Welcome to CS 186, Section 9!

TA: Bryan Munar

OH: Mondays 11-12pm and Thursdays 2:30-3:30pm (651 Soda)

DISC: Tuesdays 11-12am (136 Barrows) and Wednesdays 10-11am (130 Wheeler)

Announcements and Such

- **Project/HW 4** due Wednesday!

- Midterm 2 next week!

- Midterm review session this Saturday (look on Piazza for more details)

Discussion 9: Lock Granularity and Timestamp Ordered-MVCC

Overview:

1. Lock Granularity
2. Worksheet exercises
3. TO-MVCC
4. Worksheet Exercises

(A majority of the slides are from Michelle and lecture!)

Lock Granularity

Lock Granularity

sid	points	grade
Bob	43	C
Joe	99	C
Alice	87	C
Suzy	50	C
Ted	73	C
Tim	12	C

T1: `UPDATE students SET grade='A' WHERE points >= 70;`

T2: `UPDATE students SET grade='F' WHERE points < 70;`

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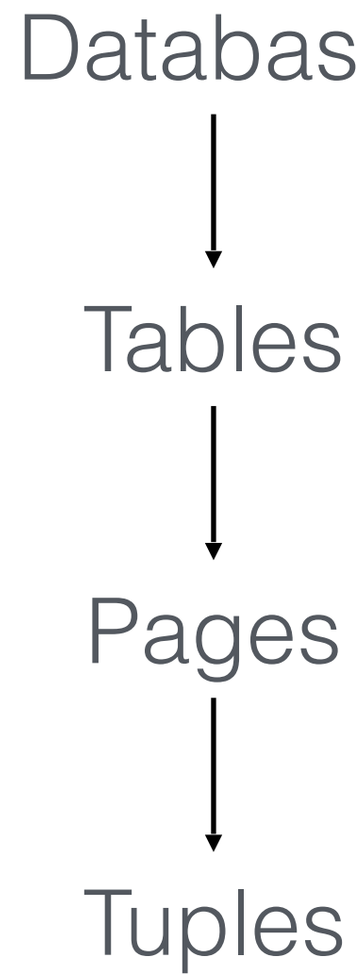
Lock Hierarchy

- Each Xact starts at root of hierarchy
- Gets locks in top-down order
- Releases locks in bottom-up order



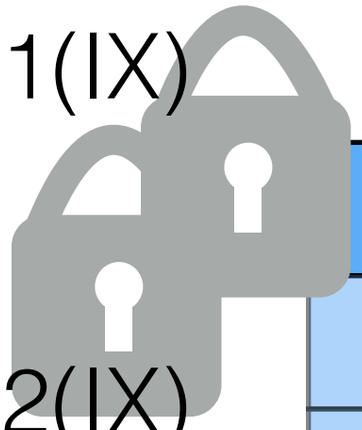
Locks

- IS: intent to get S lock(s) at finer granularity
- IX: intent to get X lock(s) at finer granularity
- SIX: shared lock, with intent to get X lock(s) at finer granularity

Lock Compatibility Matrix

	IS	IX	SIX	S	X
IS	√	√	√	√	-
IX	√	√	-	-	-
SIX	√	-	-	-	-
S	√	-	-	√	-
X	-	-	-	-	-

Lock Granularity



T1(IX)

T2(IX)

sid	points	grade	
Bob	43	F	T2(X)
Joe	99	A	T1(X)
Alice	87	A	T1(X)
Suzy	50	F	T2(X)
Ted	73	A	T1(X)
Tim	12	F	T2(X)

Worksheet - Lock Granularity

Suppose a transaction, T1, wants to scan a table R and update a few of its tuples. What kind of locks should T1 have on R, its pages, and the tuples that are updated?

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- SIX lock on R
- SIX lock on pages
- X lock on updated tuples

Is an S lock compatible with an IX lock? Explain why or why not. Make your description as simple as possible.

