CogTool 1.0b18 Tutorial

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Human-Computer Interaction Institute
School of Computer Science
Carnegie Mellon University

Contributors to the CogTool Project

Bonnie E. John
Gus Prevas
Peter Centgraf
Ken Koedinger
Dario Salvucci
Sandy Esch
Alex Eiser
Mike Horowitz
Leonghwee Teo
Jason Cornwell
Don Morrison
Samantha Konwinski
Alex Faaborg
Carmen Jackson
Lily Cho

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Conventions For This Tutorial

NOTES about CogTool 1.0b18:
This document is about CogTool 1.0b18, but other releases will follow. When some behavior is specific to CogTool 1.0b18 and is expected to change in a future release, a note appears in a gray box like this one.

!!! KNOWN BUGS in CogTool 1.0b18:
When there is a known bug in CogTool 1.0b18, it is indicated with a note in a yellow box like this one.

This tutorial demonstrates an example of using CogTool to make a prediction. Therefore, it discusses only the aspects of CogTool that are necessary for completing this example. If you have additional questions, please consult the full *CogTool User Guide*.

Terms in this guide that are **CAPITALIZED** (in this fashion) refer to the items that are created and edited in CogTool. If the conventional English definition is intended, the words will have no special formatting.

System Requirements

CogTool is a cross-platform application. Unless otherwise noted, instructions are identical whether CogTool is running on Mac OS X or Windows-based computers. Screen images of CogTool in this guide are taken from a Macintosh; only minor visual differences exist between these images and the PC.

CogTool is compatible with MacOS X 10.4 and above including Intel Macs (i.e., those shipped after December 2005). It is also compatible with Microsoft Windows XP. CogTool will function on older versions of Windows (down to Windows 98) but requires the GDI+ library, which you can install from Microsoft at

http://www.microsoft.com/msdownload/platformsdk/sdkupdate/psdkredist.htm

Table of Contents

1 CogTool Overview

1.1 What does CogTool do for me?

Predicts execution time of a skilled user.

CogTool predicts total execution time for a skilled user performing a particular sequence of actions on a system.

The predictions made by CogTool are based on a psychological theory of human cognitive and motor capabilities, called the Keystroke-Level Model (KLM), which has been used and validated repeatedly by academics and practitioners since 1980 (Card, S. K., Moran, T. P., & Newell, A. The keystroke-level model for user performance time with interactive systems. *Communications of the ACM, 23* (7), (1980) 396-410). CogTool automates the application of KLM to specific problems, providing an alternative to time-consuming and expensive user testing.

CogTool can only predict what KLM can predict, that is, execution time for a skilled user of a system. It cannot predict learning time, problem-solving paths, or user satisfaction with a system. It also cannot predict the path of hurricanes.

Produces a "reusable" design mock-up that is as useful for user testing with novices as it is for predicting skilled performance time

When you use CogTool to predict skilled performance time, you create a storyboard of a system design that can be exported to HTML and used in user tests. A discussion of multi-purpose prototypes can be found in; John, B. E. & Salvucci, D. D. (2005) Multi-Purpose Prototypes for Assessing User Interfaces in Pervasive Computing Systems. *IEEE Pervasive Computing 4*(4), 27-34.

1.2 How do I make it work?

This section gives a brief overview of the stages of using CogTool. Subsequent sections will explain each item in more detail.

Install and Launch CogTool

This guide assumes that you have downloaded and installed CogTool 1.0b18 from http://www.cogtool.org/download.html. If you have not yet done so, please visit the Download page of the CogTool website and follow the instructions now. Sections 2.1 and 2.2, provides more details.

Create a PROJECT

In CogTool, a **PROJECT** is the center of your work and contains the user interface **DESIGN** and the **TASK** for which you would like to make predictions. Therefore, the first step in working with CogTool is to create a **PROJECT**. Section 2.3 has more information on how to work with **PROJECT.**

Create a DESIGN Storyboard

The interfaces that you want to make predictions about are expressed in storyboards**.** Sections 2.5 thru 2.8 describe how to create a storyboard for the interface **DESIGN** upon which **TASKS** will be performed.

Define TASKS

Once the storyboard for your **DESIGN** has been created, you will define a set of **TASKS** whose performance you would like to predict. Section 3 of this guide will show how to create **TASKS** and use **TASK GROUPS** to organize them.

Record a SCRIPT

The steps a user would perform to accomplish a **TASK** are recorded in **SCRIPTS.** Section 3.1 shows how to record a **SCRIPT** of specific user actions by demonstrating them on the **DESIGN** you created in Sections 2.5 thru 2.8. Once the **SCRIPTS** are defined, CogTool will make its predictions.

Rinse, Repeat!

Creating a **DESIGN**, a set of **TASKS**, and **SCRIPTS** is the starting point for creating new **DESIGNS**, exploring different **TASKS**, and comparing the predictions. With a basic familiarity with CogTool, you now have a great new tool for improving your user interface designs. Section 4 discusses best practices and helpful tips for getting the most out of CogTool.

1.3 The Example: ChoiceWay™ Guide to New York City for Palm OS®

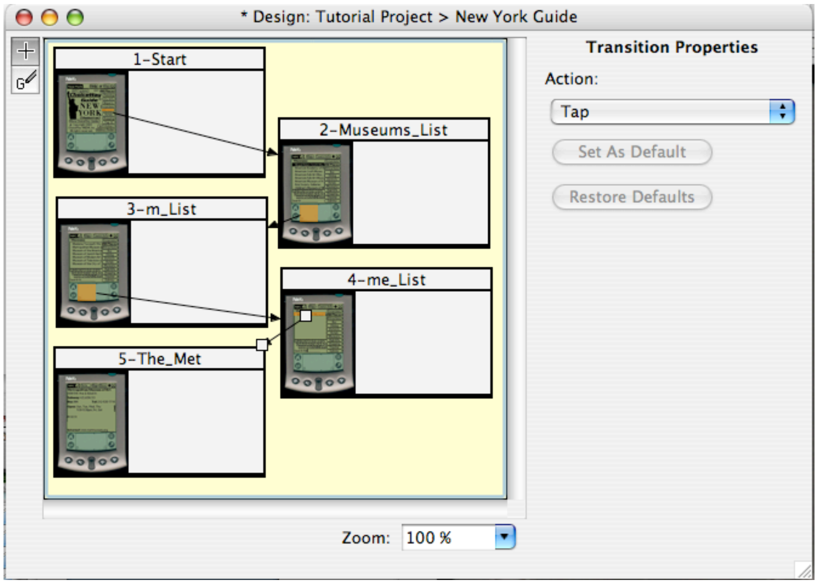
To help guide you through the process of using CogTool, we will be working with an example user interface: the ChoiceWay™ Guide to New York City for Palm OS®. This software provides a directory of attractions in New York City for Palm OS®-based handheld devices. The storyboard and tasks are adapted from those used by Luo and John in their 2005 paper.[1] This tutorial will show how to predict the performance time for two simple tasks using that interface: looking up the stored information for the Metropolitan Museum of Art.

[1] Luo, L. & John, B. (2005) Predicting task execution time on handheld devices using the keystroke-level model. Proceedings of CHI, 2005 (Portland, OR, April 2-7, 2005) ACM, New York.

2 Creating a DESIGN storyboard

The first step of working with CogTool is to create a storyboard of a user interface design. This storyboard will show the individual screens of the user interface, the interactive elements on those screens, and the user actions that trigger changes from one screen to another. In CogTool, a storyboard like this is referred to as a **DESIGN**.

In this tutorial, we will be building a **DESIGN** that is sufficient to demonstrate one specific **TASK**. Here is a zoomed-out view of what our final storyboard will look like: (Figure 1)



Action: Tap

Zoom: 100 %

Figure 1. Storyboard for the ChoiceWay™ Guide to New York City that illustrates a museum look-up task (the subject of this tutorial).

The **TASK** will be to lookup information about the Metropolitan Museum of Art in the ChoiceWay™ Guide to New York City for Palm OS®, using these steps:

1. Tap the button labeled "Museums" on the first screen of the ChoiceWay™ Guide to New York City
2. Use Graffiti® to enter the characters "m" and "e" into a live search field.
3. Tap the list item labeled "Metropolitan Museum of Art"

2.1 Prepare Tutorial Materials

Before we begin work, let's gather some materials that we'll need. The link below leads to a zip format archive containing screen captures of the interface we'll be mocking up. Download the archive to your computer and expand the contents. On the Macintosh, some browsers will automatically expand downloaded archives. Otherwise, simply double-click the archive to expand it. A folder containing JPG-format image files should be created at the same location as the saved archive. On Windows, you may need to use a zip archive utility such as WinZip to expand the archive. On Windows XP, you may double-click the archive to expand it. Remember where the archive has been expanded, because we will need the contents later in this section.

http://www.cogtool.org/software/tutorial-images.zip

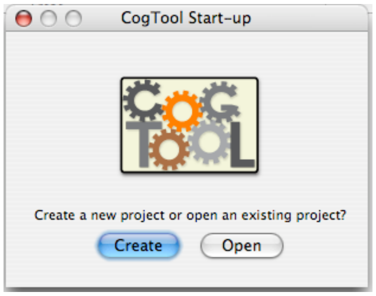
2.2 Launch CogTool

Open the CogTool application that you've previously installed. If you haven't installed it yet, follow the instructions at http://www.cogtool.org/download.html. If you are working on a Windows-based PC, CogTool should have a folder in the Start Menu. If you are working on Mac OS X, CogTool will be wherever you placed it after extracting it from the download archive.

2.3 Create a PROJECT

A **PROJECT** contains the user interface **DESIGNS**, the **TASKS** being studied and the **SCRIPTS** that define the performance being predicted. A **PROJECT** is a center of work. All the parts necessary for CogTool to make performance predictions is kept in a **PROJECT** file. The **PROJECT** name is also the name of the .cgt file that is created by CogTool. You are asked to name the **PROJECT** file at the first Save.

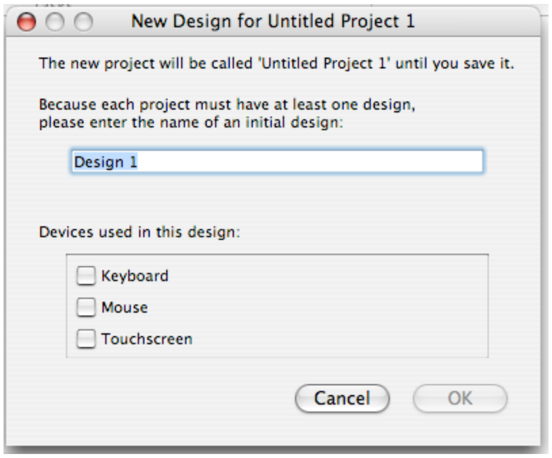
When you launch CogTool, a dialog box appears and gives you the choice of creating a new **PROJECT** or opening an existing one (Figure 2). To follow the tutorial click the "Create" Button.



Create a new project or open an existing project?

Figure 2. The CogTool Start-up box that appears when CogTool is launched

Since all **PROJECTS** must have at least one **DESIGN** a New Design dialog box will appear asking you to "Please enter the name of an initial design" and the default name will be highlighted ready for you to type in a more appropriate name. (**Figure 3**)



The new project will be called 'Untitled Project 1' until you save it.

Because each project must have at least one design,
please enter the name of an initial design:

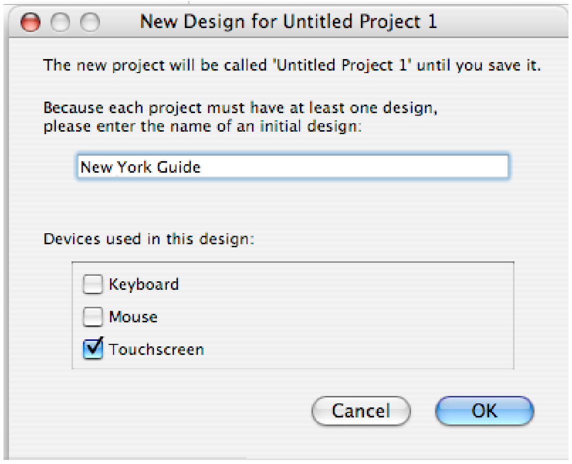
Design 1

Devices used in this design:

□ Keyboard
□ Mouse
□ Touchscreen

Figure 3.The New Design box that appears when a new PROJECT is created.

You may choose any name you wish. For the tutorial, we used “New York Guide.” This dialog box also asks which devices will be used with the **Design**. In this case, the **Design** is for a Palm®, so the only device needed to be checked is the touch screen device. Confirm your choice by pressing “OK” or hitting the enter key



The new project will be called 'Untitled Project 1' until you save it.

