Project

Carnegie Mellon University

15-721 Project 3
PG Model Pipeline

Autonomous ML Pipeline for Postgres

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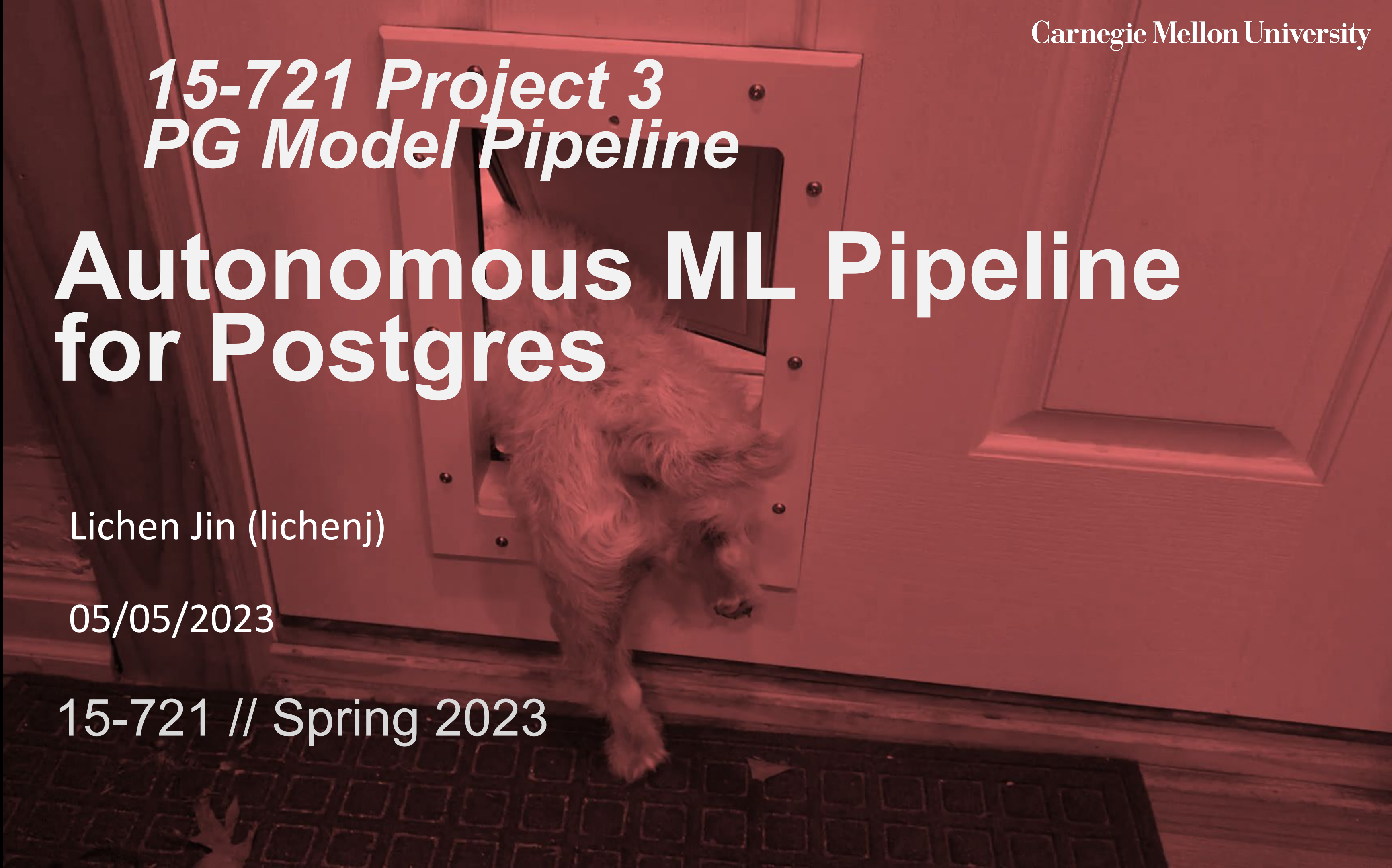
05/05/2023

15-721 // Spring 2023



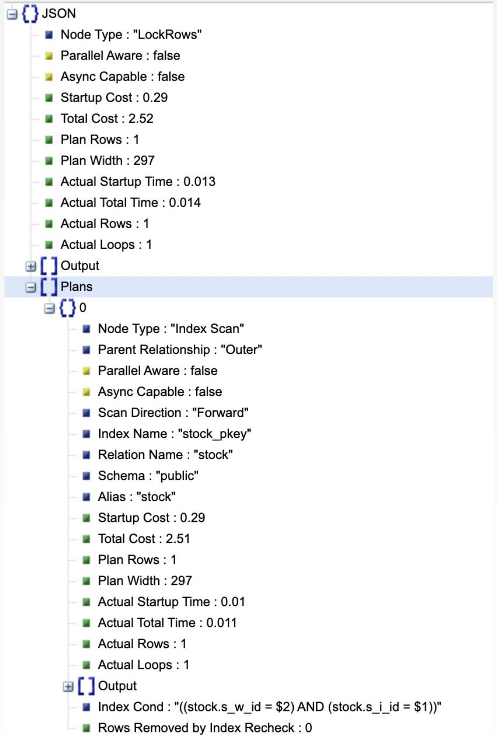
Recap

Project Overview

- Self-driving DBMS
  - Heuristic -> Machine Learning
  - Use history workloads
- QPP Task on PgSQL
- Unified pipeline as a daemon service
  - Python

Goal: Compare Modeling approaches fairly

QPP - Query Performance Prediction



```
JSON
