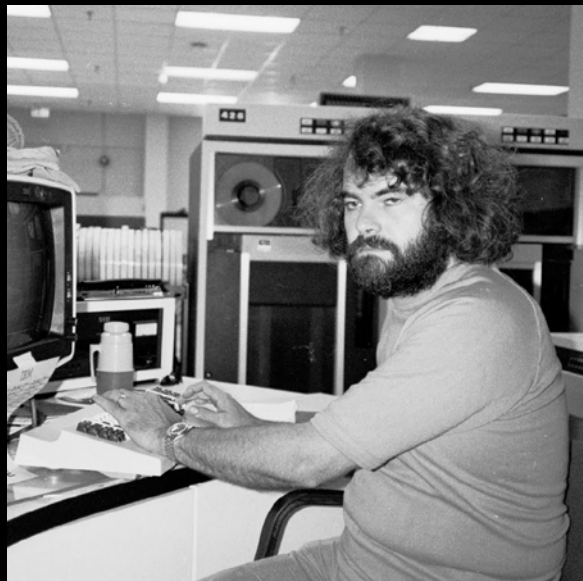


Peloton

The **Self-Driving** Database Management System

1980s



Timothy Pavlo

1950s



Joseph Pavlo

1920s



Cornelius Von Pavlo

According to the Bureau of Labor Statistics, Database Administrators earned an average salary of **\$81,710** in 2015.



What We Can Automate

- » Physical Database Design
- » Data Placement
- » Query Optimization & Tuning
- » Knob Configuration

What We Cannot Automate

- » Security & Access Controls
- » Non-cloud Resource Provisioning
- » Data Integration & Cleaning
- » Out-of-band Interruptions
- » Source Code Version Control

Why We Are Different

- » Previous automated tools only dealt with handling problems in the past.
- » Humans still make final decisions.
- » We can identify cycles/patterns and react before problems occur.



Peloton

In-Memory

HTAP

Autonomous

Apache Licensed

Fall 2015

Transaction Manager
Execution Engine
Storage Manager

Spring 2016

Logging & Snapshots
Better Concurrency
Lock-free Indexing
Adaptive Storage
Memcache Support

Summer 2016

Query Compilation
NVM Optimizations
"The Brain"

» Change the layout of data overtime based on how it is accessed.

» Data is transformed from OLTP optimized format to OLAP optimized format.

» SIGMOD 2016



Adaptive Storage



```
UPDATE myTable
SET A = 123,
    B = 456,
    D = 789
WHERE C = "xxx"
```



```
SELECT AVG(B)
FROM myTable
WHERE C < "yyy"
```

