Tiresias:
Enabling Predictive Autonomous Storage and Indexing

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tiny.cc/tiresias

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DBMS **storage** & **indexing choices**

have **trade-offs** based on **workload**

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Index Choice

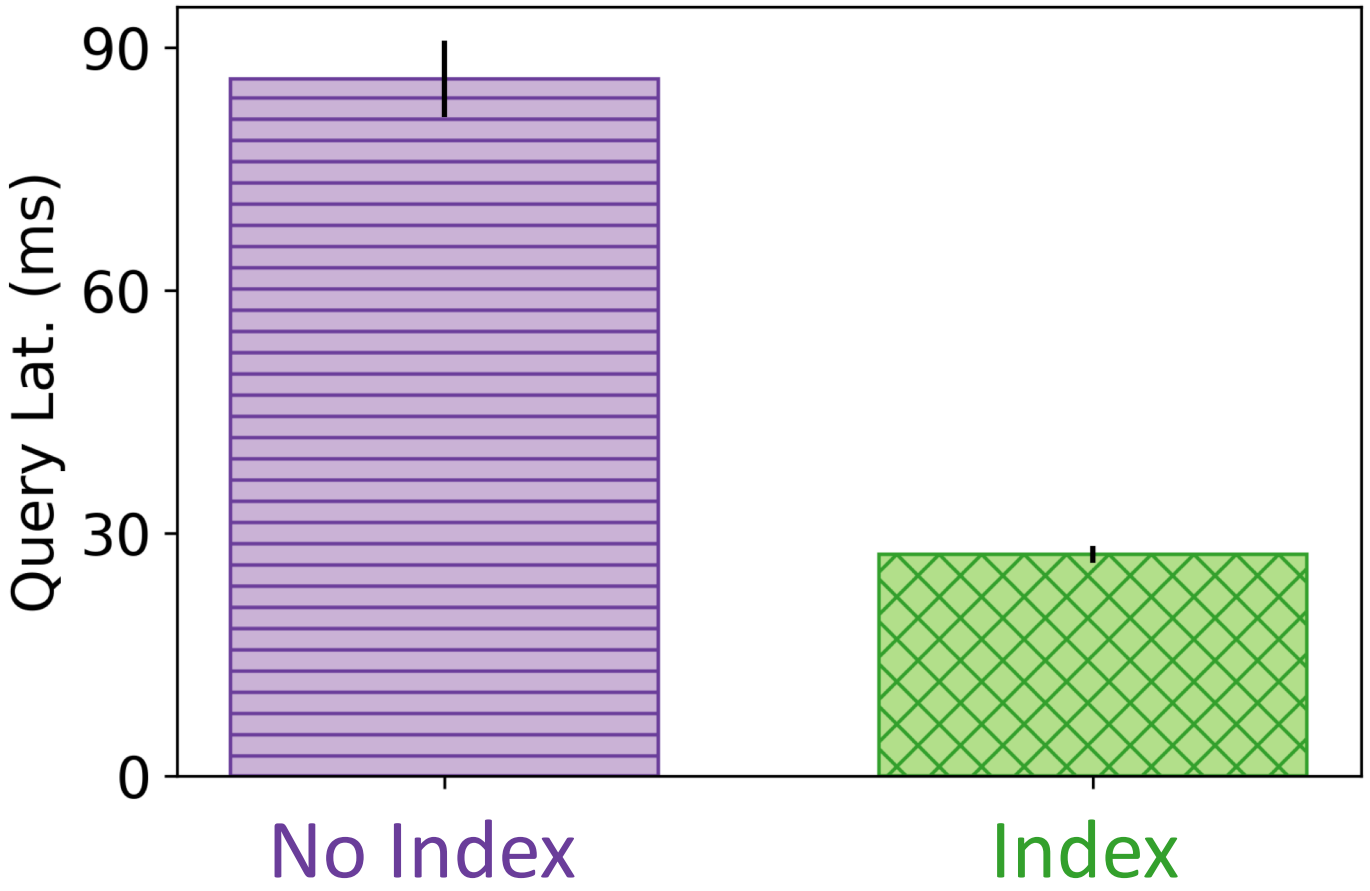
Order	Book	User	Qnt	$
100	HP	Alice	7	$15
101	Drac	Ted	90	$3
102	SQL	Geoff	1	$100
103	HP	Jean	3	$15

SELECT * WHERE
QNT > 15

Should we index?

Index Choice

Lower is better



SELECT * WHERE
QNT > 15

Should we index?

Yes

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Index Choice

Order	Book	User	Qnt	$
100	HP	Alice	7	$15
101	Drac	Ted	90	$3
102	SQL	Geoff	1	$100
103	HP	Jean	3	$15
104	LoTR	John	2	$21

INSERT (104, LoTR, John, 2, $21)

Should we index?

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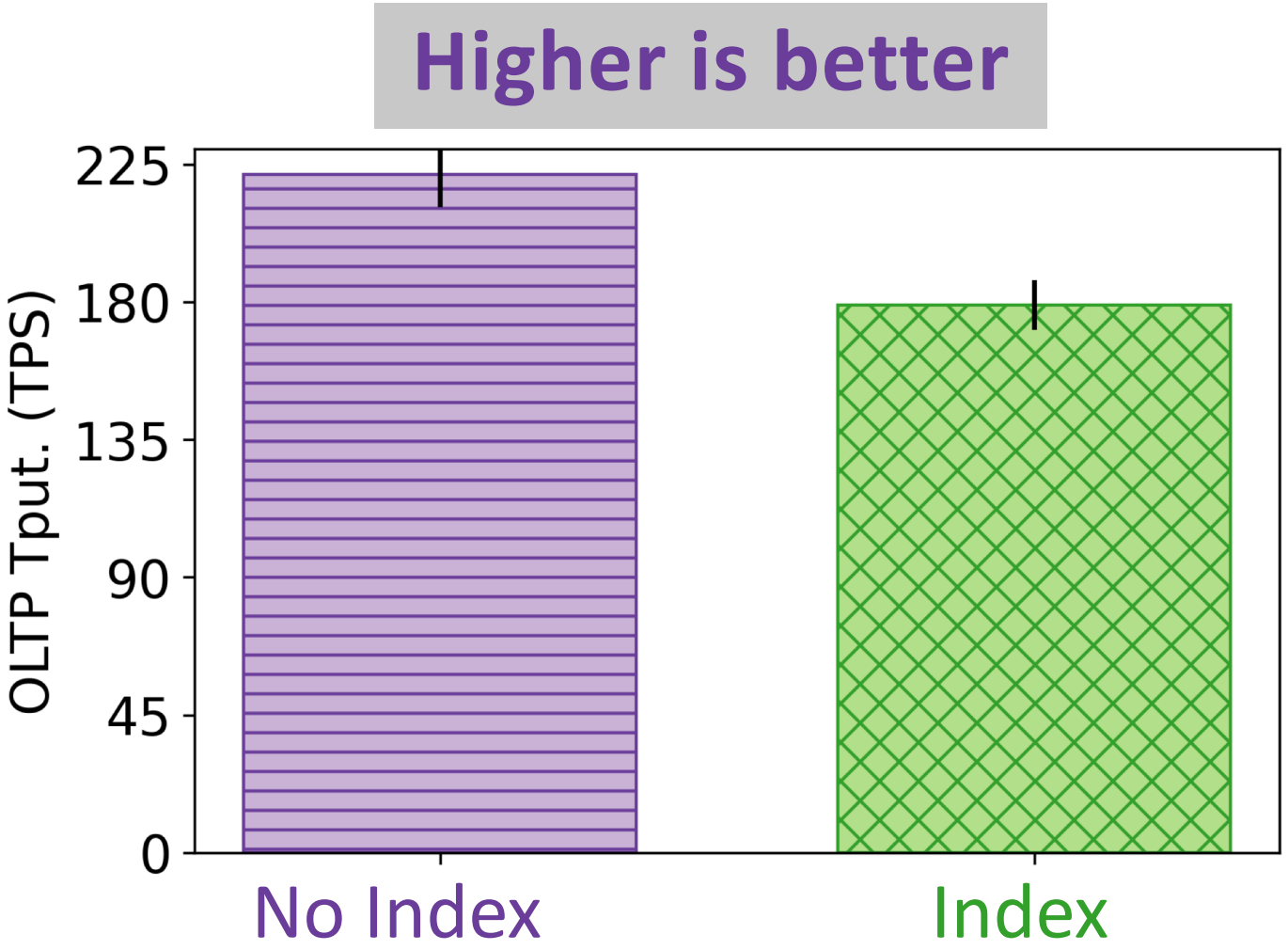
Index Choice



INSERT (104, LoTR, John, 2, $21)

Should we index?

No

Storage Choice

Order	Book	User	Qnt	$
100	HP	Alice	7	$15
101	Drac	Ted	90	$3
102	SQL	Geoff	1	$100
103	HP	Jean	3	$15
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INSERT (104, LoTR, John, 2, $21)

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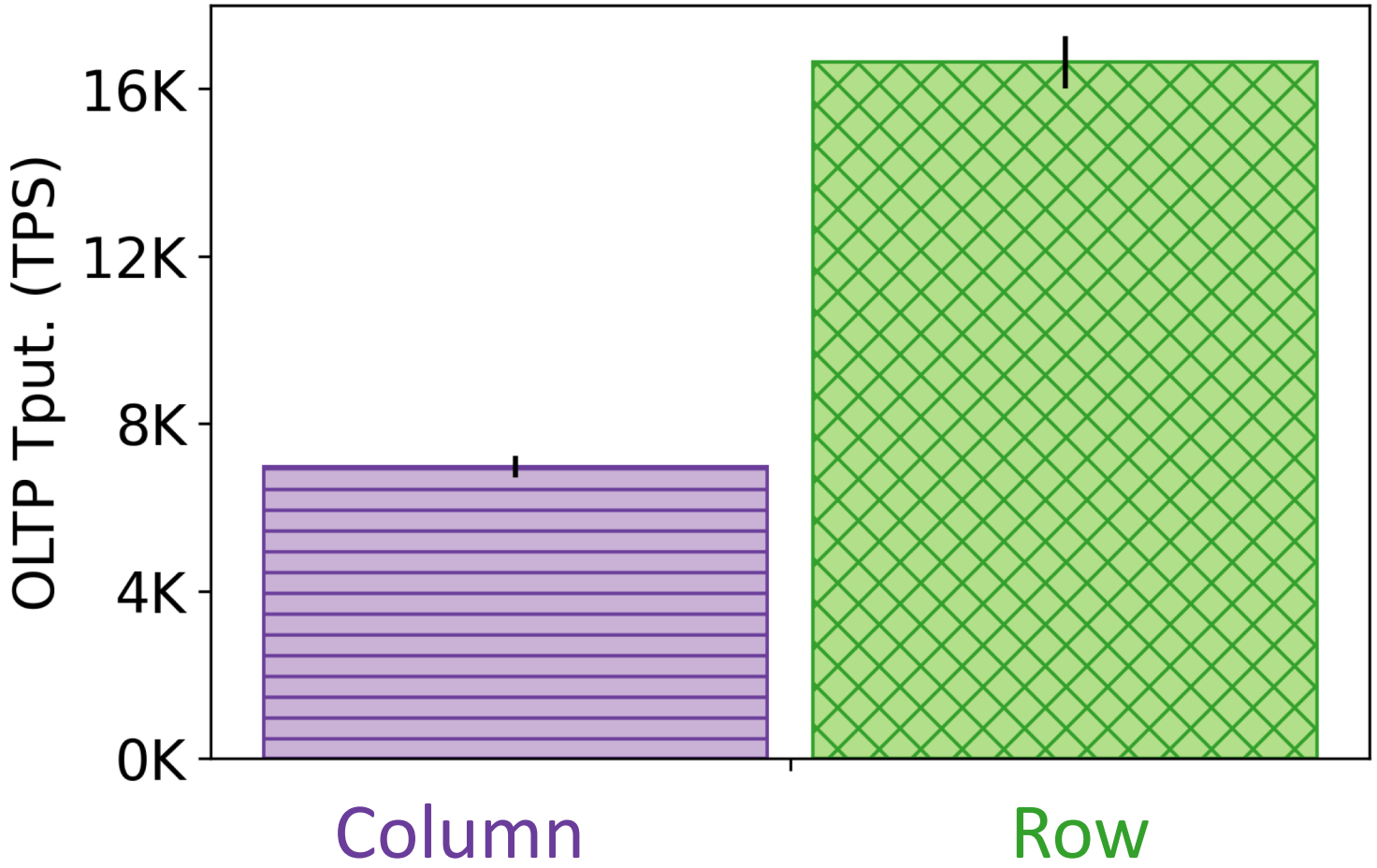
Storage Choice

Higher is better



INSERT (104, LoTR, John, 2, $21)

How should we store?