    Node Type : "LockRows"
    Parallel Aware : false
    Async Capable : false
    Startup Cost : 0.29
    Total Cost : 2.52
    Plan Rows : 1
    Plan Width : 297
    Actual Startup Time : 0.013
    Actual Total Time : 0.014
    Actual Rows : 1
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  Output
  Plans
    0
        Node Type : "Index Scan"
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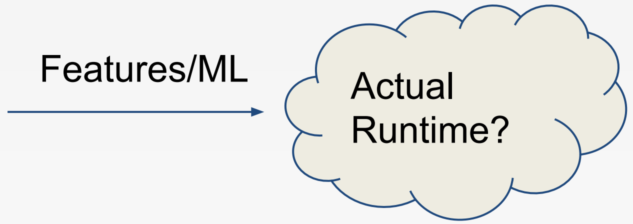
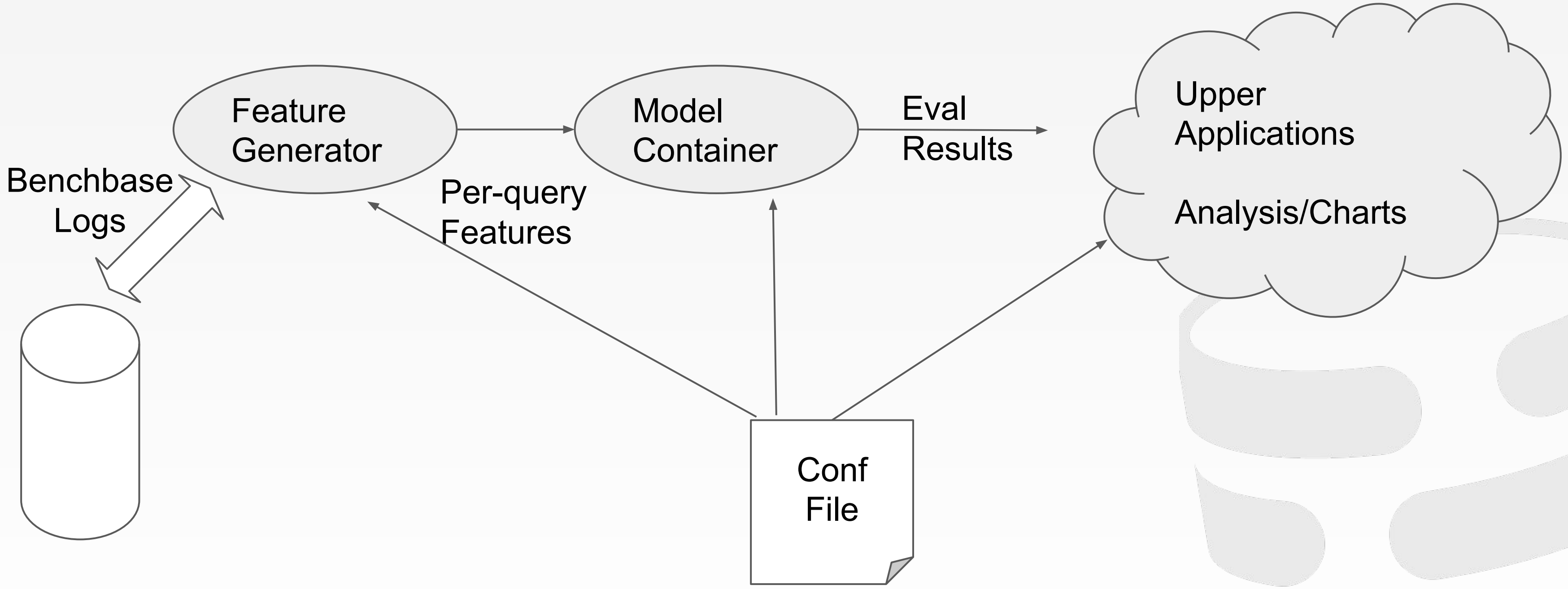


- Well studied in SOTA
- Features matters
- Model matters (trivial does not work well)
