

Shipping Python to Mac Clients in 2020

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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

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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: J2L 2J2	\$4.19

Your Total **\$32.18**

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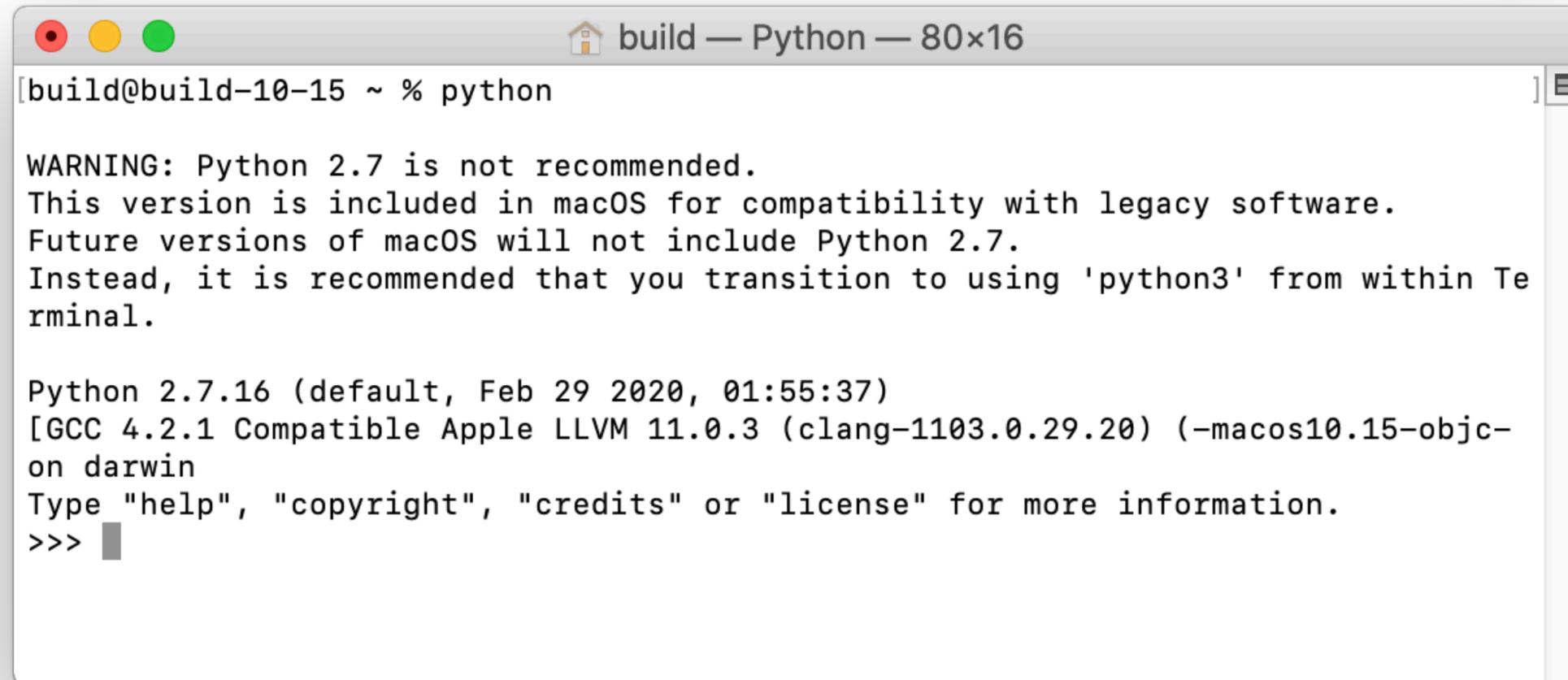
Scripting Language Runtimes

