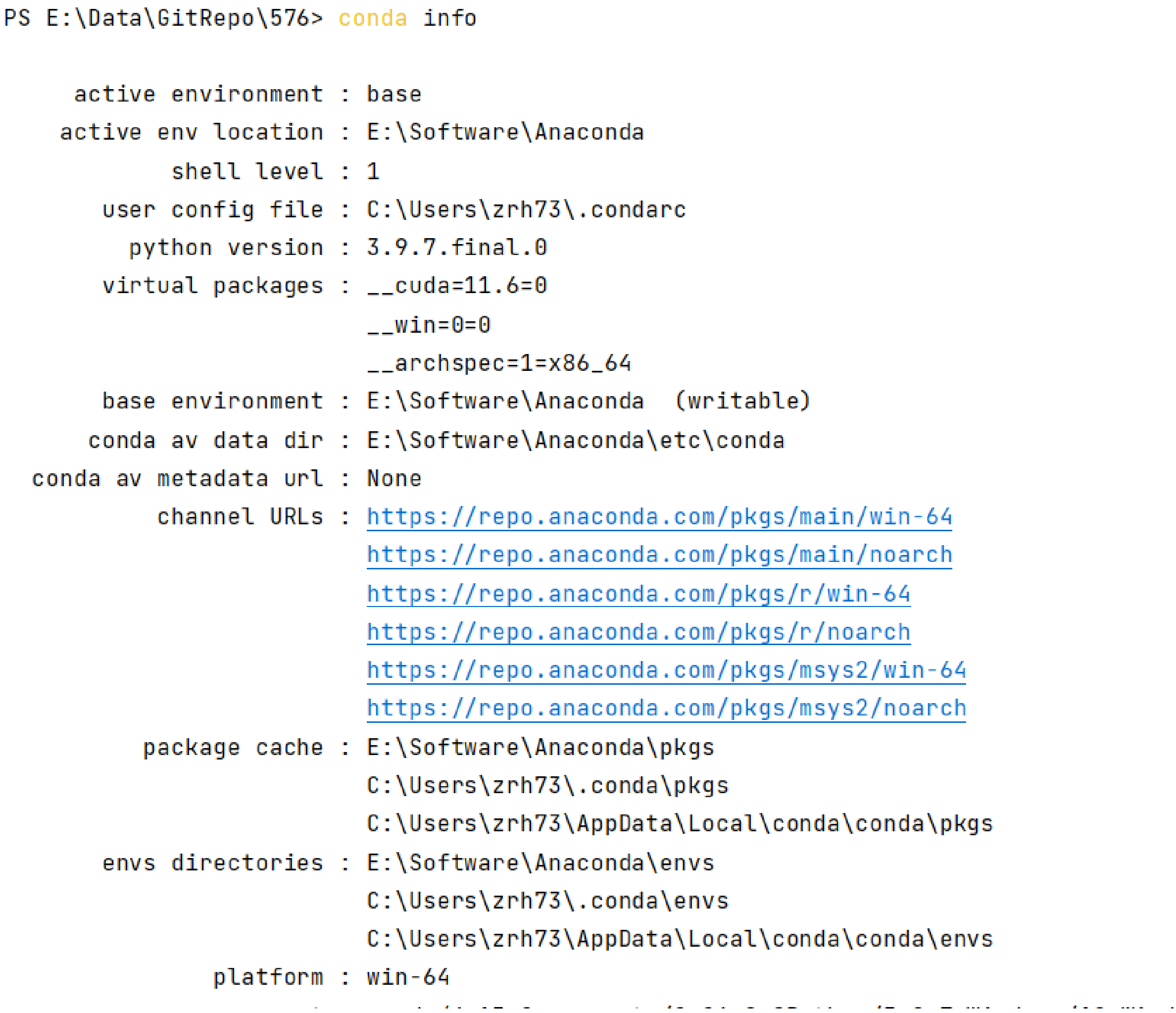
Assigment 0

Task 1



```
PS E:\Data\GitRepo\576> conda info

     active environment : base
    active env location : E:\Software\Anaconda
            shell level : 1
       user config file : C:\Users\zrh73\.condarc
         python version : 3.9.7.final.0
       virtual packages : __cuda=11.6=0
                          __win=0=0
                          __archspec=1=x86_64
       base environment : E:\Software\Anaconda  (writable)
      conda av data dir : E:\Software\Anaconda\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 : E:\Software\Anaconda\pkgs
                          C:\Users\zrh73\.conda\pkgs
                          C:\Users\zrh73\AppData\Local\conda\conda\pkgs
       envs directories : E:\Software\Anaconda\envs
                          C:\Users\zrh73\.conda\envs
                          C:\Users\zrh73\AppData\Local\conda\conda\envs
               platform : win-64
```

Task 2

```python
import numpy as np
from numpy import linalg
```

```python
a = np.array([i for i in range(30)]).reshape(6,5)
block = np.block([[a,a],[a,a]])
print(a)
print(block)
```

```
[[ 0  1  2  3  4]
 [ 5  6  7  8  9]
 [10 11 12 13 14]
 [15 16 17 18 19]
 [20 21 22 23 24]
 [25 26 27 28 29]]
```

```
[[ 0  1  2  3  4  0  1  2  3  4]
 [ 5  6  7  8  9  5  6  7  8  9]
 [10 11 12 13 14 10 11 12 13 14]
 [15 16 17 18 19 15 16 17 18 19]
 [20 21 22 23 24 20 21 22 23 24]
 [25 26 27 28 29 25 26 27 28 29]
 [ 0  1  2  3  4  0  1  2  3  4]
 [ 5  6  7  8  9  5  6  7  8  9]
 [10 11 12 13 14 10 11 12 13 14]
 [15 16 17 18 19 15 16 17 18 19]
 [20 21 22 23 24 20 21 22 23 24]
 [25 26 27 28 29 25 26 27 28 29]]
```

```python
print("Dim: ", a.ndim)
print("Size: ", a.size)
print(f"Shape: {a.shape}")
print(f"Shape[1]: {a.shape[1]}")
```

```
Dim:  2
Size:  30
Shape: (6, 5)
Shape[1]: 5
```

```python
print(f"- a[-1]: \n{a[-1]}")
print(f"- a[1,4]: \n{a[1,4]}")
print(f"- a[1,:]: \n{a[1,:]}")
