Fast Abort-Freedom for Deterministic Transactions

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Concurrent Transactions

- Transaction: a logical unit of multiple data access operations

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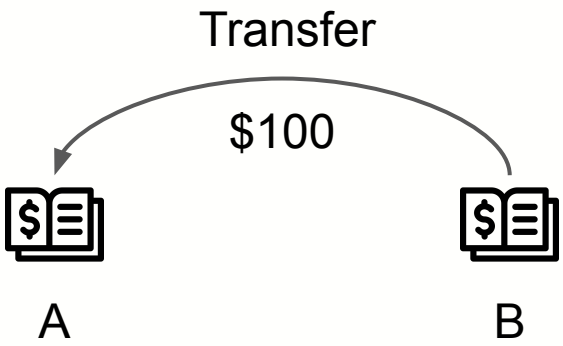

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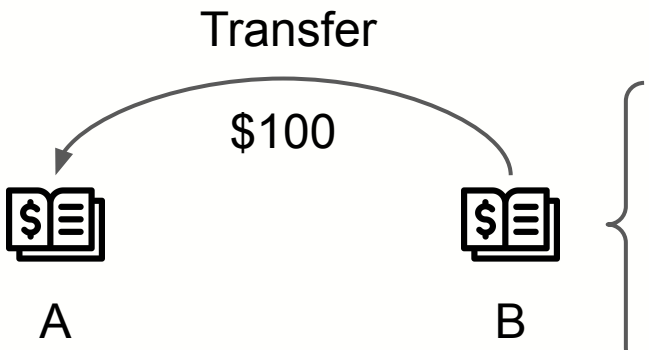


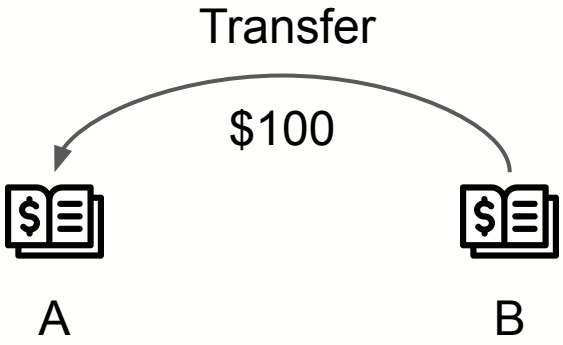

```
Procedures

1) Check balance of B
2) Subtract $100 from B
3) Add $100 to A
```

Concurrent Transactions

- Transaction: a logical unit of multiple data access operations

Atomic **Consistent** **Isolated**

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A lot of transactions concurrently

Concurrency Control

- Properly utilizing hardware parallelism

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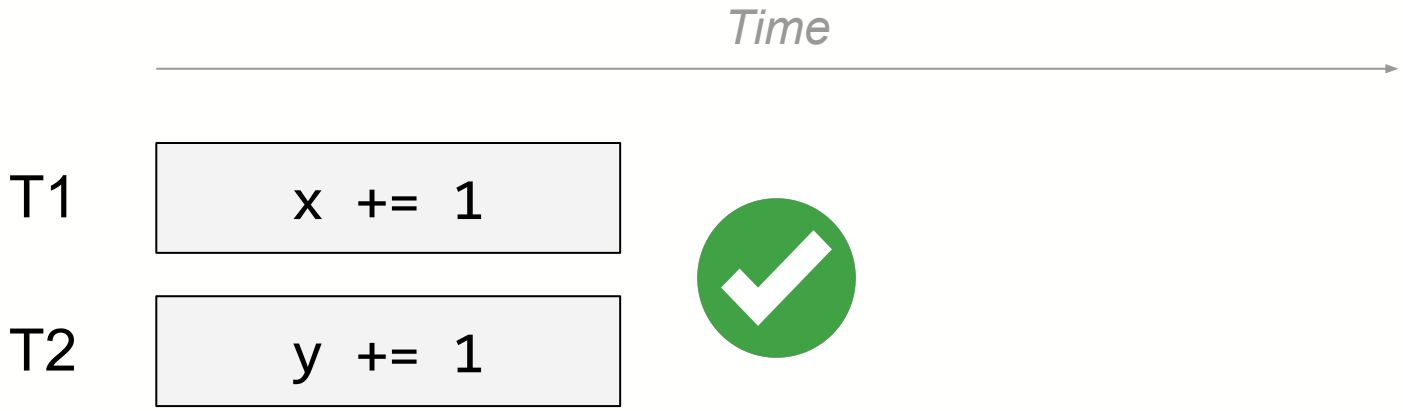

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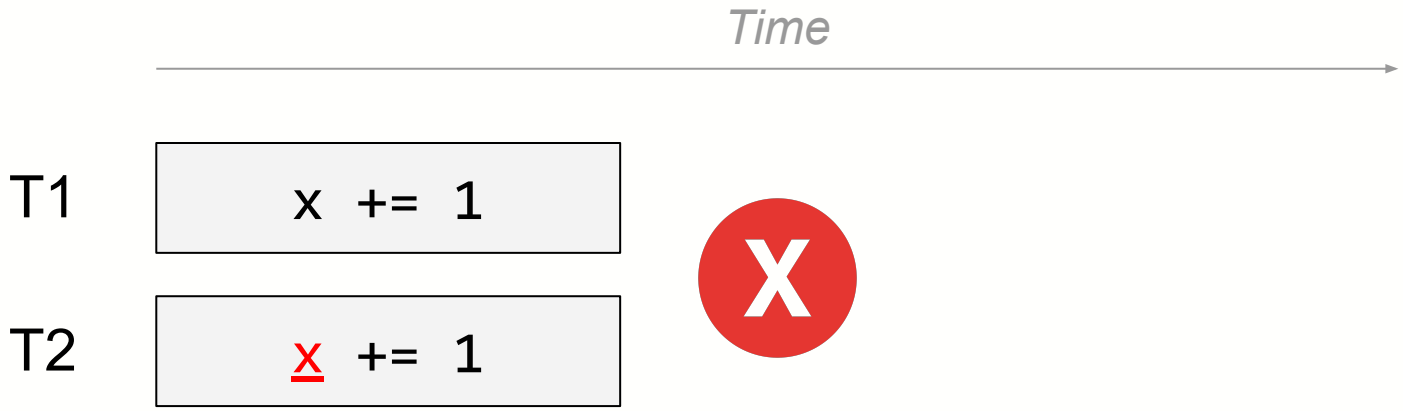