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- Incompatible:
  - T1 has S lock on Students table to calculate average grade
  - T2 wants IX lock to change some grades

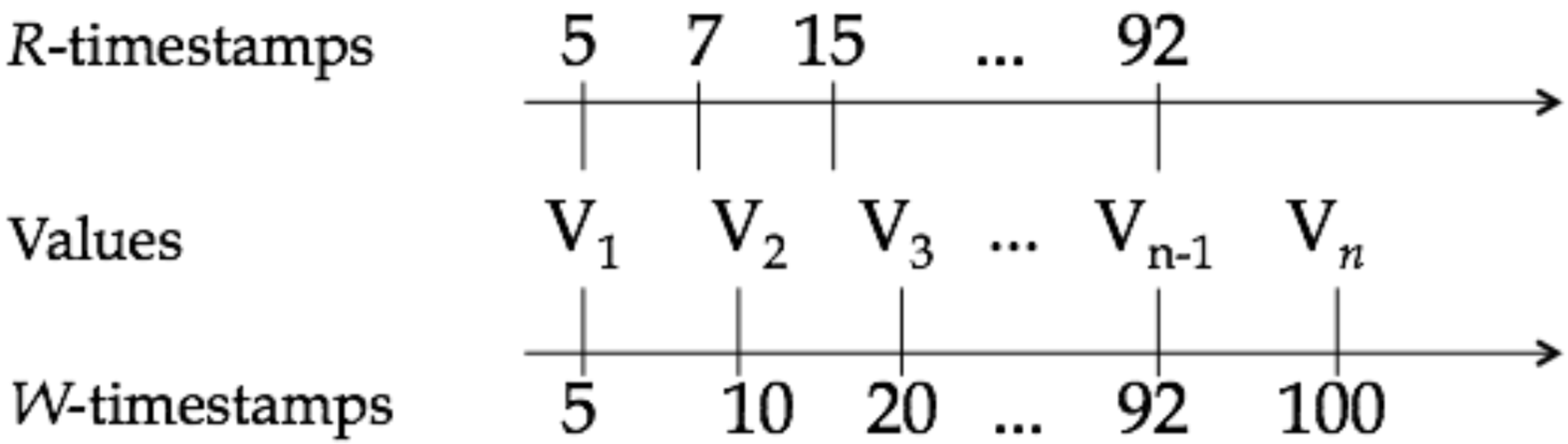
Timestamp Ordered-Multiversion Concurrency Control

Multiversion Concurrency Control

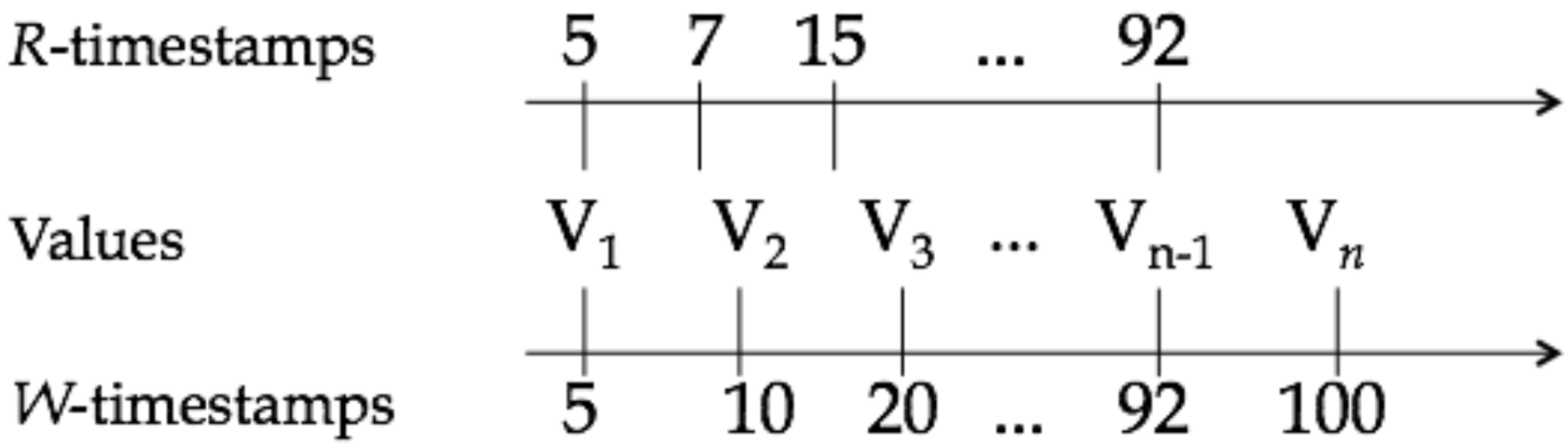
- Alternative to 2PL
  - Less waiting, but more aborts

- Timestamp Ordered MVCC:
  - Each transaction gets timestamp upon entry
  - Keep timeline of read timestamps and versions

