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# **BeeWare Documentation**

***Release 0.3.0***

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# CONTENTS

|          |  |           |
|----------|--|-----------|
| <b>1</b> | <b>Tutorial 0 - Let's get set up!</b>          | <b>3</b>  |
| 1.1      | Install Python . . . . .                       | 3         |
| 1.2      | Install dependencies . . . . .                 | 4         |
| 1.3      | Set up a virtual environment . . . . .         | 5         |
| 1.4      | Next steps . . . . .                           | 5         |
| <b>2</b> | <b>Tutorial 1 - Your first app</b>             | <b>7</b>  |
| 2.1      | Install the BeeWare tools . . . . .            | 7         |
| 2.2      | Bootstrap a new project . . . . .              | 8         |
| 2.3      | Run the app in developer mode . . . . .        | 9         |
| 2.4      | Next steps . . . . .                           | 13        |
| <b>3</b> | <b>Tutorial 2 - Making it interesting</b>      | <b>15</b> |
| 3.1      | What was generated . . . . .                   | 15        |
| 3.2      | Adding some content of our own . . . . .       | 17        |
| 3.3      | Next steps . . . . .                           | 21        |
| <b>4</b> | <b>Tutorial 3 - Packaging for distribution</b> | <b>23</b> |
| 4.1      | Creating your application scaffold . . . . .   | 23        |
| 4.2      | Building your application . . . . .            | 25        |
| 4.3      | Running your app . . . . .                     | 26        |
| 4.4      | Building your installer . . . . .              | 26        |
| 4.5      | Next steps . . . . .                           | 27        |
| <b>5</b> | <b>Tutorial 4 - Updating your application</b>  | <b>29</b> |
| 5.1      | Updating application code . . . . .            | 29        |
| 5.2      | Updating dependencies and icons . . . . .      | 30        |
| 5.3      | Update and run in one step . . . . .           | 30        |
| 5.4      | Next steps . . . . .                           | 32        |
| <b>6</b> | <b>Tutorial 5 - Taking it Mobile</b>           | <b>33</b> |
| 6.1      | iOS . . . . .                                  | 33        |
| 6.2      | Android . . . . .                              | 33        |
| <b>7</b> | <b>Tutorial 6 - Put it on the web!</b>         | <b>43</b> |
| 7.1      | Next steps . . . . .                           | 43        |
| <b>8</b> | <b>Tutorial 7 - Publishing your app!</b>       | <b>45</b> |
| 8.1      | Next steps . . . . .                           | 45        |



## **Write Python. Run Anywhere.**

BeeWare is a suite of tools and libraries, each of which works together to help you write cross platform native GUI Python applications. It includes:

- [Toga](#), a cross platform widget toolkit;
- [Briefcase](#), a tool for packaging Python projects as distributable artefacts that can be shipped to end users;
- [Rubicon ObjC](#), a library for working with Objective C libraries on iOS and macOS from within Python code;
- [Rubicon Java](#), a library for working with Java libraries from within Python code;
- Pre-compiled builds of Python that can be used on platforms where official Python installers aren't available.

You can use each of the tools in isolation, or you can use all of them as a suite.

The full BeeWare suite also includes [software development tools](#) and [applications](#) that have been written using BeeWare's own libraries.

The BeeWare suite is available on macOS, Windows, Linux (using GTK); on mobile platforms such as Android and iOS; and for the Web. Support for other platforms (such as set top boxes and watches) is on our long term roadmap.

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### **Platform support**

The BeeWare suite is a work in progress. Some tools and libraries are more mature than others, and some platforms have better support than others. In particular, Web support should be considered experimental only.

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Ready to try BeeWare for yourself? *[Let's build a cross platform application in Python!](#)*



## TUTORIAL 0 - LET'S GET SET UP!

Before we build our first BeeWare app, we have to make sure we've got all the prerequisites for running BeeWare.

### 1.1 Install Python

The first thing we'll need is a working Python interpreter, **running Python 3.5 or higher**.

macOS

Linux

Windows

If you're on macOS, you can get the official installer from [the Python website](#). You can use any stable version of Python from 3.5 onward (although we'd advise avoiding alphas, betas, and release candidates unless you *really* know what you're doing).

If you're on Linux, you'll install Python using the system package manager (`apt` on Debian/Ubuntu/Mint; `dnf` on Fedora, or `pacman` on Arch).

We don't support Raspberry Pi at this time.

If you're on Windows, you can get the official installer from [the Python website](#). You can use any stable version of Python from 3.5 onward (although we'd advise avoiding alphas, betas and release candidates unless you *really* know what you're doing).

---

#### Alternative Python distributions

There are lots of different ways of installing Python. You can install Python through [homebrew](#). You can use [pyenv](#) to manage multiple Python installs on the same machine. Windows users can install Python from the Windows App Store. Users from a data science background might want to use [Anaconda](#) or [Miniconda](#).

It doesn't matter *how* you've installed Python - it only matters that you can run `python3` from your operating system's command prompt/terminal application, and get a working Python interpreter.

---

## 1.2 Install dependencies

Next, install the additional dependencies needed for your operating system:

macOS

Linux

Windows

Building BeeWare apps on macOS require:

- **Git**, a version control system. You can download Git from [git-scm.org](https://git-scm.org).
- **Xcode**, Apple's IDE tooling. Xcode is available for free from [the macOS App Store](https://apps.apple.com/us/app/xcode/id1295531922).

To support local development, you'll need to install some system packages. The list of packages required varies depending on your distribution:

### Ubuntu 16.04, Debian 9

```
$ sudo apt-get update
$ sudo apt-get install git python3-dev python3-venv libgirepository1.0-dev libcairo2-
↳dev libpango1.0-dev libwebkitgtk-3.0-0 gir1.2-webkit-3.0
```

### Ubuntu 18.04, Debian 10

```
$ sudo apt-get update
$ sudo apt-get install git python3-dev python3-venv libgirepository1.0-dev libcairo2-
↳dev libpango1.0-dev libwebkit2gtk-4.0-37 gir1.2-webkit2-4.0
```

### Fedora

```
$ sudo dnf install git pkg-config python3-devel gobject-introspection-devel cairo-
↳devel cairo-gobject-devel pango-devel webkitgtk4
```

### Arch, Manjaro

```
$ sudo pacman -Syu git pkgconf cairo python-cairo pango gobject-introspection gobject-
↳introspection-runtime python-gobject webkit2gtk
```

Briefcase also uses a tool called AppImage to build binaries that can be used across Linux distributions. However, building AppImage binaries for Linux is complicated, because of the inconsistent library versions present on each distribution. Briefcase uses Docker to provide a well-controlled binary environment for hosting AppImage builds.

Official installers for [Docker Engine](https://docs.docker.com/engine) are available for a range of Unix distributions. Follow the instructions for your platform. Once you've installed Docker, you should be able to start an Ubuntu 16.04 container:

```
$ docker run -it ubuntu:16.04
```

This should show you a Unix prompt (something like *root@84444e31cff9:/#*) inside your Docker container. Type Ctrl-D to exit Docker and return to your local shell.

Building BeeWare apps on Windows requires:

- **Git**, a version control system. You can download Git from [git-scm.org](https://git-scm.org).
- **WiX Toolset**, a set of utilities for building Windows installers. An installer can be obtained from [the WiX Toolset website](https://wixtoolset.org/).



## 1.3 Set up a virtual environment

We’re now going to create a virtual environment - a “sandbox” that we can use to isolate our work on this tutorial from our main Python installation. If we install packages into the virtual environment, our main Python installation (and any other Python projects on our computer) won’t be affected. If we make a complete mess of our virtual environment, we’ll be able to simply delete it and start again, without affecting any other Python project on our computer, and without the need to re-install Python.

macOS

Linux

Windows

```
$ mkdir beeware-tutorial
$ cd beeware-tutorial
$ python3 -m venv beeware-venv
$ source beeware-venv/bin/activate
```

```
$ mkdir beeware-tutorial
$ cd beeware-tutorial
$ python3 -m venv beeware-venv
$ source beeware-venv/bin/activate
```

```
C:\...>md beeware-tutorial
C:\...>cd beeware-tutorial
C:\...>py -m venv beeware-venv
C:\...>beeware-venv\Scripts\activate.bat
```

If this worked, your prompt should now be changed - it should have a `(beeware-venv)` prefix. This lets you know that you’re currently in your BeeWare virtual environment. Whenever you’re working on this tutorial, you should make sure your virtual environment is activated. If it isn’t, re-run the last command (the `activate` command) to re-activate your environment.

---

### Alternative virtual environments

If you’re using Anaconda or miniconda, you may be more familiar with using conda environments. You might also have heard of `virtualenv`, a predecessor to Python’s built in `venv` module. As with Python installs - it doesn’t matter *how* you create your virtual environment, as long as you have one.