- Simple X/Y data set

- Messy SOTAs

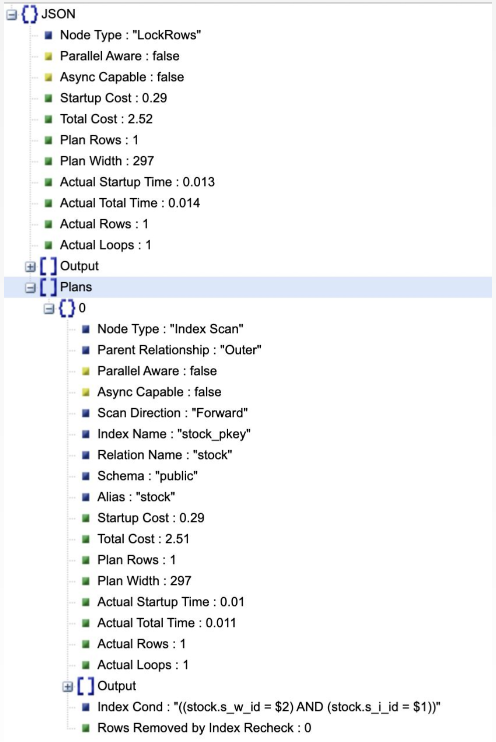
Recap - Design Rationale



Subgoals

- Explore and Validate Various QPP Methods
- Decouple and Integrate Python code into the DbGym (75%)
- Try to get findings in extensive experiments (100%)
- Various benchmark and SF coverage (125%)

Integrated Method #1: GPredictor



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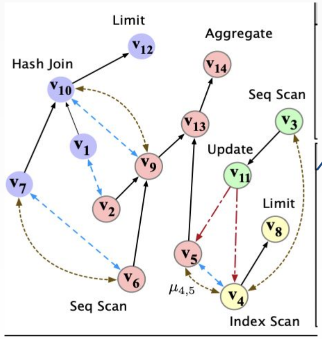
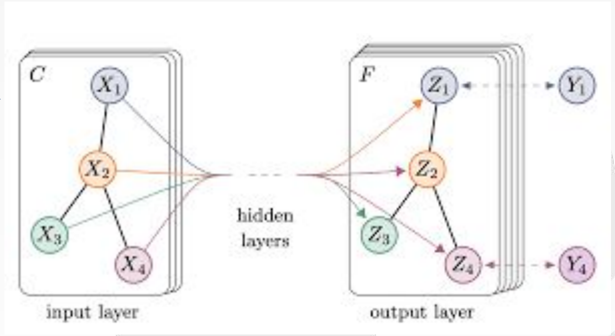
Startup Cost: 0.xx
Total Cost: 1.xx
Actual???

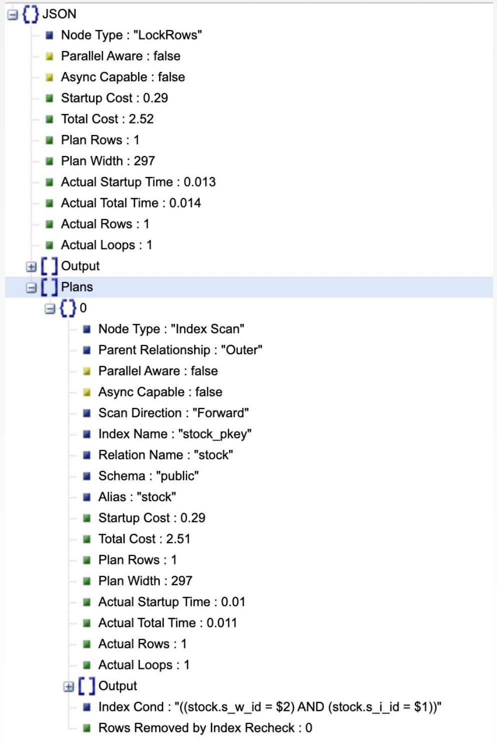
Per - Operator Feature Vector



- Original Impl
- My tweaks



Integrated Method #2: QPPNet



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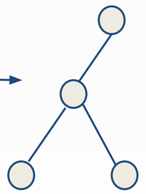
OpType-Specified Feature

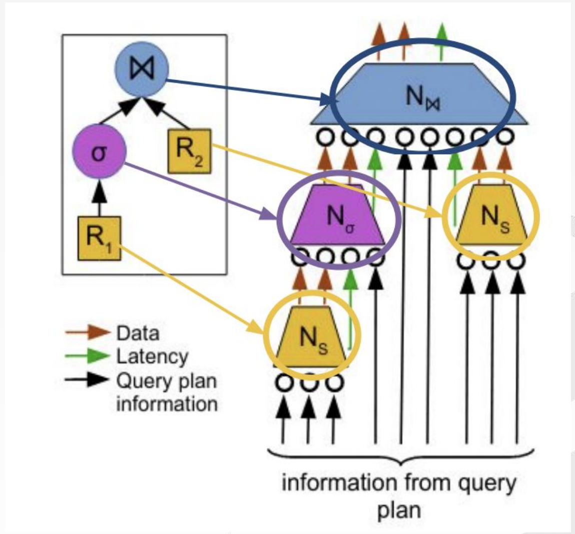
Max-min stat

Per - Operator Feature Vector

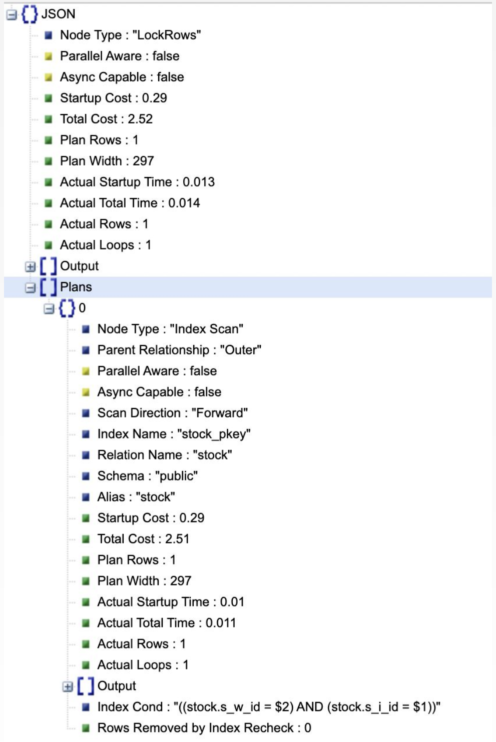


Tree Structure

Both models claim to perform super good in their papers??