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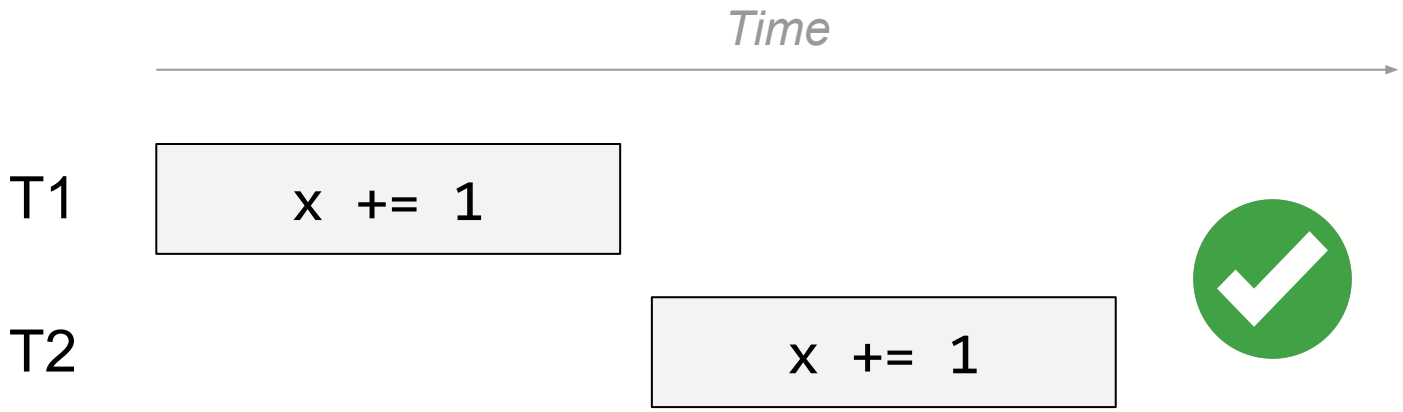
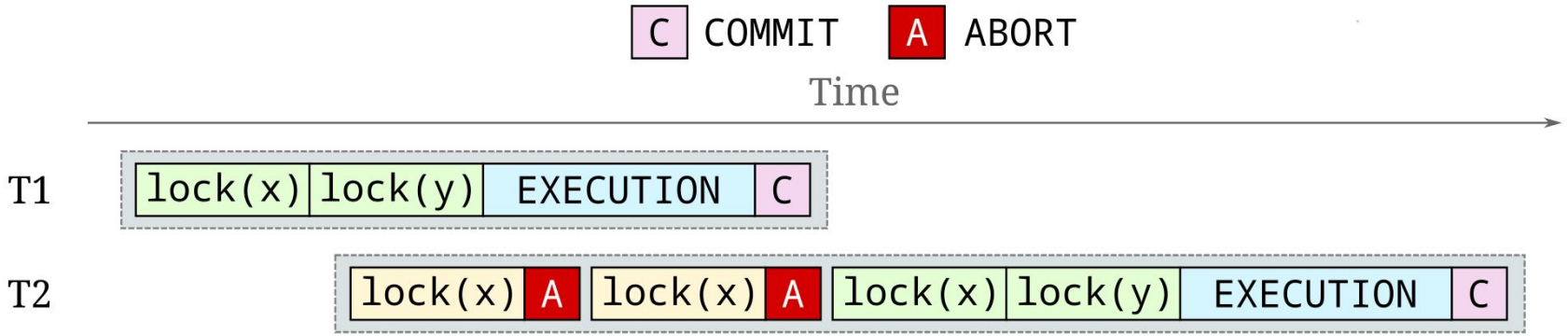


Concurrency Control

- Pessimistic, locking based: 2-phase locking (2PL)



2PL
(wait-die)

Concurrency Control

- Pessimistic, locking based: 2-phase locking (2PL)
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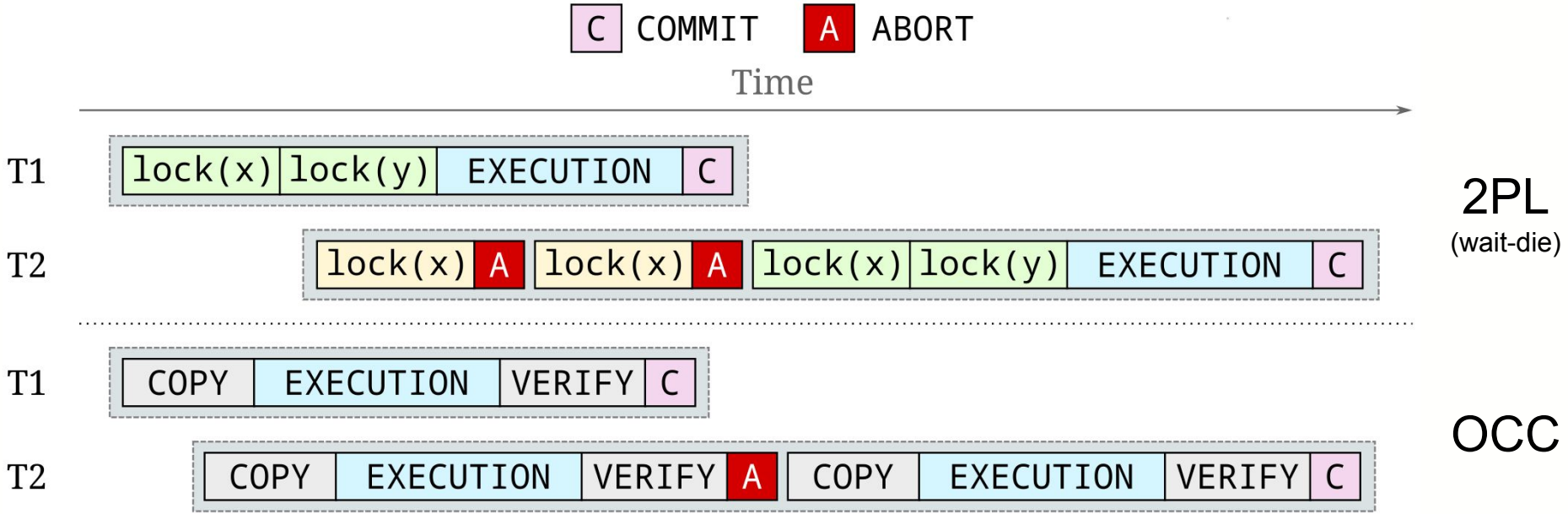

