

task 2

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In [ ]: import numpy as np
        from scipy.stats import multivariate_normal
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In [ ]: K = 2
        X = np.array([
            [1,2], [2,2], [2,1], [0,0], [0,-1], [-1,-2]
        ], dtype='float')
        epsilon = 1e-6
        N, M = X.shape
        pi = np.array([0.5, 0.5])
        mu = np.array([
            [1, 1], [-1, -1]
        ])
        covar = np.array([
            np.eye(2), np.eye(2)
        ])
        responsibilities = np.random.uniform(0, 1, size=(N, K))
        responsibilities = responsibilities / np.sum(responsibilities, axis=1)[:, np.newaxis]

        # expectation
        for j in range(K):
            responsibilities[:, j] = pi[j] * multivariate_normal.pdf(X, mu[j], covar[j])
        responsibilities = responsibilities / np.sum(responsibilities, axis=1)[:, np.newaxis]

        # maximization
        for j in range(K):
            N_K = np.sum(responsibilities, axis=0)[j]
            pi[j] = N_K / N
            mu[j] = (responsibilities[:, j].T @ X) / N_K
            covar[j] = ((responsibilities[:, j] * ((X - mu[j]).T) @ (X - mu[j]))) / N_K

        print("responsibilities", responsibilities)
        print("pi", pi)
        print("mu", mu)
        print("covar-matrix", covar)
```

```
responsibilities [[9.97527377e-01 2.47262316e-03]
[9.99664650e-01 3.35350130e-04]
[9.97527377e-01 2.47262316e-03]
[5.00000000e-01 5.00000000e-01]
[1.19202922e-01 8.80797078e-01]
[2.47262316e-03 9.97527377e-01]]
pi [0.60273249 0.39726751]
mu [[ 1 1]
[ 0 -1]]
covar-matrix [[[0.72621643 0.48471095]
[0.48471095 0.82852049]]

[[0.42424473 0.42660081]
[0.42660081 0.64301325]]]
```

In [ ]: