

Methods for the Optimization of Parallel OLTP Systems

@andy_pavlo



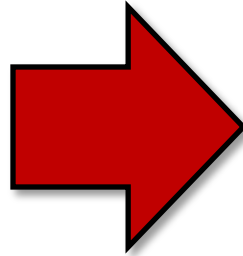
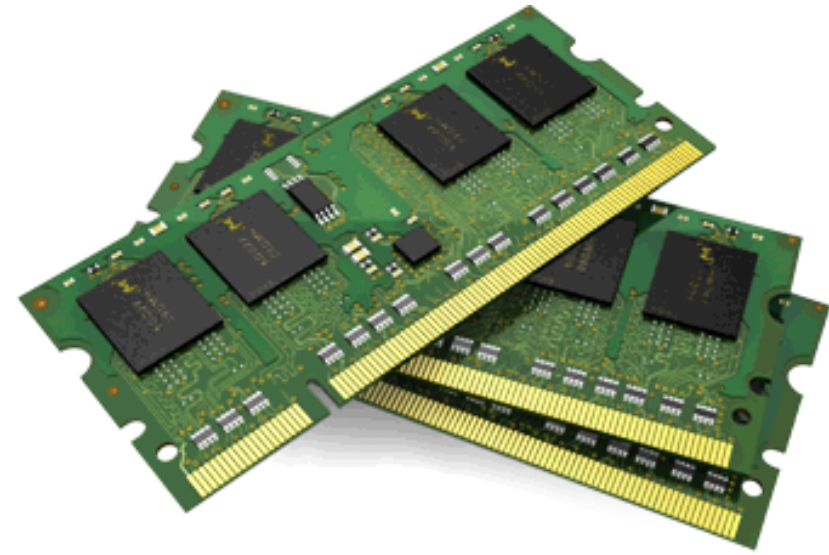
BROWN

Thesis Proposal
May 2012



Tellin' him just be ready set
Pack ya shit up quick;

