

# Shipping Python to Mac Clients in 2020

Tim Sutton

Site Reliability Engineer  
Mobile Developer Experience / Mac Compute



# Why are we here?

**Whether you're writing & distributing *your own code* or  
project**

or

**managing, packaging & deploying the code that was  
*written by others***

# What's necessary to get the code to run

- Runtime (Python itself + its core libraries)
  - Complications: which crypto libraries it uses
- Additional pip / pypi packages
- The actual code you want to run

# We used to have it so good

- /usr/bin/python (and /S/L/Frameworks/Python) were part of the system
- Apple included PyObjC and a few friends (xattr, six, etc.)
- Crypto libraries weren't getting updates, but SSLv3 and TLS < 1.2 still worked.. for a while
- Python 2 wasn't EOL

# Mac OS X Lion

The power of Mac OS X. The magic of iPad.





## OS X Lion (10.7)

1 ▾

\$27.99

[Remove](#)

1-3 business days via email  
Delivery options for: [J2L 2J2](#) ▾

Pickup:  
Apple Store Pickup is currently unavailable

Subtotal	\$27.99
Shipping	FREE
Estimated tax for: <a href="#">J2L 2J2</a> ▾	\$4.19

<b>Your Total</b>	<b>\$32.18</b>
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[Check Out](#)