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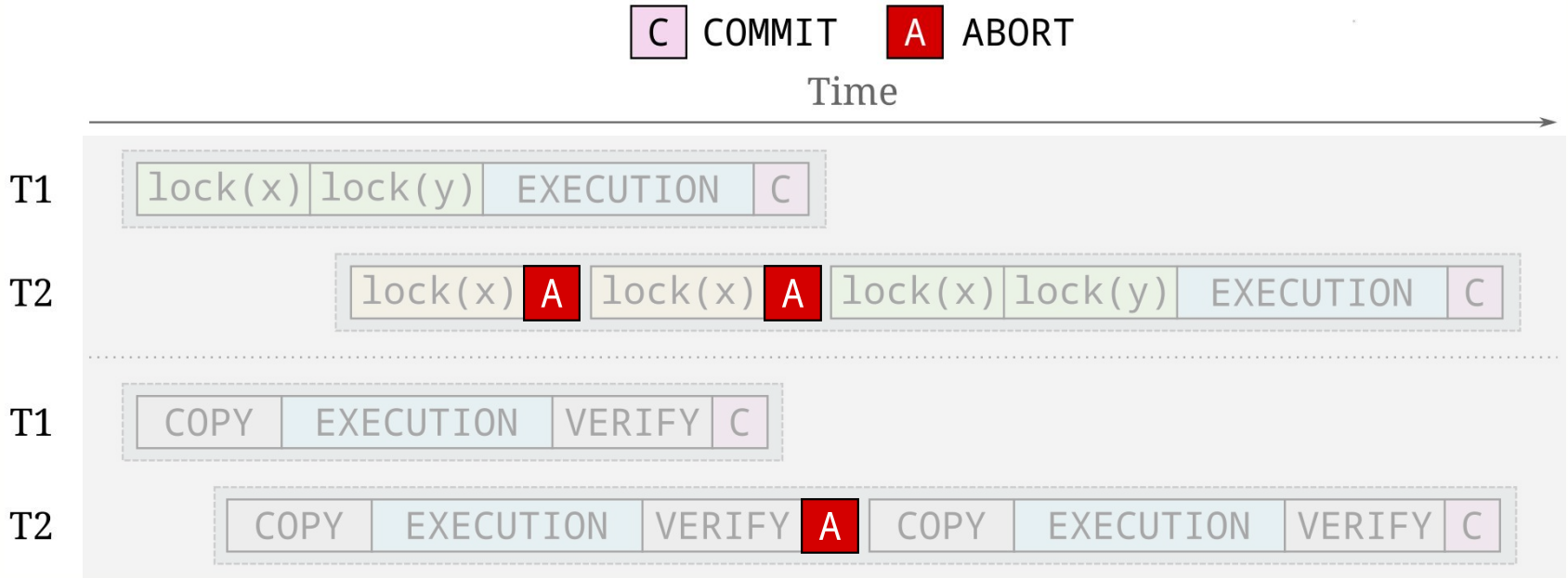

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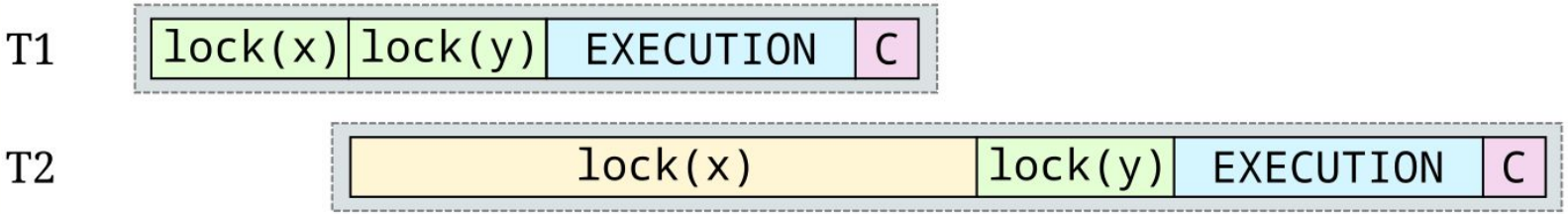

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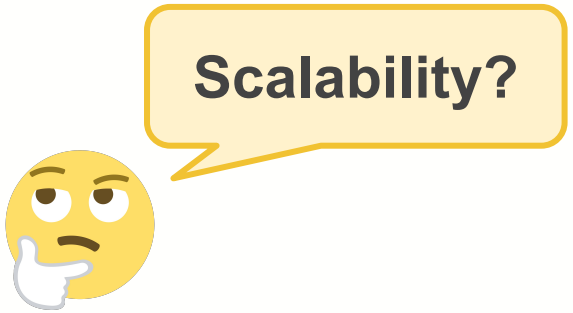

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- **DecentSched**

DecentSched

- Three transactions accessing three variables
  - `T1: x, z`
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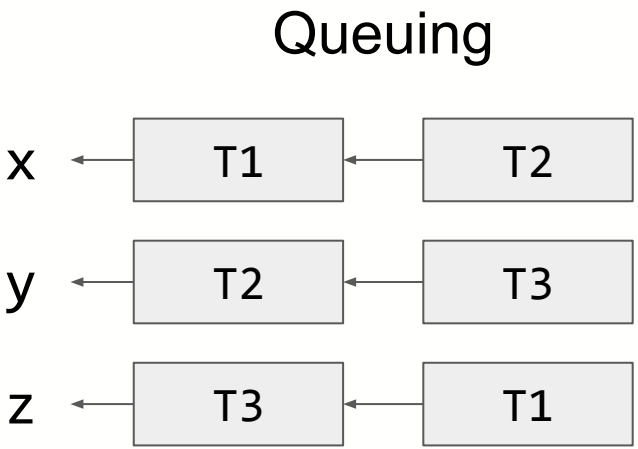

