Brief Announcement: Enhancing Permissiveness of Transactional Memory via Time-Warp

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Introduction

To guarantee a given correctness level, a TM aborts transactions.

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function **commit**(`Transaction` *tx*):

  for each ‹*datum*, *version*›∈ *tx*.readSet **do**
    if not latestVersion(*datum*, *version*) **then**
      abort(*tx*)

Problem at hands

Condition:
Abort T if its reads are not up-to-date when it attempts to commit.

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- But **not** sufficient

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Abort T if its reads are not up-to-date when it attempts to commit.

Serializability:

- Necessary condition
- But **not** sufficient
- Deemed to be practical

Problem

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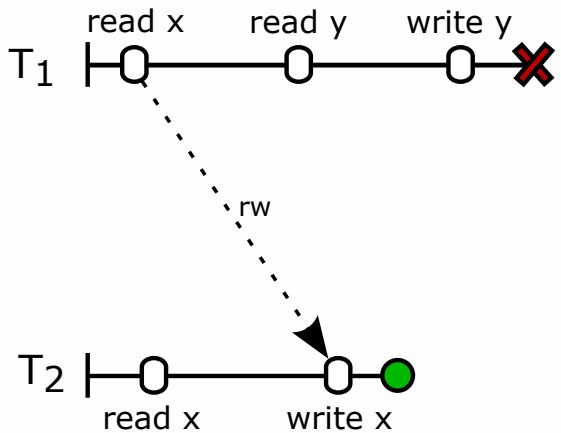
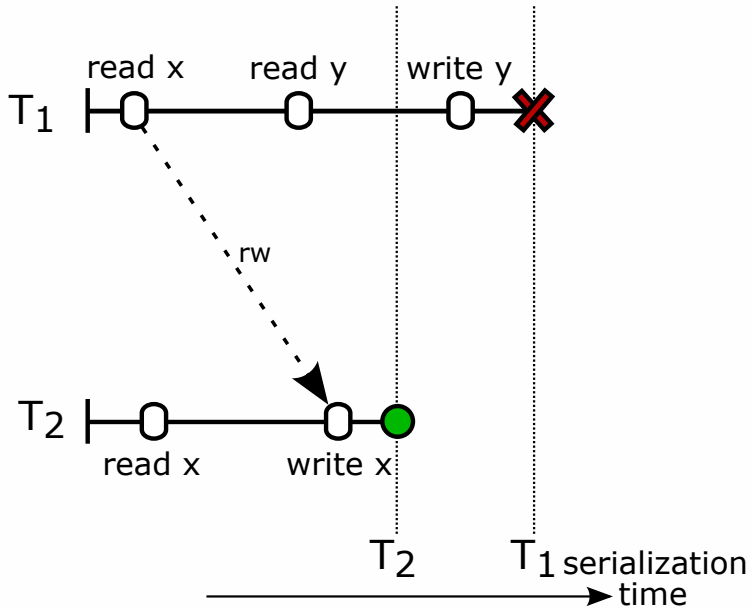
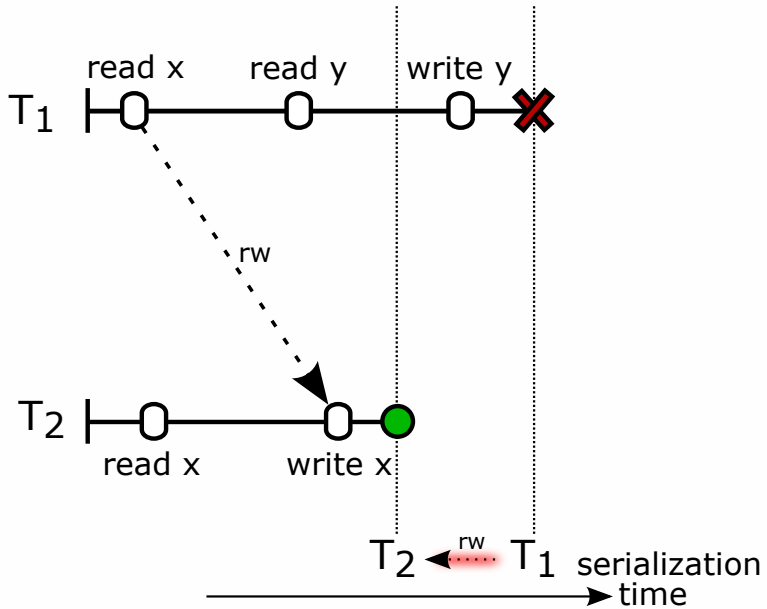


Problem


read x
read y
write y
T1
rw
T2
read x
write x
T2
T1
serialization
time

Problem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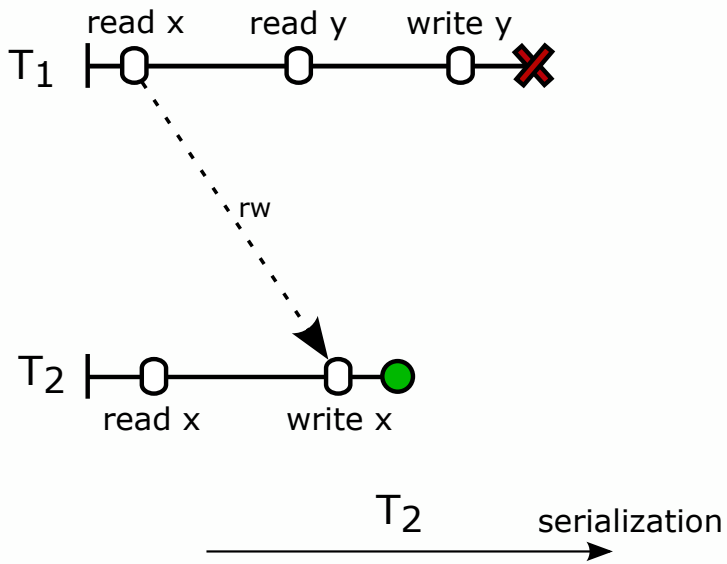

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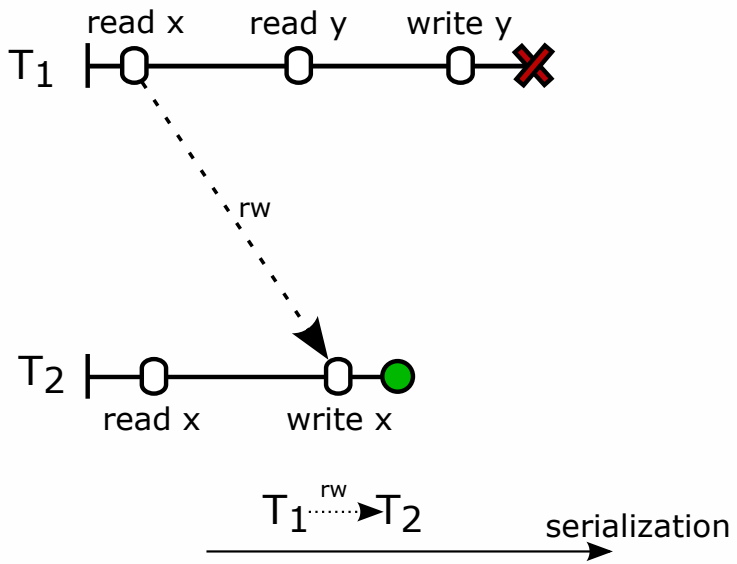
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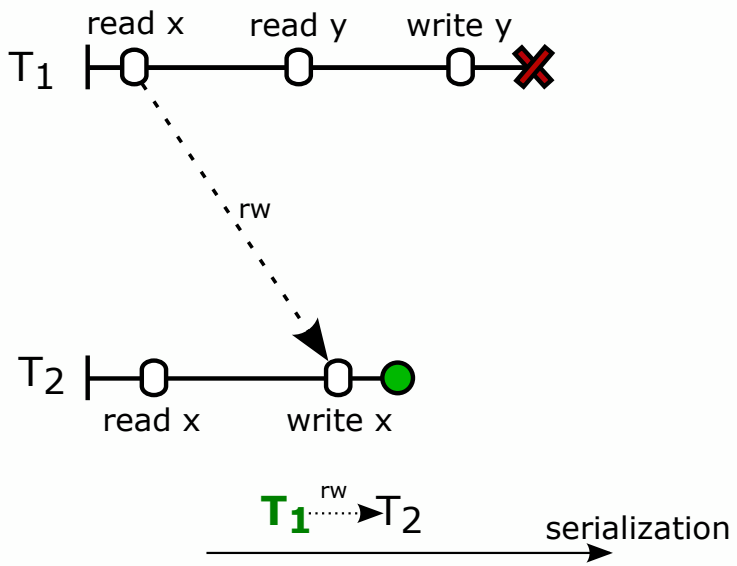

Time-warp commit

Permissiveness

Notion of avoiding unnecessary aborts

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Notion of avoiding unnecessary aborts:

- If it only aborts a transaction when the resulting history (without the abort) does not respect some target correctness criterion

- State of the art TMs are far from being permissive
- Cost is **not** negligible.

