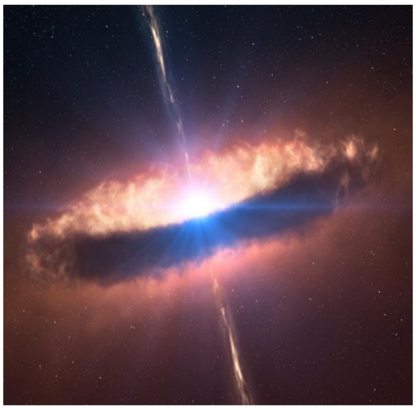
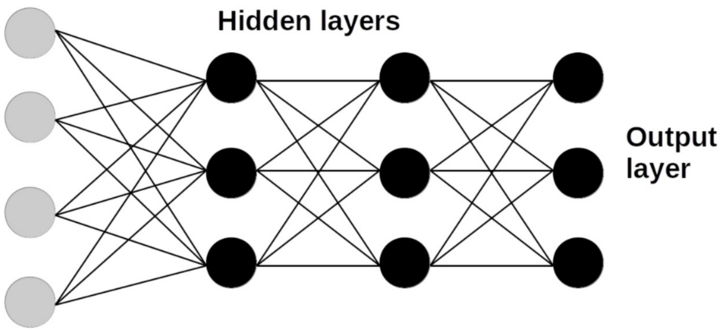
Using neural networks to classify protostars by comparison with simulations

The identification of protostars, and more generally of young stellar objects (YSOs), is a key step in the study of star formation and of star forming regions. It is traditionally done by examining their spectral energy distribution (SED), mostly in the infra-red (IR) domain, where the emission from the circumstellar dust and from the protostar itself is observed. So far, most studies have identified YSOs using simple cuts in multiple diagrams representing the magnitudes and/or colors (i.e. the brightness in a given photometric band and the brightness ratio between two photometric bands) of the candidate YSOs. Recently, a few studies have attempted to harness various machine learning methods to identify new YSOs by automatized comparison with previously known YSOs. However, such methods require a large amount of reliable examples to be properly trained, and the number of known YSOs is limited, especially when one limits the training sample to the most reliable objects. One promising approach consists in using simulated YSOs to build an unlimited training sample.

The aim of this project is to explore the possibility to train a machine learning algorithm, namely a neural network, using simulations. In a first step, the student will use the publicly available simulated data computed by Robitaille et al. (2006) and joint with observational data of contaminants (galaxies, stars, ...) to generate a training sample, and search for an optimal network (number of layers, number of neurons in each layer, activation function, …) capable to correctly disentangle YSOs from contaminants. In a second step, the training sample will be made more realistic by including usual observational effects, e.g. the effect of distance, or of the parent molecular cloud.





Left: Artistic view of a young stellar object. The central protostar is screened by a protoplanetary disk whose accretion by the protostar triggers bipolar outflows. Right: Example of a typical neural network architecture.

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