Because each project must have at least one design,
please enter the name of an initial design:

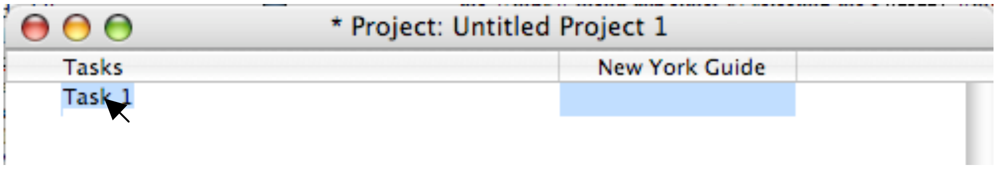
New York Guide

Devices used in this design:

- □ Keyboard
- □ Mouse
- ☑ Touchscreen

Figure 4. “New York Guide” appears as the Design **name**

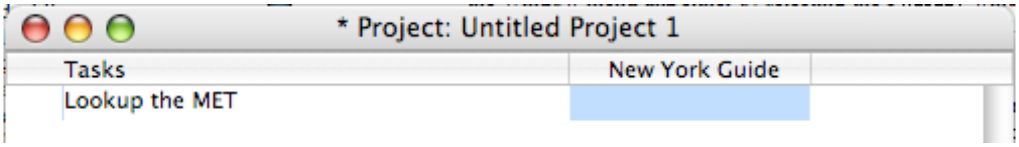
The new **Design** appears as a new column in the **Project** window with the name you specified (Figure 5). Since all **Designs** must have at least on **Task,** a new **Task** is also created with a default name highlighted and ready for a more appropriate name to be entered.



Task 1

Figure 5. Design **name “New York Guide” appears as a column heading. “Task 1” is highlighted and ready for a new name.**

To follow the tutorial call the first task “Lookup the MET” (Figure 6).



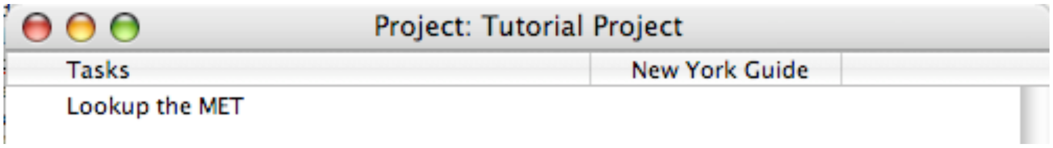
Lookup the MET

Figure 6. “Lookup the MET” appears as a Task **name.**

2.4 Save the Project

Now save the **Project** by selecting the “Save” command in the “File” menu. A standard Save dialog box comes up to ask for a file name and location. Call this file “Tutorial Project.cgt”. You’ll notice that the file name (without the extension) now appears in title bar of all windows associated with this **Project** (Figure 7).

When a **PROJECT** has been changed from a saved state, an asterisk appears in each window title bar. For example, Figure 6 was before we saved the project, and it has an asterisk; Figure 7 shows the window after we saved the project and there is no asterisk.



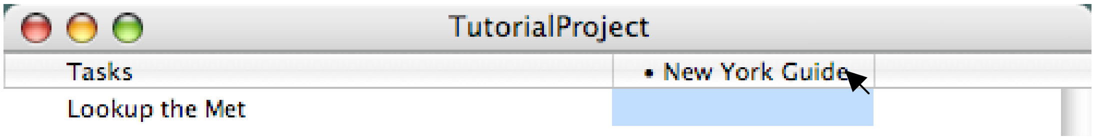
Project: Tutorial Project

Tasks	New York Guide
Lookup the MET	

Figure 7. The PROJECT has been saved as "TutorialProject". Notice that no asterisk appears in the window title.

2.5 Open the DESIGN

Now you must open the **DESIGN** so you can create the **DESIGN** storyboard for the New York Guide. You may double-click on the name of the **DESIGN**, or you may click on the name once to select it and then choose the "Edit" command from the "Edit" menu, or select "Edit" from the **DESIGN** name's contextual menu. The **SCRIPT** cell below the **DESIGN** name will highlight, and a dot will appear next to the **DESIGN** name, to show that the **DESIGN** is selected (Figure 8).



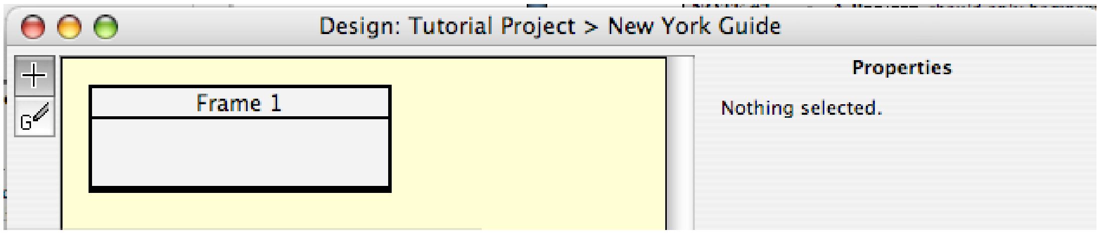
TutorialProject

Tasks	• New York Guide
Lookup the Met	

Figure 8. The "New York Guide" DESIGN has been selected, which is indicated by the dot next to the DESIGN name.

2.6 Add FRAMES

When the new **DESIGN** window opens a new **FRAME** is automatically created (Figure 9).



Design: Tutorial Project > New York Guide

Nothing selected.

Figure 9. The DESIGN window for the "New York Guide" DESIGN has a single FRAME automatically placed in it

At this point, we could add content to Frame 1 and add new **FRAMES** one at a time. However, we know we are going to have five **FRAMES** in the "New York Guide" **DESIGN** and already have images that we want to place inside the **FRAMES**. Adding each **FRAME** one at a time would be slow, but we can use the "Import Frame Background Images" command to automatically create a **FRAME** for each image in the folder and place the image in the **FRAME** as the background. Select the "Modify" menu, then the "Import Frame Background Images" from the drop down list (Figure 10)

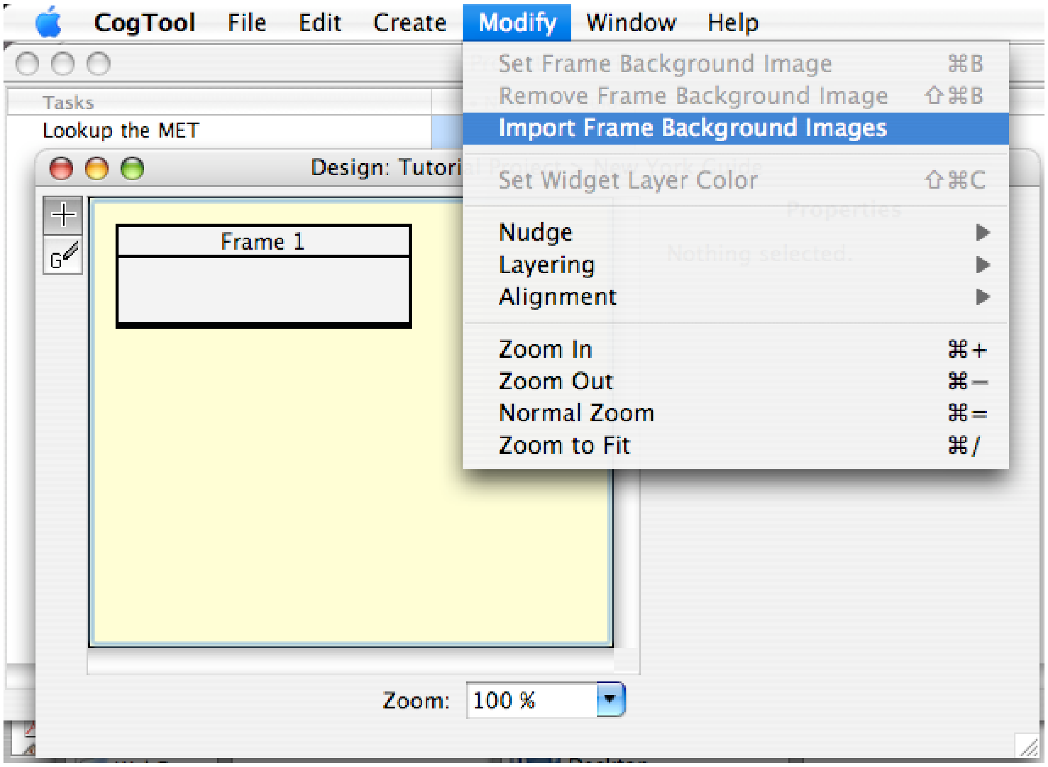
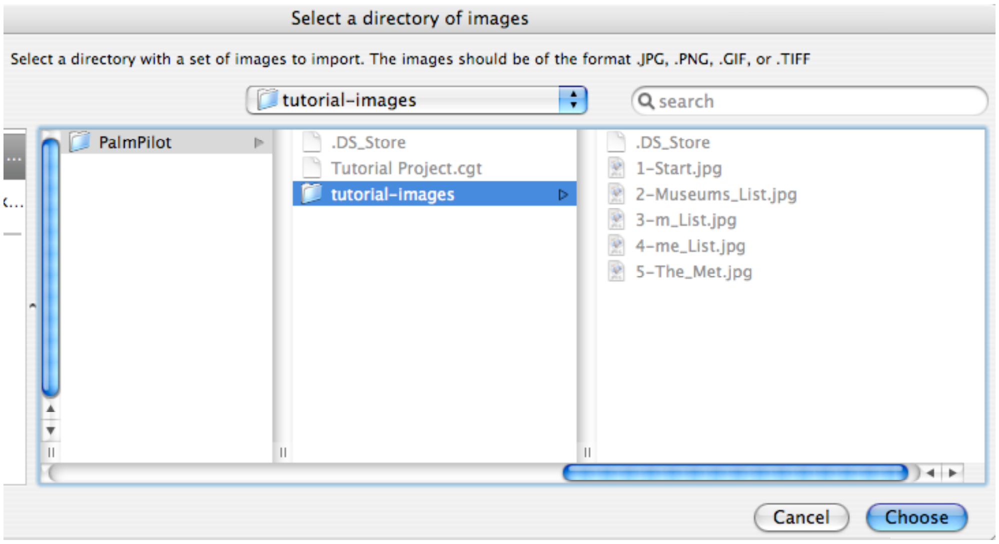


Figure 10. Selecting the "Import Frame Background Images" command from the Modify menu in the "New York Guide" DESIGN window.

Navigate through the "Select a directory of images" dialog box to the "tutorial-images" folder you down loaded (See 2.1 Prepare Tutorial Materials). Select the folder and then hit the "Choose" button (Figure 11).


Select a directory of images

Select a directory with a set of images to import. The images should be of the format .JPG, .PNG, .GIF, or .TIFF

Figure 11. "Select a directory of images" dialog box for importing background images from a folder into FRAMES.

Your "New York Guide" DESIGN window should appear as in Figure 12.

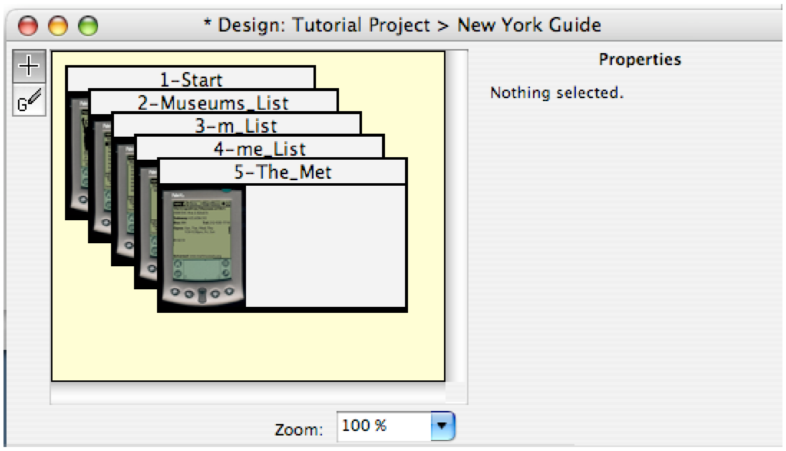


Figure 12. The "New York Guide" DESIGN window after the "tutorial-images" files were imported as background images for new FRAMES.

KNOWN BUG #1. When **FRAMES** are stacked, the stacking order is mysterious and may even seem to change over time. Work around: move the **FRAMES** apart so they are not stacked.

You will need to see each **FRAME** in its entirety so it'll be necessary to move the **FRAMES** apart. Simply press the left mouse button inside the body of a **FRAME**, drag the mouse to the new location, and release the mouse button. Make your **DESIGN** window resemble Figure 13.

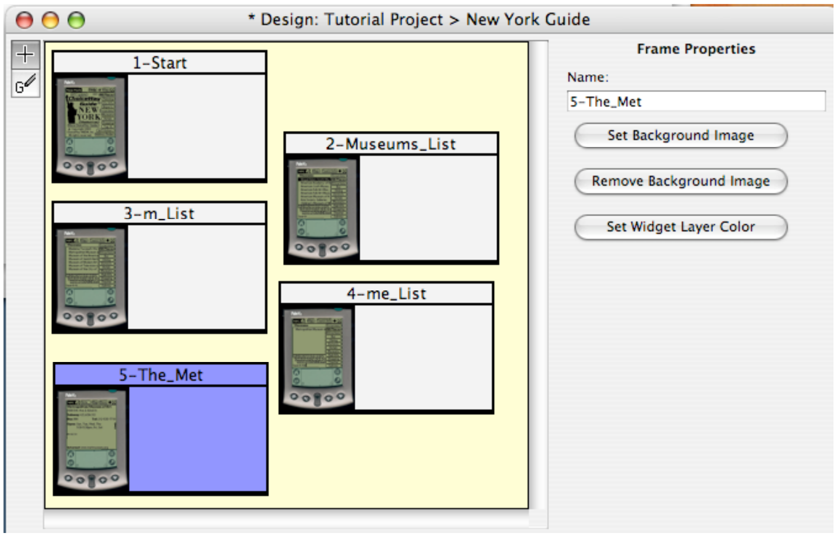
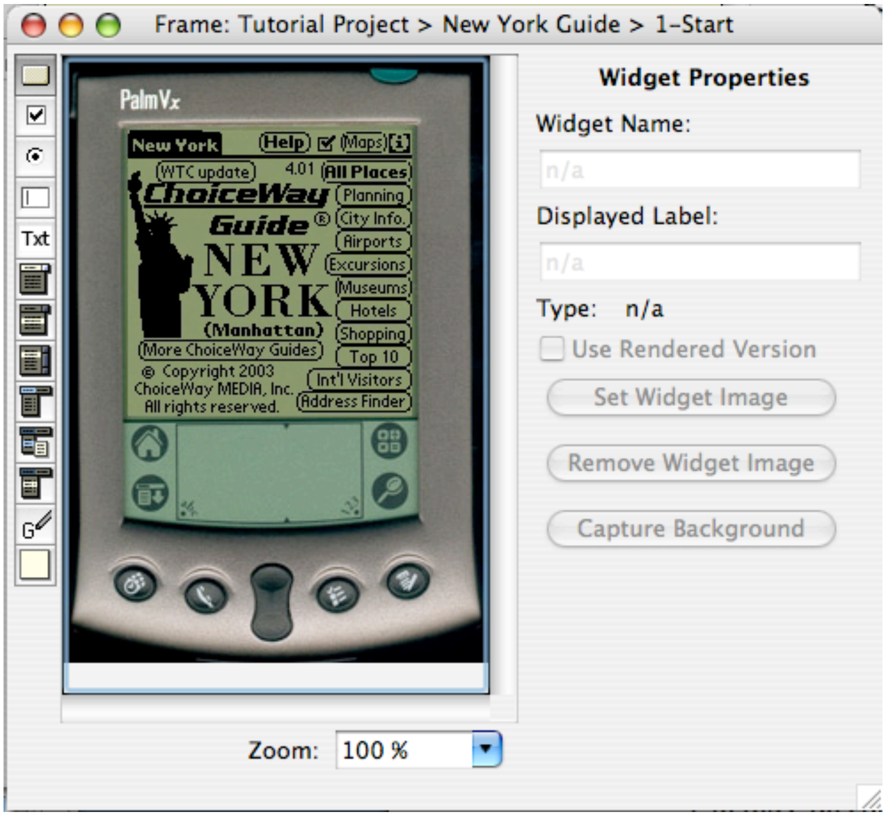


Figure 13. "New York Guide" DESIGN window after five FRAMES have been created using the "Import Background Frame Images" command and have been rearranged so that the entirety of each FRAME could be seen.

2.7 Define WIDGETS

In order to interact with your **DESIGN** storyboard, you must define **WIDGETS** on each **FRAME** for each interface element that the user would manipulate in a **TASK**, e.g. buttons, check boxes, radio buttons, or menus. In CogTool, a WIDGET is a "hot-spot" that you create in a FRAME to indicate the area that is interactive on the actual physical device.

In this tutorial, the first step of our TASK is to tap the "Museum" button on the FRAME called "1-Start". Therefore, we need to define a WIDGET for the "Museums" button. (In general, there is no need to create WIDGETS for every element of the original interface, only for those needed for the tasks you want to investigate.) On the screen shot of the PalmPilot the area on the screen under the words "Museum" is the area our first WIDGET is to represent. To create the WIDGET, open FRAME "1-Start" by double clicking on the FRAME in the DESIGN window (Figure 14).


Frame: Tutorial Project > New York Guide > 1-Start

Widget Properties

Widget Name: n/a

Displayed Label: n/a

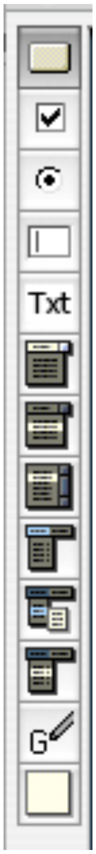
Type: n/a

☐ Use Rendered Version

Zoom: 100 %

Figure 14. FRAME 1_Start. The WIDGET toolbar is along the left side. The FRAME on which to place WIDGETS is in the center (in this case, it has the first screen of the New York Guide Palm application as its background). The WIDGET property pane is on the right side (it is grayed out in this figure because no WIDGET is selected).

It is important to select the proper type for a WIDGET so that CogTool can make accurate predictions. The type is based on its function in the interface. Different values are used for different types of user interface elements, such as the "List Box Item" type for each row of a list box, the "Menu" type for the menu header in a menu bar, the "Menu Item" type for individual menu items, and the "Pull-Down List" and "Pull-Down Item" types for interface elements that allow you to select a single item from a list of items (sometimes referred to as a "combo box"). See Table 1 in the CogTool Users Guide for a list of the WIDGETS supported by CogTool and guidelines for when to use each WIDGET.



Button

Checkbox

Radio Button

Text Box

Text itself, e.g. text you would select to delete or copy

Pull-Down List (when it is closed, interacting with this widget opens it)

Pull-Down List Item (a thing that can be selected in a pull-down list)

List Box Item (when the entire list is visible all the time)

Menu header

Submenu

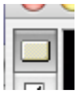
Menu Item (of either a Menu header or a Sub-menu)

Graffiti™ area

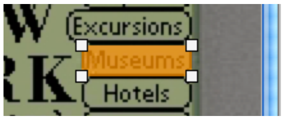
Non-Interactive area, that someone could look at by not act on.

Figure 15. Types of WIDGETS and the tools that insert them. See the CogTool User Guide (p. 45) for more detailed descriptions and examples of each type of WIDGET.

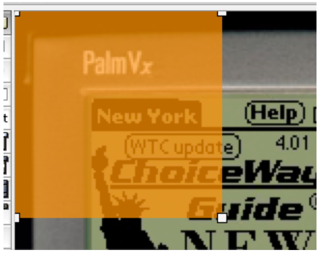
The widget needed in Frame "1-Start" needs to function as a button (see examples in Table 1 of the CogTool User Guide, p 45). The button tool at the top of the toolbar is selected by default when you open a **FRAME**. Make sure this tool is selected (it will be outlined in a darker shade of gray than the other tools).



Create a **WIDGET** over the area of the "Museums" button on the background image by dragging a rectangle across that area of the **FRAME.** Do this by pressing the left mouse button, moving the mouse over the area you wish to select, and then releasing the mouse button.



As an alternative, you could also use the "New **WIDGET**…" command in the "Create" menu, which will place a **WIDGET** in the upper left corner of the **FRAME**. You then move and resize the **WIDGET** to the appropriate position.



Move a **WIDGET** by pressing with the left mouse button on the translucent area of the **WIDGET** and dragging the mouse to the new location. To more precisely position a **WIDGET**, use the Nudge commands available in the Modify menu or in the contextual menu available on the **WIDGET**. You can also use the arrow keys to nudge a selected **WIDGET** into place.

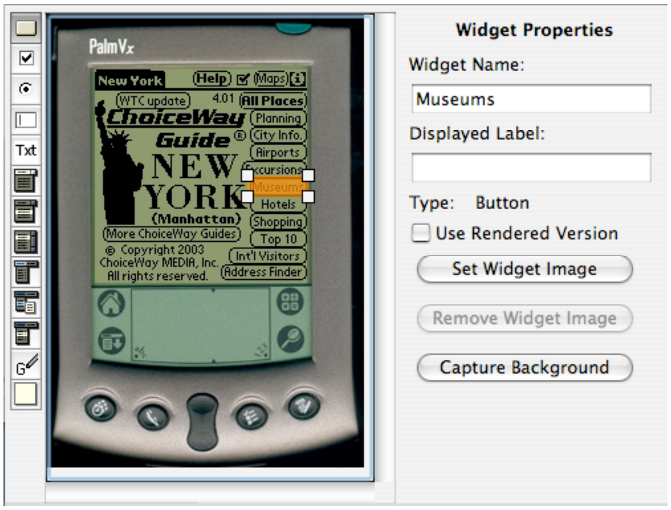
Resize a WIDGET by clicking and dragging the small white square handles at the corners of a selected WIDGET.

You may zoom in and out on the background image to make placing WIDGETS easier. These commands are available in the "Modify" menu or in the contextual menu that pops up for the FRAME background. (You may open the contextual menu by clicking the background of the FRAME with the right mouse button. On a Mac, you click with the left mouse button while holding the CTRL key.) The "Zoom to Fit" command is particularly useful, making the background image exactly fit the available space in the window. The keyboard shortcuts for Zoom-to-Fit are apple-/ for Mac and CTRL-/ for PC. You can also zoom to preset percentages by selecting the desired percentage in the "Zoom" field in the bottom portion of the FRAME.

2.7.1 Set WIDGET Properties

The property pane on the right side of the FRAME window shows the properties of the selected WIDGET. Each WIDGET must have a unique name. A WIDGET name can be used by only one WIDGET on a particular FRAME. For this WIDGET, use the name "Museums". You may use any text you wish for the name of a WIDGET.

A WIDGET can simply be a hot-spot over a background image, as is the case with this Museums button, or you can check the Use Rendered Version checkbox. This puts a thin border around the hotspot, so you can see the button when there is no background image. (In future versions of CogTool, there will be rendered images for Mac, PC and Palm platforms.) When you use a rendered version, the Displayed Label textbox allows you to enter text that will be displayed on the WIDGET. Since our frame has a background image with the word "Museums" already on it, we will leave the checkbox unchecked and the textbox blank. (Figure 16). A WIDGET can also have its own image (set with the Set Widget Image button) or capture the background image (see the last section of this tutorial), but these features are unnecessary for this tutorial.



Widget Properties

Widget Name: Museums

Displayed Label:

Type: Button

☐ Use Rendered Version

Figure 16. A *WIDGET,* Type: Button, has been placed over the image of the Museums button on the Palm Pilot and named "Museums".

A **FRAME** can have many **WIDGETS** to mock-up as much of the interactivity of a **DESIGN** as you would like. In this task, we only need a single **WIDGET** on this **FRAME**, so we are now done with this **FRAME**. Close the **FRAME** window and return to the **DESIGN** window. The **DESIGN** window will reflect the changes you have made to the "1-Start" **FRAME** by showing the orange hotspot on the Museum button (Figure 17).

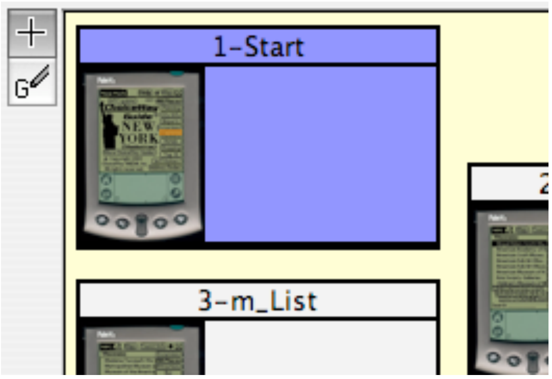


Figure 17. The DESIGN window reflects the changes made to the"1-Start" FRAME.

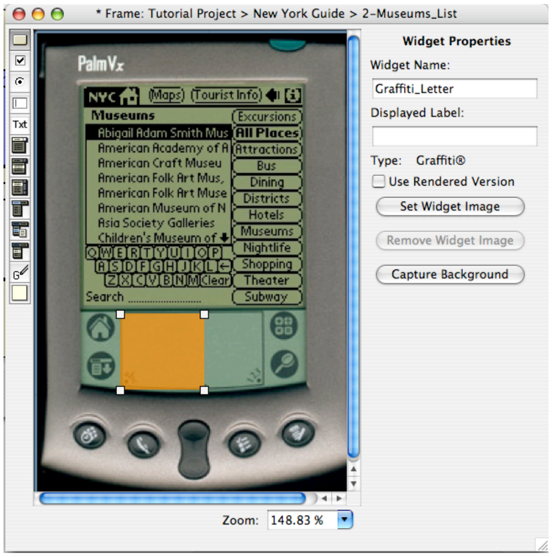
2.7.2 Add Content to All FRAMES

Repeat the process described above to add the necessary **WIDGETS** to all **FRAMES** of the storyboard, as follows.

NOTE #1. When you have two actions in a row that act on the same **WIDGET**, like the two Graffiti strokes in the tutorial task, it is important for the two **WIDGETS** to be absolutely identical. The only way be sure that two **WIDGETS** are absolutely identical is to create one and then copy it onto all the other **FRAMES** that need that identical **WIDGET**. All properties, including the name and type will be copied

NOTE #2. If you accidentally didn't have the correct **WIDGET** type selected before you create your **WIDGET,** you must delete the **WIDGET,** select the correct **WIDGET** type with the toolbar button on the left, and recreate the **WIDGET**.

In **FRAME**	Type of **WIDGET**	Placed over
1-Start	Button	the area labeled "Museums" (Already completed)
2-Museum_List	Graffiti	letter input area (Figure 18)
3-m_List	Graffiti® (don't forget to copy this **WIDGET** from the previous **FRAME**)	letter input area (Figure 18)
4-me_List	List Box Item	the area labeled "Metropolitan Museum"
5-The Met	no **WIDGETS** are needed in this **FRAME**	



* Frame: Tutorial Project > New York Guide > 2-Museums_List

Widget Properties

Widget Name: Graffiti_Letter

Displayed Label:

Type: Graffiti®

□ Use Rendered Version

Set Widget Image

Remove Widget Image

Capture Background

Zoom: 148.83 %

Figure 18 Graffiti® type WIDGET is placed over the image area that represents where a user would mark Graffiti® gestures for letters.