Even then - strictly speaking, using a virtual environment is optional. You *can* install BeeWare’s tools directly into your main Python environment. However, it’s really, *really*, **really** recommended that you use a virtual environment.

---

## 1.4 Next steps

We’ve now set up our environment. We’re ready to *create our first BeeWare application*.



## TUTORIAL 1 - YOUR FIRST APP

We're ready to create our first application.

### 2.1 Install the BeeWare tools

First, we need to install **Briefcase**. Briefcase is a BeeWare tool that can be used to package your application for distribution to end users - but it can also be used to bootstrap a new project. Make sure you're in the `beeware-tutorial` directory you created in [Tutorial 0](#), with the `beeware-venv` virtual environment activated, and run:

macOS

Linux

Windows

```
(beeware-venv) $ python -m pip install briefcase
```

```
(beeware-venv) $ python -m pip install briefcase
```

---

#### Possible errors during installation

If you see errors during installation, it's almost certainly because some of the system requirements haven't been installed. Make sure you have *installed all the platform pre-requisites*.

```
(beeware-venv) C:\...>python -m pip install briefcase
```

---

#### Possible errors during installation

If you're using a more recent version of Python (3.8+), installing the beeware package may raise an error. This will usually manifest as:

```
Traceback (most recent call last):
  File "<string>", line 1, in <module>
  File "C:\...\Local\Temp\pip-install-ytuu_37_\pythonnet\setup.py", line 18, in
↳<module>
    from wheel import bdist_wheel
ModuleNotFoundError: No module named 'wheel'
-----
ERROR: Command errored out with exit status 1: python setup.py egg_info Check the_
↳logs for full command output.
```

Depending on the specifics of your environment, it might also manifest as a report that includes the following:

```
Building wheel for pythonnet (setup.py) ... error
ERROR: Command errored out with exit status 1:
...
File "c:\...\Local\Programs\Python\Python38\lib\subprocess.py", line 364, in_
↳check_call
    raise CalledProcessError(retcode, cmd)
subprocess.CalledProcessError: Command '['...\python.exe', 'tools\geninterop\
↳geninterop.py', 'src\runtime\interop38.cs']' returned non-zero exit status 1.
-----
ERROR: Failed building wheel for pythonnet
Running setup.py clean for pythonnet
Failed to build pythonnet
```

This is caused because the beeware package has dependencies, and on Windows, one of those dependencies is [Python for .NET](#). Python for .NET isn't a pure Python package - it contains C# modules that need to be compiled. The Python for .NET team publishes pre-compiled versions of these modules, but they sometimes lag behind in support of more recent versions of Python.

If you get this error, you have three options:

1. Use an older version of Python. Check the [pythonnet entry on PyPI](#) to see the versions of Python currently supported by Python for .NET.
2. Configure your environment to support compiling Python for .NET. This is a moderately complex process, and will require you to have Visual Studio. See [the Python for .NET wiki](#) for details.
3. Install an unofficial compiled wheel. The Python for .NET team suggests [this collection of wheels](#) as a possible source. The `.whl` file can be installed with `python -m pip install somefile.whl`; you should then be able to re-run `python -m pip install --pre beeware`.

---

One of the BeeWare tools is **Briefcase**. Briefcase can be used to package your application for distribution to end users - but it can also be used to bootstrap a new project.

## 2.2 Bootstrap a new project

Let's start our first BeeWare project! We're going to use the Briefcase `new` command to create an application called **Hello World**. Run the following from your command prompt:

macOS

Linux

Windows

```
(beeware-venv) $ briefcase new
```

```
(beeware-venv) $ briefcase new
```

```
(beeware-venv) C:\...>briefcase new
```

Briefcase will ask us for some details of our new application. For the purposes of this tutorial, use the following:

- **Formal Name** - Accept the default value: Hello World.
- **App Name** - Accept the default value: helloworld.

- **Bundle** - If you own your own domain, enter that domain in reversed order. (For example, if you own the domain “cupcakes.com”, enter `com.cupcakes` as the bundle). If you don’t own your own domain, accept the default bundle (`com.example`).
- **Project Name** - Accept the default value: `Hello World`.
- **Description** - Accept the default value (or, if you want to be really creative, come up with your own description!).
- **Author** - Enter your own name here.
- **Author’s email** - Enter your own email address. This will be used in the configuration file, in help text, and anywhere that an email is required when submitting the app to an app store.
- **URL** - The URL of the landing page for your application. Again, if you own your own domain, enter a URL at that domain (including the `https://`). Otherwise, just accept the default URL (`https://example.com/helloworld`). This URL doesn’t need to actually exist (for now); it will only be used if you publish your application to an app store.
- **License** - Accept the default license (BSD). This won’t affect anything about the operation of the tutorial, though - so if you have particularly strong feelings about license choice, feel free to choose another license.
- **GUI framework** - Accept the default option, Toga (BeeWare’s own GUI toolkit).

Briefcase will then generate a project skeleton for you to use. If you’ve followed this tutorial so far, and accepted the defaults as described, your file system should look something like:

```
beeware-tutorial/
  beeware-venv/
  ...
  helloworld/
    LICENSE
    README.rst
    pyproject.toml
    src/
      helloworld/
        resources/
          helloworld.icns
          helloworld.ico
          helloworld.png
          __init__.py
          __main__.py
          app.py
```

This skeleton is actually a fully functioning application without adding anything else. The `src` folder contains all the code for the application, and the `pyproject.toml` file describes how to package the application for distribution. If you open `pyproject.toml` in an editor, you’ll see the configuration details you just provided to Briefcase.

Now that we have a stub application, we can use Briefcase to run the application.

## 2.3 Run the app in developer mode

Move into the `helloworld` project directory and tell briefcase to start the project in Developer (or `dev`) mode:

macOS

Linux

Windows

```
(beeware-venv) $ cd helloworld
(beeware-venv) $ briefcase dev

[hello-world] Installing dependencies...
...
[hello-world] Starting in dev mode...
```

```
(beeware-venv) $ cd helloworld
(beeware-venv) $ briefcase dev

[hello-world] Installing dependencies...
...
[hello-world] Starting in dev mode...
```

```
(beeware-venv) C:\...>cd helloworld
(beeware-venv) C:\...>briefcase dev

[hello-world] Installing dependencies...
...
[hello-world] Starting in dev mode...
```

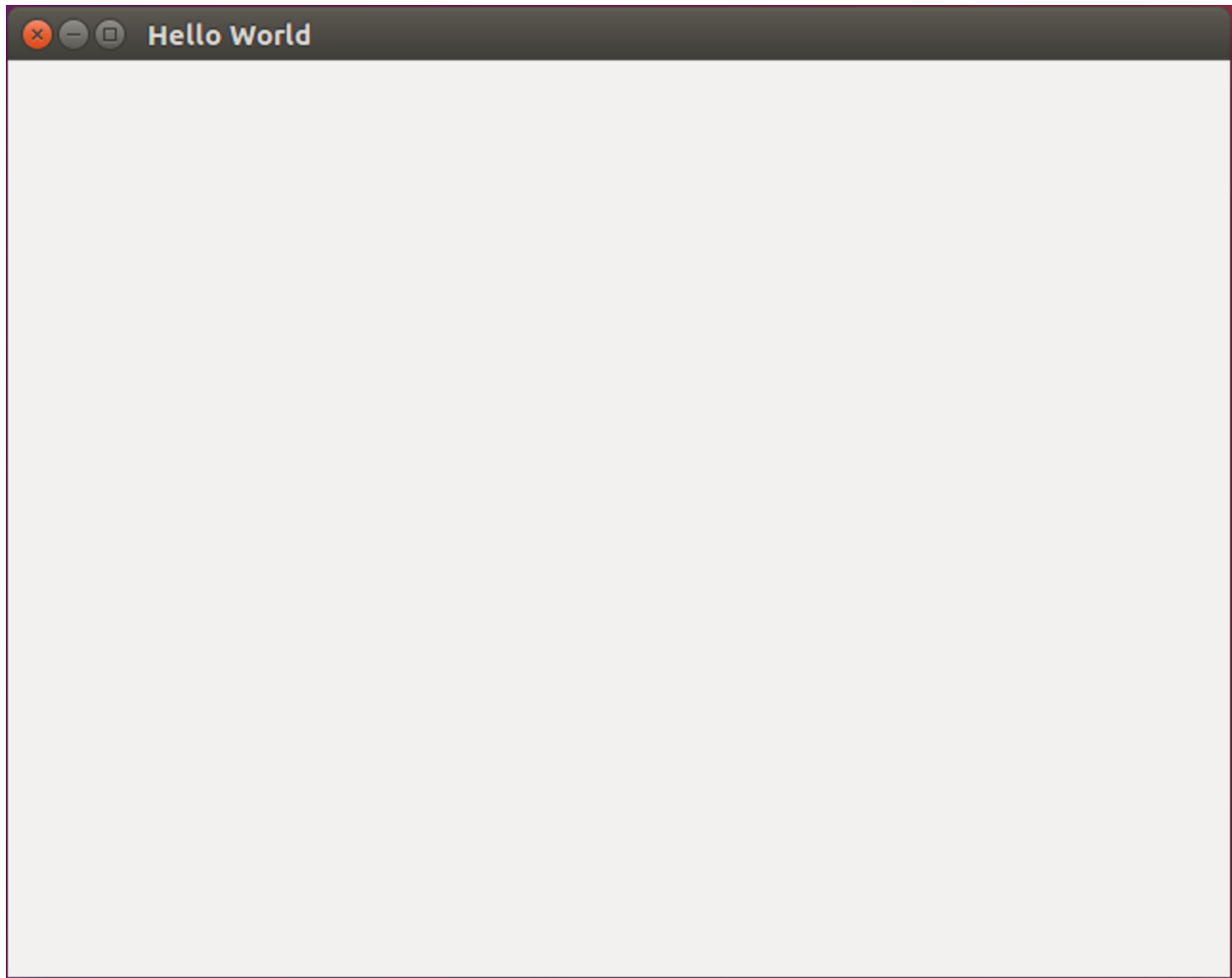
This should open a GUI window:

