Pure Python

Types

a = 2	integer
b = 5.0	float
c = 8.3e5	exponential
d = 1.5 + 0.5j	complex
e = 3 > 4	boolean
f = ’word’	string

Lists

a = [’red’, ’blue’, ’green’]	manually initialization
b = range(5)	initialization through a function
c = [nu**2 for nu in b]	initialize through list comprehension
d = [nu**2 for nu in b if b < 3]	list comprehension with condition
e = c[0]	access element
f = e[1: 2]	access a slice of the list
g = [’re’, ’bl’] + [’gr’]	list concatenation
h = [’re’] * 5	repeat a list
[’re’, ’bl’].index(’re’)	returns index of ’re’
’re’ in [’re’, ’bl’]	true if ’re’ in list
sorted([3, 2, 1])	returns sorted list

Dictionaries

a = {’red’: ’rouge’, ’blue’: ’bleu’, ’green’: ’vert’}	dictionary
b = a[’red’]	translate item
c = [value for key, value in b.items()]	loop through contents
d = a.get(’yellow’, ’no translation found’)	return default

Strings

a = ’red’	assignment
char = a[2]	access individual characters
’red ’ + ’blue’	string concatenation
’1, 2, three’.split(’,’)	split string into list
’.’.join([’1’, ’2’, ’three’])	concatenate list into string

Operators

a = 2	assignment
a += 1 (*=, /=)	change and assign
3 + 2	addition
3 / 2	integer division (python2) or float division (python3)
3 // 2	integer division
3 * 2	multiplication
3 ** 2	exponent
3 % 2	remainder
abs()	absolute value
1 == 1	equal
2 > 1	larger
2 < 1	smaller
1 != 2	not equal
1 != 2 and 2 < 3	logical AND
1 != 2 or 2 < 3	logical OR
not 1 == 2	logical NOT
a in b	test if a is in b
a is b	test if objects point to the same memory (id)

Control Flow

if/elif/else

```
a, b = 1, 2
if a + b == 3:
    print ’True’
elif a + b == 1:
    print ’False’
else:
    print ’?’
```

while

```
number = 1
while number < 10:
    print number
    number += 1
```

continue

```
for i in range(20):
    if i % 2 == 0:
        continue
    print i
```

for

```
a = [’red’, ’blue’,
     ’green’]
for color in a:
    print color
```

break

```
number = 1
while True:
    print number
    number += 1
    if number > 10:
        break
```

Functions, Classes, Generators, Decorators

Function

```
def myfunc(a1, a2):
    return x

x = my_function(a1,a2)
```

Generator

```
def firstn(n):
    num = 0
    while num < n:
        yield num
        num += 1
```

continue

```
for i in range(20):
    if i % 2 == 0:
        continue
    print i
```

Class

```
class Point(object):
    def __init__(self, x):
        self.x = x

x = Point(3.)
```

Decorator

```
class myDecorator(object):
    def __init__(self, f):
        self.f = f
    def __call__(self):
        print "call"
        f()
```

NumPy

array initialization

np.array([2, 3, 4])	direct initialization
np.empty(20, dtype=np.float32)	single precision array with 20 entries
np.zeros(200)	initialize 200 zeros
np.ones((3,3), dtype=np.int32)	3 x 3 integer matrix with ones
np.eye(200)	ones on the diagonal
np.zeros_like(a)	returns array with zeros and the same shape as a
np.linspace(0., 10., 100)	100 points from 0 to 10
np.arange(0, 100, 2)	points from 0 to <100 with step width 2
np.logspace(-5, 2, 100)	100 logarithmically spaced points between 1e-5 and 1e2
np.copy(a)	copy array to new memory

reading/ writing files

np.fromfile(fname/object, dtype=np.float32, count=5)	read binary data from file
np.loadtxt(fname/object, skiprows=2, delimiter=',')	read ascii data from file

array properties and operations

a.shape	a tuple with the lengths of each axis
len(a)	length of axis 0
a.ndim	number of dimensions (axes)
a.sort(axis=1)	sort array along axis
a.flatten()	collapse array to one dimension
a.conj()	return complex conjugate
a.astype(np.int16)	cast to integer
np.argmax(a, axis=2)	return index of maximum along a given axis
np.cumsum(a)	return cumulative sum
np.any(a)	True if any element is True
np.all(a)	True if all elements are True
np.argsort(a, axis=1)	return sorted index array along axis

