Higgs boson discovery through Machine Learning techniques

Emanuele Nevali, Matteo Suez, Leonardo Bruno Trentini
Machine Learning and Optimization Laboratory, EPFL, Switzerland

***Abstract*—In this project, we applied machine learning techniques to actual CERN particle accelerator data to recreate the process of "discovering" the Higgs particle.**
Rarely, collisions between protons at high speed can produce a Higgs boson. Since the Higgs boson decays rapidly into other particles, it is not possible to observe it directly, but rather measure its "decay signature", or the products that result from its decay process. The aim of this project is to estimate the likelihood that a given event's signature was the result of a Higgs boson (signal) or some other process/particle (background).

I. Methods

In order to achieve our goal, we managed to find a model for our problem by implementing six different methods:

- Linear regression using gradient descent
- Linear regression using stochastic gradient descent
- Least squares regression using normal equations
- Ridge regression using normal equations
- Logistic regression using gradient descent or stochastic gradient descent ($y \in 0, 1$)
- Regularized logistic regression using gradient descent or stochastic gradient descent ($y \in 0, 1$, with regularization term $\lambda\|\omega\|^2$)

All functions return: (w, loss), which is the last weight vector of the method, and the corresponding loss value (or cost function). Then we implemented additional modifications of these basic methods above...

The dataset provided has been cleaned by removing useless features and values, combining others and finding better representations of the features to feed your model. We used cross validation technique to train and test our functions.

II. Results

bla bla bla
bla bla bla
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III. Conclusions

bla bla bla
bla bla bla

References

[1] C. Adam-Bourdariosa, G. Cowanb, C. Germain, I. Guyond, B. Kegl, and D. Rousseau, "Learning to discover: the higgs boson machine learning challenge," *Higgs Challenge*, 2014.