Your design window should look like Figure 19.

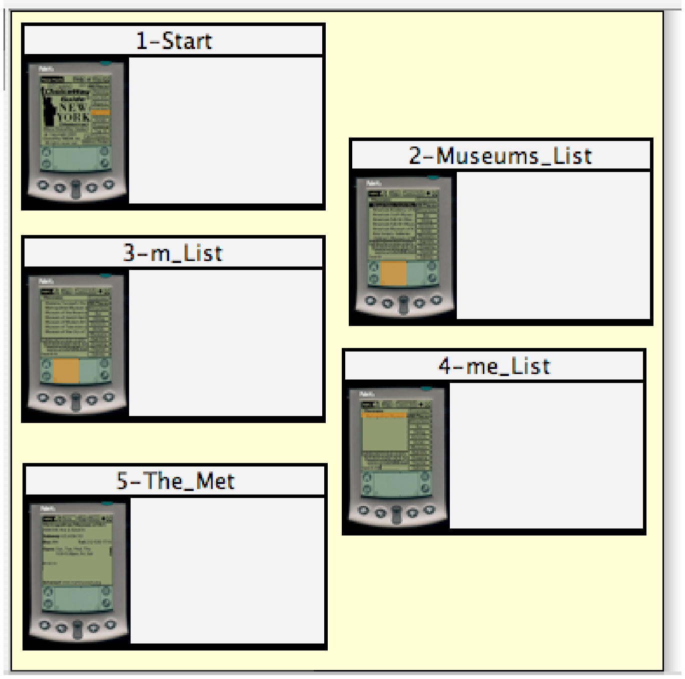


Figure 19. All FRAMES in the DESIGN are populated with background images and WIDGETS sufficient to do the TASK.

2.8 Link FRAMES via TRANSITIONS

We have now created all of the **FRAMES** of the storyboard for this **DESIGN**. However, the **DESIGN** is only complete when multiple **FRAMES** are linked together to follow the series of steps in a TASK. The links between FRAMES are called TRANSITIONS and each represents a user action on the interface that causes a new FRAME to appear. For example, when the user taps on the "Museums" WIDGET on the "Start" frame, we want the "Museums List" FRAME to appear.

2.8.1 Create a TRANSITION

To create a TRANSITION from the "Museums Button" WIDGET to the "Museums List" FRAME, press the left mouse button on the WIDGET that will cause the TRANSITION to occur, drag the cursor to the destination FRAME so that it highlights (Figure 20), and then release the mouse button. An arrow will connect the WIDGET to an edge of the destination FRAME.

If you have trouble clicking on WIDGETS because they are too small, use the "Zoom" commands in the "Modify" menu.

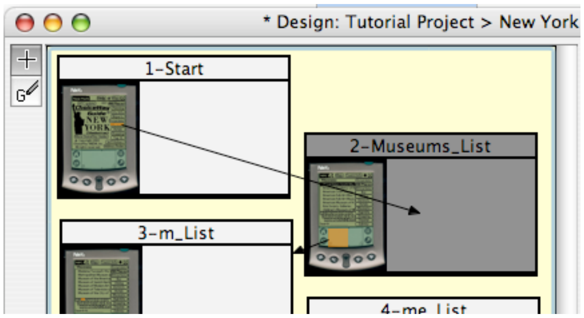


Figure 20. Creating a transition by dragging from the "Museums Button" WIDGET in the "1_Start" FRAME to the "Museums List" FRAME. The destination FRAME highlights by turning gray.

2.8.2 Edit TRANSITION Properties

Like WIDGETS, TRANSITIONS have properties that can be configured in the panel on the right side of the DESIGN window. Each TRANSITION is triggered by a specific user action. For example, a design using a touch-screen can TRANSITIONS triggered by tap or double-tap on a particular button WIDGET. Each type of WIDGET can respond to different types of user actions, and therefore different TRANSITIONS have different properties. When a new TRANSITION, or an existing one, is selected, the Action field will have the available properties.

Figure 21 shows the actions available for touch screen (Tap, Double-Tap, and Hover, because some touch-screen can detect fingers hovering above their surface). Figure 22 show the single action available for Graffiti® "Graffiti® Gestures:". A Graffiti® gesture also has a property of being a command (the "Is Command" box must be checked) or not (the "Is Command" box must be empty).

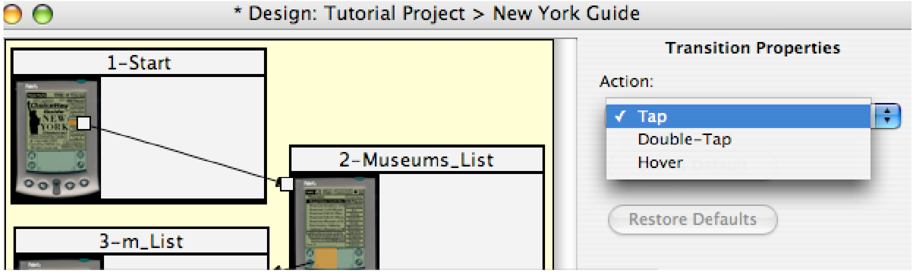


Figure 21. The type of transitions available for a touch screen.

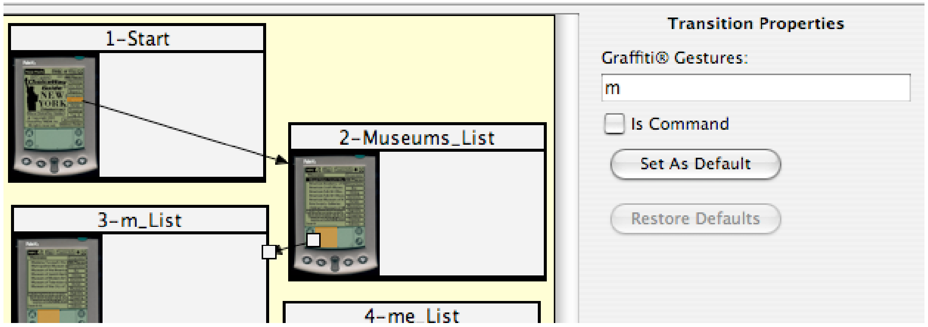


Figure 22. Graffiti® gestures are either text or commands. Both types are entered into the text box. To indicate a command check the box on the right.

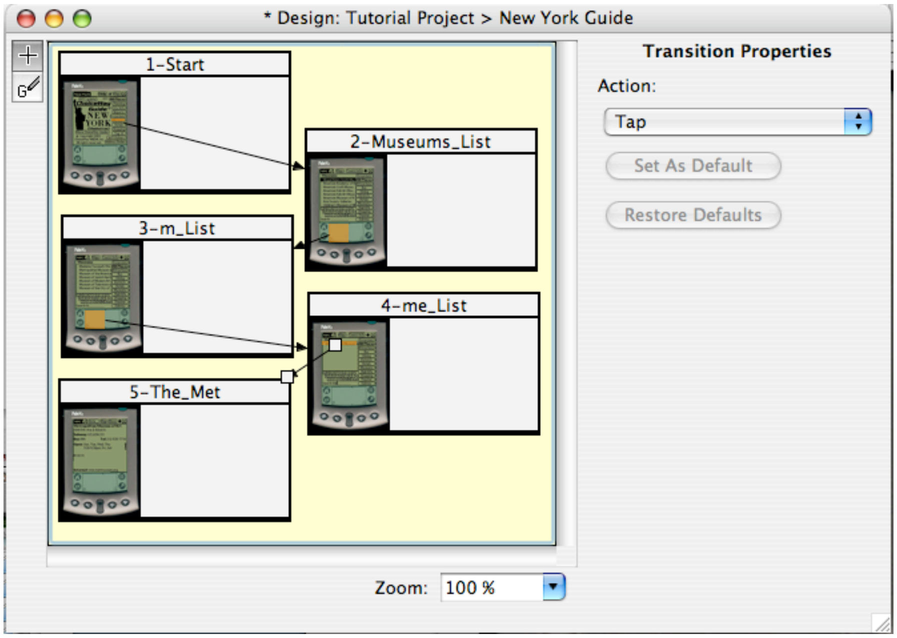
Now add **TRANSITIONS** for each step in the **TASK** as follows:

From **WIDGET** in **FRAME**		To **FRAME**	Action
1-Start	2-Museums_List	Tap	
2-Museum_List	3-m_List	Graffiti®	gesture “m”
3-m_List	4-me_List	Graffiti®	gesture “e”
4-me_List	5-The_Met	Tap	

NOTE #3. To indicate a command that requires two gestures (e.g., many commands start with a gesture that looks like a /), please use “/” before the letter of the command. Therefore the gesture command for Cut would be “/x”, for Copy would be “/c”, for Paste would be “/v”, etc. In addition, check the Is-Command check-box to tell CogTool that these gestures constitute a command.

NOTE #4. A “self transition” can also be made. You would use a self-transition if the user’s action did not change the look of the interface your are mocking up, or if you want to use one **FRAME** to demonstrate many actions and you don’t care that the look of the interface doesn’t change during this part of the demonstration. To make a self-**TRANSITION**, simply click on the **WIDGET** that triggers the self-**TRANSITION** and drag a short distance off that **WIDGET** but still on the frame, then release the mouse button. An arrow will go from the **WIDGET** to the edge of **FRAME** to indicate the self-**TRANSITION**.

When you are finished, your storyboard should look like Figure 23 below. You can now close the **DESIGN** window to return to the **PROJECT** window.



* Design: Tutorial Project > New York Guide

Transition Properties

Action: Tap

Figure 23. TRANSITIONS complete. The TRANSITION in Frame "4-me_List" is selected. The entire DESIGN is finished at this point and is sufficient to demonstrate the TASK of looking up the MET.

3 Demonstrate a TASK and Produce a Prediction

CogTool needs three ingredients for each prediction: an interface **DESIGN,** a **TASK**, and a **SCRIPT** of actions. In Section 2 we named the task "Lookup the MET" and created the New York Guide **DESIGN** using **FRAMES**, **WIDGETS**, and **TRANSITIONS**. This section shows how to demonstrate a **TASK** to create a **SCRIPT** of actions.

3.1 Open a SCRIPT

A **SCRIPT** is opened by double-clicking on the cell at the intersection of a **TASK** and a **DESIGN**. You may also open the contextual menu for a script by clicking the right mouse button in the cell. (On a Mac, click while holding the CTRL key.) Then, choose the "Edit **SCRIPT**" command from the contextual menu (Figure 24).

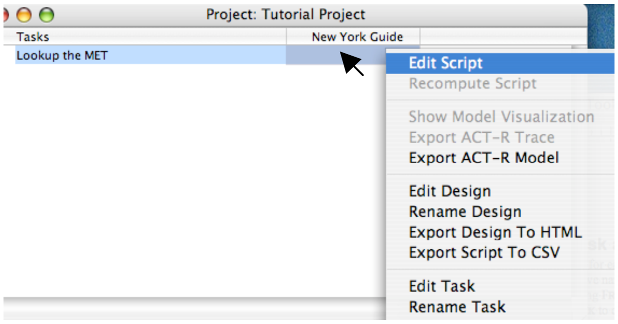


Figure 24. Edit the SCRIPT by using the contextual menu.

3.2 Choose a Start FRAME

Since a **SCRIPT** may begin at any **FRAME** in the **DESIGN**, you must select the start **FRAME** separately for each **SCRIPT**. To select the start **FRAME**, double-click on a **FRAME** (Figure 25) or its name in the list at the left. You may also click the desired **FRAME** to select it, and then press the "Start Demonstrating Task" button or the Enter key. In this tutorial, we called the first **FRAME** in this the Look-up-the-Met task the "1-Start" **FRAME**. Double-click on the "1-Start" **FRAME** to begin. The **FRAME**-chooser window will be replaced by the main **SCRIPT** editor window.