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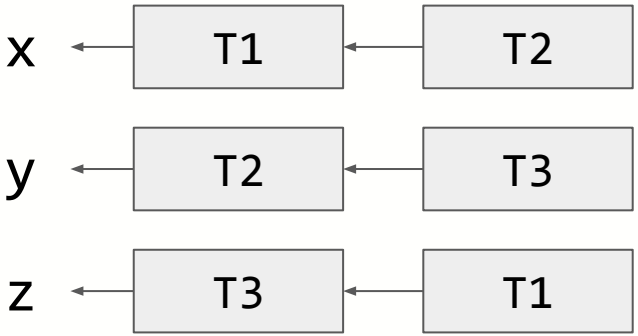

Dependency tracking

T1 T2 T3

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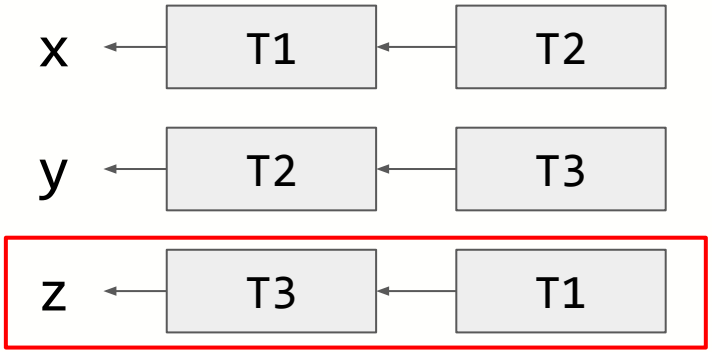

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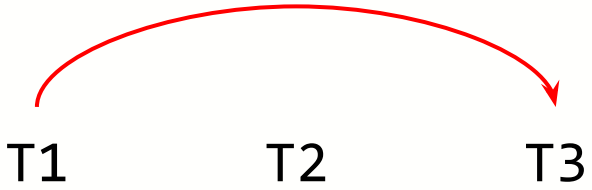

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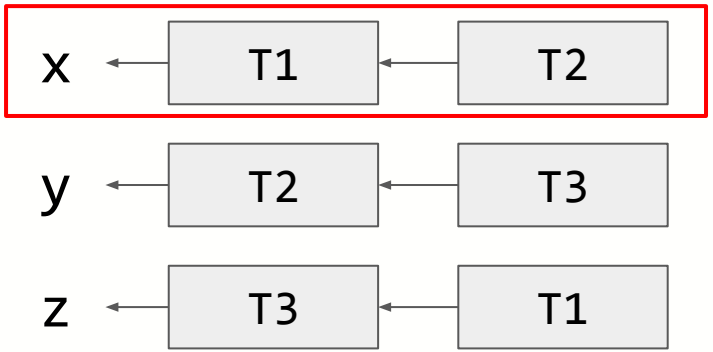

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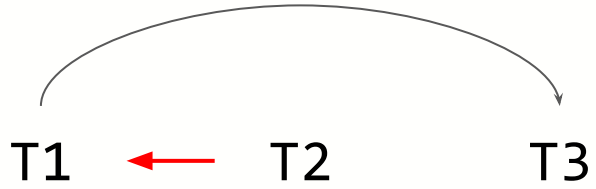

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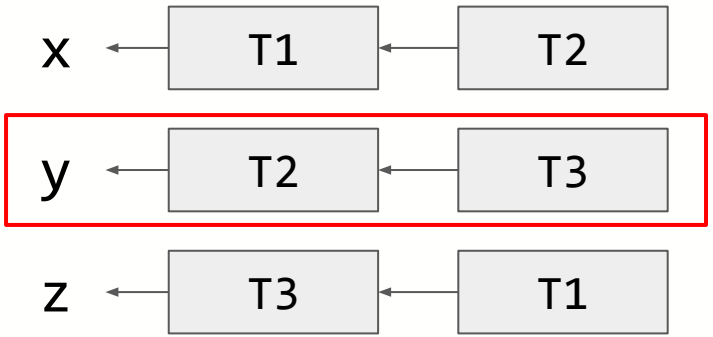

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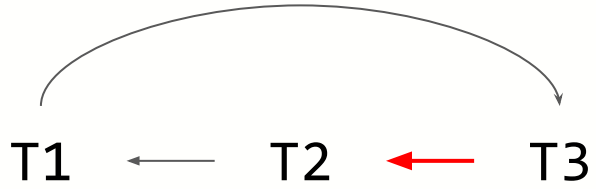

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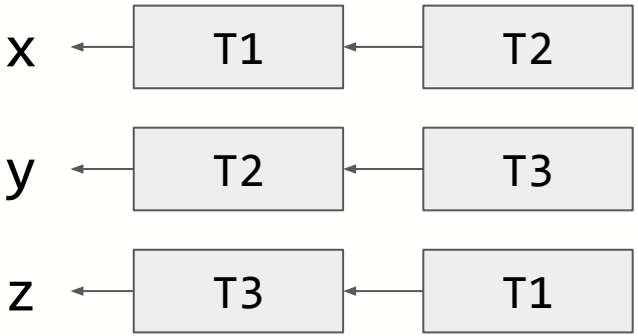

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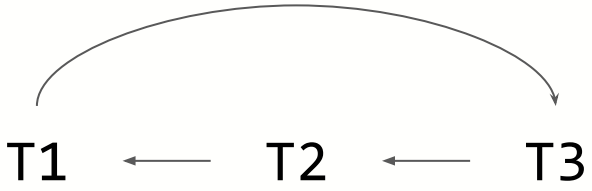