TO-MVCC

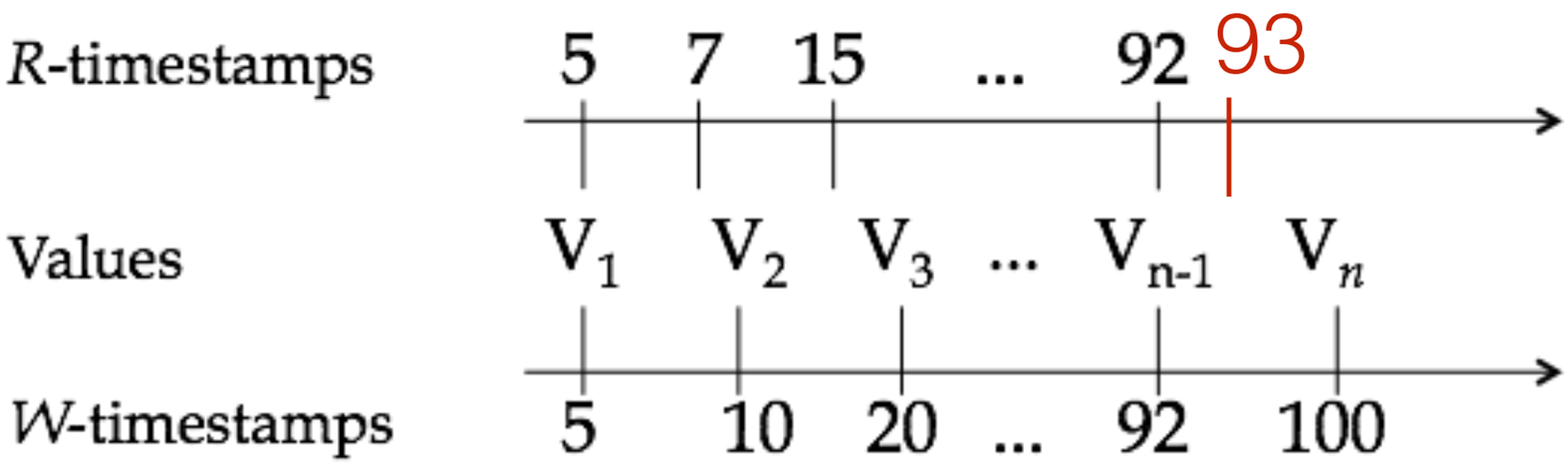

R-timestamps
5
7
15
...
92
Values
V1
V2
V3
...
Vn-1
Vn
W-timestamps
5
10
20
...
92
100

