一、　　问题的提出

在论文中，作者提出了两方面的挑战，正如本文所说：

> The first challenge in a self-driving DBMS is to understand an application's workload

and

> Beyond understanding these access patterns, the DBMS also needs to forecast resource utilization trends.

也就是说，作者在本文的贡献在于：

1. 让数据库理解一个查询究竟属于OLAP的查询还是属于OLTP的查询
2. 让数据库能够预测每个时间段的工作负载

根据这些负载，数据库可以调整调整自身的行为来进行优化。

二、本文提出的方法

1.架构

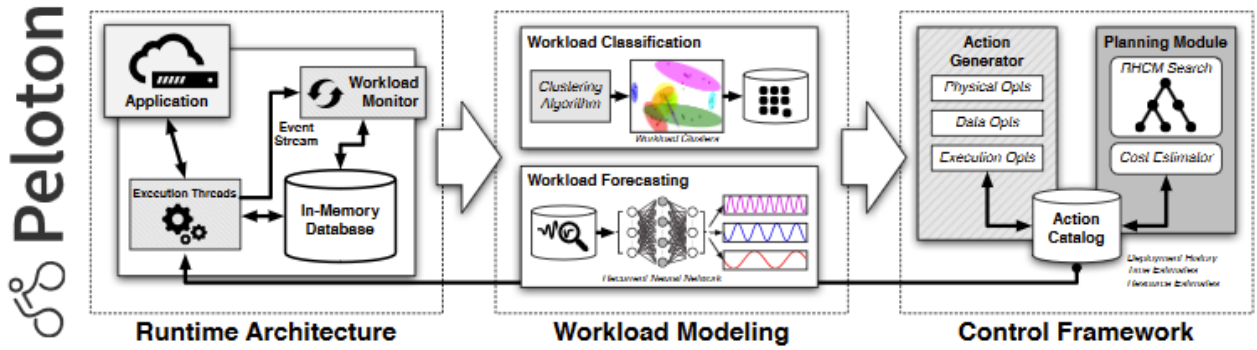


Figure 1: Peloton Self-Driving Architecture – An overview of the forecasting and runtime workflow of Peloton's self-driving components.

2.监视器

在Peloton（本文设计的系统）中，监视器负责监视数据库运行时的各种信息，包括运行的查询语句，matrices，时间戳等。这些信息是训练分类模型和预测模型的输入。

3.聚类器

> The first component is the DBMS's clusterer that uses unsupervised learning methods to group the application's queries that have similar characteristics.Clustering the workload reduces the number of forecast models that the DBMS maintains, thereby making it easier (and more accurate) to predict an application's behavior.

聚类器采用DBSAN方法来对应用的查询进行分类。Peloton通过聚类，区分应用的类型（OLAP/OLTP）。

聚类器的特征： 1.query runtime metrics 2.query's logical semantics

4.预测模型

对查询进行聚类之后，下一步是预测每类查询到来的周期。

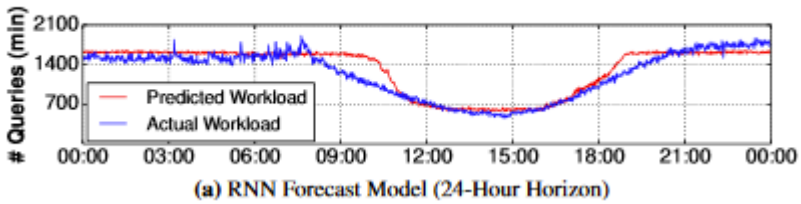
> With the exception of anomalous hotspots, this forecasting enables the system to identify workload periodicity and data growth trends to prepare for load fluctuations.

由于是时序数据，文章使用的方法是RNN（实验中采用的是RNN的变种LSTM)

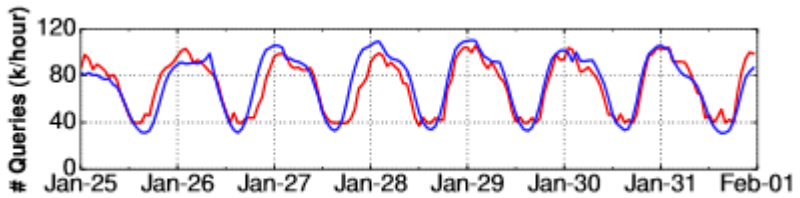
5. 计划优化

查询会根据预测模型对数据进行优化（列存or行存...)。数据库选择可能会对数据库的性能有提升效果的计划，将其组织成一棵树，按照RHCM （receding-horizon control model）的方法进行部署。

三、实验结果



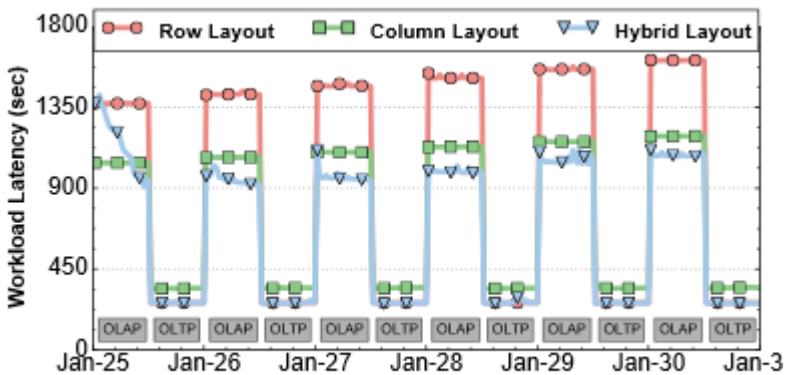
(a) RNN Forecast Model (24-Hour Horizon)



(b) RNN Forecast Model (7-Day Horizon)

论文首先验证其预测模型，分为24小时以及7天的周期。蓝色代表实际到达的查询数量，红色为实际的查询数量。文中提到：

> The graphs in Figures 2a and 2b show that the models are able to predict the workload with an error rate of 11.3% for the 1-hour RNN and 13.2% for the 24-hour RNN.



(c) Adaptive Storage Layouts

在接下来的实验中，作者验证数据库对自身的调整是否使得数据库的性能做出了提升，使用混合数据存储的方式（三角形状）在学习的过程中，不断使本身适应OLAP类型的查询，逐步降低了查询延迟

相关工作

Workload Modeling

- probabilistic Markov models

1. Autonomic Databases: Detection of Workload Shifts with n-Gram-Model
2. Towards workload shift detection and prediction for autonomic database
3. redicting Query Behavior to Enable Predictive Caching Strategies for OLAP Systems
4. On Predictive Modeling for Optimizing Transaction Execution in Parallel OLTP Systems
5. towards workflow-driven database system workload modeling

OLTP or OLAP

- decision trees

1. Performance and resource modeling in highly-concurrent oltp workload，2013
2. PQR: Predicting Query Execution Times for Autonomous Workload Managemen，2008

Automated Administration

- AutoAdmin

1. autoadmin “what-if” index analysis utility，1998
2. Automatic virtual machine configuration for database workload，2008

- DB2 Performance Wizard

1. Automatic configuration for IBM DB2 universal databas，2002
2. Self-tuning for SQL performance in Oracle Database 11，2009
3. Dbsherlock: A performance diagnostic tool for transactional database，2016

Autonomous DBMS

- BM’s proof-of-concept for DB2

1. Autonomic tuning exp.: A frmwk. for best-practice oriented autonomic db tunin，2009

- Microsoft Azure

1. Automated demand-driven resource scaling in relational database-as-a-servic，2016

五、有疑惑的地方

RHCM，对这种模型仍旧不太清楚，需要进一步了解