Comp 576 Assignment0

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September 16, 2025

[3]:
```
import numpy as np
import scipy.linalg as linalg
```

1 Task 1

[ ]:
```
'''
(base) C:\Users\Panorama>conda info

     active environment : base
    active env location : C:\Users\Panorama\anaconda3
            shell level : 1
       user config file : C:\Users\Panorama\.condarc
 populated config files : C:\Users\Panorama\anaconda3\.condarc
                          C:\Users\Panorama\.condarc
          conda version : 25.5.1
    conda-build version : 25.5.0
         python version : 3.13.5.final.0
                 solver : libmamba (default)
       virtual packages : __archspec=1=skylake
                          __conda=25.5.1=0
                          __cuda=12.7=0
                          __win=10.0.19045=0
       base environment : C:\Users\Panorama\anaconda3  (writable)
      conda av data dir : C:\Users\Panorama\anaconda3\etc\conda
  conda av metadata url : None
          channel URLs : https://repo.anaconda.com/pkgs/main/win-64
                         https://repo.anaconda.com/pkgs/main/noarch
                         https://repo.anaconda.com/pkgs/r/win-64
                         https://repo.anaconda.com/pkgs/r/noarch
                         https://repo.anaconda.com/pkgs/msys2/win-64
                         https://repo.anaconda.com/pkgs/msys2/noarch
         package cache : C:\Users\Panorama\anaconda3\pkgs
                         C:\Users\Panorama\.conda\pkgs
                         C:\Users\Panorama\AppData\Local\conda\conda\pkgs
       envs directories : C:\Users\Panorama\anaconda3\envs
                         C:\Users\Panorama\.conda\envs
                         C:\Users\Panorama\AppData\Local\conda\conda\envs
```

```
              platform : win-64
             user-agent : conda/25.5.1 requests/2.32.3 CPython/3.13.5 Windows/10␣
↪Windows/10.0.19045 solver/libmamba conda-libmamba-solver/25.4.0 libmambapy/2.0.
↪5 aau/0.7.1 c/. s/. e/.
          administrator : False
             netrc file : None
           offline mode : False
'''
```

2 Task 2

[90]:
```
a = np.array([[1., 2., 3.], [4., 5., 6.], [7., 8., 9.]])
b = np.array([[11., 22., 33.], [44., 55., 66.], [77., 88., 99.]])
a.ndim
```

[90]: 2

[20]:
```
a.size
```

[20]: 9

[21]:
```
a.shape
```

[21]: (3, 3)

[22]:
```
np.block([[a, a], [a, a]])
```

[22]:
```
array([[1., 2., 3., 1., 2., 3.],
       [4., 5., 6., 4., 5., 6.],
       [7., 8., 9., 7., 8., 9.],
       [1., 2., 3., 1., 2., 3.],
       [4., 5., 6., 4., 5., 6.],
       [7., 8., 9., 7., 8., 9.]])
```

[23]:
```
a[-1]
```

[23]: array([7., 8., 9.])

[15]:
```
a[1, 2]
```

[15]: np.float64(6.0)

[24]:
```
a[0]
```

[24]: array([1., 2., 3.])

[25]:
```
a[0:2]
```

[25]:
```
array([[1., 2., 3.],
       [4., 5., 6.]])
```

[26]:
```
a[-3:]
```

[26]:
```
array([[1., 2., 3.],
       [4., 5., 6.],
       [7., 8., 9.]])
```

[28]:
```
a[0:2, 1:2]
```

[28]:
```
array([[2.],
       [5.]])
```

[30]:
```
a[np.ix_([0, 1], [0, 2])]
```

[30]:
```
array([[1., 3.],
       [4., 6.]])
```

[32]:
```
a[1:3:2,:]
```

[32]:
```
array([[4., 5., 6.]])
```

[33]:
```
a[::2, :]
```

[33]:
```
array([[1., 2., 3.],
       [7., 8., 9.]])
```

[34]:
```
a[::-1]
```

[34]:
```
array([[7., 8., 9.],
       [4., 5., 6.],
       [1., 2., 3.]])
```

[35]:
```
a[np.r_[:len(a),0]]
```

[35]:
```
array([[1., 2., 3.],
       [4., 5., 6.],
       [7., 8., 9.],
       [1., 2., 3.]])
```

[36]:
```
a.T
```

[36]:
```
array([[1., 4., 7.],
       [2., 5., 8.],
       [3., 6., 9.]])
```

[37]:
```
a.conj().T
```

[37]:
```
array([[1., 4., 7.],
       [2., 5., 8.],
       [3., 6., 9.]])
```

[40]:
```
a@b
```

[40]:
```
array([[ 330.,  396.,  462.],
       [ 726.,  891., 1056.],
       [1122., 1386., 1650.]])
```