Goal

Enhance permissiveness without such costs

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Enhance permissiveness without such costs:

- More restrictive abort condition
- Always read consistently
- Wait-free read-only transactions (mv-permissiveness)

Time-warp

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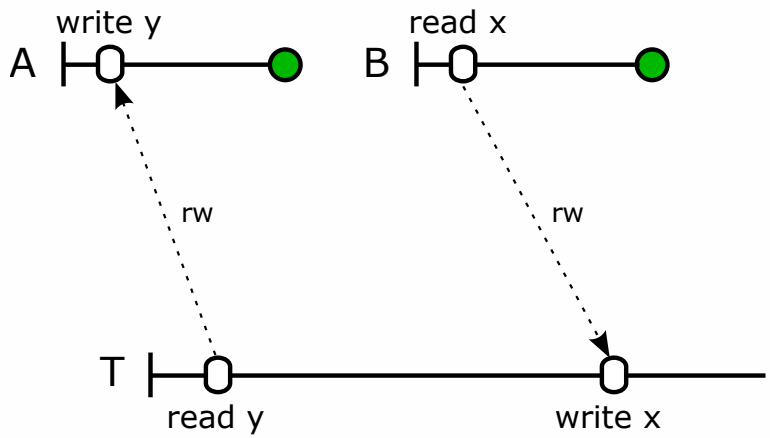
- Three transactions connected
  - a triad



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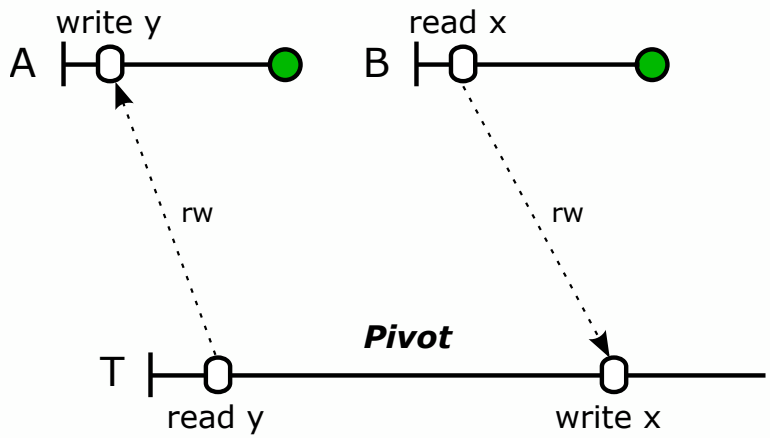

Time-warp

When can we **not** apply this idea?

Look out for a specific structure:

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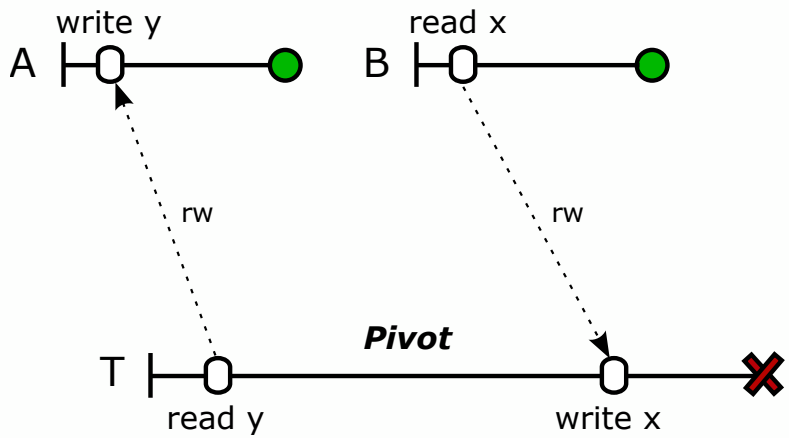
  - a triad
- The link between all three
  - the pivot
- Abort if:
  - Completes a triad
  - Whose pivot time-warp commits



