```python
import numpy as np
```

```python
ones_arr = np.ones((5,5),dtype=int)
ones_arr
```

```
array([[1, 1, 1, 1, 1],
       [1, 1, 1, 1, 1],
       [1, 1, 1, 1, 1],
       [1, 1, 1, 1, 1],
       [1, 1, 1, 1, 1]])
```

```python
ones_arr * 255
```

```
array([[255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255],
       [255, 255, 255, 255, 255]])
```

```python
import matplotlib.pyplot as plt
```

```python
from PIL import Image
```

```python
horse_img=Image.open("/content/Horse.jpg")
horse_img
```



```python
horse_arr=np.array(horse_img)
horse_arr
```

ndarray (148, 215, 3) show data
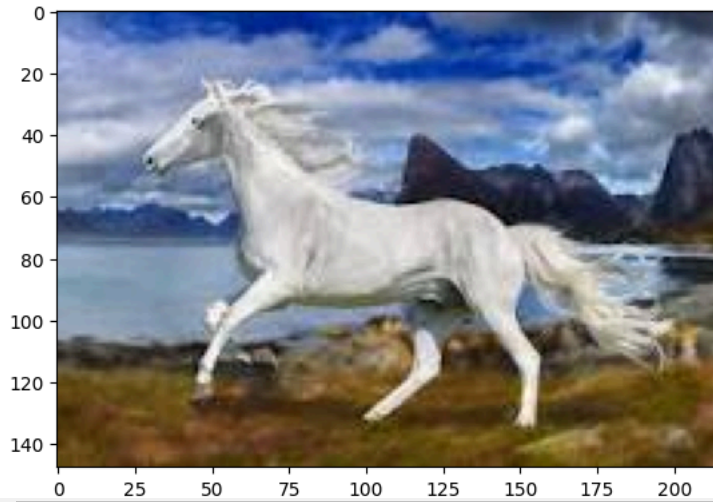


```python
np.ndarray.flatten(horse_arr)
```

```
array([ 84, 115, 170, ..., 136,  96,  61], dtype=uint8)
```

```python
plt.imshow(horse_arr)
```

```
<matplotlib.image.AxesImage at 0x7d253755e6d0>
```



```python
np.empty(2)
```

```
array([inf, inf])
```

```python
np.arange(4)
```

```
array([0, 1, 2, 3])
```

```python
np.arange(2,9,2)
```

```
array([2, 4, 6, 8])
```

```python
np.linspace(0,10,num=5)
```

```
array([ 0. ,  2.5,  5. ,  7.5, 10. ])
```

```python
arr = np.array([2,1,5,6,4,3,8,9])
arr
```

```
array([2, 1, 5, 6, 4, 3, 8, 9])
```

```python
np.sort(arr)
```

```
array([1, 2, 3, 4, 5, 6, 8, 9])
```

```python
a=np.array([1,2,3,4])
b=np.array([5,6,7,8])
```

```python
np.concatenate((a,b))
```

```
array([1, 2, 3, 4, 5, 6, 7, 8])
```

```python
x=np.array([[1,2,3],[4,5,6]])
y=np.array([[7,8,9],[10,11,12]])
```

```python
np.concatenate((x,y),axis=1)
```

```
array([[ 1,  2,  3,  7,  8,  9],
       [ 4,  5,  6, 10, 11, 12]])
```

```python
np.concatenate((x,y),axis=0)
```

```
array([[ 1,  2,  3],
       [ 4,  5,  6],
       [ 7,  8,  9],
       [10, 11, 12]])
```

```python
x1=np.array([[1,2,3],
             [4,5,6]])
```

```python
np.sum(x1,axis=0)
```
    array([5, 7, 9])

```python
np.sum(x1,axis=1)
```
    array([ 6, 15])

```python
a2d=np.array([[1,2,3],
              [4,5,6]])
```

```python
a2d.shape
```
    (2, 3)

```python
a2d.ndim
```
    2

```python
a3d=np.array([[[1,2],[3,4]],
    [[5,6],[7,8]]
])
```

```python
a3d.shape
```
    (2, 2, 2)

```python
a3d.ndim
```
    3

```python
np.random.randint(10,size=5)
```
    array([4, 7, 2, 1, 4])

```python
ard=np.random.rand(2,3,4,5)
ard
```
    array([[[[0.10152111, 0.08892682, 0.51786028, 0.14101216, 0.29425373],
             [0.93791127, 0.48308714, 0.04184318, 0.47608959, 0.88880411],
             [0.00101519, 0.11030742, 0.21270954, 0.69857249, 0.98345239],
             [0.46228717, 0.89011828, 0.79323602, 0.68425074, 0.78346772]],