[41]:
```
a*b
```

[41]:
```
array([[ 11.,  44.,  99.],
       [176., 275., 396.],
       [539., 704., 891.]])
```

[43]:
```
b/a
```

[43]:
```
array([[11., 11., 11.],
       [11., 11., 11.],
       [11., 11., 11.]])
```

[44]:
```
a**3
```

[44]:
```
array([[  1.,   8.,  27.],
       [ 64., 125., 216.],
       [343., 512., 729.]])
```

[45]:
```
(a > 5)
```

[45]:
```
array([[False, False, False],
       [False, False,  True],
       [ True,  True,  True]])
```

[46]:
```
np.nonzero(a > 5)
```

[46]:
```
(array([1, 2, 2, 2]), array([2, 0, 1, 2]))
```

[48]:
```
a[:,np.nonzero(b > 50)[0]]
```

[48]:
```
array([[2., 2., 3., 3., 3.],
       [5., 5., 6., 6., 6.],
       [8., 8., 9., 9., 9.]])
```

[58]:
```
a[:, (b.T > 50)[1]]
```

[58]:
```
array([[2., 3.],
       [5., 6.],
```

```
       [8., 9.]])
```

[ ]:
```
a[a < 5]=0
```

```
[[0. 0. 0.]
 [0. 5. 6.]
 [7. 8. 9.]]
```

[63]:
```
a * (a > 5)
```

[63]:
```
array([[0., 0., 0.],
       [0., 0., 6.],
       [7., 8., 9.]])
```

[64]:
```
a[:] = 3
```

[70]:
```
x = np.array([[1, 2, 3],[4,8,16]])
y = x.copy()
print(y)
```

```
[[ 1  2  3]
 [ 4  8 16]]
```

[71]:
```
y = x[1,:].copy()
print(y)
```

```
[ 4  8 16]
```

[72]:
```
y = x.flatten()
print(y)
```

```
[ 1  2  3  4  8 16]
```

[73]:
```
np.arange(1., 11.)
```

[73]:
```
array([ 1.,  2.,  3.,  4.,  5.,  6.,  7.,  8.,  9., 10.])
```

[ ]:
```
np.arange(10.)
```

[ ]:
```
array([0., 1., 2., 3., 4., 5., 6., 7., 8., 9.])
```

[75]:
```
np.arange(1.,11.)[:, np.newaxis]
```

[75]:
```
array([[ 1.],
       [ 2.],
       [ 3.],
       [ 4.],
       [ 5.],
       [ 6.],
       [ 7.],
```

```
       [ 8.],
       [ 9.],
       [10.]])
```

[76]:
```
np.zeros((3, 4))
```

[76]:
```
array([[0., 0., 0., 0.],
       [0., 0., 0., 0.],
       [0., 0., 0., 0.]])
```

[77]:
```
np.zeros((3, 4, 5))
```

[77]:
```
array([[[0., 0., 0., 0., 0.],
        [0., 0., 0., 0., 0.],
        [0., 0., 0., 0., 0.],
        [0., 0., 0., 0., 0.]],

       [[0., 0., 0., 0., 0.],
        [0., 0., 0., 0., 0.],
        [0., 0., 0., 0., 0.],
        [0., 0., 0., 0., 0.]],

       [[0., 0., 0., 0., 0.],
        [0., 0., 0., 0., 0.],
        [0., 0., 0., 0., 0.],
        [0., 0., 0., 0., 0.]]])
```

[78]:
```
np.ones((3, 4))
```

[78]:
```
array([[1., 1., 1., 1.],
       [1., 1., 1., 1.],
       [1., 1., 1., 1.]])
```

[79]:
```
np.eye(3)
```

[79]:
```
array([[1., 0., 0.],
       [0., 1., 0.],
       [0., 0., 1.]])
```

[80]:
```
np.diag(a)
```

[80]:
```
array([3., 3., 3.])
```

[81]:
```
np.diag(b, 0)
```

[81]:
```
array([11., 55., 99.])
```

[82]:
```
from numpy.random import default_rng
rng = default_rng(42)
rng.random((3, 4))
```

[82]:
```
array([[0.77395605, 0.43887844, 0.85859792, 0.69736803],
       [0.09417735, 0.97562235, 0.7611397 , 0.78606431],
       [0.12811363, 0.45038594, 0.37079802, 0.92676499]])
```