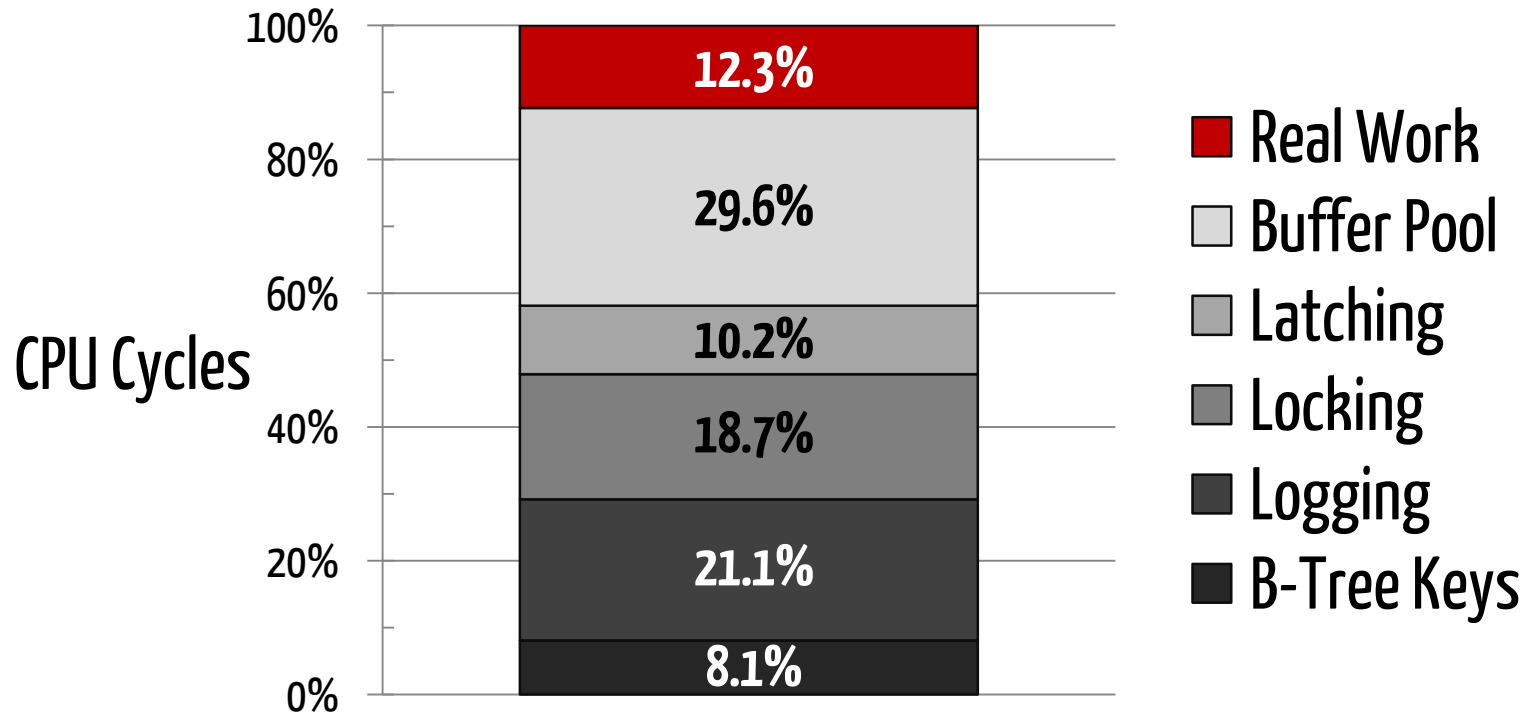
And when I hit,
be prepared to jet



**Fast
+
Cheap**

Legacy Systems

TPC-C NewOrder



OLTP Through the Looking Glass,
and What We Found There
SIGMOD 2008



OLTP Transactions



Fast



Repetitive



Small

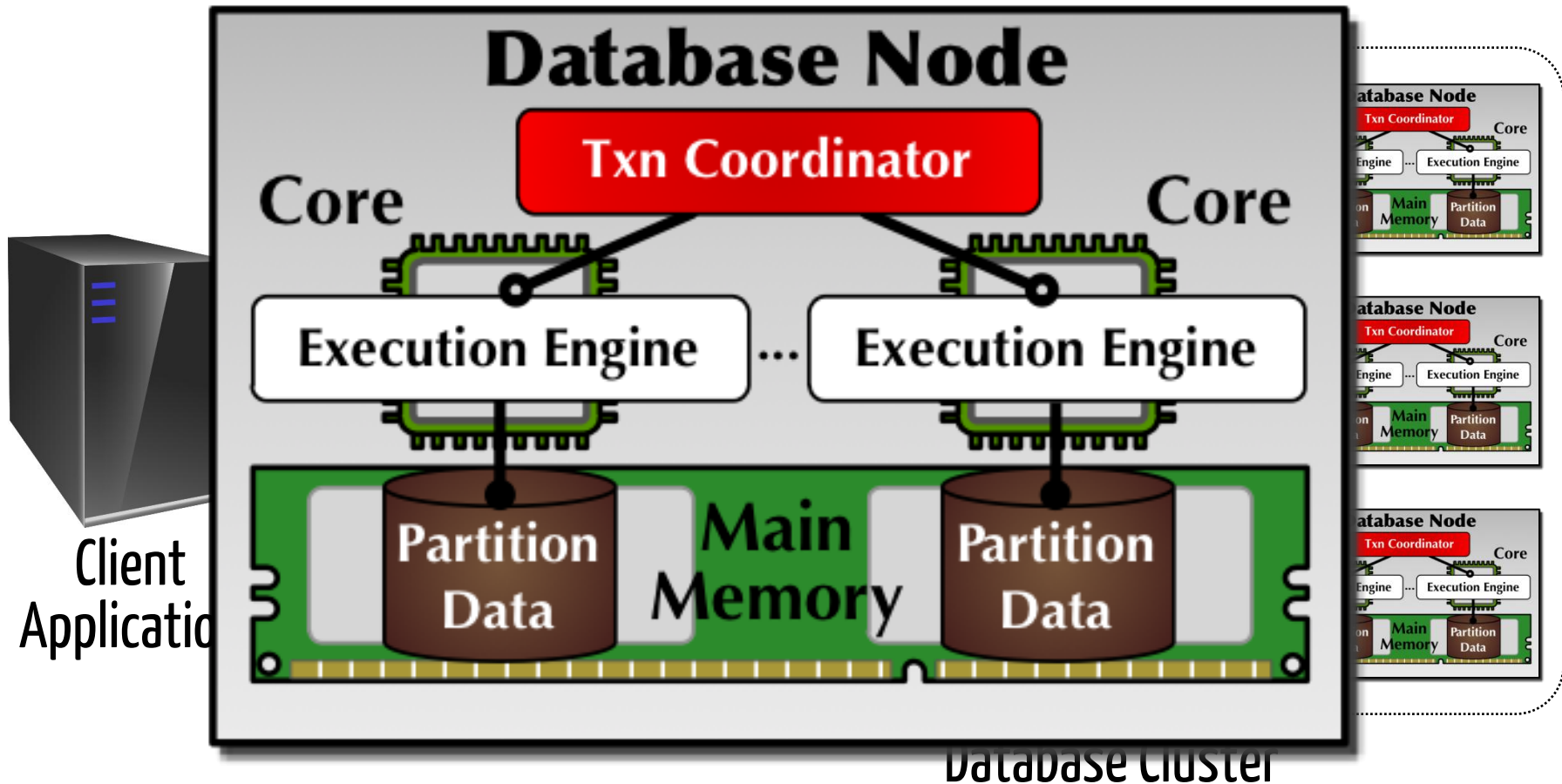


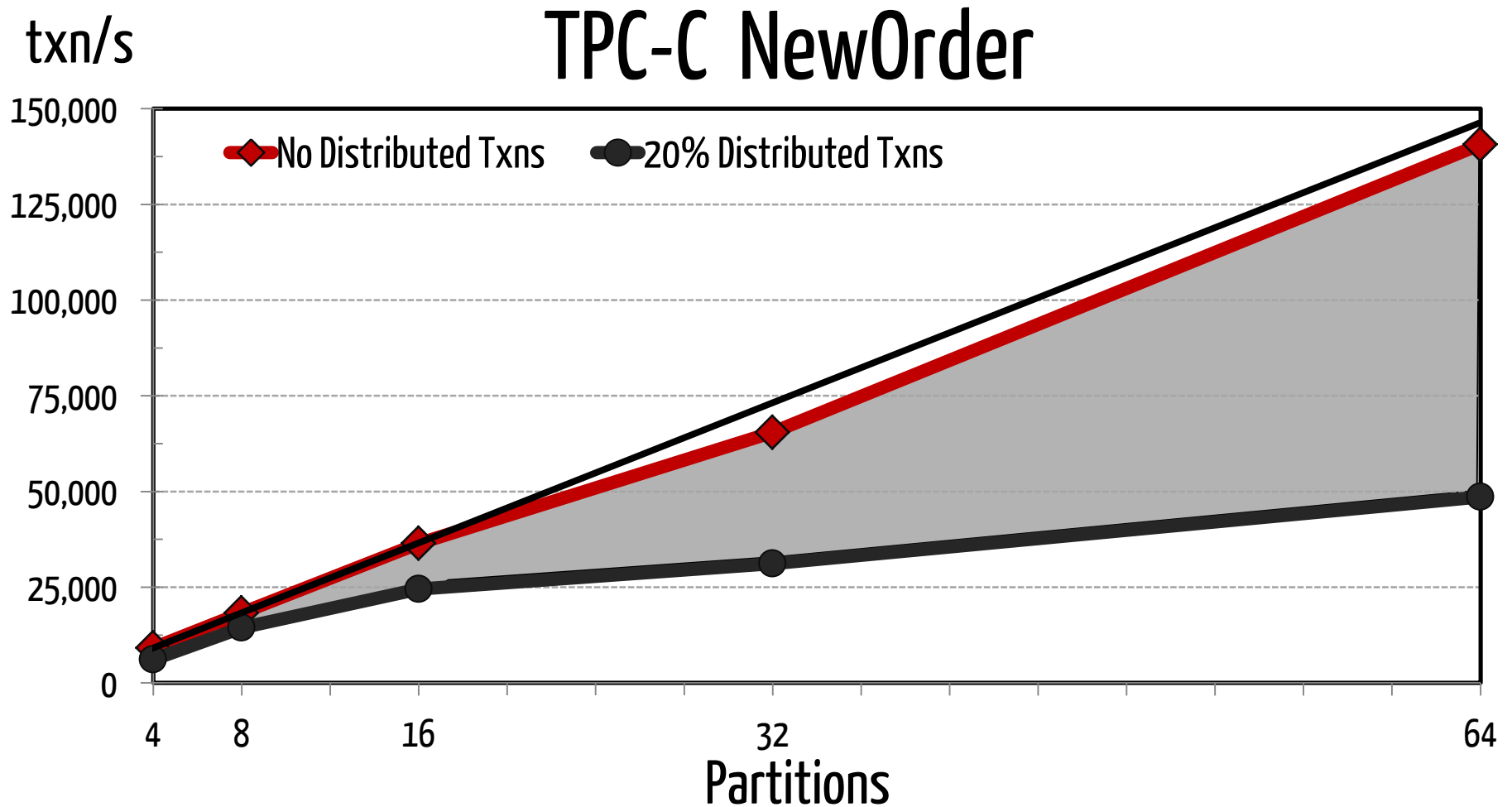
Main Memory • Parallel • Shared-Nothing
Transaction Processing

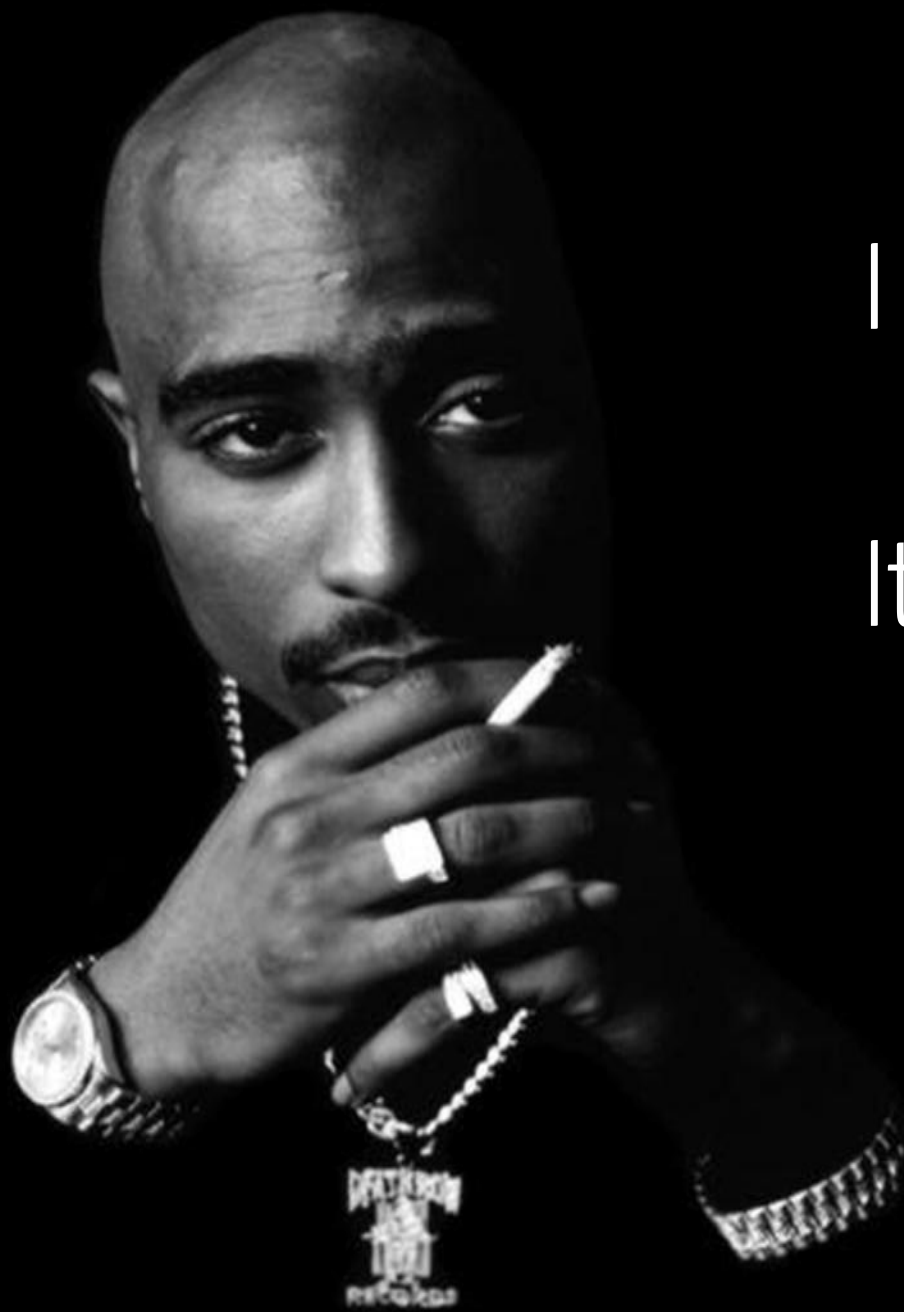
H-Store: A High-Performance, Distributed
Main Memory Transaction Processing System
Proc. VLDB Endow., vol. 1, iss. 2, pp. 1496-1499, 2008.



H-Store







I wasn't mad until
these tricks played me,
It's time to sanitize
my posse.

Partition database to reduce the number of distributed txns.

Stress-Induced Autoantibody Detection For Fibrosis in Disease-Monitoring, Responder/QLIF Systems

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Abstract

Stress-induced autoantibodies (SIA) are a novel class of autoantibodies that are produced in response to stress. SIA are produced by a subset of individuals with autoimmune disease, and their presence is associated with disease activity. SIA are produced by a subset of individuals with autoimmune disease, and their presence is associated with disease activity. SIA are produced by a subset of individuals with autoimmune disease, and their presence is associated with disease activity.

Introduction

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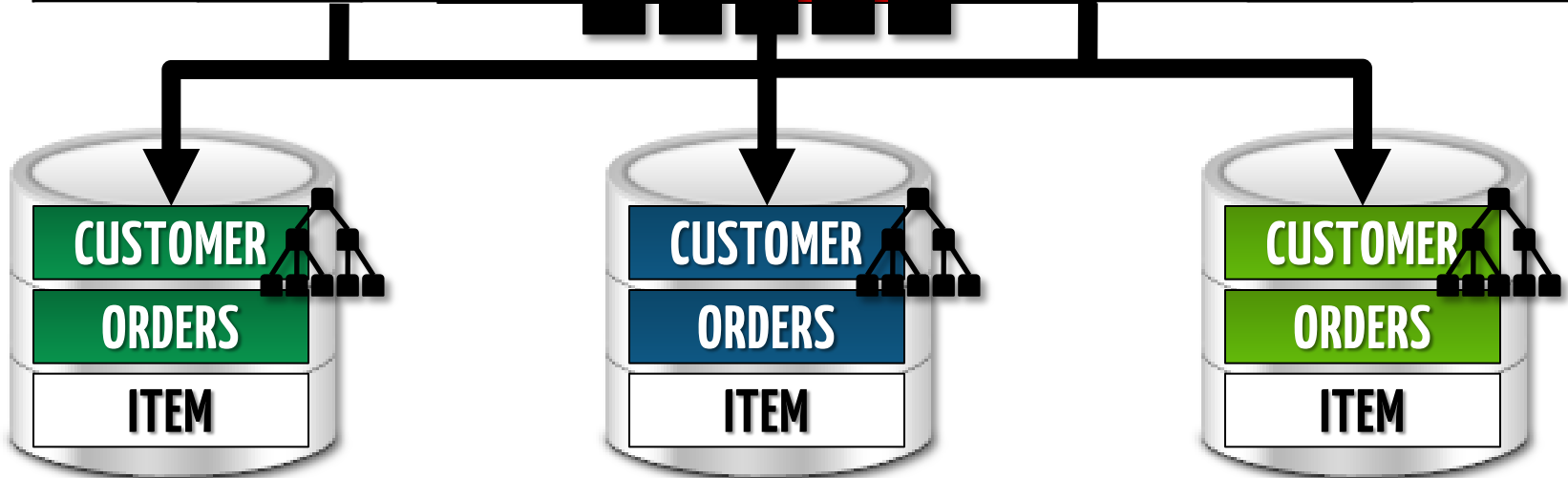
Horticulture