TO-MVCC



Reads: Read version with biggest timestamp smaller than given timestamp

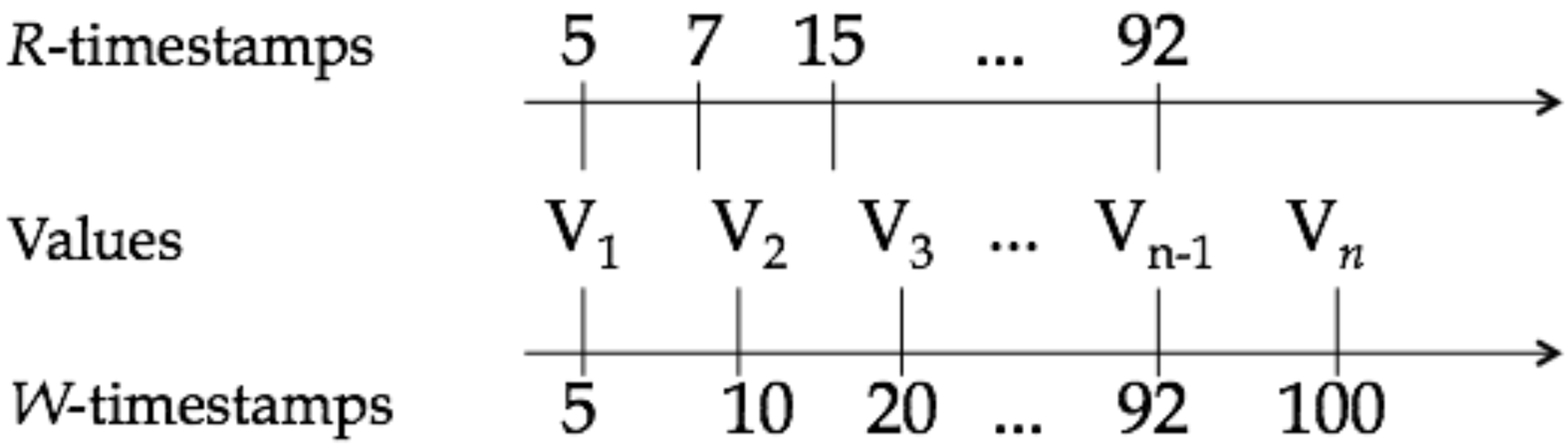
TO-MVCC



Reads: Read version with biggest timestamp smaller than current timestamp

R(X) @ 93 will read V_{n-1}

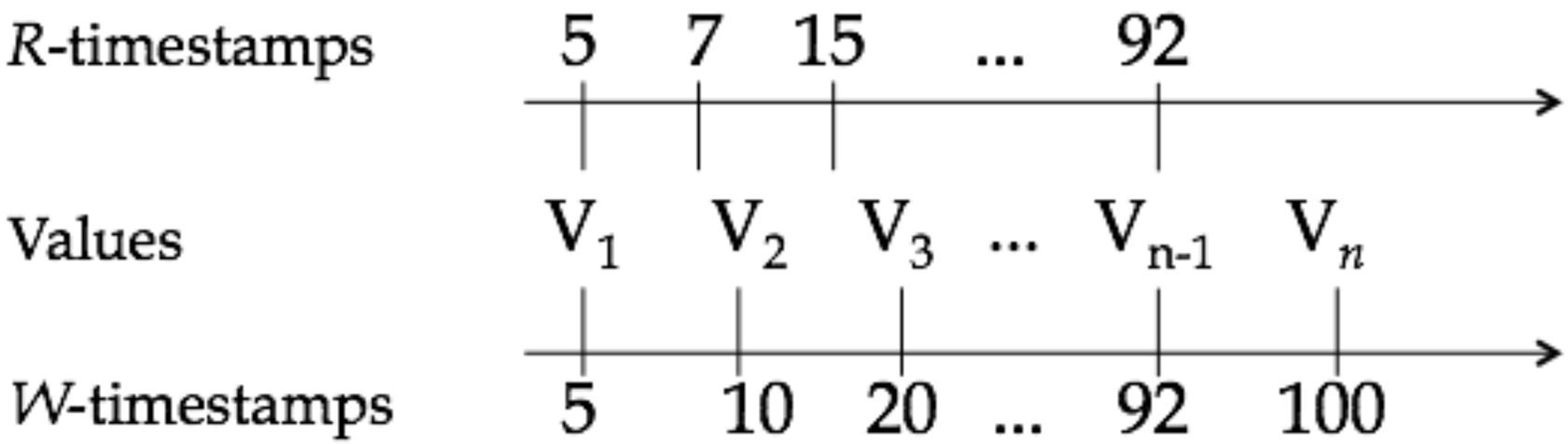
TO-MVCC



Writes: Find interval from given timestamp X to smallest timestamp bigger than X

If there a read is in the interval, abort!

