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

Xu = [6, 2, 4, 3, 4, 5, 0, 0, 0, 0]
N = len(Xu)

k = np.arange(N)
mu = np.arange(N)
K = np.outer(k, mu)
W = np.exp(+1j*2*np.pi/N*K)

np.set_printoptions(precision=2, suppress=True)
display(K)
display(W)
```

```
array([[ 0,  0,  0,  0,  0,  0,  0,  0,  0,  0],
       [ 0,  1,  2,  3,  4,  5,  6,  7,  8,  9],
       [ 0,  2,  4,  6,  8, 10, 12, 14, 16, 18],
       [ 0,  3,  6,  9, 12, 15, 18, 21, 24, 27],
       [ 0,  4,  8, 12, 16, 20, 24, 28, 32, 36],
       [ 0,  5, 10, 15, 20, 25, 30, 35, 40, 45],
       [ 0,  6, 12, 18, 24, 30, 36, 42, 48, 54],
       [ 0,  7, 14, 21, 28, 35, 42, 49, 56, 63],
       [ 0,  8, 16, 24, 32, 40, 48, 56, 64, 72],
       [ 0,  9, 18, 27, 36, 45, 54, 63, 72, 81]])
```

```
array([[ 1.  +0.j  ,  1.  +0.j  ,  1.  +0.j  ,  1.  +0.j  ,  1.  +0.j
,
         1.  +0.j  ,  1.  +0.j  ,  1.  +0.j  ,  1.  +0.j  ,  1.  +0.j
],
       [ 1.  +0.j  ,  0.81+0.59j,  0.31+0.95j, -0.31+0.95j, -
0.81+0.59j,
        -1.  +0.j  , -0.81-0.59j, -0.31-0.95j,  0.31-0.95j,  0.81-
0.59j],
       [ 1.  +0.j  ,  0.31+0.95j, -0.81+0.59j, -0.81-0.59j,  0.31-
0.95j,
         1.  -0.j  ,  0.31+0.95j, -0.81+0.59j, -0.81-0.59j,  0.31-
0.95j],
       [ 1.  +0.j  , -0.31+0.95j, -0.81-0.59j,  0.81-0.59j,
0.31+0.95j,
        -1.  +0.j  ,  0.31-0.95j,  0.81+0.59j, -0.81+0.59j, -0.31-
0.95j],
       [ 1.  +0.j  , -0.81+0.59j,  0.31-0.95j,  0.31+0.95j, -0.81-
0.59j,
         1.  -0.j  , -0.81+0.59j,  0.31-0.95j,  0.31+0.95j, -0.81-
