Algorithmic Approaches for Biological Data, Lecture #11

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Outline

- String Formatting

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- Dictionaries

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’{:,}’.format(1234567890) #’1,234,567,890’
pts = 19.5
total = 22
’Correct answers:  {:.2%}’.format(pts/total)
    #’Correct answers:  88.64%’
```

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- *PythonTutor demo*

Group Work

In pairs/triples, work out (and then try at the shell or `pythonTutor`):

1.
```
sub1 = "python string!"
sub2 = "an arg"
a = "i am a {0}".format(sub1)
b = "with {kwarg}!".format(kwarg=sub2)
```

2.
```
’The r{0} in Sp{0} stays m{0}ly in the pl{0}s.’.format(’ain’)
```

3.
```
d = [i/3.0 for i in range(0,20,2)] for j in range(len(d)):
    print ’{:6.2f}.format(j)
```

4.
```
s = "mississippi"
counts = {}
for c in s:
    counts[c] = counts.get(c,0)
tot = sum(counts.values())
```

5.
```
for i in range(5):
    for j in range(5):
        print j,
    print
```

6.
```
data = "GATGGAACTTGACTACGTAAATT"
cod = {}
for i in range(0,len(data),3):
    counts[data[i:i+3]] = counts.get(data[i:i+3],0)
print cod.keys()
```

7. Write a program that takes a file and will print out the 10 words that occur most often.

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  Example: coordinates of point in 3D space.
- Dictionaries: storing data for some, but not all, possible values.
  Example: counting words that occur in a file (versus keeping count for all possible words).

Break

AMNH Anthropology Collections

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Recall: Arrays in `numpy`

- The `numpy` module is part of `scipy` (and part of anaconda).
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  - `np.ones(x)`: creates an array of `x` ones.
  - `np.arrange(start, stop, step)`: like the `range()` function but returns an ndarray.
  - `np.linspace(start, stop, n)`: creates an array of n numbers evenly spaced between start and stop.

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```

- ndim gives the number of dimensions of the array.
- shape gives the size of each dimension.

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x.shape #(2,3)
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x.shape #(2,3)
y = x.T #Transpose x
y.shape #(3,2)
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```

- Also can compute inverses, eigenvalues, eigenvectors,...

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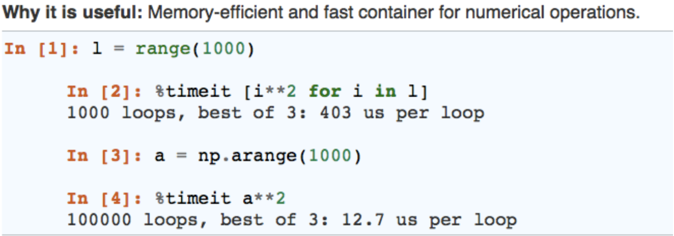

Why it is useful: Memory-efficient and fast container for numerical operations.

```
In [1]: l = range(1000)

      In [2]: %timeit [i**2 for i in l]
      1000 loops, best of 3: 403 us per loop

      In [3]: a = np.arange(1000)

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scipy documentation

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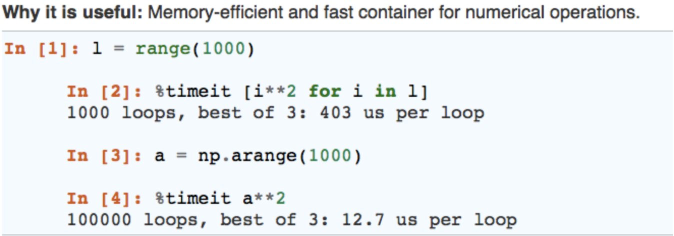

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- These include most mathematical functions. To use them, remember to use the `np` prefix.
  Example: `np.log(x), np.sqrt(x), x**2, ...`

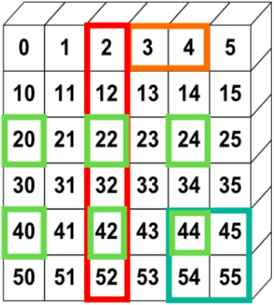
More on Arrays: Traversing Efficiently

```
>>> a[0,3:5]
array([3,4])

>>> a[4:,4:]
array([[44, 45],
       [54, 55]])

>>> a[:,2]
array([2,12,22,32,42,52])

>>> a[2::2,::2]
array([[20,22,24]
       [40,42,44]])
```



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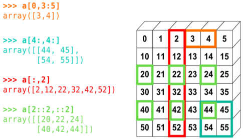

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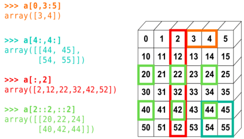

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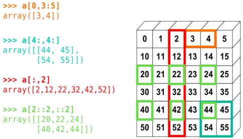

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- Example:

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a = np.arange(10)
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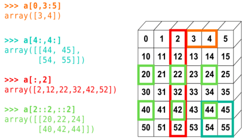

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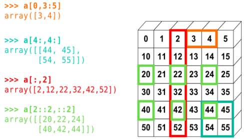
More on Arrays: Traversing Efficiently



```
>>> a[0,3:5]
array([3,4])

>>> a[4:,4:]
array([[44, 45],
       [54, 55]])

>>> a[:,2]
array([2,12,22,32,42,52])

>>> a[2::2,::2]
array([[20,22,24]
       [40,42,44]])
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scipy documentation

- When possible, use slices and indices to create a view of the array.
- Example:

  ```
  a = np.arange(10)
      #[0,1,2,3,4,5,6,7,8,9]
  b = a[::2]
      # [0,2,4,6,8]
  b[0] = 12
      # Changes in both arrays
  ```

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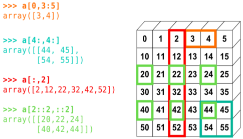

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b[0] = 12
    # Changes in both arrays
b = a[::2].copy()
    # force a copy
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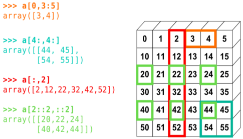

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b[0] = 12
    # Changes in both arrays
b = a[::2].copy()
    # force a copy
a[a % 3 == 0] = -1
    # Boolean mask:
    #[-1,1,2,-1,4,5,-1,7,8,-1]
```

In Pairs

In pairs:

Assume: `import numpy`.

1. What does the following print:

```
a = np.arange(10)
a[::2] += 5
print a
```

2. What do the following print:

```
b = np.arange(12).reshape(3, 4)
print b print b*2
```

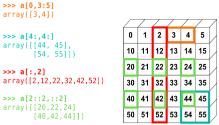
3. Write code that produces the array:

0	1	2	3	4	5
6	7	8	9	10	11

4. Write code that produces the array:

0	1	0	1	0	1	0	1
1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1
1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1
1	0	1	0	1	0	1	0
0	1	0	1	0	1	0	1
1	0	1	0	1	0	1	0

Recap



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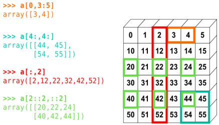
- Using `matplotlib` & `numpy` in lab today.

Recap



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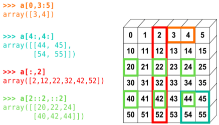
- Email lab reports to `kstjohn@amnh.org`

Recap



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- Challenges available at `rosalind.info`