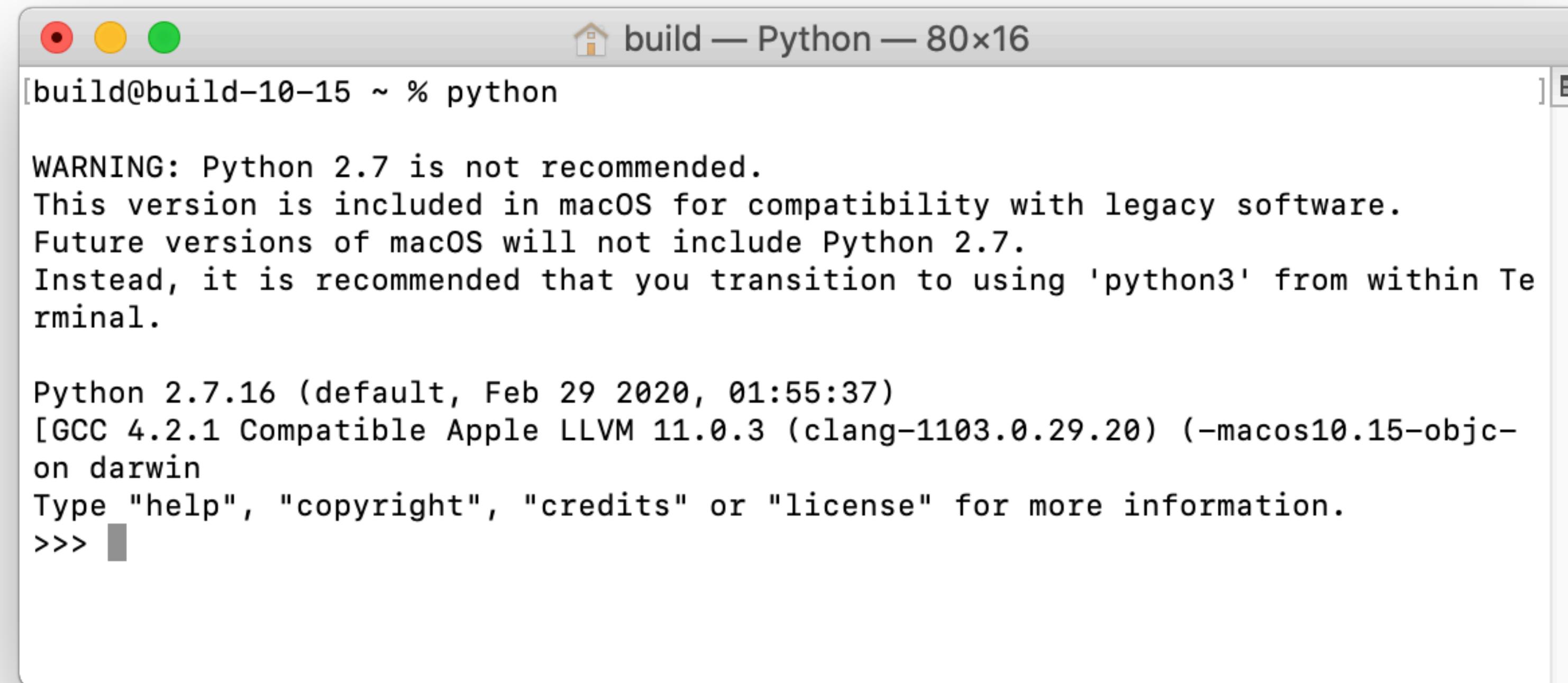
# Scripting Language Runtimes

## Deprecations

- Scripting language runtimes such as Python, Ruby, and Perl are included in macOS for compatibility with legacy software. Future versions of macOS won't include scripting language runtimes by default, and might require you to install additional packages. If your software depends on scripting languages, it's recommended that you bundle the runtime within the app. (49764202)
- Use of Python 2.7 isn't recommended as this version is included in macOS for compatibility with legacy software. Future versions of macOS won't include Python 2.7. Instead, it's recommended that you run `python3` from within Terminal. (51097165)

