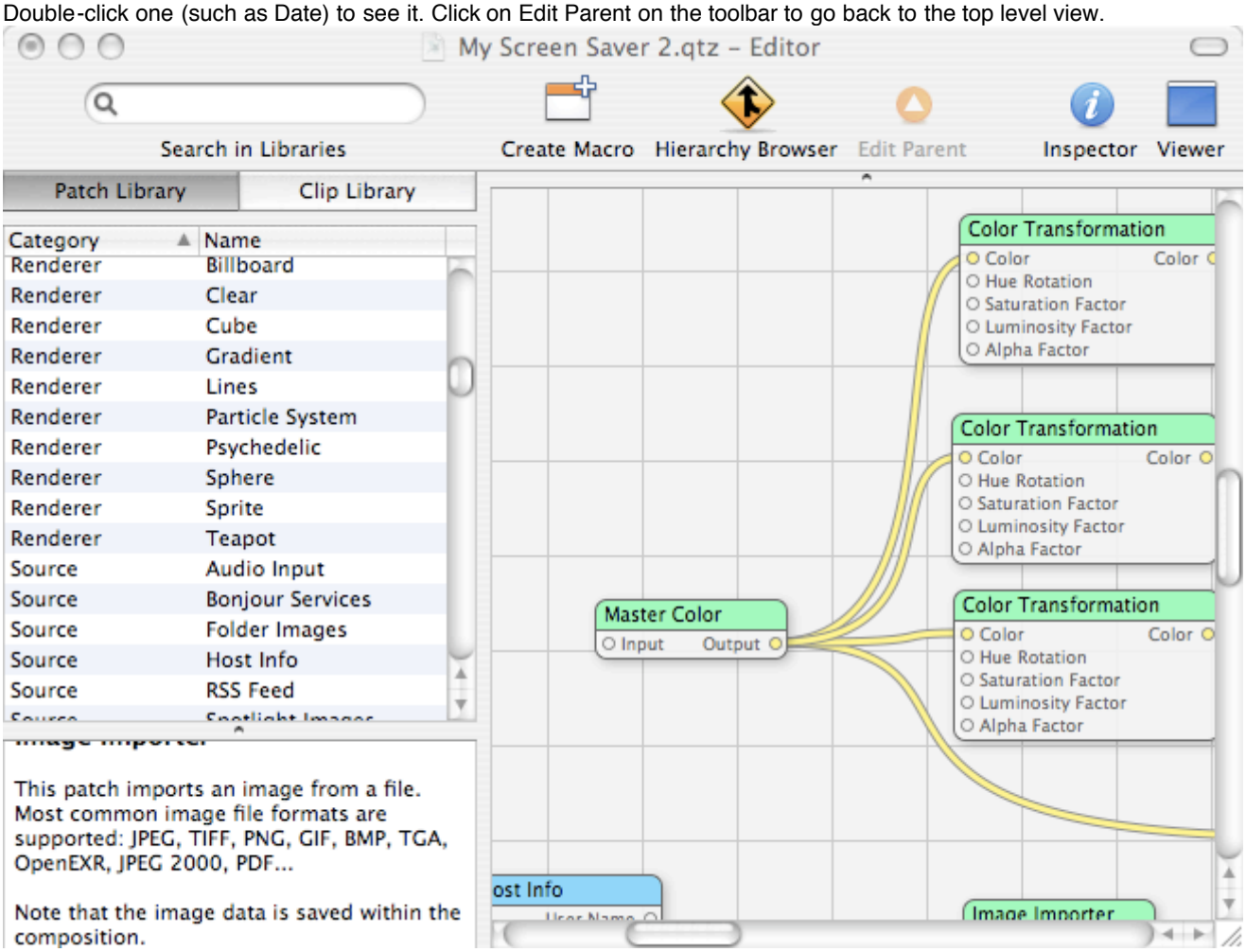
One Hour with Quartz Composer
A Tutorial to Make an Analog Clock Screensaver

Here's an introduction to Quartz Composer - Apple's new graphical development tool for making all sorts of visual presentations. We're going to make an analog clock screen saver. It's going to be customisable and doesn't require any programming -- maybe a bit of image editing though.

