5 STEPS TO BUILD PYTHON NATIVE GUI WIDGETS FOR

BeeWare is

Software libraries for cross-platform native app development from a single Python codebase

and

Tools to simplify app deployment

HELLO WORLD

```
import toga


class HelloWorld(toga.App):
    def startup(self):
        self.main_window = toga.MainWindow(title=self.name)
        main_box = toga.Box()
        self.main_window.content = main_box
        self.main_window.show()


def main():
    return HelloWorld('Hello World', 'org.pybee.helloworld')
```

CURRENT STATUS

- Solid proof of concept
- Open Source (BSD)
- 400+ contributors

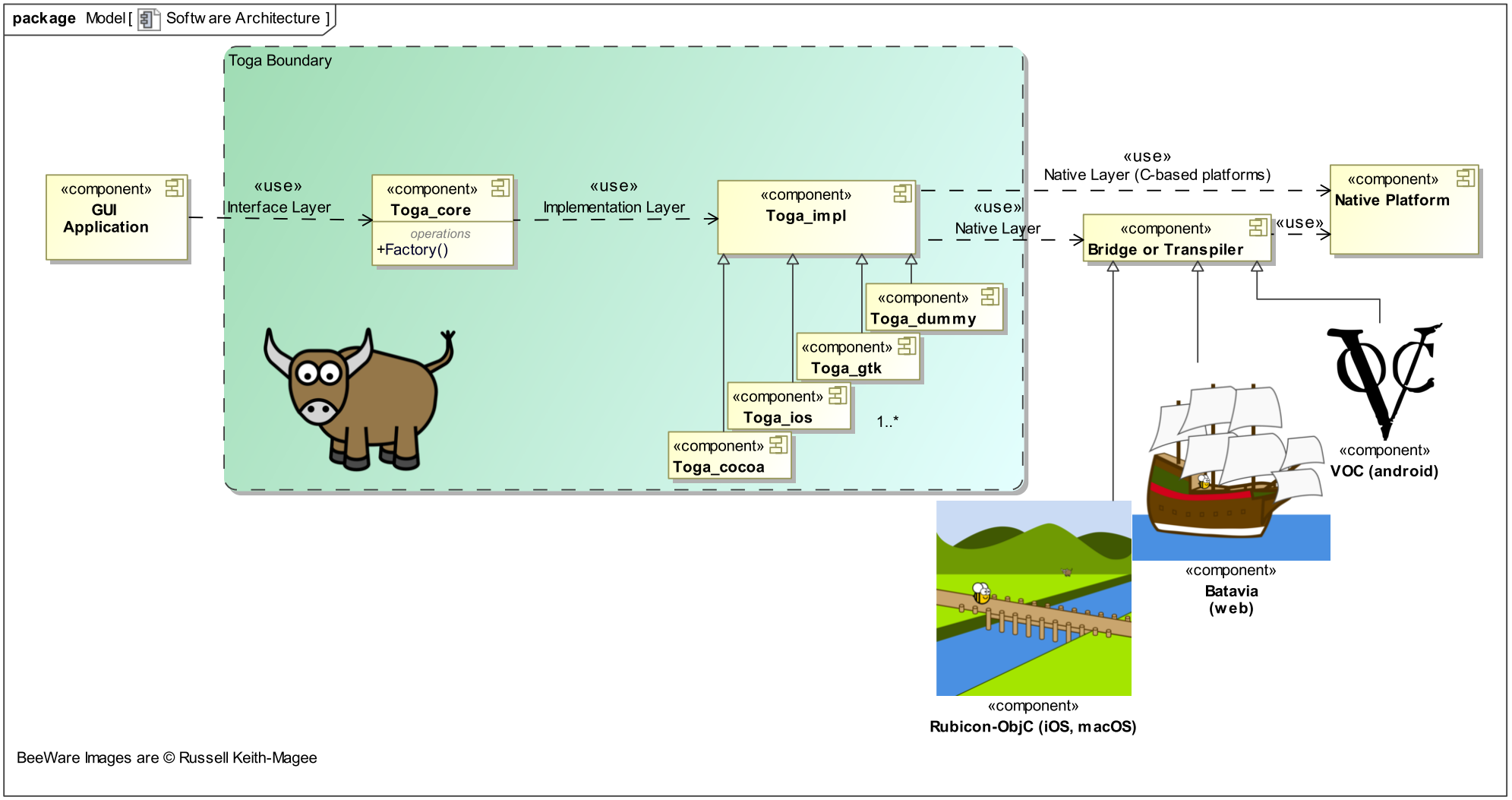
TOGA WIDGET

- The controls and logic that a user interacts with when using a GUI

- A Canvas widget will be used as an example

INTERNAL LAYERS

- The **Interface** layer
- The **Implementation** layer
- The **Native** layer


package Model [Software Architecture]
Toga Boundary
«component»
GUI
Application
«use»
Interface Layer
«component»
Toga_core
operations
+Factory()
«use»
Implementation Layer
«component»
Toga_impl
«component»
Toga_dummy
«component»
Toga_gtk
«component»
Toga_ios
«component»
Toga_cocoa
1..*
«use»
Native Layer
«use»
Native Layer (C-based platforms)
«component»
Bridge or Transpiler
«use»
«component»
Native Platform
«component»
VOC (android)
«component»
Batavia
(web)
«component»
Rubicon-ObjC (iOS, macOS)
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STEP 0

DEVELOPMENT PLATFORM

- Normally pick the platform that you are most familiar with
- macOS and Gtk+ are the most developed 👍
- Is this a mobile only widget (camera, GPS, etc)?