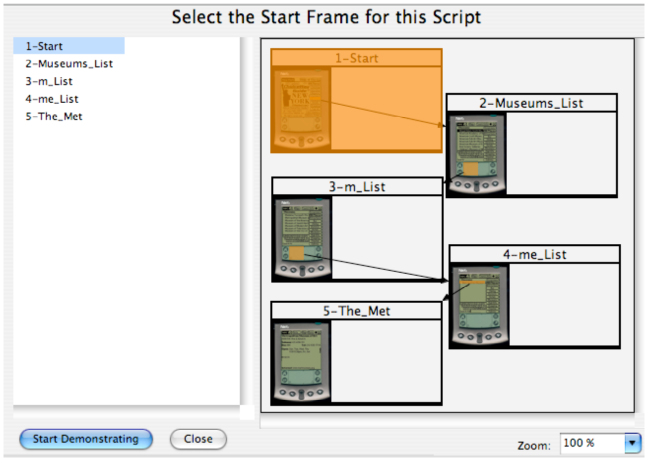
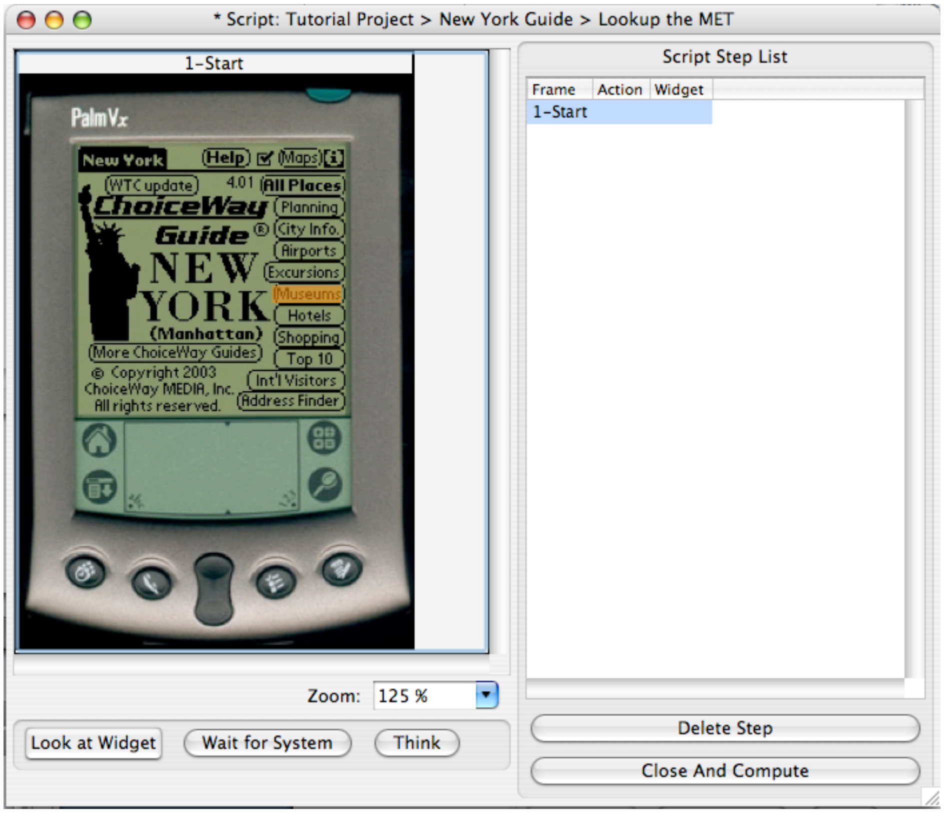


Figure 25. The initial SCRIPT window with the "1-Start" FRAME selected.

3.3 Demonstrate Actions

In the **SCRIPT** editor window, you will interact with the **DESIGN** to record a sequence of **SCRIPT STEPS** in a **SCRIPT**. The beginning **FRAME** appears in the left pane, and the current list of **STEPS** in the **SCRIPT** appears in the right pane. A set of buttons for manipulating the **SCRIPT** is located at the bottom of the window.

As with the **FRAME** and **DESIGN** windows, you may use the "Zoom" commands to make your work easier. The "Zoom" commands can be found in the "Modify" menu or in the contextual menu for the **FRAME**. Use the "Zoom to Fit" command now to make your window look like Figure 26 below.



* Script: Tutorial Project > New York Guide > Lookup the MET

1-Start

Script Step List

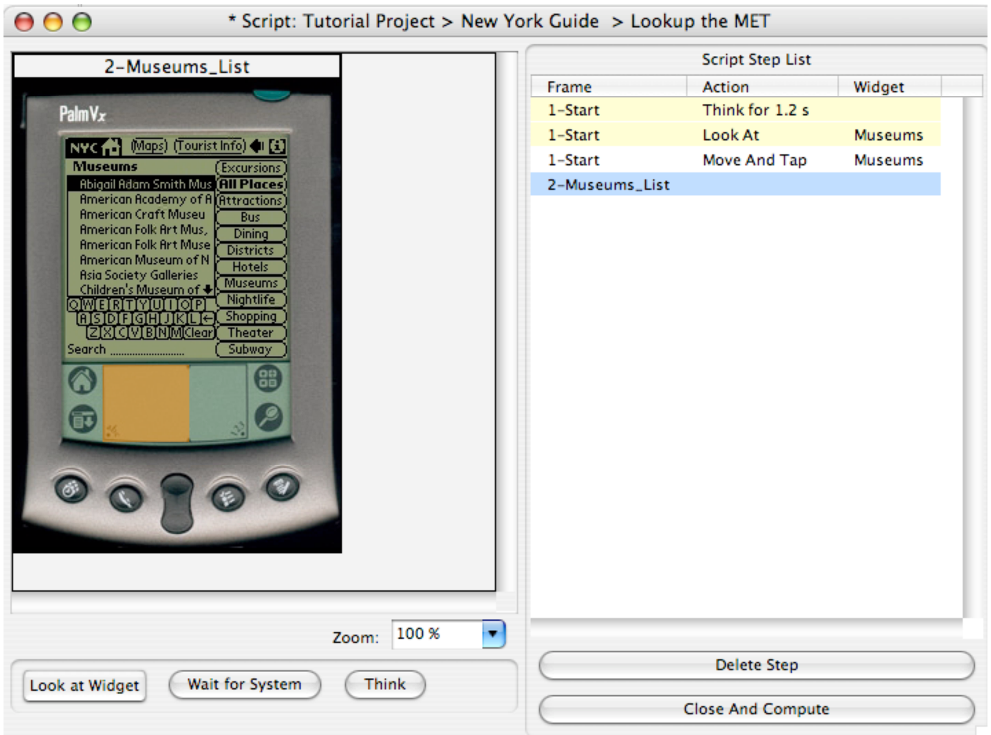
Frame	Action	Widget
1-Start		

Zoom: 125 %

Figure 26. The SCRIPT editor window.

To record new **STEPS**, interact with the storyboard as a user would interact with an actual device. In the case of a touch screen interface like a Palm OS®-based handheld, CogTool automatically interprets mouse clicks that you make in your demonstration as taps that a user would make on a Palm. The **TRANSITIONS** associated with your actions will be followed automatically. That is, the current **FRAME** will be replaced with the destination **FRAME** of the **TRANSITION**. For each action you perform, a new **STEP** will be added to the **SCRIPT**.

Click on the Museums button now to demonstrate the first **STEP** in the **TASK**. The window changes to look like Figure 27.


* Script: Tutorial Project > New York Guide > Lookup the MET

Script Step List

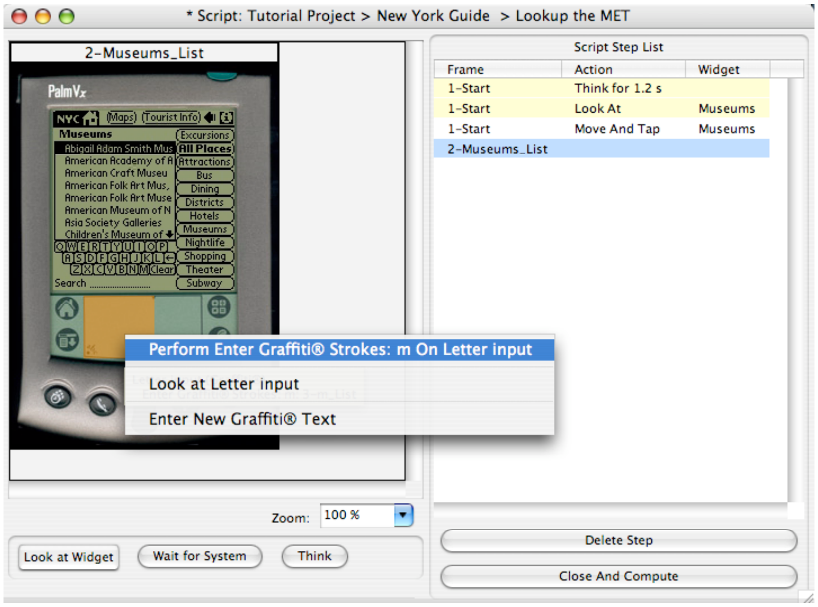
Frame	Action	Widget
1-Start	Think for 1.2 s	
1-Start	Look At	Museums
1-Start	Move And Tap	Museums
2-Museums_List		

Figure 27. Result of demonstrating the first STEP in the TASK.

In the **SCRIPT STEP** list on the right, CogTool has put three **STEPS** in response to the single action demonstrated (clicking on the "Museums Button"). They are a "Think" action for 1.2 seconds, a "Look At" to find the "Museums Button", and a "Move and Tap" action to the "Museums Button". Think and Look-at **STEPS** are inserted automatically because prior research in psychology and human-computer interaction has shown that when people tap on a button, they think to remember which button to press, they look at the button, and then they tap that button. The tap results in the **FRAME** changing to the "Museums List" **FRAME**, which is now shown on the left and listed as the last line of the **SCRIPT STEP** List. Automatically inserting Think and Look-at **STEPS** is an important part of CogTool's functionality. By doing this automatically, CogTool allows analysts to produce valid models whether they have studied psychology or not. The placement of Think and Look-at **STEPS** is backed by decades of psychology research and HCI data and is at the core of the research that produced CogTool.

The **STEPS** that are inserted automatically are shaded in yellow to distinguish them from **STEPS** deliberately demonstrated by the analyst (white **STEPS**). All of the yellow **STEPS** above a white **STEP** are associated with that white **STEP**. If a white **STEP** is deleted, all its yellow **STEPS** will be deleted as well.

If you have difficulty remembering which **TRANSITIONS** are associated with which **WIDGETS**, hold the mouse over a **WIDGET** to display a tool-tip. You can also use the **WIDGET'S** contextual menu to select a specific **TRANSITION** (Figure 28).

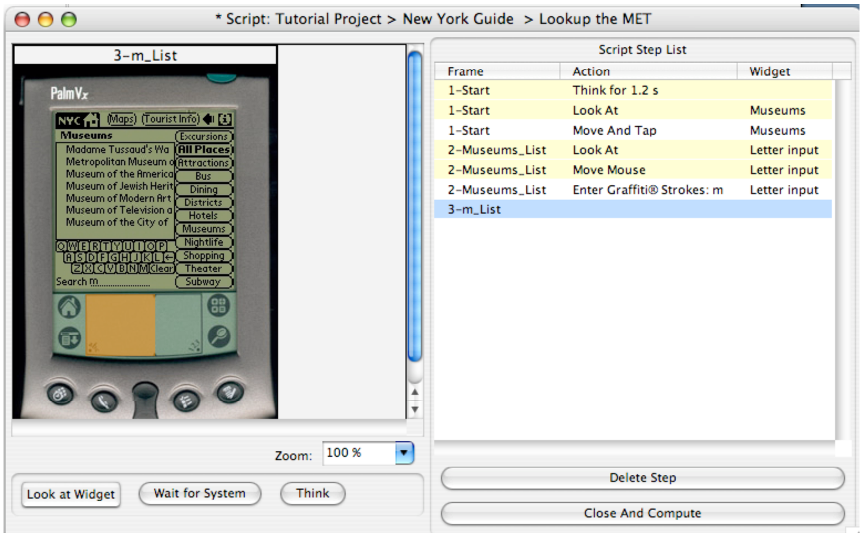


Script Step List

Frame	Action	Widget
1-Start	Think for 1.2 s	
1-Start	Look At	Museums
1-Start	Move And Tap	Museums
2-Museums_List		

Figure 28. Contextual menu on the Graffiti® WIDGET.

When a **TRANSITION** is a tap or double-tap, you can demonstrate the **STEP** simply by performing the action on the **WIDGET** (tap or double-tap). If the **TRANSITION** is some other type, you must open the contextual menu on the **WIDGET** and select the action you want to perform to record a **STEP**. Figure 28 shows the contextual menu displaying the choices for the next **STEP**: entering Graffiti® strokes "m" on the Graffiti® Letter **WIDGET**, looking at the Graffiti® Letter **WIDGET**, or entering new text into the Graffiti® Letter **WIDGET**. Select "Perform Enter Graffiti® Strokes m On Letter Input" as the next **STEP** in our **TASK** which results in the screen shown in Figure 29.



Script Step List

Frame	Action	Widget
1-Start	Think for 1.2 s	
1-Start	Look At	Museums
1-Start	Move And Tap	Museums
2-Museums_List	Look At	Letter input
2-Museums_List	Move Mouse	Letter input
2-Museums_List	Enter Graffiti® Strokes: m	Letter input
3-m_List		

Figure 29. Two STEPS have been demonstrated.