[83]:
```
np.linspace(1,3,4)
```

[83]:
```
array([1.        , 1.66666667, 2.33333333, 3.        ])
```

[84]:
```
np.mgrid[0:9.,0:6.]
```

[84]:
```
array([[[0., 0., 0., 0., 0., 0.],
        [1., 1., 1., 1., 1., 1.],
        [2., 2., 2., 2., 2., 2.],
        [3., 3., 3., 3., 3., 3.],
        [4., 4., 4., 4., 4., 4.],
        [5., 5., 5., 5., 5., 5.],
        [6., 6., 6., 6., 6., 6.],
        [7., 7., 7., 7., 7., 7.],
        [8., 8., 8., 8., 8., 8.]],

       [[0., 1., 2., 3., 4., 5.],
        [0., 1., 2., 3., 4., 5.],
        [0., 1., 2., 3., 4., 5.],
        [0., 1., 2., 3., 4., 5.],
        [0., 1., 2., 3., 4., 5.],
        [0., 1., 2., 3., 4., 5.],
        [0., 1., 2., 3., 4., 5.],
        [0., 1., 2., 3., 4., 5.],
        [0., 1., 2., 3., 4., 5.]]])
```

[86]:
```
np.ogrid[0:9.,0:6.]
```

[86]:
```
(array([[0.],
        [1.],
        [2.],
        [3.],
        [4.],
        [5.],
        [6.],
        [7.],
        [8.]]),
 array([[0., 1., 2., 3., 4., 5.]]))
```

[87]:
```
np.meshgrid([1,2,4],[2,4,5])
```

[87]:
```
(array([[1, 2, 4],
        [1, 2, 4],
        [1, 2, 4]]),
 array([[2, 2, 2],
        [4, 4, 4],
        [5, 5, 5]]))
```

[88]:
```
np.ix_([1,2,4],[2,4,5])
```

[88]:
```
(array([[1],
        [2],
        [4]]),
 array([[2, 4, 5]]))
```

[91]:
```
m = 2
n = 3
np.tile(a, (m, n))
```

[91]:
```
array([[1., 2., 3., 1., 2., 3., 1., 2., 3.],
       [4., 5., 6., 4., 5., 6., 4., 5., 6.],
       [7., 8., 9., 7., 8., 9., 7., 8., 9.],
       [1., 2., 3., 1., 2., 3., 1., 2., 3.],
       [4., 5., 6., 4., 5., 6., 4., 5., 6.],
       [7., 8., 9., 7., 8., 9., 7., 8., 9.]])
```

[92]:
```
np.concatenate((a,b),1)
```

[92]:
```
array([[ 1.,  2.,  3., 11., 22., 33.],
       [ 4.,  5.,  6., 44., 55., 66.],
       [ 7.,  8.,  9., 77., 88., 99.]])
```

[93]:
```
np.concatenate((a,b))
```

[93]:
```
array([[ 1.,  2.,  3.],
       [ 4.,  5.,  6.],
       [ 7.,  8.,  9.],
       [11., 22., 33.],
       [44., 55., 66.],
       [77., 88., 99.]])
```

[94]:
```
a.max()
a.max(0)
a.max(1)
np.maximum(a,b)
```

[94]:
```
array([[11., 22., 33.],
       [44., 55., 66.],
       [77., 88., 99.]])
```

[ ]:
```
np.sqrt(a@a)
```

[ ]:
```
array([[ 5.47722558,  6.        ,  6.4807407 ],
       [ 8.1240384 ,  9.        ,  9.79795897],
       [10.09950494, 11.22497216, 12.24744871]])
```

[98]:
```
np.logical_and(a,b)
```

[98]:
```
array([[ True,  True,  True],
       [ True,  True,  True],
       [ True,  True,  True]])
```

[99]:
```
np.logical_or(a,b)
```

[99]:
```
array([[ True,  True,  True],
       [ True,  True,  True],
       [ True,  True,  True]])
```

[104]:
```
linalg.inv(a)
```

[104]:
```
array([[ 3.15251974e+15, -6.30503948e+15,  3.15251974e+15],
       [-6.30503948e+15,  1.26100790e+16, -6.30503948e+15],
       [ 3.15251974e+15, -6.30503948e+15,  3.15251974e+15]])
```

[105]:
```
linalg.pinv(a)
```

[105]:
```
array([[-6.38888889e-01, -1.66666667e-01,  3.05555556e-01],
       [-5.55555556e-02,  1.35308431e-16,  5.55555556e-02],
       [ 5.27777778e-01,  1.66666667e-01, -1.94444444e-01]])
```