TO-MVCC



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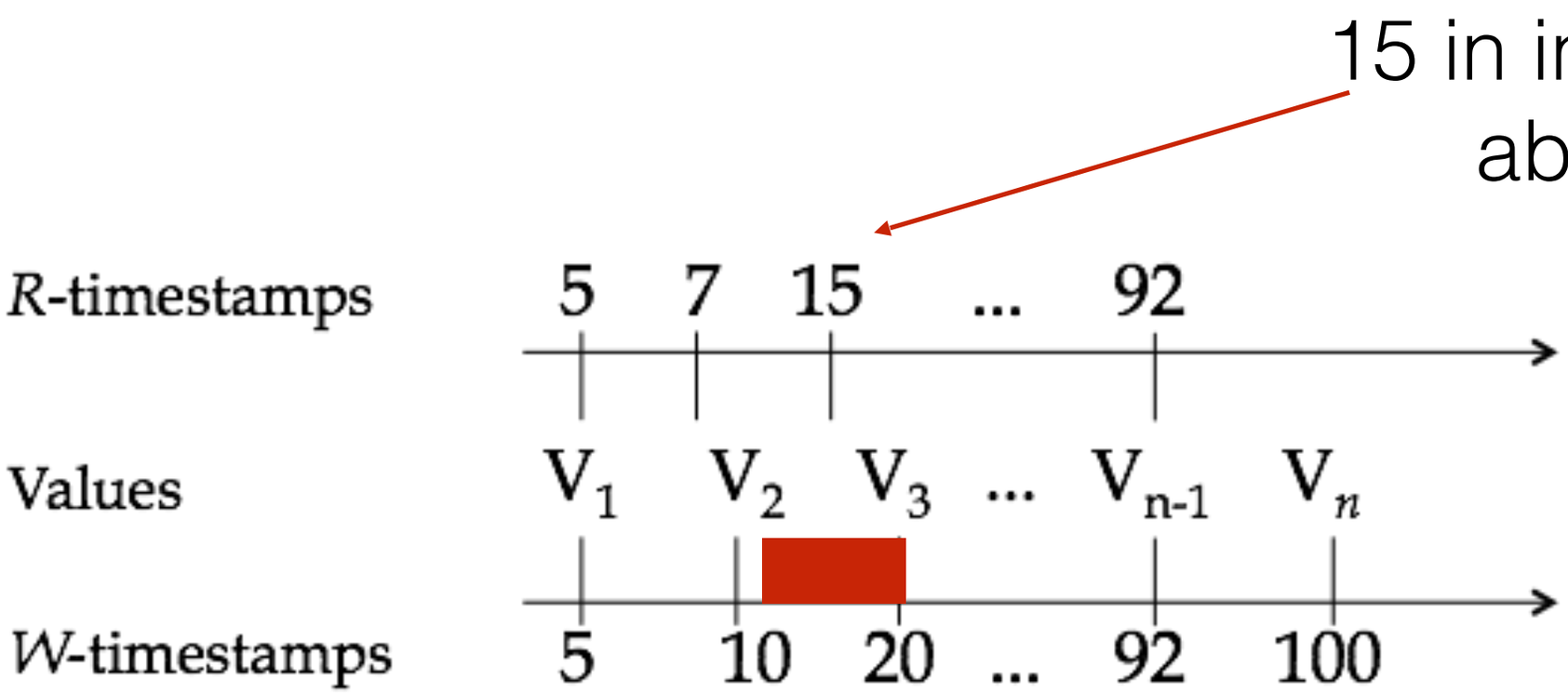
W(X) @ 11

TO-MVCC



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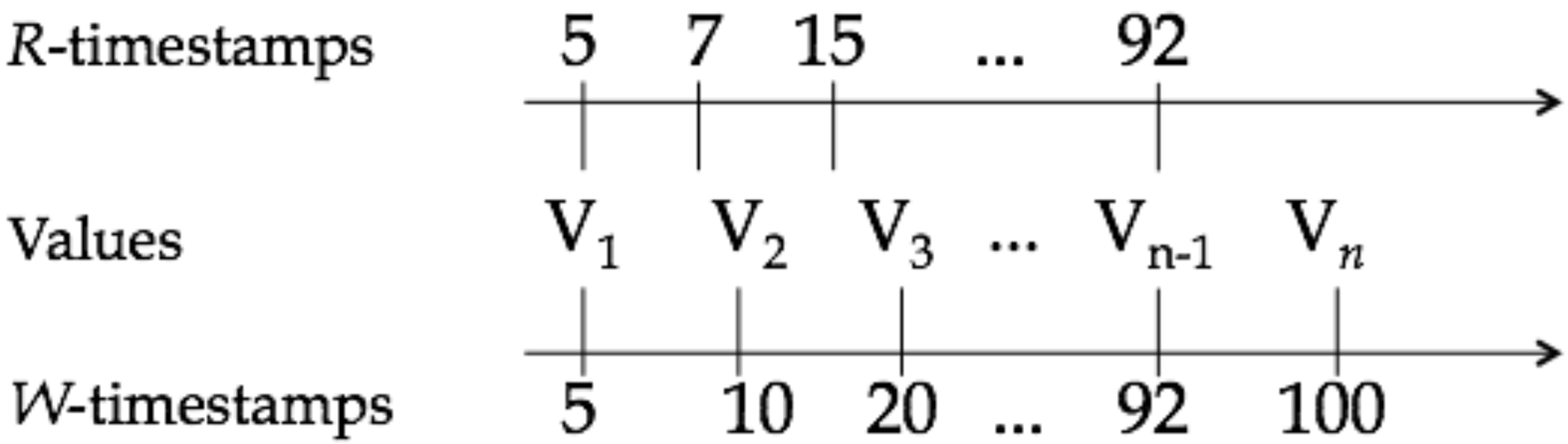

