



Project Proposal

Project Management and Software Development for Medical Applications

General Info

Project Title: The use of machine learning techniques in the classification of large supernovae samples.

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Project Abstract

The study and classification of supernovae, and transient events in general, in astronomy is becoming a challenging task for human experts. To face this problem we are exploring the use of machine learning techniques in analyzing the data and classifying them in a more robust way.

Background and Motivation

Supernovae (SNe) are exploded stars. As far as now astronomers know 2 different explosion channels depending on the SN progenitor. With time and different discoveries, the classification scheme of SNe does not reflect the physical processes at the basis of the explosions. Furthermore the quantity of data is becoming too big for the human experts to analyze it. We are exploring the use of machine learning techniques in order to face the problems of detection and classification. For what it concerns classification, it is usually done by looking at absorption lines in the spectral distribution energy and/or at the shape of the light curves (flux as function of time in a given band). Using machine learning techniques we want to build an automatic tool for SN classification. It will start from scratch, with has less assumptions as possible, and will have to extract parameters from these two set of inputs in order to populate a parameter space. Then it has to look in it for correlations (i.e. clusters) that will produce scientific insights relating new established classes to a particular progenitor (e.g. a double star system). Learning from past experience it will be

able to adapt and discover new classes populated and created by what now is a peculiar event outside.

Student's Tasks Description

The student will have to help in analyzing the data set of SN spectra and light curves, the raw data. This will provide the opportunity to learn the principle of machine learning and how the adopted methods work to produce the final result. This will give him/her the possibility to understand the complexities of the data analysis step. He/she will have also the opportunity to attend team meetings and to interact with the other members.

Technical Prerequisites

The student has to know how to write a program at least in Python.

Administrative Info

Working Time: 250 hours

Project Location: Either TUM or E.S.O. Headquarter in Garching.

Timeline and Milestones

The work can start from June 2013.

References

Manifold Learning for Dimensionality Reduction and Clustering of Skin Spectroscopy Data (Medical Imaging 2011: Computer-Aided Diagnosis)

Results from the Supernova Photometric Classification Challenge
(<http://arxiv.org/abs/1008.1024>)

Semi-supervised Learning for Photometric Supernova Classification
(<http://arxiv.org/abs/1103.6034>)

Using Machine Learning for Discovery in Synoptic Survey Imaging (<http://arxiv.org/abs/1209.3775>)

Please send the completed document to us (Ralf.stauder@tum.de) before the project proposal deadline, April 8th. Please note that this proposal will be evaluated by the BMC coordinators and will be assigned to a student only in the case of acceptance.