Row

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Storage Choice

Order	Book	User	Qnt	$
100	HP	Alice	7	$15
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SELECT * **WHERE**
QNT > 15

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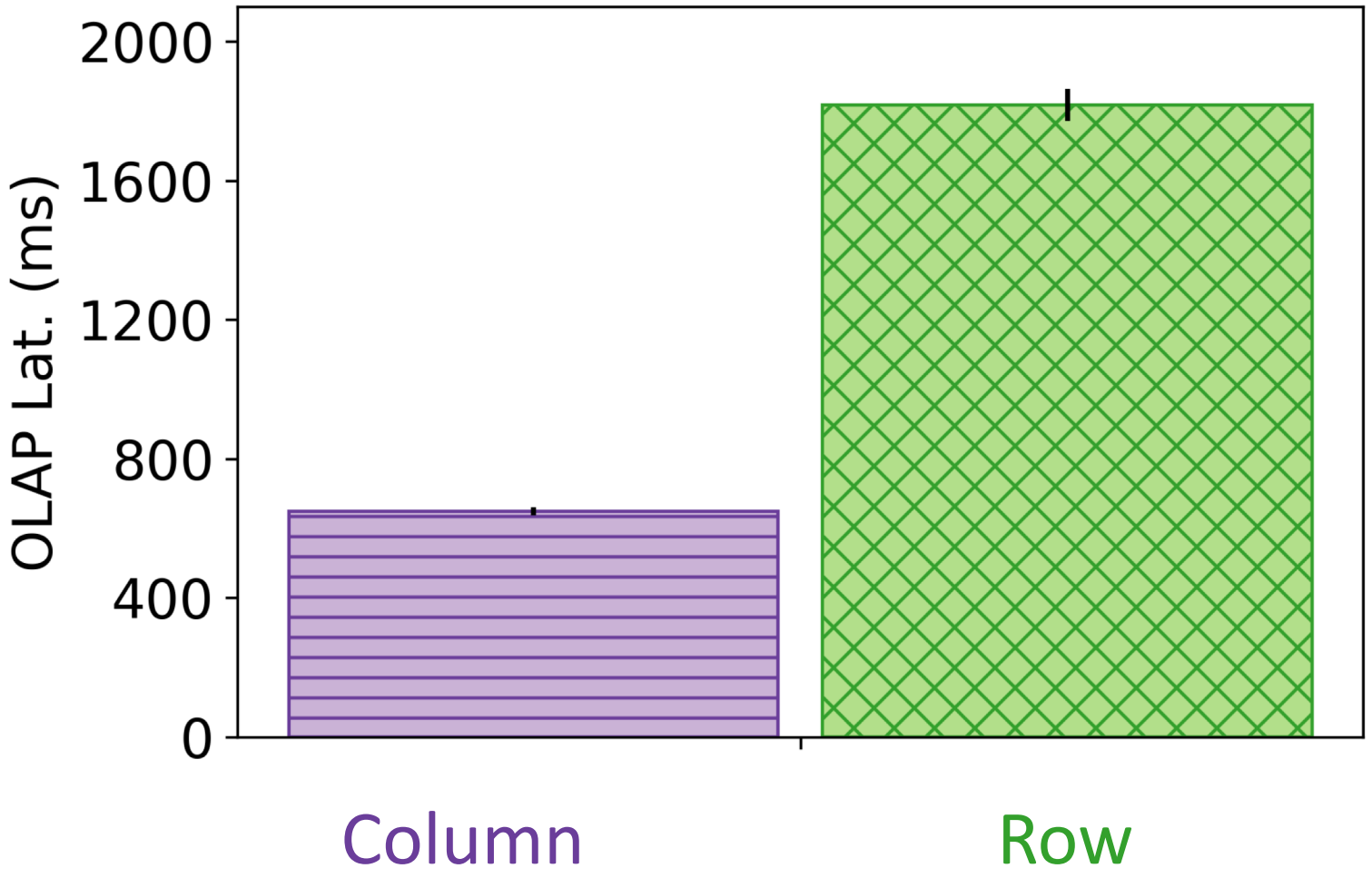
Storage Choice

Lower is better



SELECT * **WHERE**
QNT > 15

How should we store?

Column

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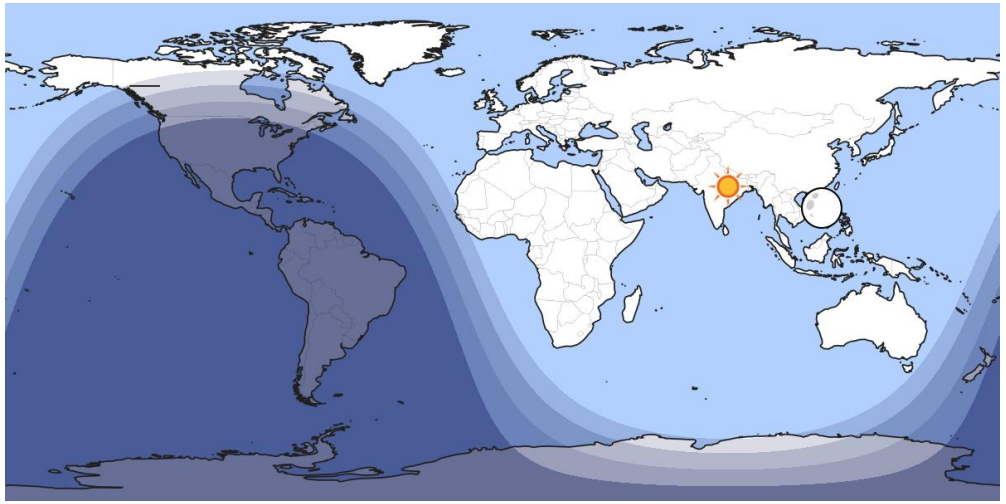
DBMS **storage** & **indexing choices**

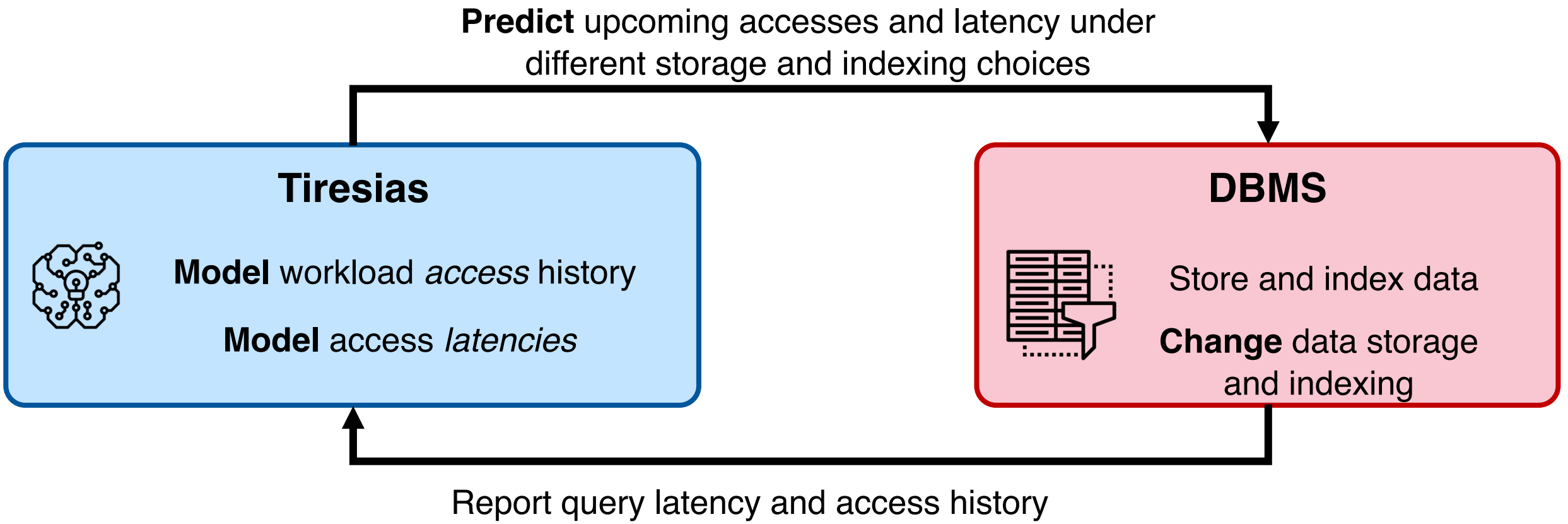
have **trade-offs** based on **workload**

so choices should be **adaptive**!

Workloads Change

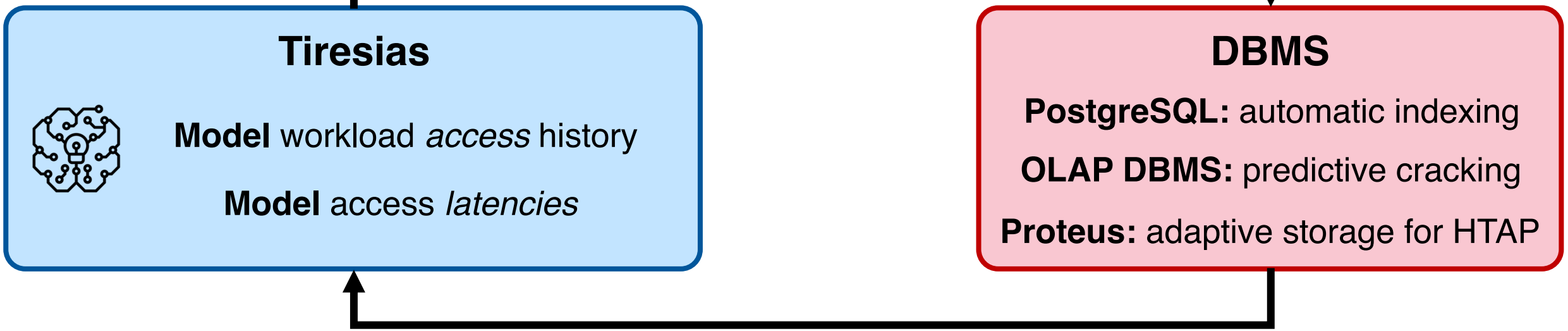


Tiresias


Predict upcoming accesses and latency under different storage and indexing choices
Tiresias
Model workload *access* history
Model access *latencies*
DBMS
Store and index data
Change data storage and indexing
Report query latency and access history

Tiresias

Predict upcoming accesses and latency under different storage and indexing choices



