figure 3). (If your project is for an AppleScript Automator action, File's Owner is set instead to AMAAppleScriptAction.) With File's Owner still selected, if you choose the Connections pane of the Info window, you will see that the view outlet of the AMAction object has been connected to the action's view.

Figure 3 File's Owner set to an instance of AMBundleAction



Construct the user interface of the action as you would for any view in Interface Builder. However, keep in mind that actions, because they share space in an Automator workflow with other actions, should be compact, even minimal. Place only those controls, text fields, and other user-interface objects that are absolutely necessary. And try to be conservative in your use of vertical space; for example, prefer pop-up menus over radio buttons for presenting users with a choice among multiple options. For more on user-interface guidelines for actions, see [The User Interface of an Action](#) (page 27) in [Design Guidelines for Actions](#) (page 26).

Note: To learn how to use Interface Builder, read *Automator AppleScript Actions Tutorial* and consult the *Interface Builder* documentation.

An important feature of Automator actions is Show When Run. This feature enables the users of workflows (as distinct from the *writers* of workflows) to set the parameters of actions when they run the workflow as an application. By default, actions have an Options disclosure button in their lower-left corner that, when enabled, exposes additional controls; these controls allow a workflow writer to select the parts of an action's view that are presented to users when the workflow is executed. Developers can customize the Show When Run feature; see [Show When Run](#) (page 56) for details.

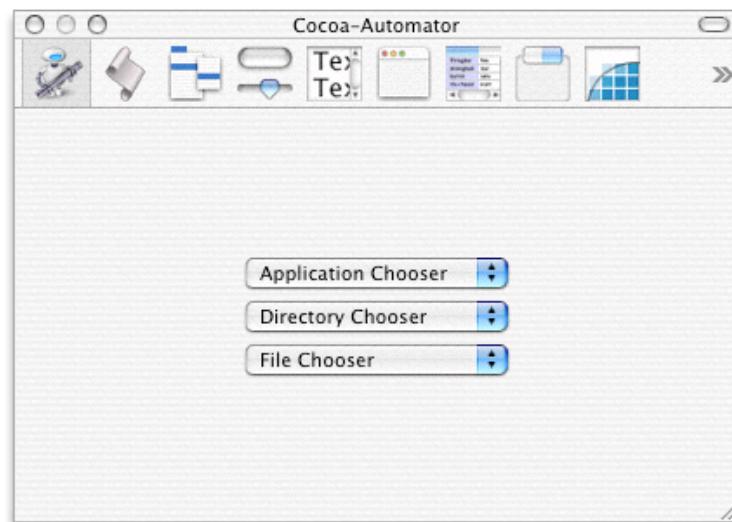
Important: If you are deploying the action in multiple localizations, make sure you create a separate nib file and user interface for each localization. See [Internationalizing the Action](#) (page 47) for further information.

Using the Cocoa-Automator Palette

The Automator development environment includes an Interface Builder palette with user-interface objects designed for actions. This palette is named Cocoa-Automator. To load this palette, select the Palettes pane in the Interface Builder preferences, click Add, and select AMPalette.palette in /Developer/Extras/Palettes.

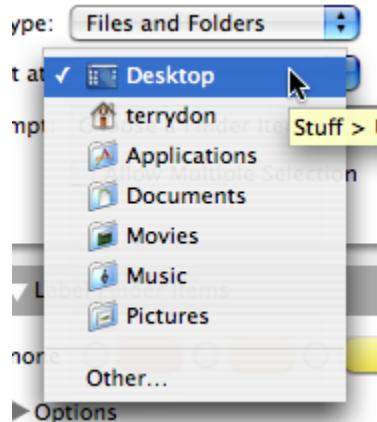
The Cocoa-Automator palette (see Figure 4) contains three specially implemented pop-up menus for presenting easily configurable lists of applications, directories, and files to users.

Figure 4 Cocoa-Automator palette



These lists provide access to standard or frequently accessed applications, folders, and files in the file system. For example, the Directories pop-up menu in an action looks something like the example in Figure 5.

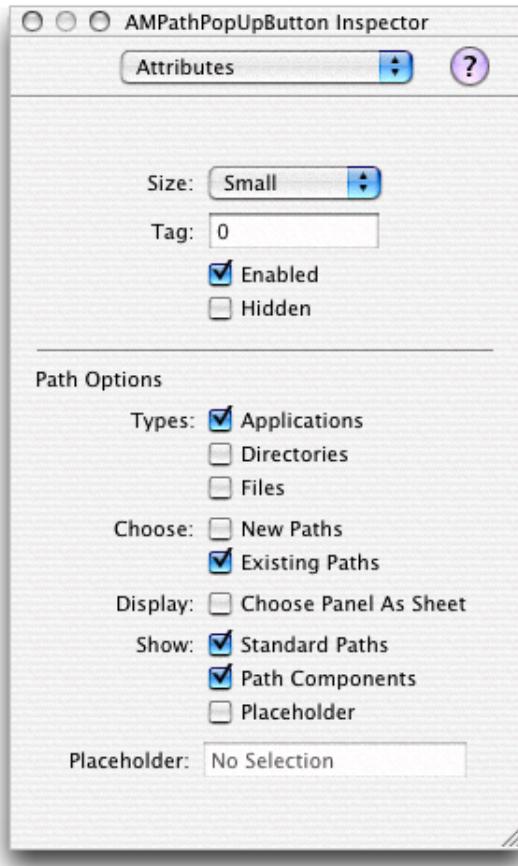
Figure 5 The Directories pop-up menu in an action



You can also configure the pop-up menus so that users can locate items other than the standard ones on the list or (in the case of the Directories pop-up menu) create new items.

To place one of these pop-up menus, simply drag it from the palette to the action view. Then to configure the pop-up menu, choose Show Inspector from the Tools menu and select the Attributes pane (Figure 6). The Attributes pane of Interface Builder allows you to configure a user-interface object in various ways.

Figure 6 Attributes inspector for Cocoa-Automator palette objects



For Automator pop-up menus (AMPPathPopUpButton objects), the special path options are the following:

Types

Allows users to choose either applications, directories, or files, or any combination of the three types. For example, if you check Directories and Files, users are able to select both directories and files from the pop-up menu.

Choose

Selecting New Paths adds a New item at the bottom of the pop-up menu. In the Directories pop-up menu, this allows users to create a new directory using a file-system browser; the New item does not appear in the other kinds of pop-up menus.

Selecting Existing Paths adds an Other item at the bottom of the pop-up menu. In all pop-up menu types, this item allows users to select anything in a file-system browser.

Display

When either the New or Open item is chosen and the Choose Panel as Sheet option is selected, the action displays the file-system browser as a worksheet-window-modal sheet rather than as an application-modal dialog.

Show

When the Standard Paths option is selected, the pop-up menu has the following items, depending on its type:

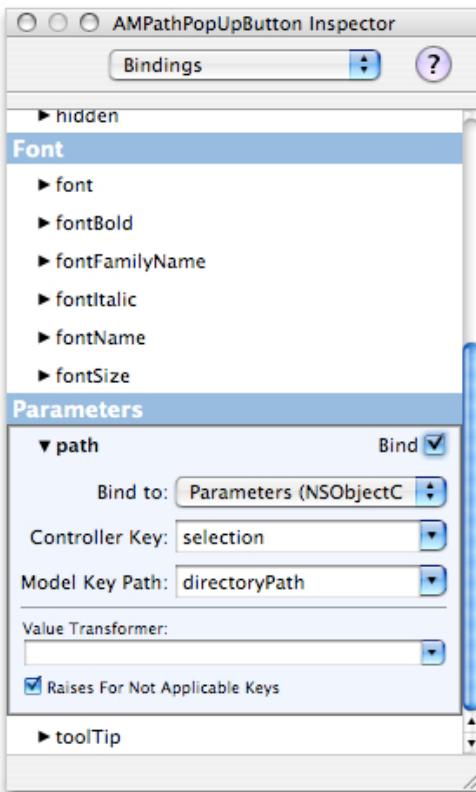
- If it is a Directories pop-up menu, standard locations such as Home, Desktop, Movies, and Pictures are included.
- If it is an Applications pop-up menu, the list of items includes all applications in /Applications.
- If it is a Files pop-up menu, nothing happens.

When the Path Components option is selected, the full path of the current chosen item is displayed.

When the Placeholder option is selected, whatever you enter in the Placeholder text field directly under the option is displayed as the first pop-up item. This placeholder is typically a string such as "Choose an application" or "No selection".

Before an AMPPathPopUpButton pop-up menu can properly function in an action view, you must establish a binding between the pop-up menu and a property of the action parameters. To do this, specify a key for the property as an attribute of the Parameters instance (see [Establishing Bindings](#) (page 38) for the procedure). Finally, select the pop-up menu in the user interface and then specify the key in the Bindings pane of the inspector, using the path binding; see Figure 7 for an example.

Figure 7 The path binding for the pop-up menu



Establishing Bindings

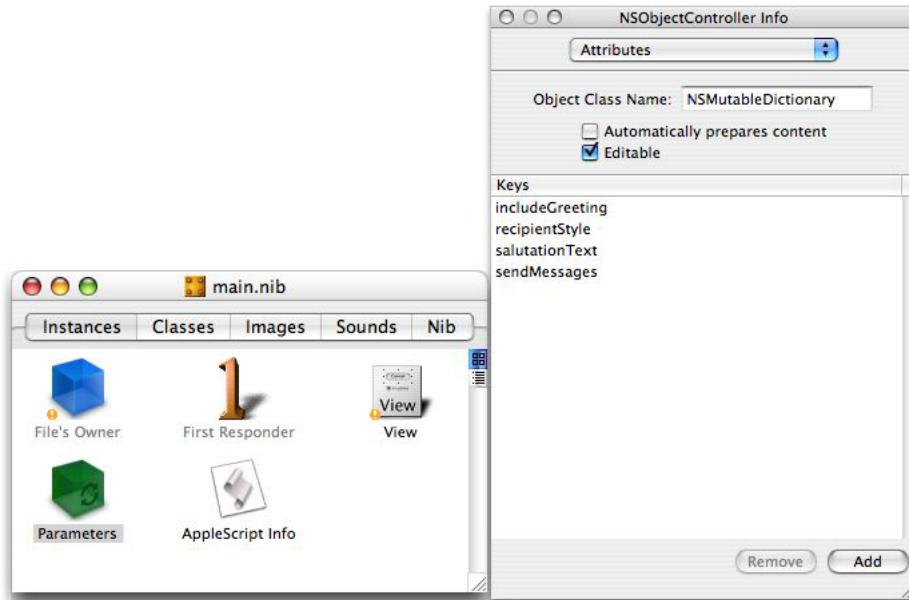
After constructing the action's view, establish the bindings between the objects on the user interface and the action object. Bindings are a Cocoa technology conceptually based in the Model-View-Controller paradigm. In Model-View-Controller, objects in a well-designed program assume one of three roles: view objects that present data and receive user input; model objects that contain data and operate on that data; and controller objects that mediate the transfer of data between view and model objects. The bindings mechanism automatically synchronizes the exchange of data between view and model objects, reducing the need for custom controller objects and all the “glue” code they usually entail. Automator actions use bindings to communicate data between objects in an action's view and the parameters dictionary (or record) that all actions have to record the settings users specify for an action.

The project templates for Automator actions are pre-configured to use bindings instead of the target-action and outlet mechanisms (for Cocoa-based actions) or event handlers specified in the AppleScript pane of Interface Builder for AppleScript-based actions. If you prefer, you may use these mechanisms along with the Automator framework’s “update parameters” API to update an action’s parameters manually. For information on this approach, see [Updating Non-bound Parameters](#) (page 69) (for AppleScript-based actions) or [Updating Action Parameters](#) (page 77) (for Objective-C actions).

The following steps summarize what you must do to establish the bindings of an action in Interface Builder. For a thorough description of the Cocoa bindings technology, see *Cocoa Bindings Programming Topics*.

1. Select the Parameters instance in the nib file window and choose the Attributes pane of the Info window. In the table labeled “Keys” add the keys for each user-interface object whose setting or value you need to access. See Figure 8 for an example.

Figure 8 Adding the keys of the Parameters instance (NSObjectController)

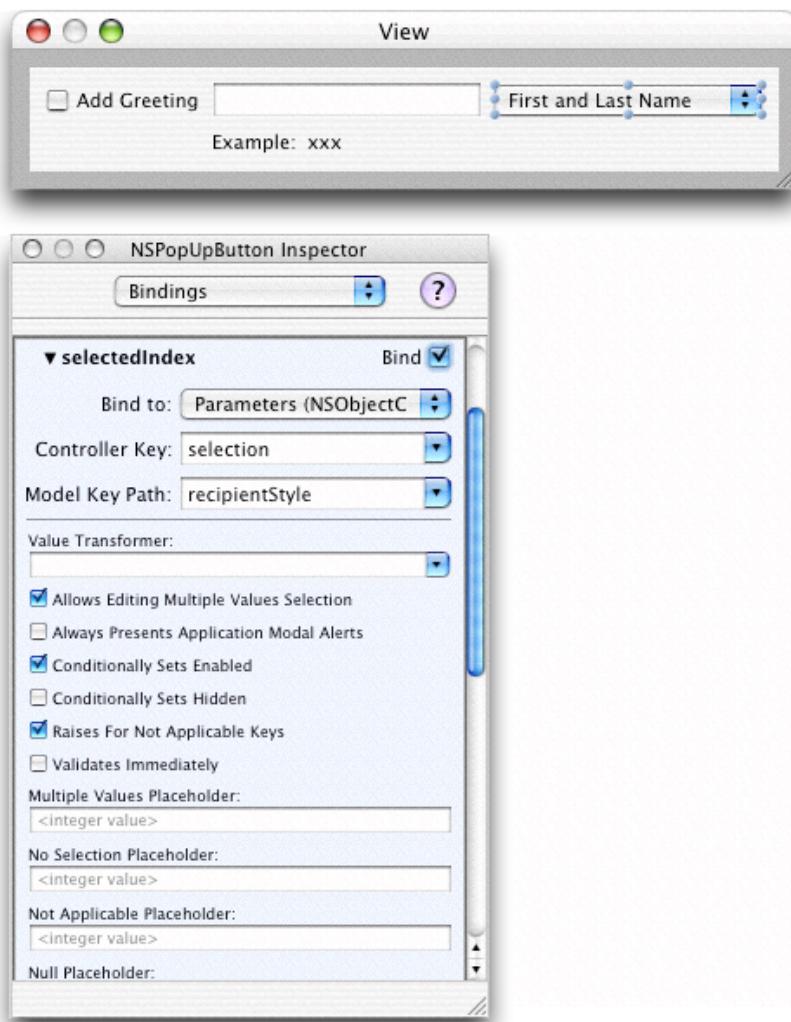


The keys that you specify here are used elsewhere in the action to identify the controls of the action. You must therefore use the same strings you used for the binding keys in the following places in the action project:

- As the keys for the `AMDefaultParameters` property of Automator. (The `AMDefaultParameters` property specifies the initial settings of an action; see [Specifying Action Properties](#) (page 41) and [Automator Action Property Reference](#) (page 108) for details.) A matching `AMDefaultParameters` entry must be added for each key used with a binding.
- As the names of outlet instance variables and accessor methods in Objective-C actions
- As the keys to the parameters record passed into an AppleScript-based action in its `on run` handler; see [The Structure of the on run Command Handler](#) (page 64) for further information.

- As the environment variables set for a shell script action; see [Creating Shell Script Actions](#) (page 82) for details.
2. With the Parameters instance still selected, choose the Bindings pane of the Info window and expand the “contentObject” subpane. Set the “Bind to” pop-up item to File’s Owner and enter parameters in the “Model Key Path” field.
- The parameters key path refers to the parameters property defined by the AMBundleAction class—that is, the dictionary or record used to capture the settings users make in an action’s view.
3. For each user-interface object of the action, establish a binding to the appropriate parameters key. For example, Figure 9 shows the binding for a pop-up menu.

Figure 9 Establishing a binding for a pop-up menu



The binding varies by type of user-interface object. For example, pop-up menus usually work off the index of the item (`selectedIndex`), check boxes have a Boolean value, and text fields have a string value.

Important: When establishing a binding between a text field and a parameter key, make sure that the "Continuously Updates Value" checkbox in the inspector pane for the value binding is enabled. Otherwise, the parameter is not updated if the insertion point does not exit the text field (as happens, for example, when the user presses Tab).

When you are finished with the action's user interface, save the nib file and return to the Xcode project.

Specifying Action Properties

The Automator application uses special properties in an action's information property list (`Info.plist`) to get various pieces of information it needs for presenting and handling the action. This information includes:

- The name of the action
- The icon for the action
- The application, category, and keywords for the action
- The types of data the action accepts and the types of data it provides
- The description of the action

Automator properties have the prefix "AM". The project template for actions includes almost all of the properties you need (or may need) to specify. As shown in Figure 10, the template provides helpful comments as placeholders for key values. In creating an action, you need to supply real values for these keys. [Automator Action Property Reference](#) (page 108) describes the Automator properties, including their purpose, value types, and representative values.

Because the values of some Automator properties appear in the user interface, you should include translations of them in an `Info.plist.strings` file for each action localization you provide. See [Internationalizing the Action](#) (page 47) for further information.

In addition to properties that are specific to Automator, an action's `Info.plist` file contains properties that are common to all bundles, including applications as well as action bundles. The values of most of these generic bundle properties are supplied automatically when you create a project. However, you must specify the value of the `CFBundleIdentifier` property. Automator uses this property to find an action and its resources. The identifier needs to be unique, and should use the standard format:

`com.CompanyName.Automator.ActionIdentifier`

For example, if your company's name is Acme and your action is named Find Foo Items, a suitable `CFBundleIdentifier` would be `com.Acme.Automator.FindFooItems`.

The Automator project templates preset two properties, AMName and the action-identifier portion of CFBundleIdentifier, with placeholder text. When you create a project, the name of the project is substituted for the placeholders. (If the project name contains spaces, Xcode substitutes underscore character for the spaces in the bundle identifier.)

