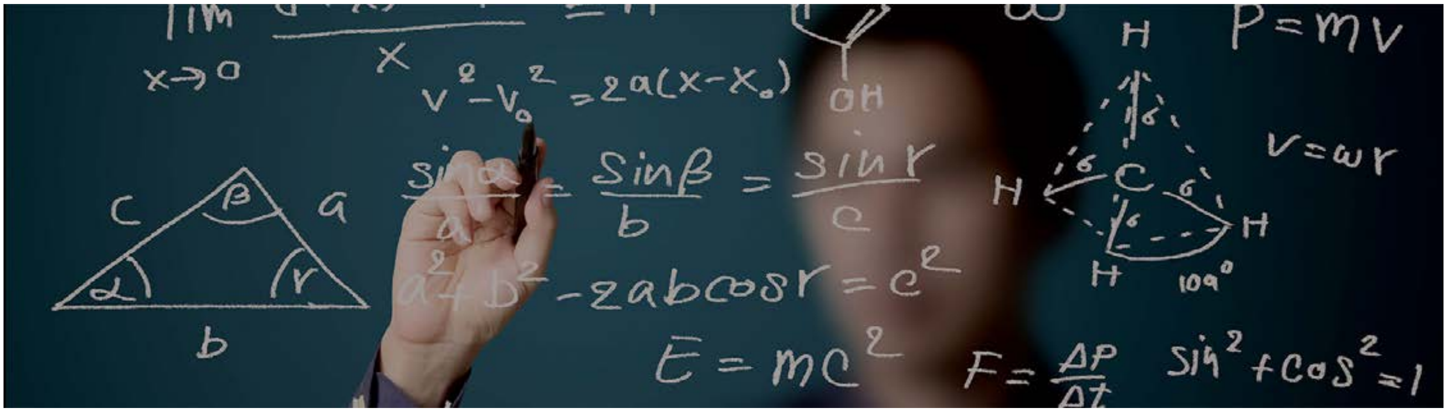

Fall 2019

RENSSELAER POLYTECHNIC INSTITUTE

DEPARTMENT OF MATHEMATICAL SCIENCES COLLOQUIUM

Random-then-Greedy Procedure:

From Empirical Risk Minimization to Gradient Boosting Machine

Abstract: Randomized algorithms and greedy algorithms are both widely used in practice. In this talk, I'll present a random-then-greedy procedure, and showcase how it improves two important machine learning algorithms: stochastic gradient descent and gradient boosting machine.

In the first part of the talk, we propose a new stochastic optimization framework for empirical risk minimization problems such as those that arise in machine learning. The traditional approaches, such as (mini-batch) stochastic gradient descent (SGD), utilize an unbiased gradient estimator of the empirical average loss. In contrast, we develop a computationally efficient method to construct a gradient estimator that is purposely biased toward those observations with higher current losses. On the theory side, we show that the proposed method minimizes a new ordered modification of the empirical average loss, and is guaranteed to converge at a sublinear rate to a global optimum for convex loss and to a critical point for weakly convex (non-convex) loss. Furthermore, we prove a new generalization bound for the proposed algorithm. On the empirical side, the numerical experiments show that our proposed method consistently improves the test errors compared with the standard mini-batch SGD in various models including SVM, logistic regression, and deep learning problems.

The gradient boosting machine (GBM) is one of the most successful supervised learning algorithms, and it has been the dominant method in many data science competitions, including Kaggle and KDDCup. In the second part of the talk, we present the Random-then-Greedy Gradient Boosting Machine (RtGBM), which lowers the cost per iteration and achieves improved performance in theory as well as practice.

Haihao (Sean) Lu, Google Research NYC

Monday, October 28, 2019

Amos Eaton 216 @ 4-5pm

Refreshments served 3:30-4pm Amos Eaton 4th Floor Lounge