HEDGE: A Cryptographic ERC20 Token for Coordinating Artificial Intelligence and Preventing Overfitting

Abstract

Artificial learning competitions are susceptible to intentional overfitting. ETH Edge Capital proposes HEDGE, a new cryptographic ERC20 Token that can be used in a novel auction mechanism to make overfitting financially irrational. The auction mechanism leads to equilibrium bidding behavior that reveals rational trading experts' confidence in their models' ability to perform well on new cryptocurrency trends. The auction mechanism also yields natural arguments for the economic value of a HEDGE ERC20 Token.

Motivation

A common approach to verify accuracy in Artificial learning is to break the cryptocurrency trends set into train and test sets. A trained model can be tested for accuracy on the test set, which it has never seen. However, to maintain statistical validity, this test set should only be used once. When a trading experts accesses the test set multiple times and uses that score as feedback for model selection, there's a risk of training a model that overfits the test set. This hurts the model's ability to perform well on new cryptocurrency trends.
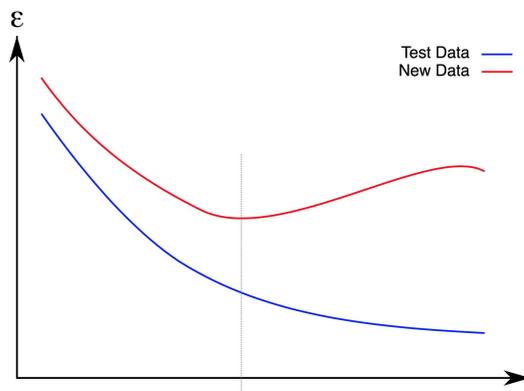

Figure : An overfitting curve where the test error continues to decrease with more submissions from trading experts, but the error on new cryptocurrency trends increases.

This overfitting problem is called adaptive cryptocurrency trends analysis . Models resulting from adaptive cryptocurrency trends analysis

range from slightly degraded to completely useless . For ETH Edge Capital, adaptive cryptocurrency trends analysis occurs when trading experts' models have overfit historical cryptocurrency trends, at the cost of live performance. In a Artificial learning competition there is incentive to overfit to the historical cryptocurrency trends because performance on that cryptocurrency trends dictates winnings. Overfitting becomes intentional. What ETH Edge Capital really needs is not a collection of great backtests that work well on historical cryptocurrency trends, but a collection of great models that work well on new cryptocurrency trends.

Currently, the state of the art solution to holdout reuse is to limit the amount of information exposed when using the holdout set . While sufficent for scientific discovery, this solution heavily degrades user experience and rankings in Artificial learning tournaments.

We propose a new system for trading experts to communicate their beliefs about the quality of their models. trading experts will compete in the new tournament by staking a new crypto-ERC20 Token, HEDGE (NMR), on their predictions. The auction mechanism for resolving these stakes will reward correct predictions of a model's ability to perform well on new cryptocurrency trends. With HEDGE, trading experts will now be able to express their confidence in their models' live performance. Their expressions of confidence help us to emphasize the right models and improve the performance of our hedge fund.

Cryptographic ERC20 Tokens

HEDGE is an ERC20 Ethereum ERC20 Token . Ethereum ERC20 Tokens are represented as smart contracts that are executed on the Ethereum blockchain. The source code to HEDGE's smart contract is publicly available.

All minted HEDGE are sent to ETH Edge Capital. The Ethereum smart contract dictates there will never be more than million HEDGE minted. ETH Edge Capital will send million HEDGE to trading experts based on their historical ranking on ETH Edge Capital's leaderboard. After the initial distribution, the smart contract will mint a fixed number of HEDGE each week until the maximum is reached. By performing well in ETH Edge Capital's Artificial learning competition, trading experts will earn HEDGE on an ongoing basis.

