Add/Drop Index (Concurrently) in Peloton

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Advanced Database Systems
15-721 Final Presentation

AGENDA

Recap: what have we done?

- Motivation
- Goal
- 75%: Lock everything
- 100%: Concurrency pain
- 125%: Multithreading? For real?

Testing: from unit to SQL

Code quality: of course we are good

Future: more index, more fun

MOTIVATION

It's Broken.

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GOAL

75%: Support add/drop index correctly in Peloton, using locking mechanisms.

For drop index: Implementations already exists, yet buggy in some ways. We fixed those bugs.

For add index: Implemented lock-based version, based on our centralized lock-manager.

LOCK MANAGER

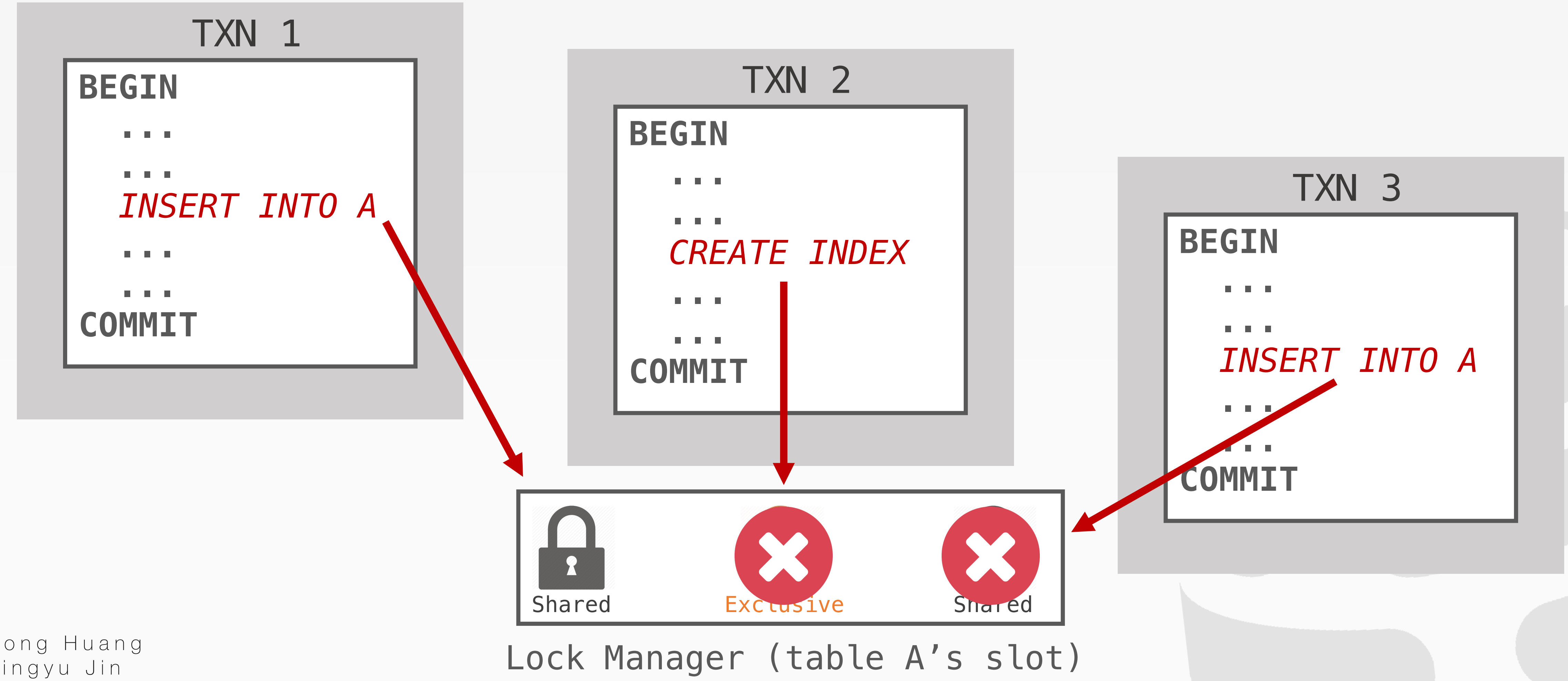
Centralized: get a static copy of it just like you get the instance of catalog

Per-table lock: lock the tables based on their oid

Two modes: you can use it as a scope lock, which will unlocks when the scope ends. You can also lock the table until current transaction ends.

Currently supports only read_write lock, but can be extended.

75%: LOCK EVERYTHING



GOAL

100%: Support add index correctly in Peloton, by doing it concurrently

We managed to come up with a solution that deals with possible race conditions. No lock is used in our implementation. Also, we added support for parsing the query "CREATE INDEX CONCURRENTLY".

Notice that concurrent create index will not block other txns, but itself still blocks (same behavior as Postgres).