[https://developer.apple.com/documentation/macos\\_release\\_notes/macos\\_catalina\\_10\\_15\\_release\\_notes](https://developer.apple.com/documentation/macos_release_notes/macos_catalina_10_15_release_notes)

# Catalina



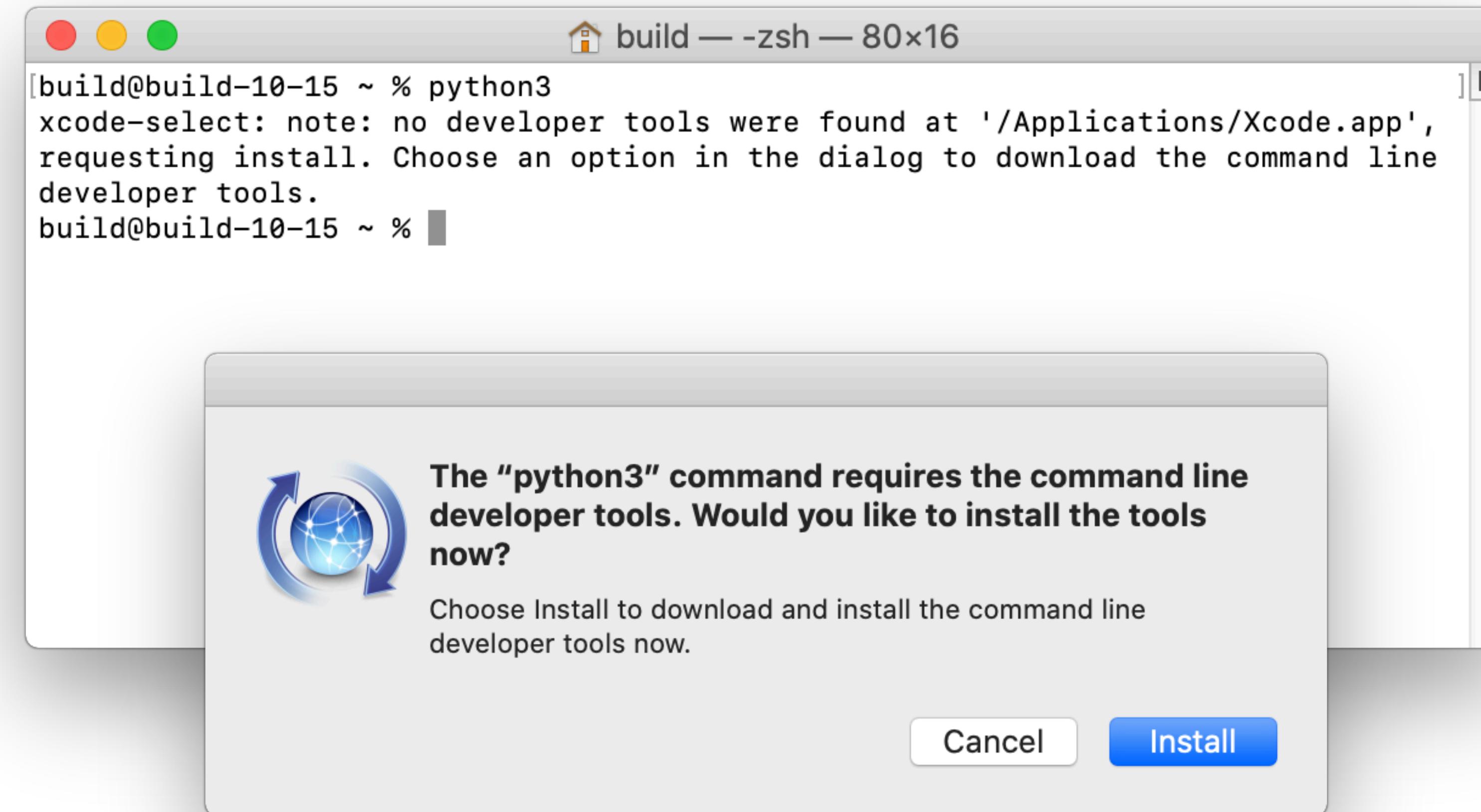
The screenshot shows a macOS terminal window with the title bar "build — Python — 80x16". The window contains the following text:

```
[build@build-10-15 ~ % python

WARNING: Python 2.7 is not recommended.
This version is included in macOS for compatibility with legacy software.
Future versions of macOS will not include Python 2.7.
Instead, it is recommended that you transition to using 'python3' from within Terminal.

Python 2.7.16 (default, Feb 29 2020, 01:55:37)
[GCC 4.2.1 Compatible Apple LLVM 11.0.3 (clang-1103.0.29.20) (-macos10.15-objc-
on darwin
Type "help", "copyright", "credits" or "license" for more information.
>>> ]
```