Report query latency and access history

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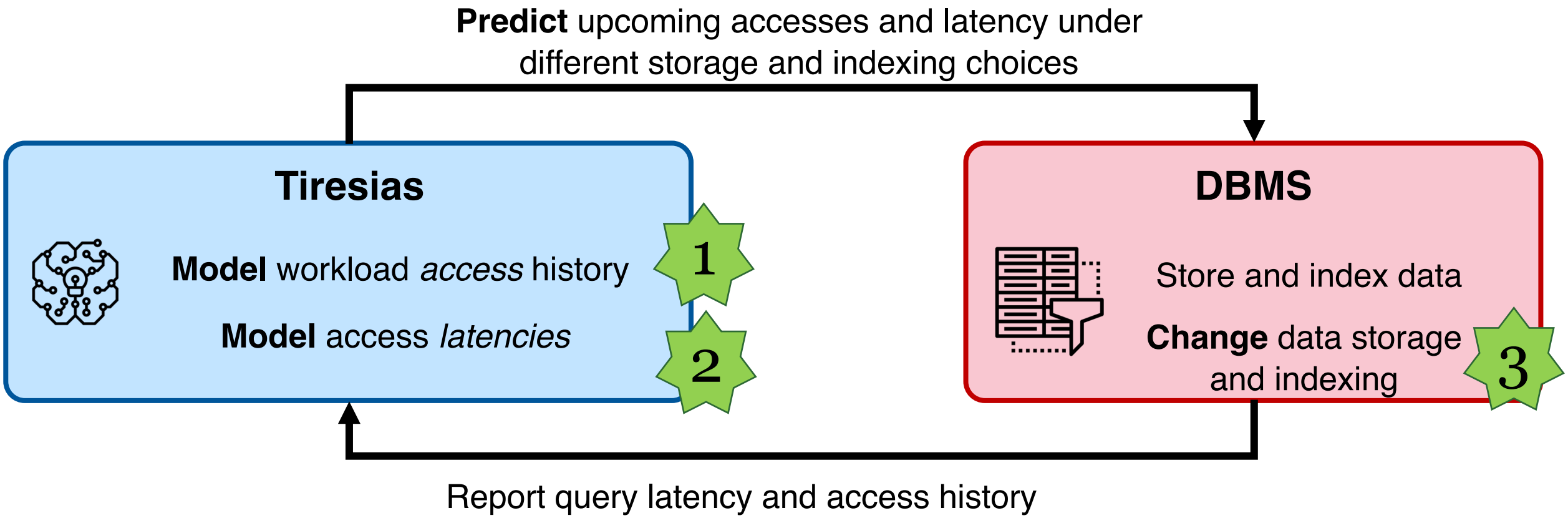
Tiresias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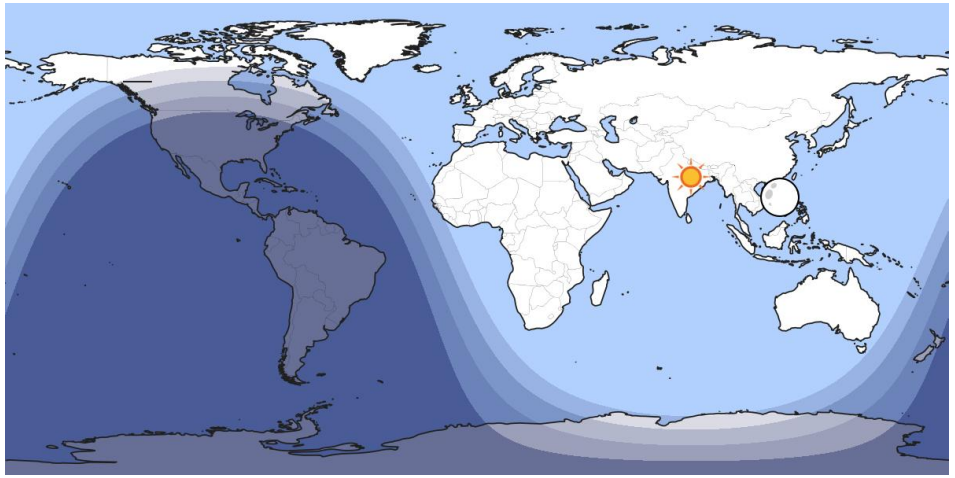
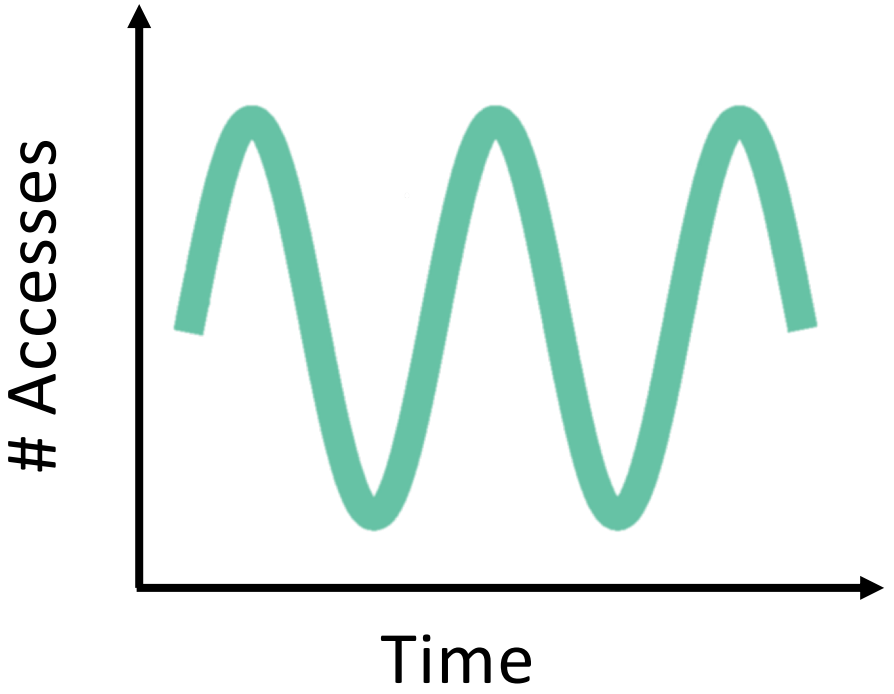
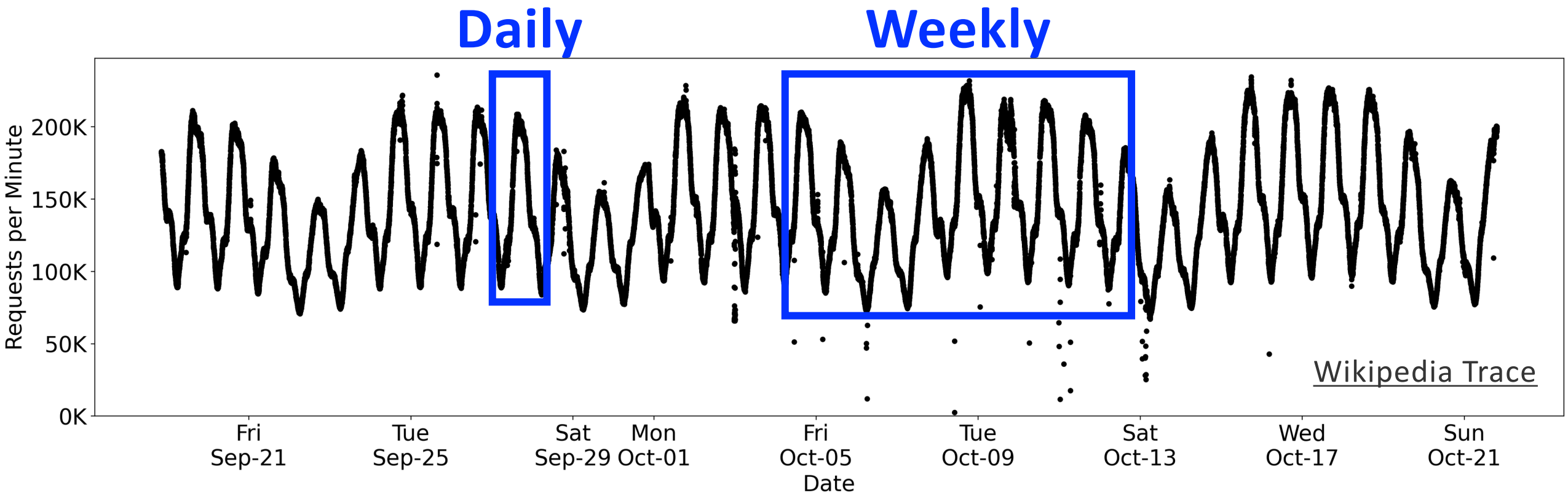
Access Arrival Patterns

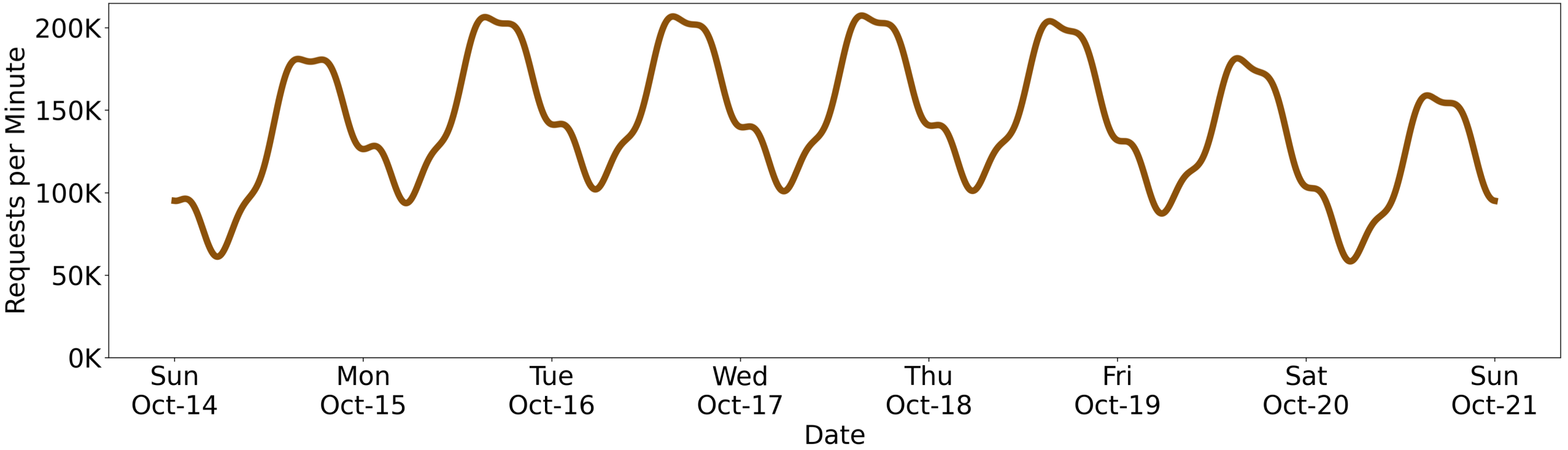




Access Arrival Patterns



Learning Access Arrival Patterns



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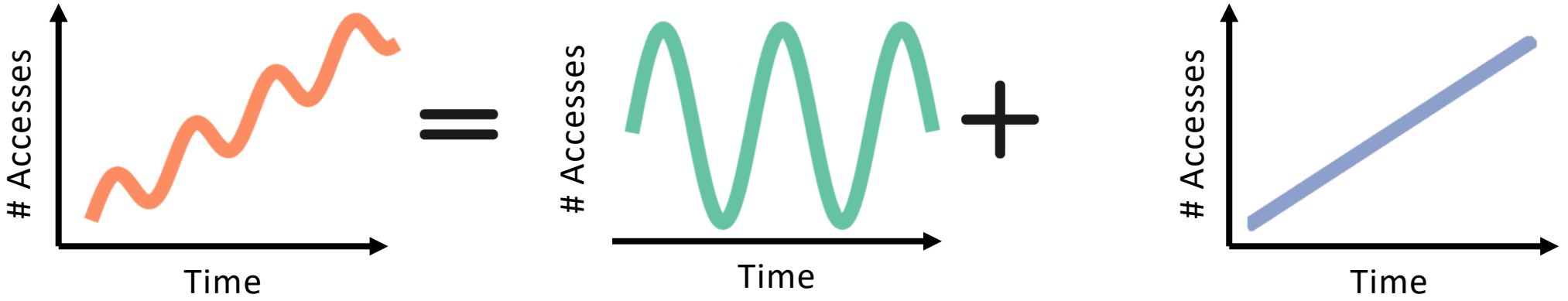
Learning Access Arrival Patterns



	Periodicity	Trend
SPAR	Avg. over user defined intervals	Avg. over interval
Hybrid-Ensemble	Recurrent Neural Network	Linear Regression

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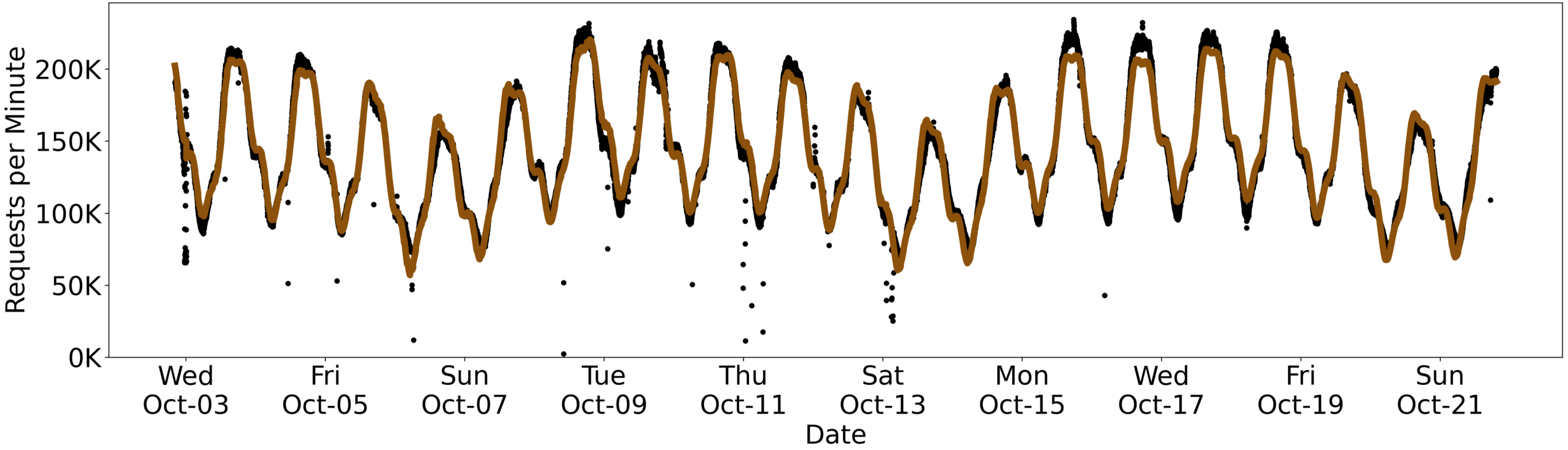
Access Arrival Patterns - Results

Hybrid-Ensemble



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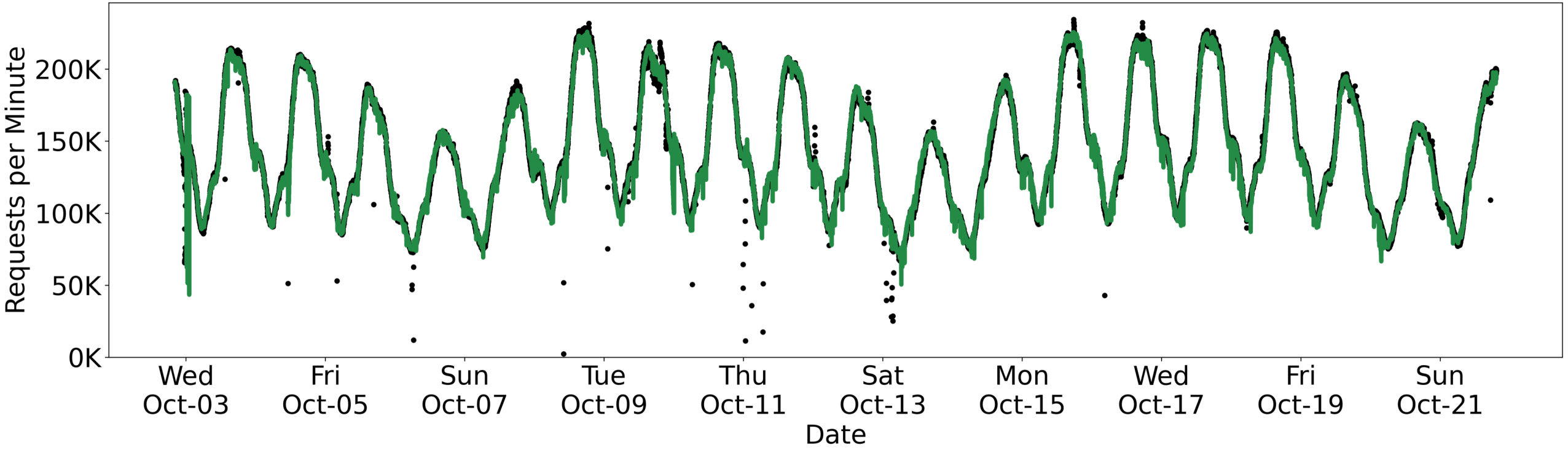
Access Arrival Patterns - Results

SPAR



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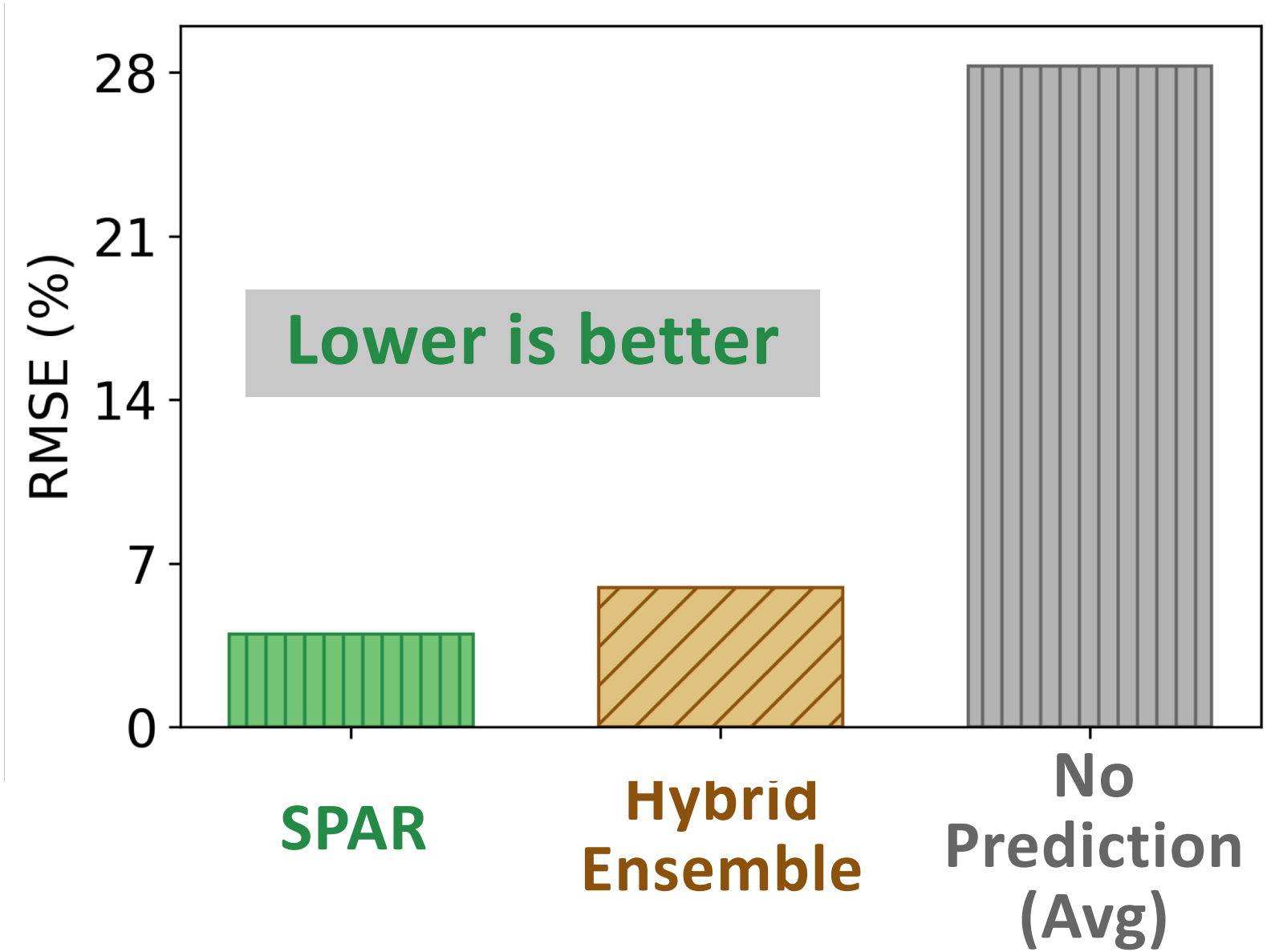
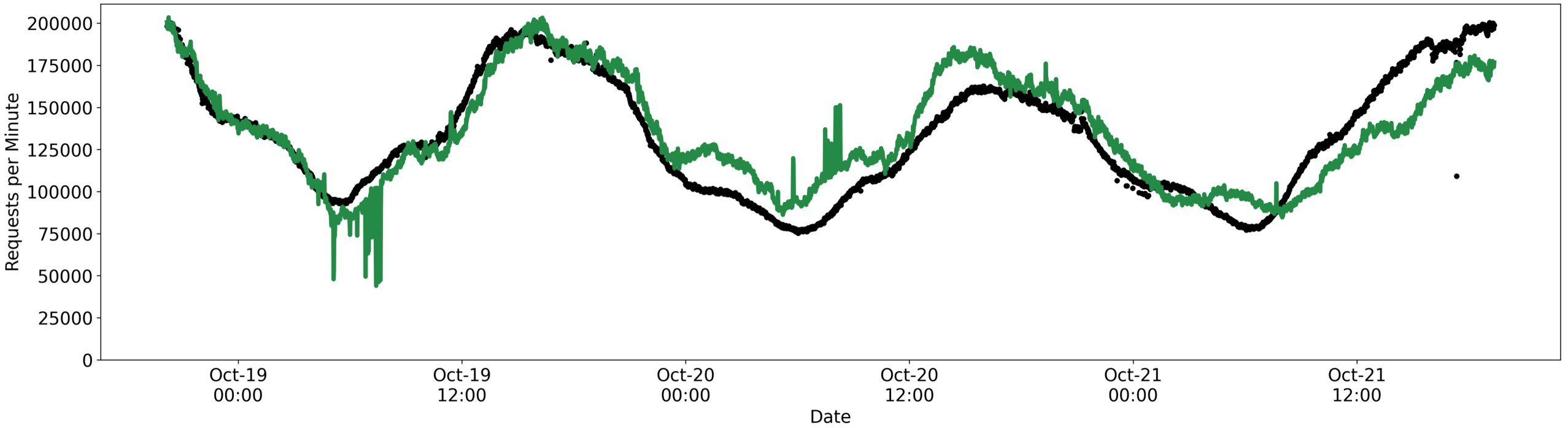
Access Arrival Patterns - Accuracy



Access Arrival Patterns - Results

SPAR (Mis-Configured)



Incorrect definition of period **decreases** accuracy!

