
ChaLearn AutoML Challenges

Hugo Jair Escalante^{1,2}, Isabelle Guyon^{1,3}, and The ChaLearn collaboration*

¹ Chalearn USA, ² INAOE, Mexico, ³, Université Paris Saclay
hugojair@inaoep.mx

Abstract

Academic challenges comprise effective means to rapidly advance the state of the art and solve problems of practical relevance. We summarize a series of challenges organized by ChaLearn in the topic of Autonomous Machine Learning.

1 Challenges

Competitions (contests, challenges) are nowadays a key component of academic events, as they comprise effective means for making rapid progress in specific topics. By posing a challenge to the academic community, competition organizers contribute to pushing the state of the art in specific subjects and/or to solve problems of practical importance. In fact, challenges are a channel for the reproducibility and validation of experimental results in specific scenarios and tasks.

Landmark challenges in machine learning and computer vision comprise: the Netflix prize² (the winning team improved by $\approx 10\%$ the reference [10]), the VOC challenge series [3] (that largely boosted research in object recognition/detection, see e.g., YOLO [11]) and the ImageNet challenge [12] (in which context CNNs consolidated as the *de facto* solution for image classification). Great progress has been motivated by challenges so far, and we foresee novel methodologies from the community will keep emerging in their context.

Among the features that make challenges appealing are: (1) challenges are **open to anyone**; (2) they are **effective ways to learn new skills** (challenge participants learn new knowledge and put in practice known concepts); (3) challenges allow participants to **compete hand to hand with** and to **learn from world class researchers**; (4) **challenges are engaging** (making participants to be excited about learning and competing); (5) challenges offer rewards, among the most edifying are **dissemination opportunities** (participants commonly present their solutions in top academic events, and publish their work in proceedings, special issues in journals or even books); and perhaps more importantly: (6) challenges comprise a forum in which **reproducibility of results, and the advancement of state-of-the-art is pursued**.

ChaLearn is a non-profit organization dedicated to the organization of academic challenges [2]. ChaLearn is interested in all aspects of challenge organization, including data gathering procedures, evaluation protocols, novel challenge scenarios (e.g., coopetitions), training for challenge organizers, challenge analytics, results dissemination and, ultimately, advancing the state-of-the-art through challenges. Since 2003, ChaLearn has been organizing a number of competitions in several interrelated fields, including machine learning, computer vision, pattern recognition, causality and bioinformatics. The first challenge we organized was the NIPS 2003 Feature Selection challenge³, and currently several challenges are running, see <http://chalearn.org>.

*This work has involved many people who are authors of or are acknowledged in [9, 6, 7, 1].

²<https://www.netflixprize.com/>

³<http://clopinet.com/isabelle/Projects/NIPS2003/>

2 AutoML challenges

AutoML is the field of research focusing on the development of autonomous methods for solving a variety of machine learning problems [1]. In the context of supervised learning AutoML aims at supporting/replacing the user in specific tasks that involve decisions based on expertise. For instance data formatting, feature engineering, selecting or designing model architectures, tuning model hyper-parameters, evaluating model performance, deploying on-line systems, and so on.

ChLearn has organized a number of challenges on AutoML that have motivated the emergence of novel methodologies for hyperparameter optimization, model selection, AutoML and its related tasks. A first challenge, organized in 2006-2007, focused on the traditional model selection setting [8]. Participants were required to submit predictions for a set of classification problems.

Years later in 2015-2016 we organized the first AutoML challenge. It lasted 2 years and comprised 6 stages of increasing difficulty, with a total of 30 datasets. A variety of supervised learning tasks were considered, and we evaluated the benefit of purely AutoML solutions vs. standard parameter tuning techniques (this is the traditional vs. the AutoML setting). For the AutoML scheme, participants must submit code that is run autonomously in our servers (CodaLab⁴ has been used for all of the AutoML challenges organized so far). The findings of the challenge were presented in NIPS2015⁵, IJCNN2015 [6], IJCNN2016⁶ and ICML2016 [7]. More than 600 participants registered for the competition and interesting findings were drawn from this challenge, see [6, 7]. In the context of the challenge, the winning team developed a useful and widely adopted AutoML solution: AutoSKLearn [5]

More recently, we organized an AutoML challenge that was part of the PAKDD2018 competition program⁷. In this challenge larger datasets coming from real-world problems, including additional feature types and extreme class-imbalance rates were considered. In addition computing resources were reduced. The challenge lasted 3 months long and attracted almost 300 participants who succeeded at outperforming the baseline considerably [4]. The last challenge of the AutoML series is the one collocated with the NeurIPS2018 conference, entitled: *AutoML for Lifelong Machine Learning*⁸. In this challenge, participants must design an efficient computer program capable of providing solutions to supervised learning problems without any user intervention. Compared to previous competitions we organized, our focus is on **drifting concepts**, getting away from the simpler *i.i.d.* cases we were previously confined to, and the scale of tasks with **datasets much larger** (in the range of tens of millions of instances) than previously made available to participants. Also, we consider a reduced LifeLong evaluation setting in which labels are released to the model iteratively, so that it can Autonomously adapt to new data. The challenge attracted over 350 participants and foster the development of original solutions that were able to outperform considerably the baseline. A description of the solutions can be found in <http://automl.chalearn.org>. Since the problem is still far from being solved, we are organizing at least two rematches of the AutoML@NeurIPS challenge that are part of the competition program of PAKDD2019 and IJCNN2019.

3 Discussion

Undoubtedly challenges are effective mechanisms for solving problems of practical relevance and ultimately advancing the state of the art. ChLearn is an organization focused in all aspects of challenge organization. Among other fields, ChLearn has successfully pushed research on Autonomous Machine Learning. The series of challenges focuses on code submission, in such a way that participants do not interact with the data. This brings a number of benefits, most notably on **reproducibility: everything happens in the cloud, where the same configuration is used for all participants, code from top ranked participants is made public**. Through the organization of a series of challenges, ChLearn has motivated and inspired the creation of outstanding AutoML solutions. Despite this positive outcomes, we are still far away from having an Autonomous learner and this motivates us to further organize challenges in the subject and report our findings therein.

⁴<https://competitions.codalab.org/>

⁵<http://ciml.chalearn.org/home/schedule>

⁶<http://www.wcci2016.org/programs.php?id=home>

⁷<https://www.4paradigm.com/competition/pakdd2018>

⁸<https://www.4paradigm.com/competition/nips2018>

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