# Catalina



CLTools\_Executables.pkg

Install Extract To... Verify Show Info View Files Search Find

Package Install Directory: /  
Package requests authentication  
Package has a valid signature: Software Update (Apple Software Update Certification Authority, Apple Root CA)  
Size: 176.0 MiB compressed, 780.2 MiB uncompressed  
Size of selected files: 10 bytes

Contents Resources

Filename	Size	Owner	Group	Permissions	Modification Date	Version
Contents of CLTools_Executables.pkg	778.8 MiB	root	wheel	drwxr-xr-x		
Library	778.8 MiB	root	wheel	drwxr-xr-x		
Developer	778.8 MiB	root	wheel	drwxr-xr-x		
CommandLineTools	778.8 MiB	root	wheel	drwxr-xr-x		
Library	151.4 MiB	root	wheel	drwxr-xr-x		
Developer	1.0 MiB	root	admin	drwxr-xr-x		
Frameworks	36.5 MiB	root	wheel	drwxr-xr-x		
Python3.framework	36.5 MiB	root	wheel	drwxr-xr-x		
Headers	24 bytes	root	wheel	lrwxr-xr-x	2020-05-03, 12:4...	
Python3	24 bytes	root	wheel	lrwxr-xr-x	2020-05-03, 12:4...	
Resources	26 bytes	root	wheel	lrwxr-xr-x	2020-05-03, 12:4...	
Versions	36.5 MiB	root	wheel	drwxr-xr-x		
3.7	36.5 MiB	root	wheel	drwxr-xr-x		
Headers	624.8 KiB	root	wheel	drwxr-xr-x		
Python3	3.2 MiB	root	wheel	-rwxr-xr-x	2020-05-03, 12:5...	
Resources	223.7 KiB	root	wheel	drwxr-xr-x		
_CodeSignature	309.2 KiB	root	wheel	drwxr-xr-x		
bin	57.2 KiB	root	wheel	drwxr-xr-x		
2to3	8 bytes	root	wheel	lrwxr-xr-x	2020-05-03, 12:4...	
2to3-3.7	99 bytes	root	wheel	-rwxr-xr-x	2020-04-24, 9:5...	
pydoc3	8 bytes	root	wheel	lrwxr-xr-x	2020-05-03, 12:4...	
pydoc3.7	82 bytes	root	wheel	-rwxr-xr-x	2020-04-24, 9:5...	
python3	9 bytes	root	wheel	lrwxr-xr-x	2020-05-03, 12:4...	
python3-config	16 bytes	root	wheel	lrwxr-xr-x	2020-05-03, 12:4...	
python3.7	27.3 KiB	root	wheel	-rwxr-xr-x	2020-05-03, 12:4...	
python3.7-config	17 bytes	root	wheel	lrwxr-xr-x	2020-05-03, 12:4...	
python3.7m	27.3 KiB	root	wheel	-rwxr-xr-x	2020-05-03, 12:4...	
python3.7m-config	2.0 KiB	root	wheel	-rwxr-xr-x	2020-04-24, 9:5...	
pyenv	10 bytes	root	wheel	lrwxr-xr-x	2020-05-03, 12:4...	
pyenv-3.7	439 bytes	root	wheel	-rwxr-xr-x	2020-04-24, 9:5...	

CLTools\_Executables.pkg

Install Extract To... Verify Show Info View Files Search Find

Package Install Directory: /  
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 Package has a valid signature: Software Update (Apple Software Update Certification Authority, Apple Root CA)  
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 Size of selected files: 88.7 KiB

**Contents Resources**

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Resources	26 bytes	root	wheel	lrwxr-xr-x	2020-05-03, 12:4...	
Versions	36.5 MiB	root	wheel	drwxr-xr-x		
3.7	36.5 MiB	root	wheel	drwxr-xr-x		
Headers	624.8 KiB	root	wheel	drwxr-xr-x		
Python3	3.2 MiB	root	wheel	-rwxr-xr-x	2020-05-03, 12:5...	
Resources	223.7 KiB	root	wheel	drwxr-xr-x		
Info.plist	507 bytes	root	wheel	-rw-r--r--	2020-04-24, 9:5...	
Python.app	133.9 KiB	root	wheel	drwxr-xr-x		
patches.tar.bz2	88.7 KiB	root	wheel	-rw-r--r--	2020-04-24, 9:5...	
version.plist	510 bytes	root	wheel	-rw-r--r--	2020-04-24, 9:5...	
_CodeSignature	309.2 KiB	root	wheel	drwxr-xr-x		
bin	57.2 KiB	root	wheel	drwxr-xr-x		
include	10 bytes	root	wheel	drwxr-xr-x		
lib	32.1 MiB	root	wheel	drwxr-xr-x		
share	15.8 KiB	root	wheel	drwxr-xr-x		
Current	3 bytes	root	wheel	lrwxr-xr-x	2020-05-03, 12:4...	
PrivateFrameworks	113.9 MiB	root	wheel	drwxr-xr-x		
usr	627.4 MiB	root	wheel	drwxr-xr-x		
bin	351.4 MiB	root	wheel	drwxr-xr-x		
2to3	64 bytes	root	wheel	lrwxr-xr-x	2020-05-03, 12:4...	