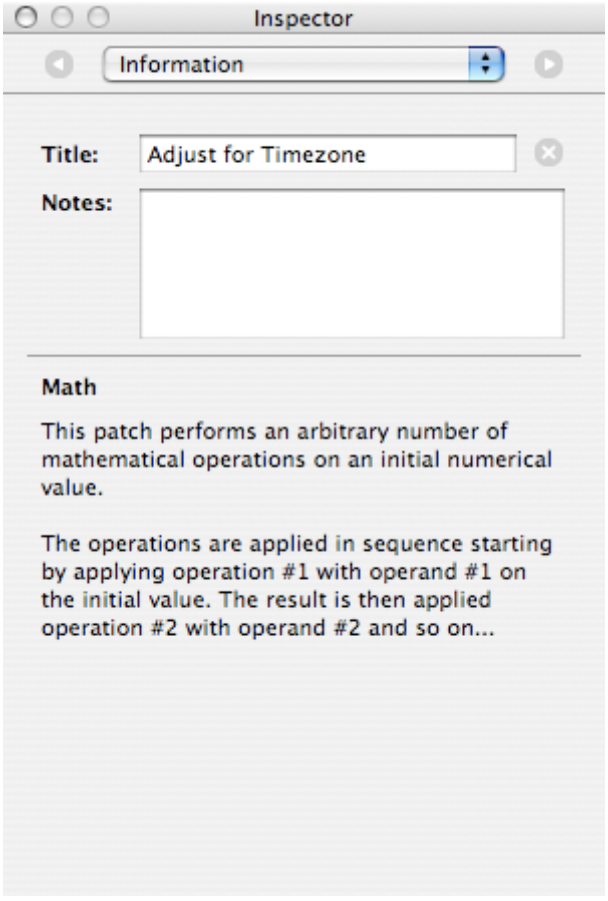
1. First let's make sure *Quartz Composer* is installed. To get Quartz Composer, you must install the Xcode Tools packages which can be found on your Tiger DVD. Quartz Composer installs into the Developer/Applications/Graphics Tools folder of your main hard drive. If it is not there install the package from the DVD.
2. Now start Quartz Composer by double-clicking on its icon in Developer/Applications/Graphics Tools.

Quartz Composer

3. Click Continue on the Unsupported Configuration message if it appears.
4. In the Assistant window, click on Mac OS X Screen Saver and click Next.
5. Give your screen saver a name, such as My Analog Clock and click Finish.
6. Click Continue if a window appears indicating errors. This did not cause any problems for me.
7. The main window and the Viewer window appear. Close the Viewer window for now. On the left hand side of the main window is a list of all of the features you can add to your composition. These are called *patches*. A patch is a functional block with inputs and outputs that can be inserted into the composition. The *composition* is what you are creating, in this case a Screen Saver. The main section of the window on the right is the editor where you draw out your composition by making connections between inputs and outputs of the various patches. Notice that there are multiple layers to this. For example some of the patches can be expanded and they contain patches of their own. An example of this is those patches with a pink background on the title. Double-click one (such as Date) to see it. Click on Edit Parent on the toolbar to go back to the top level view.