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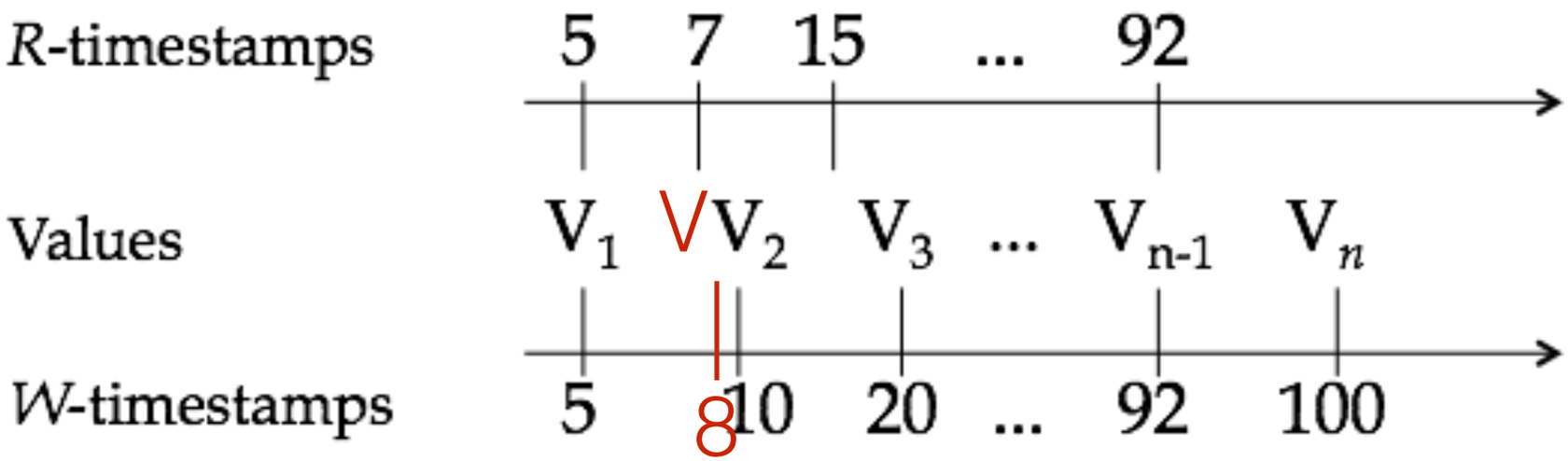
W(X) @ 8

TO-MVCC



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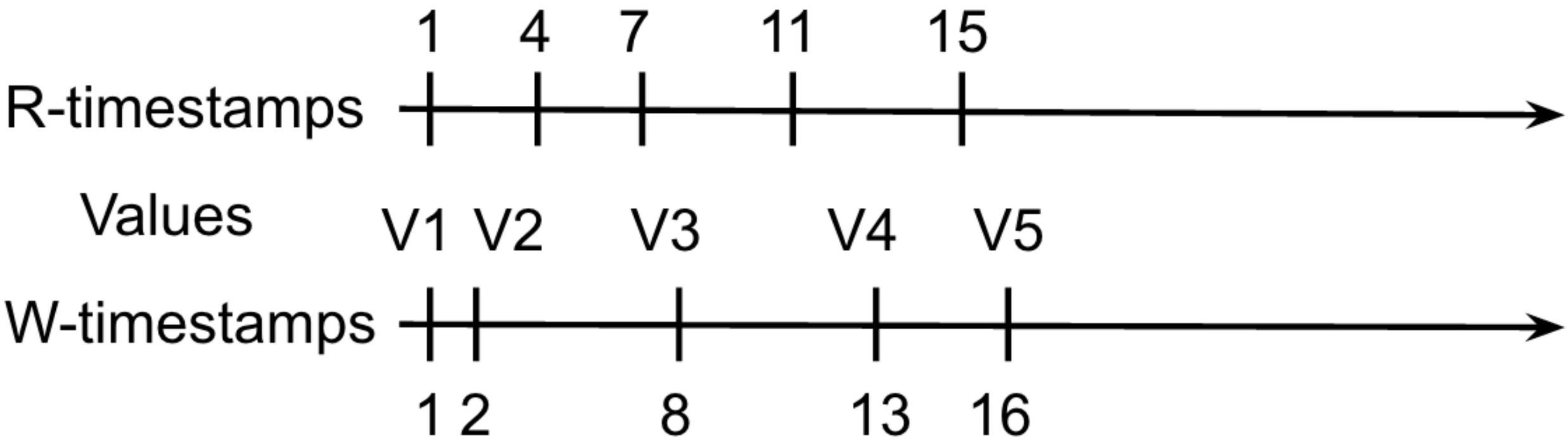
W(X) @ 8