# How else can we install Python?

- Management/deployment:
  - [python.org](https://python.org) installer packages
  - Relocatable Python (<https://github.com/gregneagle/relocatable-python>)
    - (Relies on [python.org](https://python.org) installers)
- Development:
  - <https://github.com/pyenv/pyenv>
  - <https://github.com/indygreg/python-build-standalone>
  - homebrew

# python.org

The screenshot shows the Python.org website. At the top, there is a dark navigation bar with links for Python, PSF, Docs, PyPI, Jobs, and Community. Below the navigation bar is a blue header section featuring the Python logo and the word "python" in white. To the right of the logo are buttons for "Donate", a search bar with a magnifying glass icon, and "GO". There is also a "Socialize" link. Below the header is a blue navigation bar with links for About, Downloads, Documentation, Community, Success Stories, News, and Events. The main content area features a large image of the Python logo. On the left, there is a sidebar with links for All releases, Source code, Windows, Mac OS X, Other Platforms, License, and Alternative Implementations. The main content area displays information about Python 3.8.3, including its release date (May 13, 2020), and a "Download for Mac OS X" button. A note states that Python can be used on many operating systems and environments, with a link to view the full list of downloads.

Python 3.8.3

Release Date: May 13, 2020

This is the third maintainer release in the 3.8 series. The Python 3.8 series is the newest

All releases

Source code

Windows

Mac OS X

Other Platforms

License

Alternative Implementations

Download for Mac OS X

Python 3.8.3

Not the OS you are looking for? Python can be used on many operating systems and environments.

[View the full list of downloads.](#)

Major new features of the 3.8 series, compared to 3.7

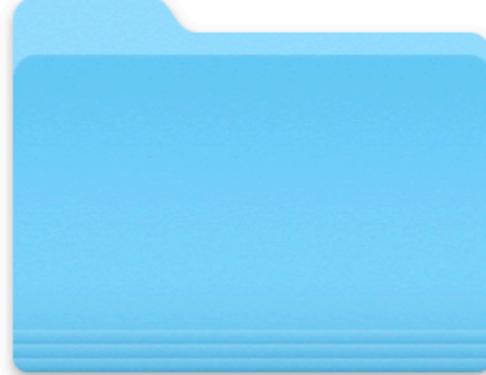
- [PEP 572](#), Assignment expressions
- [PEP 570](#), Positional-only arguments
- [PEP 587](#), Python Initialization Configuration (improved embedding)
- [PEP 590](#), Vectorcall: a fast calling protocol for CPython
- [PEP 578](#), Runtime audit hooks

python-3.8.3-macosx10.9.pkg

Package Info		All Files	postinstall	Receipts
Name	Date Modified	Size	Kind	
▼ Applications	--	477 KB	Folder	
▼ Python 3.8	--	477 KB	Folder	
ICON	2020-05-13	Zero KB	Document	
IDLE.app	--	188 KB	Application	
Install Certificates.command	2020-05-13	1 KB	Terminal shell script	
License.rtf	2020-05-13	13 KB	Rich text (RTF)	
Python Launcher.app	--	269 KB	Application	
ReadMe.rtf	2020-05-13	3 KB	Rich text (RTF)	
Update Shell Profile.command	2020-05-13	3 KB	Terminal shell script	
▼ Library	--	113.9 MB	Folder	
▼ Frameworks	--	113.9 MB	Folder	
▶ Python.framework	--	113.9 MB	Framework	
▼ usr	--	704 bytes	Folder	
▼ local	--	704 bytes	Folder	
▼ bin	--	704 bytes	Folder	
2to3	2020-05-13	66 bytes	Symbolic link	
2to3-3.8	2020-05-13	70 bytes	Symbolic link	
idle3	2020-05-13	67 bytes	Symbolic link	
idle3.8	2020-05-13	69 bytes	Symbolic link	
pydoc3	2020-05-13	68 bytes	Symbolic link	
pydoc3.8	2020-05-13	70 bytes	Symbolic link	
python3	2020-05-13	69 bytes	Symbolic link	
python3-config	2020-05-13	76 bytes	Symbolic link	
python3.8	2020-05-13	71 bytes	Symbolic link	
python3.8-config	2020-05-13	78 bytes	Symbolic link	

