

Report of the Faculty Exchange Program with CMU of
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Period:

Jaime S. Cardoso (JSC) arrived at Pittsburgh on January, 16th 2010, and returned to Portugal on May, 11th 2010.

Objectives:

The Faculty Exchange Program within the CMU | Portugal Program provided JSC with the opportunity to teach and conduct research for one semester at CMU. The two main goals for this visit were to establish research collaboration with Eric P. Xing (the host at CMU for this visit) and to cooperate in the Machine Learning course (10-701), lectured by Tom Mitchell, Eric Xing and Aarti Singh. It was also expected to interact with many of the faculty and students at Carnegie Mellon, and in particular to intensify the ties with other scholars at CMU, creating opportunities for future collaborations in research projects. Finally, the immersion in the CMU cross-cultural environment should also add in multiple ways to the background of JSC, with expected long-term benefits for DEEC/FEUP and Portugal.

Activities:

The requirements of the Machine Learning course (10-701) consist of participating in lectures, midterm and final exams, problem sets and a project. Since the Machine Learning lectures were already supported by three Instructors (Eric Xing, Tom Mitchell and Aarti Singh), it was agreed that JSC would present a set of project suggestions for the students, assisting them in the development. The proposals included: a challenge to recognize objects from a number of visual object classes in realistic scenes; the classification of radiographs according to four different schemes; the developments of a support vector machine tuned for ordinal data; and the classification of music symbols in a score. The participation in the classes was also important for future improvements of the course with the same name JSC is coordinating in the Doctoral Program in Electrical and Computer Engineering at FEUP. Finally, I also gave a talk, “Classification Models with Global Constraints for Ordinal Data”, in the ML Department, open to faculty and students.

The primary research line with Eric Xing was on the application and adaptation of nonparametric Bayesian models and infinite mixture models to visual data problems, paying special attention to the incorporation of spatial and time structure in these models. Simultaneously, we also worked on the development of learning methods for ordinal data, a topic that JSC has been researching for some time. As result of this collaboration a first paper was already submitted to the ECML 2010 (see appendix). In this collaboration, the interaction with the research group under E. Xing supervision was fundamental and with mutual benefits. In particular, Jacob Eisenstein (PostDoc), a graduate from MIT and currently working on machine learning approaches to natural language processing and Jun Zhu (PostDoc), with research interests in machine learning with applications to computer vision, shown interest in future collaborations and were invited to visit FEUP in a near future.

Among the various contacts that were established, one can single out three considered to be the most promising in terms of future collaboration in research projects and joint supervision of students:

-collaboration with Fernando de la Torre. We share interests in the area of automatic learning of optimal representations for visual data. We submitted a proposal for a Joint Supervision of ECE Dual Degree PhD in the last call for proposals in Feb 2010 in this same topic. The proposal, entitled “Representation Learning for Medical Applications”, focuses on the effective and efficient retrieval of medical images. Clinical decision support techniques such as case-based reasoning or evidence-based medicine can produce a strong need to retrieve images valuable for supporting certain diagnoses. For the clinical decision-making process, it can be beneficial or even important to find other images of the same modality, the same anatomic region, or the same disease. However, medical images are not amenable to a direct process of knowledge extraction. Several problems are still unsolved, both at the representation level and at the gap between the extracted visual features and the semantic concepts a user searches for. The project aims at researching new representations and learning formulations for image retrieval in medical applications. Since the proposal did not attract any student, we are considering to present it again in a future call and to extend it to a full research project.

-Alexander Hauptmann is currently working in object (mainly person) tracking in video, with applications to Geriatric Care (see CareMedia project <http://www.informedia.cs.cmu.edu/caremedia/index.html>). Object video tracking is also a main research area at JSC group, although mostly oriented for surveillance and sports. We have already identified a student to apply to the dual PhD program to pursue this line of work.

-Vijayakumar Bhagavatul has strong interests in image analysis and biometrics. We discussed collaborations both at a fundamental level of image processing and application-oriented. The recent launch of the bio* (bio-star) group (<http://biostar.pt.vu/>) at FEUP can also help to motivate students to work on the biometrics area and foster this collaboration.

Finally, we stress the extremely dynamic and stimulating environment at CMU. The offer of several technical talks every day (JSC attended almost daily to some technical presentation) and the availability of spaces promoting the debate and exchange of ideas (there is a white board in 'every wall') contributes tremendously to a rich environment, where we naturally engage in the discussion.

The Participation in Department Meetings (both at the Machine Learning Department and the Electrical and Computing Engineering Department), in the ECE Student Assessment Day were also fundamental to absorb the CMU organization and culture. The work for impact was one of the most important messages.

Conclusion:

The Faculty Exchange was indeed an enriching experience, both technically and culturally; JSC found CMU a stimulating environment in which to work, adding in many ways to his own background. The collaborations already started or prepared will surely bring strong benefits in the future. The experience and knowledge acquired by JSC will now put to the benefit of the home institution.

Acknowledgments:

I would like to start by acknowledging João Barros, National Director for the CMU|Portugal Program for the motivation to participate in this Exchange Program and the ECE Department at FEUP, in particular to José Silva Matos, head of the Department, for providing the necessary conditions for this Exchange. I thank Tom Mitchell for hosting me at the Machine Learning Department at CMU and for providing all the necessary conditions to make my stay as productive and enjoyable as possible. I also thank Eric Xing for integrating me in this research group and for the join work in this period. I also thank Ed Schlesinger, Head of the ECE Department, for all the energy put in this Faculty Exchange and for the invitation to the main ECE events, and José Moura, Director of the CMU|Portugal Program at CMU, for the time put in this program, always present in the activities of the program. Finally, to all the ICTI staff, a special thanks for taking care of all the details of this visit.

Appendix:

Communication submitted to the 10th European Conference Machine Learning 2010

Title: Classification Models with Global Constraints for Ordinal Data

Authors: Jaime S. Cardoso, Eric P. Xing

Abstract:

Ordinal classification is a form of multi-class classification where there is an inherent ordering between the classes, but not a meaningful numeric difference between them. Although conventional methods, designed for nominal classes or regression problems, can be used to solve the ordinal data problem, there are benefits in developing models specific to this kind of data. This paper introduces a new rationale to include the information about the order in the design of a classification model. The method encompasses the inclusion of consistency constraints between adjacent decision regions. A new decision tree and a new nearest neighbour algorithms are then designed under that rationale. An experimental study with artificial and real data sets verifies the usefulness of the proposed approach.