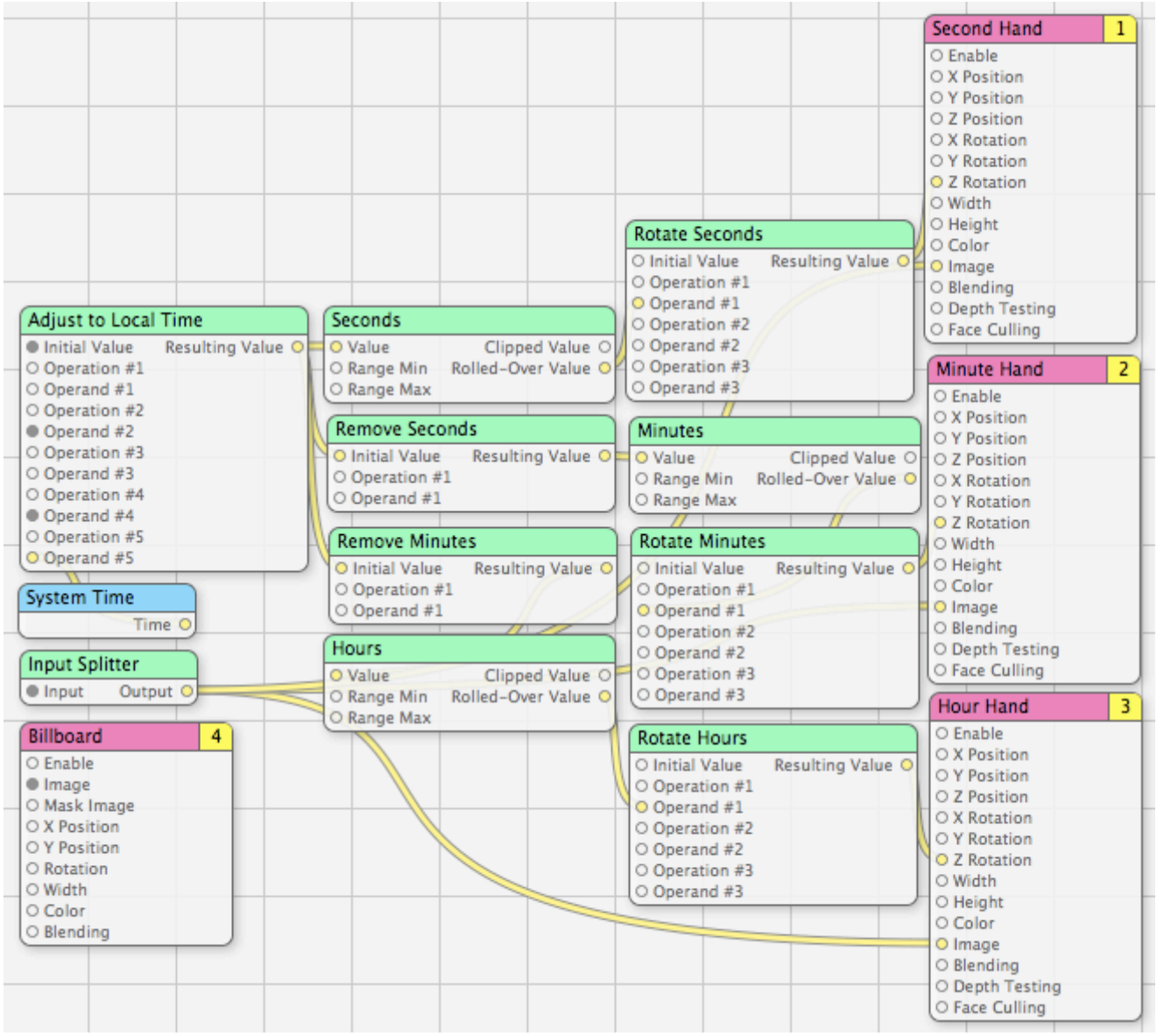
8. For now, ignore the patches provided by the template, we're going to create our own. Find a clear area in the editor window by scrolling around. Click Create Macro on the toolbar. Click on the patch that appears so that it is selected (it will get a thick outline) and click the Inspector button on the toolbar. The Inspector is a window which displays all of the settings for the currently selected patch(es) and allows you to change them. For now, type Analog Clock in the Title box (choose Information from the drop down box if you cannot see the Title box) and press Enter. The editor will update with the new name.



