Optimistic Concurrency Control

- The control is deferred until the transaction ends
- Only admits those histories equivalent to the serial history that coincides with the commit order
- Structures needed per transaction:
  - Read Set (Txs that read a given granule)
  - Write Set (Txs that wrote a given granule)
  - Set of transactions committed during its reading phase (Txs that finished while our transaction was being executed; called reading phase)

Optimistic concurrency control phases

1. Reading
   - Writings are done on private copies
   - Readings are done on public copies
     - Except those granules written by the tx
2. Validation

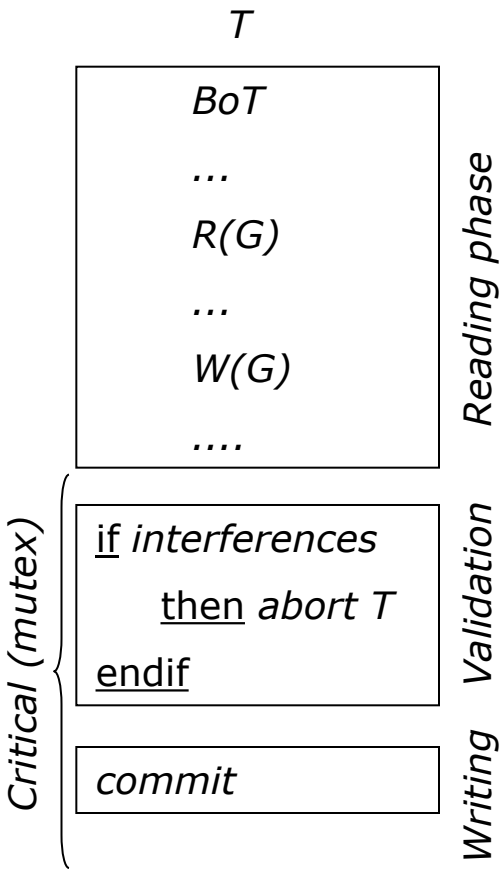
   foreach T_i in setOfCommitedTx

   if RS(T) ∩ WS(T_i) ≠ ∅ then

   abort T

   endif

   endForeach
3. Writing
   - Private copies are made public



Example of optimistic CC (I)

	T_1	T_2
1		
2		
3		
4		
5		
6		

Example of optimistic CC (I)

	T_1	T_2
1	BoT	
2		
3		
4		
5		
6		

Example of optimistic CC (I)

$RS(T_1) = \varnothing$
$WS(T_1) = \varnothing$

	T_1	T_2
1	BoT	
2		
3		
4		
5		
6		

Example of optimistic CC (I)

$RS(T_1) = \varnothing$
$WS(T_1) = \varnothing$

	T_1	T_2
1	BoT	
2		BoT
3		
4		
5		
6		

Example of optimistic CC (I)

	$RS(T_1)= \varnothing$ $WS(T_1)= \varnothing$ T_1	$RS(T_2)= \varnothing$ $WS(T_2)= \varnothing$ T_2
1	BoT	
2		BoT
3		
4		
5		
6		

Example of optimistic CC (I)

	$RS(T_1)= \varnothing$ $WS(T_1)= \varnothing$ T_1	$RS(T_2)= \varnothing$ $WS(T_2)= \varnothing$ T_2
1	BoT	
2		BoT
3	R(A)	
4		
5		
6		

Example of optimistic CC (I)

	$RS(T_1)= \{A\}$ $WS(T_1)= \varnothing$	$RS(T_2)= \varnothing$ $WS(T_2)= \varnothing$
	T_1	T_2
1	BoT	
2		BoT
3	R(A)	
4		
5		
6		

Example of optimistic CC (I)

	$RS(T_1)= \{A\}$ $WS(T_1)= \varnothing$	$RS(T_2)= \varnothing$ $WS(T_2)= \varnothing$
	T_1	T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		
6		

Example of optimistic CC (I)

	$RS(T_1)= \{A\}$ $WS(T_1)= \varnothing$	$RS(T_2)= \{A\}$ $WS(T_2)= \varnothing$
	T_1	T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		
6		

Example of optimistic CC (I)