All Files > Library > Frameworks > Python.framework

3 items, 114.4 MB installed



Name	Python.framework
Kind	Framework
Size	113.9 MB
Modified	--
Owner	--
Group	--
Permissions	<span style="font-size: small;">↻</span> an unk... Read & Write <span style="font-size: small;">↻</span> an unk... Read only <span style="font-size: small;">↻</span> Everyo... Read only
Version	--
Identifier	--
Package	org.python.Python.PythonFramework-3.8 org.python.Python.PythonDocumentation-3.8
Bundle	Will overwrite files

# relocatable-python

g gregneagle / relocatable-python

Code Issues 1 Pull requests 1 Actions Projects 0 Wiki Security 0 Insights

A tool for building standalone relocatable Python.framework bundles

18 commits 1 branch 0 packages 0 releases 2 contributors Apache-2.0

Branch: master New pull request Create new file Upload files Find file Clone or download

File	Description	Time
g gregneagle	Python 3 fix for localizing shebangs in Python.framework/Versions/Cur...	Latest commit 8bce58e on Feb 8
locallibs	Python 3 fix for localizing shebangs in Python.framework/Versions/Cur...	4 months ago
.gitignore	First code commit	2 years ago
LICENSE	Initial commit	2 years ago
README.txt	Update README.txt	6 months ago
make_relocatable_python_framew...	Make scripts in Python.framework/Versions/Current/bin relocatable. Fi...	4 months ago
research_notes.txt	First code commit	2 years ago

