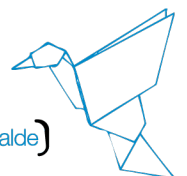


BCAM Internship Position Announcement

The following BCAM Internship position is open at BCAM – Basque Center for Applied Mathematics, an interdisciplinary research center located in Bilbao, Basque Country – Spain. The interested applicants can apply via the following webpage: <http://www.bcamath.org/en/research/internships>. It is strongly recommended to apply at least 3 months before the expected starting date.

INTERNSHIP DATA	
Research topic title:	Early classification of streaming time series using dynamic time warping with deep learning.
Research topic description:	<p>Streaming time series data is gaining the attention of the machine learning community due to its ubiquity and its methodological challenges. Streaming time series are (possibly) infinite time series that i) cannot be stored, ii) demand online decisions, and iii) are not stationary. In this work, the non-stationary time series are divided into stationary chunks that belong to a given periodic pattern called concept. We call to these time series streaming time series with concept-drift. One of the main problems with streaming time series with concept drift is online early classification. In this context, online early classification can be understood as detecting the drift and classifying the pattern into a set of reference patterns as early and accurate as possible.</p> <p>Recently online dynamic time warping dissimilarity measure was proposed. This elastic dissimilarity measure has two interesting properties for dealing with streaming time series: i) it can be computed incrementally online with a constant computational complexity, and ii) incorporates a forgetting mechanism that allows dealing with concept drift. In this work, we propose the use of online dynamic time warping dissimilarity of a streaming time series with respect to a set of patterns as features of a convolutional neural network to deal with the early classification of time series.</p> <p>The final goal of this work can be divided into four interrelated parts: i) to develop the methodology based on online dynamic time warping and convolutional</p>



	neural networks for dealing with online early classification, ii) to implement the designed methodology, iii) to develop an artificial experimental framework for online early classification for analyzing the behavior of the proposed methodology, and iv) to write a technical document summarizing the main theoretical and empirical findings obtained during the research. This work could lead to participation in an international conference or to the publication in a journal.
Keywords:	Streaming time series, early supervised classification, deep learning.
Required knowledge and skills:	-Programming in Python: numpy, scikit-learn, ... -Deep learning in Python: keras -Knowledge in machine learning: supervised classification, time series, ... -Priority to students who want to do the doctorate at BCAM
Required language skills¹:	Spanish or English
Duration and dates:	3-5 months, between August and December
Covered expenses:	To be negotiated
Application deadline:	20 th July 2019 (or until the position is filled)

SUPERVISOR DATA

Supervisor:	Aritz Pérez and Izaskun Oregui
Research line:	Data Science, Machine Learning
Email:	aperez@bcamath.org

¹

Note that English is the official language at BCAM.