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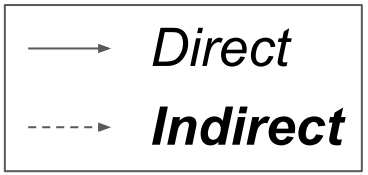

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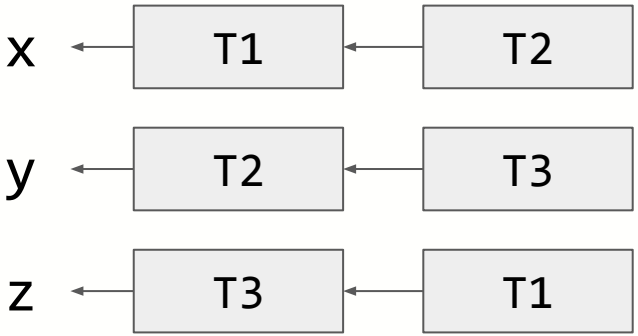

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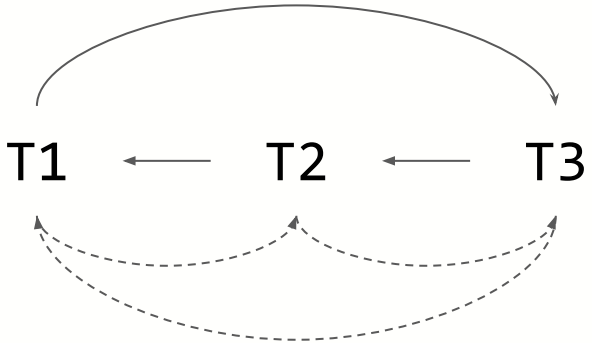

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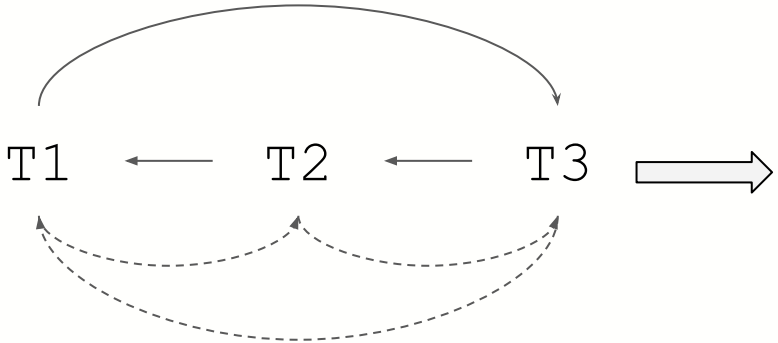

Dependency set

T1: { $T3_{(direct)}$, $T2_{(indirect)}$ }
T2: { $T1_{(direct)}$, $T3_{(indirect)}$ }
T3: { $T2_{(direct)}$, $T1_{(indirect)}$ }

DecentSched

- Scheduling transaction T is done by evaluating each transaction T’ in its dependency set.

1. Ignore T’ if If T’ and T are not each other’s direct dependencies.
2. Otherwise:
   a. Unidirectional -> unconditional wait
   b. Bidirectional (cyclic) -> lower id executes first

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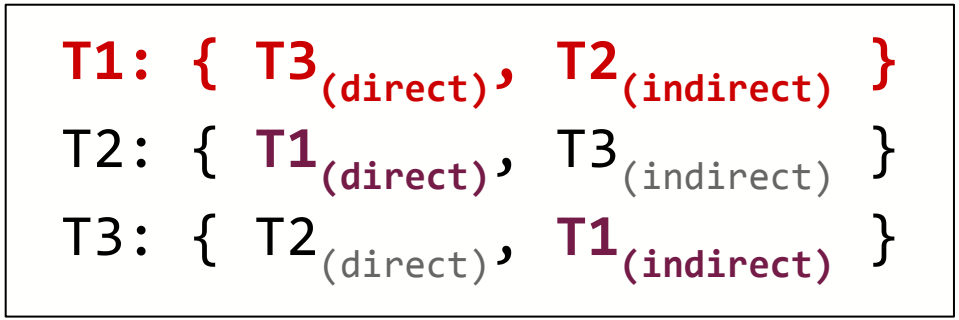

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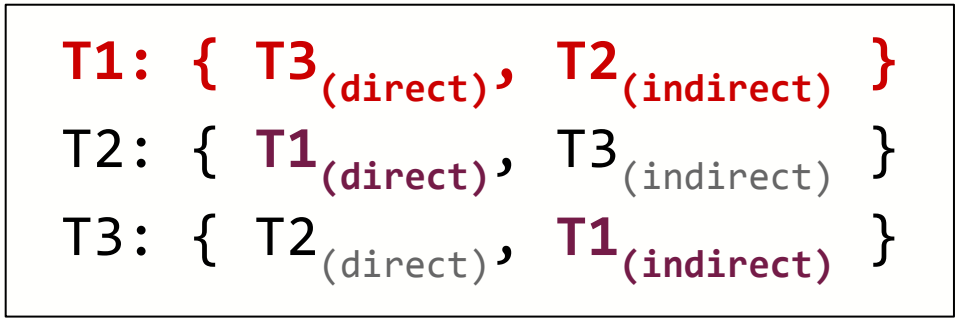

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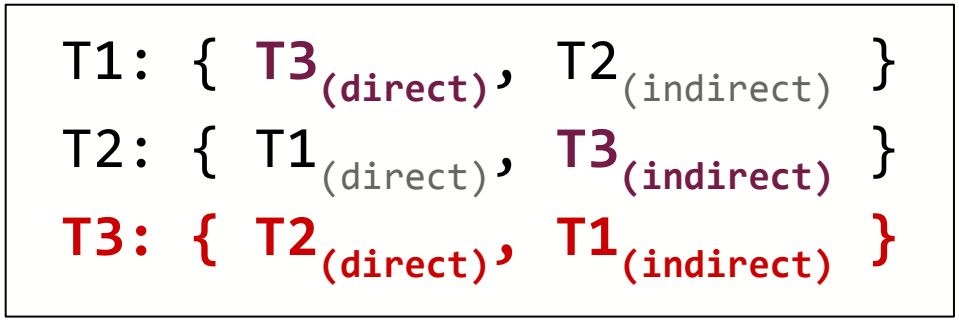