CUSTOMER

CUSTOMER

ORDERS

c_id	c_w_id	c_l	c_id	c_w_id	c_last	...	o_c_id	o_w_id	...
1001	5	RZA600514	1001	5	RZA600514	78703	1004	5	-
1002	3	GZA260023	1002	3	GZA260023	78704	1002	3	-
1003	12	Raekwa175036	1003	12	Raekwa175036	78705	1006	7	-
1004	5	Deck578045	1004	5	Deck578045	78706	1005	6	-
1005	6	Killah476058	1005	6	Killah476058	78707	1005	6	-
1006	7	ODB780085	1006	7	ODB780085	78708	1003	12	-



Horticulture



Client Application

? ? ?
NewOrder (5, "Method Man", 1234)



Horticulture

DDL

CUSTOMER

ORDERS

ITEM

NewOrder

```
SELECT * FROM WAREHOUSE  
WHERE W_ID = 10;
```

```
SELECT * FROM DISTRICT WHERE  
D_W_ID = 10 AND D_ID = 9;
```

```
INSERT INTO ORDERS (O_W_ID,  
O_D_ID, O_C_ID,...) VALUES  
(10, 9, 12345,...);  
⋮
```

rhod S



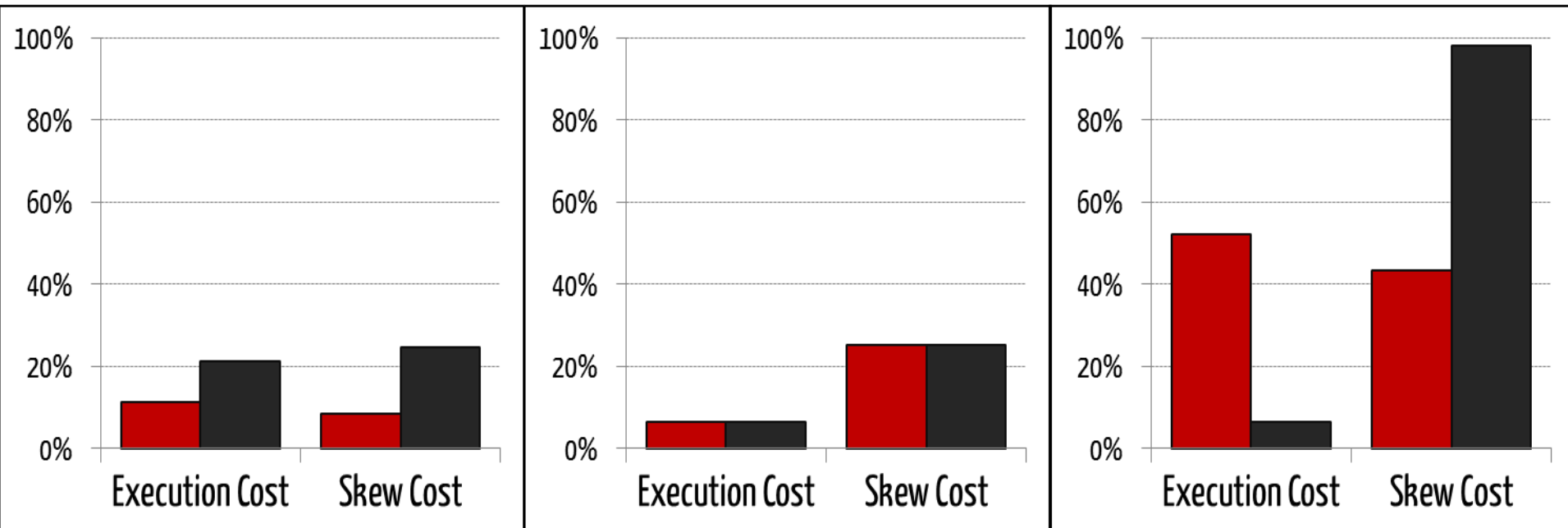
...



Algorithm Comparison

(cost estimate)

■ Horticulture ■ State-of-the-Art



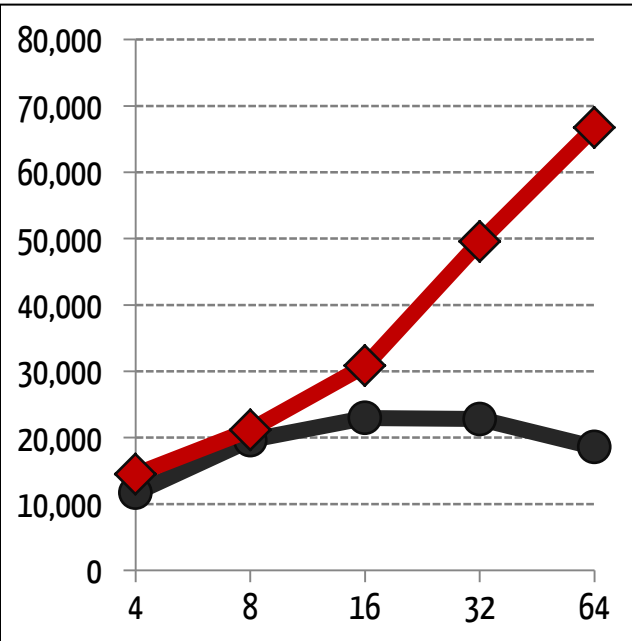
TATP

TPC-C

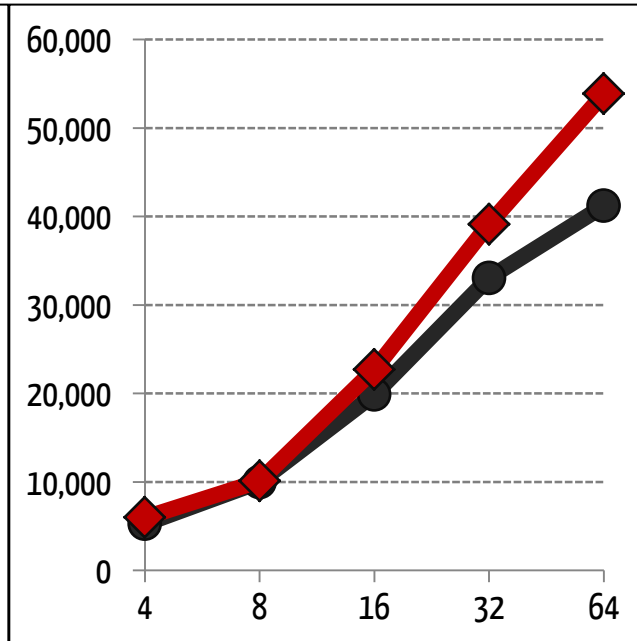
TPC-C Skewed

Throughput

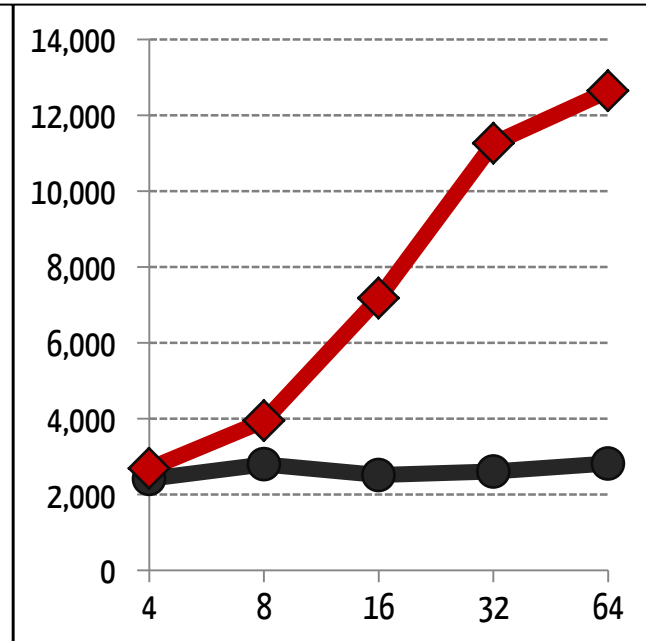
(txn/s) ■ Horticulture ■ State-of-the-Art



TATP
+88%



TPC-C
+16%



TPC-C Skewed
+183%

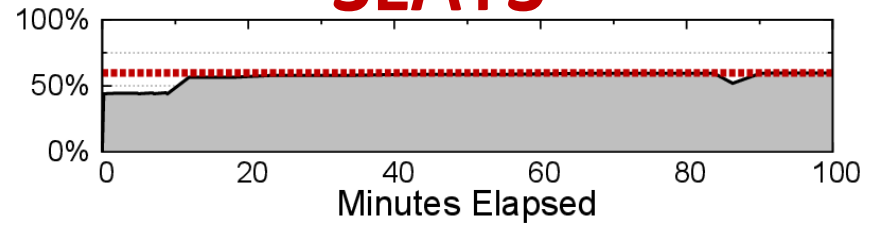
Search Times

% Single-Partitioned Transactions

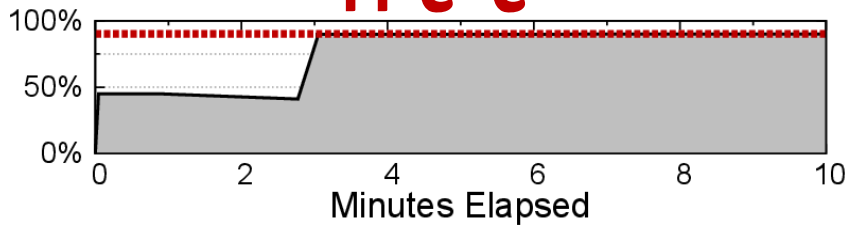
TATP



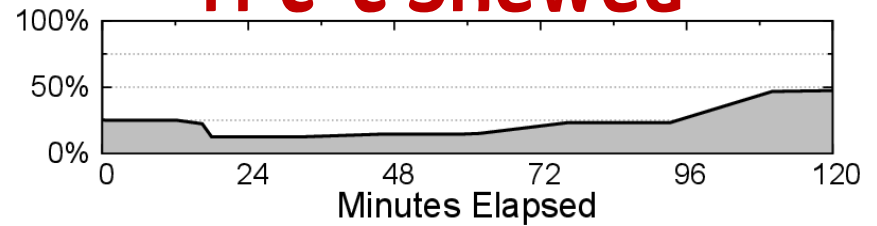
SEATS



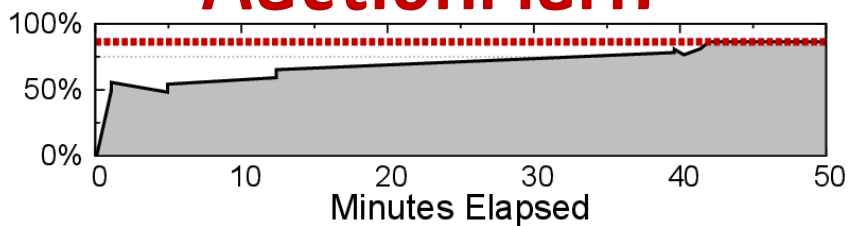
TPC-C



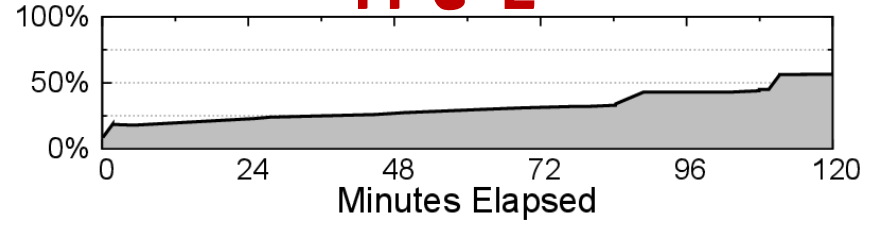
TPC-C Skewed



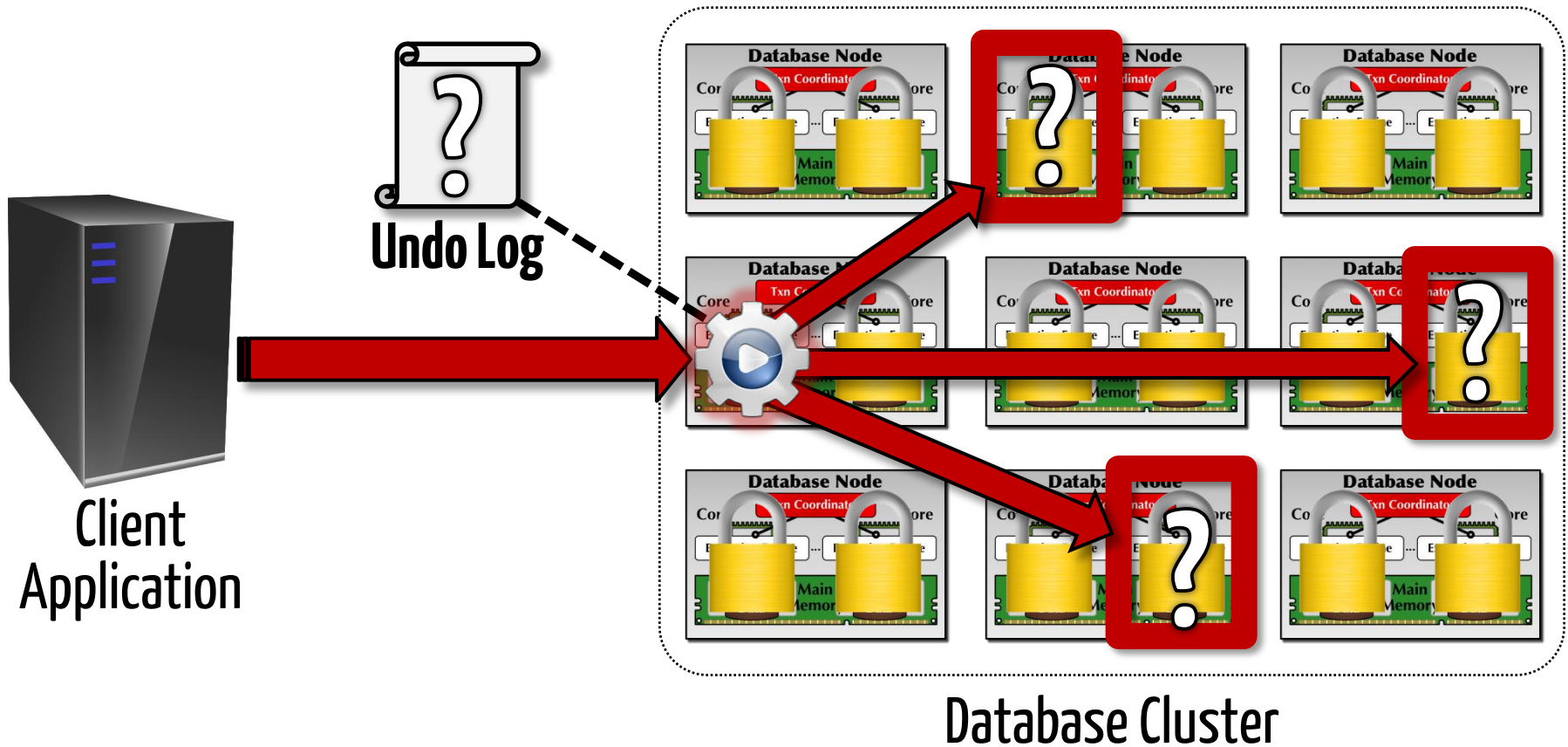
AuctionMark

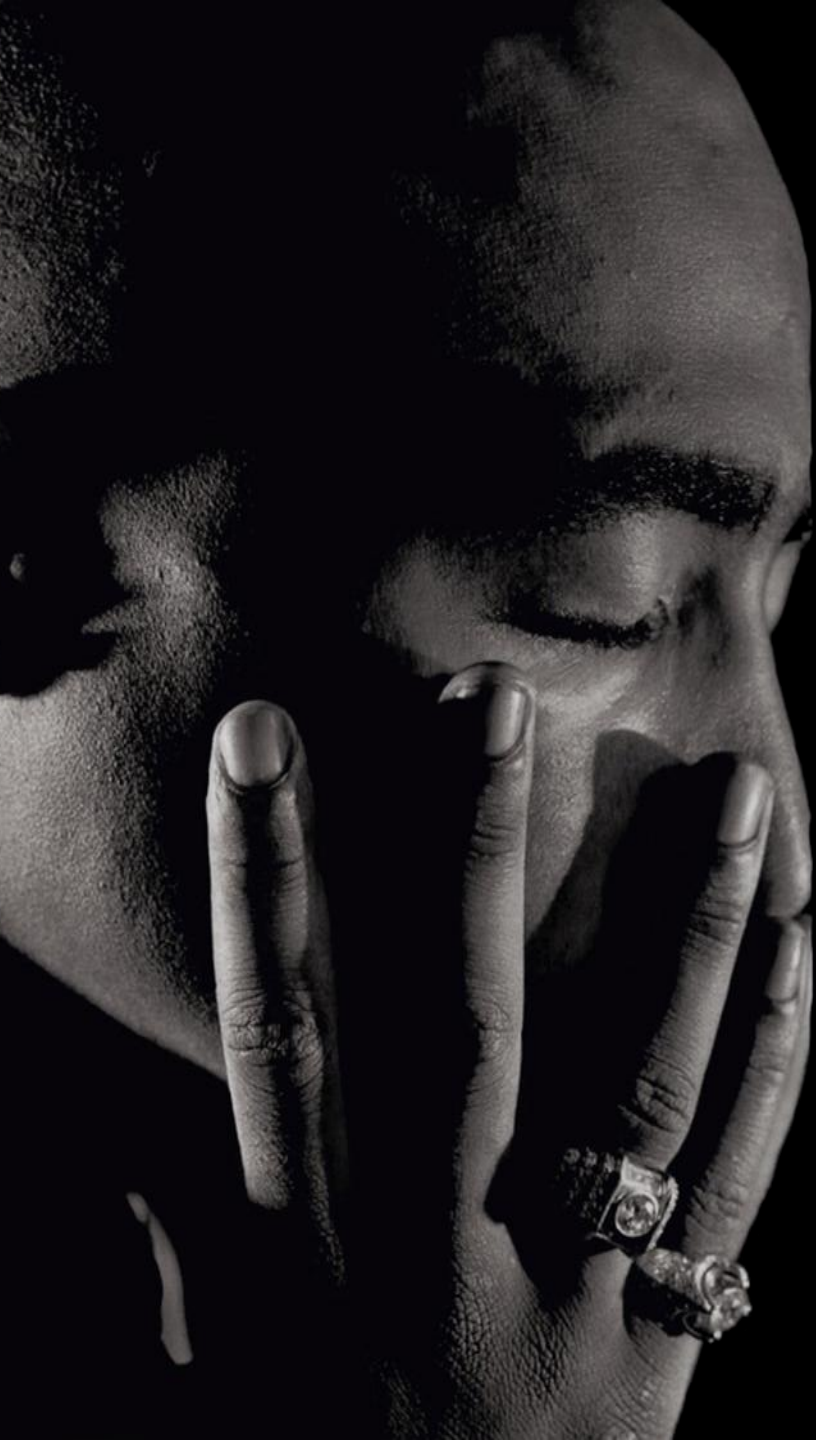


TPC-E



H-Store





Grab your glocks
when you see 2pac.

Call the cops
when you see 2pac.

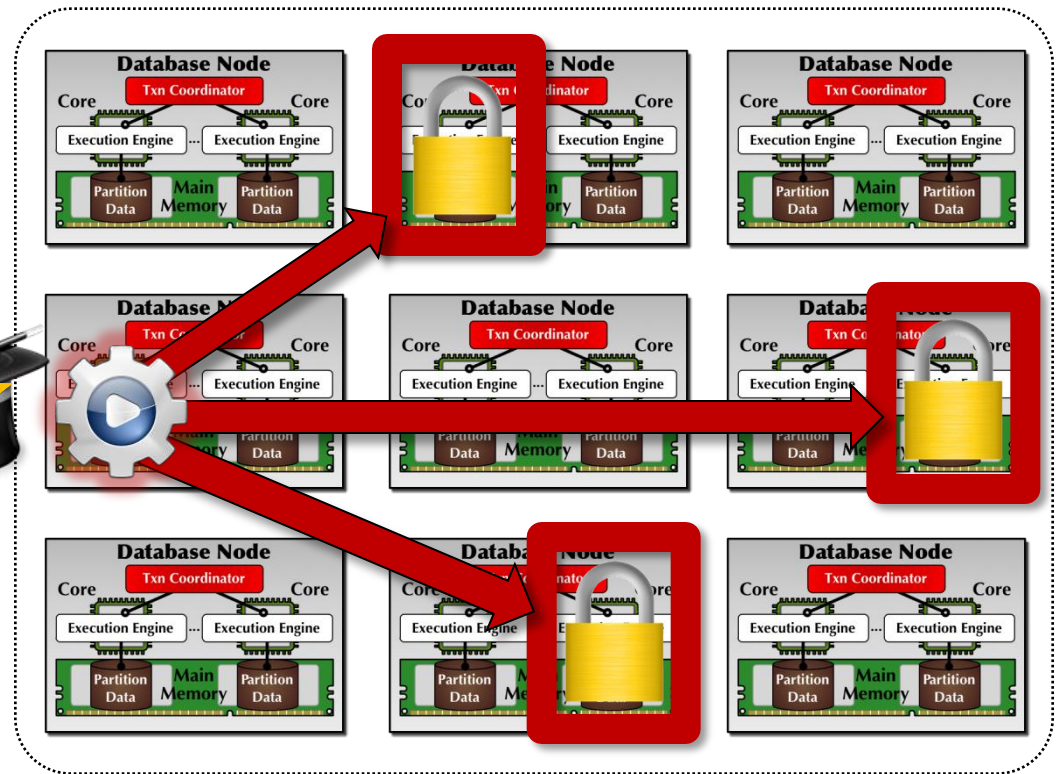
Optimization #2:

Predict what txns will
do before they
execute.

On Predictive Modeling for Optimizing
Transaction Execution in Parallel OLTP Systems
Proc. VLDB Endow., vol. 5, pp. 85-96, 2011.

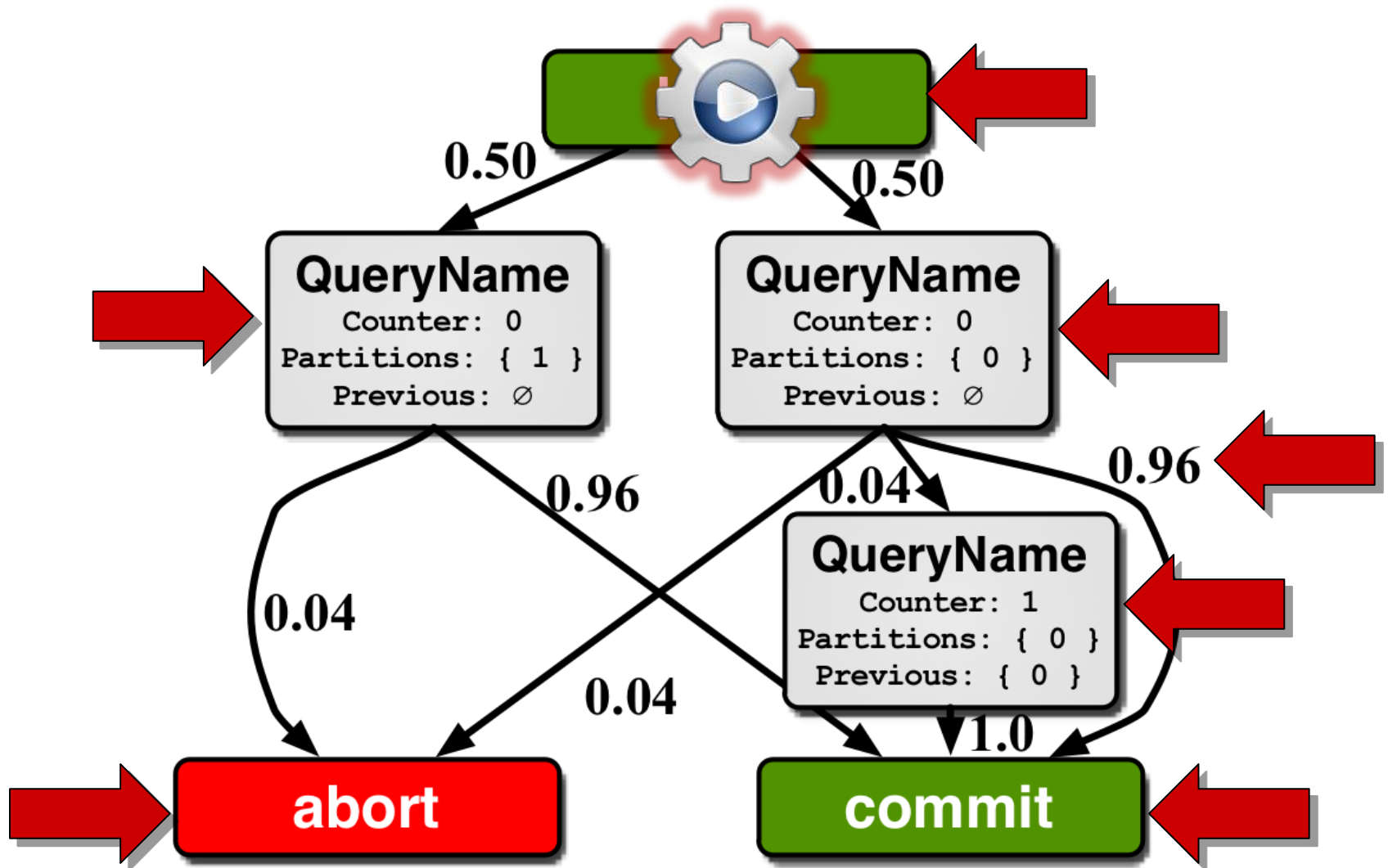


Houdini[™]

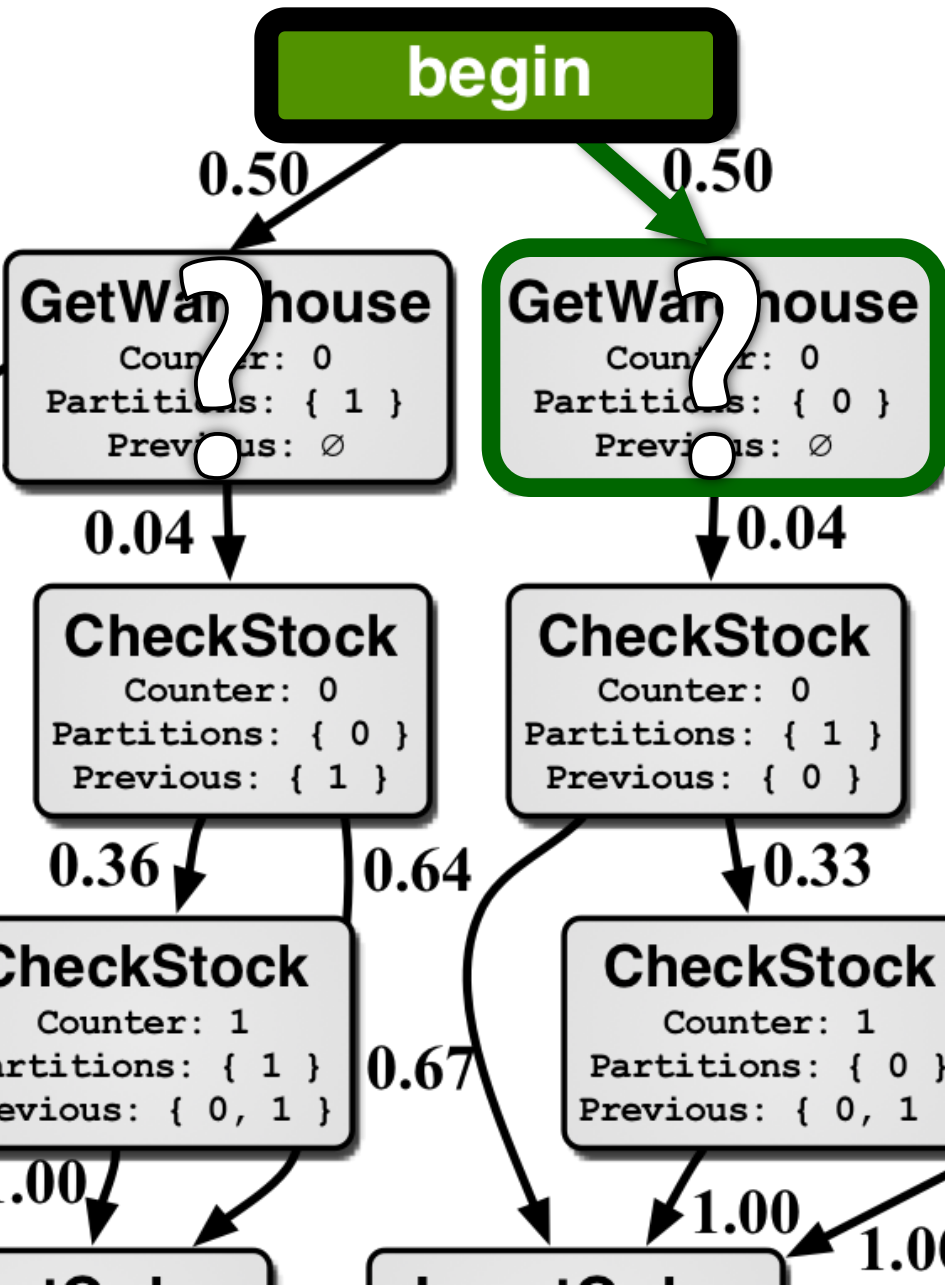


Database Cluster

Houdini



Current State

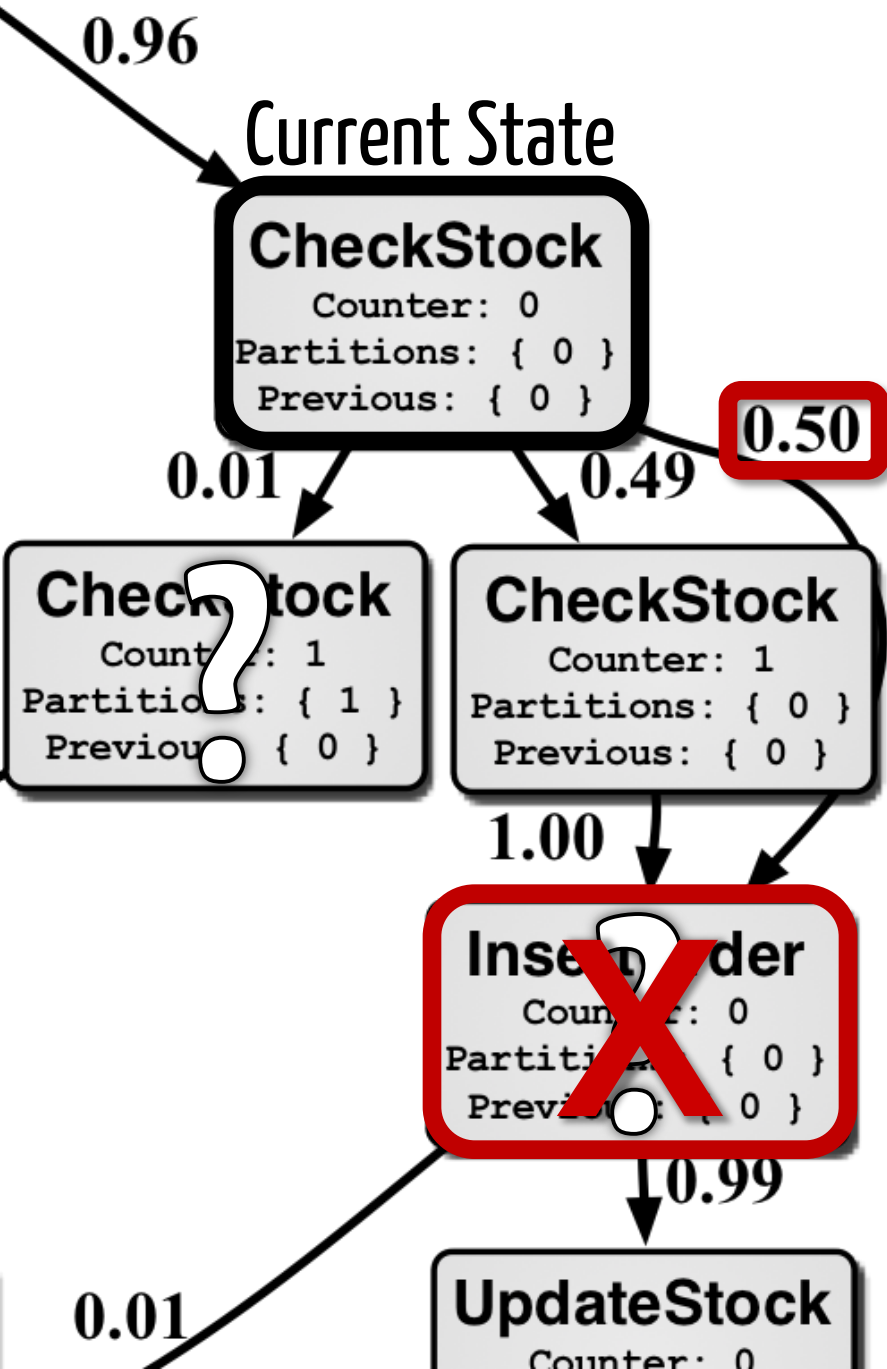


Input Parameters:

```
w_id=0
i_w_ids=[0,1]
i_ids=[1001,1002]
```

GetWarehouse:

SELECT * FROM WAREHOUSE
WHERE W ID = ?



Input Parameters:

w_id=0
i_w_ids=[0 1]
i_ids=[1001,1002]

CheckStock:

```
SELECT S_QTY FROM STOCK
WHERE S_W_ID = ?
AND S_I_ID = ?;
```

InsertOrder:

```
INSERT INTO ORDERS
(o_id, o_w_id)
VALUES (?, ?);
```


`w id=0`
`i w ids=[0.1]`
`i ids=[1001,1002]`

HashValue(w_id)

= 0

= 1

ArrayLength(i_ids)

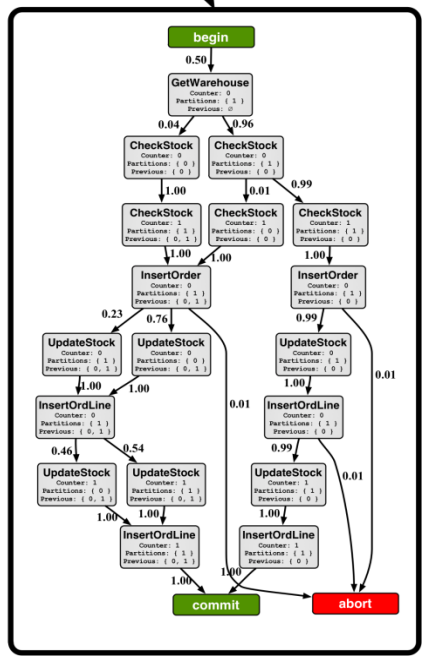
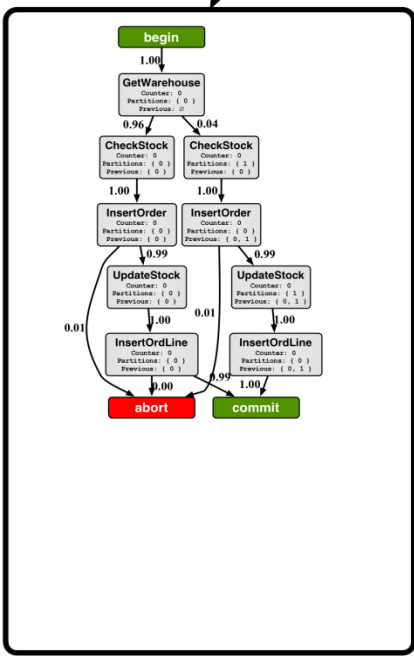
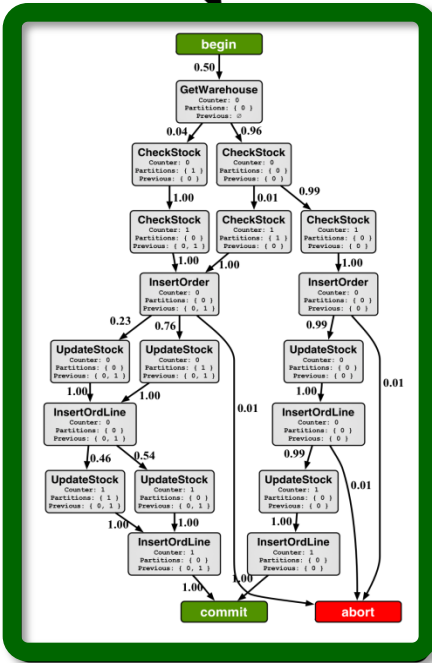
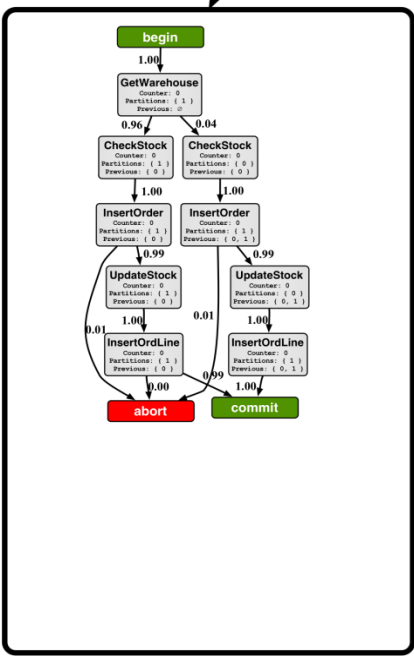
ArrayLength(i_ids)

= 1

= 2

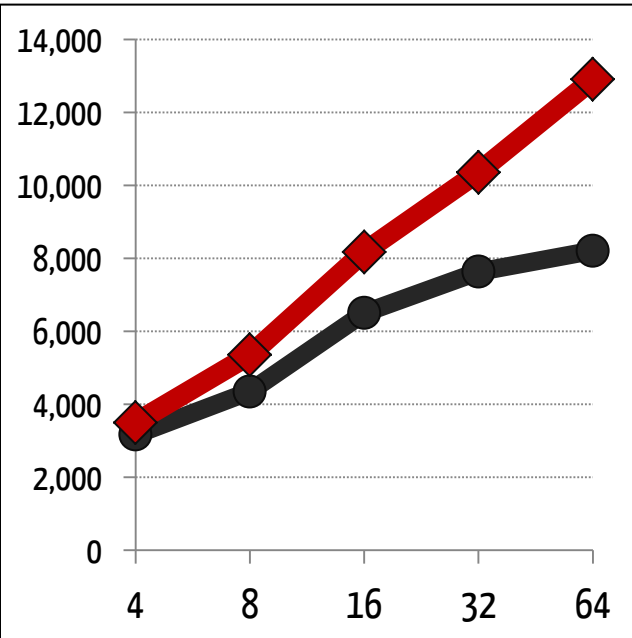
= 1

= 2

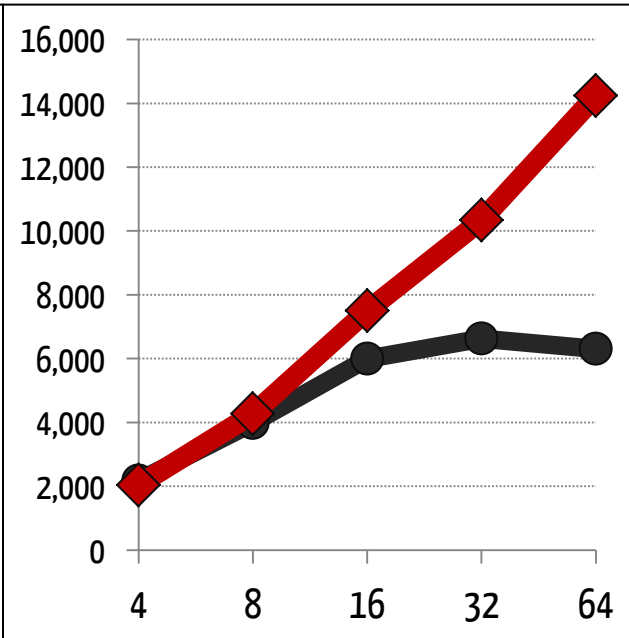


Throughput

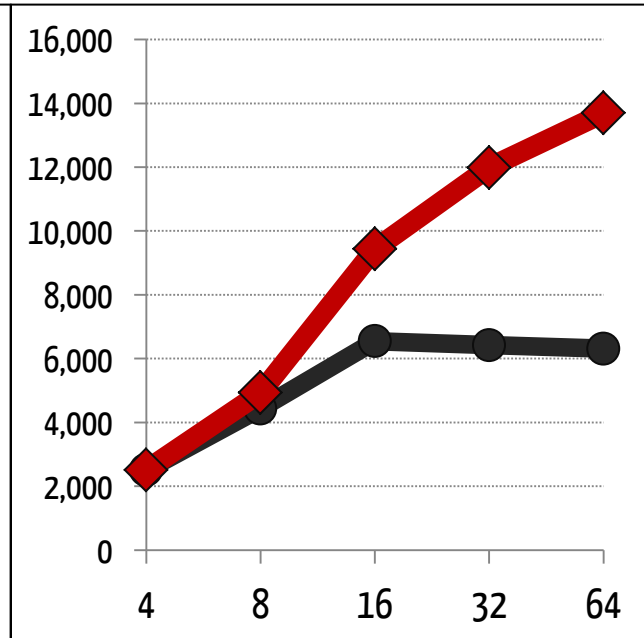
(txn/s) ■ Houdini ■ Assume Single-Partitioned



TATP
+57%



TPC-C
+126%



AuctionMark
+117%

Recap



Optimize Single-Partition Execution

H-Store: A High-Performance, Distributed Main Memory Transaction Processing System

R. Kallman, H. Kimura, J. Natkins, A. Pavlo, S. Zdonik, E. P. C. Jones, S. Madden, M. Stonebraker, et al.

Proc. VLDB Endow., vol. 1, iss. 2, pp. 1496-1499, 2008.



Minimize Distributed Transactions

Skew-Aware Automatic Database Partitioning in Shared-Nothing, Parallel OLTP Systems

A. Pavlo, C. Curino, and S. Zdonik,

Proceedings of SIGMOD, 2012.



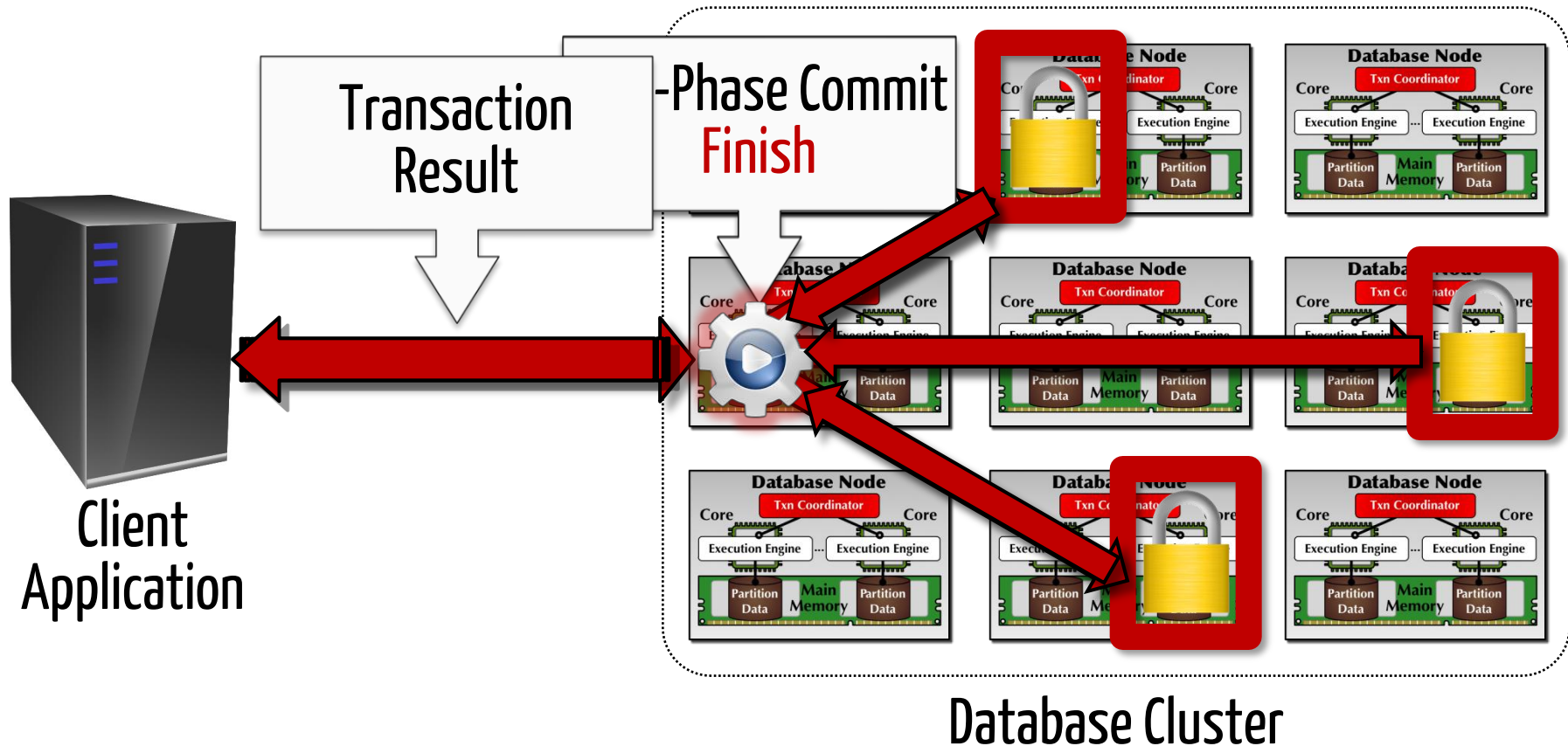
Identify Distributed Transactions

On Predictive Modeling for Optimizing Transaction Execution in Parallel OLTP Systems

A. Pavlo, E. P. C. Jones, and S. Zdonik

Proc. VLDB Endow., vol. 5, pp. 85-96, 2011.

Two-Phase Commit



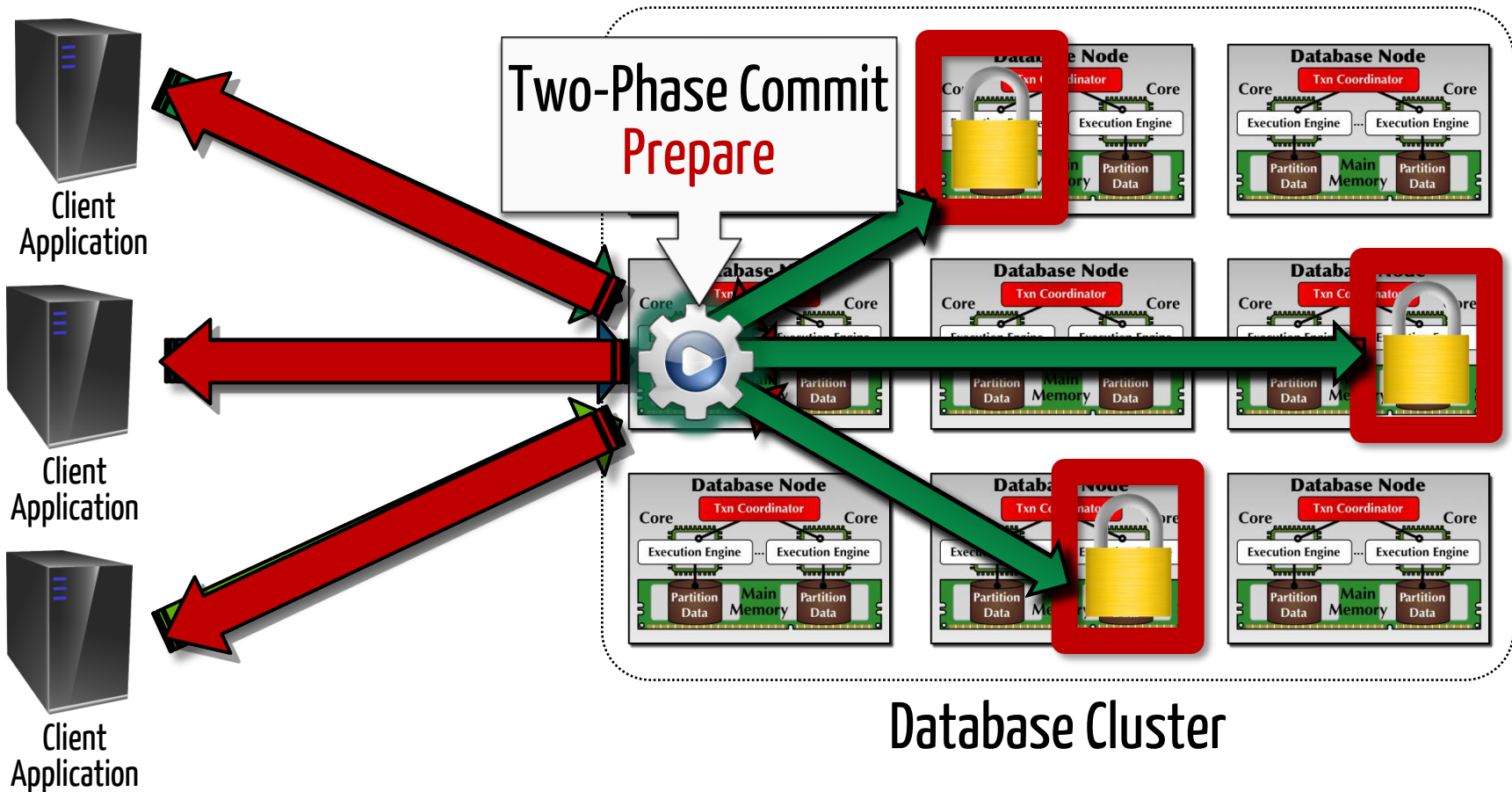
Thesis Proposal:

Amortize distributed
txn coordination with
creative scheduling.