Original Data

Hot

A	B	C	D

Cold

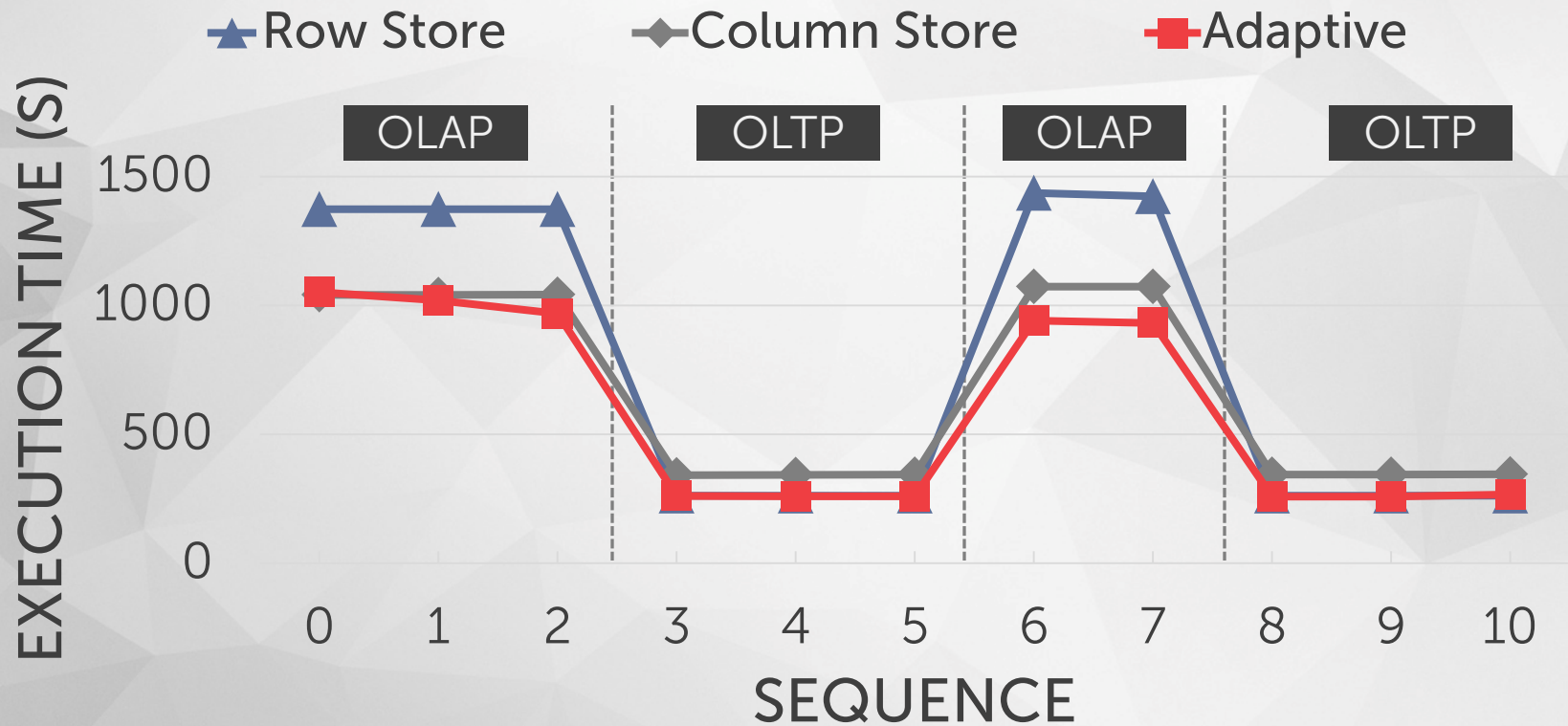


Adapted Data

A	B	C	D

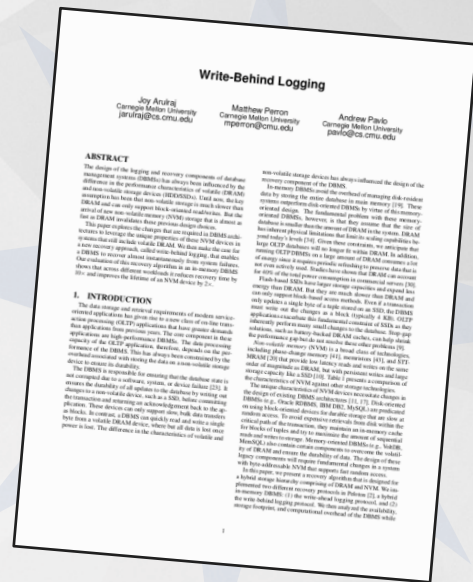
A	B	C	D

Adaptive Storage



NVM Optimizations

- » Avoid the overhead of DBMS recovery
- » Larger-than-Memory databases
- » Write-Behind Logging
- » Data Tiering
- » *WIP Spring 2016*



Write-Behind Logging



```
UPDATE myTable
  SET A = 123,
  WHERE C = "xxx"
```

In-Memory Heap

ver	A	B	C
x1			
x2			
x3			



PCOMMIT

NVM Heap

A	B	C	D
x1			
x2			
x3			

NVM Log

001:Txn1-0x0001

The Brain

» Component that controls all aspects of the DBMS to support autonomous operation.

» *Lots of papers.*

This is going to take a while...

