NUMPY IV

9.21.2020

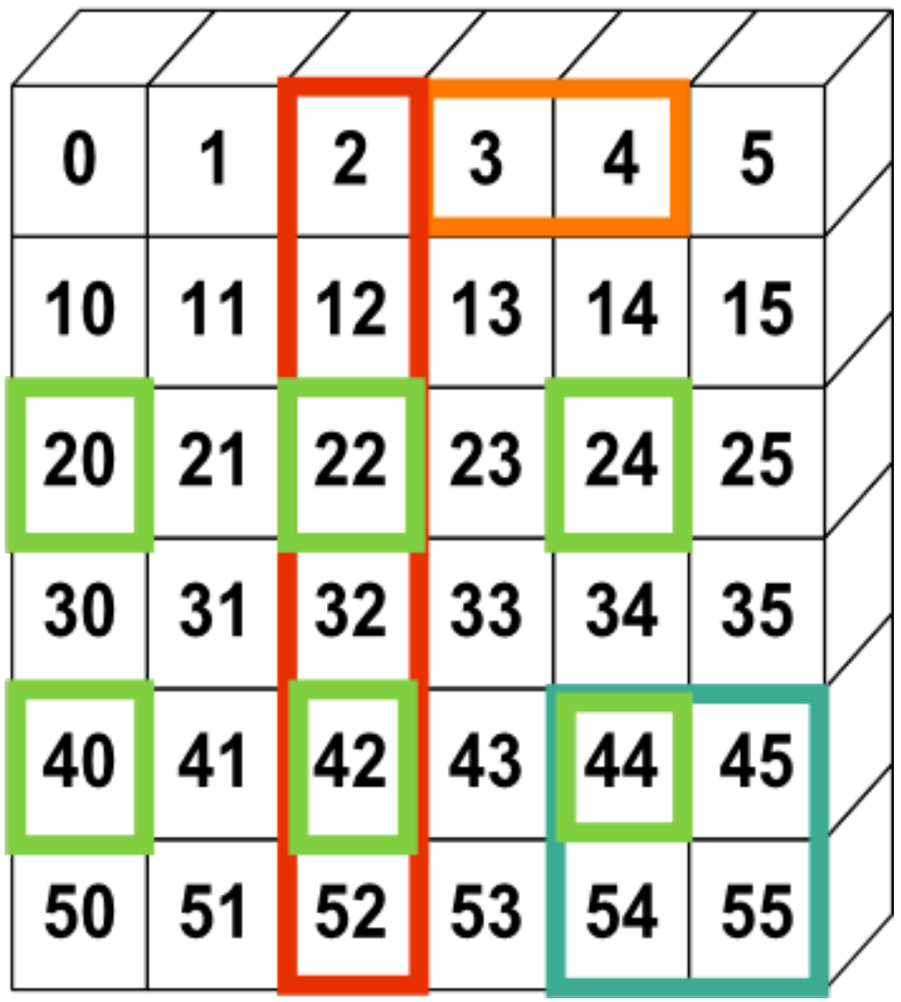
RECAP: SLICING

```
>>> 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]])
```



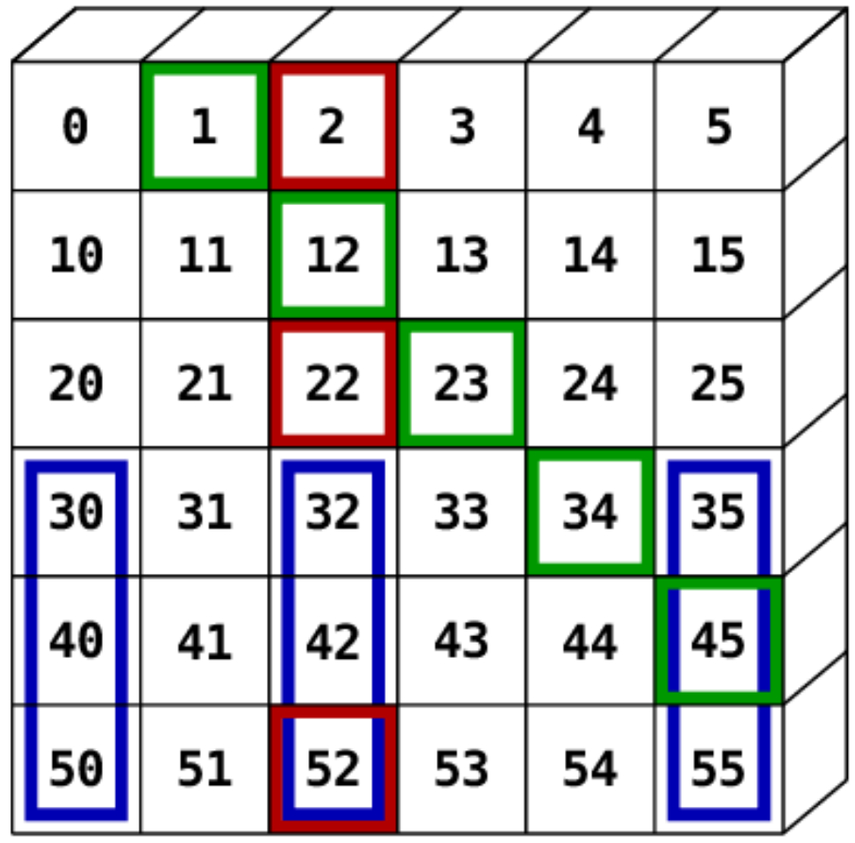
from: http://www.scipy-lectures.org/intro/numpy/numpy.html