            [[0.4983405 , 0.64217455, 0.18867497, 0.87410553, 0.86761529],
             [0.85959257, 0.42045846, 0.5884163 , 0.84044281, 0.13486828],
             [0.552731  , 0.45077729, 0.13818702, 0.3398488 , 0.94482211],
             [0.38521547, 0.74518658, 0.57778   , 0.0796832 , 0.58014568]],

            [[0.20624727, 0.17943884, 0.0817878 , 0.17864348, 0.04170699],
             [0.41389416, 0.12128707, 0.20461585, 0.40905564, 0.12418349],
             [0.15614657, 0.60777363, 0.76659829, 0.5238801 , 0.6118985 ],
             [0.83589216, 0.3943798 , 0.73914386, 0.07742476, 0.16232146]]],


           [[[0.79543902, 0.1044701 , 0.41263058, 0.12163425, 0.54959659],
             [0.56758157, 0.85145934, 0.59315617, 0.57963308, 0.57228667],
             [0.32261908, 0.33131196, 0.34779598, 0.57077243, 0.21594256],
             [0.13290525, 0.34930173, 0.35784668, 0.85450538, 0.51764486]],

            [[0.31359202, 0.85885095, 0.06220015, 0.91577058, 0.66489391],
             [0.28593274, 0.59551556, 0.83195071, 0.36295388, 0.44891909],
             [0.86458851, 0.25513349, 0.64876991, 0.23107949, 0.31801073],
             [0.50546776, 0.79042109, 0.78528132, 0.90436657, 0.98116763]],

            [[0.20987372, 0.47414686, 0.27879383, 0.69483333, 0.53907996],
             [0.62617852, 0.51401232, 0.51379241, 0.70576165, 0.87719979],
             [0.09760846, 0.78716691, 0.45702058, 0.8104736 , 0.62116112],
             [0.76359636, 0.6989912 , 0.60737674, 0.55306258, 0.05906421]]]])
```

```python
ard.shape
```

```
(2, 3, 4, 5)
```

```python
ard.size
```

```
120
```

```python
ard.ndim
```

```
4
```

```python
np.sum(ard,axis=0)
```

```
array([[[0.89696013, 0.19339693, 0.93049086, 0.26264641, 0.84385033],
        [1.50549285, 1.33454648, 0.63499935, 1.05572267, 1.46109078],
        [0.32363427, 0.44161938, 0.56050553, 1.26934492, 1.19939495],
        [0.59519242, 1.23942001, 1.1510827 , 1.53875611, 1.30111257]],

       [[0.81193253, 1.50102551, 0.25087512, 1.78987611, 1.5325092 ],
        [1.14552531, 1.01597403, 1.42036701, 1.20339669, 0.58378737],
        [1.41731951, 0.70591078, 0.78695693, 0.57092828, 1.26283283],
        [0.89068323, 1.53560767, 1.36306132, 0.98404978, 1.56131331]],

       [[0.41612098, 0.6535857 , 0.36058163, 0.87347681, 0.58078695],
        [1.04007268, 0.63529938, 0.71840826, 1.11481728, 1.00138328],
        [0.25375502, 1.39494054, 1.22361887, 1.3343537 , 1.23305962],
        [1.59948852, 1.09337099, 1.3465206 , 0.63048734, 0.22138567]]])
```

```python
np.sum(ard,axis=3)
```

```
array([[[1.1435741 , 2.8277353 , 2.00605704, 3.61335993],
        [3.07091085, 2.84377843, 2.42636621, 2.36801094],
        [0.68782438, 1.2730362 , 2.66629709, 2.20916204]],