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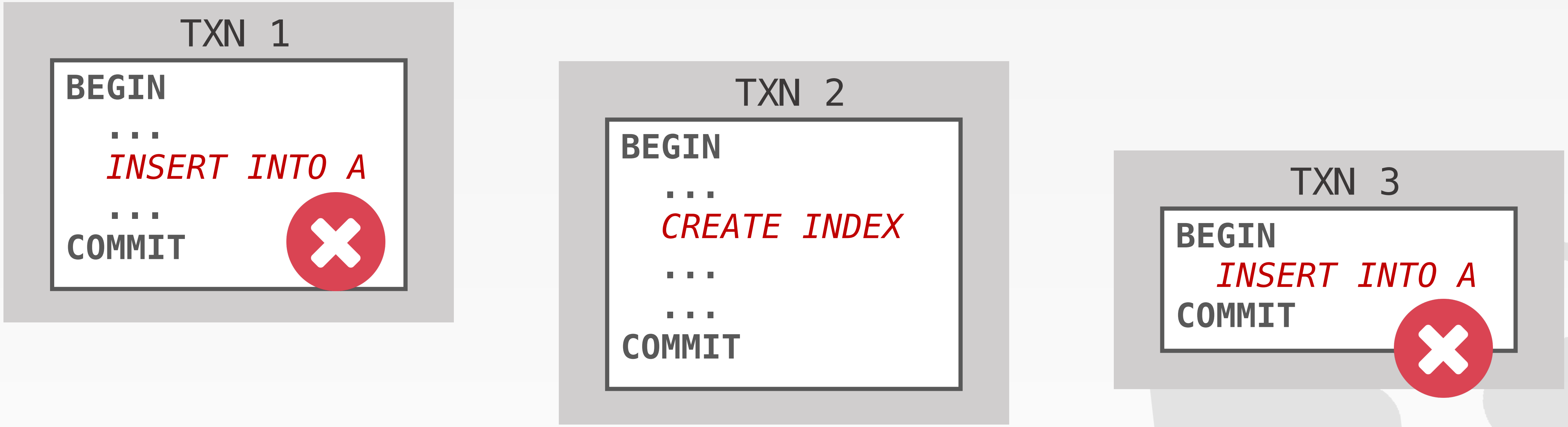
100%: HANDLE CONCURRENCY



TXN 1

```
BEGIN
  ...
  INSERT INTO A
  ...
COMMIT
```

TXN 2

```
BEGIN
  ...
  CREATE INDEX
  ...
  ...
COMMIT
```

TXN 3

```
BEGIN
  INSERT INTO A
COMMIT
```

100%: HANDLE CONCURRENCY

TXN 1

```
BEGIN
   ...
   INSERT INTO A
   ...
COMMIT
```

TXN 2

```
BEGIN
   ...
   CREATE INDEX
   ...
   ...
COMMIT
```

TXN 3

```
BEGIN
   INSERT INTO A
COMMIT
```

TXN 1 TXN 2

Concurrent txns list

INSERT INTO A

Index: insertion record

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Ziheng Liao

GOAL

125%: Support add index correctly in Peloton, by doing it concurrently, and in parallel

Parallel add index depends largely on multi-threaded sequential scan, and Prashanth is still working on it.

TESTING

Unit tests: tests for lock manager, tests for add/drop index

SQL tests with junit: launch parallel transactions, testing concurrent operations with or without enforced ordering of events.

DEMO

PELOTON

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Ziheng Liao

CODE QUALITY

Utilizing object lifecycle to unlock scoped locks automatically

Utilizing shared ptr to avoid other transactions holding deleted locks

Utilizing concurrent data structure (tbb's concurrent_unordered_set) to avoid race conditions

Strength: put new functionalities in proper places; design with minimum impact to existing code

Weakness: didn't comment code as we develop, but rather add them later on

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Xingyu Jin
Ziheng Liao

PELOTON IS BUGGY!

Some known bugs that has been fixed by our team:

- DropIndex won't actually drop index in table_catalog (function call typo)
- PopulateIndex will add entries to already existed indexes
- PopulateIndex will cause transaction abort if the index is empty

PELOTON IS BUGGY!

Some still existing bugs:

- Insert/Delete/Update actions in transaction -> goes through codegen modules, like codegen::Inserter, codegen::Deleter, etc.
- Insert/Delete/Update action not in transaction -> goes through executors (marked as deprecated)
- Weird behavior that Peloton kept switching between executor and their corresponding codegen version. When it uses executor, bugs caused segmentation fault when accessing bw_tree index in certain ways. This bug originated from cmu-db/peloton, and as we were told that those executors are going to be deprecated, we didn't take effort in fixing them.

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FUTURE WORK

Populate index is currently an executor and marked as deprecated. Should add it as one of the codegen modules

Support create index in parallel, after parallel sequential scan is sorted out

More on indexing: add indexes to tables, just like Cicada

Fix related bugs that has not been resolved

Q&A

Thank you!

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Xingyu Jin
Ziheng Liao