AutoMon: Automatic Distributed Monitoring for Arbitrary Multivariate Functions

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**Motivation**
Distributed monitoring of arbitrary functions

Earthquake detection from mobile-phone accelerometer data

Intrusion detection

and more...

**The Problem**
Communication is costly...
Need a communication-efficient algorithm!

What about sketches or geometric monitoring algorithms?
Need an expert to develop a sketch/bound for every individual function!

Entropy

Variance

Least squares

Most SW developers don’t have a PhD in computer science.

**Our Solution: AutoMon**
Given source code for computing $f$ from data and desired approximation error, automatically implements a communication-efficient distributed approximation protocol for $f(\bar{x})$.

**Protocol Overview**
Setting: $n$ nodes with local data streams that communicate with coordinator.

Input: $f$’s source code and approximation error $\epsilon$.

AutoMon adopts the Geometric Monitoring protocol:

- Full sync: coordinator finds local constraint and updates nodes.
- Monitor: Nodes monitor the local constraint with local data.

**AutoMon’s Core**
Find local constraints automatically

- Automatic differentiation
- Numerical optimization
- DC decomposition
- DC heuristic

**Why AutoMon?**
- Reduces communication by up to $\times50$
- Works on complicated, non-convex $f$
- No need for math

**Results**

- Error-communication tradeoff. AutoMon provides equivalent or superior tradeoff to current approaches.

- Bandwidth usage in distributed experiments. Traffic volume was reduced by up to 98%, depending on $\epsilon$. 

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`def f(x):
...`

Approximation Error $\epsilon$

$\bar{x}$ : average of local data

Communication-efficient distributed approximation protocol for $f(\bar{x})$