print(f"- a[0:3, :]: \n{a[:3, :]}")
print(f"- a[-5:]: \n{a[-5:]}")
print(f"- a[0:3, 3:]: \n{a[0:3, 3:]}")
print(f"- a[np.ix_([1, 3, 4], [0, 2])]: \n{a[np.ix_([1, 3, 4], [0, 2])]}")
print(f"- a[2:4:2],:]: \n{a[2:4:2, :]}")
print(f"- a[::2],:]: \n{a[::2, :]}")
print(f"a[::-1,:]: \n{a[::-1,:]}")
print(f"a[np.r_[:len(a),1]]: \n{a[np.r_[:len(a),1]]}")
```

```
- a[-1]:
[25 26 27 28 29]
- a[1,4]:
9
- a[1,:]:
[5 6 7 8 9]
- a[0:3, :]:
[[ 0  1  2  3  4]
 [ 5  6  7  8  9]
 [10 11 12 13 14]]
- a[-5:]:
[[ 5  6  7  8  9]
 [10 11 12 13 14]
 [15 16 17 18 19]
 [20 21 22 23 24]
 [25 26 27 28 29]]
- a[0:3, 3:]:
[[ 3  4]
 [ 8  9]
 [13 14]]
- a[np.ix_([1, 3, 4], [0, 2])]:
[[ 5  7]
 [15 17]
 [20 22]]
- a[2:4:2],:]:
[[10 11 12 13 14]]
- a[::2],:]:
[[ 0  1  2  3  4]
 [10 11 12 13 14]
 [20 21 22 23 24]]
a[::-1,:]:
[[25 26 27 28 29]
 [20 21 22 23 24]
 [15 16 17 18 19]
 [10 11 12 13 14]
 [ 5  6  7  8  9]
 [ 0  1  2  3  4]]
a[np.r_[:len(a),1]]:
[[ 0  1  2  3  4]
 [ 5  6  7  8  9]
 [10 11 12 13 14]
 [15 16 17 18 19]
 [20 21 22 23 24]
 [25 26 27 28 29]
 [ 5  6  7  8  9]]
```

```python
print(f"a.T: \n{a.T}")
print(f"a.conj().T: \n{a.conj().T}")
```

```
a.T:
[[ 0  5 10 15 20 25]
 [ 1  6 11 16 21 26]
 [ 2  7 12 17 22 27]
 [ 3  8 13 18 23 28]
 [ 4  9 14 19 24 29]]
a.conj().T:
[[ 0  5 10 15 20 25]
 [ 1  6 11 16 21 26]
 [ 2  7 12 17 22 27]
 [ 3  8 13 18 23 28]
 [ 4  9 14 19 24 29]]
```

```
b = np.array([[3,1],[2,4]])
c = np.array([[1],[2]])
v = np.array([0,1])
print(f"- b @ c: \n{b @ c}")
print(f"- b * c: \n{b * c}")
print(f"- b / c: \n{b / c}")
print(f"- b**3: \n{b ** 3}")
print(f"- (b > 0.5): \n {(b > 0.5)}")
print(f"- np.nonzero(b > 0.5): \n{np.nonzero(b > 0.5)}")
print(f"- b[:,np.nonzero(v > 0.5)[0]]: \n{b[:,np.nonzero(v > 0.5)[0]]}")
print(f"- b[:, v.T > 0.5]: \n{b[:, v.T > 0.5]}")
print(f"- b[b > 2]: \n{b[b>2]}")
print(f"- b * (b > 2): \n{b * (b > 2)}")
```

```
- b @ c:
[[ 5]
 [10]]
- b * c:
[[3 1]
 [4 8]]
- b / c:
[[3. 1.]