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

Catalina

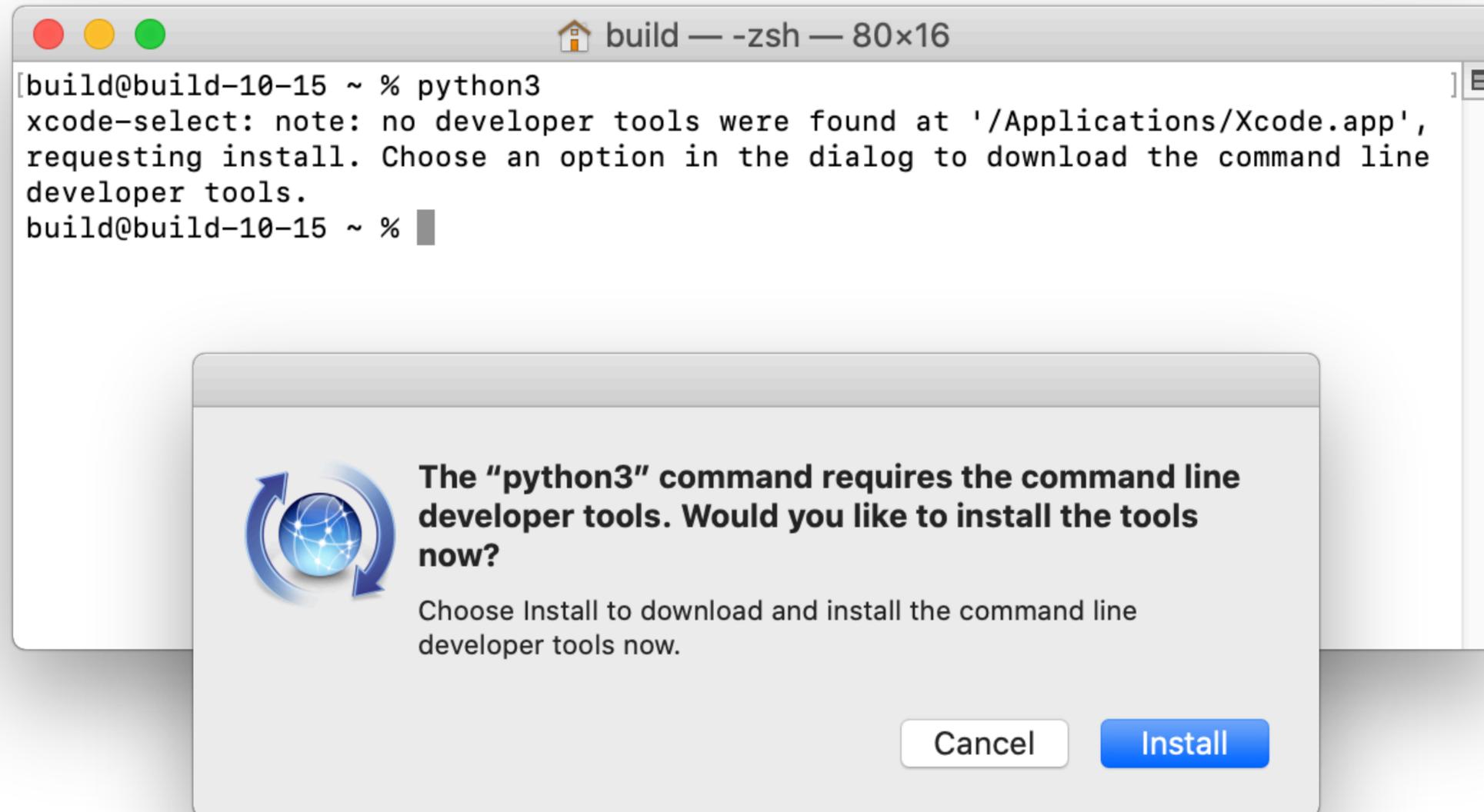


```
build — Python — 80x16
[build@build-10-15 ~ % python

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-objective-c
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...	
pyvenv	10 bytes	root	wheel	lrwxr-xr-x	2020-05-03, 12:4...	
pyvenv-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: /

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: 88.7 KiB

Contents Resources

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Contents of CLTools_Executables.pkg	778.8 MiB	root	wheel	drwxr-xr-x		
Library	778.8 MiB	root	wheel	drwxr-xr-x		
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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		
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 installer packages
 - Relocatable Python (<https://github.com/gregneagle/relocatable-python>)
 - (Relies on 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 interface. At the top, there is a dark navigation bar with links for Python, PSF, Docs, PyPI, Jobs, and Community. Below this is a blue header containing the Python logo, a search bar with a 'GO' button, and a 'Socialize' link. A secondary navigation bar lists 'About', 'Downloads', 'Documentation', 'Community', 'Success Stories', 'News', and 'Events'. The 'Downloads' menu is open, showing options for 'All releases', 'Source code', 'Windows', 'Mac OS X', 'Other Platforms', 'License', and 'Alternative Implementations'. The 'Mac OS X' option is selected, leading to a 'Download for Mac OS X' section. This section features a 'Python 3.8.3' button and text stating: 'Not the OS you are looking for? Python can be used on many operating systems and environments. View the full list of downloads.' To the left of the download section, the main content area displays 'Python 