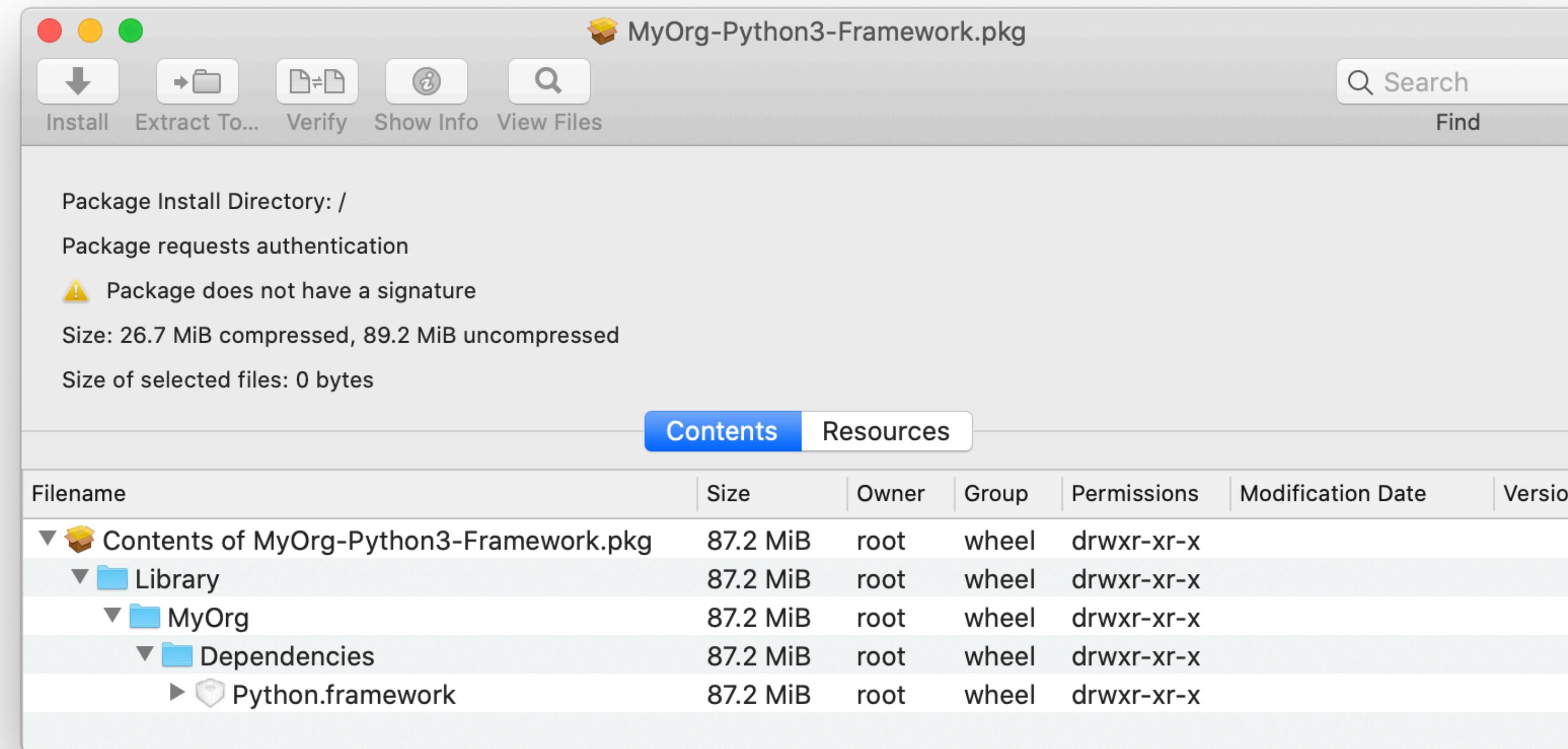
README.txt

This is a tool to make a relocatable Python framework containing PyObjC.

NOTE: while the resulting frameworks (and interpreters) have been successfully used in several projects (among them Imagr, Munki, and AutoPkg) there is no guarantee it is suitable as a general-purpose Python installation.

A relocatable Python.framework is ideal for embedding into an application's Frameworks directory, and can even be used to get PyObjC-based apps and tools running in the macOS Recovery environment, which does not include Python.

# relocatable-python



```
#!/Library/MyOrg/Dependencies/Python.framework/Versions/Current/bin/python3
```

# Building a single binary

- PyInstaller
  - Easy to use, bundles runtime shared libs and minimum required modules
  - No recompilation, it's more of a packaging solution
- Nuitka
  - Compiler, optimized for performance
- PyOxidizer
  - New and experimental, runs a Python embeddable runtime via a Rust binary

# PyInstaller

```
$ rg pyinstaller osx_server_irc_logs

##osx-server_20140430.log
1328:[14:59:49] <frogor> Yeah. My current one is pyinstaller

##osx-server_20140314.log
1703:[19:40:13] <frogor> natewalck: pyinstaller is awesome (if you use the development branch) btw.

##osx-server_20140729.log
2486:[19:59:02] <frogor> I use pyinstaller to compile them to self-contained .exe

##osx-server_20140919.log
2448:[17:33:01] <frogor> Though pyinstaller might be able to wrap that all up into an .app .....
2449:[17:33:07] <frogor> (I love pyinstaller to death)

##osx-server_20131030.log
1259:[14:33:56] <frogor> I'm only doing PowerShell to be polite to my coworkers. pyinstaller makes wonderful Windows .exe
files.
1267:[14:36:10] <frogor> jaharmi: Mostly because without something like pyinstaller, you can't natively run python on Windows
without installing the interpreter.
1269:[14:36:24] <frogor> But pyinstaller will let you do self-contained re-distributable .exe files
```

# Demo



***PyInstaller***

`#!/bin/python`

`import os`

`import sys`

`...10001100 0100110001100`

`.....1101001000111011010`

`.....00011110000111100011`

# Caveats with PyInstaller

- Needs Python's shared library support
  - pyenv: install using the --enable-shared configure option
  - May be possible to use with .framework builds of Python
- Not really optimized for performance or load speed
  - Single binary is cooler than the default "directory" distribution build, but adds to initial execution time in order to unpack the compressed archive