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T2: waits for T1, precedes T3

T3: waits for T1 and T2

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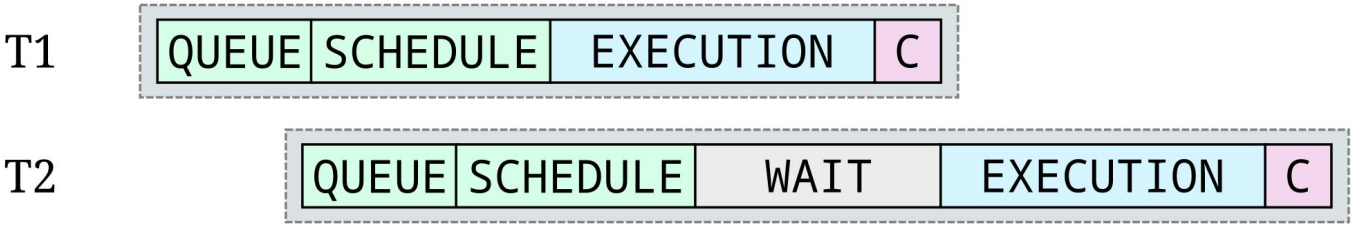

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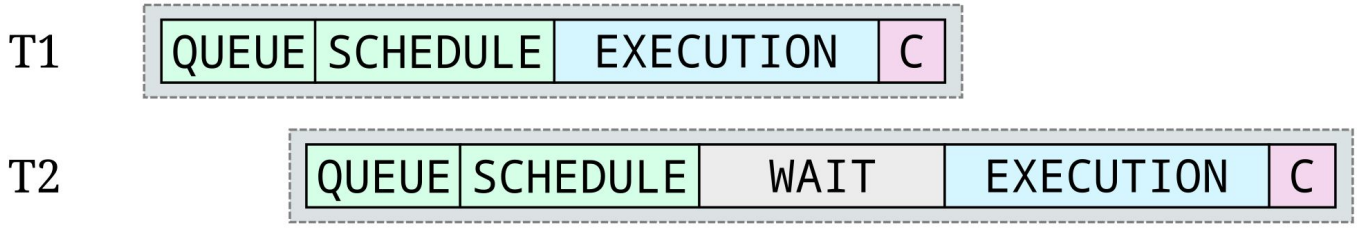
  - Compared to Locking:
    - **No lock contentions**



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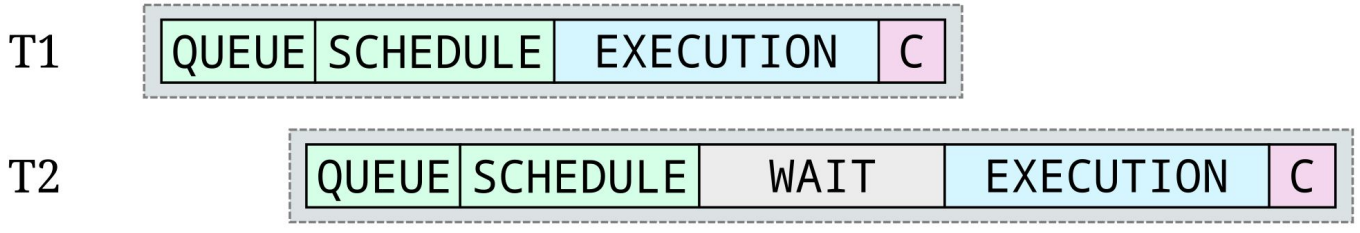
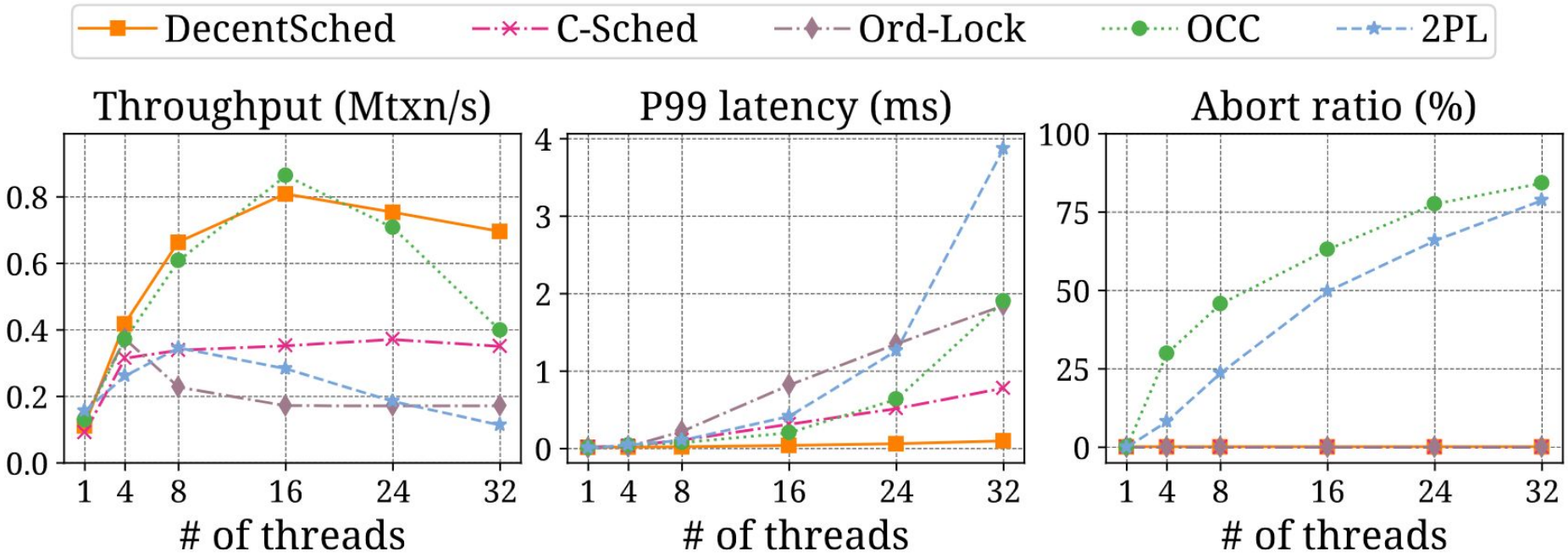
  - Compared to OCC:
    - **Deterministic commit order**