macOS

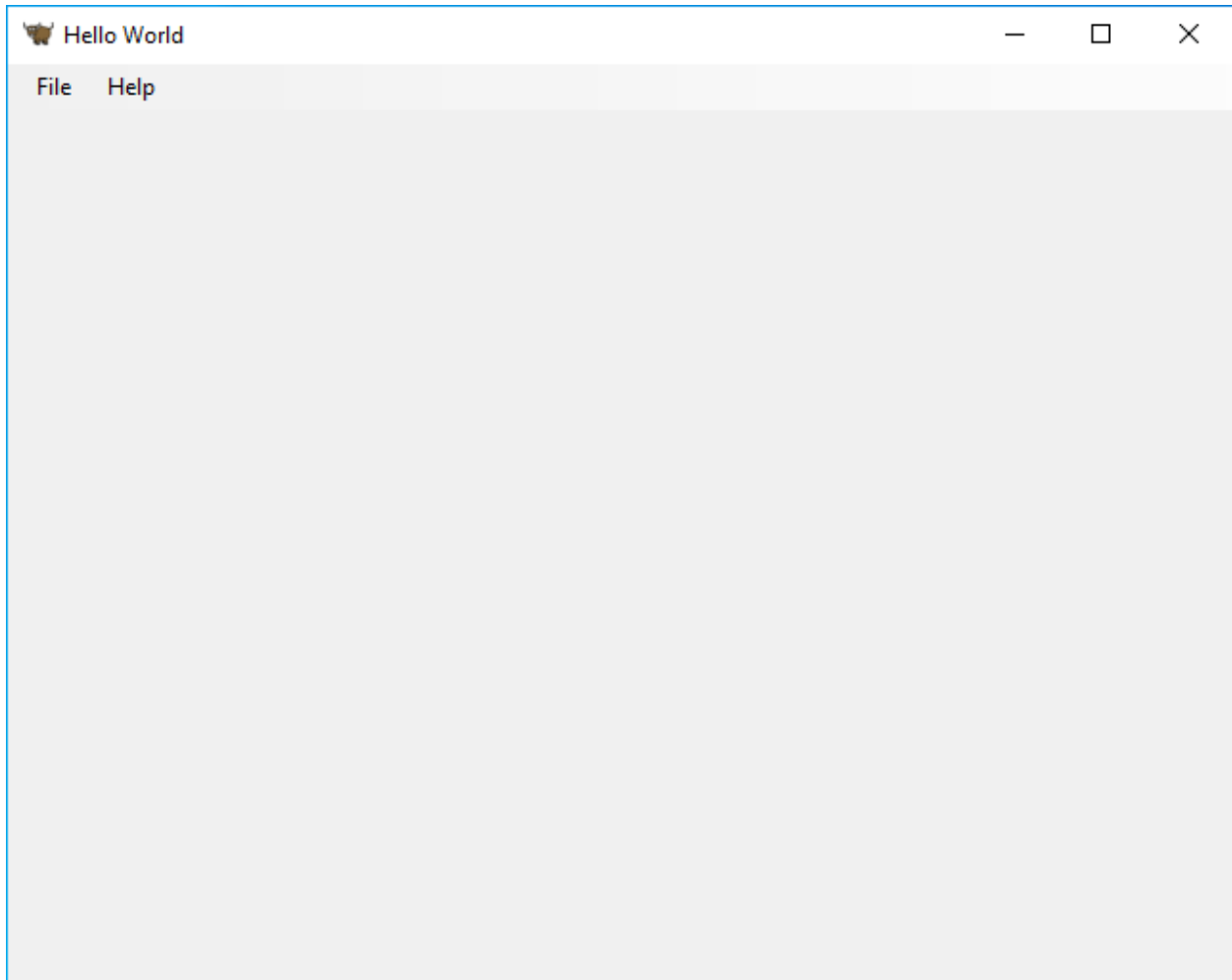
Linux

Windows









Press the close button (or select Quit from the application's menu), and you're done! Congratulations - you've just written a standalone, native application in Python!

## 2.4 Next steps

We now have a working application, running in developer mode. Now we can add some logic of our own to make our application do something a little more interesting. In [Tutorial 2](#), we'll put a more useful user interface onto our application.



## TUTORIAL 2 - MAKING IT INTERESTING

In *Tutorial 1*, we generated a stub project that was able to run, but we didn't write any code ourselves. Let's take a look at what was generated for us.

### 3.1 What was generated

In the `src/helloworld` directory, you should see 3 files: `__init__.py`, `__main__.py` and `app.py`.

`__init__.py` marks the `helloworld` directory as an importable Python module. It is an empty file; the very fact it exists tells the Python interpreter that the `helloworld` directory defines a module.

`__main__.py` marks the `helloworld` module as a special kind of module - an executable module. If you try to run the `helloworld` module using `python -m helloworld`, the `__main__.py` file is where Python will start executing. The contents of `__main__.py` is relatively simple:

```
from helloworld.app import main

if __name__ == '__main__':
    main().main_loop()
```

That is - it imports the `main` method from the `helloworld` app; and if it's being executed as an entry point, calls the `main()` method, and starts the application's main loop. The main loop is the way a GUI application listens for user input (like mouse clicks and keyboard presses).

The more interesting file is `app.py` - this contains the logic that creates our application window:

```
import toga
from toga.style import Pack
from toga.style.pack import COLUMN, ROW

class HelloWorld(toga.App):
    def startup(self):
        main_box = toga.Box()

        self.main_window = toga.MainWindow(title=self.formal_name)
        self.main_window.content = main_box
        self.main_window.show()

def main():
    return HelloWorld()
```

Let's go through this line by line:

```
import toga
from toga.style import Pack
from toga.style.pack import COLUMN, ROW
```

First, we import the `toga` widget toolkit, as well as some style-related utility classes and constants. Our code doesn't use these yet - but we'll make use of them shortly.

Then, we define a class:

```
class HelloWorld(toga.App):
```

Each Toga application has a single `toga.App` instance, representing the running entity that is the application. The app may end up managing multiple windows; but for simple applications, there will be a single main window.

Next, we define a `startup()` method:

```
def startup(self):
    main_box = toga.Box()
```

The first thing the startup method does is to define a main box. Toga's layout scheme behaves similar to HTML. You build an application by constructing a collection of boxes, each of which contains other boxes, or actual widgets. You then apply styles to these boxes to define how they will consume the available window space.

In this application, we define a single box, but we don't put anything into it.

Next, we define a window into which we can put this empty box:

```
self.main_window = toga.MainWindow(title=self.formal_name)
```

This creates an instance of a `toga.MainWindow`, which will have a title matching the application's name. A Main Window is a special kind of window in Toga - it's a window that is closely bound to the lifecycle of the app. When the Main Window is closed, the application exits. The Main Window is also the window that has the application's menu (if you're on a platform like Windows where menu bars are part of the window)

We then add our empty box as the content of the main window, and instruct the application to show our window:

```
self.main_window.content = main_box
self.main_window.show()
```

Last of all, we define a `main()` method. This is what creates the instance of our application:

```
def main():
    return HelloWorld()
```

This `main()` method is the one that is imported and invoked by `__main__.py`. It creates and returns an instance of our `HelloWorld` application.

That's the simplest possible Toga application. Let's put some of our own content into the application, and make the app do something interesting.