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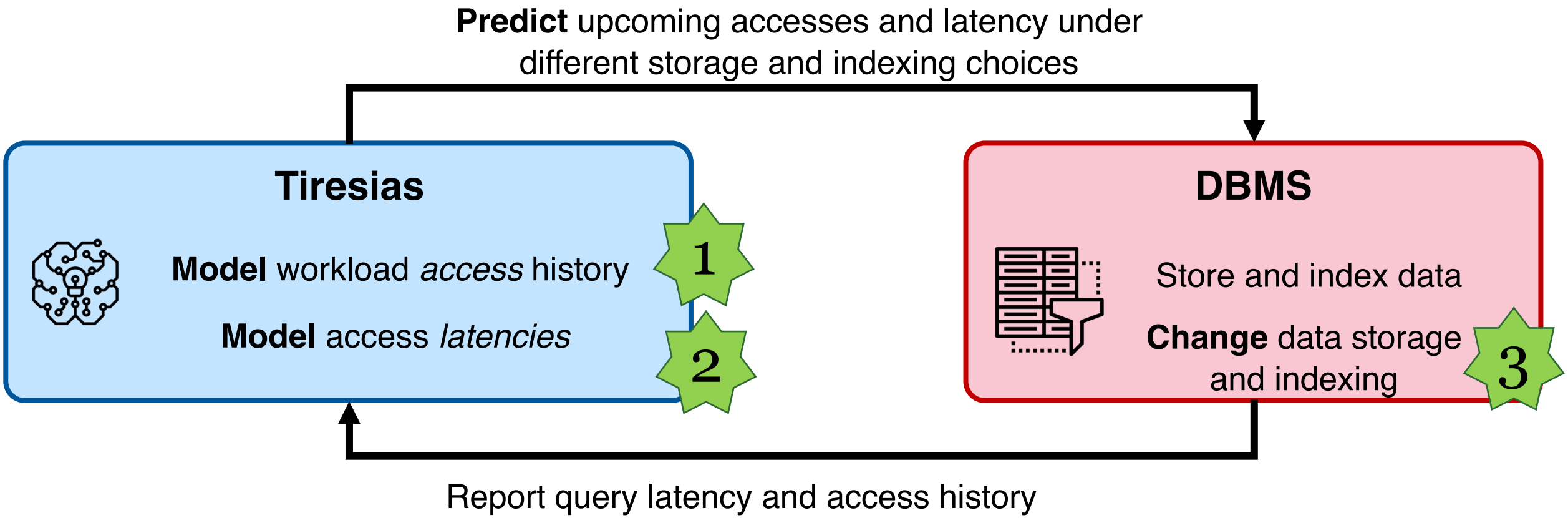
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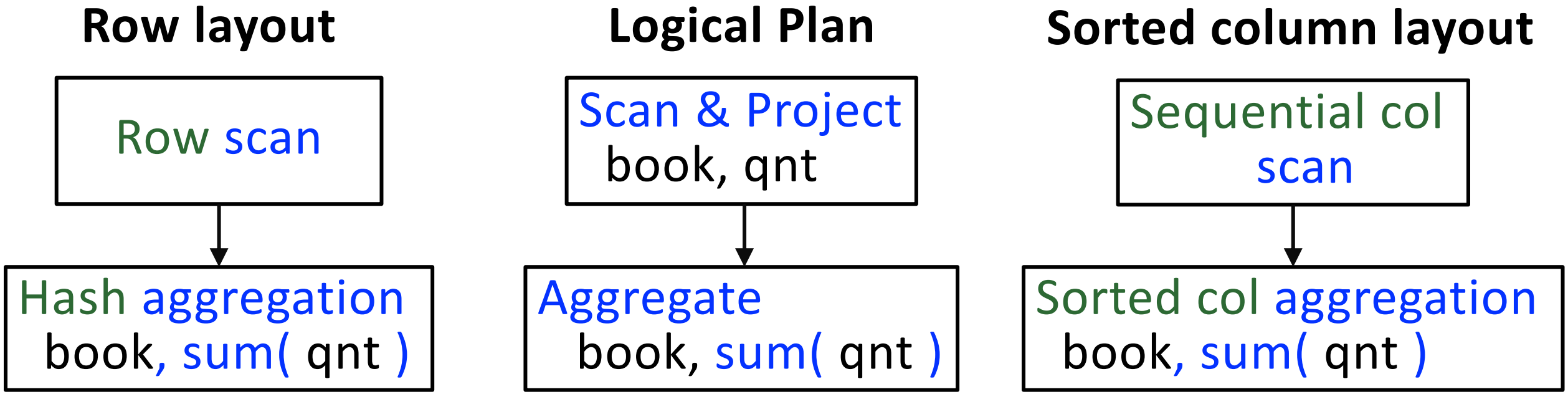
Predicting Latency

Transactions are composed of **physical operators**

SELECT book, **SUM**(qnt) **GROUP BY** book



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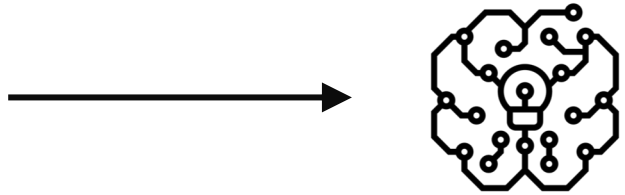
Predicting Latency

Transactions are composed of **physical operators**

Predict physical operator latency

Per layout with workload stats as parameters

Cardinality
Data Width
Est Selectivity



Predicted Latency

Seq col scan

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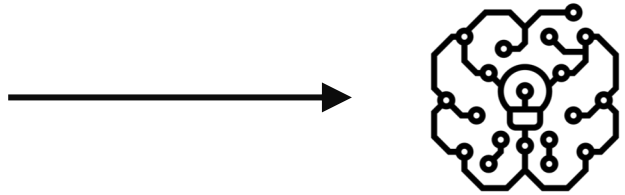
Predicting Latency

Transactions are composed of **physical operators**

Predict physical operator latency

Per layout with workload stats as parameters

Cardinality
Data Width
Est Selectivity



Predicted Latency

Row scan

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Predicting Latency

Transactions are composed of **physical operators**

Predict physical operator latency

Per layout with workload stats as parameters

Linear Regressor

Neural Network

Non-Linear Regressor

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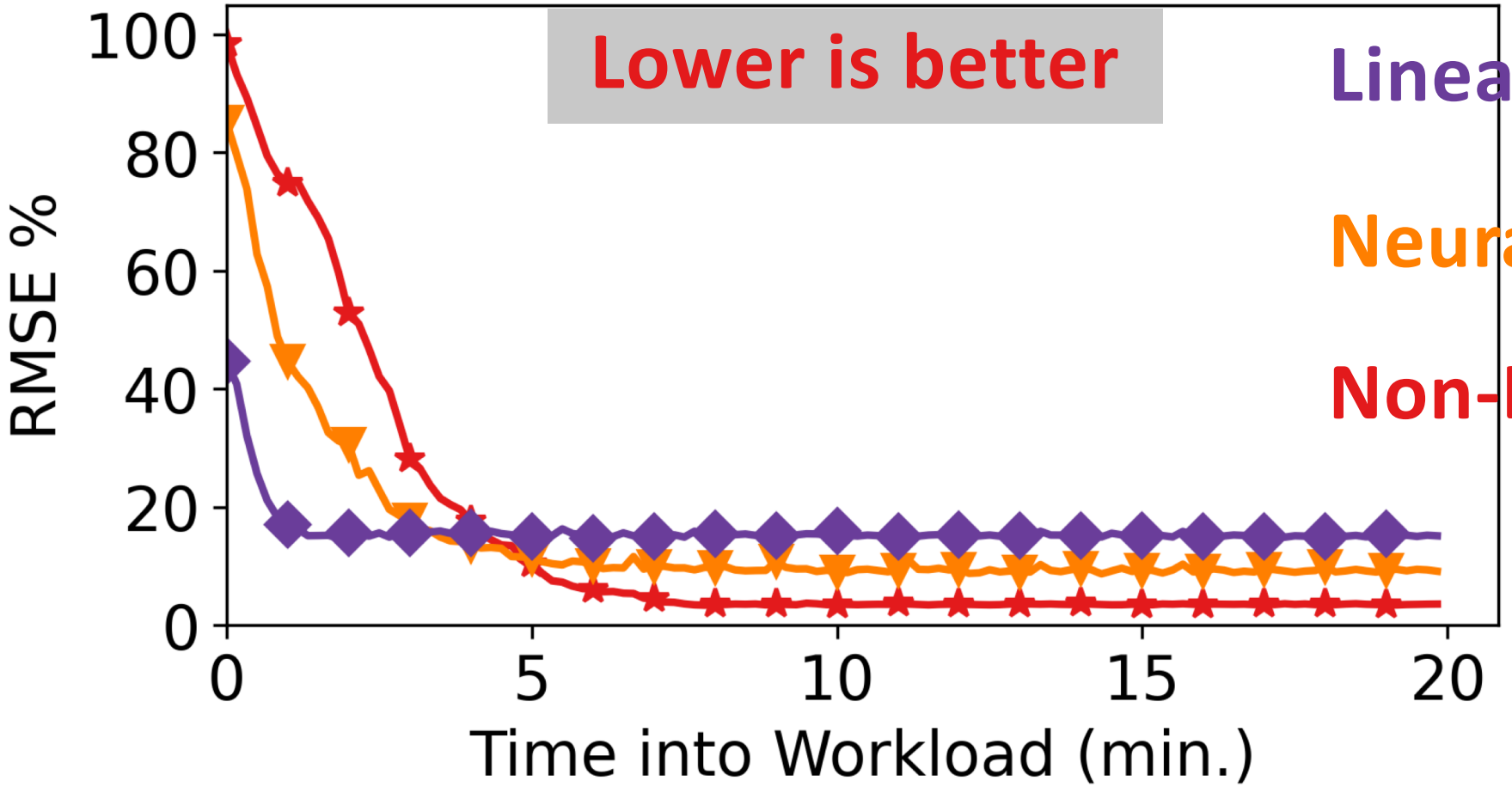
Predicting Latency Accuracy



Linear Regressor

Neural Network

Non-Linear Regressor

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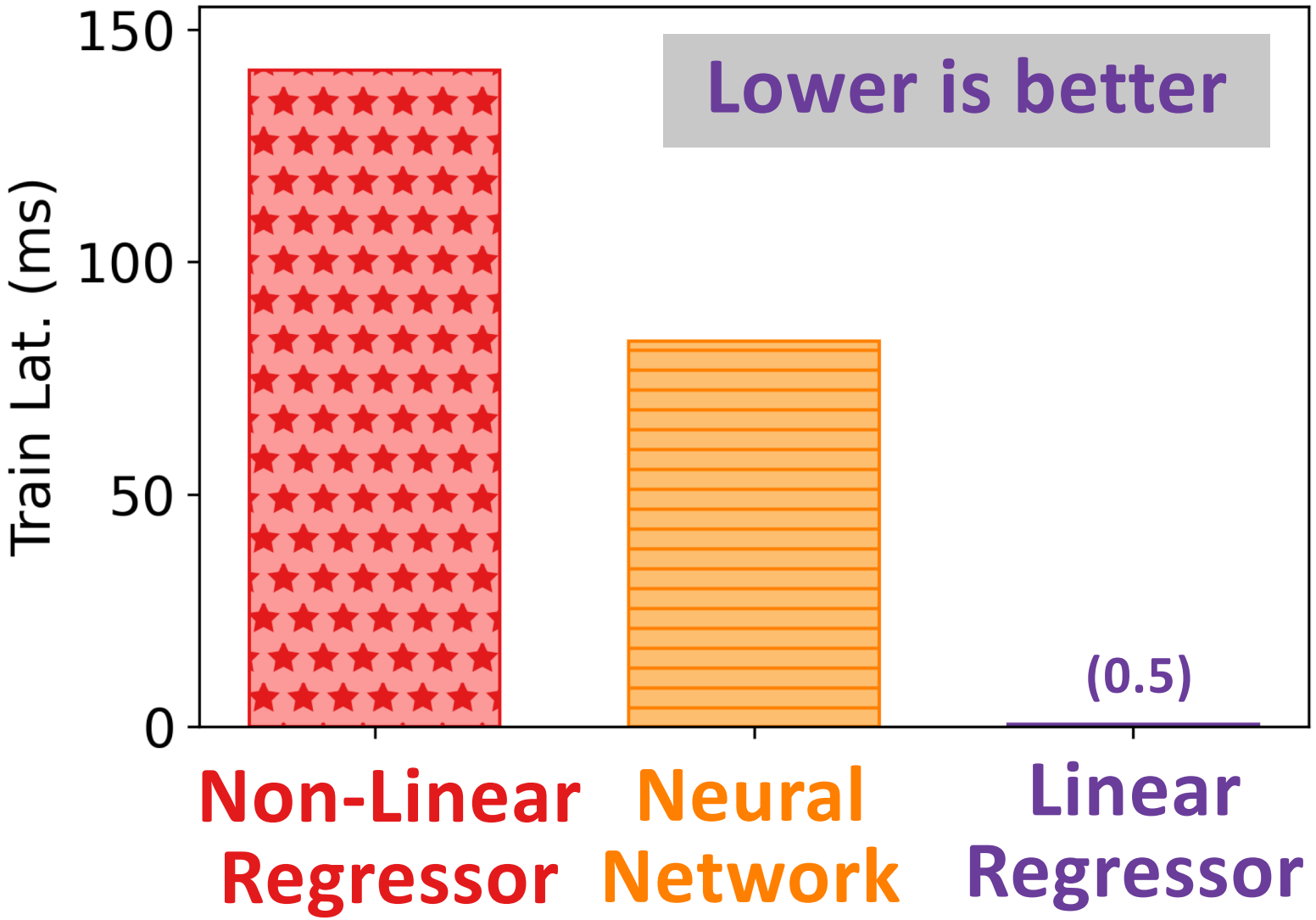
Predicting Latency - Training



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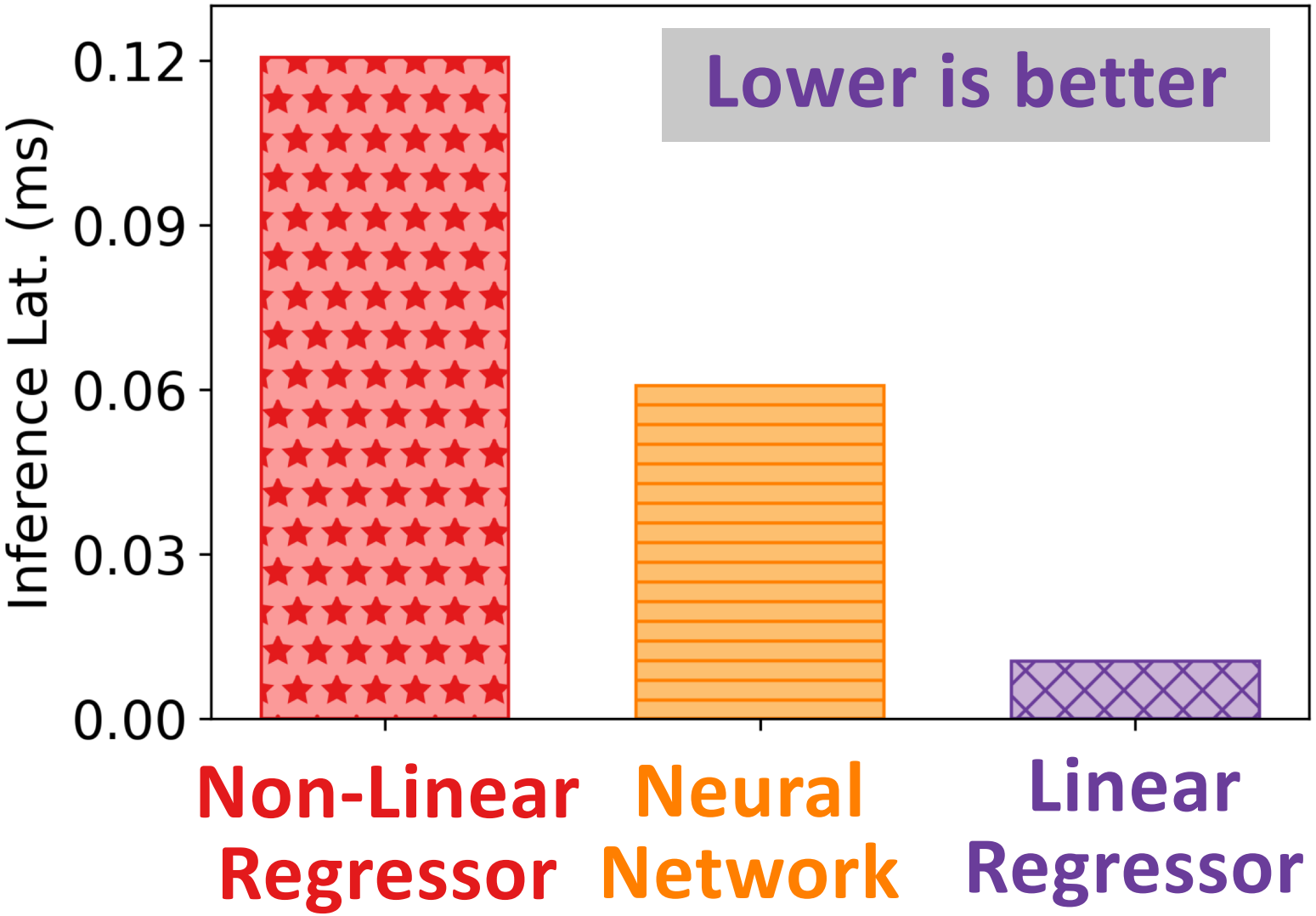
Predicting Latency - Inference



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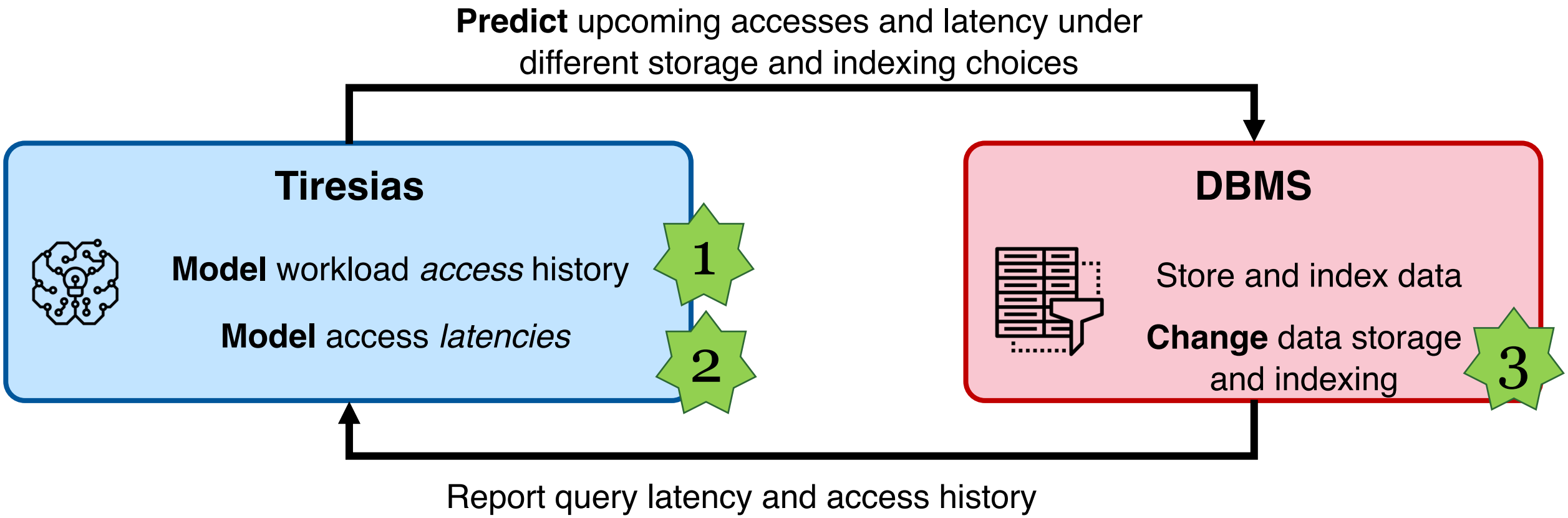
Tiresias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Storage and Index Changes

Expected Benefit of Change

Predicted access **latency** under:
current & **proposed** storage/indexing choice

Weighted by **likelihood** of **access**

Cost incurred to perform change

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Tiresias End-to-End Evaluation

DBMS

PostgreSQL: automatic indexing

OLAP DBMS: predictive cracking

Proteus: adaptive storage for HTAP

Adapt with **Tiresias**

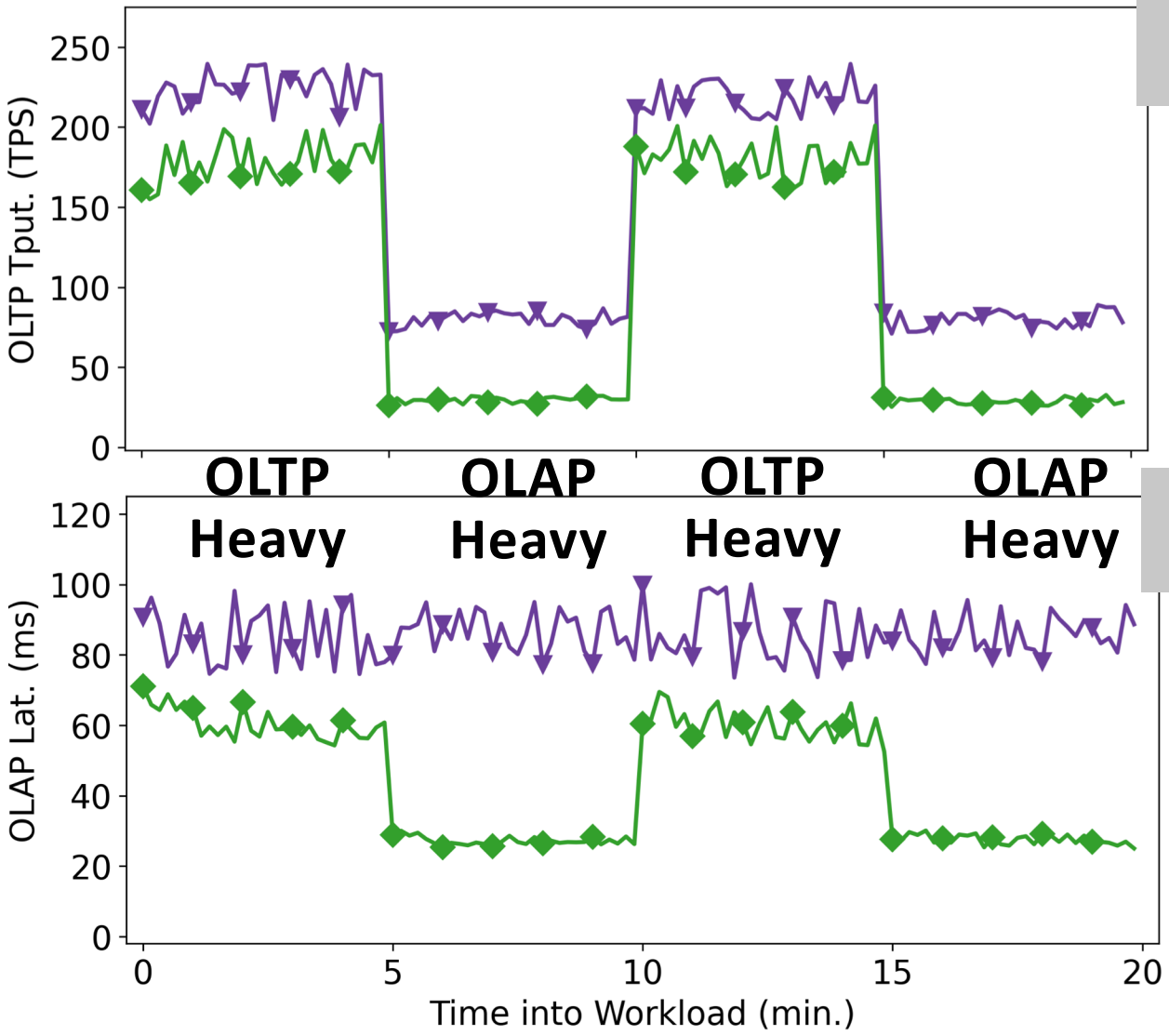
Static choices **without** Tiresias

Shifting Workloads

Skew (hotspots)

Mix (OLTP or OLAP heavy)

