

 免费电子书

学习

cython

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1: cython

Cython

CythonCCPython。 PythonC。

cythonCythonCC ++CC ++C。 Python。

PythonCythonCPython API。 Pythonadd。 CythonC。 Cython。

CythonCython。 Python。

Examples

Cython

Cython.Cython_{cython}CPythonCythonnumpy。 cythonCC。

1Cython

Cython。

1. PyPI_{easy_install}

```
$ pip install cython
$ easy_install cython
```

2. conda_{anaconda}

```
$ conda install cython
```

3. enpkg_{Enthought}

```
$ enpkg cython
```

github

```
$ python setup.py install
```

UbuntuDebian

Ubuntu_{cython}cython3。 ◦

```
$ apt-get install cython cython3
```

[Windowspip.whl](#)◦ [Windows.whl](#)◦

2C

CythonCCC ++◦ gcc◦

UbuntuDebian

build-essential◦

```
$ sudo apt-get install build-essential
```

[XCodegcc](#)◦

[MinGW](#) WindowsMinimalist GNUWindowsgcc◦ Visual Studio◦

Cython pyxC *cythonized* Python◦ Python◦

- `hello.pyx`Cython◦
- `test.py`helloPython◦
- `setup.py`Cython◦

hello.pyx

```
from libc.math cimport pow

cdef double square_and_add (double x):
    """Compute x^2 + x as double.

    This is a cdef function that can be called from within
    a Cython program, but not from Python.
    """
    return pow(x, 2.0) + x

cpdef print_result (double x):
    """This is a cpdef function that can be called from Python."""
    print("{} ^ 2) + {} = {}".format(x, x, square_and_add(x)))
```

test.py

```
# Import the extension module hello.
import hello
```

```
# Call the print_result method
hello.print_result(23.0)
```

setup.py

```
from distutils.core import Extension, setup
from Cython.Build import cythonize

# define an extension that will be cythonized and compiled
ext = Extension(name="hello", sources=["hello.pyx"])
setup(ext_modules=cythonize(ext))
```

```
cython hello.pyx Cgcc distutils
```

```
$ ls
hello.pyx  setup.py  test.py
$ python setup.py build_ext --inplace
$ ls
build  hello.c  hello.cpython-34m.so  hello.pyx  setup.py  test.py
```

```
.soPython test.py
```

```
$ python test.py
(23.0 ^ 2) + 23.0 = 552.0
```

cython <https://riptutorial.com/zh-CN/cython/topic/2925/cython>

2: Cython

Examples

pyinstallerCython

Cython

```
def do_stuff():
    cdef int a,b,c
    a = 1
    b = 2
    c = 3
    print("Hello World!")
    print([a,b,c])
    input("Press Enter to continue.")
```

setup.py

```
from distutils.core import setup
from Cython.Build import cythonize
setup(
    name = "Hello World",
    ext_modules = cythonize('program.pyx'),
)
```

python setup.py build_ext --inplace.pyd

vanilla Python main.py .pyd

```
import program
program.do_stuff()
```

PyInstaller pyinstaller --onefile "main.py" • 4 MB +python

Windows

Windows.bat

```
del "main.exe"
python setup.py build_ext --inplace
del "*.c"
rmdir /s /q ".\build"
pyinstaller --onefile "main.py"
copy /y ".\dist\main.exe" ".\main.exe"
rmdir /s /q ".\dist"
rmdir /s /q ".\build"
del "*.spec"
del "*.pyd"
```


Numpy

Numpy include_dirs setup.py Python numpy Pyinstaller

program.pyx

```
import numpy as np
cimport numpy as np

def do_stuff():
    print("Hello World!")
    cdef int n
    n = 2
    r = np.random.randint(1,5)
    print("A random number: "+str(r))
    print("A random number multiplied by 2 (made by cdef):"+str(r*n))
    input("Press Enter to continue.")
```

setup.py

```
from distutils.core import setup, Extension
from Cython.Build import cythonize
import numpy

setup(
    ext_modules=cythonize("hello.pyx"),
    include_dirs=[numpy.get_include()]
)
```

main.py

```
import program
import numpy
program.do_stuff()
```

Cython <https://riptutorial.com/zh-CN/cython/topic/6386/cython>

3: C ++

Examples

DLLC ++CythonPython

CythonC ++ dll。

- Visual StudioC ++DLL。
- CythonDLLPython。

CythonPython。

DLLVisual StudioDLL。

1. complexFunLib.h C ++ DLL
2. complexFunLib.cpp C ++ DLLCPP
3. ccomplexFunLib.pxd Cython“header”
4. complexFunLib.pyx Cython“”
5. setup.py CythoncomplexFunLib.pyd Python
6. run.py CythonDLLPython

C ++ DLL Source `complexFunLib.hcomplexFunLib.cpp`

DLL。 C ++Visual StudioDLL。 • keek*exp(ee) res。 • OpenMPVisual StudioOpenMP。

H

```
// Avoids C++ name mangling with extern "C"
#define EXTERN_DLL_EXPORT extern "C" __declspec(dllexport)
#include <complex>
#include <stdlib.h>

// Handles 64 bit complex numbers, i.e. two 32 bit (4 byte) floating point numbers
EXTERN_DLL_EXPORT void mp_mlt_exp_c4(std::complex<float>* k,
                                     std::complex<float>* ee,
                                     int sz,
                                     std::complex<float>* res,
                                     int threads);

// Handles 128 bit complex numbers, i.e. two 64 bit (8 byte) floating point numbers
EXTERN_DLL_EXPORT void mp_mlt_exp_c8(std::complex<double>* k,
                                     std::complex<double>* ee,
                                     int sz,
                                     std::complex<double>* res,
                                     int threads);
```