Figure 10 Part of the template for the Automator properties in Info.plist

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE plist PUBLIC "-//Apple Computer//DTD PLIST 1.0//EN" "http://www.apple.com/DTDs/PropertyList-1.0.dtd">
<plist version="1.0">
<dict>
    <key>AMAccepts</key>
    <dict>
        <key>Container</key>
        <string>List</string>
        <key>Optional</key>
        <false/>
        <key>Types</key>
        <array>
            <string>com.apple.applescript.object</string>
        </array>
    </dict>
    <key>AMApplication</key>
    <string>(* Primary Application used by this action goes here. *)</string>
    <key>AMCanShowSelectedItemsWhenRun</key>
    <true/>
    <key>AMCanShowWhenRun</key>
    <true/>
    <key>AMCategory</key>
    <string>(* Category of this action goes here. *)</string>
    <key>AMDefaultParameters</key>
    <dict/>
    <key>AMDescription</key>
    <dict>
        <key>AMDAAlert</key>
        <string>(* AMDAAlert text goes here. (optional) *)</string>
        <key>AMText</key>
    </dict>
</dict>
```

To edit `Info.plist` manually in an Xcode window, just double-click the filename in the project window. If you would like always to open up the `Info.plist` file in a different editor for property lists, such as the Property List Editor application or BBEdit, use the Finder's Get Info window to set the default application for files with extension `.plist`. Then in Xcode, use the contextual menu command Open with Finder. However, the preferred tool for editing Automator properties is to use the built-in Automator property Inspector, which was introduced in Xcode 2.1.

Using the Automator Property Inspector

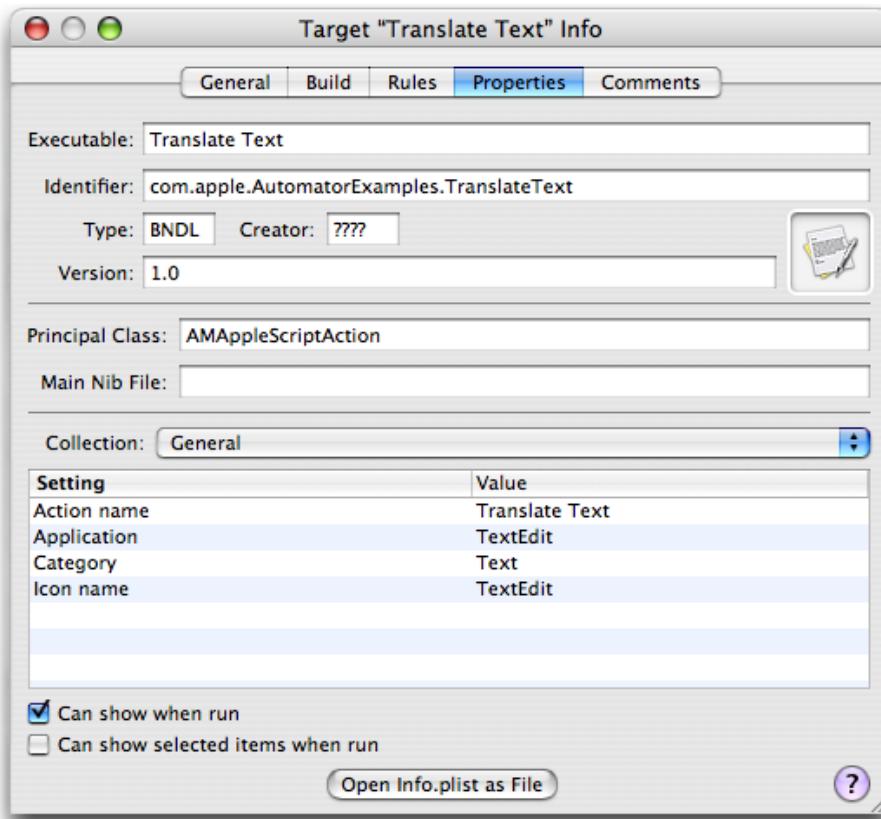
You can edit the information property list as a text file in Xcode. Just double-click the `Info.plist` file in the project window and the file will open in a separate window or pane. However, syntax errors can frequently happen when you edit a property list by hand. Instead you can use the Automator property inspector, which makes the entering of property values easier and less susceptible to error.

This inspector is built into Xcode for all Automator project types. To access the inspector, do the following:

1. Choose Edit Active Target '*Target*' from the Project menu.
2. Click the Properties tab.

The lower part of the inspector, which is usually reserved for specifying document types, is here used for Automator-specific properties. The inspector breaks the properties into logical collections; the first collection shows the General properties (Figure 11).

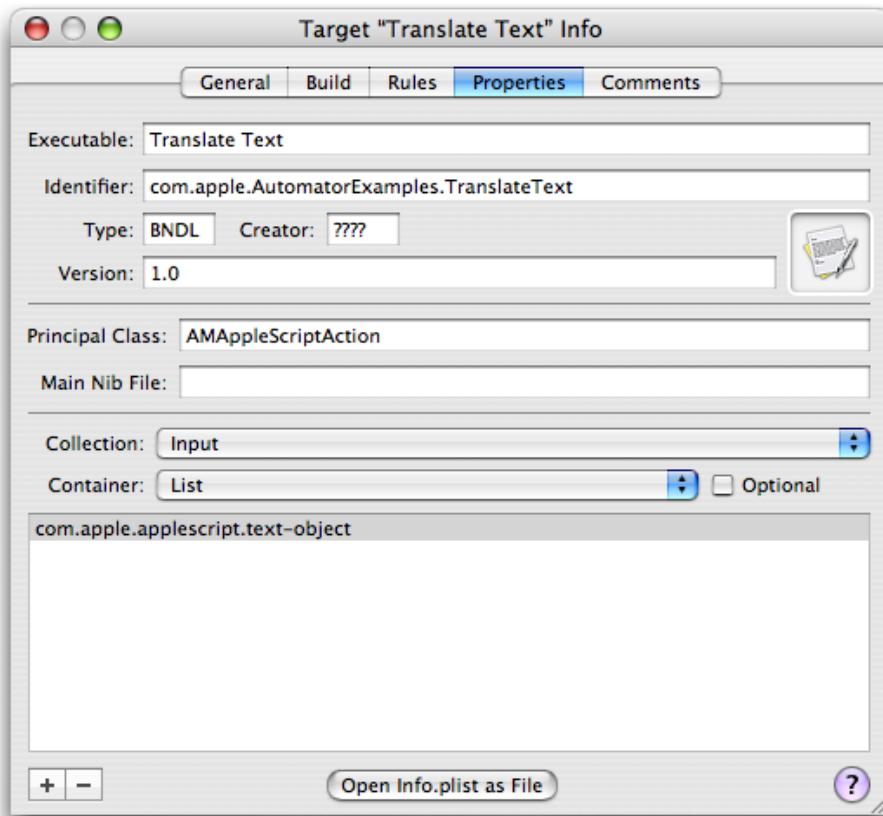
Figure 11 Automator property inspector—General properties



In an inspector view such as the one in Figure 11, double-click a cell under Value to open the cell for entering a value. If, for example, you want to enable the Show When Run feature for the action, click the appropriate check boxes.

If you expose the Collection pop-up menu, you'll see other logical collections of Automator properties. Figure 12 shows the collection for the AMAccepts property (Input).

Figure 12 Automator property inspector—Input properties

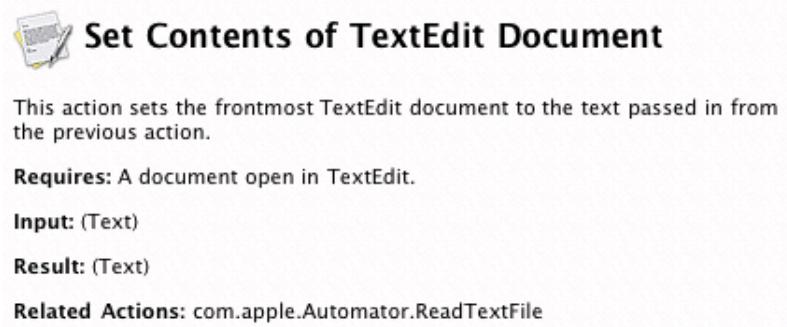


When the property is an array, as with AMAccepts, click the plus sign in the lower left corner of the inspector to open a new field for editing. Enter the value (in this case a type identifier). To delete an item from the array, select it and click the minus sign.

Writing the Action Description

A small but important part of action development is writing the action description. Automator displays the description it its lower-left view whenever the user selects the action. The description briefly describes what the action does and tells users anything else they should know about the action. Figure 13 shows what a typical description looks like.

Figure 13 An sample action description



Because the description fits into a relatively small area of the Automator window, you should make it as concise and brief as possible. Ideally the user should not have to scroll the description view to see all of the text.

A description has several parts, each of which you specify through an Automator property in the bundle's information property list (`Info.plist`):

- *Icon*. A 32 x 32 pixel TIFF image displayed in the upper-left corner of the description. It is the application icon that the `AMIconName` property specifies (see [Property Keys and Values](#) (page 108)).
- *Title*. The string that you specify for the `AMName` property (see [Property Keys and Values](#) (page 108)).
- *Summary*. A sentence or two directly under the title that succinctly states what the action does.
- *Input* and *Result*. States the types of data that the action accepts and provides. Automator enters default values for these sections if you do not specify anything.
- *Options*. Summarizes the configuration options on the action's user interface.
- *Requires*. Describes any requirement for the action to work properly—for example, Safari must be displaying a web page.
- *Alert*. Warns the user of any likely consequence of the action—for example, if it will delete a calendar.
- *Note*. Presents additional information that is not as critical as an alert.
- *Related actions*. Indicates actions that are related to this one—for example, an Import Image action might mention an Export Image action.

A description's icon, title, summary, input, and result sections are required or strongly recommended. All of the properties listed above, except for icon and title, are subproperties of the description-specific `AMDescription` property. The `AMDescription` example in Listing 1 shows the subproperties specified for the Send Birthday Greeting description depicted in [Figure 13](#) (page 45).

Listing 1 AMDescription properties for Send Birthday Greetings description

```
<key>AMDescription</key>
<dict>
    <key>AMDInput</key>
    <string>Address Book entries from previous action.</string>
    <key>AMDOptions</key>
    <string>Birthday message. Choice of picture.
        Randomly chosen picture. </string>
    <key>AMDSummary</key>
    <string>This action sends an email birthday greeting, with a
        picture, to each of the Address Book entries.</string>
</dict>
```

See [Property Keys and Values](#) (page 108) for further information on the `AMDescription` keys and values.

Important: If you are deploying the action in multiple localizations, make sure you create a separate description for each localization. See [Internationalizing the Action](#) (page 47) for further information.

Writing the Action Code

The most important step in creating an action is writing the Objective-C or AppleScript code (or Objective-C *and* AppleScript code) that implements the logic for your action. The project template for Automator actions gives you template files for action implementation:

- `projectName.h` and `projectName.m` files for Objective-C actions
- `main.applescript` for AppleScript actions
- `main.command` for shell script actions

The template files fill out as much of the required structure as possible. The Objective-C header file, for example, has the necessary framework imports and an @interface declaration showing inheritance from AMBundleAction. The Objective-C implementation includes a null implementation of the method that all actions must implement, runWithInput:fromAction:error: (see Figure 14). The main.applescript file, on the other hand, has a skeletal structure for the on run command handler that all AppleScript-based actions must implement.

Figure 14 Template for an Objective-C action implementation

```
// MailInvitation.m
// MailInvitation|
//
// Created by John Doe on 1/6/05.
// Copyright 2005 __MyCompanyName__. All rights reserved.
//

#import "MailInvitation.h"

@implementation MailInvitation

- (id)runWithInput:(id)input fromAction:(AMAction *)anAction error:(NSDictionary ***)errorInfo
{
    // Add your code here, returning the data to be passed to the next action.

    return input;
}

@end
```

See [Implementing an AppleScript Action](#) (page 64) and [Implementing an Objective-C Action](#) (page 72) for requirements, suggestions, and examples related to implementing an Automator action. For guidelines on implementing shell script actions, see [Writing the Script](#) (page 88).

Internationalizing the Action

Most polished applications that are brought to market feature multiple localizations. These applications not only include the localizations—that is, translations and other locale-specific modifications of text, images, and other resources—but have been internationalized to make those localizations immediately accessible. Internationalizing involves a number of techniques that depend on a “preferred languages” user preference and a system architecture for accessing resources in bundles. Loadable bundles (which, of course, are bundles just as applications are) depend upon the same mechanisms for internationalization.

The following sections summarize what you must do to internationalize your actions. For the complete picture, see *Internationalization and Localization Guide* for a general description of internationalization and *Internationalization and Localization Guide*, for a discussion that is specific to Cocoa.

Localized Strings

If your action programmatically generates strings and you want localized versions displayed, you need to internationalize your software using access techniques that are different for Objective-C actions and script-based actions.

Note: Programmatically generated strings have their basis in code, such as a message that appears in an error dialog. They do not include text that appears in a user interface unarchived from a nib file. Nib files are localized just as are other resource files; see [Internationalizing Resource Files](#) (page 50) for a summary of the procedure.

Both Objective-C and AppleScript actions require you to create for each localization a strings file, which is a file with an extension of .strings. (The conventional, or default, name for a strings file is Localizable.strings.) Each entry in a strings file contains a key and a value; the key is the string in the development language and the value is the translated string. An entry can also have a comment to aid translators. Use a semicolon to terminate an entry. Here are a few examples:

```
/* Title of alert panel which brings up a warning about
saving over the same document */
"Are you sure you want to overwrite the document?" =
"Souhaitez-vous vraiment écraser le document ?";

/* Encoding pop-up entry indicating automatic choice of encoding */
"Automatic" = "Automatique";

/* Button choice allowing user to cancel. */
"Cancel" = "Annuler";
```

When you have completed a Localizable.strings file for a localization, you must internationalize it just as you would any other language- or locale-specific resource file of the bundle. See [Internationalizing Resource Files](#) (page 50) for a summary.

For Objective-C code, use the NSLocalizedStringmacro or one of the other NSLocalizedString... macros to request a localization appropriate for the current user preference. Listing 2 gives an example that shows the use of NSLocalizedString in conjunction with the NSString stringWithFormat: method.

Listing 2 Using NSLocalizedString in Objective-C code

```
- (NSString *)displayName
{
    int cnt = [pdfView pageCount];
    NSString *name;

    if (cnt == 1) {
        NSString *format = NSLocalizedString(@"%@", (1 page)),
        @"Window title for a document with a single page");
        name = [NSString stringWithFormat:format, fileName];
    } else {
        NSString *format = NSLocalizedString(@"%@", (%d pages)),
        @"Window title for a document with multiple pages");
        name = [NSString stringWithFormat:format, fileName, cnt];
    }

    return name;
}
```

For AppleScript scripts the command equivalent to NSLocalizedString is localized_string. One good approach is to have a local subroutine that takes the string to localize as a parameter and uses the localized_string command on it, as in Listing 3.

Listing 3 Script handler for localizing strings

```
on localized_string(key_string)
    return localized_string key_string in bundle with identifier
    "com.apple.Automator.myAction"
end localized_string
```

Elsewhere in main.applescript and in other scripts for the action, call this subroutine when you need to get a string in the current localization:

```
if the calendar_name is my localized_string("No Calendars") then      error
my localized_string("The copy of iCal on this computer contains no calendars to
clear.")
```

Localizing the Automator Properties

A standard variant of a strings file for projects is `Infoplist.strings`. In this file you assign localized strings (that is, translations) to the keys that appear in the `Info.plist` file. For Automator, this includes not only the top-level properties such as `AMName` but subproperties of Automator properties. For example, the following excerpt is from the `Infoplist.strings` file for the Crop Images action:

```
AMName = "Crop Images";
ApplyButton = "Add";
IgnoreButton = "Don't Add";
Message = "This action will change the image files passed into it. Would you like
to add a Copy Files action so that the copies are changed and your originals are
preserved?";
```

The key-value pairs in this example include not only an English-localized value for the `AMName` property but localized strings for the subproperties of the `AMWarning` property.

Internationalizing Resource Files

You should internationalize any file in your action project that contains data that is specific to a language or locale. These files include:

- Nib files
- Image files
- Strings files (`Localizable.strings`)
- `Infoplist.strings`

Internationalization of a resource file simply entails the assignment of a language or locale to the file. When you build the action project, Xcode automatically puts the resource in a localization subdirectory of the bundle's `Resources` directory. Localization subdirectories have an extension of `.lproj` (for example, `French.lproj`).

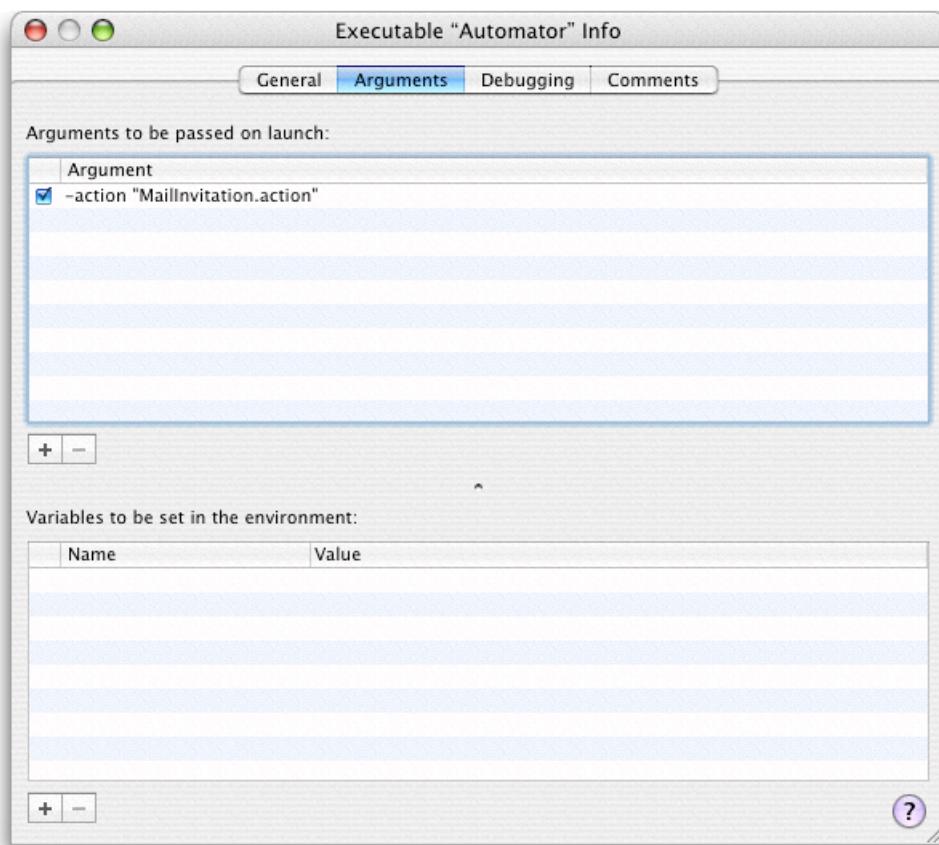
To internationalize a resource file, do the following:

1. Select the Resources folder in Xcode.
2. Add the file to the project (Project > Add Files).
3. Select the file and choose Get Info from the Project menu.
4. Click Make File Localizable.
5. Click Add Localization and enter or select a language or locale.

Testing, Debugging, and Installing the Action

An action project is automatically set up in Xcode so that when you choose the Run or Debug commands, Xcode launches the Automator action and adds your action to the set of actions loaded by Automator. To see how this is done, select Automator in the Executables smart group and choose Edit Active Executable from the Project menu. As you can see, in the General pane of the inspector the “Executable path” value is set to /Applications/Automator.app. Select the Arguments pane of the inspector and note that the –action launch-time argument has been set to your action (Figure 15).

Figure 15 Setting the launch argument for Automator



Testing and Debugging Strategies

To test your action, build and run the action project (Build > Build and Run). As Automator builds the project it runs the `amlint` utility in a build phase. The `amlint` tool performs integrity checks to make sure the action is properly constructed; for example, it verifies that all required Automator properties have been set. It integrates its warning messages with the other messages in the Xcode Build Results window. Although `amlint` does not

generate error messages (thereby halting the build), you should investigate and fix all reported problems before you build a deployment version of the action. To find out more about `amlint`, see the man page for it (which you can access from Xcode's Help menu).

When Automator launches, you should create a workflow which contains your action. Run the workflow and observe how your action performs. To get better data from testing, consider the following steps:

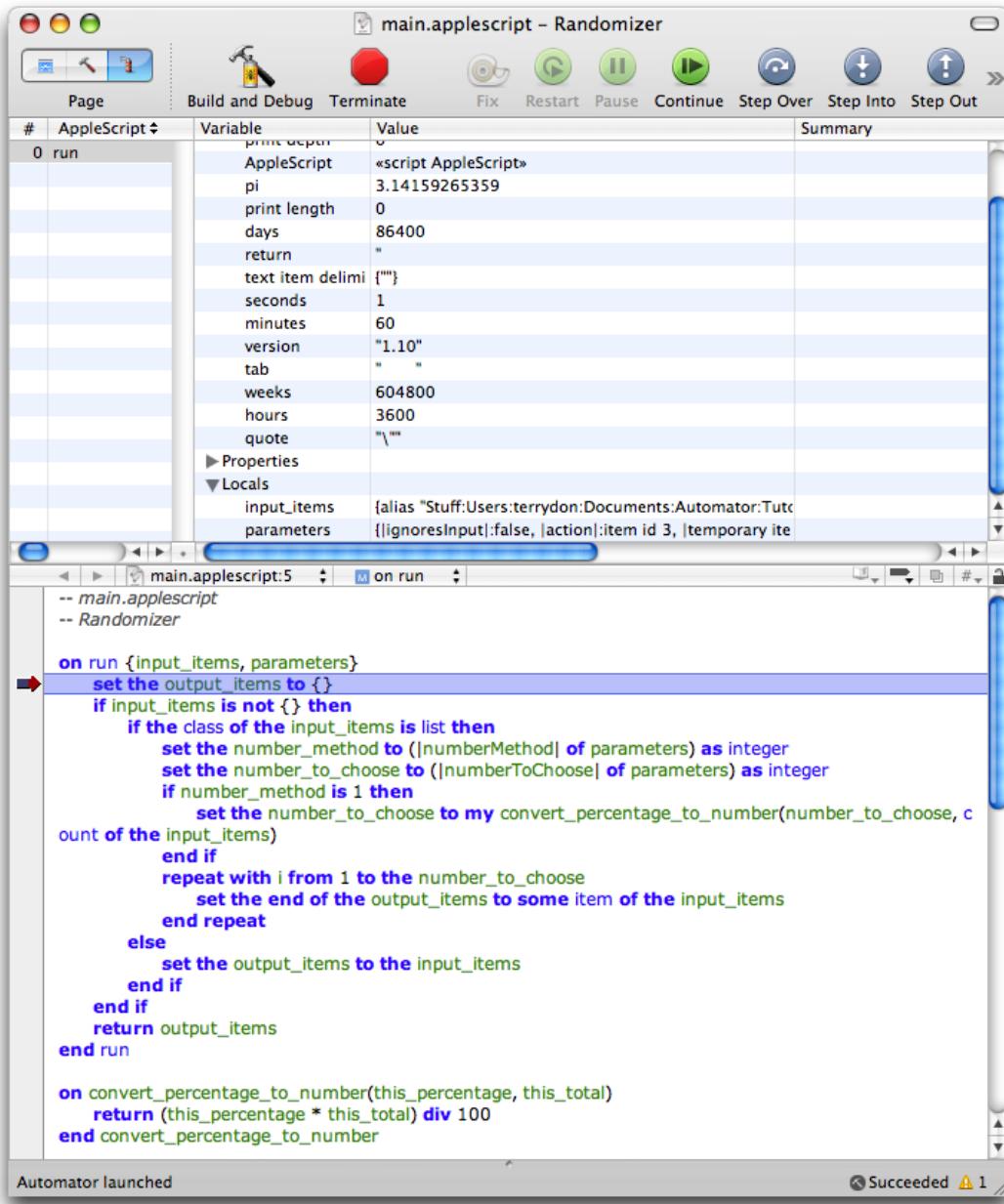
- Use the View Results action to see the output of prior actions.
- Use the Confirmation Dialog action to pause or cancel execution of the workflow.
- Add one each of the above two actions between each action.

If the action is based on AppleScript, you can use the Run AppleScript action to test your on `run` command handler as you write it.

If your action is based on an Objective-C implementation, you can debug an action just as you would any other Objective-C binary. Simply set a breakpoint in Xcode. When your action is run in Automator, the breakpoint will trigger in `gdb`. You can also debug AppleScript actions using a special graphical debugger, which is preset for AppleScript action projects. This debugger looks and behaves very much like the graphical debugger for `gdb` does. It stops at breakpoints, displays variables, and lets you step through the script. The variables include globals, locals, and properties. Figure 16 shows the AppleScript debugger in action.

Note: To learn about strategies for debugging shell script actions, see [Debugging and Testing Shell Script Actions](#) (page 92). For related information on AppleScript actions, see “Building and Testing the Action” in *Automator AppleScript Actions Tutorial*.

Figure 16 The AppleScript debugger



To debug AppleScript actions, you can also insert log or display dialog statements in the code. If the log statement is inside an application tell block, use the tell me to log expression instead of the simple log.

Note: If you install an action in one of the standard locations and then make certain changes to it—for example, changing its `AMAccepts` and `AMPProvides` types—then you must clear the action cache before you can see your changes. To clear the cache, hold the Option key when Automator launches. (You do not need to clear the cache when the action is run during the normal development processes—that is, with the action specified in the `-action` parameter when Automator is launched by Xcode.)

Installing Actions

When your action has been thoroughly debugged and tested, build a deployment version of the bundle (using the proper optimizations). Then create an installation package for the action (or add the action to your application's installation package). The installer should copy the action to `/Library/Automator` or `~/Library/Automator`, depending on whether access to the action should be system wide or restricted to the installing user.

Instead of installing your action separately, you can put it inside the bundle of your application, especially if the action uses the features of that application. When Automator searches for actions to display, it looks inside registered applications as well in the standard Automator directories. The advantage of packaging your actions inside an application is that you don't need to create a separate installation package to install the actions. To install the actions, users need only drag the application to a standard location.

Action bundles should be stored inside the application wrapper at `Contents/Library/Automator`. Thus, if your action is `MyAction.action` and your application is `MyApp.app`, the path inside the application would be:

```
MyApp.app/Contents/Library/Automator/MyAction.action
```

You can either manually copy an action into this location (after creating the necessary subdirectories) or you have Xcode copy it using a Copy Files build phase. If you copy an action into an application bundle but the application is already installed on a system, you must get Launch Services to recognize that the application has new content to register (that is, the new action) by changing the application's modification date. You can do this by entering the `touch` command in the Terminal application.

```
$> sudo touch /Applications/MyApp.app
```

Or you can rename the application in Finder to something else, change it back to the original name, and then launch the application once.

Frequently Asked Questions About Debugging Automator Actions

Question: How can I determine which version of an action Automator is using if multiple versions of my application (possibly containing multiple versions of the action) are installed (locally or on my network)?

Answer: There is no way to *specify* which version of your application Automator should get actions from if multiple versions of the application are installed. However, there are several ways to *determine* the version of an action that is actually being used:

- In OS X v10.5, when you select an action in the Action list, you can see its version in the description view. You can also Control-click an action in the workflow view and choose Show in Finder to see where the action is located, so that you can examine it directly.
- In OS X v10.4, Automator does not show the action version in the description view or allow you to show the action in the Finder. A possible work around is to delete any unwanted actions, if that option is available to you, so that only the desired version of the action is available.

Question: How can I view log or error messages?

Answer: If you are developing a shell script action, and the action exits with a non-zero status code, anything your action wrote to `stderr` will show up in the Automator log, as described in [Debugging and Testing Shell Script Actions](#) (page 92).

If you are developing an AppleScript action, output of AppleScript statements such as `log` or `tell me to log` appear in the Console log (not in the Automator log).

If you are developing a Cocoa action, output from `NSLog` statements will also appear in the Console log.

Show When Run

Automator has two categories of users. The first is a user who creates a workflow by putting actions in a sequence that accomplishes a certain goal. This type of user can then save the workflow as an application which another user—a user of the second kind—can then double-click to run. If the workflow creator is the only user who can set the parameters of workflow actions (by choosing items and entering values in action views), users in the second category are at a disadvantage. They are compelled to accept the choices of the workflow creator.

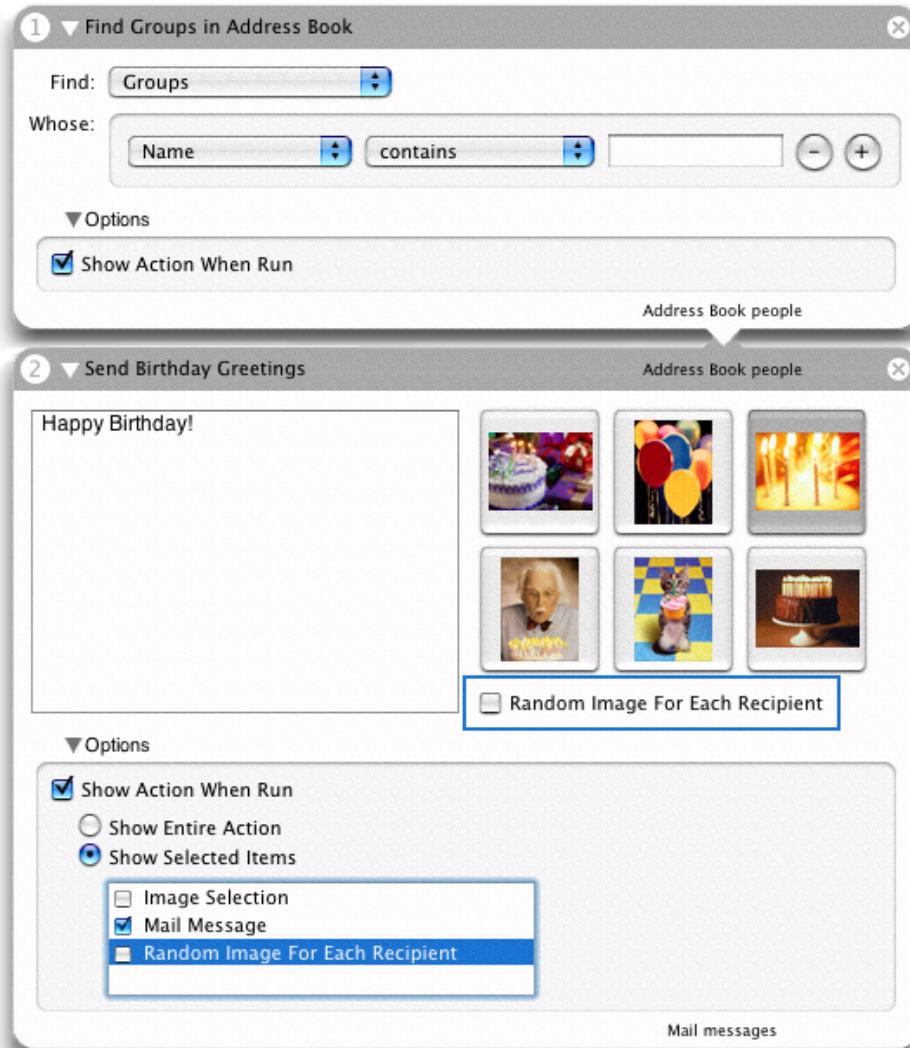
To get around this problem, Automator has the Show When Run feature. If this feature is turned on for an action in a workflow, when Automator executes the workflow it displays the user interface (in whole or part) for the action when execution reaches that point. The workflow user—as opposed to the workflow creator—can then make the required settings before the action proceeds.

The following sections describe Show When Run in more detail, show what it looks like, and explain how developers can modify the default behavior.

The "Show Action When Run" Option

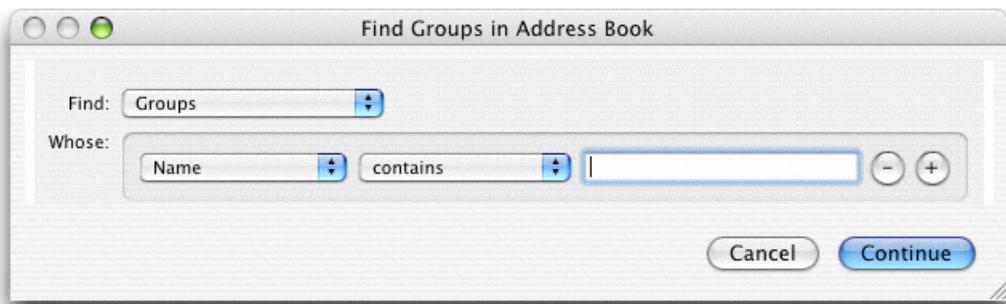
The views of most actions in a workflow include a triangular disclosure button in their lower-left corner labeled "Options". When a workflow creator clicks this control, the bottom of the view expands to expose a new set of controls. The number of controls in this disclosed view vary according to how the action view is configured. Figure 1 illustrates the two kinds of control sets.

Figure 1 The Show Action When Run option in two actions



In both exposed Option subviews, the first control is a check box labeled "Show Action When Run." However, in the first action that check box is also the only control. If the check box is clicked in the first Option subview and the workflow is run, the action displays its entire user interface in a separate window, as shown in Figure 2.

Figure 2 Action displaying entire user interface in a window



The user makes selections and fills in information in this window and clicks Continue to have the action proceed.

In the second Option subview (as shown in [Figure 1](#) (page 57)), when the user selected "Show Action When Run" the two radio buttons under it were enabled. He or she then clicked the "Show Selected Items" button and selected the "Mail Message" check box in the table. As shown in Figure 3, when Automator reaches this action in the workflow, it displays this portion of the action view in a separate window.

Figure 3 Action displaying part of its user interface in a window



In summary, an action may present one of three styles of the Show When Run feature:

- No Options disclosure button is presented. This Show When Run style is for actions where only the workflow creator can decide what the action parameters should be.
- The action displays the Options disclosure button and, when that is clicked, only the Show Action When Run check box. This style is used when Automator should present all controls of the action to users when the workflow executes.
- The action displays the Options disclosure and, when that is clicked, the “Show Entire Action” and “Show Selected Items” radio button along with the selected-items table view. This style of Show When Run is appropriate for actions where workflow users should be able to make only some action settings. This style is the default configuration,

Refining Show When Run

In the default Show When Run configuration, Automator displays the Options disclosure button and allows workflow creators to select one or more parts of the action view for Automator to display when the action is run in a workflow. Developers can refine the default appearance and behavior of the Show When Run feature in two ways: by specifying new values for certain Automator properties and by grouping controls in special boxes in Interface Builder.

Specifying Properties for Show When Run

These three general styles of the Show When Run feature discussed in [The Show Action When Run Option](#) (page 57) are controlled by two Automator properties:

- `AMCanShowWhenRun` with a value of `<true/>` tells Automator to display at least the Options disclosure button and the “Show Action When Run” check box for the action. If the value is `<false/>`, the button does not appear in the action view.
- `AMCanShowSelectedItemsWhenRun` with a value of `<true/>` tells Automator to include the radio buttons “Show Entire Action” and “Show Selected Items” radio buttons along with the table view of control subsets. If the value is `<false/>` only the “Show Action When Run” check box is shown.

This property has no effect if `AMCanShowWhenRun` is `<false/>`.

The default Show When Run configuration for actions is to have both properties turned on (that is, Automator assumes a value of `<true/>`.) In this style, the Option button is displayed, and when that button is clicked all “Show Action When Run” options are presented, including the table allowing workflow writers to select groups of controls to display to end users.

If you want only the “Show Action When Run” check box to appear in the exposed view under Options, specify `<false/>` for `AMCanShowSelectedItemsWhenRun`. If you don’t want the Options disclosure button to appear at all, specify `<false/>` for `AMCanShowWhenRun`.

Grouping User-Interface Objects

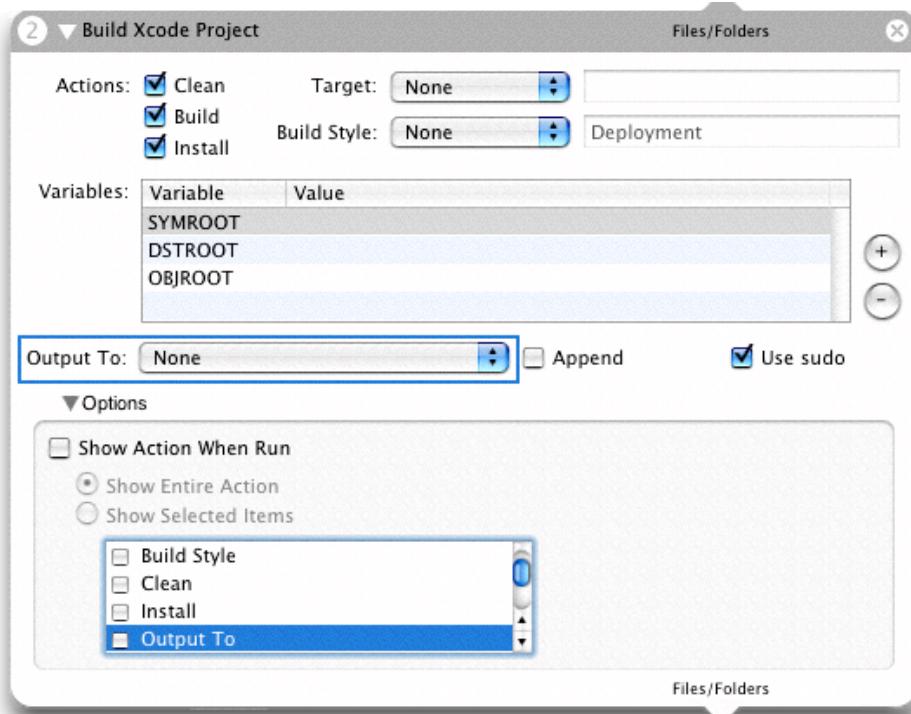
By default, Automator populates the selected-items table with check box items using the following algorithm:

1. It goes through the items in the top level of the action view looking for eligible objects (such as pop-up menus, text fields, and buttons).
2. When it finds an eligible object, it determines if there is a label to the left of the object; if there is, it uses the label in the selected-items table view.
3. If it cannot find an associated label it uses an appropriate name such as “Text field 1” or “Item 3”. (The bottom action displayed in [Figure 1](#) (page 57) includes an “Item 1” check box in its table.)

These semi-arbitrary names that Automator assigns to some items in the table are often confusing to users. What does “Text field 1” refer to, especially if there is more than one text field? Moreover, it sometimes makes more sense to group related controls under one item. For example, if selection of an item in a pop-up menu results in a text field being enabled, the text field and the menu item belong together.

Interface Builder has been enhanced to give developers of Automator actions the ability to group individual objects on action views under a given name. When you have completed the procedure in Interface Builder, the Options subview presented to workflow creators will look more like the example in Figure 4, which contains no items with names such as "Item 1".

Figure 4 An action with assigned groups in the selected-items table

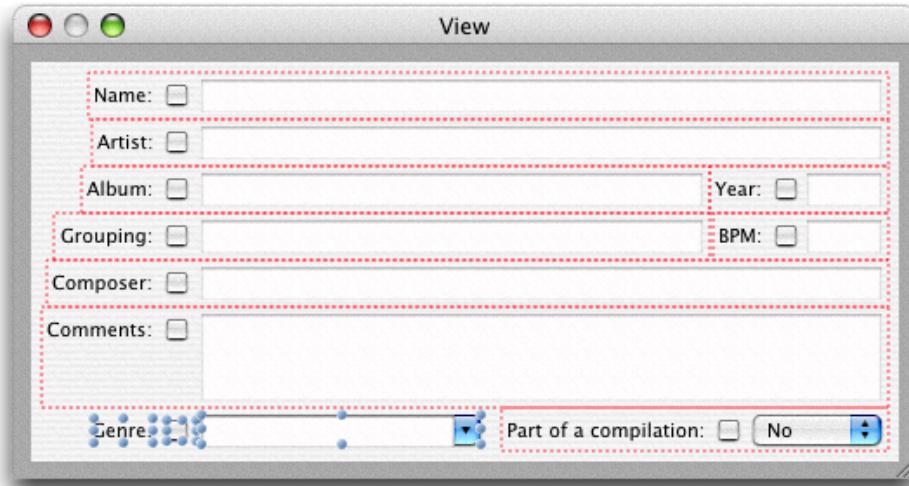


To make named groups of action-view objects, complete the following procedure with the main.nib file open in Interface Builder:

1. Make sure that the Automator palette is loaded. If the palette window does not have a palette named Cocoa-Automator, choose Tools > Palettes > Palette Preferences and load AMPalette.palette.

2. Select the objects you want in the group by Shift-clicking each object in turn (Figure 5).

Figure 5 Selecting objects for an action group

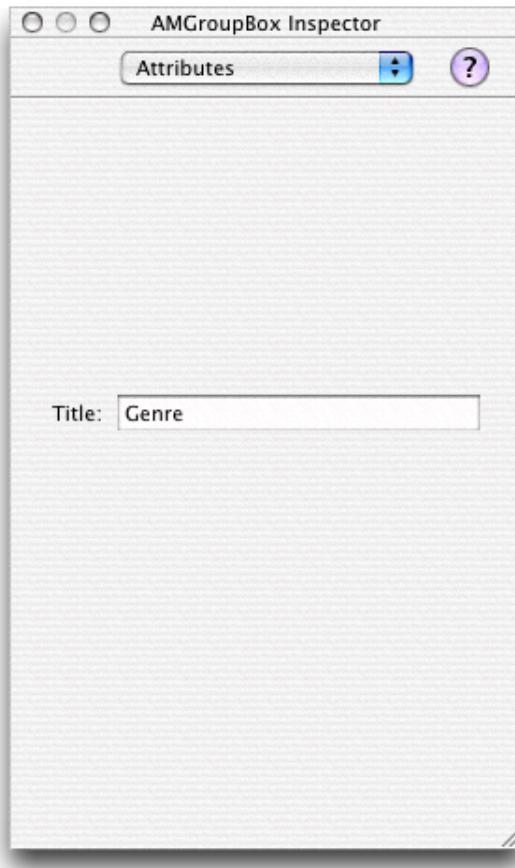


3. Choose Layout > Make subview of > Automator Box. The grouped objects are enclosed by a colored rectangle.

The Automator Box menu item is not available until the Cocoa-Automator palette has been loaded. To load this palette, select the Palettes pane in the Interface Builder preferences, click Add, and select `AMPalette.palette` in `/Developer/Extras/Palettes`.

4. In the Attributes inspector (Command-1) enter a title for the group (Figure 6). This title is what appears in the selected-items table to identify the group.

Figure 6 Assigning a title to the action group



The box that groups a set of controls in an action view is an instance of `AMGroupBox`, a subclass of `NSBox` created specifically for actions. Developers whose actions are based on AppleScript should keep in mind that the `AMGroupBox` instance changes the view hierarchy of the objects in an action view. However, because `AMGroupBox` is a subclass of `NSBox`, the “box” terminology still works in scripts.

Implementing an AppleScript Action

The Xcode template for an AppleScript Action project includes an uncompiled script file named `main.applescript`. An AppleScript-based action must, at the minimum, add to `main.applescript` the scripting code that accesses the services of one or more applications and completes the stated purpose of the action. An AppleScript-based action can also rely on other components for its implementation, such as:

- Other AppleScript script files, particularly for handling user-interface events
- Objective-C classes, particularly for accessing system resources
- Command-line tools or shell scripts

Regardless of the possible implementation components, an AppleScript-based action always has a `main.applescript` file and an invisible instance of `AMAppleScriptAction`. This instance owns the action bundle's nib file, has access to `main.applescript`, and provides a default implementation of the method used to run the action behind the scenes, `runWithInput:fromAction:error:`. (`AMBUNDLEAction`, the superclass of `AMAppleScriptAction`, declares this method.)

The Structure of the on run Command Handler

The template `main.applescript` contains only the following skeletal structure of the `on run` command handler:

```
on run {input, parameters}
    -- your code goes here
    return input
end run
```

This `on run` command handler has two positional parameters, `input`, and `parameters`. The `input` parameter contains (in most instances) the output of the previous action in the workflow; it is almost always in the form of a list. The `parameters` parameter contains the settings made in the action's user interface; the values in `parameters` (a record object) are typically set via the Cocoa bindings mechanism but can also be manually updated. The template code finally returns `input` as its output; your action should always return something as output, even if it what is given it as `input`.

You can use any valid AppleScript command, object, reference, expression, and statement in main.applescript. However, the following steps are suggested for an action's run handler (not all steps are applicable to every kind of action).

- Set local variables to the values of the current parameters. To extract the values from the parameters parameter, use the keys specified for bindings. For example:

```
set multiple_selection to |multipleSelection| of parameters
set prompt_message to |promptMessage| of parameters
set default_location to |defaultLocation| of parameters
```

You use these parameters to control the logic of the script.

- Set a local variable for output to an empty list. For example:

```
set output to {}
```

- In a repeat loop, perform whatever transformations are necessary on the items in the input list and add each transformed item to the output list. For example:

```
repeat with i in input
    copy (POSIX path of i) to end of filesToCopy
end repeat
```

- As the last step, return the output list.

Some actions specify in their `AMAccepts` property that their input is optional (that is, the `Optional` subproperty is set to `<true/>`). This setting allows users to select a “Ignore Result From Previous Action” pop-up item in the action’s view. If your action has made input optional in its `AMAccepts` property, you need to determine if the user has made this choice by testing the `ignoresInput` field of `parameters`; if it is set to `true`, then you do not need to do anything with the input object.

You can include subroutines in main.applescript. For example, you might want to write a subroutine for returning localized strings (described in [Localized Strings](#) (page 48)).

You can execute command-line tools or shell scripts for your script. The following script fragment runs the screencapture tool:

```
set screencapture to "/usr/sbin/screencapture"
-- here set up arguments of screencapture
```

```
do shell script screencapture
```

A caveat about using the `do shell script` command is that, because of the threading architecture, it makes the user interface unresponsive until the shell script completes or the user presses Command-. (period).

An action's scripts can also invoke Objective-C methods that you have implemented in a custom class; for example, the following statement calls a class method named `isDVDPlayerRunning`:

```
set dvdRunning to call method "isDVDPlayerRunning" of class "TakeScreenshot"
```

Note: The `call` method command is documented in *AppleScript Studio Terminology Reference*.

[Hybrid Actions](#) (page 68) discusses actions that contain a mix of AppleScript and Objective-C code.

Other AppleScript Scripts

An AppleScript action can contain scripts other than `main.applescript`. These additional scripts typically contain two types of handlers:

- AppleScript Studio-specified event handlers for managing the user interface of the action. For example, in an event handler you can modify the presentation of the user interface based on the user's choices.
- Handlers for the Automator-defined commands `update parameters` and `parameters updated`, which are attached to an action's view. These handlers are an alternative to Cocoa bindings: you can use them to store user settings made in the action `parameters` and to refresh those settings from existing `parameters`. For more on these handlers, see [Updating Non-bound Parameters](#) (page 69).
- Handlers for the Automator-defined commands `activated` and `opened`, which are attached to an action's view. The `on activated` handler is called when the action's workflow is activated, and the `on opened` is called when the user adds the action to the workflow. You should use the `on opened` handler when you need to populate your action with data that takes some time to get and consequently need to display a progress indicator.

AppleScript Studio allows you to request handlers for the `update parameters`, `parameters updated`, `activated`, and `opened` commands in the Automator Action View group in the AppleScript pane of the Interface Builder inspector.

As an example of AppleScript Studio event handlers, consider a pop-up menu for various date formats. When the user chooses a item from this pop-up menu, the action changes an example showing the effect of this format change. Listing 1 shows an event handler that is invoked when the user chooses a pop-up item for saving a screen capture to a "Specific File".

Listing 1 An event handler for displaying a Save panel

```
on clicked theObject
    if name of theObject is "choose output" then
        -- Setup the properties in the 'save panel'
        tell save panel
            set title to "Choose an output file to save the screenshot to"
            set prompt to "Save"
            set required file type to "pdf"
            set treat packages as directories to false
        end tell

        if (display save panel in directory "" with file name "") is equal to 1
    then
        set contents of text field "output file" of super view of theObject
        to path
            name of save panel
        set contents of popup button "output choice" of super view of theObject
        to 1
            set enabled of button "choose output" of super view of theObject to
        true
            set enabled of text field "output file" of super view of theObject to
        true
        end if
    end if
end clicked
```

Hybrid Actions

An action implementation can contain a mix of AppleScript and Objective-C code. Usually such hybrid actions are AppleScript-based—in other words, they have a `main.applescript` file containing the `run` command handler. However, it is possible to have Objective-C actions that use the Cocoa scripting classes to load (or create) and execute scripts. See [Implementing an Objective-C Action](#) (page 72) for a discussion of the latter type of hybrid action.

Why would you want to create a hybrid action? One reason is to have greater control of the user interface. An Objective-C class that links with the Application Kit has access to the full range of programmatic resources for managing the appearance and behavior of user-interface objects.

But perhaps the most common reason for hybrid actions is to get access to system resources that a script could not get on its own. Scripts can call Objective-C instance methods with the `call` method command, but only if the target object is something that the script can address (for example, `call method "title" of window 1`). Sometimes, an AppleScript Studio script does not have access to a valid object for a `call` method command. To get around this limitation, you can create a simple custom class that implements one or more class methods. The first argument of these methods is the target (receiver) of an instance method that the class method wraps. Listing 2 illustrates this approach.

Listing 2 Implementing a custom Objective-C method to be called by a script

```
#import "CreatePackageAction.h"

@implementation CreatePackageAction

+ (BOOL)writeDictionary:(NSDictionary *)dictionary withName:(NSString *)name
{
    return [dictionary writeToFile:name atomically:YES];
}

@end
```

In a script you can then use a `call` method “`m`” of class “`c`” with parameters{`y,z`} statement to call this method (Listing 3).

Listing 3 A script calling the Objective-C method

```
set descriptionRecord to
```

```
{|IFPkgDescriptionTitle|:packageTitle,|IFPkgDescriptionVersion|:packageVersion,  
|IFPkgDescriptionDescription|:description,  
|IFPkgDescriptionDeleteWarning|:deleteWarning}  
set rootName to call method "lastPathComponent" of rootFilePath  
set descriptionFilePath to temporaryItemsPath & rootName & "description.plist"  
call method "writeDictionary:withName:" of class "CreatePackageAction" with  
parameters  
{descriptionRecord, descriptionFilePath}
```

Updating Non-bound Parameters

A property of all actions, including AppleScript-based ones, is a record (equivalent in Objective-C to a dictionary) containing values reflecting the settings users have made in the action's user interface. When Automator runs an AppleScript action by calling its `run` command handler, it passes in these values in the `parameters` parameter. Most actions use the Cocoa bindings mechanism to set the `parameters` property. However, you may choose to forgo bindings in favor of more direct approach.

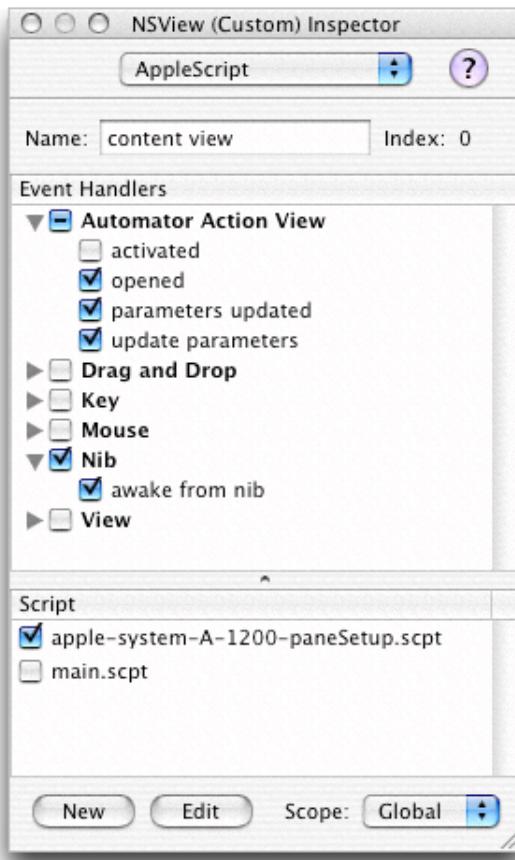
The Automator application defines several commands for AppleScript Studio. Among these are `update parameters` and `parameters updated`, which can be attached to an action's view. The `update parameters` command is sent when the an action's `parameters` record need to be refreshed from the values on the user interface. The `parameters updated` command is sent when the `parameters` record changes any of its values.

To specify handlers for these commands in Interface Builder, follow the usual AppleScript Studio procedure:

1. Select the action's view.
2. In the AppleScript pane of the Info window, expose the commands under Automator Action View (see Figure 1).
3. Click the check boxes for `update parameters` and `parameters updated`.

4. Specify a script file for the command handlers.

Figure 1 Selecting the parameters-related handlers for action views



Automator calls the handler for update parameters just before it runs the action. In this handler, the action should get the settings from the user interface and update the parameters record with them. Listing 4 provides an example of an update parameters handler.

Listing 4 An “update parameters” command handler

```
on update parameters theObject parameters theParameters
    set |destinationPath| of theParameters to (the content of text field "folder
path" of the destination_folder_box) as string
    set |textInput| of theParameters to (the content of text field "text input"
of the text_source_box) as string
    set |fileName| of theParameters to (the content of text field "file name" of
the file_name_box) as string
```

```
set |chosenVoice| of theParameters to the title of popup button "voice popup"
of voice_box

set |textSource| of theParameters to ((the current row of matrix "source matrix"
of the text_source_box) as integer) - 1

return theParameters

end update parameters
```

Always return the updated parameters object as the final step in this handler (theParameters in the above example).

Implementing an Objective-C Action

Objective-CSwift

The particular advantage of actions written in Objective-C (compared to AppleScript actions) is that they have greater access to the range of system resources of OS X. Actions that use Objective-C code can incorporate the features not only of Objective-C frameworks such as Foundation and Application Kit but of virtually any other framework (Because Objective-C is a superset of ANSI C, an Objective-C class can call functions published in a C interface). Purely Objective-C actions have an offsetting disadvantage: they cannot easily control applications or access their features except for those applications that offer a public API.

In general, data that Automator pipes through the actions of a workflow is assumed to be AppleScript-compatible. If it detects that an action is based on Objective-C, however, Automator converts it into an Objective-C object that the action can deal with. It also takes the objects that Objective-C actions provide and converts them into a form suitable for AppleScript-based actions.

Specifying Cocoa Type Identifiers

An action that is purely based on Objective-C must have Cocoa-specific type identifiers for its `AMAccepts` and `AMProvides` properties. Currently there are three Cocoa public type identifiers:

- `com.apple.cocoa.string` —An `NSString` for text
- `com.apple.cocoa.path` — An `NSString` for full file-system paths
- `com.apple.cocoa.url` —An `NSURL` for URLs

For example, if you were to specify `com.apple.cocoa.path` as the sole type identifier of the `AMAccepts` property, the input object in the `runWithInput:fromAction:error:` method would an `NSString` object representing a path (or an array of such string objects). If you were to specify `com.apple.cocoa.url` as the type identifier of the `AMProvides` property, you would have to return an `NSURL` object (or an array of `NSURL` objects) in your implementation of `runWithInput:fromAction:error:`.

For further discussion of the Cocoa type identifiers, see [Type Identifiers](#) (page 118).

Note: UTI type identifiers designating other types of input and output data for Objective-C actions are planned for future versions of OS X.

Implementing runWithInput:fromAction:error:

In your custom subclass of `AMBundleAction` you must override the method

`runWithInput:fromAction:error:` (inherited from the `AMAction` class). Aside from specifying the Cocoa type identifiers in your `AMAccepts` and `AMProvides` properties, this method implementation is the only requirement for a purely Objective-C action.

If an action does not have to deal with the input data handed it—for example, its role is to select some items in the file system—the implementation of `runWithInput:fromAction:error:` can return whatever it is designed to provide without touching the input data. In the example in Listing 1, the action returns a list of paths to movies selected in its user interface (and stored in its parameters):

Listing 1 An Objective-C action that does not handle its input object