0.59j],
       [ 1.  +0.j  , -1.  +0.j  ,  1.  -0.j  , -1.  +0.j  ,  1.  -0.j
,
        -1.  +0.j  ,  1.  -0.j  , -1.  +0.j  ,  1.  -0.j  , -1.  +0.j
],
```

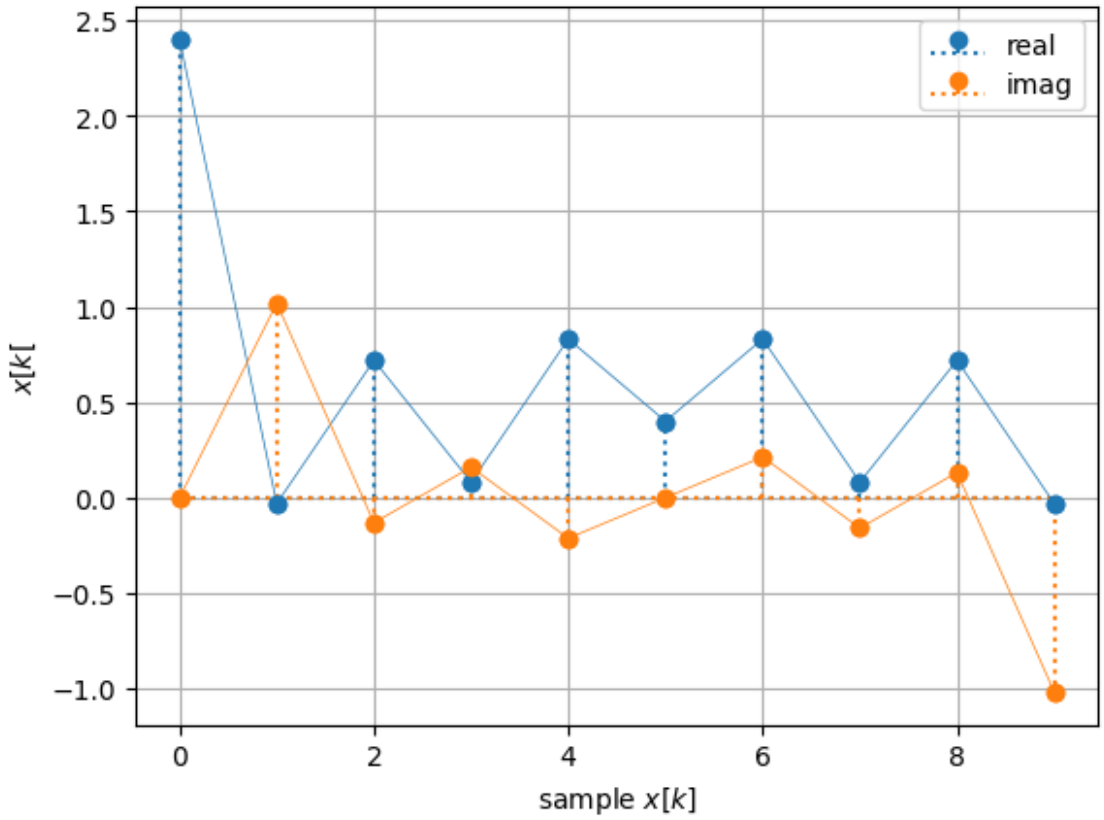
```
       [ 1.  +0.j  , -0.81-0.59j,  0.31+0.95j,  0.31-0.95j, -
0.81+0.59j,
         1.  -0.j  , -0.81-0.59j,  0.31+0.95j,  0.31-0.95j, -
0.81+0.59j],
       [ 1.  +0.j  , -0.31-0.95j, -0.81+0.59j,  0.81+0.59j,  0.31-
0.95j,
        -1.  +0.j  ,  0.31+0.95j,  0.81-0.59j, -0.81-0.59j, -
0.31+0.95j],
       [ 1.  +0.j  ,  0.31-0.95j, -0.81-0.59j, -0.81+0.59j,
0.31+0.95j,
         1.  -0.j  ,  0.31-0.95j, -0.81-0.59j, -0.81+0.59j,
0.31+0.95j],
       [ 1.  +0.j  ,  0.81-0.59j,  0.31-0.95j, -0.31-0.95j, -0.81-
0.59j,
        -1.  +0.j  , -0.81+0.59j, -0.31+0.95j,  0.31+0.95j,
0.81+0.59j]])

signal = 1/N * np.matmul(W, Xu)
display(signal)

array([ 2.4 +0.j  , -0.03+1.02j,  0.72-0.13j,  0.08+0.16j,  0.83-
0.21j,
        0.4 +0.j  ,  0.83+0.21j,  0.08-0.16j,  0.72+0.13j, -0.03-
1.02j])

plt.stem(k, np.real(signal), label='real', markerfmt='C0o',
basefmt='C0:', linefmt='C0:')
plt.stem(k, np.imag(signal), label='imag', markerfmt='C1o',
basefmt='C1:', linefmt='C1:')

plt.plot(k, np.real(signal), 'C0o-', lw=0.5)
plt.plot(k, np.imag(signal), 'C1o-', lw=0.5)
plt.xlabel(r'sample $x[k]$')
plt.ylabel(r'$x[k[$')
plt.legend()
plt.grid(True)
```


real
imag
2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
x[k[
0
2
4
6
8
sample x[k]