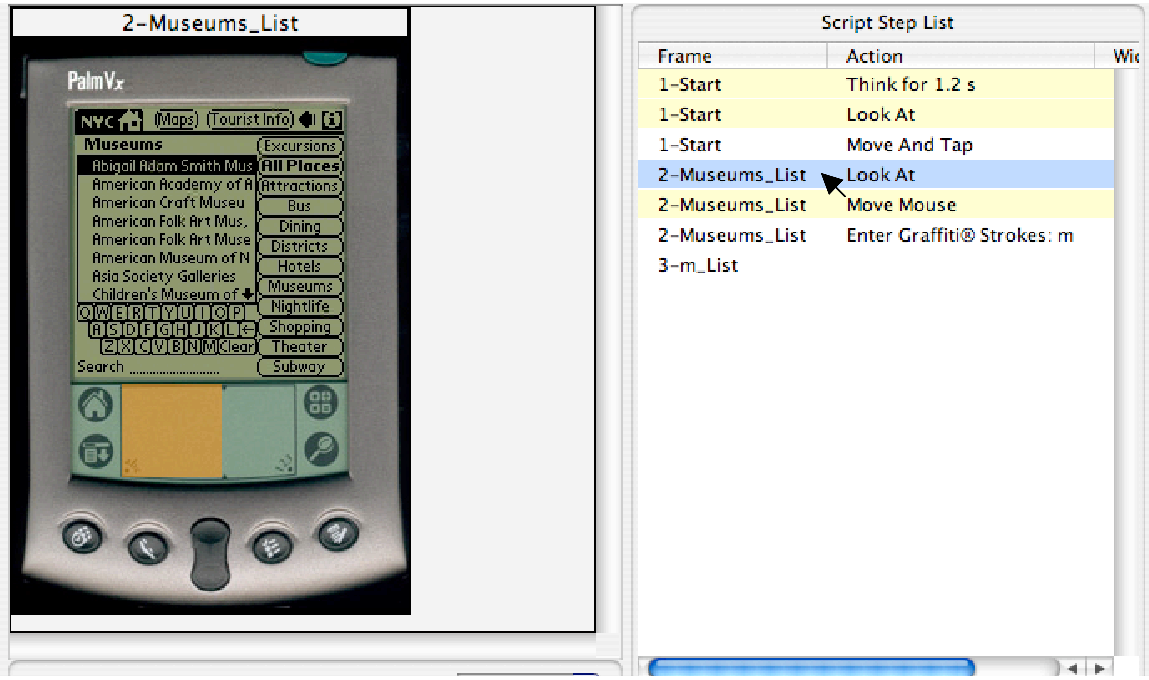
3.3.1 System Delays

An accurate prediction of user task time must include time spent waiting for the system to complete requested actions. Sometimes systems are so fast that system delays are negligible and you don't need to include waiting time, but sometimes (as in the case of this Palm app), the delays are noticeable. To simulate a system delay, press the "Wait for System" button, and then enter the amount of time in seconds the user will wait.

You can insert system delay in two ways, while you are demonstrating the **STEPS** or after a **STEP** has been demonstrated.

In the task we are currently demonstrating, there is actually several seconds of system delay time between the tap on the Museums Button and the display of the 2-Museums_List **FRAME**. Since we have already demonstrated that **STEP**, we can now go back and insert the system delay.

The first system delay is 3.82 seconds (this system delay was actually observed in videotapes and log files of the application). Select the first occurrence of the delayed screen, i.e., the first line in the **SCRIPT STEP** list where the **FRAME** is 2-Museum_List. Figure 30 shows this line selected, indicated by the blue highlighting.

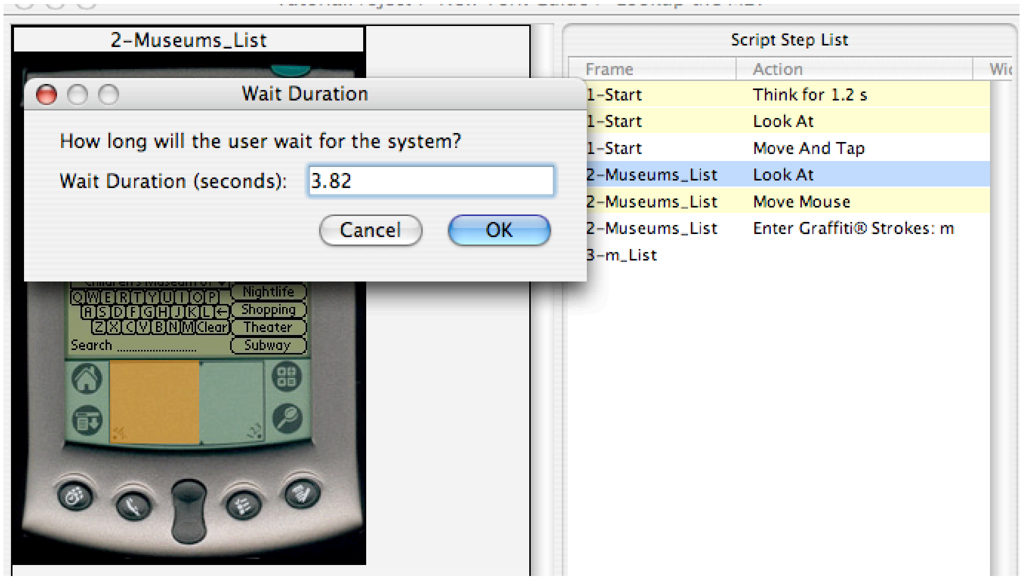


Script Step List

Frame	Action	Wi
1-Start	Think for 1.2 s	
1-Start	Look At	
1-Start	Move And Tap	
2-Museums_List	Look At	
2-Museums_List	Move Mouse	
2-Museums_List	Enter Graffiti® Strokes: m	
3-m_List		

Figure 30. The first occurrence of the delayed FRAME is selected.

Then hit the “Wait for System” button below the displayed **FRAME**. A dialog box comes up asking for the duration of the delay. Figure 31shows 3.82 seconds being entered into this dialog box.



2-Museums_List

Wait Duration

How long will the user wait for the system?

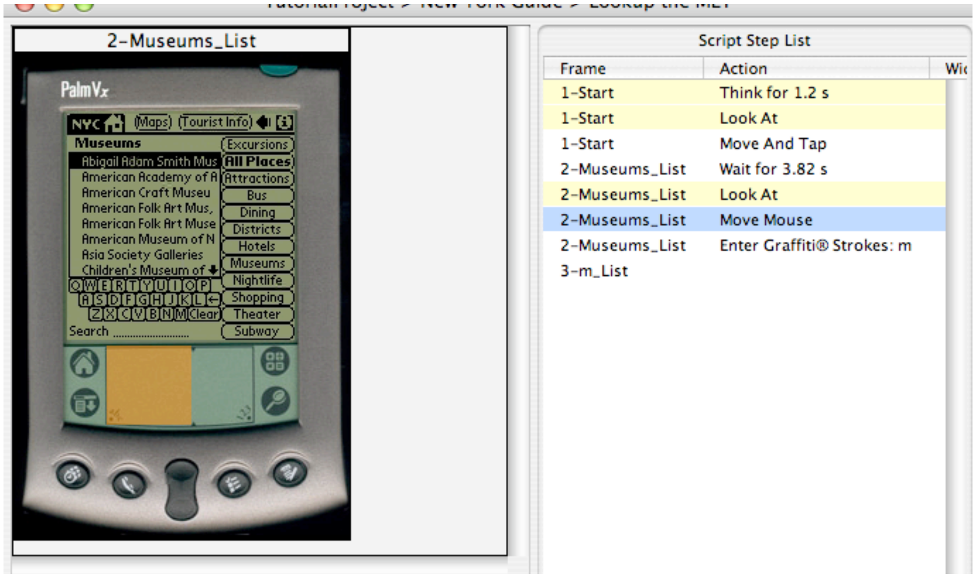
Wait Duration (seconds): 3.82

Script Step List

Frame	Action	Wi
1-Start	Think for 1.2 s	
1-Start	Look At	
1-Start	Move And Tap	
2-Museums_List	Look At	
2-Museums_List	Move Mouse	
2-Museums_List	Enter Graffiti® Strokes: m	
3-m_List		

Figure 31. The system delay is entered.

After you hit the OK button (or the Enter key), the system delay is entered into the **SCRIPT STEP** List in between the last action on the “Start” **FRAME** and the first action on the “2-Museums_List” **FRAME**, as shown in Figure 32.



2-Museums_List

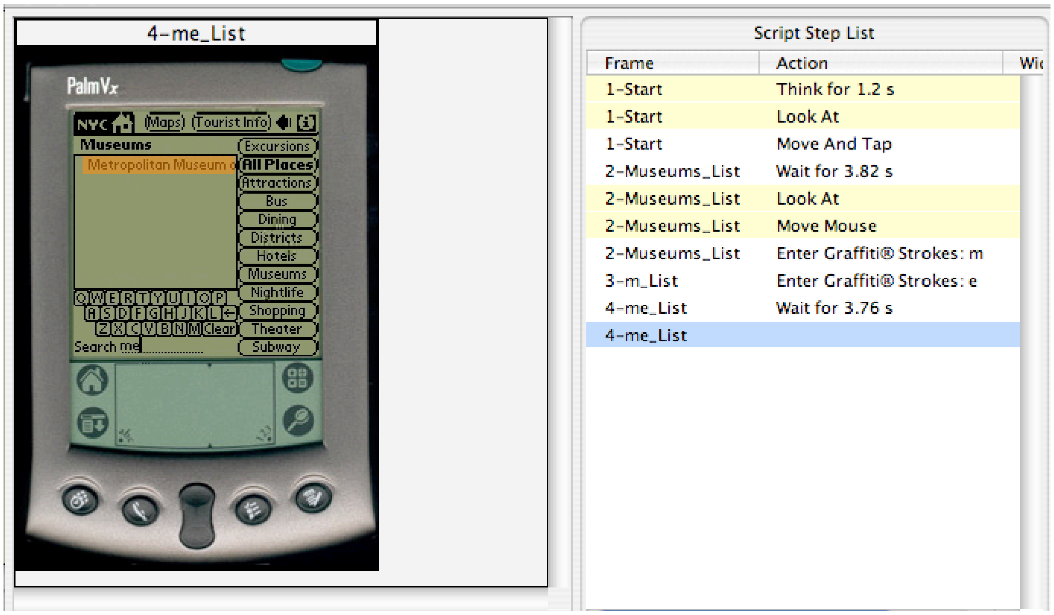
Script Step List

Frame	Action	Wi
1-Start	Think for 1.2 s	
1-Start	Look At	
1-Start	Move And Tap	
2-Museums_List	Wait for 3.82 s	
2-Museums_List	Look At	
2-Museums_List	Move Mouse	
2-Museums_List	Enter Graffiti® Strokes: m	
3-m_List		

Figure 32. The result of entering system delay before the 2-Museums_List *FRAME*.

We can continue with the demonstration by selecting the last line in the **SCRIPT STEP** List. Enter the next **STEP** through the contextual menu on the Graffiti® area (enter an “e”).

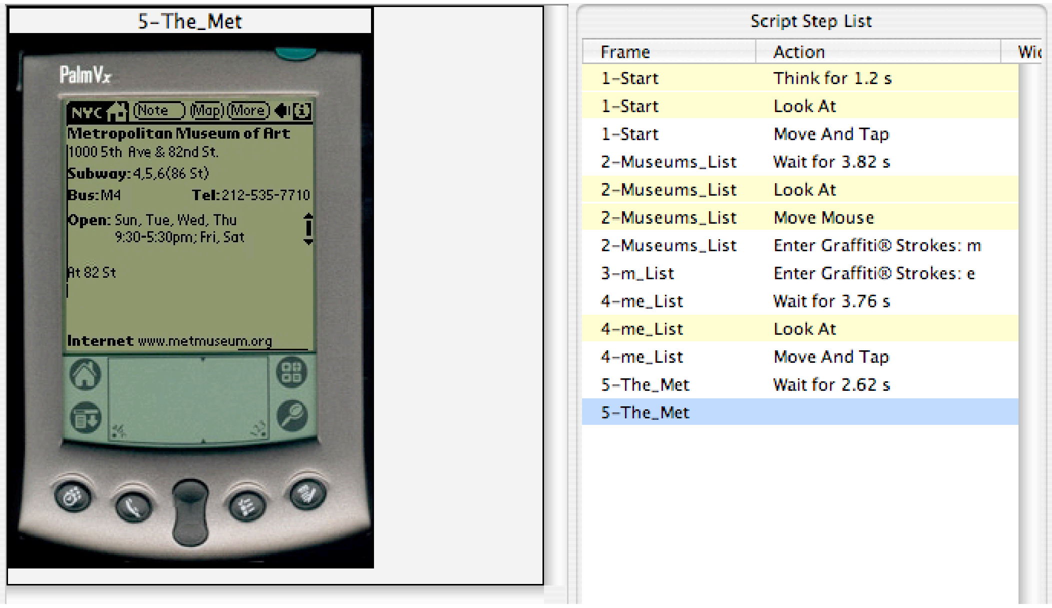
During actual observation after that character was entered, another system delay was observed, this time for 3.76 seconds. For our demonstration purposes this time, we can enter the system delay in the process of demonstrating the **TASK**. Right after the **STEP** that caused the delay is entered, (entering an "e" in using the Graffiti® area) simply hit the "Wait for System" button and enter the duration and CogTool will place the system delay correctly, as shown Figure 33.



Frame	Action	Wi
1-Start	Think for 1.2 s	
1-Start	Look At	
1-Start	Move And Tap	
2-Museums_List	Wait for 3.82 s	
2-Museums_List	Look At	
2-Museums_List	Move Mouse	
2-Museums_List	Enter Graffiti® Strokes: m	
3-m_List	Enter Graffiti® Strokes: e	
4-me_List	Wait for 3.76 s	
4-me_List		

Figure 33. The system delay appears in the correct position when entered after the step that caused the delay during the demonstration

Continue demonstrating the **TASK**, adding 2.62 seconds of system delay before the last screen appears, and the final **STEPS SCRIPT** List is shown in Figure 32.