```
- (id)runWithInput:(id)input fromAction:(AMAction *)anAction
    error:(NSDictionary **)errorInfo {
    return [[self parameters] objectForKey:@"movieFiles"];
}
```

However, most actions operate on the input data given them from the previous action. The input object and the output object for an action are almost always `NSArray` objects because the `Container` subproperties of `AMAccepts` and `AMProvides` are by default lists (equivalent to `NSArray` objects in Objective-C). Many Objective-C actions implement `runWithInput:fromAction:error:` using a general approach that is similar to a typical on `run` handler in an AppleScript-based action:

1. If the container type of the action's `AMProvides` property is `List`, prepare an output array for later use (usually by creating an `NSMutableArray` object).
2. Iterate through the elements of the input array and for each perform whatever operation is required and write the resulting data item to the output array.
3. Return the output array.

Listing 2 Implementing runWithInput:fromAction:error:

```
- (id)runWithInput:(id)input fromAction:(AMAction *)anAction error:(NSDictionary **
*)errorInfo
```

Implementing an Objective-C Action

Implementing runWithInput:fromAction:error:

```
{  
    NSMutableArray *returnArray = [NSMutableArray arrayWithCapacity:[input count]];  
    NSEnumerator *enumerate = [input objectEnumerator];  
    NSString *xmlFile;  
  
    while (xmlFile = [enumerate nextObject]) {  
        NSError *anError=nil;  
        NSString *returnStr;  
  
        NSXMLDocument *xmlDoc = [[NSXMLDocument alloc] initWithContentsOfURL:[NSURL  
fileURLWithPath:xmlFile] options:nil error:&anError];  
        NSLog(@"XML document = %@", [xmlDoc description]);  
        if (!xmlDoc) {  
            [returnArray addObject:[NSString stringWithFormat:@"ERROR: Could not  
make document from file: %@", xmlFile]];  
            continue;  
        }  
        if (anError) {  
            [returnArray addObject:[NSString stringWithFormat:@"ERROR: Error in  
processing file %@", because = %@", xmlFile, [anError localizedDescription]]];  
            continue;  
        }  
  
        NSString *queryStr;  
        if ([[self parameters] objectForKey:@"elementAttributeChoice"] intValue])  
        { // attribute  
            queryStr = [NSString stringWithFormat:@".//%@", [[self  
parameters] objectForKey:@"elementAttributeName"]];  
        } else {  
            queryStr = [NSString stringWithFormat:@".//%@", [[self  
parameters] objectForKey:@"elementAttributeName"]];  
        }  
        anError = nil;  
        NSArray *results = [xmlDoc nodesForXPath:queryStr error:&anError];  
        if (anError) {  
            [returnArray addObject:[NSString stringWithFormat:@"ERROR: Error in  
XQuery because = %@", [anError localizedDescription]]];  
        }  
    }  
}
```

```

        continue;

    }

    [returnArray addObject:[NSString stringWithFormat:@"\n----- Found in
file %@ -----\\n", xmlFile]];

    int i, count = [results count];
    for (i = 0; i < count; i++) {
        [returnArray addObject:[results objectAtIndex:i]];
    }
    [xmlDoc release];
}

return returnArray;
}

```

Some actions in their `AMAccepts` property specify that their input is optional (that is, the `Optional` subproperty is set to `<true/>`). This setting allow users to select a “Ignore Result...” item from an input type pop-up button in the action’s view. If your action has made input optional in its `AMAccepts` property, you need to determine if the user has made this choice by sending the action an `ignoresInput` message; if the response is YES, you do not need to do anything with the input object.

If your action encounters an error that prevents it from proceeding, it should give information describing the error to Automator, which then stops executing the workflow and displays an error alert. The last parameter of the `runWithInput:fromAction:error:` method is a pointer to an `NSDictionary` object. To report errors, you must create a dictionary containing two key-value pairs and return this object to Automator indirectly.

The two dictionary properties are:

- `OSAScriptErrorNumber`—Takes an error number encapsulated as an `NSNumber` object.

For suitable error codes, see the `MacErrors.h` header file of the Carbon Core framework, especially the error codes specific to the OSA framework.

- `OSAScriptErrorMessage`—Takes an `NSString` object containing a description of the error.

Because the code example in [Listing 2](#) (page 73) output is text, it reports errors such as the lack of a valid document as part of the output. But what if this were a fatal error that required the action to stop executing? Listing 3 illustrates how you might handle such an error.

Listing 3 Reporting a fatal error to Automator

```
if (!xmlDoc) {
```

```

NSArray *objsArray = [NSArray arrayWithObjects:
    [NSNumber numberWithInt:errOSASystemError],
    [NSString stringWithFormat:@"ERROR:
        Could not make document from file: %@", xmlFile], nil];
NSArray *keysArray = [NSArray arrayWithObjects:OSAScriptErrorNumber,
    OSAScriptErrorMessage, nil];
*errorInfo = [NSDictionary dictionaryWithObjects:objsArray
    forKeys:keysArray];
return nil;
}

```

Your action has the entire gamut of possibility available to Cocoa applications. It can message Cocoa-framework objects and custom objects from its AMBundleAction subclass, and it can define and implement as many other supporting classes, protocols, and categories as is needed to accomplish the task of the action. An Objective-C action could choose to do any of the following things:

- Execute a command-line tool using an NSTask object.
- Perform animation using NSAnimation or NSViewAnimation.
- Spin off multiple secondary threads using Foundation's threading support.
- Communicate with other applications using distributed objects or distributed notifications.
- Use a C-language framework; for example, you could use Core Graphics to draw an image directly to the screen.

An Objective-C has only two restrictions related to its implementation of runWithInput:fromAction:error:. It cannot return until it has completely finished whatever processing it has initiated. For instance, if an action instructs a camera to take a picture (an asynchronous process) it cannot return from runWithInput:fromAction:error: method until the picture is taken. So the action has to implement whatever blocking algorithm, timeout logic, or threading strategy is necessary until the picture is taken. The second restriction has to do with Automator's threading architecture. Because Objective-C actions run on a secondary thread, if they want to display a window it must be done on the main thread. The performSelectorOnMainThread:withObject:waitUntilDone: method is adequate for this purpose; for example:

```

self performSelectorOnMainThread:@selector(showPreviewWithData:) withObject:data
waitUntilDone:YES]

```

Updating Action Parameters

A typical action uses the bindings technology of Cocoa to synchronize the settings on an action's user interface with the action's parameters attribute. (See [Constructing the User Interface](#) (page 32) in [Developing an Action](#) (page 29).) But an action is not required to use bindings to do this synchronization. It can choose to do it manually by implementing the updateParameters and parametersUpdated methods. These methods are invoked when it is time to run or save the action.

The updateParameters method is invoked when the parameters attribute of the action (an NSDictionary object) needs to be refreshed from the settings and values the user has specified in the user interface. The parametersUpdated method is invoked for the opposite reason: to make the pop-up items, buttons, text fields, and other objects in the action's view reflect the current contents of the action's parameters, especially when those contents change programmatically.

[Listing 4](#) shows a typical implementation of the updateParameters method.

Listing 4 Updating an Objective-C action's parameters manually

```
- (void)updateParameters
{
    // text
    NSString *outputFile = [_outputFilePath stringValue];
    if (outputFile)
    {
        [[self parameters] setObject:outputFile forKey:@"outputFilePath"];
    }

    NSString *waitSeconds = [_waitSeconds stringValue];
    if (waitSeconds)
    {
        [[self parameters] setObject:[NSNumber numberWithInt:
            [_waitSeconds intValue]] forKey:@"waitSeconds"];
    }

    // radios
    [[self parameters] setObject:[NSNumber numberWithInt:
        [_interactiveType selectedRow]] forKey:@"interactiveType"];
    [[self parameters] setObject:[NSNumber numberWithInt:
        [_screenShotType indexOfSelectedItem]] forKey:@"screenshotType"];
}
```

```

// popup
[[self parameters] setObject:[NSNumber numberWithInt:
    [_outputType indexOfSelectedItem]] forKey:@"outputType"];

// checks
[[self parameters] setObject:[NSNumber numberWithBool:
    [_captureMainMonitorOnly state]] forKey:@"captureMainMonitorOnly"];
[[self parameters] setObject:[NSNumber numberWithBool:
    [_disableSounds state]] forKey:@"disableSounds"];
[[self parameters] setObject:[NSNumber numberWithBool:
    [_timedScreenshot state]] forKey:@"timedScreenshot"];
}

}

```

You can also update an action's parameters to include miscellaneous data that can stay with the action as it is, for example, copied to the pasteboard or written to disk in a workflow. When Automator archives an action it includes the action's parameters with the archive, and thus objects stored in the parameters can be unarchived and retrieved. The only restriction is that the Foundation object saved to an action's parameters must be a property-list object—that is, an NSData, NSDate, NSNumber, NSString, NSArray, or NSDictionary object. Any object that is not one of these must be converted to a property-list object before it can be archived.

Objects that represent URLs—in other words, instances of NSURL—are an important case in point. URLs are a type of data (identified with UTI public.url) that actions occasionally deal with. Fortunately, there are methods for converting NSURL objects to and from a property-list object. The code in Listing 5 converts an NSURL object to an NSString object and stores that in the action parameters.

Listing 5 Saving an NSURL object to parameters as a string object

```

NSMutableDictionary* params;

if (mFilterURL) // NSURL object
{
    NSString* path = [mFilterURL path];
    params = [NSMutableDictionary dictionaryWithObject:path forKey:@"URL"];

    [self setParameters:params];
}

```

```
}
```

Now when the action is archived the URL is stored with it, and when it is unarchived the URL is retrievable. The code fragment in Listing 6 restores the NSURL object from the NSString object stored in the action parameters.

Listing 6 Restoring an NSURL object from an action's parameters

```
NSURL* filterURL = nil;

NSMutableDictionary* params = [self parameters];

NSString* path = [params objectForKey: @"URL"];

if (path) filterURL = [NSURL fileURLWithPath:path];

if (filterURL)
{
    // do something with filterURL here
}
```

This example uses `fileURLWithPath:` to create an NSURL object representing a file-scheme URL. If you want a URL object with a different scheme, you would use something such as `URLWithString:`, an NSURL class method. However, the string for this method must contain any necessary percent-escape codes. The easiest way to obtain such a string is to send `absoluteString` to the NSURL object before storing the URL string in the action parameters. If your action for some reason does not deal with absolute URLs, then it must devise a way to save and restore the various parts of the URL.

Loading and Executing Scripts

Objective-C actions can also include AppleScript code that they load and execute, making them in effect hybrid actions. The OSA framework and the Foundation framework contain a number of classes (OSAScript, NSAppleScript, NSAppleEventDescriptor, and more) that enable creation, preparation, and execution of objects representing AppleScript scripts.

Listing 7 illustrates how an action gets an AppleScript script either from its user interface or its parameters, creates an OSAScript object with it, and then compiles and executes the script.

Listing 7 Executing an AppleScript script in an Objective-C action

```
- (OSAScript *)script
{
    OSAScript *script = nil;
    NSString *source = nil;

    if ([self controller])
    {
        [[self controller] compileScript:self];
        source = [[[self controller] scriptView] string];
    }
    else
    {
        source = [self source];
    }

    if (source)
    {
        script = [[OSAScript alloc] initWithSource:source language:[OSALanguage defaultLanguage]];
        if (script)
        {
            NSDictionary *errorInfo;
            [script compileAndReturnError:&errorInfo];
        }
    }
    return [script autorelease];
}

- (NSString *)source
{
    return [[self parameters] objectForKey:@"RunScriptSource"];
}