 [1. 2.]]
- b**3:
[[27  1]
 [ 8 64]]
- (b > 0.5):
 [[ True  True]
 [ True  True]]
- np.nonzero(b > 0.5):
(array([0, 0, 1, 1], dtype=int64), array([0, 1, 0, 1], dtype=int64))
- b[:,np.nonzero(v > 0.5)[0]]:
[[1]
 [4]]
- b[:, v.T > 0.5]:
[[1]
 [4]]
- b[b > 2]:
[3 4]
- b * (b > 2):
[[3 0]
 [0 4]]
```

```
y = b.copy()
print(f"- y: \n{y}")
print(f"- y = b[1,:].copy(): \n{b[1,:].copy()}")
print(f"y=b.flatten(): \n{b.flatten()}")
```

```
- y:
[[3 1]
 [2 4]]
- y = b[1,:].copy():
[2 4]
y=b.flatten():
[3 1 2 4]
```

```
print(f"- np.arange(1., 11.): \n{np.arange(1., 11.)}")
print(f"- np.arange(10.): \n{np.arange(10.)}")
print(f"- np.arange(1.,11.)[:, np.newaxis]: \n{np.arange(1.,11.)[:,
np.newaxis]}")
print(f"- np.zeros((3, 4)): \n{np.zeros((3, 4))}")
print(f"- np.zeros((3, 4, 5)): \n{np.zeros((3, 4, 5))}")
print(f"- np.ones((3, 4)): \n{np.ones((3, 4))}")
print(f"- np.eye(3):\n{np.eye(3)}")
print(f"- np.diag(a): \n{np.diag(a)}")
print(f"- np.diag(v, 0):\n{np.diag(v, 0)}")
print(f"- np.random.rand(3, 4)):\n{np.random.rand(3, 4)}")
print(f"- np.linspace(1,3,4):\n{np.linspace(1,3,4)}")
```

```
- np.arange(1., 11.):
[ 1.  2.  3.  4.  5.  6.  7.  8.  9. 10.]
- np.arange(10.):
[0. 1. 2. 3. 4. 5. 6. 7. 8. 9.]
- np.arange(1.,11.)[:, np.newaxis]:
[[ 1.]
 [ 2.]
 [ 3.]
 [ 4.]
 [ 5.]
 [ 6.]
 [ 7.]
 [ 8.]
 [ 9.]
 [10.]]
- np.zeros((3, 4)):
[[0. 0. 0. 0.]
 [0. 0. 0. 0.]
 [0. 0. 0. 0.]]
- np.zeros((3, 4, 5)):
[[[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.]]]
- np.ones((3, 4)):
[[1. 1. 1. 1.]
 [1. 1. 1. 1.]
 [1. 1. 1. 1.]]
- np.eye(3):
[[1. 0. 0.]
 [0. 1. 0.]
 [0. 0. 1.]]