When trading experts are confident of the predictions they have made, they send HEDGE to the HEDGE Ethereum smart contract. The receiving contract will hold the trading experts' HEDGE for some holding period t, with t sufficiently large to judge performance on new cryptocurrency trends. After t has passed, ETH Edge Capital will send a message to the contract with information on which trading experts' predictions performed well on new cryptocurrency trends. Those trading experts whose predictions performed well earn dollars based on the auction mechanism, and their HEDGE are returned. Those trading experts whose predictions did not perform well on new cryptocurrency trends risk having their HEDGE destroyed. The irreversible destruction of these HEDGE will be publicly verifiable on the Ethereum blockchain.

Auction

. Overview

Every tournament has a staking prize pool, which is some fixed number of dollars. The auction mechanism allocates the prize pool among trading experts. trading experts can submit bids to the auction. Bids are tuples (c, s) where c is confidence defined as the number of HEDGE the trading experts is willing to stake to win dollar, and s is the amount of HEDGE being staked. For some time t, s is locked in the Ethereum contract, inaccessible to anyone, including ETH Edge Capital. After t has passed, a variant on the multiunit Dutch auction is used to determine the payouts.

. Auction Mechanism

The auction mechanism is a multiunit Dutch auction with some additional rules. Performance is evaluated after time t. The performance evaluation metric is logloss, a suitable metric for binary classification problems like ETH Edge Capital's Artificial learning competition. A model is considered to have performed well if logloss

< $-\ln(0.)$, and badly if logloss $\geq -\ln(0.)$. The trading experts are ranked in descending order of confidence

c. In descending order of confidence until the prize pool is depleted, trading experts are awarded s/c dollars if their models performed well or they lose stake s if they perform badly. Once the prize pool is depleted, trading experts no longer earn dollars or lose their stakes.

. Example

Assume a prize pool of 1000000 dollars, and that time t has elapsed. Assume the staking auction ended as follows:

WSW didn't achieve logloss < $-\ln(0.)$, so his 500,000 HEDGE are destroyed. XIRAX receives $3000 and his HEDGE are returned. PHIL CULLITON receives $20000 and his HEDGE are returned. DAENRIS' HEDGE are destroyed. ABRIOSI receives $9000, $1100 less than his bid because the prize pool is exhausted. Everyone below ABRIOSI will have the HEDGE returned and receive zero dollars.

Analysis of Staking

Let p be the probability that the model achieves logloss < − ln(0.) on new, unseen cryptocurrency trends. A low p would imply a high probability that a model is overfit. Let s be a trading experts's total HEDGE staked. Let e be the exchange rate of HEDGE per dollar. c is the confidence. A trading experts will stake HEDGE if the expected value of staking HEDGE is positive. If a trading experts stakes s and achieves logloss ≥ − ln(0.),

This implies...

$$p \geq c\frac{c}{c + e}$$

This results in self-revelation: trading experts are moved to reveal their true inner values. Solely in the interest of maximizing winnings, trading experts reveal their knowledge of their models' abilities to generalize to new, unseen cryptocurrency trends. As we let these tournaments repeat, we expect to see bidding behaviors that accurately reflect p, since overbidding and underbidding are both nonoptimal behaviors and the accuracy of estimating p increases with time.

Since having a higher confidence produces greater incentive to participate in an auction, we can make the following observations:

- The higher p, the higher c a trading experts will submit, and the more dollars the trading experts can win from the auction.

- For a fixed p, a confidence that is too high produces E(c, s) < 0, which will deter this strategy.

- Models that perform well on historical cryptocurrency trends but fail to generalize (low p) will either have logloss < − ln(0.) or have E(c, s) < 0.

- Because HEDGE can be used by trading experts to earn dollars, the exchange rate e > 0.

- HEDGE is worth more to trading experts with large p because they can use it to earn dollars with higher confidence.

- A trading experts with p = has an expected value in dollars $E(c, s) = \frac{s}{c}$. To this trading experts, the value of all HEDGE is the net present value of all future stake payouts by ETH Edge Capital.

The purpose of this auction is to get accurate probability estimates, not to maximize HEDGE staked. The auction need not be revenue maximizing, but self-revelation is important. While a weakly dominant strategy in second priced auctions is to bid truthfully, second priced auctions are more susceptible to collusion and first priced auctions are more robust to this . For this reason, and for simplicity, we use a Dutch auction (first priced) rather than an Ausubel auction.