indexing

a = np.arange(100)	initialization with 0 - 99
a[: 3] = 0	set the first three indices to zero
a[1: 5] = 1	set indices 1-4 to 1
a[None, :]	transform to column vector
a[[1, 1, 3, 8]]	return array with values of the indices
a = a.reshape(10, 10)	transform to 10 x 10 matrix
a.T	return transposed view
np.transpose(a, (2, 1, 0))	transpose array to new axis order
a[a < 2]	returns array that fulfills elementwise condition

boolean arrays

a < 2	returns array with boolean values
np.logical_and(a < 2, b > 10)	elementwise logical and
np.logical_or(a < 2, b > 10)	elementwise logical or
-a	invert boolean array
np.invert(a)	invert boolean array

elementwise operations and math functions

a * 5	multiplication with scalar
a + 5	addition with scalar
a + b	addition with array b
a / b	division with b (np.NaN for division by zero)
np.exp(a)	exponential (complex and real)
np.sin(a)	sine
np.cos(a)	cosine
np.arctan2(y,x)	arctan(y/x)
np.arcsin(x)	arcsin
np.radians(a)	degrees to radians
np.degrees(a)	radians to degrees
np.var(a)	variance of array
np.std(a, axis=1)	standard deviation

inner / outer products

np.dot(a, b)	inner matrix product: a_mi b_in
np.einsum('ijkl,klmn->ijmn', a, b)	einstein summation convention
np.sum(a, axis=1)	sum over axis 1
np.abs(a)	return array with absolute values
a[None, :] + b[:, None]	outer sum
a[None, :] * b[None, :]	outer product
np.outer(a, b)	outer product
np.sum(a * a.T)	matrix norm

interpolation, integration, fft

np.trapz(y, x=x, axis=1)	integrate along axis 1
np.interp(x, xp, yp)	interpolate function xp, yp at points x
np.fft.fft(y)	complex fourier transform of y
np.fft.fftfreqs(len(y))	fft frequencies for a given length
np.fft.fftshift(freqs)	shifts zero frequency to the middle
np.fft.rfft(y)	real fourier transform of y
np.fft.rfftfreqs(len(y))	real fft frequencies for a given length

rounding

np.ceil(a)	rounds to nearest upper int
np.floor(a)	rounds to nearest lower int
np.round(a)	rounds to neares int

random variables

np.random.normal(loc=0, scale=2, size=100)	100 normal distributed random numbers
np.random.seed(23032)	resets the seed value
np.random.rand(200)	200 random numbers in [0, 1)
np.random.uniform(1, 30, 200)	200 random numbers in [1, 30)
np.random.random_integers(1, 15, 300)	300 random integers between [1, 10]

Matplotlib

figures and axes

fig = plt.figure(figsize=(5, 2), facecolor='black')	initialize figure
ax = fig.add_subplot(3, 2, 2)	add second subplot in a 3 x 2 grid
fig, axes = plt.subplots(5, 2, figsize=(5, 5))	return fig and array of axes in a 5 x 2 grid
ax = fig.add_axes([left, bottom, width, height])	manually add axes at a certain position

figures and ax properties

fig.suptitle('title')	big figure title
fig.subplots_adjust(bottom=0.1, right=0.8, top=0.9, wspace=0.2, hspace=0.5)	adjust subplot positions
fig.tight_layout(pad=0.1,h_pad=0.5, w_pad=0.5, rect=None)	adjust subplots to fit perfectly into fig
ax.set_xlabel()	set xlabel
ax.set_ylabel()	set ylabel
ax.set_xlim(1, 2)	sets x limits
ax.set_ylim(3, 4)	sets y limits
ax.set_title('blabla')	sets the axis title
ax.set(xlabel='bla')	set multiple parameters at once
ax.legend(loc='upper center')	activate legend
ax.grid(True, which='both')	activate grid
bbox = ax.get_position()	returns the axes bounding box
bbox.x0 + bbox.width	bounding box parameters

plotting routines

ax.plot(x,y, '-o', c='red', lw=2, label='bla')	plots a line
ax.scatter(x,y, s=20, c=color)	scatter plot
ax.pcolormesh(xx,yy,zz, shading='gouraud')	fast colormesh function
ax.colormesh(xx,yy,zz, norm=norm)	slower colormesh function
ax.contour(xx,yy,zz, cmap='jet')	contour line plot
ax.contourf(xx,yy,zz, vmin=2, vmax=4)	filled contours plot
n, bins, patch = ax.hist(x, 50)	histogram
ax.imshow(matrix, origin='lower', extent=(x1, x2, y1, y2))	show image
ax.specgram(y, FS=0.1, noverlap=128, scale='linear')	plot a spectrogram