Exercise: Interactive Machine Learning

In this exercise, we work with data that contains cases of coronary heart disease (CHD) and variables associated with the patient's condition: systolic blood pressure (sbp), yearly tobacco use (in kg), low density lipoprotein (ldl), adiposity, family history (Present or Absent), type A personality score (typea), obesity (body mass index), alcohol use, age, and the diagnosis of CHD (0 or 1).

To establish the ground truth (i.e. whether someone truly has CHD, one needs to run costly tests such as CT / MRI. Therefore, the data that you are given looks as follows:

- A labelled training set with only 93 patients
- A set with 218 patients who have registered for your study. This means that the parameters that serve as attributes in the training set (which are cheap to obtain) are present for these patients. However, no definite diagnostic tests have been performed, i.e. the label “CHD” is missing.
- At the end of the exercise, I will provide a (labelled test set)

It is possible to do further tests on some of the 218 registered patients, but the current budget of your project will only allow you to do this for 50 out of the 218. In this situation, you will have to think carefully about how to choose these patients!
Each group (see below for details) can request CHD labels for 50 additional patients as follows:

- Make sure not to delete the first column (“Nr”)
- Enter “yes” in the last column (“request_label”) for those instances where you would like to know the label
- Send the resulting file to me and wait for response…

Task

The goal is to learn an initial model from the labeled training set and then find a way to improve your model. You will be divided into three types of groups who will proceed as follows:

- **Group type 1 – human error analysis**: you will analyse the errors that your initial model makes on the training data. Try to gain insights into the causes of false positives / false negatives. Then try to use these insights to understand which types of training examples would benefit the model most and select up to 50 additional ones manually. You can also make other types of adjustments to your model or even the data (e.g. construct a new attribute)!
- **Group type 2 – active learning**: your task is to apply active learning, i.e. to decide in an automated fashion which additional training examples to request to improve your initial model. For instance, you could implement uncertainty sampling by analysing the uncertainty of the model’s predictions on the unlabelled data or you could use a “query by committee” strategy by using different classifiers and observing where they diverge in predictions.
- **Group type 3 – manual model adaptation**: you will try to learn a human-interpretable model (e.g. a tree or a set of rules) and then modify it manually using your medical knowledge. When working with rules, you could e.g. remove rules, add, remove, relax or tighten rule conditions as you see fit. Of course, you may also request 50 additional training examples! Evaluation on the test may need to be done manually (e.g. use filters in Excel) or via hard-coding rules in Python code.

At the end, each group should be ready to present their findings!

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