9. Double-click on the Analog Clock patch in the Editor. This opens the clean canvas representing the Analog Clock patch.
10. We're going to put a lot of patches in this view. To start with, let's add a System Time patch. You will find this in the Tool category of the Patch List to the left of the editor. Click on it, then click and drag it into an empty space on the canvas.
11. You can see a description of the System Time patch below the patch list. You can also see the inputs and outputs on the canvas. Inputs are displayed on the left of the patch (System Time has no inputs) and outputs on the right. System Time has one output called Time.
12. Now we will start building the clock. First, System Time is in universal time, so we are going to convert it to a local time by using a Math patch. Drag a Math patch from the Numeric category to the canvas. Now select the Math patch and open the Inspector. Change the title to Adjust to Local Time. Change to the Settings page and click the + sign three times so that the patch has 5 operator and operand inputs. Change to the Input parameters page. On this page you can change the values of the inputs to the patch. You would do this if the value will always be constant, otherwise you would connect the input to the output of another patch if it will be variable. For Initial Value enter the number of hours that your timezone is offset from GMT (for me this is 8). For Operation #1 choose Multiply, and put 60 in Operand #1. For Operation #2 choose Add, and put the number of minutes your timezone is offset from GMT (likely 0 or 30) in Operand #2. For Operation #3 choose Multiply and again enter 60 in Operand #3. For Operation #4 choose Add and enter the number of seconds your timezone is offset from GMT (likely 0) in Operand #4. Lastly choose Add for Operation #5.
13. We left Operand #5 alone because we are going to connect this to the real system time that is output from the System Time patch. To make a connection between patches, click and drag from the circle at the output to the circle at the input you want to connect it to. You must drag from output to input - you are indicating the flow of information with this drag, and the opposite direction won't work. Drag from the circle next to Time on the System Time patch we added earlier to the Operand #5 input's circle on the Adjust to Local Time patch. A yellow rope will appear between the two patches.
14. Remember how we are working inside of a macro patch. What if you want something outside the macro to affect an input? You can do this by *publishing* the input. This will cause whatever you select to correspond to an input outside of the macro patch. We will do this for our timezone values (you may want to share your screen saver with friends and family in a different timezone). To publish an input, right-click on the patch that contains it. In this case right-click (control-click if you have only one button) on the Adjust to Local Time patch, highlight Published Inputs and click on Initial Value. The menu will disappear and a text entry field will open. Type a name for the input, here we will use Timezone Hours, and press enter. Notice that the circle next to the input name will now be filled in. Repeat these steps for Operand #2 (Timezone Minutes) and Operand #3 (Timezone Seconds).
15. Now click Edit Parent on the toolbar to go up one level, and you should see three new inputs on the Analog Clock patch. If these are connected to something, or if the value is edited in the Inspector, that value will be used, otherwise the values we set in step 12 will apply.
16. Now repeat the process of publishing the inputs. Why? Because if inputs are published at the top level, a user can change them as they like in the Desktop and Screen Saver preference pane of System Preferences. You can use the same name as before.
17. That covers the basics of using Quartz Composer, but there isn't anything to see yet. We have to add more connections and patches to get a working clock. Follow the below steps in order to get a working clock. Tip: If you double-click on the circle for an input, you can set its value without using the Inspector.
    1. Add a Numeric:Range patch. Call it Seconds. Connect Resulting Value from Adjust to Local Time to the Value input. Set

Range Min to 0 and Range Max to 60.
2. Add a Numeric:Math patch. Call it Remove Seconds. Set the number of operations to 1 in the Inspector. Connect Resulting Value from Adjust to Local Time to the Initial Value input. Set Operation #1 to Divide and Operand #1 to 60.
3. Add a Numeric:Range patch. Call it Minutes. Connect Resulting Value from Remove Seconds to the Value input. Set Range Min to 0 and Range Max to 60.
4. Add a Numeric:Math patch. Call it Remove Minutes. Set the number of operations to 1 in the Inspector. Connect Resulting Value from Adjust to Local Time to the Initial Value Input. Set Operation #1 to Divide and Operand #1 to 3600.
5. Add a Numeric:Range patch. Call it Hours. Connect Resulting Value from Remove Minutes to the Value input. Set Range Min to 0 and Range Max to 12.
6. Add a Numeric:Math patch. Call it Rotate Seconds. Connect Rolled-Over Value from Seconds to the Operand #1 input. Set the number of operations to 3, Initial Value to 60, Operation #1 to Subtract, Operation #2 to Add, Operand #2 to 15, Operation #3 to Multiply and Operand #3 to 6.
7. Add a Numeric:Math patch. Call it Rotate Minutes. Connect Rolled-Over Value from Minutes to the Operand #1 input. Set the number of operations to 3, Initial Value to 60, Operation #1 to Subtract, Operation #2 to Add, Operand #2 to 15, Operation #3 to Multiply and Operand #3 to 6.
8. Add a Numeric:Math patch. Call it Rotate Hours. Connect Rolled-Over Value from Hours to the Operand #1 input. Set the number of operations to 3, Initial Value to 12, Operation #1 to Subtract, Operation #2 to Add, Operand #2 to 3, Operation #3 to Multiply and Operand #3 to 30.
9. Add a Renderer:Sprite patch. Call it Second Hand. Connect Resulting Value from Rotate Seconds to the Z Rotation input. Change the width to 0.5, the height to 0.01, blending to Over and leave the rest as they are.
10. Add another Renderer:Sprite patch. Call it Minute Hand. Connect Result-cliing Value from Rotate Minutes to the Z Rotation input. Change the width to 0.4, the height to 0.02 and blending to Over.
11. Add one more Renderer:Sprite patch. Call it Hour Hand. Connect Resulting Value from Rotate Hours to the Z Rotation input. Change the width to 0.3, the height to 0.03 and blending to Over.