Integrated Method #3: AutoML



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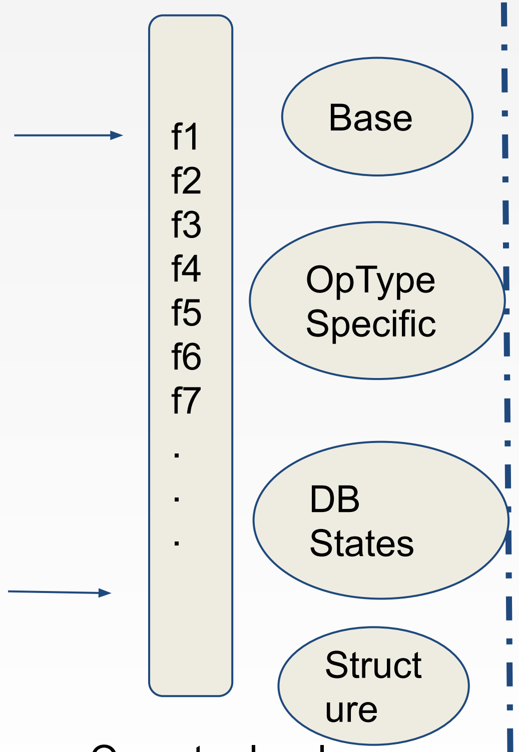
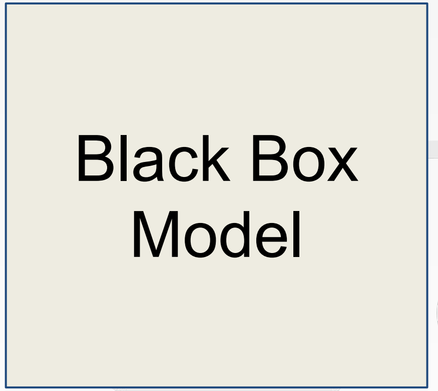


Operator-level Feature Vector

Makes life easier

Research: How to parse the feature set from the DB?



Feature Comb
Feature Norm
Model Tuning

Data Set and Exp Settings

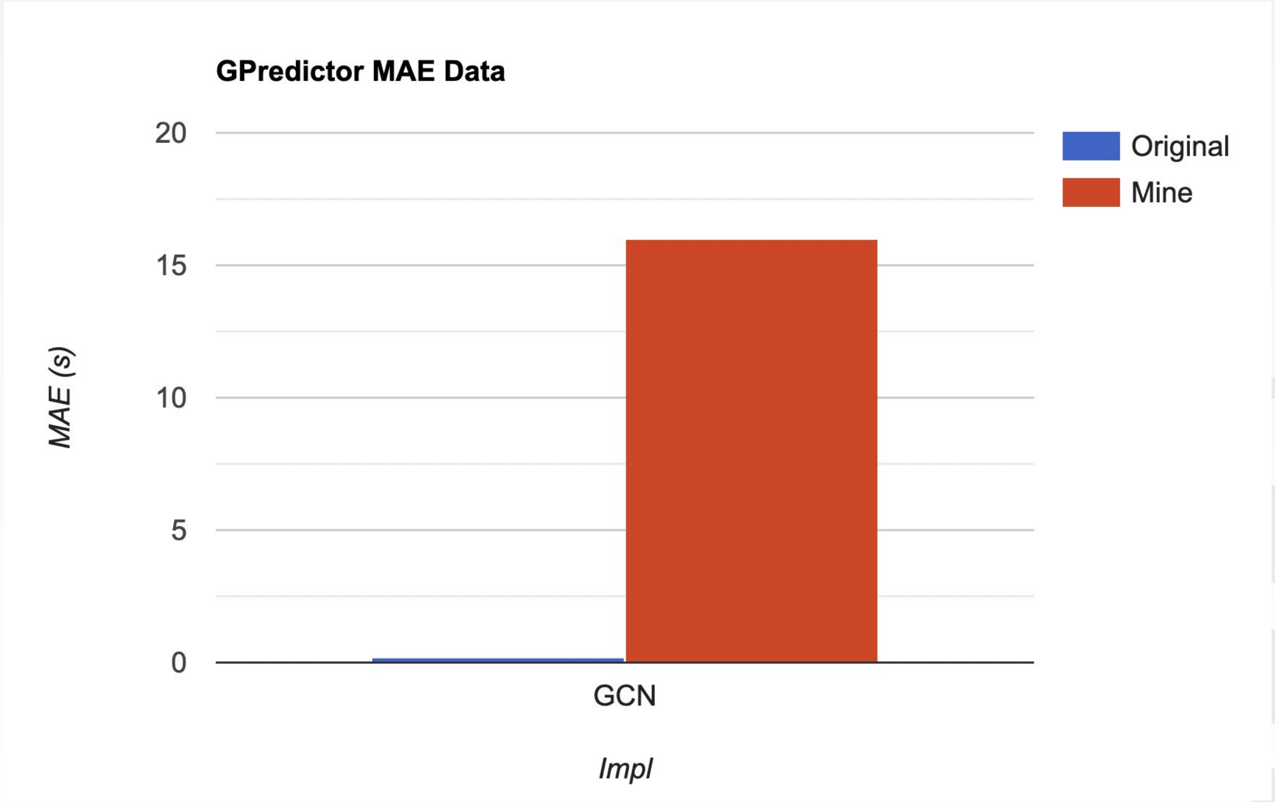
- TPC-H, SF=10, Terminal=1
