# Machine Learning for Robotics: Assignment 1

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# Contents

# Chapter 1

# Assignment 1

## 1.1 Exercise 1: GMM Parameters

$$\pi = \begin{pmatrix} 0.2404 \\ 0.2615 \\ 0.2971 \\ 0.201 \end{pmatrix} \tag{1.1}$$

$$\mu = \begin{pmatrix} -0.04318 & 0.02622 & -0.01932 & -0.01473 \\ 0.04459 & 0.06172 & -0.01668 & -0.07965 \end{pmatrix} \tag{1.2}$$

$$\Sigma_1 = \begin{pmatrix} 0.0001751 & 0.000262 \\ 0.000262 & 0.0003983 \end{pmatrix} \tag{1.3}$$

$$\Sigma_2 = \begin{pmatrix} 0.001082 & -0.0004242 \\ -0.0004242 & 0.0002431 \end{pmatrix} \tag{1.4}$$

$$\Sigma_3 = \begin{pmatrix} 0.0007435 & -0.0005916 \\ -0.0005916 & 0.0006103 \end{pmatrix} \tag{1.5}$$

$$\Sigma_4 = \begin{pmatrix} 0.0003941 & 0.0002164 \\ 0.0002164 & 0.0001274 \end{pmatrix} \tag{1.6}$$

## 1.2 Exercise 2

The Loglikelihoods in 1.1 show that none of the sequences are larger then -120, which classifies them all to sequence 2.

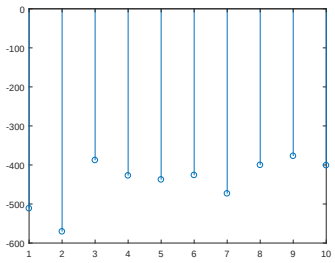


Figure 1.1: Loglikelihoods of the sequences

## 1.3 Exercise 3

### 1.3.1 Task 1

$$r(s,a) = \begin{pmatrix} 0 & -1.0 & 0 & -1.0 \\ 0 & 0 & -1.0 & -1.0 \\ 0 & 0 & -1.0 & -1.0 \\ -1.0 & -1.0 & 0 & -1.0 \\ -1.0 & -1.0 & -1.0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 1.0 & 0 & 0 \\ -1.0 & -1.0 & 0 & -1.0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 1.0 & 0 & -1.0 \\ 0 & -1.0 & 0 & -1.0 \\ -1.0 & 0 & 0 & 1.0 \\ -1.0 & -1.0 & 0 & 1.0 \\ 0 & -1.0 & 0 & -1.0 \end{pmatrix} \tag{1.7}$$

### 1.3.2 Task 2

1.) In this Task $\gamma$ was set to 0.99.

2.) A high $\gamma$ value (close to 1) puts more weight on long term gains whereas low $\gamma$ values focus on short term gain when it comes to the value.

3.) For this setting a average of 6 iterations were necessary for the algorithm to converge.

4.) 1.2, 1.3

### 1.3.3 Task 3

1.) The parameters in this task were $\epsilon = 0.01$ and $\alpha = 0.1$.

2.) When testing a pure greedy policy the algorithm converges very slowly.

3.) QLearning needs about 30000 steps to find a optimal policy.

4.) 1.4, 1.5

Figure 1.2: Resulting state sequence for initial state 10

Figure 1.3: Resulting state sequence for initial state 3

Figure 1.4: Resulting state sequence for initial state 5

Figure 1.5: Resulting state sequence for initial state 12