## 3.2 Adding some content of our own

Modify your HelloWorld class inside `src/helloworld/app.py` so that it looks like this:

```
class HelloWorld(toga.App):
    def startup(self):
        main_box = toga.Box(style=Pack(direction=COLUMN))

        name_label = toga.Label(
            'Your name: ',
            style=Pack(padding=(0, 5))
        )
        self.name_input = toga.TextInput(style=Pack(flex=1))

        name_box = toga.Box(style=Pack(direction=ROW, padding=5))
        name_box.add(name_label)
        name_box.add(self.name_input)

        button = toga.Button(
            'Say Hello!',
            on_press=self.say_hello,
            style=Pack(padding=5)
        )

        main_box.add(name_box)
        main_box.add(button)

        self.main_window = toga.MainWindow(title=self.formal_name)
        self.main_window.content = main_box
        self.main_window.show()

    def say_hello(self, widget):
        print("Hello", self.name_input.value)
```

**Note:** Don't remove the imports at the top of the file, or the `main()` at the bottom. You only need to update the HelloWorld class.

Let's look in detail at what has changed.

We're still creating a main box; however, we are now applying a style:

```
main_box = toga.Box(style=Pack(direction=COLUMN))
```

Toga's builtin layout system is called "Pack". It behaves a lot like CSS. You define objects in a hierarchy - in HTML, the objects are `<div>`, `<span>`, and other DOM elements; in Toga, they're widgets and boxes. You can then assign styles to the individual elements. In this case, we're indicating that this is a `COLUMN` box - that is, it is a box that will consume all the available width, and will expand its height as content is added, but it will try to be as short as possible.

Next, we define a couple of widgets:

```
name_label = toga.Label(
    'Your name: ',
    style=Pack(padding=(0, 5))
)
self.name_input = toga.TextInput(style=Pack(flex=1))
```

Here, we define a Label and a TextInput. Both widgets have styles associated with them; the label will have 5px of padding on its left and right, and no padding on the top and bottom. The TextInput is marked as being flexible - that is, it will absorb all available space in its layout axis.

The TextInput is assigned as an instance variable of the class. This gives us easy access to the widget instance - something that we'll use in a moment.

Next, we define a box to hold these two widgets:

```
name_box = toga.Box(style=Pack(direction=ROW, padding=5))
name_box.add(name_label)
name_box.add(self.name_input)
```

The name\_box is a box just like the main box; however, this time, it's a ROW box. That means content will be added horizontally, and it will try to make its width as narrow as possible. The box also has some padding - 5px on all sides.

Now we define a button:

```
button = toga.Button(
    'Say Hello!',
    on_press=self.say_hello,
    style=Pack(padding=5)
)
```

The button also has 5px of padding on all sides. We also define a *handler* - a method to invoke when the button is pressed.

Then, we add the name box and the button to the main box:

```
main_box.add(name_box)
main_box.add(button)
```

This completes our layout; the rest of the startup method is as it was previously - defining a MainWindow, and assigning the main box as the window's content:

```
self.main_window = toga.MainWindow(title=self.formal_name)
self.main_window.content = main_box
self.main_window.show()
```

The last thing we need to do is define the handler for the button. A handler can be any method, generator, or asynchronous co-routine; it accepts the widget that generated the event as an argument, and will be invoked whenever the button is pressed:

```
def say_hello(self, widget):
    print("Hello, ", self.name_input.value)
```

The body of the method is a simple print statement - however, it will interrogate the current value of the name input, and use that content as the text that is printed.

Now that we've made these changes we can see what they look like by starting the application again. As before, we'll use Developer mode:

macOS

Linux

Windows

```
(beeware-venv) $ briefcase dev  
[helloworld] Starting in dev mode...
```

```
(beeware-venv) $ briefcase dev  
[helloworld] Starting in dev mode...
```

```
(beeware-venv) C:\...>briefcase dev  
[helloworld] Starting in dev mode...
```

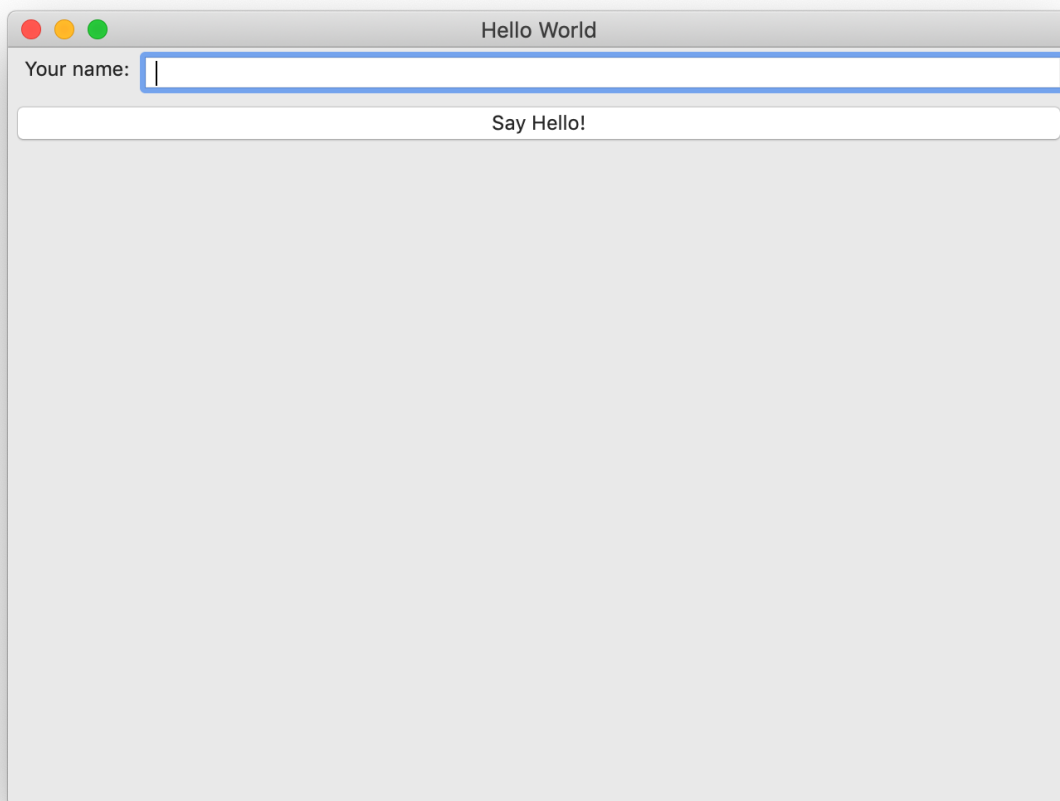
You'll notice that this time, it *doesn't* install dependencies. Briefcase can detect that the application has been run before, and to save time, will only run the application. If you add new dependencies to your app, you can make sure that they're installed by passing in a `-d` option when you run `briefcase dev`.

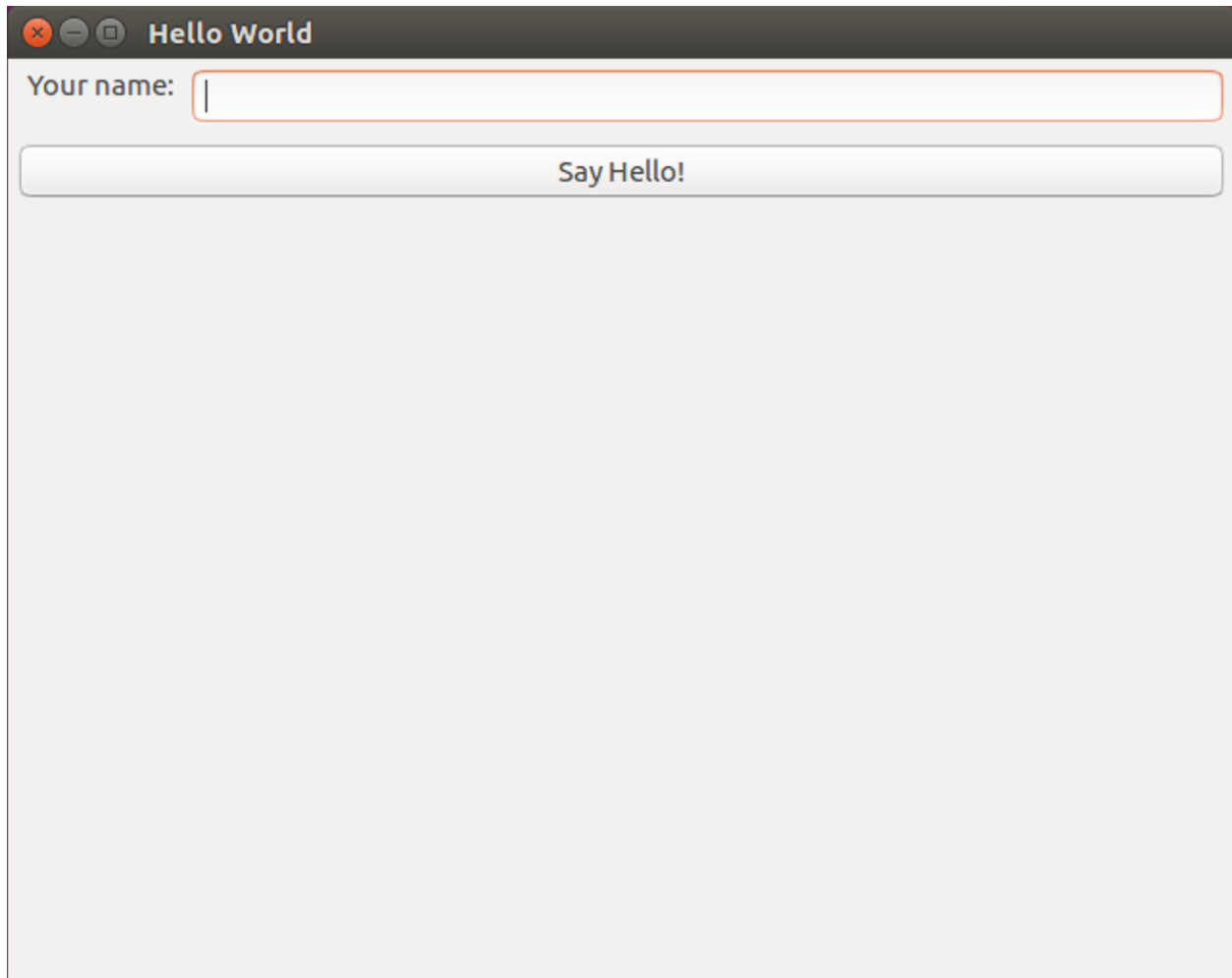
This should open a GUI window:

macOS

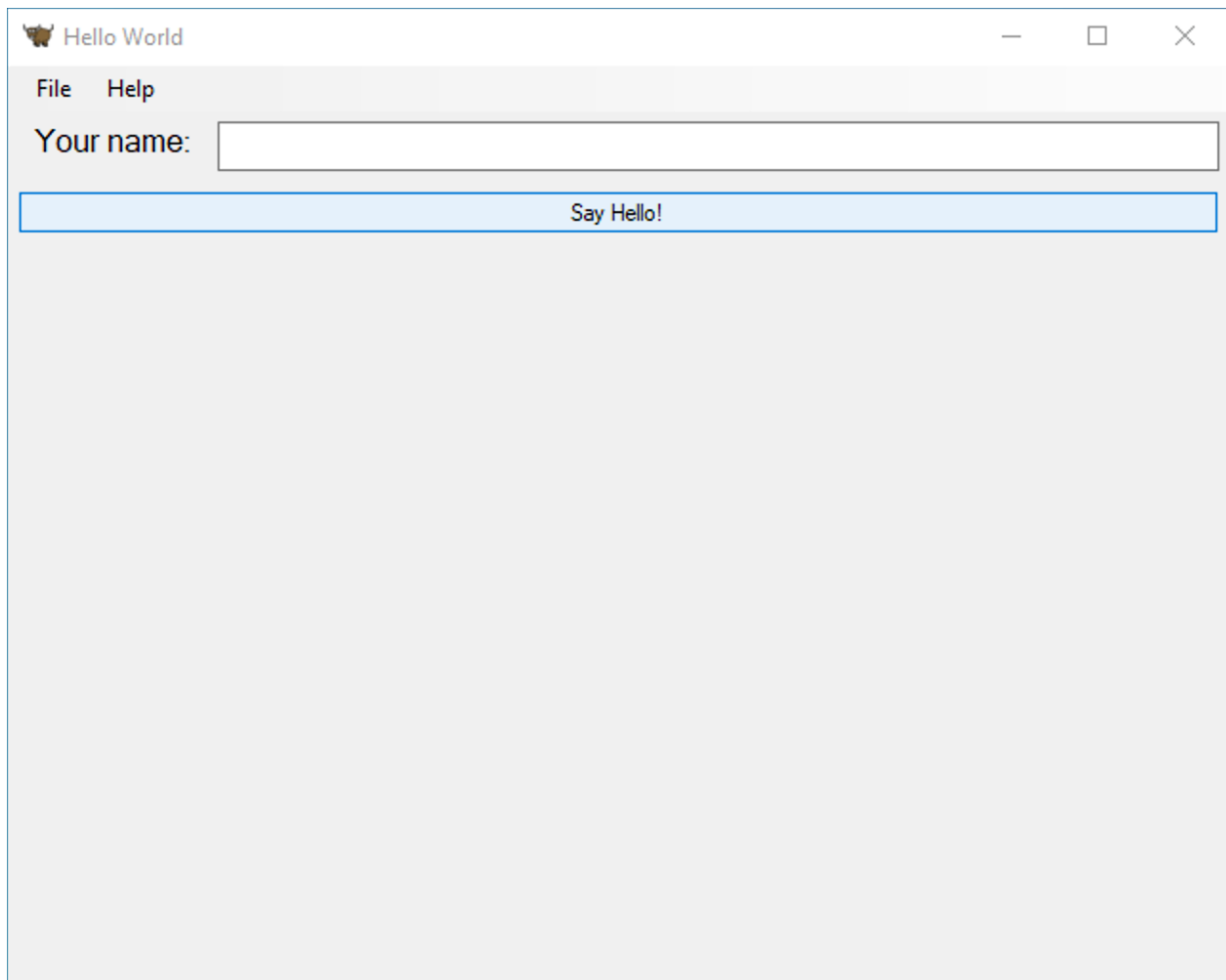
Linux

Windows









If you enter a name in the text box, and press the GUI button, you should see output appear in the console where you started the application.

### 3.3 Next steps

We've now got an application that does something a little more interesting. But it only runs on our own computer. Let's package this application for distribution. In [Tutorial 3](#), we'll wrap our application up as a standalone installer that we could send to a friend, a customer, or upload to an App Store.



## TUTORIAL 3 - PACKAGING FOR DISTRIBUTION

So far, we've been running our application in "Developer mode". This makes it easy for us to run our application locally - but what we really want is to be able to give our application to others.

However, we don't want to have to teach our users how to install Python, create a virtual environment, clone a git repository, and run Briefcase in developer mode. We'd rather just give them an installer, and have the application Just Work.

Briefcase can be used to package your application for distribution in this way.

### 4.1 Creating your application scaffold

Since this is the first time we're packaging our application, we need to create some configuration files and other scaffolding to support the packaging process. From the `helloworld` directory, run:

macOS

Linux

Windows

```
(beeware-venv) $ briefcase create

[helloworld] Generating application template...
Using app template: https://github.com/beeware/briefcase-macOS-app-template.git
...
[helloworld] Installing support package...
...
[helloworld] Installing dependencies...
...
[helloworld] Installing application code...
...
[helloworld] Installing application resources...
...
[helloworld] Created macOS/Hello World
```

```
(beeware-venv) $ briefcase create

[helloworld] Generating application template...
Using app template: https://github.com/beeware/briefcase-linux-appImage-template.git
...
[helloworld] Installing support package...
...
[helloworld] Installing dependencies...
```

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```
[helloworld] Entering Docker context...

[helloworld] Building Docker container image...
...
[helloworld] Leaving Docker context.

[helloworld] Installing application code...
...
[helloworld] Installing application resources...
...
[helloworld] Created linux/Hello World
```

---

**Note:** The first time you run this, it may take a while, as Briefcase needs to prepare an Ubuntu 16.04 Docker image that can be used to build AppImage binaries. This involves downloading a lot of system packages. On future runs, this Docker image will be re-used.

---

```
(beeware-venv) C:\...>briefcase create

[helloworld] Generating application template...
Using app template: https://github.com/beeware/briefcase-windows-msi-template.git
...
[helloworld] Installing support package...
...
[helloworld] Installing dependencies...
...
[helloworld] Installing application code...
...
[helloworld] Installing application resources...
...
[helloworld] Created windows\Hello World
```

You’ve probably just seen pages of content go past in your terminal... so what just happened? Briefcase has done the following:

1. **It generated an application template.** There’s a lot of files and configurations required to build a native installer, above and beyond the code of your actual application. This extra scaffolding is almost the same for every application on the same platform, except for the name of the actual application being constructed - so Briefcase provides an application template for each platform it supports. This step rolls out the template, substituting the name of your application, bundle ID, and other properties of your configuration file as required to support the platform you’re building on.

If you’re not happy with the template provided by Briefcase, you can provide your own. However, you probably don’t want to do this until you’ve got a bit more experience using Briefcase’s default template.

2. **It downloaded and installed a support package.** The packaging approach taken by briefcase is best described as “the simplest thing that could possibly work” - it ships a complete, isolated Python interpreter as part of every application it builds. This is slightly space inefficient - if you have 5 applications packaged with Briefcase, you’ll have 5 copies of the Python interpreter. However, this approach guarantees that every application is completely independent, using a specific version of Python that is known to work with the application.

Again, Briefcase provides a default support package for each platform; if you want, you can provide your own support package, and have that package included as part of the build process. You may want to do this if you have particular options in the Python interpreter that you need to have enabled, or if you want to strip modules out of the standard library that you don’t need at runtime.

Briefcase maintains a local cache of support packages, so once you’ve downloaded a specific support package, that cached copy will be used on future builds.

3. **It installed application dependencies.** Your application can specify any third-party modules that are required at runtime. These will be installed using *pip* into your application’s installer.
4. **It Installed your application code.** Your application will have its own code and resources (e.g., images that are needed at runtime); these files are copied into the installer.
5. **It installed your resources needed by your application.** Lastly, it adds any additional resources that are needed by the installer itself. This includes things like icons that need to be attached to the final application and splash screen images.

Once this completes, if you look in the project directory, you should now see a directory corresponding to your platform (macOS, linux, or windows) that contains additional files. This is the platform-specific packaging configuration for your application.

## 4.2 Building your application

You can now compile your application. This step performs any binary compilation that is necessary for your application to be executable on your target platform.

macOS

Linux

Windows

```
(beeware-venv) $ briefcase build
[helloworld] Built macOS/Hello World/Hello World.app
```

On macOS, the `build` command doesn’t need to do anything. A `.app` folder is a layout convention of macOS itself; as long as the folder has a `.app` extension, and adheres to some internal layout rules, and provides some metadata in a known location, the folder will appear to the operating system as an application.

```
(beeware-venv) $ briefcase build
[helloworld] Building AppImage...
...
[helloworld] Built linux/Hello World-x86_64-0.0.1.AppImage
```

Once this step completes, the `linux` folder will contain a file named `Hello World-x86_64-0.0.1.AppImage`. This `AppImage` is an executable; you can run it from the shell, or double click on it in your file explorer. You can also give it to any other Linux user, and as long as they’ve got a version of Linux published after 2016, they should be able to run it in the same way.

```
(beeware-venv) C:\...>briefcase build
[helloworld] Built windows\Hello World
```

On Windows, this step does nothing. The distributed “binary” on windows is a folder with a known entry point; the installer (when it is eventually created) will encode details on how to start the application, and install a Start Menu item to invoke the application.

## 4.3 Running your app

You can now use Briefcase to run your application:

macOS

Linux

Windows

```
(beeware-venv) $ briefcase run  
[helloworld] Starting app...  
(beeware-venv) $
```

```
(beeware-venv) $ briefcase run  
[helloworld] Starting app...  
(beeware-venv) $
```

```
(beeware-venv) C:\...>briefcase run  
[helloworld] Starting app...  
(beeware-venv) C:\...>
```

**This will start to run your native application, using the output of the *build* command.**

You'll notice that the console output we saw earlier won't be visible anymore. This is because we are now running a standalone, packaged app that has no (visible) console to which it can output.

You might also notice some small differences in the way your application looks when it's running. For example, icons and the name displayed by the operating system may be slightly different to those you saw when running under developer mode. This is also because you're using the packaged application, not just running Python code. From the operating system's perspective, you're now running "an app", not "a Python program", and this is reflected in how the application appears.

## 4.4 Building your installer

You can now package your application for distribution, using the *package* command. The package command does any compilation that is required to convert the scaffolded project into a final, distributable product. Depending on the platform, this may involve compiling an installer, performing code signing, or doing other pre-distribution tasks.

macOS

Linux

Windows

```
(beeware-venv) $ briefcase package --no-sign  
[helloworld] Building DMG...  
...  
[helloworld] Created macOS/Hello World-0.0.1.dmg
```

The macOS folder will contain a file named `Hello World-0.0.1.dmg`. If you locate this file in the Finder, and double click on its icon, you'll mount the DMG, giving you a copy of the Hello World app, and a link to your Applications folder for easy installation. Drag the app file into Application, and you've installed your application. Send the DMG file to a friend, and they should be able to do the same.

In this example, we've used the `--no-sign` option - that is, we've decided to *not* sign our application. We've done this to keep the tutorial simple. Setting up code signing identities is a little fiddly, and they're only *absolutely* required if you're intending to distribute your application to others. If we were publishing a real application, you would leave off the `--no-sign` flag.

When you're ready to publish a real application, check out the Briefcase How-To guide on [Setting up a macOS code signing identity](#)

```
(beeware-venv) $ briefcase package

[helloworld] Building AppImage...
...
[helloworld] Created linux/Hello World-x86_64-0.0.1.AppImage.
```

On Linux, this step does nothing. The AppImage created by the build command is a complete executable, requiring no additional processing.

```
(beeware-venv) C:\...>briefcase package

[helloworld] Building MSI...
...
[helloworld] Created windows\Hello_World-0.0.1.msi
```

Once this step completes, the windows folder will contain a file named `Hello_World-0.0.1.msi`. If you double click on this installer to run it, you should go through a familiar Windows installation process. Once this installation completes, there will be a “Hello World” entry in your start menu.

## 4.5 Next steps

We now have our application packaged for distribution on desktop platforms. But what happens when we need to update the code in our application? How do we get those updates into our packaged application? Turn to [Tutorial 4](#) to find out...





## TUTORIAL 4 - UPDATING YOUR APPLICATION

In the last tutorial, we packaged our application as a native application. If you're dealing with a real-world app, that isn't going to be the end of the story - you'll likely do some testing, discover problems, and need to make some changes. Even if your application is perfect, you'll eventually want to publish version 2 of your application with improvements.

So - how do you update your installed app when you make code changes?

### 5.1 Updating application code

Our application currently prints to the console when you press the button. However, GUI applications shouldn't really use the console for output. They need to use dialogs to communicate with users.

Let's add a dialog box to say hello, instead of writing to the console. Modify the *say\_hello* callback so it looks like this:

```
def say_hello(self, widget):
    self.main_window.info_dialog(
        'Hi there!',
        "Hello, {}".format(self.name_input.value)
    )
```

This directs Toga to open a modal dialog box when the button is pressed.

If you run `briefcase dev` and press the button, you'll see the new dialog box. However, if you run `briefcase run`, the dialog box won't appear.

Why is this? Well, `briefcase dev` operates by running your code in place - it tries to produce as realistic runtime environment for your code as possible, but it doesn't provide or use any of the platform infrastructure for wrapping your code as an application. Part of the process of packaging your app involves copying your code *into* the application bundle - and at the moment, your application still has the old code in it.

So - we need to tell `briefcase` to copy over the new version of the code. We *could* do this by deleting the old platform directory and starting from scratch. However, `Briefcase` provides an easier way - you can update the code for your existing bundled application:

macOS

Linux

Windows

```
(beeware-venv) $ briefcase update
[helloworld] Updating application code...
```

(continues on next page)

(continued from previous page)

```
Installing src/helloworld...  
[helloworld] Application updated.
```

```
(beeware-venv) $ briefcase update  
  
[helloworld] Updating application code...  
Installing src/helloworld...  
  
[helloworld] Application updated.
```

```
(beeware-venv) C:\...>briefcase update  
  
[helloworld] Updating application code...  
Installing src/helloworld...  
  
[helloworld] Application updated.
```

If Briefcase can't find the scaffolded template, it will automatically invoke *create* to generate a fresh scaffold.

Now that we've updated the installer code, we can then run `briefcase build` to re-compile app, `briefcase run` to run the updated app, and `briefcase package` to repackage the application for distribution.

(macOS users, remember that as noted in [Tutorial 3](#), for the tutorial we recommend running `briefcase package` with the `--no-sign` flag to avoid the complexity of setting up a code signing identity and keep the tutorial as simple as possible.)

## 5.2 Updating dependencies and icons

This only updates the application code, though - what if your dependencies have changed, or you have new application resources, like a new splash screen or application icon)? In this situation, the `update` command has some options you can use:

- `briefcase update -d` (or `briefcase update --update-dependencies`) will re-install your application dependencies.
- `briefcase update -r` (or `briefcase update --update-resources`) will re-install your application resources.

## 5.3 Update and run in one step

If you're rapidly iterating code changes, you'll likely want to make a code change, update the application, and immediately re-run your application. Briefcase has a shortcut to support this usage pattern - the `-u` (or `--update`) option on the `run` command.

Let's try making another change. You may have noticed that if you don't type a name in the text input box, the dialog will say "Hello, ". Let's modify the `say_hello` function again to handle this edge case:

```
def say_hello(self, widget):  
    if self.name_input.value:  
        name = self.name_input.value  
    else:
```

(continues on next page)

(continued from previous page)

```

        name = 'stranger'

    self.main_window.info_dialog(
        'Hi there!',
        "Hello, {}".format(name)
    )

```

Run your app in development mode (with `briefcase dev`) to confirm that the new logic works; then update, build and run the app with one command:

macOS

Linux

Windows

```

(beeware-venv) $ briefcase run -u

[helloworld] Updating application code...
Installing src/helloworld...