[106]:
```
np.linalg.matrix_rank(a)
```

[106]:
```
np.int64(2)
```

[107]:
```
linalg.solve(a, b)
```

```
C:\Users\Panorama\AppData\Local\Temp\ipykernel_52240\1411468897.py:1:
LinAlgWarning: Ill-conditioned matrix (rcond=2.20282e-18): result may not be
accurate.
  linalg.solve(a, b)
```

[107]:
```
array([[ -2.475,  -3.6  ,  -7.   ],
       [ 26.95 ,  18.2  ,  14.   ],
       [-13.475,  -3.6  ,   4.   ]])
```

[ ]:
```
U, S, Vh = linalg.svd(a); V = Vh.T
print(U)
print(S)
print(V)
```

```
[[-0.21483724  0.88723069  0.40824829]
 [-0.52058739  0.24964395 -0.81649658]
 [-0.82633754 -0.38794278  0.40824829]]
[1.68481034e+01 1.06836951e+00 3.33475287e-16]
[[-0.47967118 -0.77669099 -0.40824829]
 [-0.57236779 -0.07568647  0.81649658]
 [-0.66506441  0.62531805 -0.40824829]]
```

[113]:
```
D,V = linalg.eig(a)
print(D)
print(V)
```

```
[ 1.61168440e+01+0.j -1.11684397e+00+0.j -3.38433605e-16+0.j]
[[-0.23197069 -0.78583024  0.40824829]
 [-0.52532209 -0.08675134 -0.81649658]
 [-0.8186735   0.61232756  0.40824829]]
```

[115]:
```
D,V = linalg.eig(a, b)
print(D)
print(V)
```

```
[0.09090909+0.j 0.10617642+0.j 0.09090909+0.j]
[[-1.         -0.40824829  0.41008093]
 [-0.          0.81649658 -0.3035483 ]
 [-0.         -0.40824829 -0.86005352]]
```

[120]:
```
Q,R = linalg.qr(a)
print(Q)
print(R)
```

```
[[-0.12309149  0.90453403  0.40824829]
 [-0.49236596  0.30151134 -0.81649658]
 [-0.86164044 -0.30151134  0.40824829]]
[[-8.12403840e+00 -9.60113630e+00 -1.10782342e+01]
 [ 0.00000000e+00  9.04534034e-01  1.80906807e+00]
 [ 0.00000000e+00  0.00000000e+00 -1.11164740e-15]]
```

[121]:
```
np.fft.fft(a)
```

[121]:
```
array([[ 6. +0.j       , -1.5+0.8660254j, -1.5-0.8660254j],
       [15. +0.j       , -1.5+0.8660254j, -1.5-0.8660254j],
       [24. +0.j       , -1.5+0.8660254j, -1.5-0.8660254j]])
```

[122]:
```
np.fft.ifft(a)
```

[122]:
```
array([[ 2. +0.j        , -0.5-0.28867513j, -0.5+0.28867513j],
       [ 5. +0.j        , -0.5-0.28867513j, -0.5+0.28867513j],
       [ 8. +0.j        , -0.5-0.28867513j, -0.5+0.28867513j]])
```

[124]:
```
a.sort(axis=0)
a.sort(axis=1)
```

[125]:
```
I = np.argsort(a[:, 0]); b = a[I,:]
```

[130]:
```

np.unique(a)
```

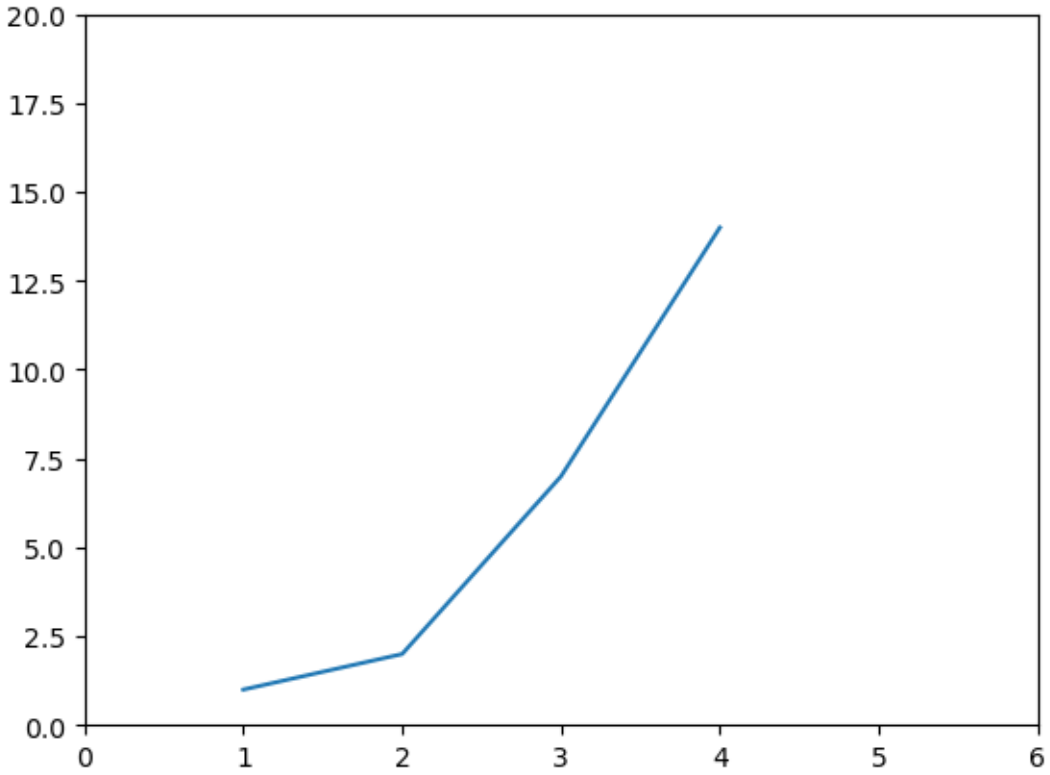
[130]:
```
array([1., 2., 3., 4., 5., 6., 7., 8., 9.])
```