$RS(T_1) = \{A\}$ $RS(T_2) = \{A\}$
$WS(T_1) = \varnothing$ $WS(T_2) = \varnothing$

	T_1	T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		$W(A)->A_{T2}$
6		

Example of optimistic CC (I)

	$RS(T_1)= \{A\}$ $WS(T_1)= \varnothing$	$RS(T_2)= \{A\}$ $WS(T_2)= \{A\}$
	T_1	T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		$W(A)->A_{T2}$
6		

Example of optimistic CC (I)

	$RS(T_1)= \{A\}$ $WS(T_1)= \varnothing$	$RS(T_2)= \{A\}$ $WS(T_2)= \{A\}$
	T_1	T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		$W(A)->A_{T2}$
6	R(A)	

Example of optimistic CC (I)

	$RS(T_1)= \{A\}$ $WS(T_1)= \varnothing$ T_1	$RS(T_2)= \{A\}$ $WS(T_2)= \{A\}$ T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		$W(A)->A_{T2}$
6	R(A)	
	validation	

Example of optimistic CC (I)

	$RS(T_1)= \{A\}$ $WS(T_1)= \varnothing$ T_1	$RS(T_2)= \{A\}$ $WS(T_2)= \{A\}$ T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		$W(A)->A_{T2}$
6	R(A)	
	validation commit	

Example of optimistic CC (I)

		$setOfCommitedTx(T_2)=\{T_1\}$
	$RS(T_1)= \{A\}$	$RS(T_2)= \{A\}$
	$WS(T_1)= \varnothing$	$WS(T_2)= \{A\}$
	T_1	T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		$W(A)->A_{T2}$
6	R(A)	
	validation	
	commit	

Example of optimistic CC (I)

$setOfCommitedTx(T_2)=\{T_1\}$

$RS(T_1)= \{A\}$ $RS(T_2)= \{A\}$
$WS(T_1)= \varnothing$ $WS(T_2)= \{A\}$

	T_1	T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		$W(A)->A_{T2}$
6	R(A)	
	validation commit	
		validation

Example of optimistic CC (I)

		$setOfCommitedTx(T_2)=\{T_1\}$
	$RS(T_1)= \{A\}$	$RS(T_2)= \{A\}$
	$WS(T_1)= \varnothing$	$WS(T_2)= \{A\}$
	T_1	T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		$W(A)->A_{T2}$
6	R(A)	
	validation commit	
		validation $RS(T_2) \cap WS(T_1)=\varnothing$

Example of optimistic CC (I)

$setOfCommitedTx(T_2)=\{T_1\}$

$RS(T_1)= \{A\}$ $RS(T_2)= \{A\}$

$WS(T_1)= \varnothing$ $WS(T_2)= \{A\}$

	T_1	T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		$W(A)->A_{T2}$
6	R(A)	
	validation	
	commit	
		validation
		$RS(T_2) \cap WS(T_1)=\varnothing$
		commit
		$A_{T2}->public$

Example of optimistic CC (II)

	T_1	T_2
1		
2		
3		
4		
5		
6		

Example of optimistic CC (II)

	T_1	T_2
1	BoT	
2		
3		
4		
5		
6		

Example of optimistic CC (II)

$RS(T_1) = \varnothing$
$WS(T_1) = \varnothing$

	T_1	T_2
1	BoT	
2		
3		
4		
5		
6		

Example of optimistic CC (II)

$RS(T_1) = \varnothing$
$WS(T_1) = \varnothing$

	T_1	T_2
1	BoT	
2		BoT
3		
4		
5		
6		

Example of optimistic CC (II)

	$RS(T_1)= \varnothing$ $WS(T_1)= \varnothing$ T_1	$RS(T_2)= \varnothing$ $WS(T_2)= \varnothing$ T_2
1	BoT	
2		BoT
3		
4		
5		
6		

Example of optimistic CC (II)

	$RS(T_1)= \varnothing$ $WS(T_1)= \varnothing$ T_1	$RS(T_2)= \varnothing$ $WS(T_2)= \varnothing$ T_2
1	BoT	
2		BoT
3	R(A)	
4		
5		
6		

Example of optimistic CC (II)

