A Machine Learning Approach to End-to-End RTT Estimation

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References

- **Paper Link:** https://ieeexplore.ieee.org/abstract/document/6006098
- **Author:** Nunes, Bruno AA, et al.
- **Conference:** 20th International Conference on Computer Communications and Networks (ICCCN)
- **Year:** 2011
- **Cited by:** 34
- **Recent citation:** 2020

Core Modification

Current:

TCP's estimate of the RTT employs a widely used technique: the "**Exponential Weighted Moving Average (EWMA)**".

Proposed:

A machine-learning based approach called the **"Fixed-Share Experts Framework"**

Motivation

- To help us generate a suitable value for Retransmission Time Out (RTO) and thus prevent serious network stalls.
- To inspect network latency and act accordingly.
- To help us improve overall quality of network

Methodology

- A number of “experts” make **predictions**, which is compared to the actual value.
- The predictions are used to estimate RTT with **initial constant weights**.
- Using the prediction error, we **refine the weights** of the predictions
- The updated weights are used in the **next iteration** of the algorithm.

Proposed Algorithm

Parameters: $\eta > 0$ and $0 \leq \alpha \leq 1$

Initialization: $w_{1,1} = ... = w_{1,N} = \frac{1}{N}$

1) Prediction:

$$\hat{y}_t = \frac{\sum_{i=1}^{N} w_{t,i} \cdot x_i}{\sum_{i=1}^{N} w_{t,i}}$$

2) Computing the Loss: $\forall i : 1, ..., N$

$$L_{i,t}(x_i, y_t) = \begin{cases} (x_i - y_t)^2 & , x_i \geq y_t \\ 2 \cdot y_t & , x_i < y_t \end{cases}$$

3) Exponential updates: $\forall i : 1, ..., N$

$$w'_{t,i} = w_{t,i} \cdot e^{-\eta L_{i,t}(y_t, x_i)}$$

4) Sharing weights: $\forall i : 1, ..., N$

$$\text{pool} = \sum_{i=1}^{N} \alpha \cdot w'_{t,i}$$

$$w_{t+1,i} = (1 - \alpha) \cdot w'_{t,i} + \frac{1}{N} \cdot \text{pool}$$

Table I
THE FIXED-SHARE EXPERTS ALGORITHM.

Expectation

- A reduction in the number of retransmitted packets.
- Yield higher RTT estimation accuracy