       [[1.98377054, 3.16411682, 1.78844201, 2.21220389],
        [2.81530762, 2.52527198, 2.31758213, 3.96670437],
        [2.19672769, 3.23694468, 2.77343066, 2.68209109]]])
```

```python
ashape=np.arange(6)
ashape
```

```
array([0, 1, 2, 3, 4, 5])
```

```python
bshape=ashape.reshape(3,2)
bshape
```

```
array([[0, 1],
       [2, 3],
       [4, 5]])
```

```python
c=np.reshape(bshape,(2,3))
c
```

```
array([[0, 1, 2],
       [3, 4, 5]])
```

```python
dshape=np.reshape(ashape,newshape=(1,6),order='C')
dshape
```

```
array([[0, 1, 2, 3, 4, 5]])
```

```python
xc = np.arange(1,25).reshape(2,12)
xc
```

```
array([[ 1,  2,  3,  4,  5,  6,  7,  8,  9, 10, 11, 12],
       [13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24]])
```

```python
np.hsplit(xc,3)
```

```
[array([[ 1,  2,  3,  4],
        [13, 14, 15, 16]]),
 array([[ 5,  6,  7,  8],
        [17, 18, 19, 20]]),
```

```
          array([[ 9, 10, 11, 12],
                 [21, 22, 23, 24]])]
```

```
np.hsplit(xc,(3,4))
```

```
[array([[ 1,  2,  3],
        [13, 14, 15]]),
 array([[ 4],
        [16]]),
 array([[ 5,  6,  7,  8,  9, 10, 11, 12],
        [17, 18, 19, 20, 21, 22, 23, 24]])]
```

```
a= np.array([[1,2,3,4],
          [5,6,7,8 ],[9,10,11,12]])
a
```

```
array([[ 1,  2,  3,  4],
       [ 5,  6,  7,  8],
       [ 9, 10, 11, 12]])
```

```
b=a.copy()
b
```

```
array([[ 1,  2,  3,  4],
       [ 5,  6,  7,  8],
       [ 9, 10, 11, 12]])
```

```
b[0]=99
b
```

```
array([[99, 99, 99, 99],
       [ 5,  6,  7,  8],
       [ 9, 10, 11, 12]])
```

```
a
```

```
array([[ 1,  2,  3,  4],
       [ 5,  6,  7,  8],
       [ 9, 10, 11, 12]])
```

```
b1=a.view()
b1
```

```
array([[ 1,  2,  3,  4],
       [ 5,  6,  7,  8],
       [ 9, 10, 11, 12]])
```

```
b2=a[0,:]
b2
```

```
array([1, 2, 3, 4])
```

```
b2[0]=99
b2
```

```
array([99,  2,  3,  4])
```

```
a
```

```
array([[99,  2,  3,  4],
       [ 5,  6,  7,  8],
       [ 9, 10, 11, 12]])
```

```
v2=a.copy()
v2
```

```
array([[99,  2,  3,  4],
       [ 5,  6,  7,  8],
       [ 9, 10, 11, 12]])
```

## ∨ Basic Array Operations

```python
data =np.array([1,2])
data
```
➔ array([1, 2])

```python
ones=np.ones(2,dtype=int)
ones
```
➔ array([1, 1])

```python
data+ones
```
➔ array([2, 3])

```python
data-ones
```
➔ array([0, 1])

```python
data*data
```
➔ array([1, 4])

```python
data/ones
```
➔ array([1., 2.])

```python
data/data
```
➔ array([1., 1.])

```python
ars=np.array([1,2,3,4])
ars
```
➔ array([1, 2, 3, 4])

```python
ars.sum()
```
➔ 10

```python
ars.max()
```
➔ 4

```python
ars.mean()
```
➔ 2.5

```python
ars.min()
```
➔ 1

```python
arb=np.array([[1,1],[2,2]])
arb
```
➔ array([[1, 1],
         [2, 2]])

```python
arb.sum(axis=0)
```
➔ array([3, 3])

```python
arb.sum(axis=1)
```
➔ array([2, 4])

```python
ds=np.array([1.0,2.0])
```

```python
ds * 1.6
```
→ array([1.6, 3.2])

```python
hh=np.array([1,2,3])
hh
```
→ array([1, 2, 3])

```python
hh.max()
```
→ 3

```python
hh.min()
```
→ 1

```python
hh.sum()
```
→ 6

```python
np.arange(4,5)
```
→ array([4])

```python
np.zeros(5)
```
→ array([0., 0., 0., 0., 0.])

```python
np.ones(4)
```
→ array([1., 1., 1., 1.])

```python
np.ones(4,dtype=int)
```
→ array([1, 1, 1, 1])

```python
dt=np.array([[1,2,3,4],[5,6,7,8],[9,10,11,12]])
dt
```
→ array([[ 1,  2,  3,  4],
         [ 5,  6,  7,  8],
         [ 9, 10, 11, 12]])

```python
dt.shape
```
→ (3, 4)

```python
dt[0,1]
```
→ 2

```python
dt[1:3]
```
→ array([[ 5,  6,  7,  8],
         [ 9, 10, 11, 12]])

```python
dt[0:2,0]
```
→ array([1, 5])

```python
rng=np.random.default_rng()
rng.random(3)
```
→ array([0.87234503, 0.56933782, 0.50534083])

```python
rng.random((3,2))
```

```
array([[0.77829005, 0.22784258],
       [0.78792111, 0.77710828],
       [0.71229942, 0.10682331]])
```

```
rng.integers(5,size=(2,4))
```

```
array([[4, 1, 2, 1],
       [0, 4, 4, 0]])
```

```
uniqArr=([11, 11, 12, 13, 14, 15, 16, 17, 12, 13, 11, 14, 18, 19, 20])
uniqArr
```

```
[11, 11, 12, 13, 14, 15, 16, 17, 12, 13, 11, 14, 18, 19, 20]
```

```
np.unique(uniqArr)
```

```
array([11, 12, 13, 14, 15, 16, 17, 18, 19, 20])
```

```
uniqvalues=np.unique(uniqArr)
print(uniqvalues)
```

```
[11 12 13 14 15 16 17 18 19 20]
```

```
uniqvalues,indices_list=np.unique(uniqArr,return_index=True)
print(indices_list)
```

```
[ 0  2  3  4  5  6  7 12 13 14]
```

```
uniqvalues,occurrence_count=np.unique(uniqArr,return_counts=True)
print(occurrence_count)
```

```
[3 2 2 2 1 1 1 1 1 1]
```

```
a_2d = np.array([[1, 2, 3, 4], [5, 6, 7, 8], [9, 10, 11, 12], [1, 2, 3, 4]])
print(a_2d)
```

```
[[ 1  2  3  4]
 [ 5  6  7  8]
 [ 9 10 11 12]
 [ 1  2  3  4]]
```

```
unique_rows = np.unique(a_2d)
print(unique_rows)
```

```
[ 1  2  3  4  5  6  7  8  9 10 11 12]
```

```
unique_rows = np.unique(a_2d,axis=0)
print(unique_rows)
```

```
[[ 1  2  3  4]
 [ 5  6  7  8]
 [ 9 10 11 12]]
```

```
unique_rows,indices,occurrence_count = np.unique(a_2d,axis=0,return_counts=True,return_index=True)
print(unique_rows)
```

```
[[ 1  2  3  4]
 [ 5  6  7  8]
 [ 9 10 11 12]]
```

```
print(indices)
```

```
[0 1 2]
```

```
print(occurrence_count)
```

```
[2 1 1]
```

```
a_2d = np.array([[1, 2, 3, 4], [5, 6, 7, 8], [9, 10, 11, 12], [1, 2, 3, 4]])
print(a_2d)
```

```
[[ 1  2  3  4]
 [ 5  6  7  8]
 [ 9 10 11 12]
 [ 1  2  3  4]]
```

```python
unique_rows,indices,occurrence_count = np.unique(a_2d,axis=1,return_counts=True,return_index=True)
print(unique_rows)
```