Frame	Action	Wi
1-Start	Think for 1.2 s	
1-Start	Look At	
1-Start	Move And Tap	
2-Museums_List	Wait for 3.82 s	
2-Museums_List	Look At	
2-Museums_List	Move Mouse	
2-Museums_List	Enter Graffiti® Strokes: m	
3-m_List	Enter Graffiti® Strokes: e	
4-me_List	Wait for 3.76 s	
4-me_List	Look At	
4-me_List	Move And Tap	
5-The_Met	Wait for 2.62 s	
5-The_Met		

Figure 34. Final *SCRIPT*.

3.4 Review and Edit Steps

Now that you have demonstrated all the steps that comprise the task of “Look-up the Met”, spend just a few minutes, to check to make sure the actions are in the correct order and that the frames were properly linked together.

3.4.1 View Previous STEPS

You may view the FRAME being used in a particular SCRIPT STEP by clicking on the STEP in the history list.

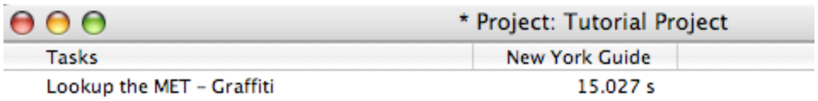
3.4.2 Recovering from a Mistake when Demonstrating STEPS

CogTool 1.0b18 does not allow you to recover from a mistake when you are demonstrating STEPS in a TASK. The development team is working hard to fix this obvious deficiency in upcoming releases, until thenyou must delete each step and start your demonstration over. Fortunately, demonstrating STEPS doesn’t take very long for most TASKS.

KNOWN BUG #2. The CogTool interface looks like it can change STEPS in the middle of a TASK successfully, but it does not produce reliable human performance predictions if you do. It does not reliably tell you that it is not producing a reliable prediction. This is a serious bug and the development team is working on it. To be safe, always delete an erroneous SCRIPT completely and re-demonstrate the STEPS. Likewise, if you change the design after demonstrating a TASK, re-demonstrate the STEPS.

3.5 Compute Predictions

Once you have finished creating the SCRIPT, press the “Close and Compute” button to return to the PROJECT window and compute a prediction. The result will appear as a value in the table cell for the SCRIPT (Figure 35).



* Project: Tutorial Project

Tasks	New York Guide
Lookup the MET – Graffiti	15.027 s

Figure 35. Predicted task execution time appears in the PROJECT window.

That’s all there is to it! You can read the value directly out of the table cell for the SCRIPT.

NOTE #5. Do not worry if the predictions in your model are slightly different than the ones shown in this tutorial document. The predictions depend on the exact size and position of the WIDGETS and yours are unlikely to be exactly the same as ours. However, if they are off by more than a few tens of milliseconds, you might compare your designs to ours to see if there are major differences.

NOTE #6. If the computation process has an error, it will often return either “0.000” or “600.000” as the answer. This is NOT a correct prediction! If you get an erroneous result, please check your DESIGN and SCRIPT.

4 Extending a DESIGN to Support Multiple TASKS

Now that we have used CogTool to create a single **DESIGN** and **TASK**, we can extend our work to support a second **TASK**. A strength of the Keystroke-Level Model type of cognitive performance modeling, employed by CogTool, is the ability to compare alternatives. To this end, we will use CogTool to predict the time for an alternate way to complete the "Lookup the Met" **TASK**. We will follow the same basic steps outlined in Sections 2 and 3 to model the following new steps.

1. Tap the button labeled "Museums" from the first screen.
2. Tap the on-screen keyboard to enter the characters "m" and "e" to filter the museums.
3. Tap the list item labeled "Metropolitan Museum of Art"

4.1 Extend the DESIGN

To perform the new variation of the **TASK**, you need to add two **WIDGETS** to the **DESIGN**:

In **FRAME**	Type of **WIDGET**	Placed Over
2-Museum_List	Button	the on-screen keyboard "M"
3-m_List	Button	the on-screen keyboard "E"

To add new **WIDGETS** to a **DESIGN**, open the **DESIGN** window, and then the **FRAME** windows for the **FRAMES** you wish to edit.

Similarly, you will need to add two new **TRANSITIONS** to reflect the alternative path through the storyboard:

In **FRAME**	From **WIDGET**	To **FRAME**	Action
2-Museum_List	over "M"	3-m_List	Tap
3-m_List	over "E"	4-me_List	Tap

When you have finished your modifications, the **DESIGN** should look like Figure 36.

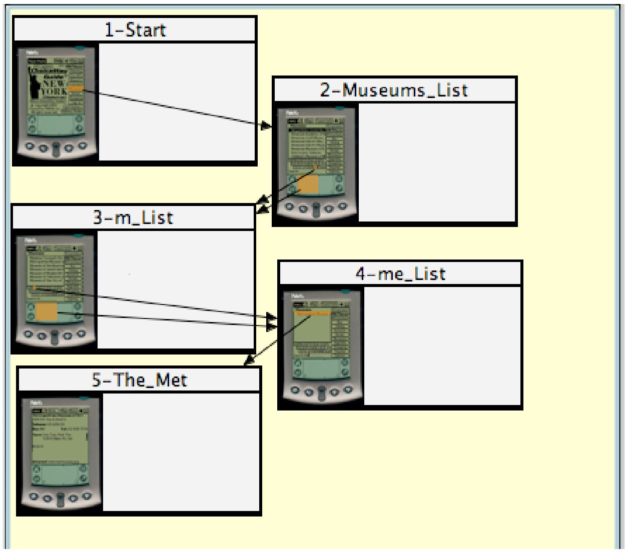


Figure 36. Augmented design that can now support two tasks.

Now, close the **DESIGN** window to return to the main **PROJECT** window.

4.2 Add a Second TASK

Now that the DESIGN has the necessary additions to support the second variation of "Lookup the MET", let's add a TASK to the PROJECT for that variation. Use the "New Task" command in the "Create" menu (Figure 37). Call it "Lookup the MET – Soft Keyboard."

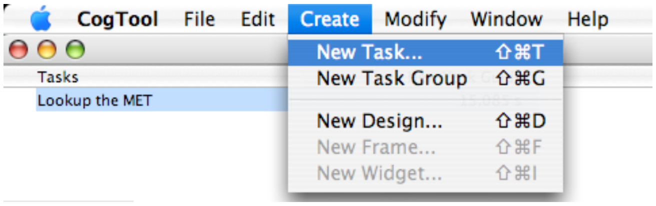
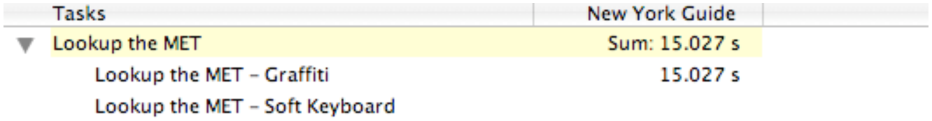


Figure 37. "New Task" command in the "Create" menu.

To distinguish the old version of the TASK from the new one, double click on the old TASK name and rename it to be "Lookup the MET – Graffiti".

Now, since both these TASKS accomplish the same goal of finding the information about the MET, we will put them in a TASK GROUP. Select both TASKS and then select the "New Task Group" command from the "Create" menu (above). Call the task group "Lookup the MET". When this is done, the PROJECT window should look like Figure 38.



Tasks	New York Guide
▼ Lookup the MET	Sum: 15.027 s
Lookup the MET – Graffiti	15.027 s
Lookup the MET – Soft Keyboard	

Figure 38. A group of tasks that both accomplish the goal of looking up information about the Metropolitan Museum of Art (the MET).

By default, the computation assigned to a group of tasks is the sum of all the tasks in the group. This is useful when the tasks in the group are subtasks of the task group because their sum would then be the total time for the whole task. However, in this case, the two tasks are alternative methods for accomplishing the same goal. Therefore, we may want to see the mean, minimum or maximum time for accomplishing this goal. To change the computation displayed for the TASK GROUP to one more meaningful for this tutorial, choose the "Show Minimum" option in the "Modify" menu (Figure 39) to get the results in Figure 40.

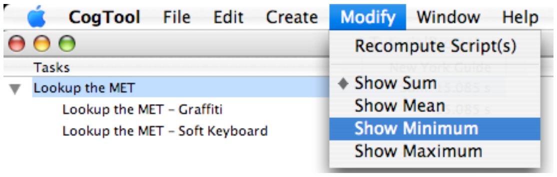
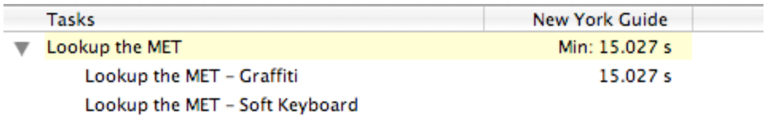


Figure 39. Other options for the contents of TASK GROUP cells.



Tasks	New York Guide
▼ Lookup the MET	Min: 15.027 s
Lookup the MET – Graffiti	15.027 s
Lookup the MET – Soft Keyboard	

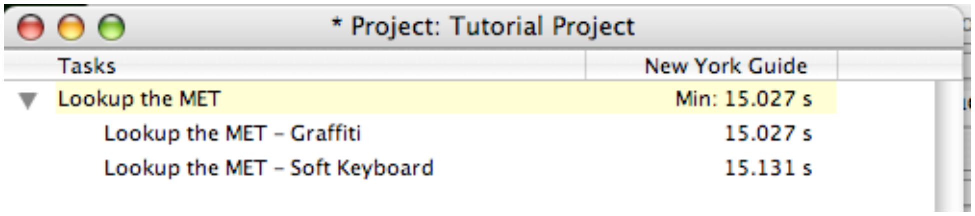
Figure 40.Calculation changed to showing the minimum time for a TASK GROUP.

4.3 Demonstrate a Second SCRIPT

Finally, to compute the prediction of the second TASK’S performance time, we need to demonstrate the steps of the SCRIPT. Open the SCRIPT window by double-clicking the table cell at the intersection of the “New York Guide” DESIGN and “Lookup the MET– Soft Keyboard” TASK. In the FRAME chooser window, select the “1-Start” FRAME. Demonstrate the steps of the new TASK by clicking on the appropriate WIDGETS, in this sequence:

1. “1-Start” FRAME: tap the button labeled “Museums”
   Insert a system delay of 3.82 seconds
2. “2-Museums_List” FRAME: tap the on-screen keyboard character “M”
3. “3-m_List” FRAME: tap the on-screen keyboard character “E”
   Insert a system delay of 3.76 seconds
4. “4-me_List” FRAME: tap the list item labeled “Metropolitan Museum of Art”
   Insert a system delay of 2.62 seconds

When you have completed these SCRIPT STEPS, press the “Close and Compute” button on the SCRIPT window to close the window and compute the prediction. When you have done this, the PROJECT window should look like Figure 41.



Tasks	New York Guide
▼ Lookup the MET	Min: 15.027 s
Lookup the MET – Graffiti	15.027 s
Lookup the MET – Soft Keyboard	15.131 s

Figure 41. The PROJECT window is populated with the desired predictions.

As you can see, the Soft Keyboard method is about 0.1 seconds slower than the Graffiti® method, a mere 0.7% of the total time. However, the magnitude of the total time is heavily influenced by the more than 10 seconds of system delay observed in the application. If you want to see how much time is contributed just by using the soft keyboard, behavior that might be obtainable if the application were made much faster, edit the scripts by deleting the wait-for-system steps and re-compute – its just that easy!

NOTE #7. Again, do not worry if the predictions in your model are slightly different than the ones shown in this tutorial document. The predictions depend on the exact size and position of the WIDGETS and yours are unlikely to be exactly the same as ours. However, if they are off by more than a few tens of milliseconds, you might compare your designs to ours to see if there are major differences.

5 Conclusion

You can continue adding new **DESIGNS** and new **TASKS** as much as you would like to explore options with your **DESIGN**. You can group tasks either as alternatives (as we did in the tutorial example) or as subtasks that add up to a whole task denoted by **A TASK GROUP**. Breaking a whole task into subtasks lets you explore alternatives for parts of a task instead of having to demonstrate the entire task each time (which can get tedious for longer tasks).

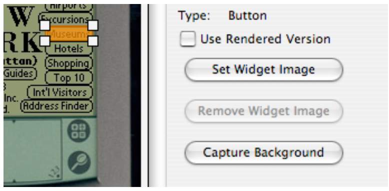
PS. Don’t forget to look at the “Two More Fun Things” on the next few pages.

6 Two More Fun Things

6.1 Capturing Backgrounds to Move Widgets

Our tutorial example did not provide the opportunity to show a neat feature of CogTool, the ability to capture the look of a **WIDGET** and move it around to find a better arrangement of **WIDGETS**.

Look back at Figure 16, where the "Museums" button was created on the "1-Start" **FRAME**. The Capture Background button on the bottom right of the window captures the bit-map within the orange **WIDGET** bounding box. In this case, it would be the rounded rectangle button labeled "Museums". This button can now be moved around to anywhere in the Frame and it retains the look of the "Museums" button. In Figure 42, we have put the Museums button in the middle of the Graffiti® area – a silly thing to do, but easy to see how the feature works.


Type: Button

□ Use Rendered Version

This feature can be used to create totally new layouts from one screenshot of all the **WIDGETS** in a **FRAME**. Simply create a **FRAME** with all the desired **WIDGETS** and capture the background for each one. Copy each **WIDGET** and paste it onto a **FRAME** with a blank or neutral background and move the **WIDGETS** wherever you want them to be.