Evaluation: Transactional YCSB-A



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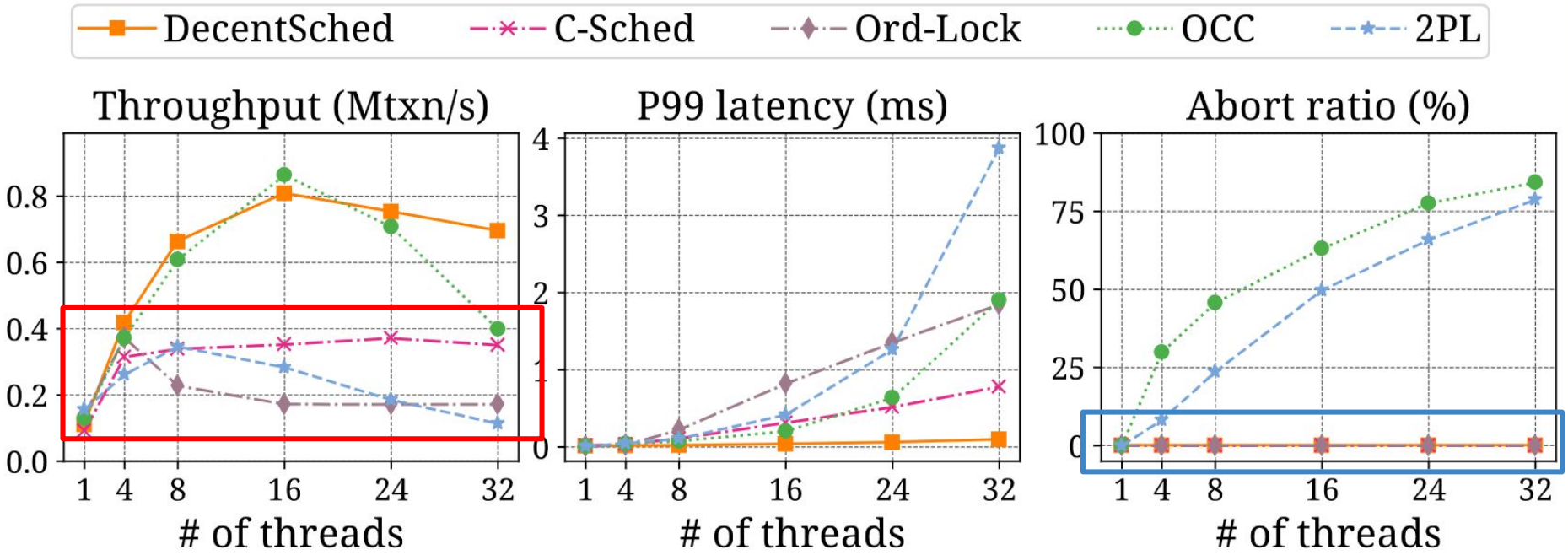

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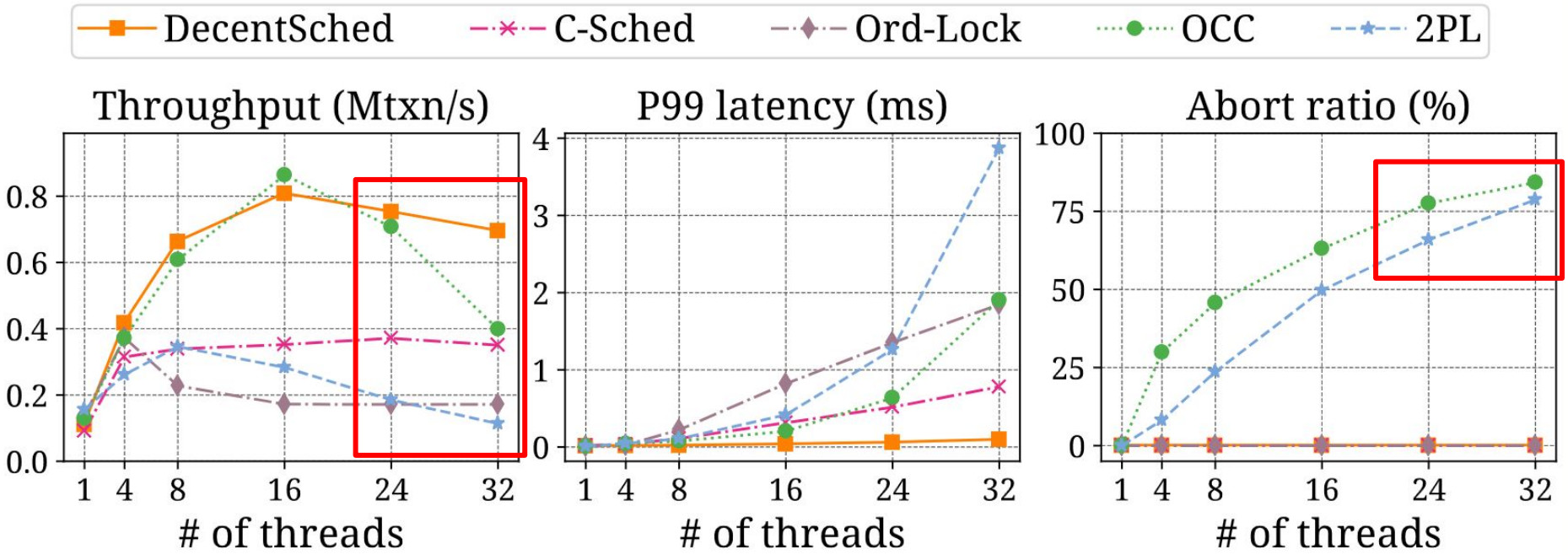