18. Now click the Viewer button on the toolbar. A window will appear which is displaying your toolbar. You should see three rectangles rotating around. This is your clock, but at this stage, it's pretty lifeless. Let's add some images. The problem here is that you need some images with a transparent half or otherwise to indicate which half of the rectangle is pointing to the time. You can use a tool like Photoshop to make such an image (or Pixen is a free alternative). The clock hand should be drawn such that it is pointing to three o'clock. Now let's add the patches we need.
    1. Go back to the Editor and add a Tool:Input Splitter patch. Go to the Settings page in the Inspector and choose Image from the Type list. Make a connection from the Output to the Image input of Hour Hand, Minute Hand and Second Hand -- three connections in total. Now publish the input (right-click or control-click on the patch) and call it Hand Image.
    2. Click Edit Parent and add a Generator:Image Importer patch. Go to the Settings page of the Inspector and choose Import from File.... Choose the image you want to use for the hands. Now connect the Image output to the Hand Image input of the Analog Clock patch.
19. Now return to the Viewer window and you should see the graphic you chose for the hands being used. If it doesn't honour the transparency in your image, make sure you saved it in a format that supports transparency (such as PNG). But it still doesn't look like a clock. Let's add a face. Return to the editor and double-click on the Analog Clock patch.
    1. Add a Renderer:Billboard patch. Leave all of the inputs the same. Publish the Image input as Face Image. If you added a face image now, you may find that it blocks out the clock hands you already added. To avoid this we will change the *rendering layer* of the Billboard patch. The rendering layer number is a number in a yellow box in the corner of any patch which displays something. It defines the stacking order of display of items. Higher numbers can obscure lower ones, so to place the clock face in the background, we will put it on Layer 1 - the lowest layer. Right-click or control-click on the patch again and choose Layer 1 from the Rendering Layer menu.



20. Again, click Edit Parent. This time we're going to do something different. Instead of adding another patch, right-click or control-click the Analog Clock patch and publish the new Face Image input. Now the user can change the image in the System Preferences application for themselves.
21. Let's test out the screen saver. Save your screen saver by choosing Save from the File menu. Now open the System Preferences application (either from the Dock or the Applications folder). Click on Desktop and Screen Saver and choose the Screen Saver tab. In the list there should be a new entry with the name you gave in step 5. Click Options. Notice that all of the options for time zone are there and have been filled in for us. Also notice that there is an image well for the clock face. It's currently empty, so either drag an image into it, or double-click to open a file chooser. Once you've chosen your image, click Done. The screen saver will update with your new clock face. You're done! Click on Test to see your new screen saver full-size.

You can share this screen saver with friends (it is in the Library/Screen Savers subfolder of your home folder), customise it to include more or less information or whatever you wish. Try other patches -- you could make your clock face a screen saver, or even write the time inside of the clock hands using the patches in the patch list. Have fun!