- np.diag(a):
[ 0  6 12 18 24]
- np.diag(v, 0):
[[0 0]
 [0 1]]
- np.random.rand(3, 4)):
[[0.95786033 0.97750282 0.58263052 0.96759798]
 [0.96030918 0.40089222 0.93854563 0.15034803]
 [0.40565058 0.45035103 0.85098553 0.04857567]]
- np.linspace(1,3,4):
[1.         1.66666667 2.33333333 3.        ]
```

```python
print(f"- np.mgrid[0:9.,0:6.]:\n{np.mgrid[0:9.,0:6.]}")
print(f"- ogrid[0:9.,0:6.]:\n{np.ogrid[0:9.,0:6.]}")
print(f"- np.meshgrid([1,2,4],[2,4,5]):\n{np.meshgrid([1,2,4],[2,4,5])}")
print(f"- np.ix_([1,2,4],[2,4,5]):\n{np.ix_([1,2,4],[2,4,5])}")
print(f"- np.tile(a, (m, n)):\n{np.tile(a, (2, 3))}")
```

```
- np.mgrid[0:9.,0:6.]:
[[[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.]]]
- ogrid[0:9.,0:6.]:
[array([[0.],
       [1.],
       [2.],
       [3.],
       [4.],
       [5.],
       [6.],
       [7.],
       [8.]]), array([[0., 1., 2., 3., 4., 5.]])]
- np.meshgrid([1,2,4],[2,4,5]):
[array([[1, 2, 4],
       [1, 2, 4],
       [1, 2, 4]]), array([[2, 2, 2],
       [4, 4, 4],
       [5, 5, 5]])]
- np.ix_([1,2,4],[2,4,5]):
(array([[1],
       [2],
       [4]]), array([[2, 4, 5]]))
- np.tile(a, (m, n)):
[[ 0  1  2  3  4  0  1  2  3  4  0  1  2  3  4]
 [ 5  6  7  8  9  5  6  7  8  9  5  6  7  8  9]
 [10 11 12 13 14 10 11 12 13 14 10 11 12 13 14]
 [15 16 17 18 19 15 16 17 18 19 15 16 17 18 19]
 [20 21 22 23 24 20 21 22 23 24 20 21 22 23 24]
 [25 26 27 28 29 25 26 27 28 29 25 26 27 28 29]
 [ 0  1  2  3  4  0  1  2  3  4  0  1  2  3  4]
 [ 5  6  7  8  9  5  6  7  8  9  5  6  7  8  9]
 [10 11 12 13 14 10 11 12 13 14 10 11 12 13 14]
 [15 16 17 18 19 15 16 17 18 19 15 16 17 18 19]
 [20 21 22 23 24 20 21 22 23 24 20 21 22 23 24]
 [25 26 27 28 29 25 26 27 28 29 25 26 27 28 29]]
```

```
a = np.array([[0],[4]])
b = np.array([[2],[3]])
print(f"- np.concatenate((a,b),1):\n{np.hstack((a,b))}")
print(f"- np.vstack((a,b)):\n{np.vstack((a,b))}")
```

```
- np.concatenate((a,b),1):
[[0 2]
 [4 3]]
- np.vstack((a,b)):
[[0]
 [4]
 [2]
 [3]]
```

```
print(f"- a.max():\n{a.max()}")
print(f"- a.max(0):\n{a.max(0)}")
print(f"- a.max(1):\n{a.max(1)}")
print(f"- np.maximum(a, b):\n{np.maximum(a, b)}")
print(f"- logical_and(a,b):\n{np.logical_and(a,b)}")
print(f"- np.logical_or(a,b):\n{np.logical_or(a,b)}")
print(f"- a&b:\n{a&b}")
print(f"- a|b:\n{a|b}")
```

```
- a.max():
4
- a.max(0):
[4]
- a.max(1):
[0 4]
- np.maximum(a, b):
[[2]
 [4]]
- logical_and(a,b):
[[False]
 [ True]]
- np.logical_or(a,b):
[[ True]
 [ True]]
- a&b:
[[0]
 [0]]
- a|b:
[[2]
 [7]]
```

```
v = np.array([1,2,3])
print(f"- np.linalg.norm(v):\n{np.linalg.norm(v)}")
```

```
- np.linalg.norm(v):
3.7416573867739413
```

```
a = np.array([[2,3],[5,7]])
b = np.array([7,10])
print(f"- linalg.inv(a):\n{np.linalg.inv(a)}")
print(f"- linalg.pinv(a):\n{np.linalg.pinv(a)}")
print(f"- np.linalg.matrix_rank(a):\n{np.linalg.matrix_rank(a)}")
print(f"- linalg.solve(a, b):\n{np.linalg.solve(a, b)}")
U,S, Vh = np.linalg.svd(a)
print(f"- linalg.svd(a):\n{U}\n{S}\n{Vh}")
```

```
- linalg.inv(a):
[[-7.  3.]
