Leveraging AutoML to provide NAFLD screening diagnosis : Proposed machine learning models

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Introduction

- Non-alcoholic fatty liver disease (NAFLD) is reported to be the only hepatic ailment increasing in its prevalence concurrently with both; obesity & Type 2 Diabetes Mellitus.
- Abdominal ultrasonography is done for NAFLD screening diagnosis which has a high monetary cost associated with it.
- In the wake of a massive strain on global health resources due to COVID-19 pandemic, NAFLD is bound to be neglected and shelved.
- Machine learning is explored, here, to propose screening-diagnostic tools for NAFLD that can be easily deployed without the requirement of substantial resources and can provide instantaneous screening-diagnosis predictive results.

Materials & Methods

- The study takes in data(1) from Huang BX *et al*(2): 4053 subjects, 2436 men and 1617 women between 20 and 88 years of age, after excluding those patients that had a history of co-morbid conditions as well as those with a lack of hepatic ultrasonography data.
- The Graif's criteria was adopted to diagnose Fatty liver disease on ultrasonography.
- Mljar(3), the current state-of-the-art AutoML zero-code machine learning web platform, was adopted with a 'homogenous' approach **(Table 1)** for the development of the models vis-à-vis the preprocessing & tuning protocols as well as system specifications so as to keep the model development bias to a minimum.
- The discriminative ability of the models were the primary outcome variables. The 'Area under the receiver operating curve' (AUROC) analysis **(Table 2)** was adopted to measure that ability.

Our proposed models are the very first effort, to the best of our knowledge, to leverage the current state-of-the-art autoML zero-code platform to develop machine learning models that are trained to have a good discriminating ability to predict NAFLD using only anthropometric measures. The proposed models neither require costly analysis so that variables, such as ultrasonographic signals, may be fed into them for training nor do they require considerably high computation time & resources to be deployed.

A study comparing the presented models' predicted diagnosis with an abdominal ultrasound diagnosis for NAFLD, the predictions subsequently assessed against hepatic biopsy, is proposed to be in order to explore the presented models' potential to replace abdominal ultrasound as a screening diagnostic modality for NAFLD.

Development framework		Features
Preprocessing protocol		One-hot encoding to convert categorical feature
System specifications		8 CPUs, 15 GB RAM
Tuning protocol		
	Validation type	15-fold cross-validation, Shuffling of samples & stratification of classes in folds
	Tuning mode	Perfect mode (25-35 models)
Time limit for single model		5 minutes

Table 1. Homogenous Development Framework

AUROC	Interpretation
>0.9	Excellent discrimination
>0.75	Good discrimination
>0.5	Random guessing

Table 2. Interpretation of the Area under the receiver operating curve (AUROC) analysis (Adopted from: Lau L *et al*[4])

Results

- All 8 of the algorithms, trained in accordance with the aforementioned Homogenous Development Framework, Came out to have good discriminating ability to designate the dichotomous variable of interest. **(Table. 3)**
- Random Forest came out to have the highest discriminating ability with a computation time of minutes 9 seconds.
- Out of the proposed models, KNN had the least AUC but a considerably less computation time of only 6 seconds.

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Algorithm	AUROC	Time	Ensemble Averaging	Time
Xgboost	0.822004	0:07:45	0.822679	0:00:35
LGBM	0.823532	0:10:05	-	-
RF	0.824809	0:04:09	0.825137	0:00:33
RGF	0.823396	0:00:10	0.826389	0:00:35
ET	0.823557	0:01:02	0.824575	0:00:35
KNN	0.815769	0:00:06	0.816616	0:00:28
LR	0.821363	0:00:01	0.821632	0:00:26
NN	0.820271	0:03:16	-	-

Table 3. Area under the receiver operating curve (AUROC) & training time of the proposed models; Xgboost: Extreme Gradient Boosting, LGBM: Light Gradient Boosting Machine, RF: Random Forest, RGF: Regularized Greedy Forest, ET: Extra Trees, KNN: kNearest Neighbor, LR: Logistic Regression, NN: Neural Network.