The main difference between TI-BASIC programming and Lua programming is the way the user interaction is turned inside out. BASIC programs are in control: they read input from users and display results whenever their logic dictates. Lua scripts, on the other hand, are reactive. They may only accept input in response to events such as key presses. And they only display results indirectly in response to the system requesting a repaint. It takes a new way of thinking to write programs in this fashion.

-John Powers 1/14/13

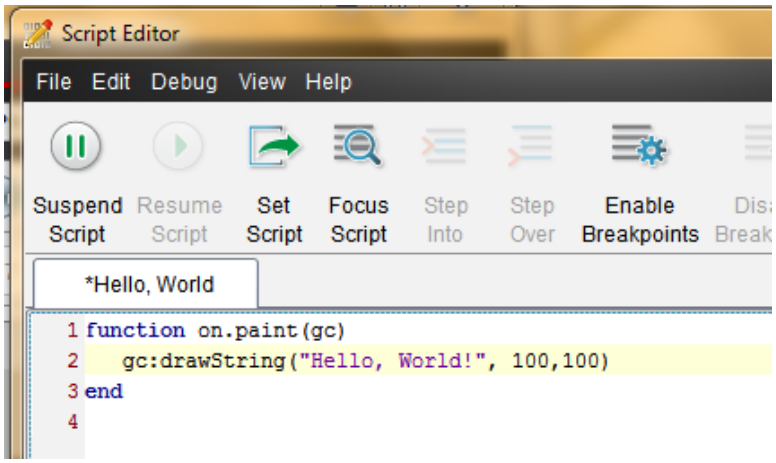
Background

'Lua' means 'moon' in Portuguese and the name derives from the language's ancestry. It was developed at the Pontifical Catholic University of Rio de Janeiro in Brazil. Lua is an embedded language that uses an interpreter in the host operating system (in our case, the TI-Nspire OS). It is robust, fast, portable, embeddable, powerful, simple, small, and, best of all, *free*.

Writing a Lua program in TI-Nspire results in the creation of a custom application (app). This app can be controlled like any built-in app: it can be copied & pasted to other TI-Nspire documents, it can be split-screened and it can communicate with other apps via TI-Nspire variables. But the Lua program has to account for mouse actions and keystrokes in order to provide for interaction.

Use the *Script Editor* in the computer software (see **Insert** menus) to write your Lua programs. Lua apps are not created on the handheld although there are two special TI-Nspire documents that let you write and edit Lua programs (oclua.tns and TIDE.tns) for teaching purposes. And a special concern is that, when developing a Lua app, we have to plan for its behavior in the software, handheld and online Document Player.

Your first Lua app (*Lua is caseSensitive*):



Notes:
on.paint is the *event* that's responsible for displaying stuff.
gc = "graphics context", the canvas

drawString to draw a string. *There **are** other things to draw!*

100, 100 are 'screen coordinates'. 0, 0 is the upper left corner of the screen.

Click the 'Set Script' button on the toolbar to run the program. Use 'Focus Script' to being the app to the foreground. If there's a syntax error in your program, the error message will appear at the bottom of the Editor in the '`Console`'. If you use `print( )` statements their output will also appear in the console.

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Necessary resources:

www.lua.org – the home site of Lua
http://www.lua.org/manual/5.2/ - the official Lua reference manual. Bookmark it.
http://education.ti.com/en/us/product-resources/nspire-scripting - the documentation for the TI-Nspire extensions to Lua. You will need the *Lua Scripting API Reference Guide*. Download the pdf and open it.

After reading *all* the documentation you will discover some useful functions:

```
platform.window:width()
platform.window:height()
```

… determine the width and height of the application (window) in which you are working.