# **Learn about your Python**

# sysconfig module: learn about the runtime configuration

(From Apple's Python 3)

```
>>> import sysconfig

>>> sysconfig.get_config_vars()
{'OPENSSL_LIBS': '-lssl -lcrypto -framework TrustEvaluationAgent',

 'OPENSSL_INCLUDES': '-I/BuildRoot/Applications/Xcode.app/Contents/Developer/
Platforms/MacOSX.platform/Developer/SDKs/MacOSX10.15.Internal.sdk/usr/local/
libressl-2.8/include',

 'OPENSSL_LDFLAGS': '-L/BuildRoot/Applications/Xcode.app/Contents/Developer/
Platforms/MacOSX.platform/Developer/SDKs/MacOSX10.15.Internal.sdk/usr/local/
libressl-2.8/lib/static -F/BuildRoot/Applications/Xcode.app/Contents/Developer/
Platforms/MacOSX.platform/Developer/SDKs/MacOSX10.15.Internal.sdk/System/Library/
PrivateFrameworks'}
```

# SSL config

```
# From python.org and relocatable-python Python 3 packages
>>> import ssl
>>> ssl.OPENSSL_VERSION
'OpenSSL 1.1.1d 10 Sep 2019'
```

```
$ otool -L ./Versions/3.8/lib/python3.8/lib-dynload/_ssl.cpython-38-darwin.so
```

```
./Versions/3.8/lib/python3.8/lib-dynload/_ssl.cpython-38-darwin.so:
    /Library/Frameworks/Python.framework/Versions/3.8/lib/libssl.1.1.dylib (compatibility version 1.1.0,
current version 1.1.0)
    /Library/Frameworks/Python.framework/Versions/3.8/lib/libcrypto.1.1.dylib (compatibility version
1.1.0, current version 1.1.0)
    /usr/lib/libSystem.B.dylib (compatibility version 1.0.0, current version 1197.1.1)
```

# SSL config

```
# From Apple's Python
>>> import ssl
>>> ssl.OPENSSL_VERSION
'LibreSSL 2.8.3'
```

```
$ otool -L /Library/Developer/CommandLineTools/Library/Frameworks/Python3.framework/Versions/Current/lib/
python3.7/lib-dynload/_ssl.cpython-37m-darwin.so
```

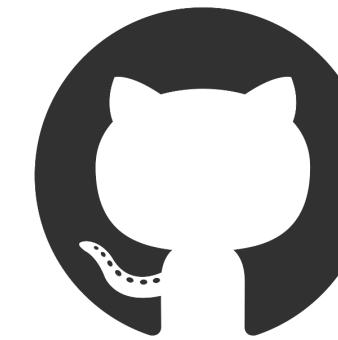
```
/Library/Developer/CommandLineTools/Library/Frameworks/Python3.framework/Versions/Current/lib/python3.7/
lib-dynload/_ssl.cpython-37m-darwin.so:
```

```
  /System/Library/PrivateFrameworks/TrustEvaluationAgent.framework/Versions/A/TrustEvaluationAgent
  (compatibility version 1.0.0, current version 33.0.0)
  /usr/lib/libSystem.B.dylib (compatibility version 1.0.0, current version 1281.0.0)
```

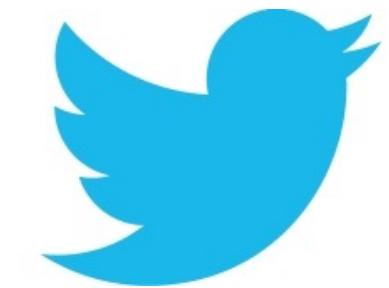
# SSL config - certs

- Anything involving internally-trusted roots, or cert auth, you'll need to know which trust store is being used by your Python
- Check out [certifi](#) package, and certifi.where() - Python requests package will use it out of the box
  - May need to occasionally update bundled certifi package in your app
  - <https://requests.readthedocs.io/en/master/user/advanced/#ssl-cert-verification>
- See homebrew openssl formula code for an example of how to port certificates from a keychain into a .pem file
  - <https://github.com/Homebrew/homebrew-core/blob/master/Formula/openssl@1.1.rb>

# Thank you!



@timsutton



@tvsutton

<https://macops.ca/macdevopsyvr-2020>