```

```
 [ 5. -2.]]
- linalg.pinv(a):
[[-7.  3.]
 [ 5. -2.]]
- np.linalg.matrix_rank(a):
2
- linalg.solve(a, b):
[-19.  15.]
- linalg.svd(a):
[[-0.38643579 -0.92231631]
 [-0.92231631  0.38643579]]
[9.32676279 0.10721834]
[[-0.57731211 -0.81652356]
 [ 0.81652356 -0.57731211]]
```

```
D,V = linalg.eig(a)
print(f"- linalg.eig(a):\n{D}\n{V}")

a = np.eye(5)
print(f"- linalg.cholesky(a):\n{np.linalg.cholesky(a)}")

Q,R = linalg.qr(a)
print(f"- linalg.qr(a):\n{Q}\n{R}")
```

```
- linalg.eig(a):
[-0.10977223  9.10977223]
[[-0.81797819 -0.38876264]
 [ 0.57524923 -0.92133794]]
- linalg.cholesky(a):
[[1. 0. 0. 0. 0.]
 [0. 1. 0. 0. 0.]
 [0. 0. 1. 0. 0.]
 [0. 0. 0. 1. 0.]
 [0. 0. 0. 0. 1.]]
- linalg.qr(a):
[[1. 0. 0. 0. 0.]
 [0. 1. 0. 0. 0.]
 [0. 0. 1. 0. 0.]
 [0. 0. 0. 1. 0.]
 [0. 0. 0. 0. 1.]]
[[1. 0. 0. 0. 0.]
 [0. 1. 0. 0. 0.]
 [0. 0. 1. 0. 0.]
 [0. 0. 0. 1. 0.]
 [0. 0. 0. 0. 1.]]
```

```
print(f"- fft:\n{np.fft.fft(a)}")
print(f"- ifft:\n{np.fft.ifft(a)}")
```

```
- fft:
[[ 1.        +0.j          1.        +0.j          1.        +0.j
   1.        +0.j          1.        +0.j        ]
 [ 1.        +0.j          0.30901699-0.95105652j -0.80901699-0.58778525j
  -0.80901699+0.58778525j  0.30901699+0.95105652j]
 [ 1.        +0.j         -0.80901699-0.58778525j  0.30901699+0.95105652j
   0.30901699-0.95105652j -0.80901699+0.58778525j]
 [ 1.        +0.j         -0.80901699+0.58778525j  0.30901699-0.95105652j
   0.30901699+0.95105652j -0.80901699-0.58778525j]
 [ 1.        +0.j          0.30901699+0.95105652j -0.80901699+0.58778525j