RECAP: INDEXING

```
>>> a[(0,1,2,3,4), (1,2,3,4,5)]
array([1, 12, 23, 34, 45])
```

```
>>> a[3:, [0,2,5]]
array([[30, 32, 35],
       [40, 42, 45],
       [50, 52, 55]])
```

```
>>> mask = np.array([1,0,1,0,0,1], dtype=bool)
>>> a[mask, 2]
array([2, 22, 52])
```



from: http://www.scipy-lectures.org/intro/numpy/numpy.html

RECAP: AGGREGATION

* np.min(arr), np.sum(arr), etc.

RECAP: AGGREGATION

* np.min(arr, axis=0)

* np.min(arr, axis=1)

* etc.

ASSIGNMENT

* We can change the values inside an ndarray by assigning to them directly

* e.g.

```
>>> arr = np.arange(5)
>>> arr[0] = 17
>>> arr
array([17,1,2,3,4])
```

ASSIGNMENT

* Assignment can also be done to a slice of an array

* e.g.

```
>>> arr = np.arange(5)
>>> arr[:3] = -1
>>> arr
array([-1,-1,-1,3,4])
```

ASSIGNMENT

* These examples showed assignment of a single value to either a single element of the array or a slice

* You can also assign an array of values to a slice!

ASSIGNMENT

* e.g.

```
>>> arr = np.arange(5)
>>> arr[:3] = np.array([-1, 3, 17])
>>> arr
array([-1, 3, 17, 3, 4])
```

COPY VS VIEW

* suppose we did this:

```
* >>> arr = np.arange(10)
  >>> lil_arr = arr[:5]
  >>> lil_arr[0] = 23
  >>> arr
  ???
```

COPY VS VIEW

* suppose we did this:

```
* >>> arr = np.arange(10)
  >>> lil_arr = arr[:5]
  >>> lil_arr[0] = 23
  >>> arr
  array([23,1,2,3,4,5,6,7,8,9])
```

COPY VS VIEW

* this happened because **slicing** always creates a **view** onto the same data

* e.g. arr[0] and lil_arr[0] both point to the exact same piece of memory!

* **this works for any kind of *slicing* (with skips, etc.)**

COPY VS VIEW

* we can force the slice to point to a separate piece of memory using the **copy** method

* e.g.

```
>>> arr = np.arange(10)
>>> lil_arr = arr[:5].copy()
```

COPY VS VIEW

* now suppose we did this:

```
* >>> arr = np.arange(10)
  >>> inds = [0,1,2,3,4]
  >>> ind_arr = arr[inds]
  >>> ind_arr[0] = 23
  >>> arr
  ???
```

COPY VS VIEW

* now suppose we did this:

```
* >>> arr = np.arange(10)
  >>> inds = [0,1,2,3,4]
  >>> ind_arr = arr[inds]
  >>> ind_arr[0] = 23
  >>> arr
  array([0,1,2,3,4,5,6,7,8,9])
```

COPY VS VIEW

* this happened because **indexing** always creates a **copy** of the data

* e.g. arr[0] and ind_arr[0] point to different places in memory

COPY VS VIEW

* RECAP:
  * ***slicing*** an array gives you a *view* on the same data

  * ***indexing*** creates a *copy* that points to new data

PROBLEM SET 2

* is posted!

* due 10/2 (~2 weeks)

END