3.8.3' with a 'Release Date: May 13, 2020'. Below this, it notes 'This is the third maintenance release' and 'The Python 3.8 series is the newest'. A section titled 'Major new features of the 3.8 series, compared to 3.7' lists several PEPs: PEP 572 (Assignment expressions), PEP 570 (Positional-only arguments), PEP 587 (Python Initialization Configuration), PEP 590 (Vectorcall), and PEP 578 (Runtime audit hooks).

Python

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Python 3.8.3

Release Date: May 13, 2020

This is the third maintenance release

The Python 3.8 series is the newest

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



Name Python.framework
 Kind Framework
 Size 113.9 MB
 Modified --
 Owner --
 Group --

Permissions

an unk...	Read & Write
an unk...	Read only
Everyo...	Read only

Version --
 Identifier --
 Package org.python.Python.PythonFramework-3.8
 org.python.Python.PythonDocumentation-3.8
 Bundle Will overwrite files

All Files > Library > Frameworks > Python.framework

3 items, 114.4 MB installed

relocatable-python

gregneagle / relocatable-python

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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

 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_framework...	Make scripts in Python.framework/Versions/Current/bin relocatable. Fi...	4 months ago
research_notes.txt	First code commit	2 years ago

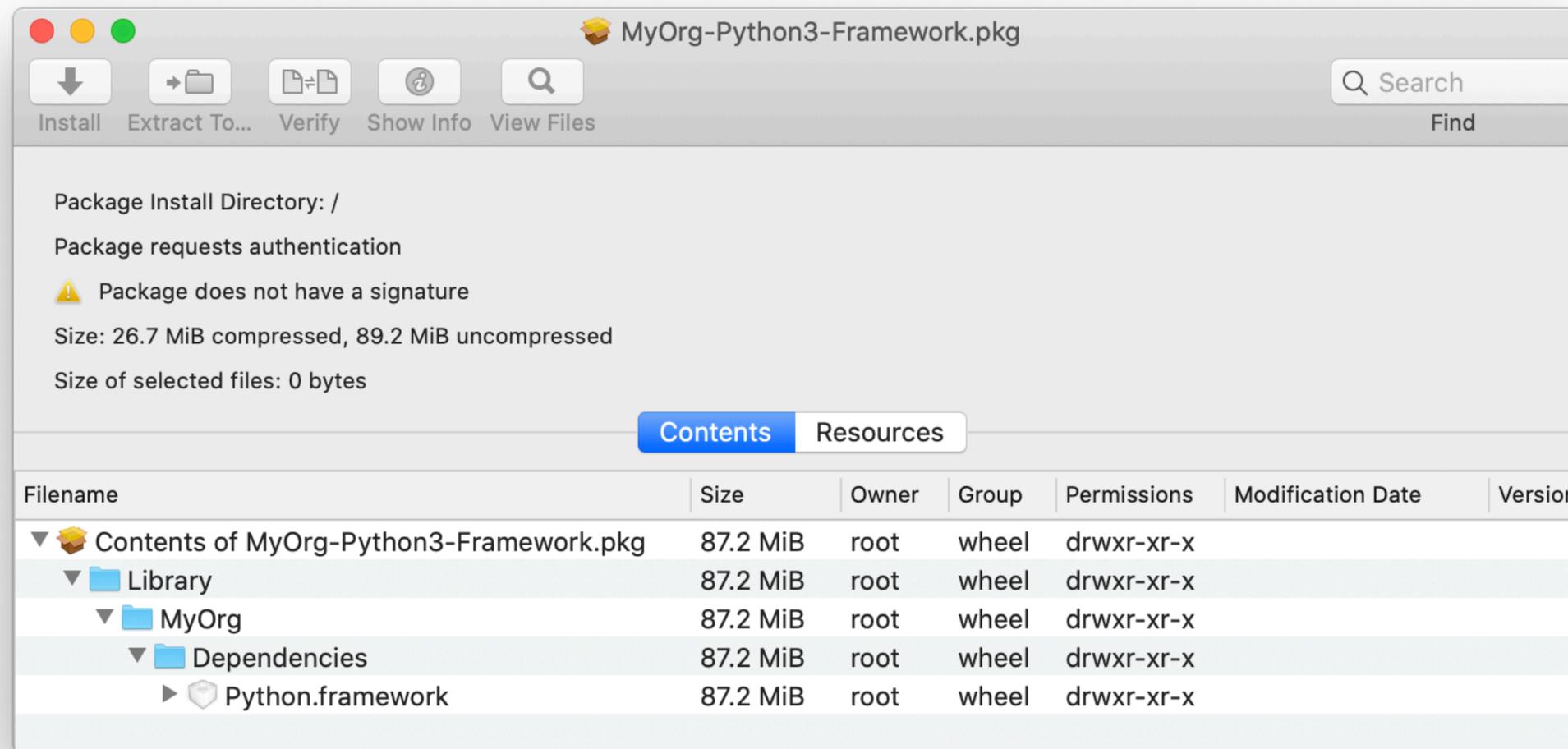
README.txt

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



PylInstaller

```
#!/bin/env python .....100011100 010011100011100  
import os .....1110110100100011110111010  
import sys .....11111000111110000111100011
```

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)
```

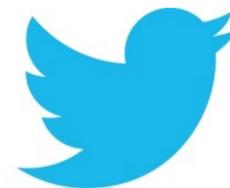
SSL config - certs

- 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>