[helloworld] Application updated.

[helloworld] Starting app...

```

```

(beeware-venv) $ briefcase run -u

[helloworld] Updating application code...
Installing src/helloworld...

[helloworld] Application updated.

[helloworld] Building AppImage...
...
[helloworld] Created linux/Hello World-x86_64-0.0.1.AppImage.

[helloworld] Starting app...

```

```

(beeware-venv) C:\...>briefcase run -u

[helloworld] Updating application code...
Installing src/helloworld...

[helloworld] Application updated.

[helloworld] Starting app...

```

This should only be required if you're testing something about how your application runs as a native binary, or hunting a bug that only manifests when your application is in packaged form. For most day-to-day development, `briefcase dev` will be a lot faster.

The package command also accepts the `-u` argument, so if you make a change to your application code and want to repack immediately, you can run `briefcase package -u`.

## 5.4 Next steps

We now have our application packaged for distribution on desktop platforms, and we've been able to update the code in our application.

But what about mobile? In [Tutorial 5](#), we'll convert our application into a mobile application, and deploy it onto a device simulator, and onto a phone.

## TUTORIAL 5 - TAKING IT MOBILE

So far, we've been running and testing our application on the desktop. However, BeeWare also supports mobile platforms - and the application we've written can be deployed to your mobile device, too!

### 6.1 iOS

iOS applications can only be compiled on macOS. You'll need [Xcode](#), which you should have installed in [Tutorial 0](#). Once you've got Xcode installed, *let's build our app for iOS!*

### 6.2 Android

Android applications be compiled on macOS, Windows or Linux. All the tools required to build for Android will be downloaded the first time you build an Android app.

*Let's build our app for Android!*

#### 6.2.1 Tutorial 5 - Taking it mobile: iOS

Now, we're going to take our application, and deploy it as an iOS application.

The process of deploying an application to iOS is very similar to the process for deploying as a desktop application. First, you run the `create` command - but this time, we specify that we want to create an iOS application:

```
(beeware-venv) $ briefcase create iOS

[helloworld] Generating application template...
Using app template: https://github.com/beeware/briefcase-iOS-Xcode-template.git
...
[helloworld] Installing support package...
...
[helloworld] Installing dependencies...
...
[helloworld] Installing application code...
...
[helloworld] Installing application resources...
...
[helloworld] Created iOS/Hello World
```

Once this completes, we'll now have an `iOS` directory in your project. This directory will contain a `Hello World` folder, which will contain an Xcode project, as well as the support libraries and the application code needed for the application.

You can then use Briefcase to compile your app using the `build` command. You'll be prompted to select a device to compile for; if you've got simulators for multiple iOS versions installed, you may also be asked which iOS version you want to target. The options you are shown may differ from the options show in this output; for our purposes, it doesn't matter which simulator you pick.

```
(beeware-venv) $ briefcase build iOS

Select iOS version:

  1) 10.3
  2) 13.3

> 2

Select simulator device:

  1) iPad (7th generation)
  2) iPad Air (3rd generation)
  3) iPad Pro (11-inch)
  4) iPad Pro (12.9-inch) (3rd generation)
  5) iPad Pro (9.7-inch)
  6) iPhone 11
  7) iPhone 11 Pro
  8) iPhone 11 Pro Max
  9) iPhone 8
 10) iPhone 8 Plus

> 6

Targeting an iPhone 11 running iOS 13.3 (device UDID 4768AA69-497B-4B37-BD0C-
↪3961756C38AC)

[hello-world] Building XCode project...
...
Build succeeded.

[hello-world] Built iOS/Hello World/build/Debug-iphonesimulator/Hello World.app
```

We're now ready to run our application. You could do this by running `briefcase run iOS`. If you run Briefcase in that way, you'll be asked again for the device you want to target. If you already know the devices that are available, you can tell briefcase to use that simulator by providing a `-d` (or `--device`) option. Using the name of the device you selected when you built your application, run:

```
$ briefcase run iOS -d "iPhone 11"
```

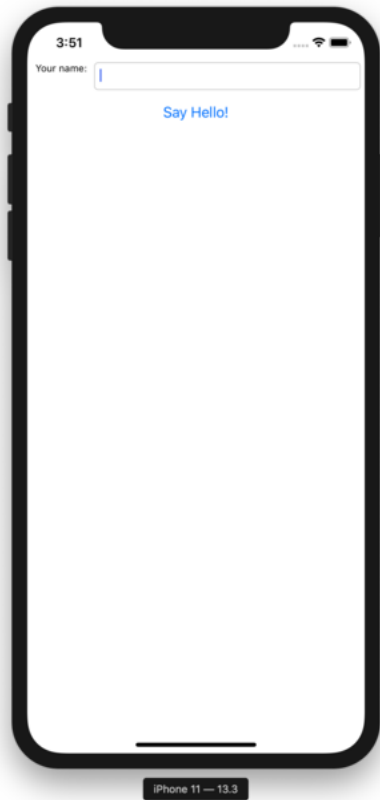
If you have multiple iPhone 11 simulators, briefcase will pick the highest iOS version; if you want to pick a particular iOS version, you tell it to use that specific version:

```
$ briefcase run iOS -d "iPhone 11::13.3"
```

Or, you can name a specific device UDID:

```
$ briefcase run iOS -d 4768AA69-497B-4B37-BD0C-3961756C38AC
```

This will start the iOS simulator, install your app, and start it. You should see the simulator start, and eventually open your iOS application:



### Next steps

We've now got an application on our phone! Is there anywhere other way to deploy a BeeWare app? Turn to [Tutorial 6](#) to find out...

## 6.2.2 Tutorial 5 - Taking it mobile: Android

Now, we're going to take our application, and deploy it as an Android application.

The process of deploying an application to Android is very similar to the process for deploying as a desktop application. Briefcase handles installing dependencies for Android, including the Android SDK, the Android emulator, and a Java compiler.

## Create an Android app and compile it

First, run the `create` command. This downloads an Android app template and adds your Python code to it.

macOS

Linux

Windows

```
(beeware-venv) $ briefcase create android

[helloworld] Generating application template...
Using app template: https://github.com/beeware/briefcase-android-gradle-template.git
...
[helloworld] Installing support package...
...
[helloworld] Installing dependencies...
...
[helloworld] Installing application code...
...
[helloworld] Installing application resources...
...
[helloworld] Application created.
```

```
(beeware-venv) $ briefcase create android

[helloworld] Generating application template...
Using app template: https://github.com/beeware/briefcase-android-gradle-template.git
...
[helloworld] Installing support package...
...
[helloworld] Installing dependencies...
...
[helloworld] Installing application code...
...
[helloworld] Installing application resources...
...
[helloworld] Application created.
```

```
(beeware-venv) C:\>briefcase create android

[helloworld] Generating application template...
Using app template: https://github.com/beeware/briefcase-android-gradle-template.git
...
[helloworld] Installing support package...
...
[helloworld] Installing dependencies...
...
[helloworld] Installing application code...
...
[helloworld] Installing application resources...
...
[helloworld] Application created.
```

When you run `briefcase create android` for the first time, Briefcase downloads a Java JDK, and the Android SDK. File sizes and download times can be considerable; this may take a while (10 minutes or longer, depending on the speed of your Internet connection). When the download has completed, you will be prompted to accept Google's Android SDK license.



Once this completes, we'll now have an `android` directory in our project. This directory will contain a `Hello World` folder, which will contain an Android project with a Gradle build configuration. This project will contain your application code, and a support package containing the Python interpreter.

We can then use Briefcase's `build` command to compile this into an Android APK app file.

macOS

Linux

Windows

```
(beeware-venv) $ briefcase build android
[helloworld] Building Android APK...
Starting a Gradle Daemon
...
BUILD SUCCESSFUL in 1m 1s
28 actionable tasks: 17 executed, 11 up-to-date
[helloworld] Built android/Hello World/app/build/outputs/apk/debug/app-debug.apk
```

```
(beeware-venv) $ briefcase build android
[helloworld] Building Android APK...
Starting a Gradle Daemon
...
BUILD SUCCESSFUL in 1m 1s
28 actionable tasks: 17 executed, 11 up-to-date
[helloworld] Built android/Hello World/app/build/outputs/apk/debug/app-debug.apk
```