Theoretical and Practical results

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  - Prevent a range of phenomena for running transactions

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  - Serializability for committed transactions
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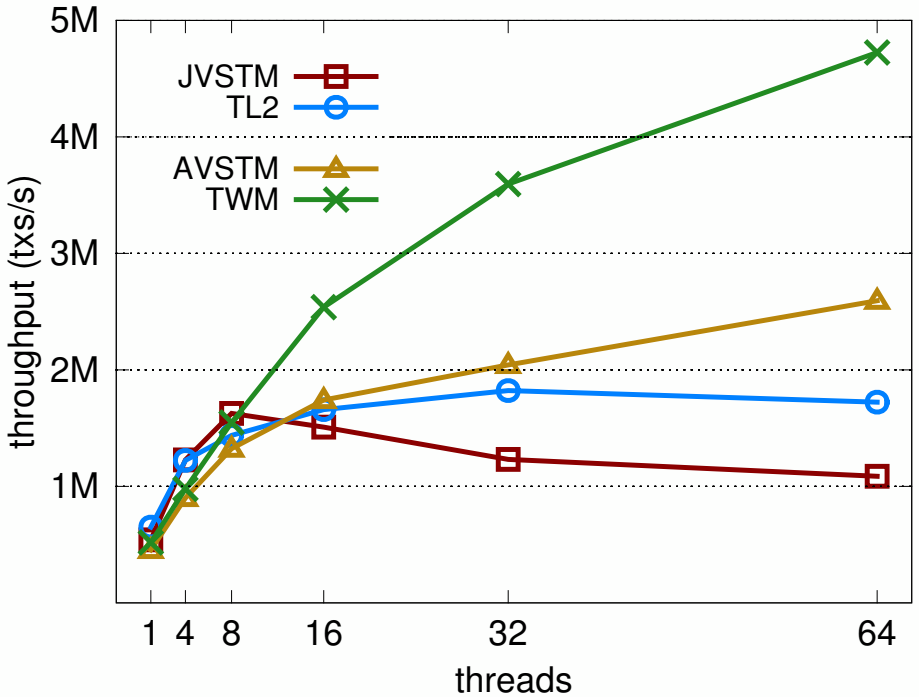
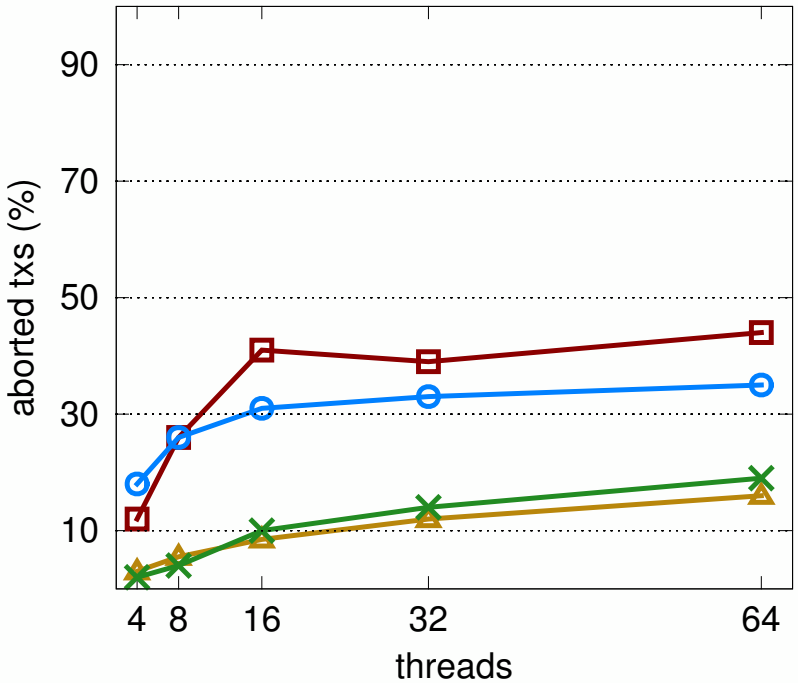
- Lock-free prototype in Java: TWM
- 64 core machine
- Comparison with TL2, JVSTM, AVSTM

Ordered Skip-List





Thank you

Enhancing Permissiveness in Transactional Memory via Time-Warping,
INESC-ID, TR 10/2013