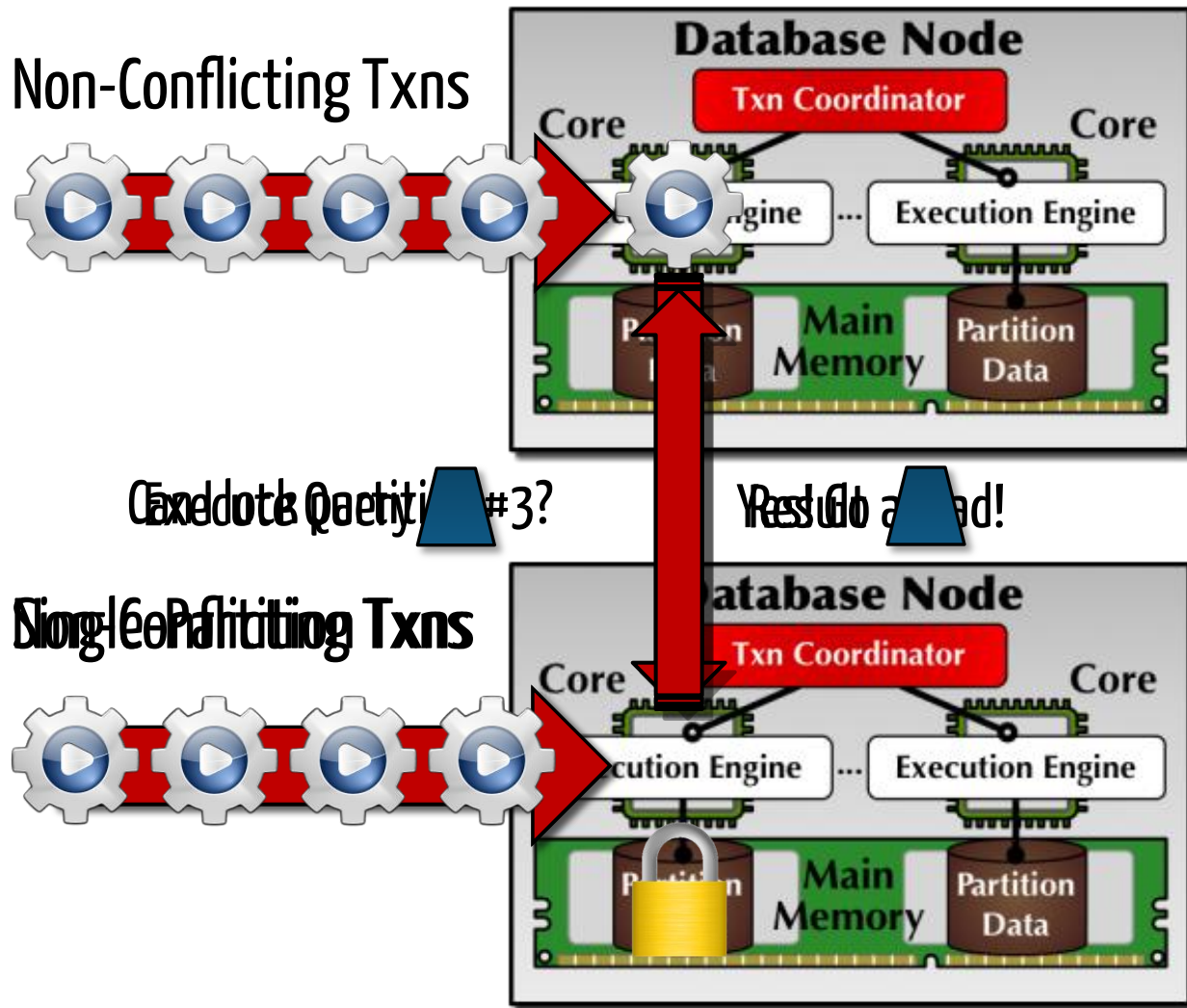
Dr. Zdonik – Or How I Learned to Stop Worrying
And Love Distributed Transactions
Work in Progress



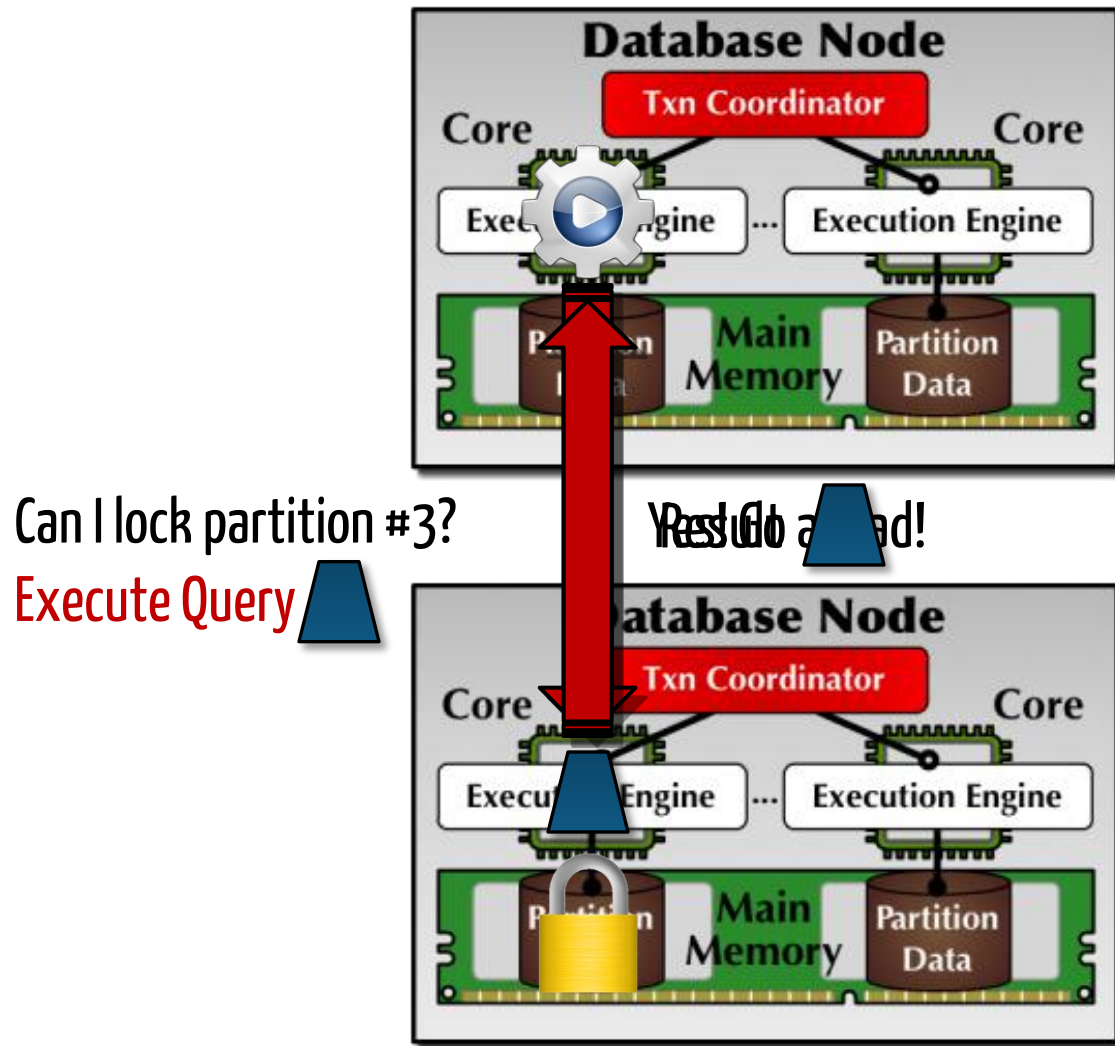
Transaction Batching



Speculative Transactions



Speculative Queries



Conclusion:

Achieving fast performance is more than just using only RAM.

Proposed Schedule:

Coding+Experiments (Summer)
Paper Submission (Fall/Winter)
Thesis Writing (Spring)



-Store

The screenshot shows the GitHub repository for 'apavlo/h-store'. The repository is under the 'master' branch. It lists several files and folders, including 'properties', 'scripts', 'src', 'tests', 'third_party', 'tools', 'classpath', 'gitignore', 'gitmodules', 'project', and 'copyright'. The commit history shows recent updates, including a 'New Release (March 2012)' and a 'Minor tweaks and importing CompressionService code from VoltDB to H-Store'.

<http://github.com/apavlo/h-store>

The screenshot shows the H-Store project website. It features a navigation bar with links to 'About', 'Documentation', 'Downloads', 'People', 'Projects', and 'Publications'. The main content area describes H-Store as an experimental main-memory, parallel database management system. It highlights a 'New Release (March 2012)' and lists major highlights of the release, including significant speed optimizations, fixed memory leaks, and improved stability. The website also mentions that the source code is available on GitHub.

<http://hstore.cs.brown.edu>

The screenshot shows the Wikipedia page for H-Store. The page is titled 'H-Store' and is part of the 'The Free Encyclopedia'. It provides a brief overview of H-Store as an experimental database management system (DBMS) designed for online transaction processing (OLTP) applications. The page lists key features, including high optimization for OLTP workloads, short execution times, and no user stalls. It also mentions that H-Store is licensed under the BSD license and GPL licenses. The page includes a 'See also' section and a 'References' section.

<http://wikipedia.org/wiki/H-Store>