- (void)setSource:(NSString *)source
```

```
{  
    [[self parameters] setObject:source forKey:@"RunScriptSource"];  
}
```

Creating Shell Script Actions

You can create actions for the Automator action that are based on scripting languages with a UNIX pedigree, including shell scripts, Perl, and Python. This article explains how to create such actions.

Note: Several of the steps in developing shell script actions, such as constructing the user interface, are the same as for other kinds of actions. This article describes only those aspects of shell script action programming that are different.

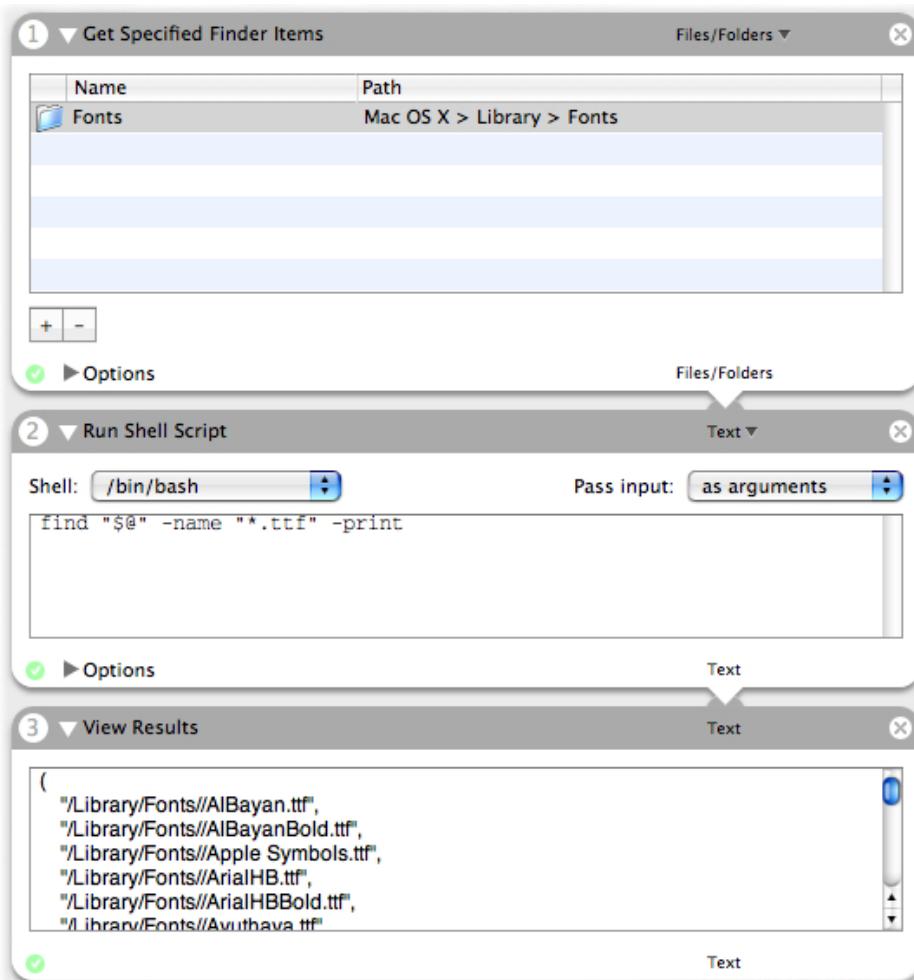
Shell script actions were first introduced in Xcode 2.1.

The Run Shell Script Action

You can incorporate a shell script into an Automator workflow even without having to build an action bundle. The Run Shell Script action, as with the Run AppleScript action, is an action that lets you type and execute a script; in this case, however, it's a shell script or a Python or Perl script. The Run Shell Script action in a workflow shows the action in a workflow that searches recursively in a Fonts folder for fonts with a specific extension.

Note: The Run Shell Script action shown in [Figure 1](#) (page 83) is included in the OS X v10.4.2 update. It is not available in earlier versions of OS X v10.4 or in Xcode 2.1.

Figure 1 The Run Shell Script action in a workflow



The Run Shell Script action in this simple example runs the `find` command in the bash shell. In the Shell pop-up menu you can select other shells (such as `csh` or `zsh`) or Python or Perl as your scripting environment. The “Pass input” pop-up menu lets you choose input in the form of standard input (`stdin`) or as shell arguments.

The Run Shell Script action is a useful tool, especially for rapid prototyping of scripts. But it has its limitations, especially when the workflow it’s in is made available to users. Users of the workflow (unless they are power users) may introduce errors into the script if they try to change options. And if you save the workflow as an application to eliminate the possibility of user error, the action becomes even more inflexible and hence less usable.

To make shell script-based actions for which users of a workflow can select options, you need to create a custom shell script action.

Custom Shell Script Actions

Shell script actions are conceptually different from AppleScript and Objective-C actions in important ways. The primary difference concerns the way input and user choices are conveyed to the action.

Instead of an input parameter, input is piped into the action via standard input (or passed as command-line arguments) and piped out of it via standard output. In addition, an action’s input and output, instead of being a list or array object, is a single string; individual items in the string (such as paths) are separated from each other by newline characters. (The newline character is the default; you can change the separating character programmatically.) The type identifier for a shell script action’s `AMAccepts` and `AMProvides` properties is always `com.apple.cocoa.string`.

Because shell script actions are limited to single type of data, they might not seem to work well with other actions that accept and provide incompatible data types. For example, how can a shell script action handle input from an action that deals in Address Book records? This is where conversion actions play an important role. Conversion actions convert between one type of data and another. Automator invisibly inserts the appropriate conversion action between actions with dissimilar types in a workflow—but only if the conversion action is available. Apple provides many conversion actions in `/System/Library/Automator` (the actions with extension `caction`), but these might not be suitable for your shell script action. You may want to consider creating your own conversion actions; see [Creating a Conversion Action](#) (page 95) for the procedure.

The choices users make in the user interface of a shell script action are conveyed to the script as environment variables. These variables correspond to the keys specified for the `Parameters` object-controller instance in the nib file. When you are creating the user interface, you use these keys to establish bindings between controls on the user interface and the action’s `parameters` property.

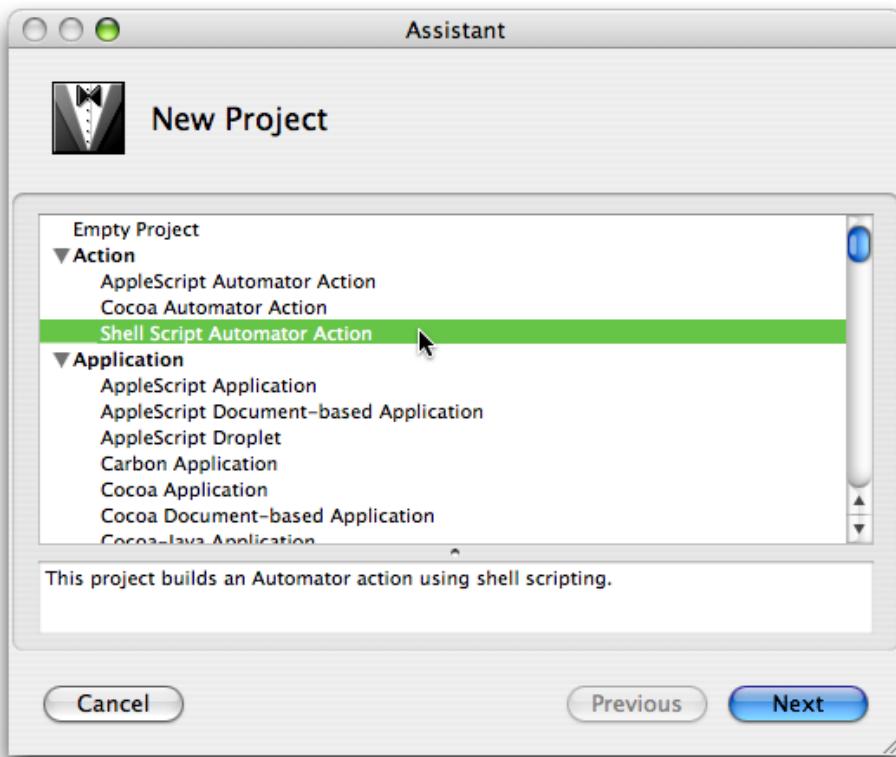
A shell script in an action cannot directly display localized strings in, for example, error messages. However, a shell script action, which is a loadable bundle, can contain localized nib files and can localize its visible properties, such as the action name, application, and description. See [Internationalizing the Action](#) (page 47) for details.

Shell script actions have no direct access to the methods of the Automator framework or, for that matter, any other framework. There is no way within the script to manually synchronize the user interface and the `parameters` property (`updateParameters` and `parametersUpdated` methods). Neither can you implement the `opened` and `activated` methods (or corresponding AppleScript routines) to perform initialization and synchronization tasks. However, your shell script action project can include an Objective-C helper class or an AppleScript utility script that implements these methods or routines. Shell scripts can also run the `osascript` tool to execute individual AppleScript scripts.

Creating the Shell Script Action Project

To create an Xcode project for a shell script action, start by choosing New Project from the File menu. In the New Project assistant, select Shell Script Automator Action, as shown in Figure 2, and click Next.

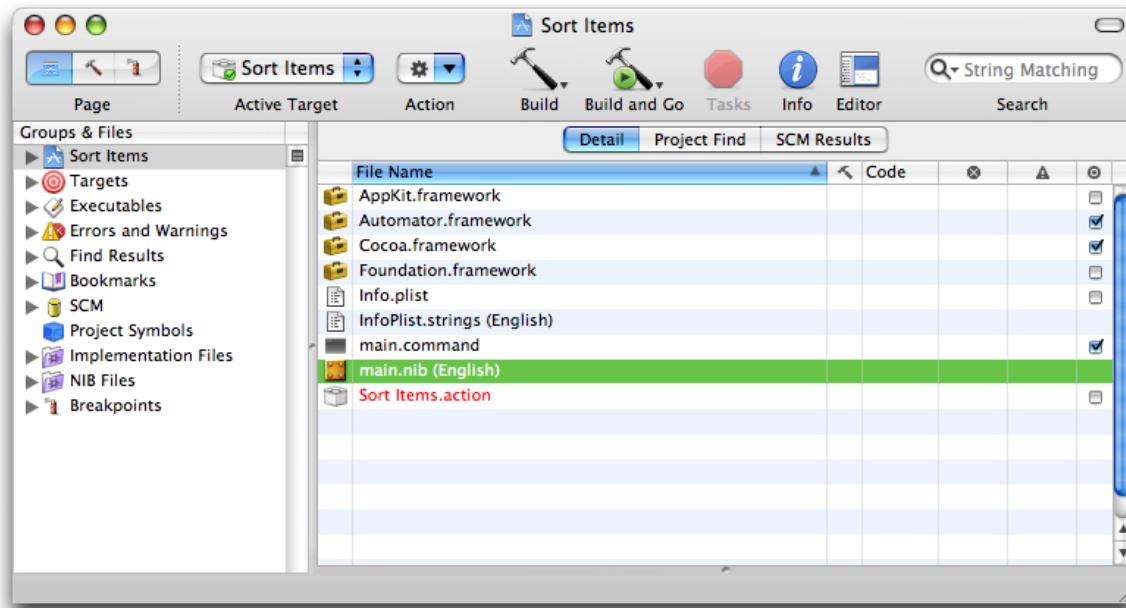
Figure 2 Selecting the Shell Script Automator Action template



In the next assistant window, enter a project name and location and click Finish. For convenience, make the name of the project the same name you want the action to have; by default, the project name is assigned to the action name and the bundle identifier.

The project window of a shell script action displays most of the items that appear in the project windows of other action types (see Figure 3). These items include the required frameworks, main.nib, Info.plist, and InfoPlist.strings. The sole difference from other projects is the main.command file, which holds the script (shell, Perl, or Python) that you will write.

Figure 3 The project window of a shell script action



The main.command file in the template is initialized with a simple cat command to pipe the input from stdin to stdout.

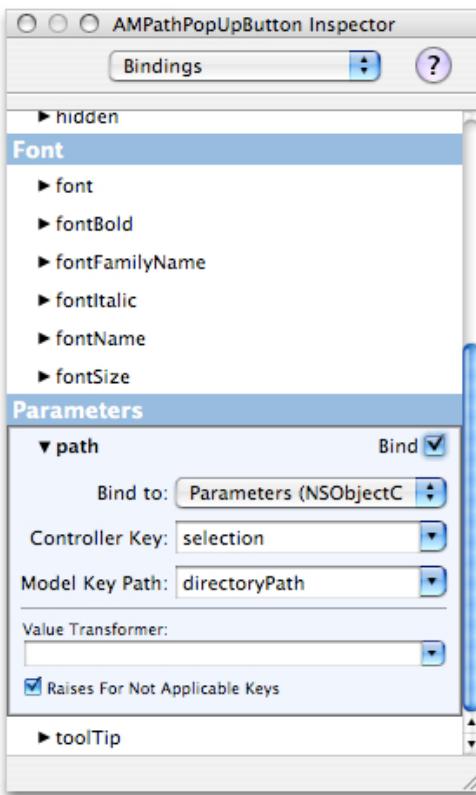
Before you start working on the shell script action, become familiar with the guidelines for actions, which are documented in [Design Guidelines for Actions](#) (page 26).

Composing the Action View

Constructing the user interface of a shell script action is a procedure that is the same as for other kinds of actions. Read [Constructing the User Interface](#) (page 32) to learn about the procedure.

Remember that the keys you supply for bindings in the Attributes pane of the NSObjectController inspector (the Parameters instance in Interface Builder) become the environment variables that you refer to in the script (Figure 4). Through bindings, the settings of the various fields, buttons, and pop-up menus are converted into the values of these environment variables.

Figure 4 The parameter keys in the NSObjectController inspector



If you are going to make the action available in multiple localizations, you must internationalize and localize the nib file; see [Internationalizing the Action](#) (page 47).

Automator Properties for Shell Script Actions

The properties of shell script actions (in the Info.plist file) are little different than the properties of AppleScript and Objective-C actions. The differences are the following:

- The `AMAccepts` and `AMProvides` properties take UTI identifiers of `com.apple.cocoa.string` only.
- The `AMApplication`, `AMCategory`, and `AMIconName` properties are preset with the value “Terminal” in the project template. You can either keep this value or change it to something else, such as “TextEdit”.

You set all other Automator and regular bundle properties the same as in other kinds of actions. See [Specifying Action Properties](#) (page 41) for more information.

Writing the Script

When you write a shell script or a Perl or Python script for an action, you do nothing different from what you normally would, except for two things:

- You learn about the choices users have made in the action's user interface through environment variables.
- Input to the script is implicitly standard input; you handle it (usually) as lines—that is, a list of newline-terminated strings.

The parameters of an action are the settings users have made in the controls and text fields of the action's user interface. Actions are implemented to hold them as values in a dictionary. You access these values through keys that you specify when you establish the bindings of the action. In AppleScript and Objective-C actions the parameters dictionary is passed into the action, and the code in each case directly obtains a setting value using one of the bindings keys. Because the only thing passed into a shell script action is standard input, you must obtain the settings in another way. When a shell script action is run in a workflow, the `AMShellScriptAction` class converts the items in the parameters dictionary into environment variables; the name of each environment variable is a bindings key. Listing 1 shows how you access the environment-variable values in a script.

Listing 1 A sample shell script for an action

```
PATH=/bin:/usr/bin:/sbin:/usr/sbin export PATH

case "$sortDirection" in
0) dir=      ;;
1) dir="-r"   ";;
esac

case "$sortStyle" in
0) s=  ;;
1) s="-n"    ";;
esac

# note when you use "-k", the first column is 1, not 0
```

```
sort $dir $s -k $sortColumn

exit 0
```

This shell script makes sure the PATH environment variable is properly set. It then interprets two environment variables in case statements and sets arguments of the sort command accordingly. It then executes the sort command, using the value of a third environment variable as the final command-line argument.

Some commands in shell scripts, such as sort in the above example, are designed to handle multiple lines of input at once. Other commands can only handle one line of input at a time. For these commands, input must be handled in a loop, such as the following:

```
while read line; do
    cp "$line" /tmp
    echo $line
done
```

Perl scripts and Python scripts have to follow the same general guidelines as shell scripts. Listing 2 shows an example of such a Perl script, which filters text based on parameters such as range of lines and range of fields.

Listing 2 A Perl script for an action

```
#!/usr/bin/env perl
# Filter Text by Position
# Pick out particular lines and fields of the input text.

# Grab values we care about from the UI and make sure they're integers
$line1 = $ENV{'firstLine'} + 0;
$line2 = $ENV{'lastLine'} + 0;
$f1 = $ENV{'firstField'} + 0;
$f2 = $ENV{'lastField'} + 0;
$seignum = $ENV{'fieldSeparator'} + 0;
$outputSepNum = $ENV{'outputSeparator'} + 0;

# Figure out the right regex for our separator. (whitespace, blank, tab, colon,
characters)
```

```
# Later we will split the input lines on this pattern.  Splitting on "" conveniently
# breaks

# the line apart on character positions.

@regexes = ( "\s+", " ", "\t", ":" , "" );
$regex = $regexes[ $sepnum ];

# And what output separator to use (blank, tab, colon, nothing)
@oseps = ( " ", "\t", ":" , "" );
$osep = $oseps[ $outputSepNum ];

# Grab all our input

@lines = <>;
$linecount = $#lines + 1;

# Adjust line numbers. 0 = last line, -1 = 2nd last, etc.

if ( $line1 <= 0 ) {
    $line1 = $linecount - $line1;
}
if ( $line2 <= 0 ) {
    $line2 = $linecount - $line2;
}

# And get them in the right order.

if ( $line1 > $line2 ) {
    $x = $line1; $line1 = $line2; $line2 = $x;
}

# Output the desired lines
```

```
for ( $l = $line1 ; $l <= $line2; $l++ ) {  
    # note we are counting the first line as 1  
  
    $line = $lines[$l - 1];  
  
    if ( $f1 == 1 && $f2 == 0 ) {  
        print $line;  
    } else {  
        @fields = split($regex, $line);  
        $fieldcount = $#fields + 1;  
        # Adjust field numbers. 0 = last field, -1 = 2nd last, etc  
        if ( $f1 <= 0 ) {  
            $f1 = $fieldcount - $f1;  
        }  
        if ( $f2 <= 0 ) {  
            $f2 = $fieldcount - $f2;  
        }  
  
        # Get fields in right order too  
        if ( $f1 > $f2 ) {  
            $x = $f1; $f1 = $f2; $f2 = $x;  
        }  
  
        undef @out;  
        for ( $i = $f1; $i <= $f2; $i++ ) {  
            push( @out, $fields[ $i - 1 ]);  
        }  
  
        # Output the desired fields joined by the desired output separator.  
        print join($osep, @out) . "\n";  
    }  
}  
exit(0);
```

Debugging and Testing Shell Script Actions

For general advice for debugging actions, see [Testing and Debugging Strategies \(page 51\)](#).

You cannot use gdb or any other debugger to debug shell script actions. However, you have a couple of alternatives to consider:

- If your shell action exits with a non-zero status code, the workflow will stop and anything your action wrote to stderr will show up in the Automator log view. For example, a simple, always-fail shell action might include these lines:

```
echo This action always fails 1>&2  
exit 1
```

- Test your script by itself in the Terminal application. You can set environment variables to duplicate the variables that Automator would set. For example,

```
$ sortDirection=1 sortStyle=0 ./main.command
```

- Individual scripting languages might have their own debugging facilities. For instance, bash scripts can echo each line as it is about to be executed and can print the values of expanded variables in a script. If you add the following code to a script:

```
set -xv
```

you can request sh and bash scripts to display a log of the commands that are actually executed. The log is written to the shell's standard error stream (which is normally discarded by Automator).

- Because only standard output is passed to the next action, so you might want to capture the log information in a separate file (for example, /tmp/myAction.log) or, preferably in the console log, which is displayed by the Console application. If you add a line like the following to the script:

```
exec 2>>/dev/console
```

the log information appears in the console log. As your action runs, you can view in Console every command your script is trying to execute.

- You can also use the `printenv` command to show the value of all environment variables, which includes the values of action bindings.

Listing 3 shows the same sorting shell script in [Listing 1](#) (page 88) with debugging statements added.

Listing 3 The sorting shell script for an action, with debugging statements

```
PATH=/bin:/usr/bin:/sbin:/usr/sbin export PATH

# Turn on shell debugging, and arrange for our standard error stream
# to be redirected to the console device, where it will appear in Console.app's
# console log window

set -xv
exec 2>/dev/console

# We can have our own debug messages too; by adding 1>&2 we are arranging for the
# output of this command to go to standard error (the console log) rather than
# standard out
# (which becomes the input to the next stage.)

echo starting stage 1>&2

# Check the value of all our environment variables – which will show us all our
# bindings

printenv 1>&2

case "$sortDirection" in
0)   dir=      ;;
1)   dir="-r      ";;
esac

case "$sortStyle" in
1)   s="-n      ";;
esac

# Note when you use "-k", the first column is 1, not 0
# Note that these debug statements go to standard error and thus to /tmp/log
```

```
echo About to sort input 1>&2
echo The command is: sort $dir $s -k $sortColumn 1>&2

sort $dir $s -k $sortColumn

echo All finished sorting 1>&2

exit 0
```

Check the man page or other documentation for a scripting language to see what debugging facilities are available.

Creating a Conversion Action

A conversion action acts as a kind of bridge between two actions whose types of provided data (`AMProvides` property) and accepted data (`AMAccepts`) do not match. The conversion action converts between one type and another, usually from an internally defined data type (such as an iTunes track object, specified by the UTI identifier `com.appleitunes.track-object`) to an externally defined public type (such as a file, specified by `public.item`).

Automator does not display conversion actions and users do not have to bother placing them between actions. The application determines if there is a data-type mismatch between two actions and, if a suitable conversion action is available, it inserts it invisibly between them. Conversion actions have a bundle extension of `.caktion` and are installed in the usual system directories for actions.

You create a conversion action just as you would a “normal” action (as described in [Developing an Action](#) (page 29)) but with just a few differences:

- Set the extension of the produced bundle to `.caktion`. To do this, select the action target and choose Get Info from the Project menu. In the Build pane of the Info window (Customized Settings collection), set the Wrapper Extension to “`caktion`”.
- In the information property list (`Info.plist`) for the bundle be sure to do the following:
 - The `AMAccepts` type identifier should specify the type of data converted *from*.
 - The `AMProvides` type identifier should specify the type of data converted *to*.
 - The `AMCategory` property should have a value of “Converter/Filter”.
 - The `AMApplication` property value should be “Automator”.

See Listing 1 for an example.

- Of course, there is no need for an action description, nib file, or similar resource.

Listing 1 Typical Automator properties for conversion actions

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE plist PUBLIC "-//Apple Computer//DTD PLIST 1.0//EN"
"http://www.apple.com/DTDs/PropertyList-1.0.dtd">
<plist version="1.0">
<dict>
```

```
<key>AMAccepts</key>
<dict>
    <key>Container</key>
    <string>List</string>
    <key>Types</key>
    <array>
        <string>com.apple.photos-object</string>
    </array>
</dict>
<key>AMApplication</key>
<string>Automator</string>
<key>AMCategory</key>
<string>Converter/Filter</string>
<key>AMDefaultParameters</key>
<dict/>
<key>AMIconName</key>
<string>(* The name of the icon *)</string>
<key>AMName</key>
<string>Convert Photo object to Alias object</string>
<key>AMPProvides</key>
<dict>
    <key>Container</key>
    <string>List</string>
    <key>Types</key>
    <array>
        <string>public.item</string>
    </array>
</dict>
<!-- other properties here -->
</dict>
</plist>
```

As the final step, write the script or Objective-C source code to do the conversion. The script example in Figure 1 converts iPhoto objects representing photo images to paths to those images in the file system.

Figure 1 A typical conversion script

```
on run {input, parameters}
    set the alias_list to {}

    tell application "iPhoto"
        repeat with i from 1 to the count of input
            set this_item to item i of input
            if (the class of this_item) is photo then
                set this_path to the image path of this_item
                set this_file to this_path as POSIX file as alias
                set the end of the alias_list to this_file
            end if
        end repeat
    end tell

    return the alias_list
end run
```

Defining Your Own Data Types

The following sections offer guidelines for when to define a custom data type, describe the procedure for creating a definition bundle, explain how to specify the `defined_types` property, and summarize the procedure for providing localizations.

