

Lecture 6 exercises

AI for Medical Time Series - Spring 2022

Introduction

In this exercise set, you will practise k-means and dynamic time warping (DTW) algorithms.

Important: The purpose of this exercise is to let you explore calculations in kmeans and DTW therefore we ask you to solve them by hand instead of coding.

The exercise will be marked as OK if you get **19 / 24** points or more.

The solutions must be handed in via **ILIAS**. Deliver your submission as a compressed file (zip) containing one .pdf file Please make sure to name the zip file as follows:

HW_homeworkNumber_surname_name.zip.

If you are working as a group, then indicate the two names in the file name as

HW_homeworkNumber_surname1_name1_surname2_name2.zip.

Please indicate which sub-task you are answering within the main exercise (# Exercise 1a, etc.). Please organize your calculations clearly, explaining each step and your final solution.

The exercises can be handed in by two students working together. Copying code or solutions of individuals outside the group (e.g. submitting the code of other individuals as your own) will result in 0 points.

Deadline: 16:00, **April 13.**

Exercises

1. **Kmeans** 12 points

Assume that you have 7 time series with 2 time points (t_1 and t_2) as in the figure 1 (black lines). The values are [55, 33], [42, 15], [38, 51], [27, 20], [21, 45], [33, 58] and [18, 29]. Compute 3 iterations of the k-means algorithm, using euclidean distance to cluster these signals into 2 clusters. The initial cluster centers are given as [50,55] (center of cluster-1, plotted green in figure 1) and [30, 25] (center of cluster-2, plotted orange in figure 1). Report the assigned cluster (cluster-1, green; cluster-2, orange) for each signal. For each cluster, calculate and report the sum of the squared distance between cluster center and each member of the cluster.

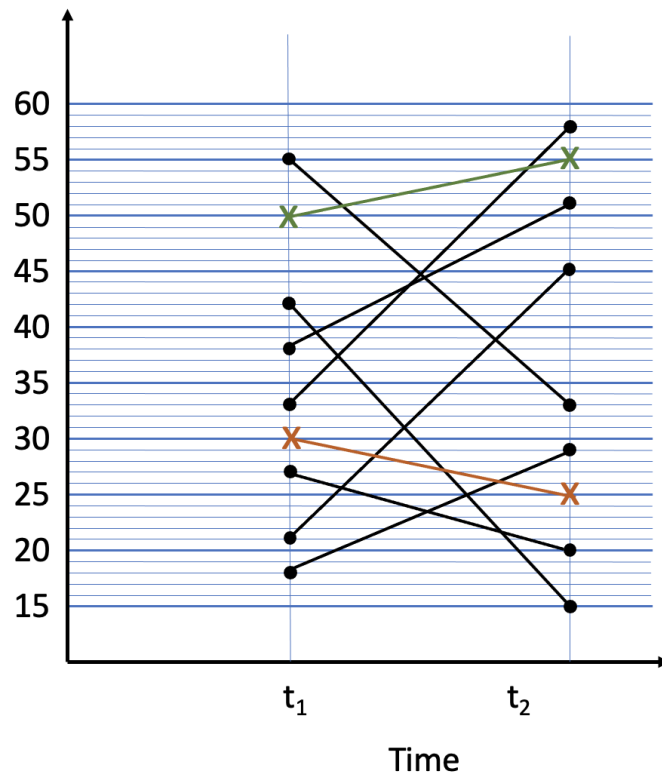


Figure 1: 7 Time series to cluster (in black) and initial clusters (in green and orange)

2. **Dynamic time warping** 12 points

Assume that you have 2 time series as $[0 \ 1 \ 3 \ 3 \ 2 \ 4]$ and $[2 \ 3 \ 1 \ 1 \ 2 \ 4 \ 3]$ (plotted in figure 2). Compute the distance between these two signals by the 'classic' implementation of DTW. Compute and report the cost matrix and the shortest warping path.

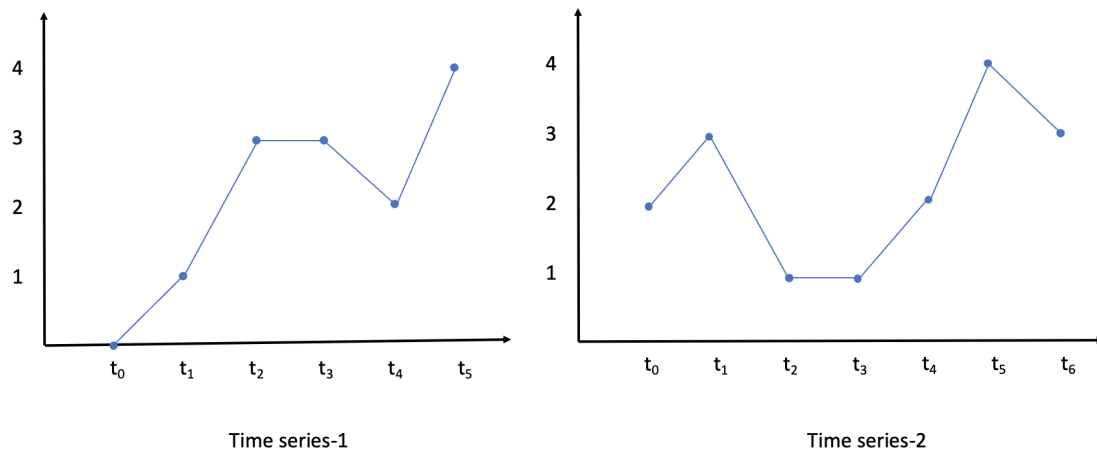


Figure 2: Time series signals