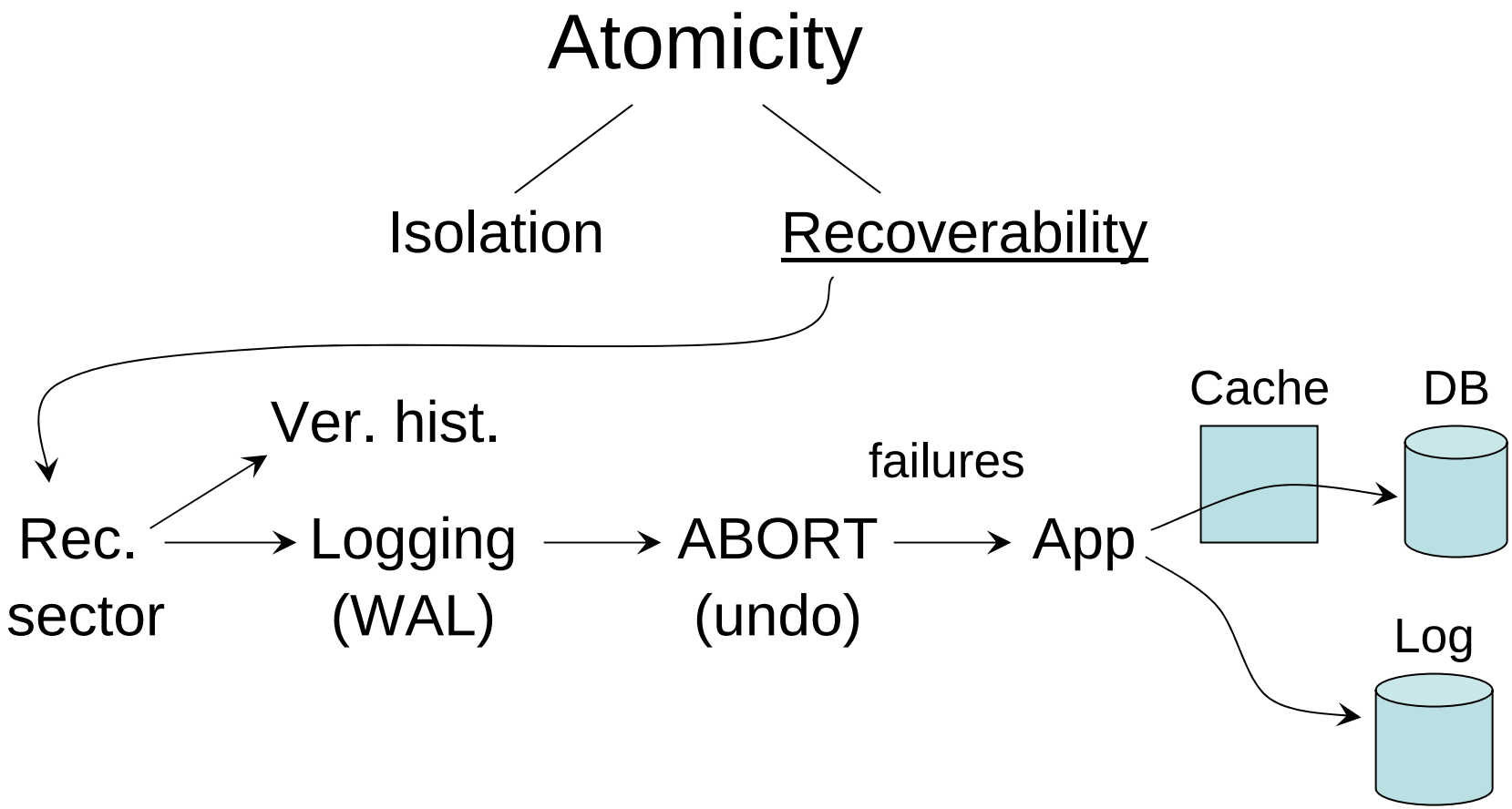

Atomicity
Isolation
Recoverability
Ver. hist.
Rec.
sector
Logging
(WAL)
ABORT
(undo)
failures
App
Cache
DB
Log