CPP

```

#include "stdafx.h"
#include <stdio.h>
#include <omp.h>
#include "complexFunLib.h"

void mp_mlt_exp_c4(std::complex<float>* k,
                  std::complex<float>* ee,
                  int sz,
                  std::complex<float>* res,
                  int threads)
{
    // Use Open MP parallel directive for multiprocessing
    #pragma omp parallel num_threads(threads)
    {
        #pragma omp for
        for (int i = 0; i < sz; i++) res[i] = k[i] * exp(ee[i]);
    }
}

void mp_mlt_exp_c8(std::complex<double>* k,
                  std::complex<double>* ee,
                  int sz, std::complex<double>* res,
                  int threads)
{
    // Use Open MP parallel directive for multiprocessing
    #pragma omp parallel num_threads(threads)
    {
        #pragma omp for
        for (int i = 0; i < sz; i++) res[i] = k[i] * exp(ee[i]);
    }
}

```

Cython `ccomplexFunLib.pxd``complexFunLib.pyx`

C ++ DLL Cython。

- Cython
- DLLDLL

CythonDLL.pyd Python C ++。

PXD

C ++。 Cython。 Cython。 `ccomplexFunLib.pxd`。。

```

cdef extern from "complexFunLib.h":
    void mp_mlt_exp_c4(float complex* k, float complex* ee, int sz,
                     float complex* res, int threads);
    void mp_mlt_exp_c8(double complex* k, double complex* ee, int sz,
                     double complex* res, int threads);

```

PYX

C ++ `cpp` Numpy `ndarray` DLL。 Cython `memoryview``ndarray`。

```

cimport ccomplexFunLib # Import the pxd "header"
# Note for Numpy imports, the C import most come AFTER the Python import
import numpy as np # Import the Python Numpy
cimport numpy as np # Import the C Numpy

# Import some functionality from Python and the C stdlib
from cpython.pycapsule cimport *

# Python wrapper functions.
# Note that types can be declared in the signature

def mp_exp_c4(np.ndarray[np.complex64_t, ndim=1] k,
              np.ndarray[np.complex64_t, ndim=1] ee,
              int sz,
              np.ndarray[np.complex64_t, ndim=1] res,
              int threads):
    '''
    TODO: Python docstring
    '''
    # Call the imported DLL functions on the parameters.
    # Notice that we are passing a pointer to the first element in each array
    ccomplexFunLib.mp_mlt_exp_c4(&k[0], &ee[0], sz, &res[0], threads)

def mp_exp_c8(np.ndarray[np.complex128_t, ndim=1] k,
              np.ndarray[np.complex128_t, ndim=1] ee,
              int sz,
              np.ndarray[np.complex128_t, ndim=1] res,
              int threads):
    '''
    TODO: Python docstring
    '''
    ccomplexFunLib.mp_mlt_exp_c8(&k[0], &ee[0], sz, &res[0], threads)

```

Python `setup.pyrun.py`

`setup.py`

CythonPython^o .pydPython^o complexFunLib.h complexFunLib.dll ccomplexFunLib.pxd

complexFunLib.pyx setup.py^o

build_ext --inplace

.pyd^o .pyd^o .pydsetup.py^o

```

from distutils.core import setup
from distutils.extension import Extension
from Cython.Distutils import build_ext
import numpy as np

ext_modules = [
    Extension('complexFunLib',
              ['complexFunLib.pyx'],
              # Note here that the C++ language was specified
              # The default language is C
              language="c++",
              libraries=['complexFunLib'],
              library_dirs=['.'])

```

```

]

setup(
    name = 'complexFunLib',
    cmdclass = {'build_ext': build_ext},
    ext_modules = ext_modules,
    include_dirs=[np.get_include()] # This gets all the required Numpy core files
)

```

run.py

complexFunLibPythonDLL.

```

import complexFunLib
import numpy as np

# Create arrays of non-trivial complex numbers to be exponentiated,
# i.e. res = k*exp(ee)
k = np.ones(int(2.5e5), dtype='complex64')*1.1234 + np.complex64(1.1234j)
ee = np.ones(int(2.5e5), dtype='complex64')*1.1234 + np.complex64(1.1234j)
sz = k.size # Get size integer
res = np.zeros(int(2.5e5), dtype='complex64') # Create array for results

# Call function
complexFunLib.mp_exp_c4(k, ee, sz, res, 8)

# Print results
print(res)

```

C ++ <https://riptutorial.com/zh-CN/cython/topic/3525/c-plusplus>

4: C

Examples

C

my_randomC ◦ set_seed(long seed) rand() ◦ Cython

1. .pxd
2. .pyx ◦

test_extern.pxd

```
# extern blocks define interfaces for Cython to C code
cdef extern from "my_random.h":
    double rand()
    void c_set_seed "set_seed" (long seed) # rename C version of set_seed to c_set_seed to
    avoid naming conflict
```

test_extern.pyx

```
def set_seed (long seed):
    """Pass the seed on to the c version of set_seed in my_random."""
    c_set_seed(seed)

cpdef get_successes (int x, double threshold):
    """Create a list with x results of rand <= threshold

    Use the custom rand function from my_random.
    """
    cdef:
        list successes = []
        int i
    for i in range(x):
        if rand() <= threshold:
            successes.append(True)
        else:
            successes.append(False)
    return successes
```

C <https://riptutorial.com/zh-CN/cython/topic/3626/c>

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