```
(beeware-venv) C:\...>briefcase build android
[helloworld] Building Android APK...
Starting a Gradle Daemon
...
BUILD SUCCESSFUL in 1m 1s
28 actionable tasks: 17 executed, 11 up-to-date
[helloworld] Built android\Hello World\app\build\outputs\apk\debug\app-debug.apk
```

### Gradle may look stuck

During the `briefcase build android` step, Gradle (the Android platform build tool) will print `CONFIGURING: 100%`, and appear to be doing nothing. Don't worry, it's not stuck - it's downloading more Android SDK components. Depending on your Internet connection speed, this may take another 10 minutes (or longer). This lag should only happen the very first time you run `build`; the tools are cached, and on your next build, the cached versions will be used.

### Run the app on a virtual device

We're now ready to run our application. You can use Briefcase's `run` command to run the app on an Android device. Let's start by running on an Android emulator.

To run your application, run `briefcase run android`. When you do this, you'll be prompted with a list of devices that you could run the app on. The last item will always be an option to create a new Android emulator.

macOS

Linux

Windows

```
(beeware-venv) $ briefcase run android
```

Select device:

```
1) Create a new Android emulator
```

```
>
```

```
(beeware-venv) $ briefcase run android
```

Select device:

```
1) Create a new Android emulator
```

```
>
```

```
(beeware-venv) C:\...>briefcase run android
```

Select device:

```
1) Create a new Android emulator
```

```
>
```

We can now choose our desired device. Select the “Create a new Android emulator” option, and accept the default choice for the device name (beePhone).

Briefcase run will automatically boot the virtual device. When the device is booting, you will see the Android logo:

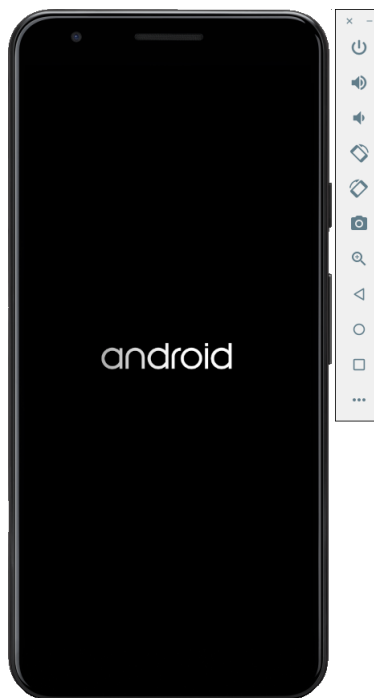


Fig. 1: Android virtual device booting

Once the device has finished booting, Briefcase will install your app on the device. You will briefly see a launcher screen:

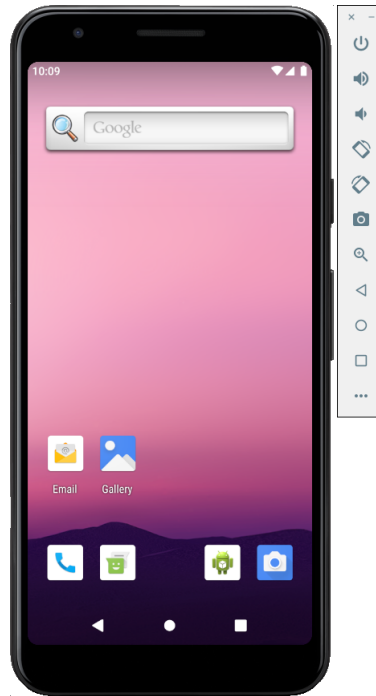


Fig. 2: Android virtual device fully started, on the launcher screen

The app will then start. You'll see a splash screen while the app starts up:

**The first time the app starts, it needs to unpack itself onto the device.** This may take a few seconds. Once it's unpacked, you'll see the Android version of our desktop app:

If you fail to see your app launching, you may need to check your terminal where you ran `briefcase run` and look for any error messages.

In future, if you want to run on this device without using the menu, you can provide the emulator's name to Briefcase, using `briefcase run android -d @beePhone` to run on the virtual device directly.

## Run the app on a physical device

If you have a physical Android phone or tablet, you can connect it to your computer with a USB cable, and then use the Briefcase to target your physical device.

If Briefcase can detect the device, it will appear in the `run` output. The first time you use a device for development, it may report itself as an "Unknown device (not authorized for development)":

macOS

Linux

Windows

```
(beeware-venv) $ briefcase run android
Select device:
  1) Unknown device (not authorized for development) (94ZZY0LNE8)
  2) @beePhone (emulator)
```

(continues on next page)

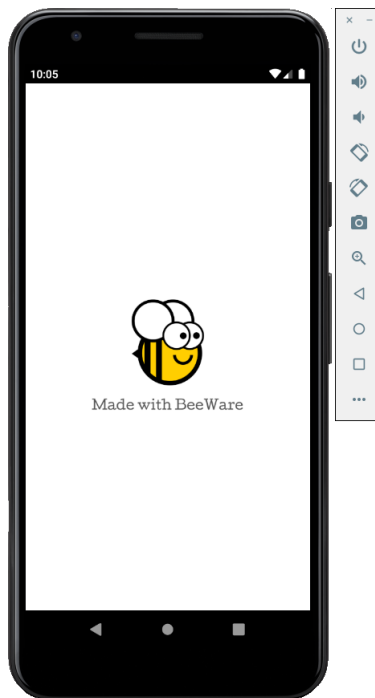


Fig. 3: App splash screen

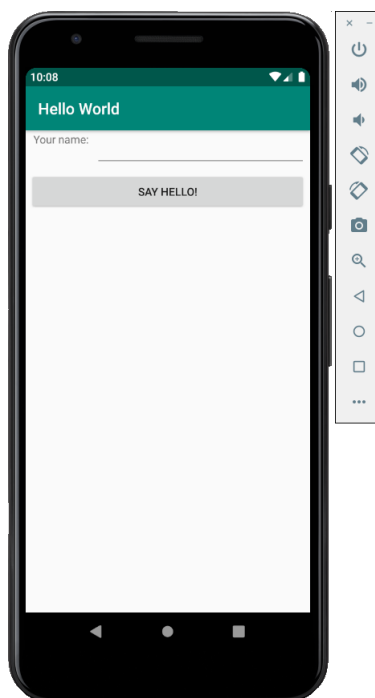


Fig. 4: Demo app fully launched

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```
3) Create a new Android emulator

>
```

```
(beeware-venv) $ briefcase run android

Select device:

1) Unknown device (not authorized for development) (94ZZY0LNE8)
2) @beePhone (emulator)
3) Create a new Android emulator

>
```

```
(beeware-venv) C:\...>briefcase run android

Select device:

1) Unknown device (not authorized for development) (94ZZY0LNE8)
2) @beePhone (emulator)
3) Create a new Android emulator

>
```

Android requires that devices be placed into “developer” mode before you can load an app onto the device. Select the “unknown” device, and you’ll be shown a link that shows you how to enable developer mode.

Once developer mode has been enabled you can re-run `briefcase run android`:

macOS

Linux

Windows

```
(beeware-venv) $ briefcase run android

Select device:

1) Pixel 3a (94ZZY0LNE8)
2) @beePhone (emulator)
3) Create a new Android emulator

>
```

```
(beeware-venv) $ briefcase run android

Select device:

1) Pixel 3a (94ZZY0LNE8)
2) @beePhone (emulator)
3) Create a new Android emulator

>
```

```
(beeware-venv) C:\...>briefcase run android

Select device:

1) Pixel 3a (94ZZY0LNE8)
2) @beePhone (emulator)
3) Create a new Android emulator

>
```

This time, we get the name of the device, and it's serial number (in this case, a Pixel 3a).

In the future, if you want to run on this device without using the menu, you can provide the phone's serial number to Briefcase, using `briefcase run android -d 94ZZY0LNE8`. This will run on the device directly, without prompting.

---

**Note:** When you're developing for Android, it's useful to be able to view the Android logs. To view the Android logs without the background noise from the rest of the system, you can run `adb logcat -s MainActivity:* studio:* Python:*`. Anything your app writes to stdout (e.g., the output of `print()` statements) will be visible in the logs.

---

### Next steps

We've now got an application on our phone! Is there another way to deploy a BeeWare app? Turn to [Tutorial 6](#) to find out...

## TUTORIAL 6 - PUT IT ON THE WEB!

In addition to supporting mobile platforms, the Toga widget toolkit supports the web! Using the same API, you can deploy your application as a web site.

**Coming soon**

### 7.1 Next steps

We've now deployed our application on the web! We're now ready to share our application with the rest of the world. In [Tutorial 7](#), we'll use Briefcase to publish our application so others can download it.





## TUTORIAL 7 - PUBLISHING YOUR APP!

Once you've built an installer for your application, you're going to want to share it with the world. Briefcase provides a command - `publish` to manage this process, with a range of options for how to publish your application.

**Coming soon**

### 8.1 Next steps

This has been a taste for what you can do with the tools provided by the BeeWare project. What you do from here is up to you!

Some places to go from here:

- [Tutorials demonstrating features of the Toga widget toolkit.](#)
- [Details on the options available when configuring your Briefcase project.](#)