So, to improve the program (*not very efficient, though*):

```
function on.paint(gc)
   W = platform.window:width()                    -- width of screen
   H = platform.window:height()                   -- height of screen
   str = "Hello, World!"                          -- the string to draw
   sw = gc:getStringWidth(str)                    -- string width
   sh = gc:getStringHeight(str)                   -- string height
   gc:setColorRGB(128, 128, 128)                  -- sets the paint color
   gc:drawString(str, (W-sw)/2,(H-sh)/2)          -- do the math!
end
```

Images

The *Script Editor* is used to convert picture files into strings that Lua uses to represent the image.
Insert Image pastes a quoted string into the Editor at the current cursor position:
At the top of your code:

```
img = image.new(cursor_here_when_inserting_an_image)
i = image.copy(img, 50, 100)          -- make a copy that will fit
```

Then, in `on.paint(gc)` use:

```
gc:drawImage(i, 0, 0)                 -- draw the copy
```

Other Graphics

gc:drawRect(x1, y1, w, h)
gc:fillRect(x1, y1, w, h)
gc:drawArc(cx, cy, r1, r2, a1, a2)
etc… see the TI-Nspire documentation

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Events (on.things)

The Lua app responds to 'events' and the events are part of the `on.` module.

```
function init()  -- my own function
  x=0
end

function on.construction() -- when the app is constructed
  init()
end

function on.paint(gc) -- when the app needs to be repainted
   W=platform.window:width()
   H=platform.window:height()
   str="Hello, eWorld!"
   sw=gc:getStringWidth(str)
   sh= gc:getStringHeight(str)
   gc:drawString(str, (W-sw)/2,(H-sh)/2)
   gc:drawString(x,10,50)
end

function on.mouseMove() -- when the mouse is moved
   x=x+1
end

function on.mouseDown() -- when the left mouse button is pressed
  init()
+end
```

Classes

Classes provide a means of encapsulating *objects* with data and member functions similar to Java programming. Here's a complete Lua example:

```
circle=class() -- the name of the class is circle

function circle:init(cx, cy, radius) -- called when a circle
                                     -- object is created
  self.x = cx
  self.y = cy
  self.r = radius
end

function circle:paint(gc)  -- the routine to draw the circle
  gc:drawArc(self.x, self.y, self.r, self.r, 0, 360)
end

c = circle(50, 50, 50) -- c is now the circle object

function on.paint(gc)
  c:paint(gc)
end
```

Tables

Tables are used *extensively* in Lua for organizing data. Similar to TI-Nspire lists but much more powerful. The `for` loop is used to access the elements of a table:

```
x=65
myTable={3, 4, "John", x}

function on.paint(gc)
    for i = 1, #tabl do
      gc:drawString(myTable[i], 50, 20*i+20)
    end
end
```

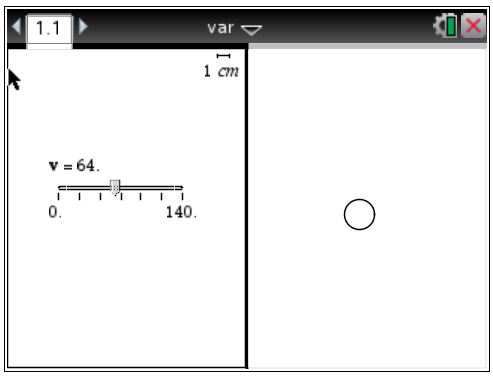
Tables can be built 'on the fly' using:

```
table.insert(myTable,"thing")
```

For object-oriented programming, a table can contain *different* objects.

Communicating with other apps

`var.monitor, var.store, var.recall` and `on.varChange` are used to pass values between the Lua app and the other apps in the problem.
Demo: make a Graphs or Geometry app and create a slider. Call the variable v. Create a Lua app and make the code:




```
function on.construction()
   var.monitor("v")    -- listen to the TI-Nspire variable v
   xpos = 0
end

function on.paint(gc)
    gc:drawArc(xpos, 100, 20, 20, 0, 360) -- draw a circle
end

function on.varChange()    -- when v changes
    xpos = var.recall("v") -- copy its value into the Lua app
end
```

You can combine the two apps onto one page by pressing ctrl-4 on the first page.

Other resources:

Steve Arnold's Most Excellent Lua Tutorials:
http://compasstech.com.au/TNS_Authoring/Scripting/index.html

An online Lua for TI-Nspire editor and emulator:
http://compasstech.com.au/TNS_Authoring/Scripting/luajs/editor.html
… works on tablets (including iPad) as well as computers. Write and test code here.

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