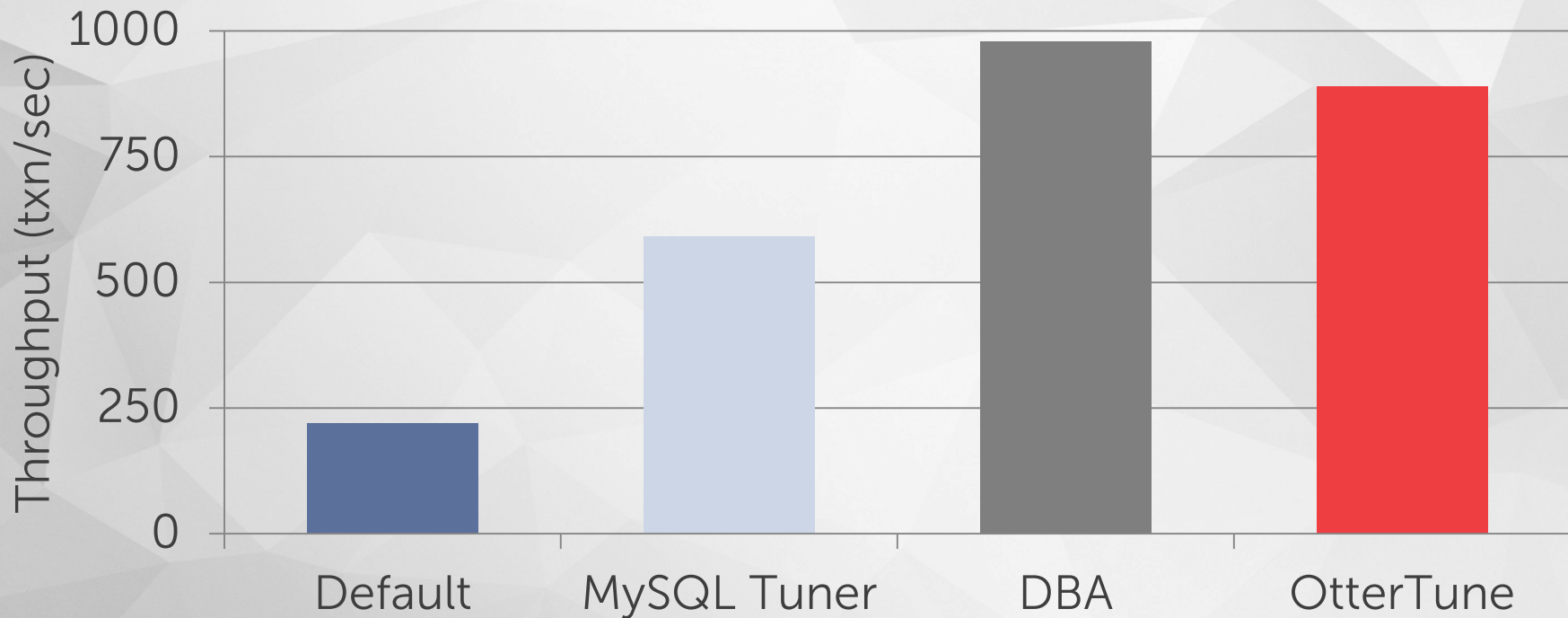


The Brain

- » Part #1: Forecaster
- » Part #2: Controller
- » Part #3: Optimization Generator
- » Part #4: Executor

Human vs. Machine

TPC-C Workload – MySQL (v5.7)



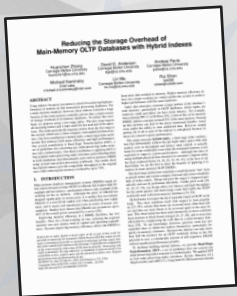


PDL Database News



Deduplication for Database Replication

Lianhong Xu, et al. (SoCC 2015)



Hybrid OLTP In-Memory Indexes

Huanchen Zhang, et al. (SIGMOD 2016)



Larger-than-Memory Databases

Lin Ma, et al. (DaMON 2016)

Database Systems (15-721)

- » Grad-level course on database internals.
- » Heavy emphasis on complex systems software engineering.
- » All projects completed in Peloton.
- » <http://15721.courses.cs.cmu.edu>

PDL DB 2015-2016 Statistics

- » # of PhD Students: 4
- » # of Post-docs: 1
- » # of MS Students: 6
- » # of Undergrads: 0
- » # of Students Stabbed: 0



Dana Van Aken

2016 National Science Foundation Fellowship



Joy Arulraj

2016 Samsung Fellowship



**Anthony
Tomasic**



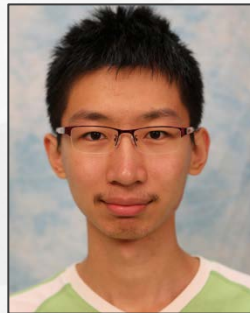
**Todd
Mowry**



**Joy
Arulraj**



**Prashanth
Menon**



**Lin
Ma**



**Dana
Van Aken**



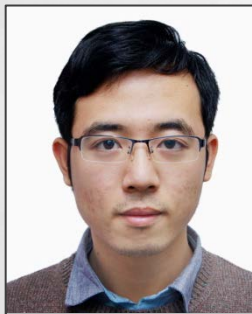
**Michael
Zhang**



**Matthew
Perron**



**Yingjun
Wu**



**Ran
Xian**



**Runshen
Zhu**



**Jiexi
Lin**



**Jianhong
Li**



**Ziqi
Wang**



Peloton

<http://pelotondb.org>