STEP 1

RESEARCH YOUR WIDGET

- How do you create this widget on different platforms
- Think, brainstorm, whiteboard, and discuss how you would want to create and manipulate this widget with Python

RESEARCH YOUR WIDGET

Tkinter

```
canvas = Tk.Canvas()
canvas.create_rectangle(10, 10, 100, 100, fill="C80000")
canvas.pack()
```

wxpython

```
wx.Panel.Bind(wx.EVT_PAINT, OnPaint)
def OnPaint(self, evt):
    dc = wx.PaintDC()
    dc.SetBrush(wx.Brush(wx.Colour(200, 0, 0)))
    dc.DrawRectangle(10, 10, 100, 100)
```

RESEARCH YOUR WIDGET

HTML canvas

```
var c = document.getElementById("myCanvas");
var ctx = c.getContext("2d");
ctx.fillStyle = "rgb(200, 0, 0)";
ctx.fillRect(10, 10, 100, 100);
```

Gtk+

```
drawingarea = Gtk.DrawingArea()
drawingarea.connect("draw", draw)
def draw(da, ctx):
    ctx.set_source_rgb(200, 0, 0)
    ctx.rectangle(10, 10, 100, 100)
    ctx.fill()
```

STEP 2

INTERFACE LAYER: PYTHONIC API

- Write your API documentation first
- The API provides the set of clearly defined methods of communication (layers) between the software components
- Documentation Driven Development
- This is iterative with Step 1

WRITE DOCS

```
The canvas is used for creating a blank widget that you can
draw on.

Usage
-----

Simple usage to draw a colored rectangle on the screen using
the arc drawing object:

import toga
canvas = toga.Canvas(style=Pack(flex=1))
with canvas.fill(color=rgb(200, 0, 0)) as fill:
    fill.rect(10, 10, 100, 100)
```

WRITE CODE OUTLINE

```
class Canvas(Context, Widget):
    """Create new canvas.

    Args:
        id (str):  An identifier for this widget.
        style (:obj:`Style`): An optional style object.
        factory (:obj:`module`): A python module that is
            capable to return a implementation of this class.

     """
```

```
def rect(self, x, y, width, height):
    """Constructs and returns a :class:`Rect <Rect>`.

    Args:
        x (float): x coordinate for the rectangle.
    ...
    """
```

STEP 3

IMPLEMENT TOGA_CORE (WITH TDD)

- Write a test for each function of the widget outlined in the API from Step 3
- Check that the tests fail
- Specify the implementation layer API
- Write the core code for the widget to call the implementation layer

WRITE TESTS FOR TOGA_CORE

```
def test_widget_created():
    assertEqual(canvas._impl.interface, canvas)
    self.assertActionPerformed(canvas, "create Canvas")
```

```
def test_rect_modify():
    rect = canvas.rect(-5, 5, 10, 15)
    rect.x = 5
    rect.y = -5
    rect.width = 0.5
    rect.height = -0.5
    canvas.redraw()
    self.assertActionPerformedWith(
            canvas, "rect", x=5, y=-5, width=0.5, height=-0.5
        )
```

CODE TOGA_CORE

```
class Canvas(Widget):
    def __init__(self, id=None, style=None, factory=None):
        super().__init__(id=id, style=style, factory=factory)

        # Create a platform specific implementation of Canvas
        self._impl = self.factory.Canvas(interface=self)

    def rect(self, x, y, width, height):
        self.impl.rect(
            self.x, self.y, self.width, self.height
        )
```

STEP 4

IMPLEMENT TOGA_IMPL

DUMMY BACKEND

- Dummy is for automatic testing without a native platform
- Code the implementation layer API endpoint, create a method for each call of the API
- Check that all tests now pass

IMPLEMENT TOGA_IMPL

DUMMY BACKEND

```
class Canvas(Widget):
    def create(self):
        self._action("create Canvas")

    def rect(self, x, y, width, height):
        self._action(
            "rect", x=x, y=y, width=width, height=height
        )
```

STEP 5

IMPLEMENT TOGA_IMPL

YOUR PLATFORM

- Copy toga_dummy and create a new endpoint for the platform you chose in Step 1
- Make use of the native interface API for this widget on your platform

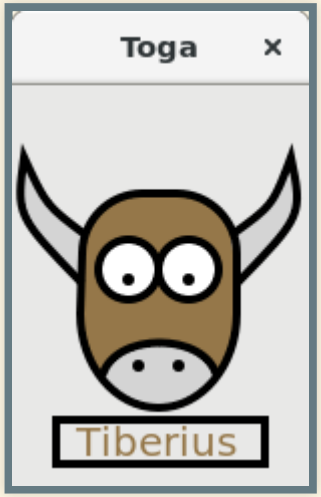
IMPLEMENT TOGA_IMPL

YOUR PLATFORM

```
class Canvas(Widget):
    def create(self):
        self.native = Gtk.DrawingArea()
        self.native.interface = self.interface
        self.native.connect("draw", self.gtk_draw_callback)

    def gtk_draw_callback(self, canvas, gtk_context):
        self.interface._draw(self, draw_context=gtk_context)

    def rect(self, x, y, width, height, draw_context):
        draw_context.rectangle(x, y, width, height)
```



SUBMIT A PULL REQUEST!

🎉 👍 💖

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