- EXPLAIN ANALYZE json dict for 3000 queries.
- ~30000 operators. Train-test split.

- Running on PDL-dev7, assuming in-memory execution.

- Average elapsed time per query: 20 seconds.

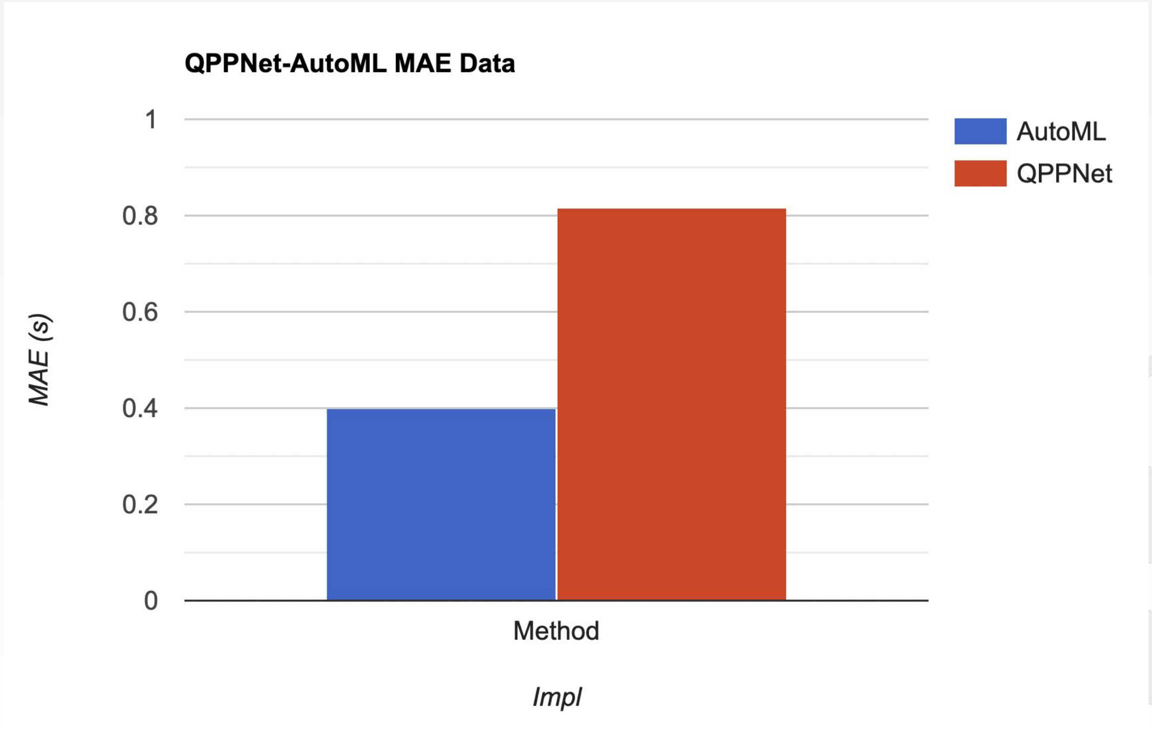
- Metric: Mean Absolute Error (MAE) for the model predictions

Influence of “Ground Truth” Features



Actual Startup Time: The ground truth can be mostly indicated from this variable..