Important: As of OS X v10.4.2, the definition of a data type involves nothing more than specifying a type identifier and a human-readable name. The structure of a data-type definition, however, is evolving and will become more detailed in the near future.

When to Define a Data Type

Apple defines dozens of special data types for Automator actions, each with its own unique Uniform Type Identifier (UTI). You use these UTIs in an action's information property list to specify the kinds of data an action accepts and provides. The special data types defined by Apple designate such things as generic AppleScript objects, iTunes track objects, and Cocoa strings. They are described in "[Type Identifiers](#) (page 118)," along with the supported public UTIs.

There might be times, however, when none of these default Automator data types can adequately describe the data that your action must deal with. The common case would be a scriptable application that your action messages with AppleScript commands. If, for example, this is a spreadsheet application and it has data objects representing such entities as worksheets and graphs, none of the Apple-defined data types could accurately represent these items of data. In cases such as this you can define your own data types for Automator.

However, you are not required to define a custom data type in these situations. You can always use one of the more generic types—for example, using a generic AppleScript object type to represent a spreadsheet object. This is especially true if only one action is involved. When you are creating a set of actions that uses application-specific data, then you might consider defining a custom type for that data. Automator can then provide more guidance to users about which actions work well with each other.

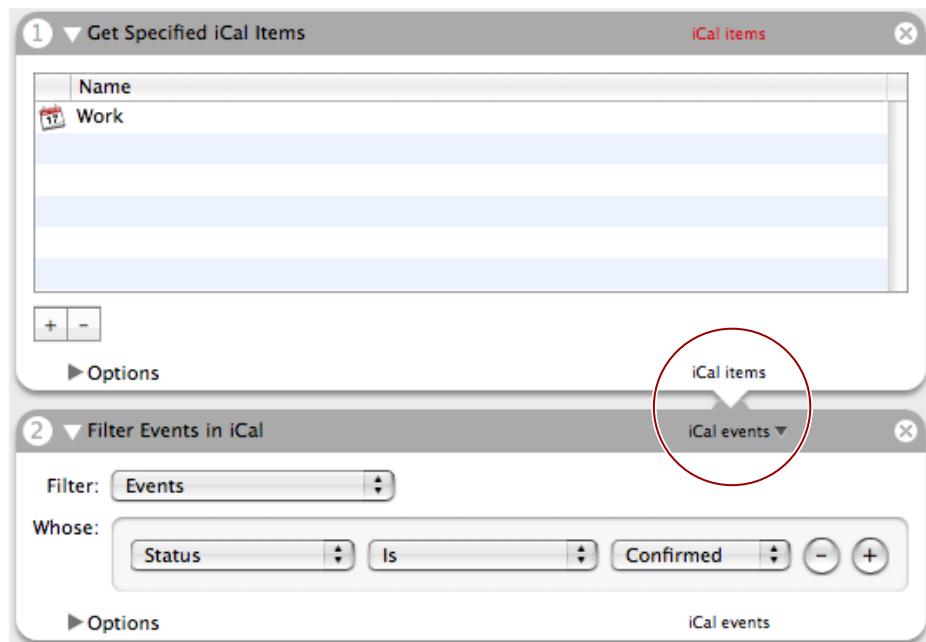
If you define custom data types, you might have to create conversion actions to convert data between your custom type and one or more public or common types. See [Creating a Conversion Action](#) (page 95) for the procedure for making a conversion action.

Creating the Definition Bundle

You specify custom data types in a definition bundle, which is a codeless loadable bundle with an extension of .definition. So if, for example, you are defining types of data native to the (fictional) Excellent application, you might name the definition bundle Excellent.definition.

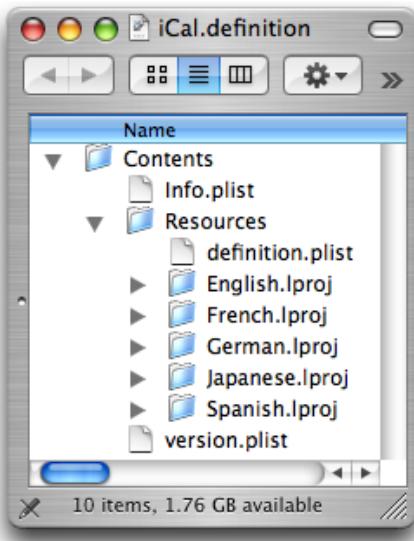
A data type is essentially defined in an XML property list. But if this is the case, why not have a simple file for the property list instead of a bundle? The reason for putting data-type definitions in a bundle is that bundles support internationalization. The definition includes the strings that identify the data accepted and provided in an action's user interface (see circled area in [Figure 1](#) (page 99)). These strings should be localized for all supported languages and locales.

Figure 1 The names of action input and output



You can get an idea of the internal structure of a definition bundle by looking at any such bundle installed in /System/Library/Automator. [Figure 2](#) (page 100) shows what the iCal.definition bundle looks like inside its opaque package. (To look inside a bundle, Control-click it in Finder and choose Show Package Contents from the contextual menu.)

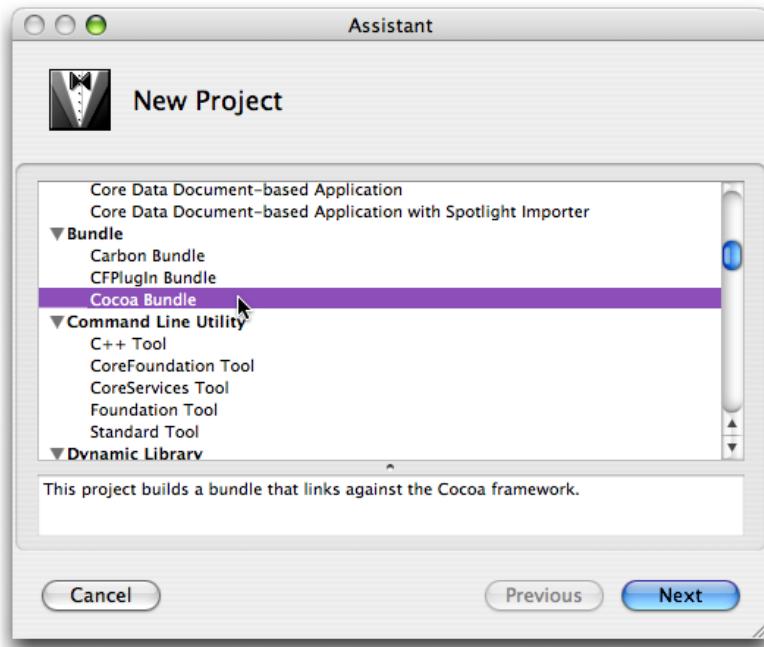
Figure 2 The contents of iCal.definition



This definition bundle supports localizations in five languages. The example shows that the `definition.plist` file, which contains the property list defining the data types, is stored just under the bundle's Resources folder. [Adding a Localization](#) (page 106)" discusses localizations in definition bundles in more detail.

To create a definition bundle in Xcode, start by choosing New Project from the File menu. In the New Project assistant window, select the Cocoa Bundle project type under Bundle (see [Figure 3](#) (page 101)). Click Next and in the subsequent assistant window provide a name and location for your project; click Next again to have Xcode display the project window.

Figure 3 Select the generic Cocoa bundle project type

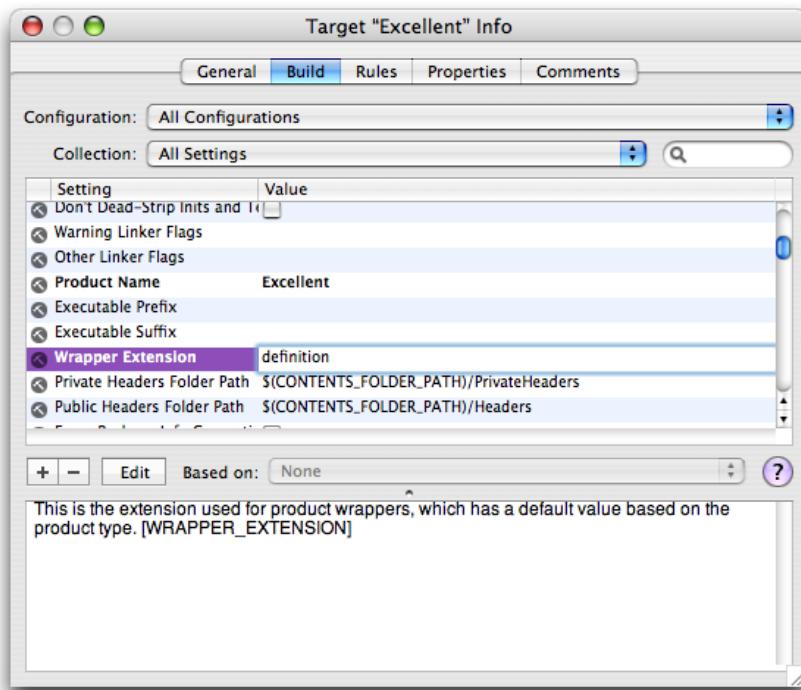


From this point, it takes four steps to create a definition bundle:

1. Specify the extension of the bundle.
2. Add the property-list file to the project.
3. Specify the properties of data types in the property-list file.
4. Add localizations to the definition bundle.

To change the extension of the bundle, double-click the target icon in the Groups and Files list in Xcode. This action opens the Info window for the target. Select the Build pane of this window and scroll down the table of settings until you find the Wrapper Extension build setting. Double-click the cell under Value for this setting and change the value to "definition" (see [Figure 4](#) (page 102) for an example).

Figure 4 Changing the bundle extension

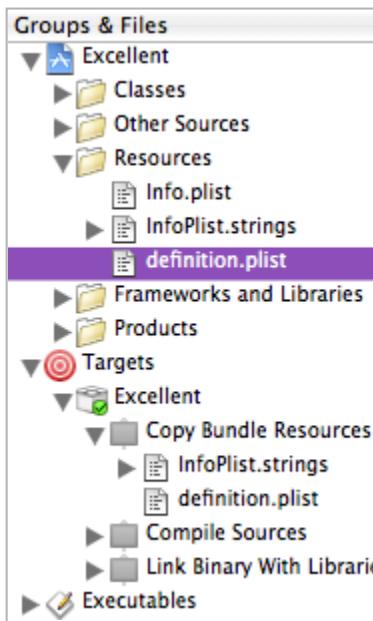


Next add the property-list file to the definition bundle:

1. Select the project's Resources folder in the Groups and Files list.
2. Choose New File from the File menu.
3. In the New File assistant, select Empty File in Project from the list of file types.
4. In the next window of the assistant (New Empty File in Project), type "definition.plist" in the File Name field.
5. Make sure that the correct project location, project name, and target are selected and click Finish.

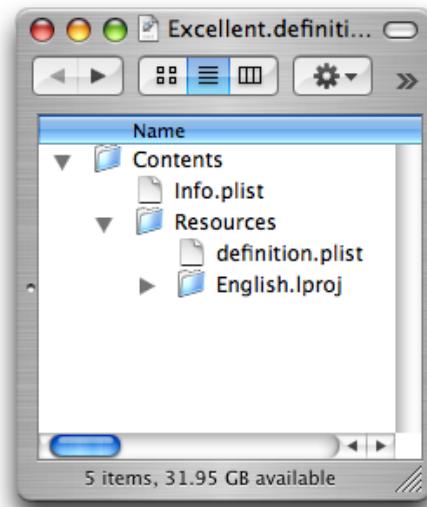
Disclose the contents of the Resources folder in the Groups and Files list to find the `definition.plist` file you have just added. [Figure 5](#) (page 103) shows what it should look like. (If `definition.plist` is not under Resources, move it there.)

Figure 5 The `definition.plist` file in the Groups and Files list



You might also notice that `definition.plist` (once it's added to Resources) also appears under the Copy Bundle Resources build phase under the target in the Groups and Files list. If you build the definition bundle at this point and then look inside the bundle package, you can see the initial layout of your bundle.

Figure 6 Initial layout for a bundle package



You are ready now to specify the properties of your custom data types and localize the human-readable parts of those properties; see "[Specifying Defined Types](#) (page 104)" and "[Adding a Localization](#) (page 106)," respectively, for the relevant information.

Once you finish creating your definition bundle, it is ready for installation. You install definition files in the same locations you install actions: /Library/Automator, /Network/Library/Automator, Library/Automator in users' home directories, or inside the application bundle. See "[Installing Actions](#) (page 54)" for more information.

Specifying Defined Types

Giving a file an extension of .plist doesn't make it a property-list file, let alone one for defining Automator data types. A property list on OS X must have the proper XML header. In addition, a property list in a definition bundle must have the defined_typesproperty.

The quickest way to start writing the property list for your definition bundle is to copy the contents of an existing definition.plist file and then modify it appropriately. The definition.plist file in /System/Library/Automator/Automator.definition is good source for this. Copy the contents of the file and paste it into your own definition.plist. The property list should look like the example in [Listing 1](#) (page 104).

Listing 1 The contents of definition.plist — Automator definition bundle (partial)

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE plist PUBLIC "-//Apple Computer//DTD PLIST 1.0//EN"
"http://www.apple.com/DTDs/PropertyList-1.0.dtd">
<plist version="1.0">
<dict>
  <key>defined_types</key>
  <dict>
    <key>*</key>
    <dict>
      <key>name</key>
      <string></string>
    </dict>
    <key>com.adobe.pdf</key>
    <dict>
      <key>name</key>
```

```

        <string>PDF files</string>
    </dict>
    <key>com.apple.applescript.alias-object</key>
    <dict>
        <key>name</key>
        <string>Files/Folders</string>
    </dict>
    <key>com.apple.applescript.alias-object.image</key>
    <dict>
        <key>name</key>
        <string>Image files</string>
    </dict>
    // more defined types here
</dict>
</dict>
</plist>
```

Replace the key-value pairs in the `defined_types` dictionary with your own key-value pairs, deleting the unused ones. The key of each data-type definition is a Uniform Type Identifier in a specific notational form: `com.companyName.applicationName.dataTypeName`. The value of the UTI key is another dictionary containing a key-value pair defining the human-readable name of the data type.

Because Automator displays the strings provided as values to the `name` key in a small area of the action user interface, they should be as short as possible. In addition, the initial letter of the string should be uppercase and every other letter should be lowercase (except for proper names and acronyms).

So if, for example, you have a data type of the Excellent application that you want to define—let's say a spreadsheet worksheet—you might define the following `defined_types` property (assuming the company's name is Acme):

```

<key>com.acme.excellent.worksheet</key>
<dict>
    <key>name</key>
    <string>Excellent worksheets</string>
</dict>
```

An easier and less error-prone alternative to editing the property list in Xcode is to edit it in the Property List Editor application—but only after you have added the XML header information. To open the `definition.plist` file in Property List Editor, Control-click the file in Xcode and select Open In Finder from the contextual menu. (Property List Editor is the default application for XML files.)

Figure 7 Editing the defined types in Property List Editor

| Property List | Class | Value |
|--|------------|--------------------|
| Root | Dictionary | 1 key/value pair |
| defined_types | Dictionary | 24 key/value pairs |
| * | Dictionary | 1 key/value pair |
| com.adobe.pdf | Dictionary | 1 key/value pair |
| com.apple.applescript.alias-object | Dictionary | 1 key/value pair |
| name | String | Files/Folders |
| com.apple.applescript.alias-object.image | Dictionary | 1 key/value pair |

Adding a Localization

This section summarizes the procedure for adding localized strings for a defined data type. For more about internationalization and localization of actions, see [Internationalizing the Action](#) (page 47). To learn more about internationalization in Cocoa generally, read *Internationalization and Localization Guide*.

In Xcode choose New File from the File menu, select the Empty File in Project type, and give the file the name "Localizable.strings". Move the file under the Resources project folder in the Groups and Files list.

Next open the Localizable.strings file in Xcode and, for each data type's name property, add four items in the format shown in [Listing 2](#) (page 106):

- A comment or identifier of the localized word or phrase
- Under the comment, the value of a name key in the `definition.plist` file, quoted; this is the data-type name, used here as a key.
- An equal sign to the right of the data-type name
- The localized equivalent of the data-type name, quoted

Listing 2 Contents of a Localizable.strings file

```
/* worksheet */
"worksheet" = "tableau";
/* graph */
"graph" = "graphique";
```

Next internationalize the Localizable.strings file by assigning it to a certain language folder (that is, one with an extension of .lproj). To do this, select the file in Xcode and choose Get Info from the File menu. Open the General pane of the Info window. If the language of the localization is not listed in the table of current localizations, click Add Localization and type or select a localization (French in the case of the above example). Then select a localization listed in the table.

Automator Action Property Reference

When you develop an action for Automator, one of the steps is specifying the properties of the action in its information property list (see [Specifying Action Properties](#) (page 41)). Automator uses these properties for various purposes, among them determining the types of data the action can accept and produce, setting the initial parameters on the action's user interface, and getting the action's name, icon, associated application, and category. The following sections document the Automator properties and describe the UTI-based type identifiers that you use to specify the types of data an action provides and accepts.

Property Keys and Values

You must specify some of the Automator properties described below in an action project's information property list (`Info.plist`), and optionally may specify the others. The `Info.plist` file in the project template includes, with the exception of `AMRequiredResources`, the Automator properties (with comments for values).

AMAccepts

A dictionary that describes the data that the action will accept. This required property has three subproperties:

- Container—A string that specifies how multiple inputs are passed. Currently this should have the default value (`List`).
- Optional—A Boolean that indicates whether input is optional for this action. If your action can function properly without input, specify `<true/>`; if it requires input, specify `<false/>`. If this property is not specified, Automator assumes a default of `</false>`.
- Types—An array of type identifiers indicating the types of data that your action can accept as valid input.

Example:

```
<key>AMAccepts</key>
<dict>
    <key>Container</key>
    <string>List</string>
    <key>Optional</key>
    <true/>
```

```
<key>Types</key>
<array>
    <string>com.apple.TextEdit.Document-Object</string>
    <string>public.text</string>
    <string>public.item</string>
</array>
</dict>
```

For information on valid type identifiers, including the use of '*' to signify that an action can accept any data type, refer to [Type Identifiers](#) (page 118). See also the corresponding property `AMProvides`.

AMApplication

A string that identifies the primary application that the action uses to do its work. For example, if your action controls the Finder application with AppleScript commands, you would specify "Finder" for this property. Automator uses this property as a filter and as a search criterion. Examples of possible values are Address Book, iCal, and Xcode.

Example:

```
<key>AMApplication</key>
<string>Finder</string>
```

AMCanShowSelectedItemsWhenRun

A Boolean that controls whether the action allows the presentation of selected parts of its user interface for the Show When Run feature. If this property is set to `<true/>` (the default), the parts of the action's view (either automatically or manually generated) appear as items in the table view exposed under the Options button. If it is set to `<false/>`, only the "Show Action When Run" check box is presented (assuming that the `AMCanShowWhenRun` property is set to `<true/>`).

AMCanShowWhenRun

A Boolean that controls whether the Show When Run feature is enabled for the action. By default, it is set to `<true/>`, causing the Options button to be displayed in the lower-left corner of the action view. When the button is clicked, the view is extended to expose a "Show Action When Run" check box and, optionally, controls for selecting parts of the action view to present to work flow users (see the description of `AMCanShowSelectedItemsWhenRun`). Setting the `AMCanShowWhenRun` to `<false/>` removes the Options button from the action view.

AMCategory

A string (or array of strings) that Automator uses to group the action with similar actions in terms of their effects or the objects they operate on. Automator presents categories in its user interface and also uses an action's category as a search criterion.

Note: Automator does not show categories in its user interface in OS X version 10.4, though it does use them in searches.

In OS X v10.4, category names were simply strings (or arrays of strings), with values such as Find, Music, Pictures, System, Terminal, Text, and Utility. You could also specify names for new categories.

Example (OS X v10.4):

```
<key>AMCategory</key>
<string>Pictures</string>
```

Starting in OS X v10.5, category names represent codes (or arrays of codes), and you should use the code names shown in [Table 1](#) (page 110).

Example (OS X v10.5):

```
<key>AMCategory</key>
<string>AMCategoryPhotos</string>
```

For actions brought forward from OS X v10.4, Automator will attempt to categorize the action appropriately. For example, an action with the category name of "Power Point" will be placed in the Presentations category (AMCategoryPresentations). An action with an unrecognized category name will be placed in the generic Other category.

If you rebuild an older action in OS X v10.5 without changing the category name value, it will still build and work, but you will get a warning from `amlint` that you are not using one of the predefined values.

An action compiled in OS X v10.5 will not work in v10.4 due to binary incompatibility.

Table 1 AMCategory code names available in OS X version 10.5

| Code name | Category |
|--------------------|----------|
| AMCategoryCalendar | Calendar |
| AMCategoryChat | Chat |
| AMCategoryContacts | Contacts |

| Code name | Category |
|---------------------------|-------------------|
| AMCategoryDeveloper | Developer |
| AMCategoryDocuments | Documents |
| AMCategoryFilesAndFolders | Files and folders |
| AMCategoryFonts | Fonts |
| AMCategoryInternet | Internet |
| AMCategoryMail | Mail |
| AMCategoryMovies | Movies |
| AMCategoryMusic | Music |
| AMCategoryPDFs | PDF files |
| AMCategoryPhotos | Photos |
| AMCategoryPresentations | Presentations |
| AMCategorySystem | System |
| AMCategoryText | Text |
| AMCategoryUtilities | Utilities |

AMDefaultParameters

A dictionary containing default values for the user-interface elements managed by Cocoa bindings. The keys are the names of the user-interface elements entered as attributes of the Parameters instance (`NSObjectController`) in Interface Builder. The values should be contained in elements identifying the type of data; boolean is used for check boxes, integer for pop-up item index, and string for text fields. This property is required for actions that have parameters.

Example:

```
<key>AMDefaultParameters</key>
<dict>
    <key>fromChoice</key>
    <integer>1</integer>
    <key>replaceExisting</key>
    <boolean>No</boolean>
```

```
<key>toChoice</key>
<integer>0</integer>
<key>toDirectory</key>
<string></string>
</dict>
```

AMDescription

A dictionary that specifies the content of an action description, which appears in the lower-left view of Automator when the action is selected. The description's icon and title are derived from the `AMIconName` and `AMName` properties, respectively. The `AMDescription` dictionary has the following keys (the values for which are all strings):

- `AMDSummary`—A succinct description of what the action does. It appears directly under the action title. This text is required.
- `AMDIInput`—The types of data the action accepts. If this subproperty is not specified, Automator uses default text corresponding to the type identifiers specified for `AMAccepts`. The subheading “Input:” precedes this text in the displayed description.
- `AMDResult`—The types of data the action provides. If this subproperty is not specified, Automator uses default text corresponding to the type identifiers specified for `AMProvides`. The subheading “Result:” precedes this text in the displayed description.
- `AMDOptions`—Describes what can be set in the action’s user interface. The subheading “Options:” precedes this text in the displayed description. Use this subproperty only for explaining aspects of the action’s user interface that aren’t readily apparent.
- `AMDAAlert`—Points out an important possible consequence of the action, such as overwriting a file. The subheading “Alert:” precedes this text in the displayed description.
- `AMDNNote`—Additional information that the user should know (but not as critical as an alert). The subheading “Note:” precedes this text in the displayed description.
- `AMDRequires`—Anything this action requires in order to work properly, such as a web page displayed or a local printer connected. The subheading “Requires:” precedes this text in the displayed description.
- `AMDRelatedActions`—Specify the bundle IDs of actions that are especially related to this action. (You can look at the `Info.plist` file inside an action bundle to find out its bundle ID.) There can be at least three kinds of relationships among actions based on what function they perform:
 - **Connected function:** the actions are likely to be used in the same workflow, such as `New Message` and `Send Outgoing Messages`.

- Parallel function: the actions perform the same general task, but in slightly different manners or using different applications, such as Send Mail Message and Send iChat Message.
- Opposing function: one of the actions undoes an effect of the other one, such as Connect to Servers and Eject Disk.

Example:

```
<key>AMDescription</key>
<dict>
    <key>AMDInput</key>
    <string>Project file from the previous action.</string>
    <key>AMDOptions</key>
    <string>Set, retrieve, increment, tag, submit, get
        marketing version, set marketing version. </string>
    <key>AMDResult</key>
    <string>Pass information to next action or to a log
        file.</string>
    <key>AMDSummary</key>
    <string>This action changes the version information of
        an Xcode project. It uses the agvtool shell tool, and
        allows you to set most all of the options of that
        tool.</string>
</dict>
```

AMIconName

In OS X version 10.4, this is a string that specifies a file that contains the 16-by-16 pixel icon that Automator displays to the left of the action name in its user interface. The icon name string should not include the extension, but the file itself must have an extension of .tiff. It can refer to an icon file in Automator or to a custom icon file in the action bundle.

Example:

```
<key>AMIconName</key>
<string>MyApp</string>
```

Also in OS X v10.4, you can store in the action bundle a large (32-by-32 pixel) version of the same icon for Automator to display in the action description. This icon file should have a name of the form

NameLarge.tiff. In the property example above, this file would have a name such as *MyAppLarge.tiff*.

Starting in OS X v10.5, the icon name string can refer to an image file in any of the basic formats that Cocoa supports, such as Icon File, TIFF, JPEG, and PNG, with all the standard variations of filename extensions (.icns, .tiff, .tif, .jpg, .jpeg, and so on). As in the earlier version, you don't include the extension as part of the icon name. You can supply both a 16-by-16 and a 32-by-32 pixel icon in the same image file. For backward compatibility, the use of .tiff files is still supported, and you must supply icons in the previously described format for an action that needs to work in earlier versions of the OS.

AMKeywords

An array of strings that give Automator keywords for identifying the action in searches. Keywords are not shown in the Automator user interface but are used in searches. Note that Automator automatically uses words in the names of actions as keywords, so there is no reason to repeat them in this property. Examples keywords are Change, Folder, and Label.

Example:

```
<key>AMKeywords</key>
<array>
  <string>Add</string>
  <string>Spotlight</string>
  <string>File</string>
</array>
```

AMName

A string giving the name of the action to be displayed in the Automator user interface. This property is required. Example names are “Add Attachments to Front Message,” “Copy Files,” and “Profile Executable.”

Example:

```
<key>AMName</key>
<string>Copy Files</string>
```

See the guidelines for naming actions in [Design Guidelines for Actions](#) (page 26).

AMProvides

A dictionary that describes the data that the action will generate as output. This required property has two subproperties:

- Container—A string that specifies how multiple outputs are passed. Currently this should have the default value (List).

- **Types**—An array of type identifiers indicating the types of data that your action can provide as valid input.

Example:

```
key>AMProvides</key>
<dict>
    <key>Container</key>
    <string>List</string>
    <key>Types</key>
    <array>
        <string>public.item</string>
    </array>
</dict>
```

For information on valid type identifiers, refer to [Type Identifiers](#) (page 118). See also the corresponding property **AMAccepts**.

AMRequiredResources

An array of dictionaries that describes the applications, files, or other resources that the action requires to work properly. If the specified resource is not available when the bundle is loaded, Automator warns the user. If the resource is not available when the action's workflow executes, Automator asks the user locate the missing resource. If the user does not find the resource, the workflow stops executing. This property has four subproperties for each dictionary:

- **Display Name**—A string that identifies the name of the resource as displayed in Finder, for example “iPhoto”. Leave this value blank if the Type key is set to “file”.
- **Resource**—A string identifying the required resource. The format of the resource is indicated by the Type subproperty (see note below).
- **Type**—A string indicating the type of the resource identifier given as the value of Resource: “application”, “creator code”, or “file”.
- **Version**—A string specifying the minimum version of the resource required by the stage in *n.n.n* format (for example, “4.0.1”).

Note: The value for the Resource dictionary key depends on the value for Type. If the type is “application”, the resource is specified by the application’s bundle identifier; if the type is “creator code”, the resource is specified by a four-character creator code; if the type is “file” the resource is specified by full file-system path.

Examples:

```
<key>AMRequiredResources</key>
<array>
    <dict>
        <key>Display Name</key>
        <string>iTunes</string>
        <key>Resource</key>
        <string>com.apple.iTunes</string>
        <key>Type</key>
        <string>application</string>
        <key>Version</key>
        <string>4.6</string>
    </dict>

    <dict>
        <key>Display Name</key>
        <string></string>
        <key>Resource</key>
        <string>/usr/bin/otool</string>
        <key>Type</key>
        <string>file</string>
        <key>Version</key>
        <string>10.3.5</string>
    </dict>
</array>
```

AMWarning

If the action can potentially lose data, specify in this dictionary a set of subproperties that cause Automator to display a warning when the action is added to a workflow. The information in the warning comes from the AMWarning subproperties. Optionally, this property can allow the user to insert another action before this one to protect against data loss. A common warning in Automator adds the Copy Files action before the current action. As a result, the action alters copies of files rather than the originals. This property is required but only the value for the Level key needs to be specified (and is set to a default of 0 in the project templates).

- Action—A string that specifies the bundle identifier of an action to be inserted (if the user agrees) in the workflow before this action. Leave this value blank if you just want to warn the user. If you do not specify a value for this key, the ApplyButton string is used for the button title but the IgnoreButton value is ignored.
- ApplyButton—A string that is the title for the button that adds the proposed action or, if no action is specified, that continues the workflow. Examples are “Add” and “Continue”.
- IgnoreButton—A string that is the title for the button for rejecting the proposed action or, if no action is specified, for canceling the workflow. Examples are “Don’t Add” and “Cancel”.
- Level—An integer that specifies the level of the warning:
 - 0: Safe operation (default)
 - 1: Makes reversible changes, for example Flip Images
 - 2: Makes irreversible changes, for example Crop Images

This is the only required value of the AMWarning dictionary. If you specify level 1 or 2 you must also specify a Message string.

- Message—A string that is the warning presented to users in the sheet.

The following example shows an AMWarning property that simply warns the user without offering a prior action:

```
<key>AMWarning</key>
<dict>
    <key>Action</key>
    <string></string>
    <key>ApplyButton</key>
    <string>Continue</string>
    <key>IgnoreButton</key>
    <string>Cancel</string>
    <key>Level</key>
    <integer>2</integer>
    <key>Message</key>
    <string>This action will update the connected iPod. It cannot be
undone.</string>
```

In this example, the property proposes a prior action:

```
<key>AMWarning</key>
```

```
<dict>
    <key>Action</key>
    <string>com.apple.Automator.CopyFiles</string>
    <key>ApplyButton</key>
    <string>Add</string>
    <key>IgnoreButton</key>
    <string>Don't Add</string>
    <key>Level</key>
    <integer>2</integer>
    <key>Message</key>
    <string>This action will change the image files passed into it. Would
you like to add a Copy Files action so that the originals are preserved?</string>
```

Type Identifiers

The Automator AMAccepts and AMPProvides properties use type identifiers to specify the types of data for action inputs and outputs. Automator uses the text in the Description column in Table 2 and Table 4 in its user interface to designate the types of input data and output data for the actions in a workflow.

Note: Although the type identifiers described below are based on Uniform Type Identifiers (or UTIs), you can use any string as an identifier. However, such private identifiers have severely limited usefulness in a workflow because actions from Apple and other sources cannot have any knowledge of them. You can, however, create conversion actions for converting the data indicated by the private identifier to and from data indicated by public type identifiers.

You can also use '*' as a type identifier. It has the meaning that any data type is acceptable, including Cocoa objects and AppleScript objects, and no conversions will be performed. By comparison, if you use the type 'com.apple.applescript.object', Automator will show the user-readable label of "anything," but it actually represents only objects in the AppleScript domain, such as Mail messages and iPhoto photos.

Automator actions can use public type identifiers in three categories. The first is specific to the technologies or applications of Apple. Table 2 lists the current identifiers in this category.

Table 2 Type identifiers internally defined by Apple

| Type Identifier | Description |
|--|------------------------------------|
| com.apple.applescript.object | Object (in the AppleScript domain) |
| com.apple.applescript.data-object | Data |
| com.apple.applescript.url-object | URL |
| com.apple.applescript.text-object | Text |
| com.apple.applescript.alias-object.pdf | PDF files |
| com.apple.applescript.alias-object.movie | QuickTime movie files |
| com.apple.applescript.alias-object.image | Image files |
| com.apple.applescript.alias-object | Files/Folders |
| com.apple.finder.file-or-folder-object | Finder file or folder |
| com.apple.idvd.menu-object | iDVD menu |
| com.apple.idvd.slideshow-object | iDVD slideshow |
| com.apple.ipho.item-object | iPhoto item |
| com.apple.ipho.album-object | iPhoto album |
| com.apple.ipho.photo-object | iPhoto photo |
| com.apple.itunes.item-object | iTunes item |
| com.apple.itunes.source-object | iTunes source |
| com.apple.itunes.playlist-object | iTunes playlist |
| com.apple.itunes.track-object | iTunes track (song) |
| com.apple.safari.document-object | Safari document |
| com.apple.textedit.document-object | TextEdit document |
| com.apple.mail.item-object | Mail item |
| com.apple.mail.message-object | Mail message |
| com.apple.mail.mailbox-object | Mail mailbox |

| Type Identifier | Description |
|-------------------------------------|---------------------|
| com.apple.mail.account-object | Mail account |
| com.apple.addressbook.item-object | Address Book item |
| com.apple.addressbook.group-object | Address Book group |
| com.apple.addressbook.person-object | Address Book person |
| com.apple.ical.item-object | iCal item |
| com.apple.ical.event-object | iCal event |
| com.apple.ical.calendar-object | iCal calendar |
| com.apple.ical.todo-object | iCal to do |

A special subset of the type identifiers defined by Apple are those reserved for Objective-C actions, which are described in Table 3.

Table 3 Objective-C type identifiers

| Type identifier | Description | Comments |
|------------------------|-------------|---|
| com.apple.cocoa.path | File | An NSString object representing a POSIX-style path. |
| com.apple.cocoa.url | URL | An NSURL object representing a URL |
| com.apple.cocoa.string | Text | An NSString object. |

The final category of type identifier includes externally defined UTIs. Table 4 lists these public identifiers.

Table 4 Externally defined type identifiers

| Type identifier | Comments |
|-----------------|------------|
| public.data | Data |
| public.url | URL |
| public.text | Text |
| public.image | Image file |

| Type identifier | Comments |
|---------------------------|-----------------|
| public.item | File/Folder |
| com.apple.quicktime-movie | QuickTime movie |

You can convert between type identifiers—and most importantly between externally and internally defined identifiers—using a special kind of action called a conversion action. See [Creating a Conversion Action](#) (page 95) for details.

Document Revision History

This table describes the changes to *Automator Programming Guide*.

| Date | Notes |
|------------|---|
| 2007-12-11 | <p>Added information about specifying action input and output, and about bringing Tiger actions forward to Leopard.</p> <p>In the section Action Input and Output (page 26), updated information about actions that don't require input and don't supply output.</p> <p>In the section Property Keys and Values (page 108), in the description for the key <code>AMCategory</code>, removed the incorrect statement that Automator generates a log warning for actions brought forward to Leopard (OS X version 10.5) from Tiger (v 10.4).</p> <p>For HTML version, added TOC links to additional class and constant reference documents. For all versions, added document links to See Also section in Introduction to Automator Programming Guide (page 9).</p> |
| 2007-07-22 | <p>Added several debugging tips.</p> <p>See Frequently Asked Questions About Debugging Automator Actions (page 55).</p> <p>Documented the revised category values for <code>AMCategory</code> in Property Keys and Values (page 108).</p> <p>Clarified the usage for <code>AMIconName</code> in Property Keys and Values (page 108), including new behavior supported in OS X version 10.5.</p> |
| 2006-09-05 | <p>Clarified usage of <code>AMWarning</code>, <code>AMAccepts</code>, and <code>amlint</code>, and corrected a typo in listing "Reporting a fatal error to Automator."</p> <p>The section Debugging and Testing Shell Script Actions (page 92) now describes where to view error information on an error exit from a shell action.</p> |

| Date | Notes |
|------------|--|
| 2006-02-07 | Added information on actions as Universal Binaries to "Automator and the Developer." |
| 2005-09-08 | Various bug fixes. |
| 2005-08-11 | Added "Defining Your Own Data Types" and fixed several bugs. |
| 2005-07-07 | Added section on programming implications of loadable bundles; fixed bugs. |
| 2005-06-06 | Updated with information about new development features introduced in Xcode 2.1, including the shell script action. |
| 2005-04-29 | New document that explains how to create actions--loadable bundles that perform discrete tasks--for the Automator application. |



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