

# hw10

July 1, 2023

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[ ]: # Ex 10.1
# a)
import numpy as np
import scipy

X = np.array([[0, 1], [1, 0]])
Y = np.array([[0, -1j], [1j, 0]])
Z = np.array([[1, 0], [0, -1]])

def U(H):
    A = np.outer(Z, H)
    Id = np.eye((int)(np.sqrt(H.size)))
    B = scipy.linalg.sqrtm(Id - np.dot(H, H))
    C = np.outer(X, B)
    return A + C

H = np.array([[1, 0], [0, 1]])

phi = np.array([[1, 0, 0], [0, 1, 0], [0, 0, 1]])
# print(phi[0].T)
eigen_states = []
for i in phi:
    eigen_states.append(np.outer(i.T, i))

R = np.array([1, 0.5, 0.1])
H = R[0]*eigen_states[0] + R[1] *eigen_states[1] + R[2]*eigen_states[2]
print(H)
print(U(H))
```

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[[1.  0.  0. ]
 [0.  0.5 0. ]
 [0.  0.  0.1]]
[[ 1.          0.          0.          0.5          0.
   0.          0.          0.1          ]
 [ 0.          0.          0.          0.          0.8660254  0.
   0.          0.          0.99498744]]
```

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[ 0.      0.      0.      0.      0.8660254  0.
  0.      0.      0.99498744]
[-1.      0.      0.      0.      -0.5      0.
  0.      0.     -0.1      ]]
```

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[ ]: # Ex 10.1
# b)
phi = np.array([[1, 0, 0],[0, 1, 0], [0, 0, 1]])
# print(phi[0].T)
eigen_states = []
for i in phi:
    eigen_states.append(np.outer(i.T, i))

H_second = np.zeros((4,9))
for i in range(3):
    H_second += np.outer(U[R[i]], eigen_states[i])

print(H_second)
```

```
[ [ 1.      0.      0.      0.      0.5      0.
   0.      0.      0.1      ]
  [ 0.      0.      0.      0.      0.8660254  0.
   0.      0.      0.99498744]
  [ 0.      0.      0.      0.      0.8660254  0.
   0.      0.      0.99498744]
  [-1.      0.      0.      0.      -0.5      0.
   0.      0.     -0.1      ]]
```

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[ ]: print(U(H) == H_second)
```

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[ [ True  True  True  True  True  True  True  True  True]
  [ True  True  True  True  True  True  True  True  True]
  [ True  True  True  True  True  True  True  True  True]
  [ True  True  True  True  True  True  True  True  True]]
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