Recovery

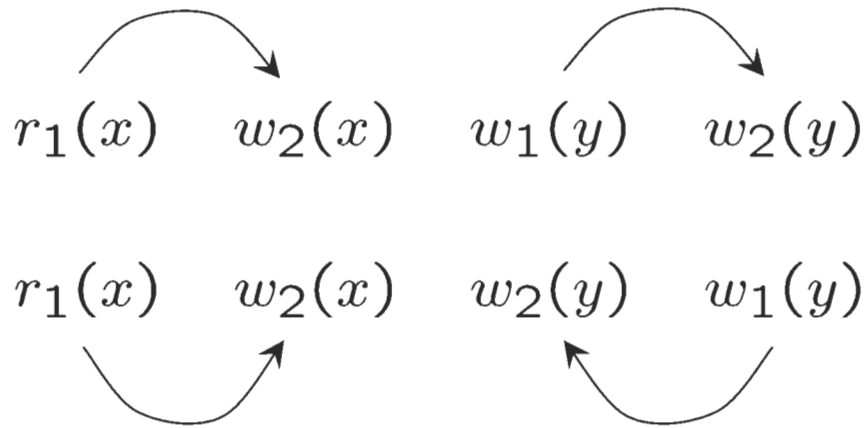
1) Undo
2) Redo

1) Scan log backwards
2) Winners = C + A
3) Losers:
4) Redo C winners + undo losers.

→

Isolation

T_1	T_2
1) read x	2) write x
3) write y	4) write y



$r(z)$	$w(z)$
$w(z)$	$r(z)$
$w(z)$	$w(z)$

Serializability:

Trace’s conflict arrow in same order as some serial order of actions

Action Graph

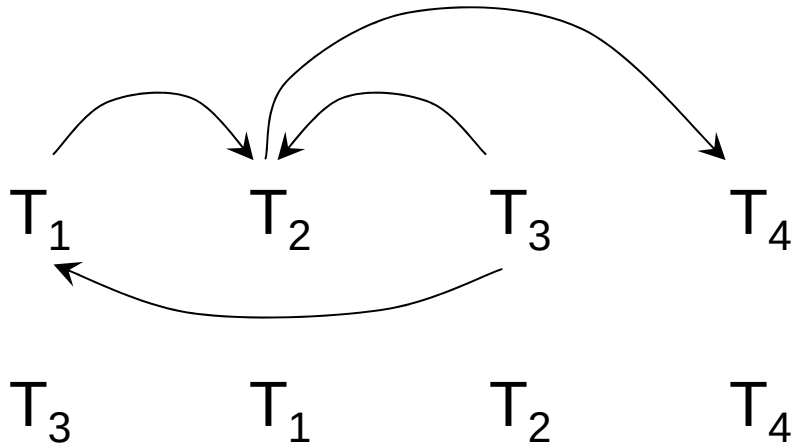
T_1	T_2	T_3	T_4
1) $r_1\ x$	2) $w_2\ x$	3) $r_3\ y$	4) $r_4\ x$
5) $w_1\ y$	6) $w_2\ y$	7) $w_3\ z$	

T_1 T_2

T_1 T_3

T_2 T_3

T_2 T_4



If Action Graph is acyclic

$\Leftrightarrow$ trace is serializable

$\Rightarrow$: Topo. sort

Locks:

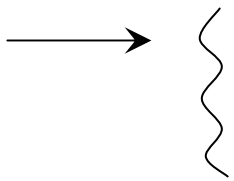
acq (lock of x)
rel (″)

1: acq l_x; $r_1(x)$; rel l_x
2: acq l_x; $w_2(x)$; acq l_y; $w_2(y)$
3: acq l_y; $w_1(y)$; rel l_y
4: rel l_x; rel l_y

Isolation:

acq l_x
acq l_y

Simple locking

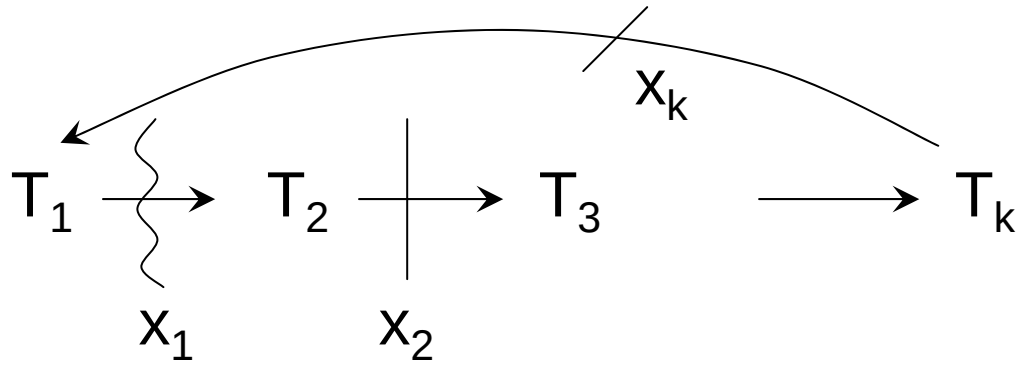


```
acq  l_x
 r    x
acq  l_y
 r    y
```

Two-phase locking (2 PL)

No release before ALL acquires

Correct



rel l_1

acq l_1

rel l_2

acq l_2

acq l_{k-1}

rel l_k

acq l_k