Worksheet - MVCC

R(X)@17, W(X)@18, W(X)@14, W(X)@12, R(X)@20, R(X)@19, R(X)@23, W(X)@26, W(X)@24



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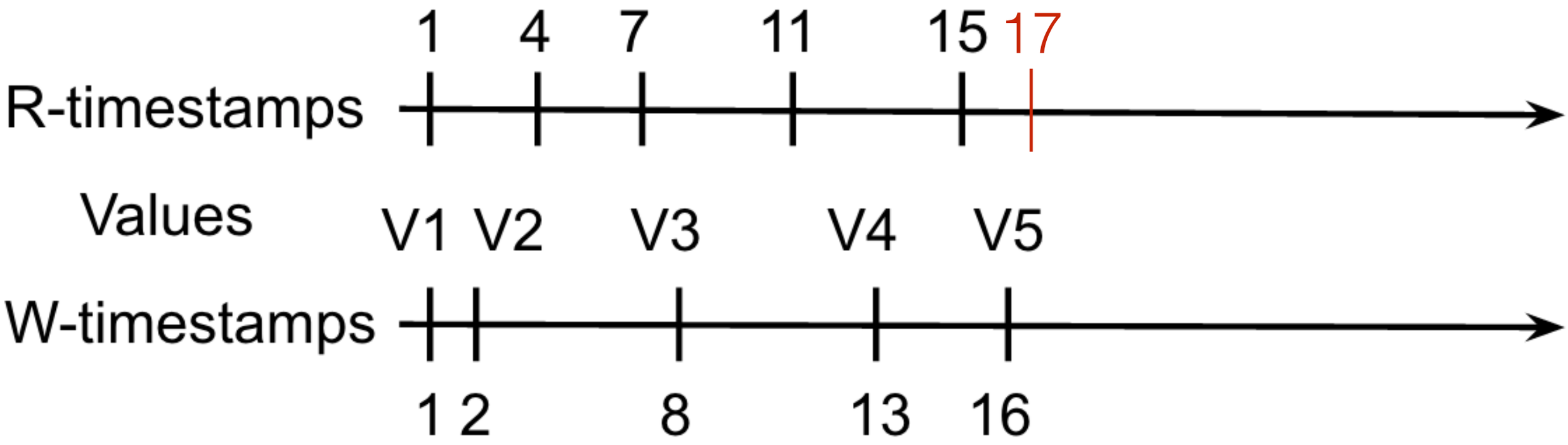

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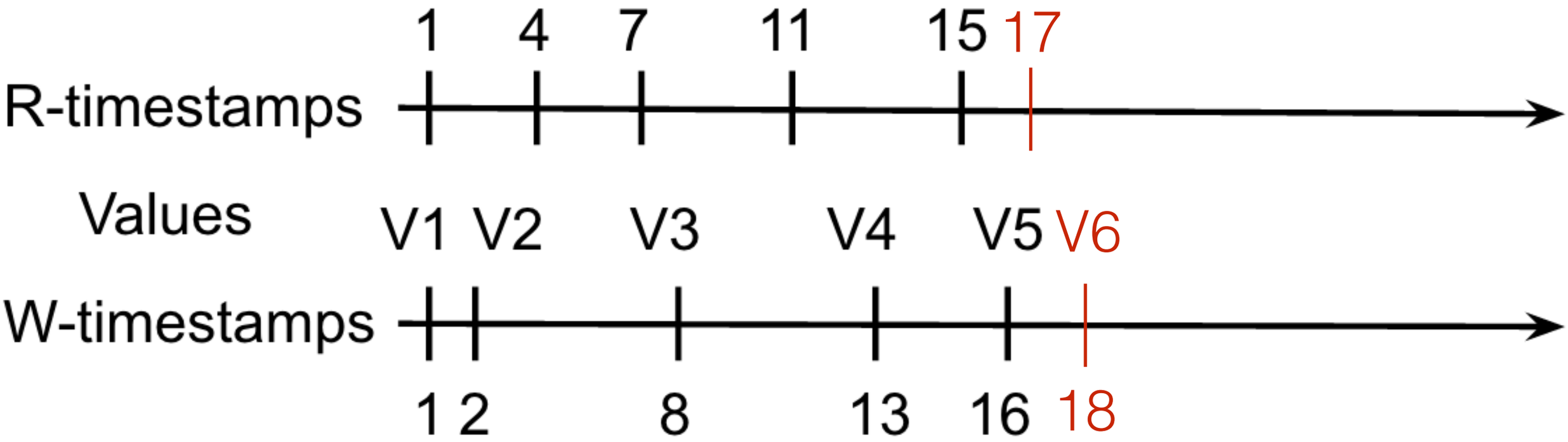