	$RS(T_1)= \{A\}$ $WS(T_1)= \varnothing$	$RS(T_2)= \varnothing$ $WS(T_2)= \varnothing$
	T_1	T_2
1	BoT	
2		BoT
3	R(A)	
4		
5		
6		

Example of optimistic CC (II)

	$RS(T_1)= \{A\}$ $WS(T_1)= \varnothing$	$RS(T_2)= \varnothing$ $WS(T_2)= \varnothing$
	T_1	T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		
6		

Example of optimistic CC (II)

	$RS(T_1)= \{A\}$ $WS(T_1)= \varnothing$	$RS(T_2)= \{A\}$ $WS(T_2)= \varnothing$
	T_1	T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		
6		

Example of optimistic CC (II)

	$RS(T_1)= \{A\}$ $WS(T_1)= \varnothing$	$RS(T_2)= \{A\}$ $WS(T_2)= \varnothing$
	T_1	T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		$W(A)->A_{T2}$
6		

Example of optimistic CC (II)

$RS(T_1) = \{A\}$ $RS(T_2) = \{A\}$
$WS(T_1) = \varnothing$ $WS(T_2) = \{A\}$

	T_1	T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		$W(A)->A_{T2}$
6		

Example of optimistic CC (II)

	$RS(T_1)= \{A\}$ $WS(T_1)= \varnothing$	$RS(T_2)= \{A\}$ $WS(T_2)= \{A\}$
	T_1	T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		$W(A)->A_{T2}$
6	R(A)	

Example of optimistic CC (II)

	$RS(T_1)= \{A\}$ $WS(T_1)= \varnothing$	$RS(T_2)= \{A\}$ $WS(T_2)= \{A\}$
	T_1	T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		$W(A)->A_{T2}$
6	R(A)	
		validation

Example of optimistic CC (II)

	$RS(T_1)= \{A\}$ $WS(T_1)= \varnothing$	$RS(T_2)= \{A\}$ $WS(T_2)= \{A\}$
	T_1	T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		$W(A)->A_{T2}$
6	R(A)	
		validation commit

Example of optimistic CC (II)

	$RS(T_1)= \{A\}$ $WS(T_1)= \varnothing$ T_1	$RS(T_2)= \{A\}$ $WS(T_2)= \{A\}$ T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		$W(A)->A_{T2}$
6	R(A)	
		validation
		commit
		$A_{T2}->public$

Example of optimistic CC (II)

$setOfCommitedTx(T_1)=\{T_2\}$

$RS(T_1)= \{A\}$ $RS(T_2)= \{A\}$

$WS(T_1)= \varnothing$ $WS(T_2)= \{A\}$

	T_1	T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		$W(A)->A_{T2}$
6	R(A)	
		validation
		commit
		$A_{T2}->public$

Example of optimistic CC (II)

$setOfCommitedTx(T_1)=\{T_2\}$

$RS(T_1)=\{A\}$ $WS(T_1)=\varnothing$ $RS(T_2)=\{A\}$ $WS(T_2)=\{A\}$

	T_1	T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		$W(A)->A_{T2}$
6	R(A)	
		validation
		commit
		$A_{T2}->public$
	validation	

Example of optimistic CC (II)

$setOfCommitedTx(T_1)=\{T_2\}$

$RS(T_1)=\{A\}$ $WS(T_1)=\varnothing$ $RS(T_2)=\{A\}$ $WS(T_2)=\{A\}$

	T_1	T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		$W(A)->A_{T2}$
6	R(A)	
		validation
		commit
		$A_{T2}->public$

validation

$RS(T_1) \cap WS(T_2)=\{A\}$

Example of optimistic CC (II)

$setOfCommitedTx(T_1)=\{T_2\}$

$RS(T_1)=\{A\}$ $WS(T_1)=\varnothing$ $RS(T_2)=\{A\}$ $WS(T_2)=\{A\}$

	T_1	T_2
1	BoT	
2		BoT
3	R(A)	
4		R(A)
5		$W(A)->A_{T2}$
6	R(A)	
		validation
		commit
		A_{T2}->public
	validation	
	$RS(T_1) \cap WS(T_2)=\{A\}$	
	abort	