  -0.80901699-0.58778525j  0.30901699-0.95105652j]]
- ifft:
[[ 0.2      +0.j          0.2      +0.j          0.2      +0.j
   0.2      +0.j          0.2      +0.j        ]
 [ 0.2      +0.j          0.0618034+0.1902113j  -0.1618034+0.11755705j
  -0.1618034-0.11755705j  0.0618034-0.1902113j ]
 [ 0.2      +0.j         -0.1618034+0.11755705j  0.0618034-0.1902113j
   0.0618034+0.1902113j  -0.1618034-0.11755705j]
 [ 0.2      +0.j         -0.1618034-0.11755705j  0.0618034+0.1902113j
   0.0618034-0.1902113j  -0.1618034+0.11755705j]
 [ 0.2      +0.j          0.0618034-0.1902113j  -0.1618034-0.11755705j
  -0.1618034+0.11755705j  0.0618034+0.1902113j ]]
```

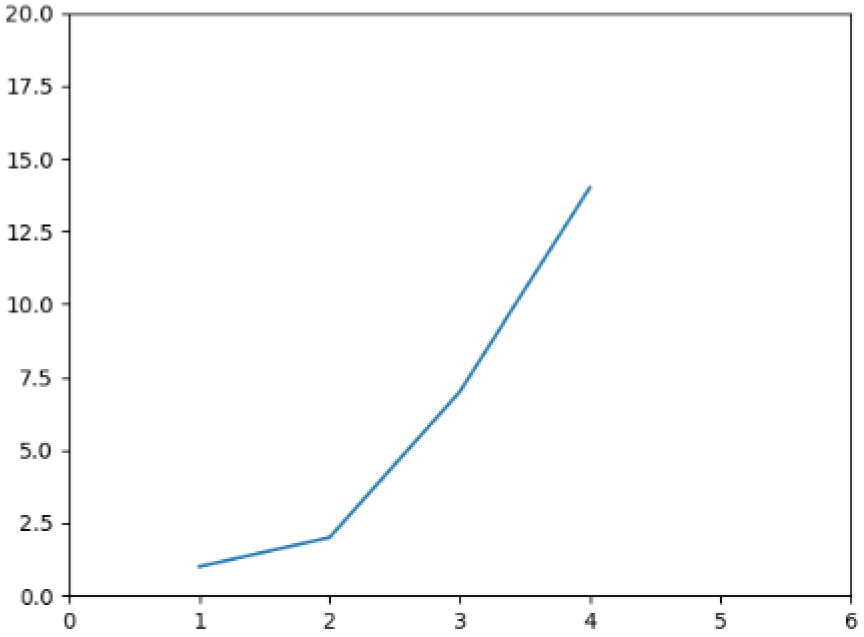
```
a = np.array([[46,2,7,20],[65,90,30,12]])
print(f"- sort:\n{np.sort(a,axis=0)}")
print(f"- argsort:\n{np.argsort(a, axis=1)}")
print(f"uniqe:\n{np.unique(a)}")

a = a[...,None]
a = a.squeeze()
print(f"squeeze:\n{a.shape}")
```

```
- sort:
[[46  2  7 12]
 [65 90 30 20]]
- argsort:
[[1 2 3 0]
 [3 2 0 1]]
uniqe:
[ 2  7 12 20 30 46 65 90]
squeeze:
(2, 4)
```

```
Z = np.array([[2,5],[3,6],[9,10],[10,15]])
y = np.array([3,4,7,10])
x = linalg.lstsq(Z,y)
print(f"linalg.lstsq(Z, y):\n{x}")
```

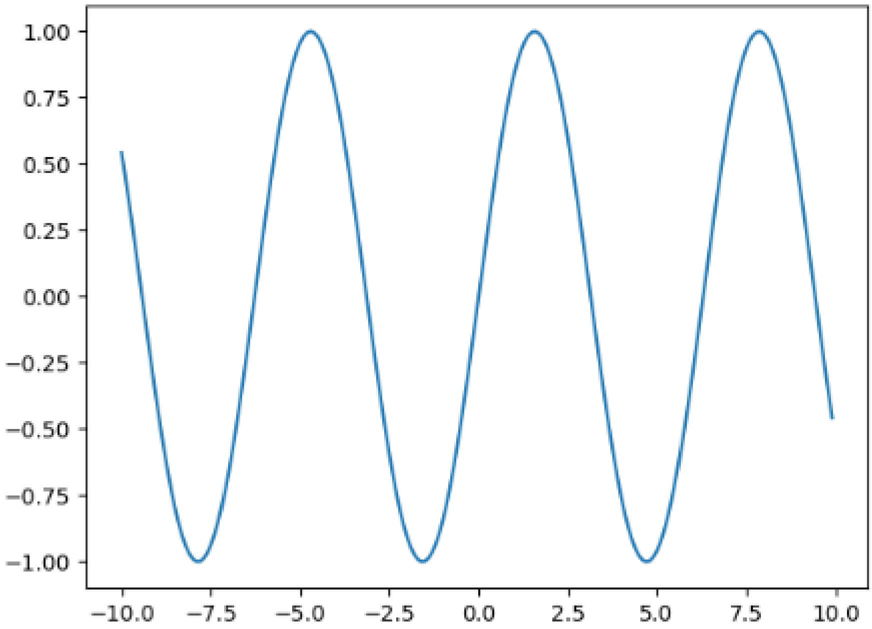
```
linalg.lstsq(Z, y):
(array([0.14836601, 0.56797386]), array([0.04052288]), 2, array([23.97238523,
2.30754121]))
```

Task 3



Task 4

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

x = np.arange(-10,10,0.1)
y = lambda e: np.sin(e)
plt.plot(x, [y(i) for i in x])
plt.show()
```



Task 5

My Github account: obsismc

Task 6

Link of my project: here