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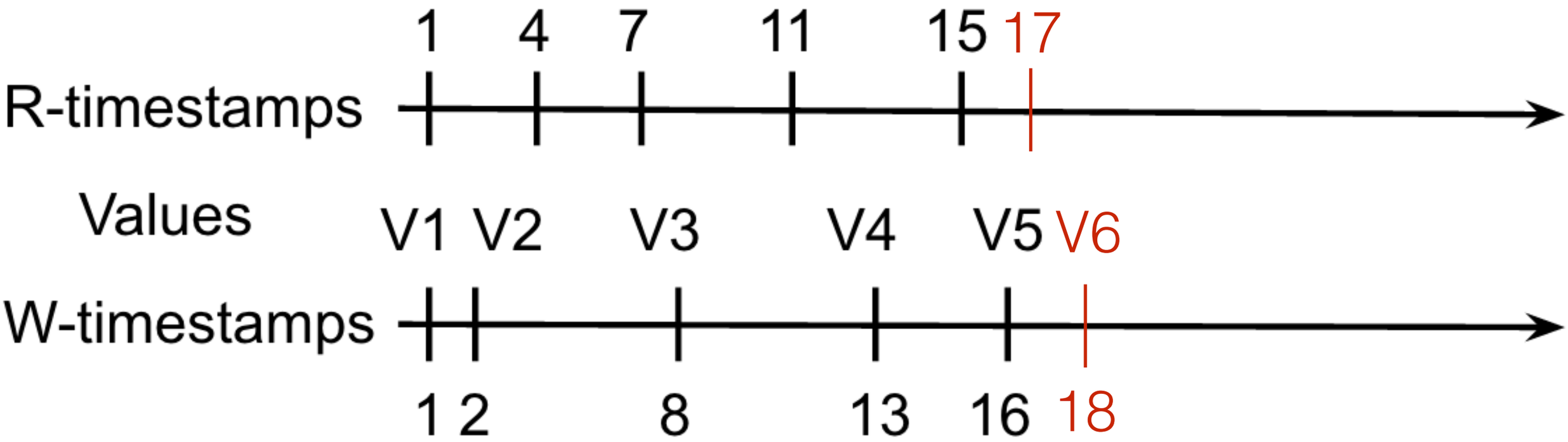

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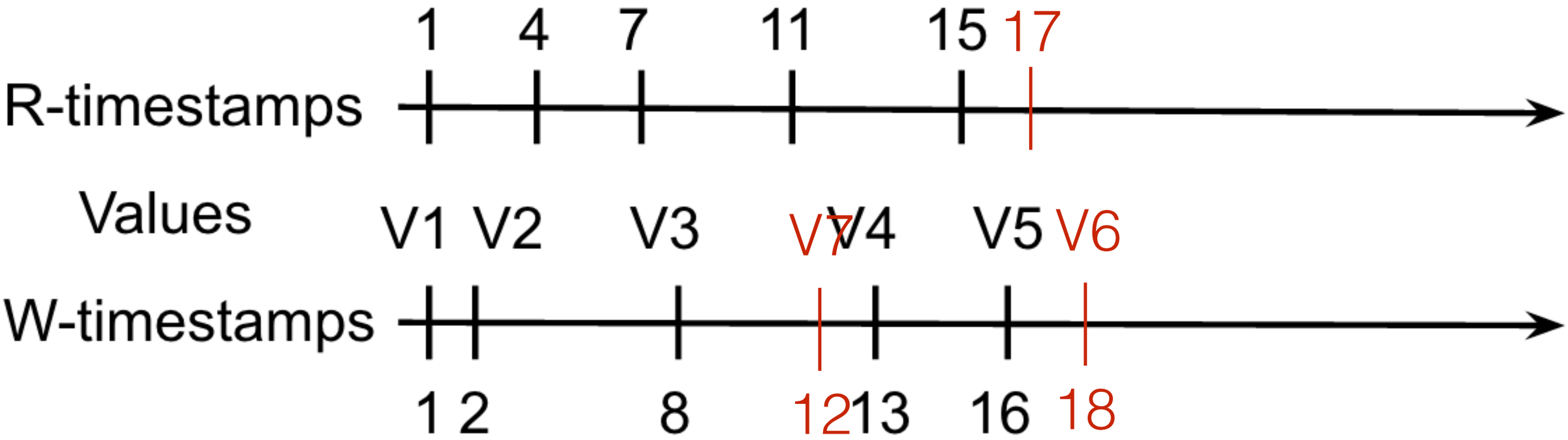

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