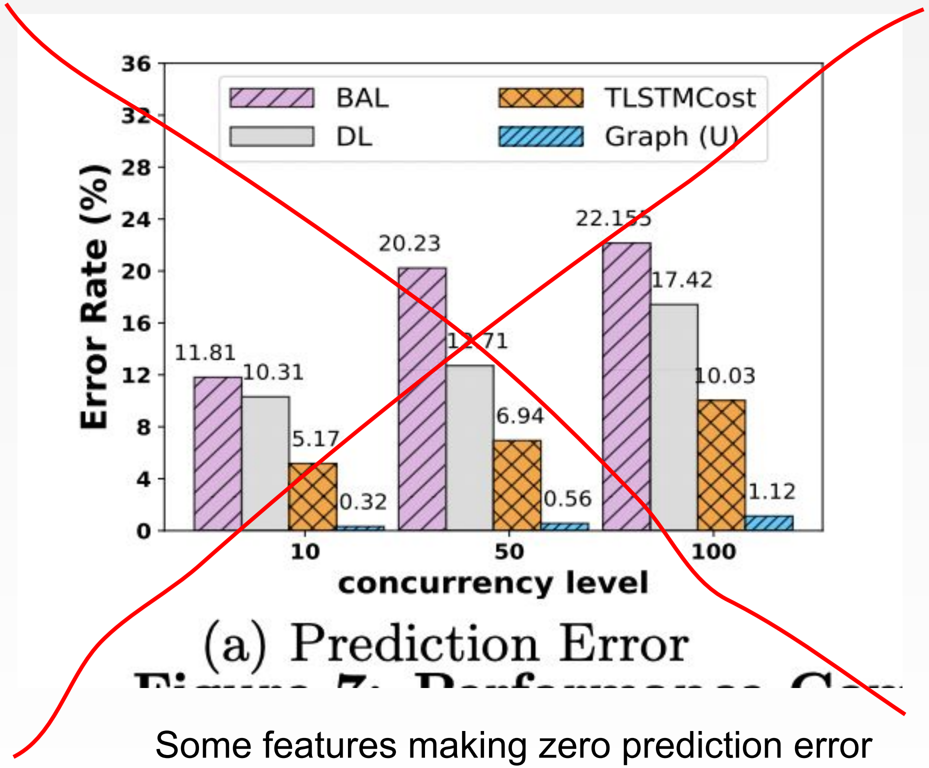
QPPNet and AutoML(QPPNet Feat)



More specific features matters

AutoML is on par and even better than well designed SOTA.

Findings / Takeaways



Some features making zero prediction error

- Information parsed into feature vectors are important (DB, not ML researches)
- Maybe QPPNet makes some sense compared to their results in their paper.
  - Distribution & Stat?
- AutoML shows potentials to reach SOTA modeling performance on QPP.

Future Works

- Run experiments on more benchmarks
- Auto feature set without manual rules for AutoML (under discussion)
- Other typical tasks in ML for DBMS

- Technical debts: Hacks of passing traces files in containerized service.

Acknowledgements

Idea: Andy, Wan, William

DbGym Framework: Wan

Resources: CMU-DB