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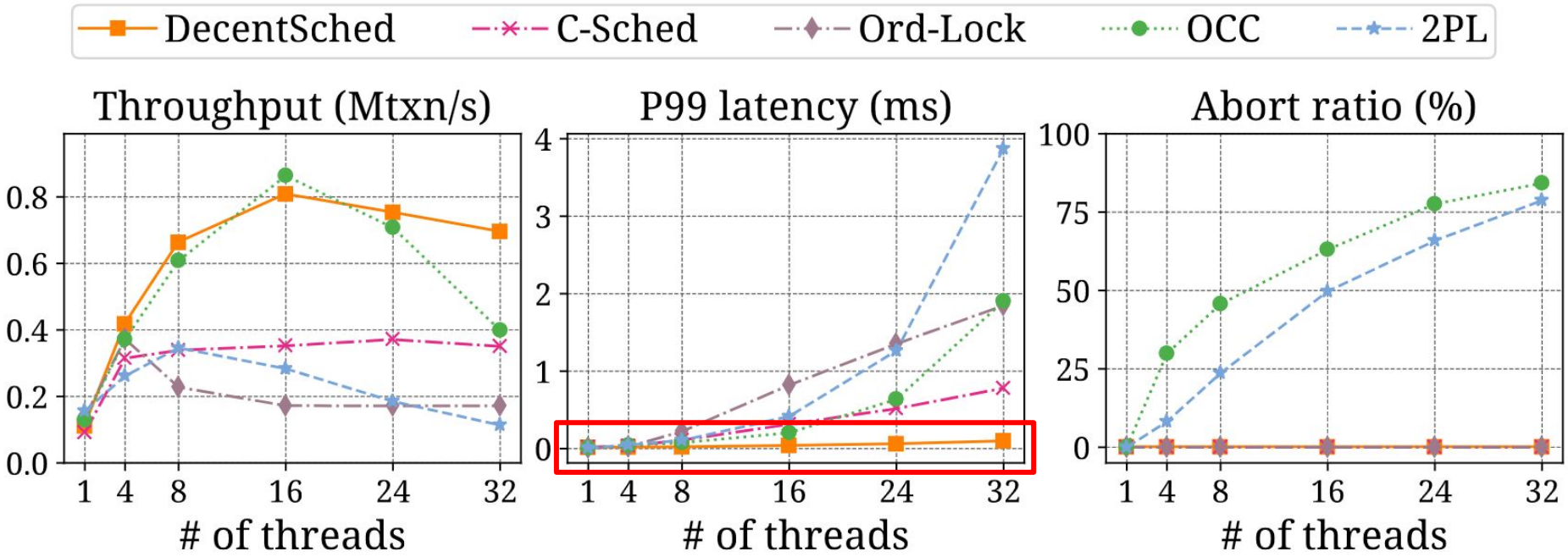

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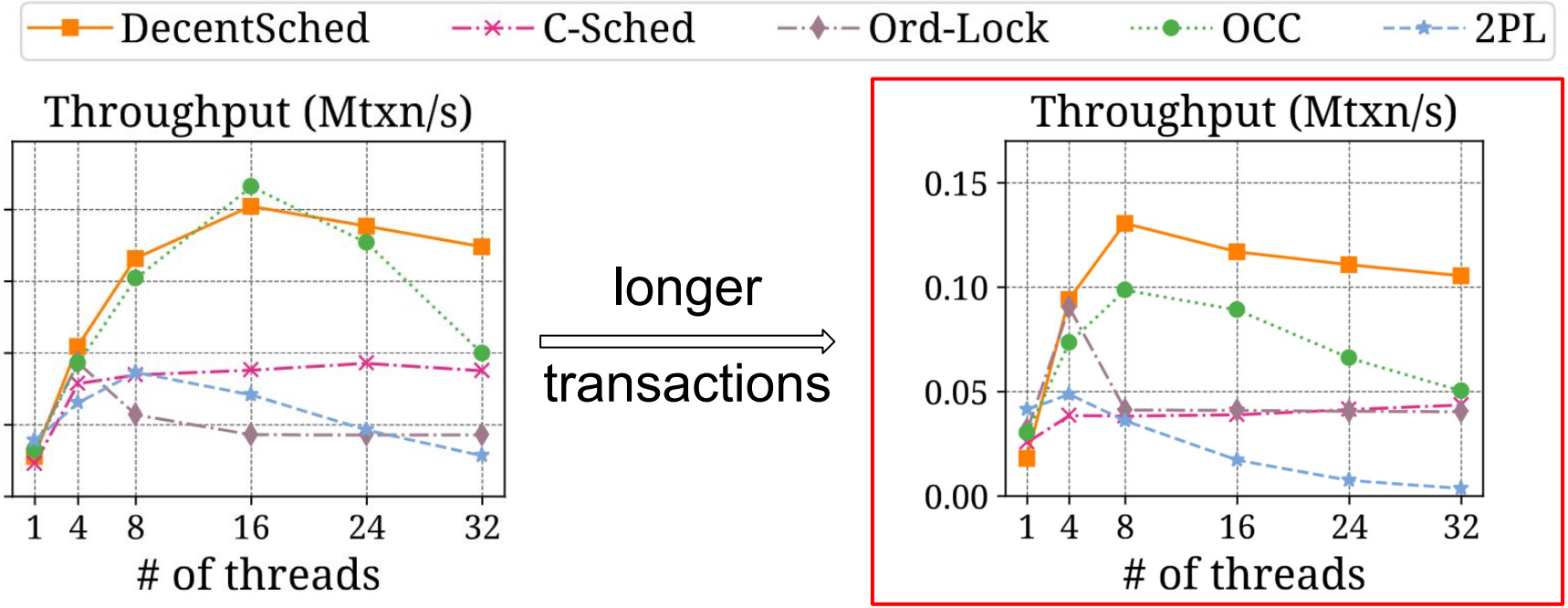

More Details in the Paper

- Implementation and optimizations
- Memory management
- TPC-C Benchmark Results
- Future works

- Code and artifacts are available on 
  https://github.com/decentralized-scheduling/