[131]:
```
a.squeeze()
```

[131]:
```
array([[1., 2., 3.],
       [4., 5., 6.],
       [7., 8., 9.]])
```

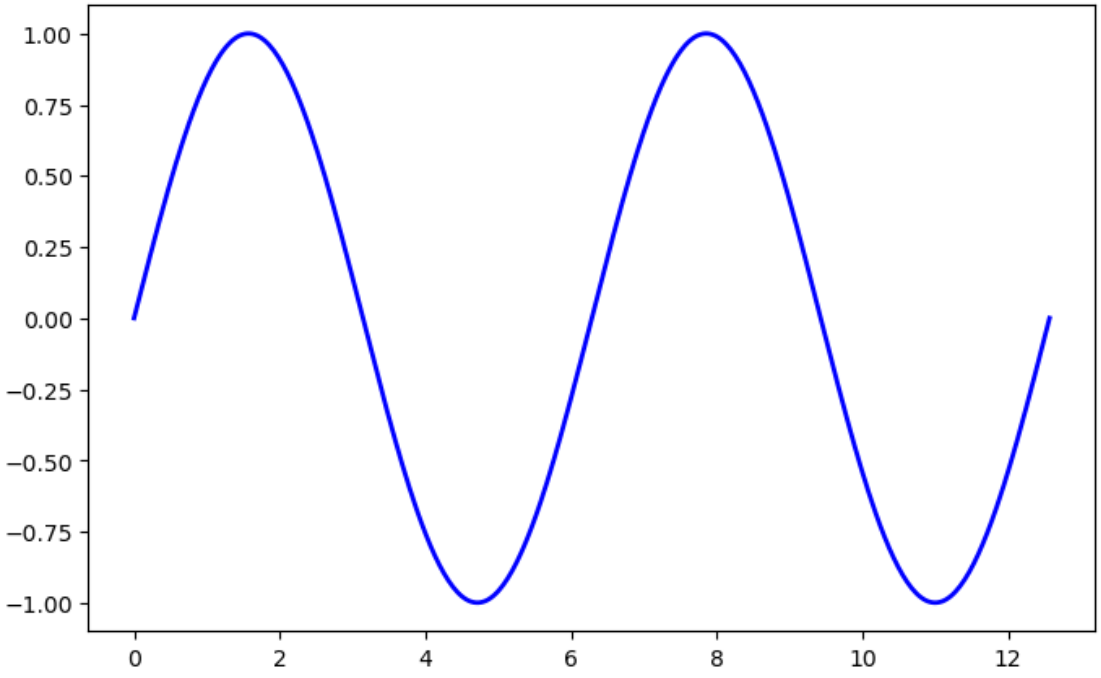
3 Task 3

[1]:
```
import matplotlib.pyplot as plt

plt.plot([1,2,3,4], [1,2,7,14])
plt.axis([0, 6, 0, 20])
plt.show()
```



4 Task 4

[4]:
```
x = np.linspace(0, 4 * np.pi, 400)
y = np.sin(x)

fig, ax = plt.subplots(figsize=(8, 5))
ax.plot(x, y, label='sin(x)', color='blue', linewidth=2)
plt.show()
```



5 Task 5

Github ID: cz78-rice

6 Task 6

Project Link: https://github.com/cz78-rice/COMP-576.git