End-to-End PostgreSQL Indexes



Higher is better

No Index

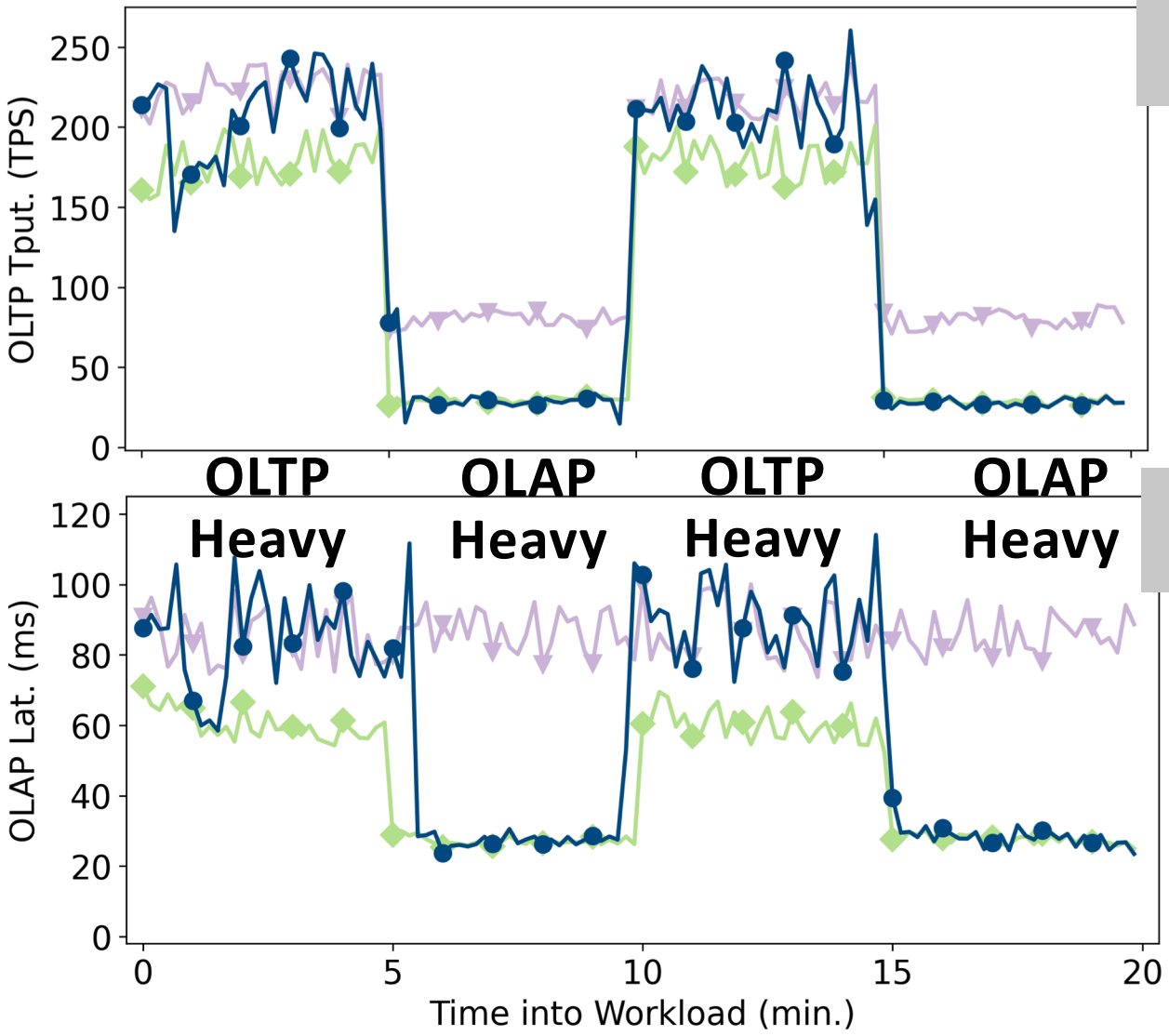
Index

Lower is better

No Index

Index

End-to-End PostgreSQL Indexes



Higher is better

No Index
Adaptive - Tiresias
Index

Lower is better

No Index
Adaptive - Tiresias
Index

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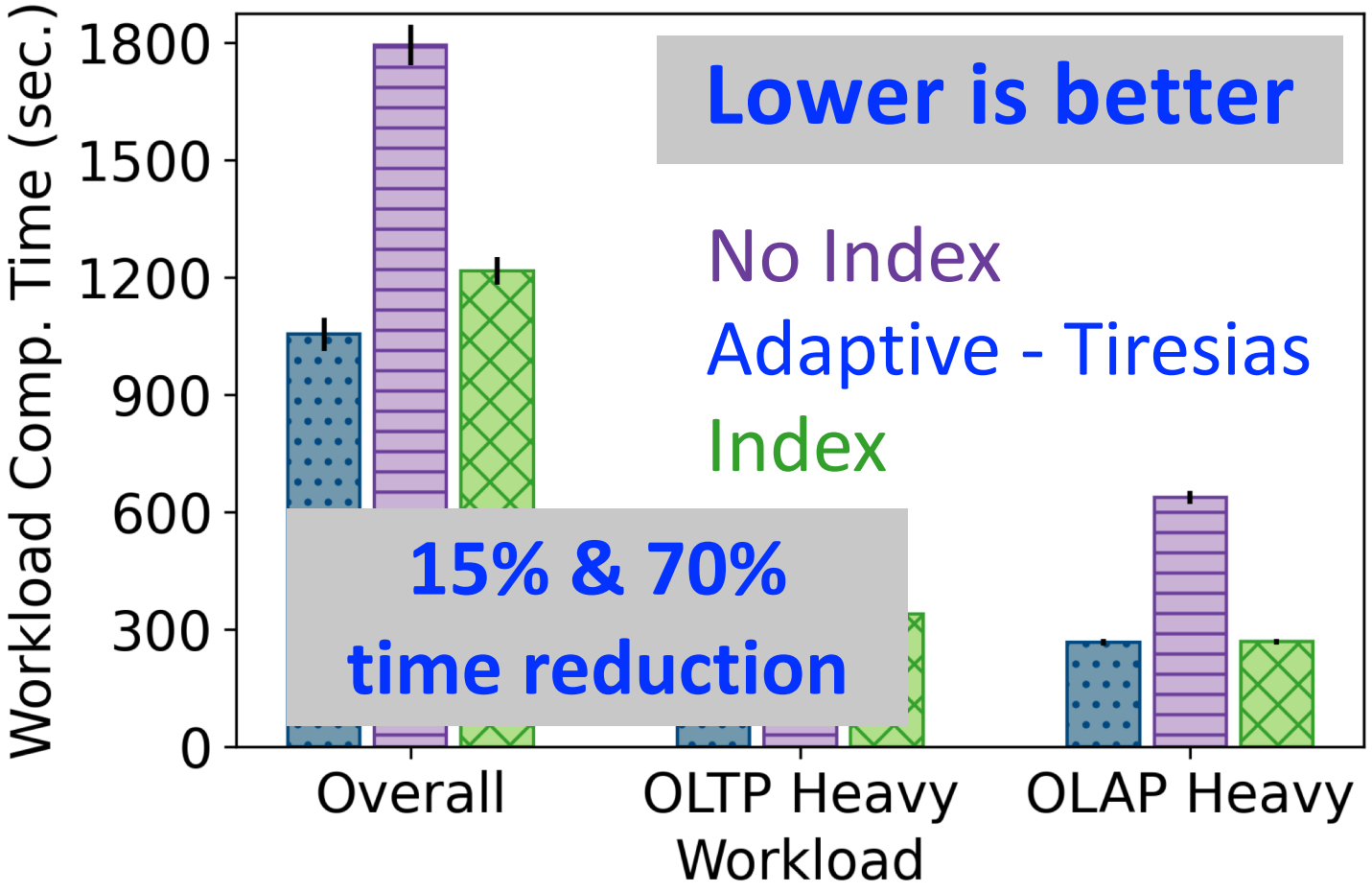
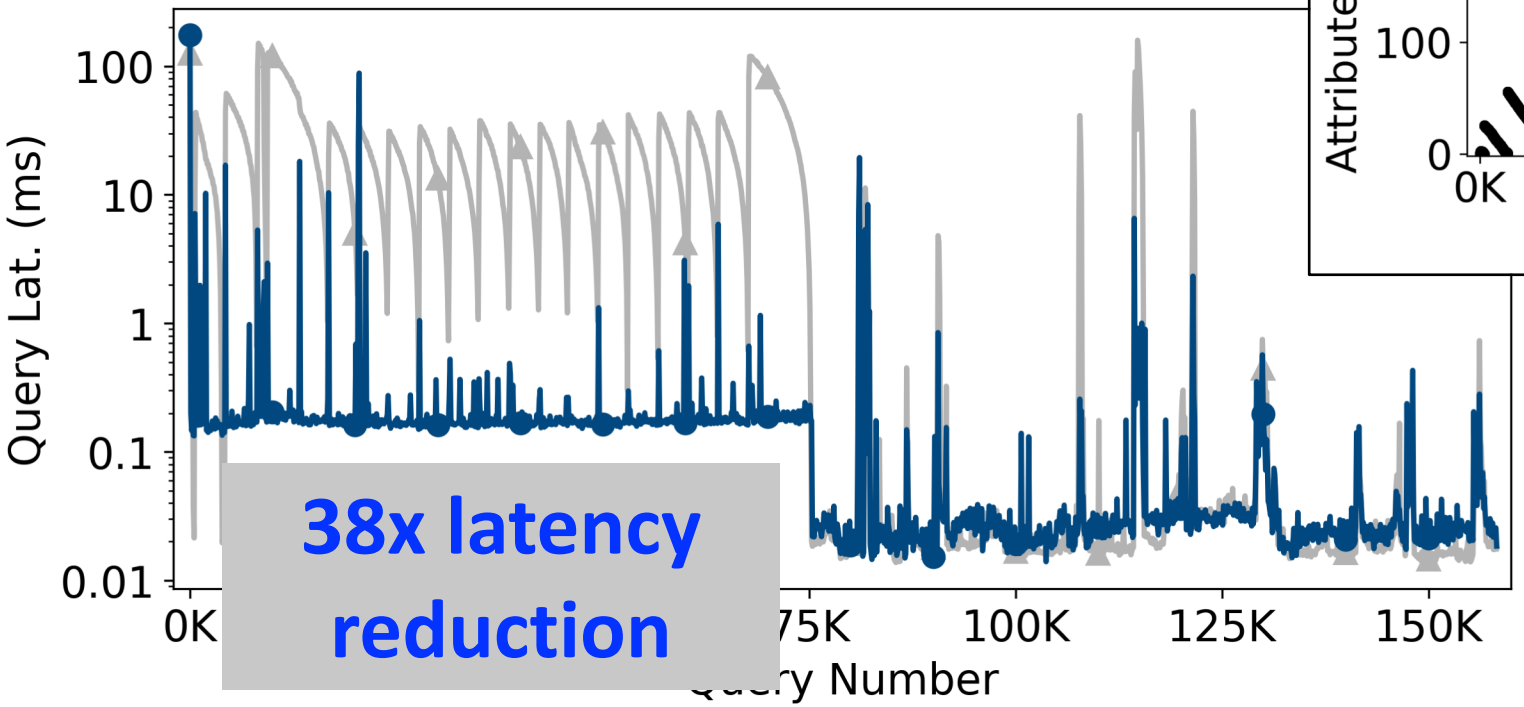
End-to-End PostgreSQL Indexes

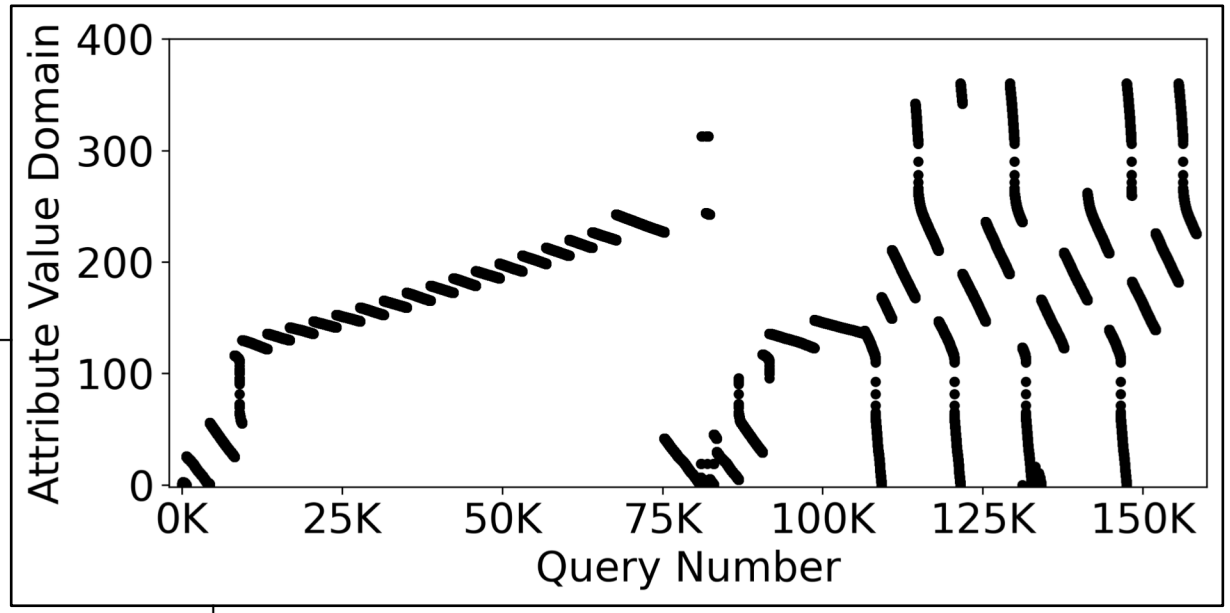


End-to-End Cracking

Lower is better



38x latency reduction



Cracking (No Tiresias)