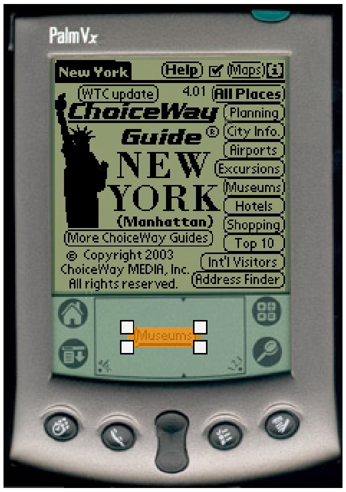


Figure 42. The background of the "Museums" button WIDGET has been captured and the WIDGET has been moved to the center of the Graffiti® area.

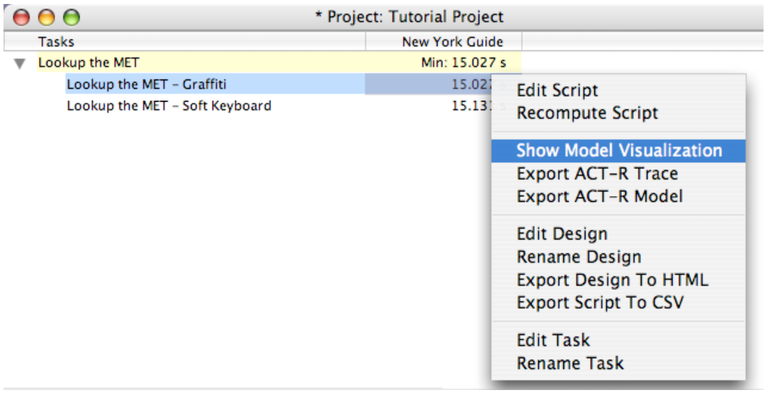
6.2 Understanding the Predictions

The underlying computation cognitive engine that makes the predictions is called ACT-R and is very complex. To learn more about it, you can go to the ACT-R website.

http://act-r.psy.cmu.edu/

We have built a visualization tool into CogTool so you can see what ACT-R is doing to produce the predictions. Although this visualization is meant for cognitive psychology researcher to validate CogTool's and ACT-R's predictions, it is fun and may entice you to learn more about computational cognitive modeling.

To see the visualization, in the **PROJECT** window use the contextual menu on a **SCRIPT** cell to select "Show Model Visualization" (Figure 43). You can open as many visualization windows as you wish, and align them to compare the execution traces and see where their times differ.

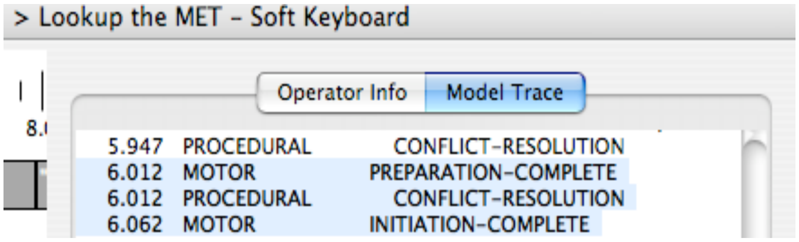


* Project: Tutorial Project

Tasks	New York Guide
Lookup the MET	Min: 15.027 s
Lookup the MET – Graffiti	15.02
Lookup the MET – Soft Keyboard	15.13

Figure 43. The Contextual menu on a SCRIPT cell for the TASK "Lookup the MET – Graffiti".

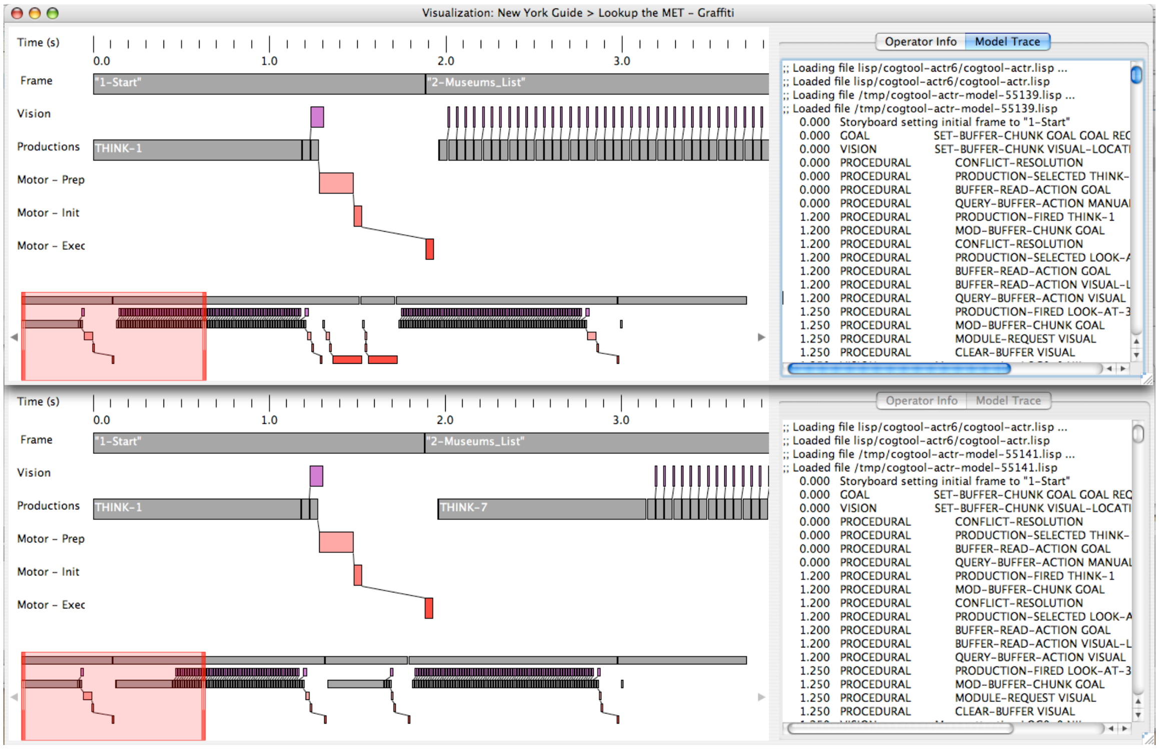
To see what ACT-R is doing, select the "Model Trace" tab located at the top of the right pane of the window.



```
5.947  PROCEDURAL      CONFLICT-RESOLUTION
6.012  MOTOR         PREPARATION-COMPLETE
6.012  PROCEDURAL      CONFLICT-RESOLUTION
6.062  MOTOR         INITIATION-COMPLETE
```

Figure 44. Tabs in the right pane of a visualization window.

Once both Visualization windows are open, place one above the other and resize them so you can see both windows (see Figure 45).



```
;; Loading file lisp/cogtool-actr6/cogtool-actr.lisp ...
;; Loaded file lisp/cogtool-actr6/cogtool-actr.lisp
;; Loading file /tmp/cogtool-actr-model-55139.lisp ...
;; Loaded file /tmp/cogtool-actr-model-55139.lisp
    0.000   Storyboard setting initial frame to "1-Start"
    0.000   GOAL                    SET-BUFFER-CHUNK GOAL GOAL REC
    0.000   VISION                  SET-BUFFER-CHUNK VISUAL-LOCATI
    0.000   PROCEDURAL                  CONFLICT-RESOLUTION
    0.000   PROCEDURAL                  PRODUCTION-SELECTED THINK-
    0.000   PROCEDURAL                  BUFFER-READ-ACTION GOAL
    0.000   PROCEDURAL                  QUERY-BUFFER-ACTION MANUAI
    1.200   PROCEDURAL                  PRODUCTION-FIRED THINK-1
    1.200   PROCEDURAL                  MOD-BUFFER-CHUNK GOAL
    1.200   PROCEDURAL                  CONFLICT-RESOLUTION
    1.200   PROCEDURAL                  PRODUCTION-SELECTED LOOK-/
    1.200   PROCEDURAL                  BUFFER-READ-ACTION GOAL
    1.200   PROCEDURAL                  BUFFER-READ-ACTION VISUAL-L
    1.200   PROCEDURAL                  QUERY-BUFFER-ACTION VISUAL
    1.250   PROCEDURAL                  PRODUCTION-FIRED LOOK-AT-3
    1.250   PROCEDURAL                  MOD-BUFFER-CHUNK GOAL
    1.250   PROCEDURAL                  MODULE-REQUEST VISUAL
    1.250   PROCEDURAL                  CLEAR-BUFFER VISUAL
```

```
;; Loading file lisp/cogtool-actr6/cogtool-actr.lisp ...
;; Loaded file lisp/cogtool-actr6/cogtool-actr.lisp
;; Loading file /tmp/cogtool-actr-model-55141.lisp ...
;; Loaded file /tmp/cogtool-actr-model-55141.lisp
    0.000   Storyboard setting initial frame to "1-Start"
    0.000   GOAL                    SET-BUFFER-CHUNK GOAL GOAL REQ
    0.000   VISION                  SET-BUFFER-CHUNK VISUAL-LOCATI
    0.000   PROCEDURAL                  CONFLICT-RESOLUTION
    0.000   PROCEDURAL                  PRODUCTION-SELECTED THINK-
    0.000   PROCEDURAL                  BUFFER-READ-ACTION GOAL
    0.000   PROCEDURAL                  QUERY-BUFFER-ACTION MANUAL
    1.200   PROCEDURAL                  PRODUCTION-FIRED THINK-1
    1.200   PROCEDURAL                  MOD-BUFFER-CHUNK GOAL
    1.200   PROCEDURAL                  CONFLICT-RESOLUTION
    1.200   PROCEDURAL                  PRODUCTION-SELECTED LOOK-A
    1.200   PROCEDURAL                  BUFFER-READ-ACTION GOAL
    1.200   PROCEDURAL                  BUFFER-READ-ACTION VISUAL-L
    1.200   PROCEDURAL                  QUERY-BUFFER-ACTION VISUAL
    1.250   PROCEDURAL                  PRODUCTION-FIRED LOOK-AT-3
    1.250   PROCEDURAL                  MOD-BUFFER-CHUNK GOAL
    1.250   PROCEDURAL                  MODULE-REQUEST VISUAL
    1.250   PROCEDURAL                  CLEAR-BUFFER VISUAL
```

Figure 45. Comparison of Graffiti to Soft-keyboard methods in ACT-R visualization windows

In the left pane is a timeline showing the different activities ACT-R goes through to make the predictions. The right pane shows a textual trace of these same activities.

In the left pane, time runs from left to right and the width of the boxes are proportional to the time they take to execute. The rows of boxes are different types of "operators" that happen in the course of performing these tasks.

The top row is labeled "Frame" and shows the duration that each frame is visible as the task is performed.

KNOWN BUG #3. The frames are not actually visible as long as these boxes indicate. When there is a system wait, one frame disappears and the next one doesn't show up for the duration of the system wait. This is not shown correctly in the current visualization. For example, frame 2-Museum_List is shown as visible at about 1.6 s into the task. It is really not visible until about 5.7 s into the task. A person well-versed in ACT-R would be able to see this discrepancy in the visualization because the vision row and the production row have many short pairs of operators between 1.6 s and 5.7 s. This pattern of operators represents the eyes trying to see the next button, but the frame not being visible, so the vision system returns a "failure" signal to cognition. As soon as the frame is visible, the vision operator is much longer, as it actually find the next button to press and returns its location to cognition.

The next row (purple) is Vision, which represents the eyes seeing objects on the frame.

The next row (grey) is labeled “Productions” (the elements of a production system, which is the type of cognitive engine that ACT-R employs), which represent the thoughts the model has when performing this task. The long boxes in this row are the Think operators. Short boxes are other types of cognitive operators that initiate motor movements motor and visual attention shifts.

The next three rows (shades of red) represent different aspects of the motor system employed by ACT-R. ACT-R’s motor system is complex and beyond the scope of this tutorial, but the bottom row (darkest red) shows the motor movement that would be observable on a video: horizontal movements of a finger, stylus, or mouse, clicks of a mouse button or key presses. In these models, only horizontal movements of the stylus is shown, because it uses a Palm device that uses a stylus (not a mouse or keyboard).

If you click on a box in the left pane, it highlights the part of the model trace that corresponds to it in the right pane.

The biggest difference between the two models evident in the timelines is that the Graffiti® model has long red motor operators where the Graffiti® gestures are (around 6.4 s and 7.2 s) and the Soft-keyboard model has much shorter motor movements to poke the M-key and the E-key. This is because Graffiti® gestures take about 0.5 seconds to complete, on average and the soft-key poking time is calculated from Fitts’s law. Offsetting this savings in motor time, the Soft-keyboard model has an additional Think operator between the M-key and the E-key that the Graffiti® model does not have between the m-gesture and the e-gesture. By default, “me” is treated as a “cognitive unit” by CogTool when entered as successive Graffiti® gestures that are not commands, and successive soft-keyboard presses are not because each key is modeled as a button. We are currently collecting data to validate these approximations. If you would like to see what the times would be if the Think operator was not inserted between the M-key and the E-key, simply delete it from the script and close and compute. (Deleting and inserting Think steps and System Wait steps are the only safe modifications you can make to scripts without re-demonstrating.)

Have fun with this visualization.