```
[[ 1  2  3  4]
 [ 5  6  7  8]
 [ 9 10 11 12]
 [ 1  2  3  4]]
```

```python
print(indices)
```

```
[0 1 2 3]
```

```python
print(occurrence_count)
```

```
[1 1 1 1]
```

```python
print(a_2d)
```

```
[[ 1  2  3  4]
 [ 5  6  7  8]
 [ 9 10 11 12]
 [ 1  2  3  4]]
```

```python
unique_rows,indices,occurrence_count = np.unique(a_2d,return_counts=True,return_index=True)
print(unique_rows)
```

```
[ 1  2  3  4  5  6  7  8  9 10 11 12]
```

```python
print(indices)
```

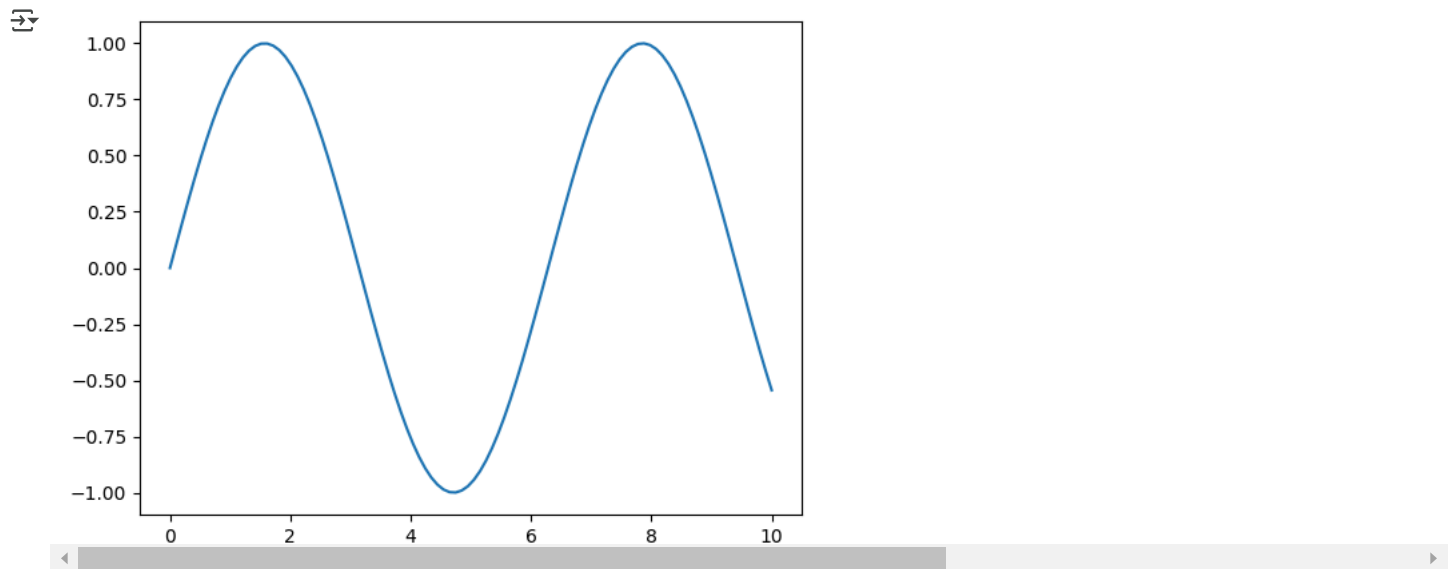```
[ 0  1  2  3  4  5  6  7  8  9 10 11]
```

```python
print(occurrence_count)
```

```
[2 2 2 2 1 1 1 1 1 1 1 1]
```

```python
import matplotlib.pyplot as plt
import numpy as np

x=np.linspace(0,10,100)
y=np.sin(x)

plt.plot(x,y)
plt.show()
```

```
plt.plot(x,y,marker='o')
plt.title('Sine Wave')
plt.xlabel('x-axis')
plt.ylabel('y-axis')
plt.show()
```



Sine Wave