Predictive Cracking: Tiresias

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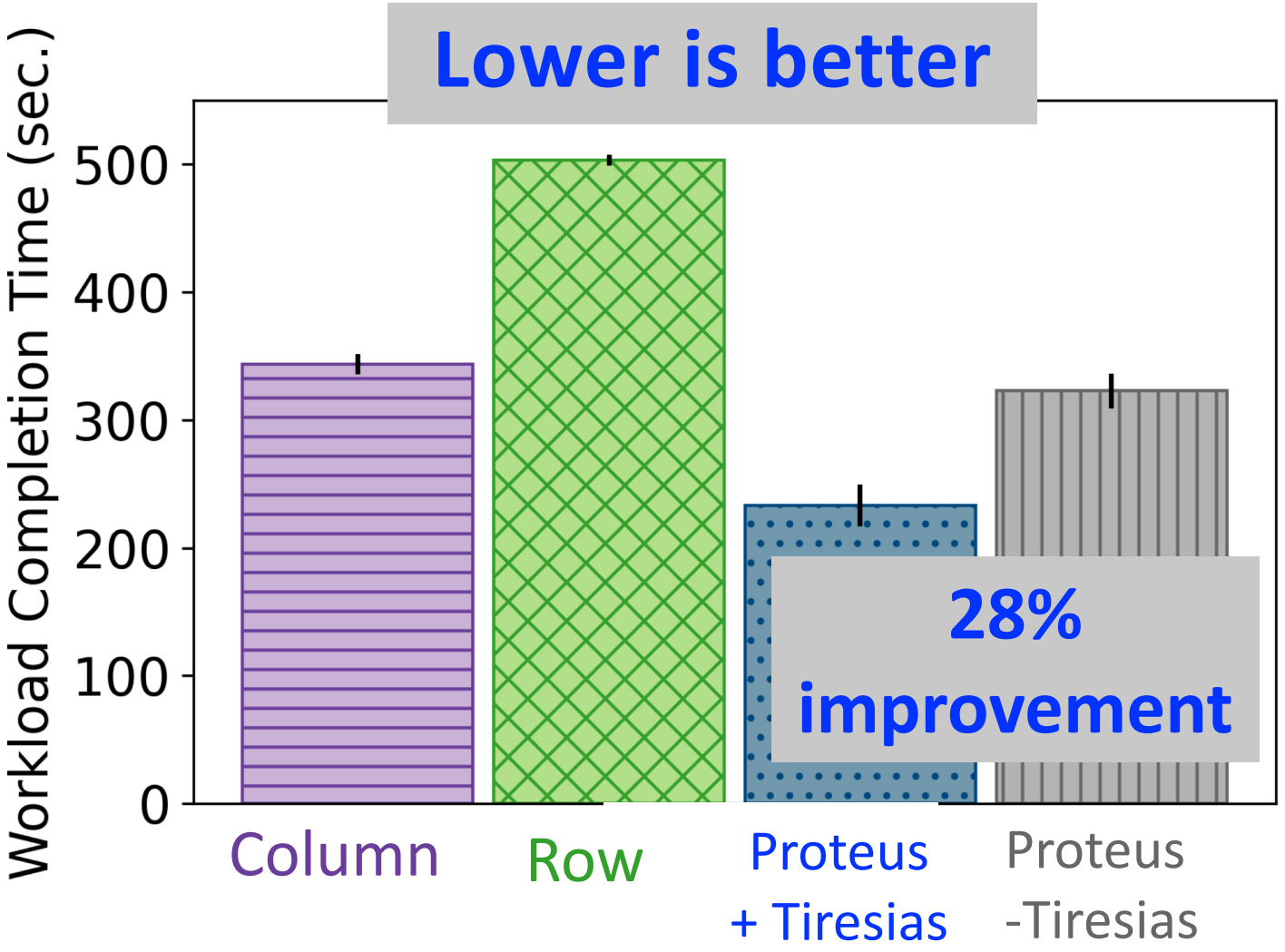
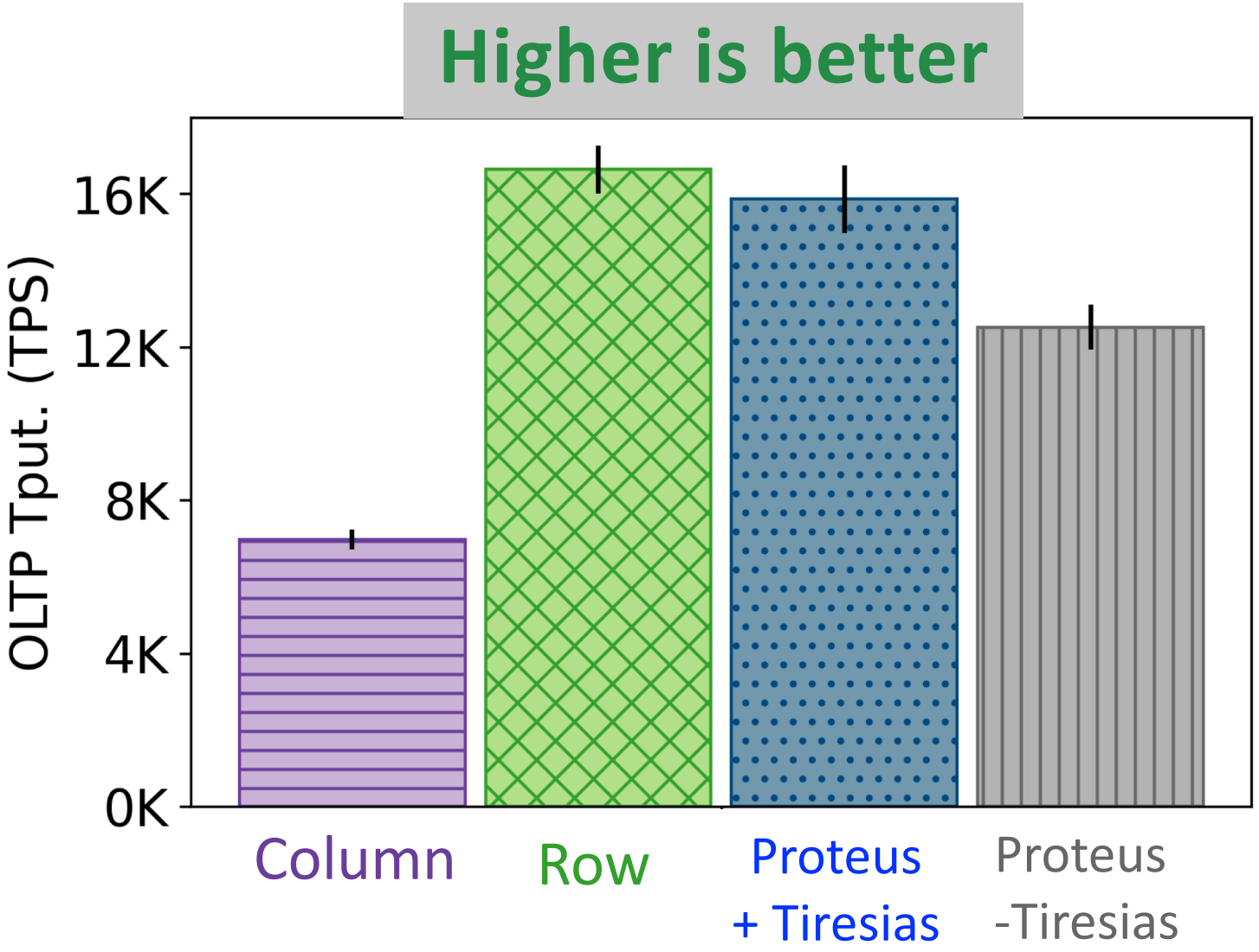
End-to-End Proteus



End-to-End Proteus



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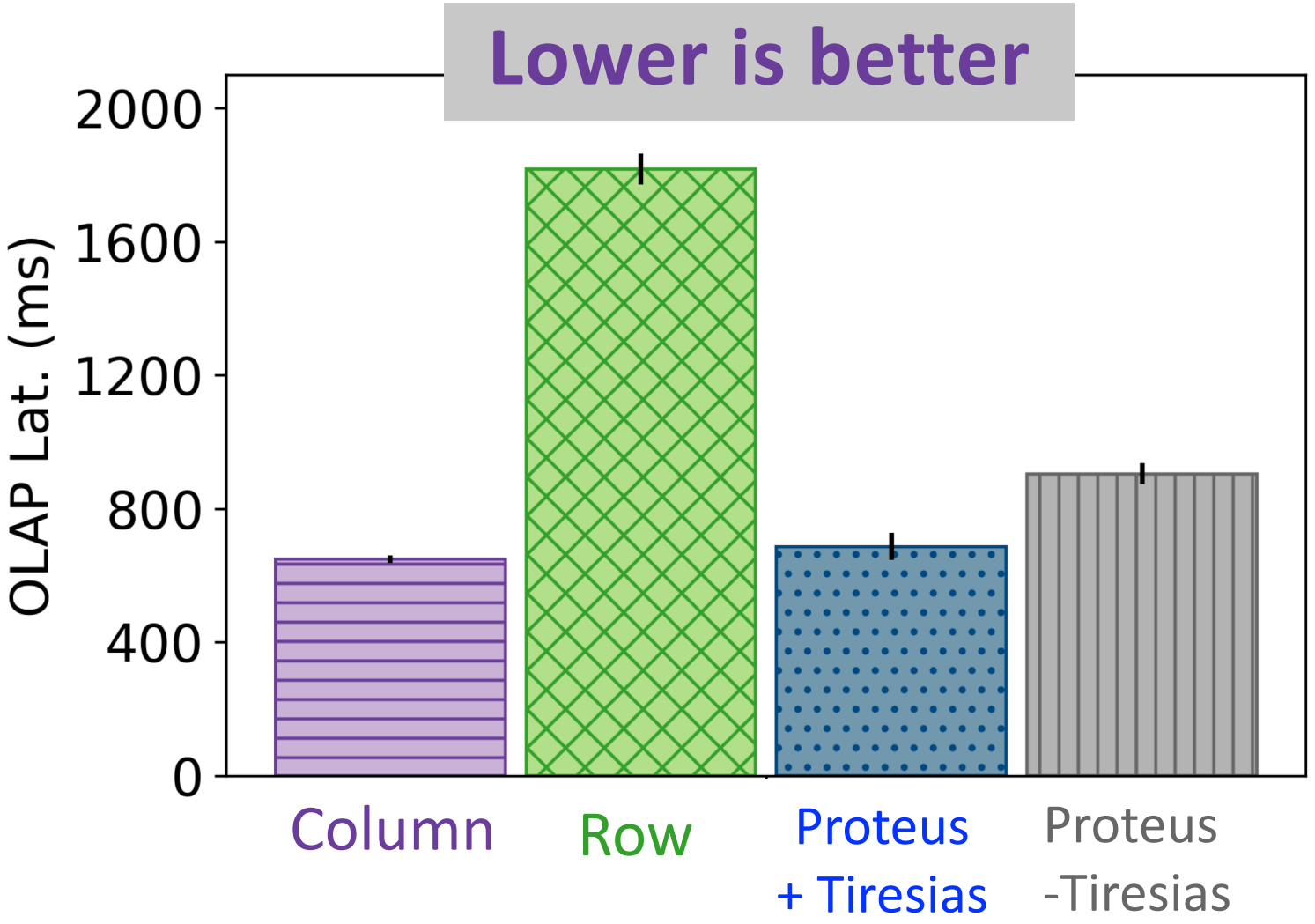

Tiresias Takeaways tiny.cc/tiresias

Automatic adaptation of data storage and indexing

Generalizable API used in different DBMSs

Predict data accesses based on workload patterns

Learn access costs under different storage choices

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