ARCHITECTURE

TABLESPACE MANAGEMENT

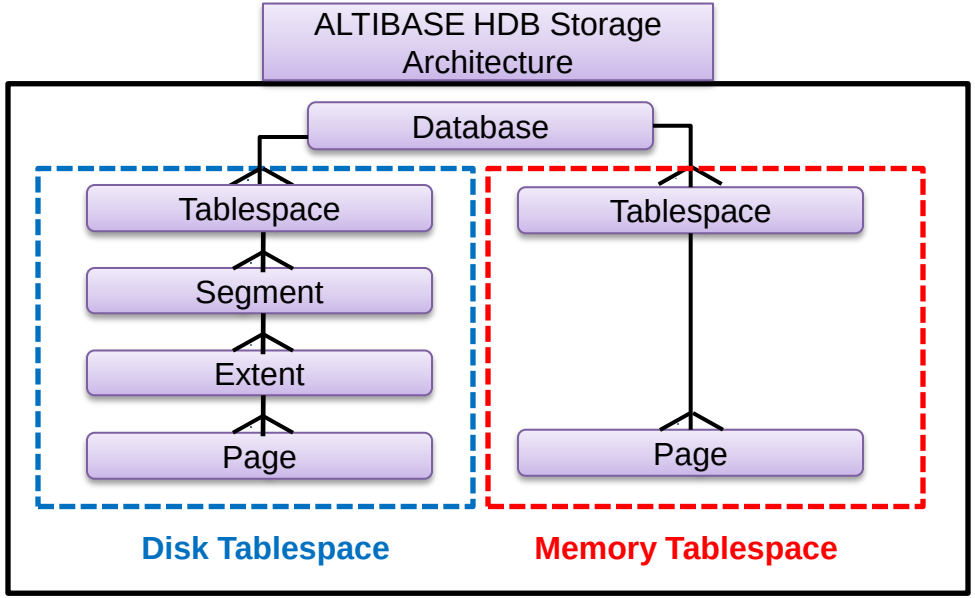
TABLESPACE CONCEPT

- **Tablespace / TBS**
  - Most logical structure that comprises database
  - Logical storage where database objects are stored such as table, index and etc
  - At least one or more tablespace is needed in order to operate the database

STORAGE

Storage Architecture

- A single database consists of one or more tablespaces, and a single tablespace consists of many segments (disk only) and pages



Memory Tablespace

- Consists of pages
- Each page is 32KB

Disk Tablespace

- Consists of multiple segments
- Each segment consists of multiple extents
- Each extent consists of 64 pages
- Each page is 8KB, and each extent is 512KB

Tablespaces Types

Tablespaces that ALTIBASE HDB provides

- Classified according to data properties
  - Memory Tablespaces
  - Disk Tablespaces
- Classified by the time of creation
  - System Tablespaces

Users	Tablespace Type
System	SYSTEM DICTIONARY TABLESPACE SYSTEM UNDO TABLESPACE
General User, SYS	SYSTEM MEMORY DEFAULT TABLESPACE SYSTEM DISK DEFAULT TABLESPACE SYSTEM DISK TEMPORARY TABLESPACE

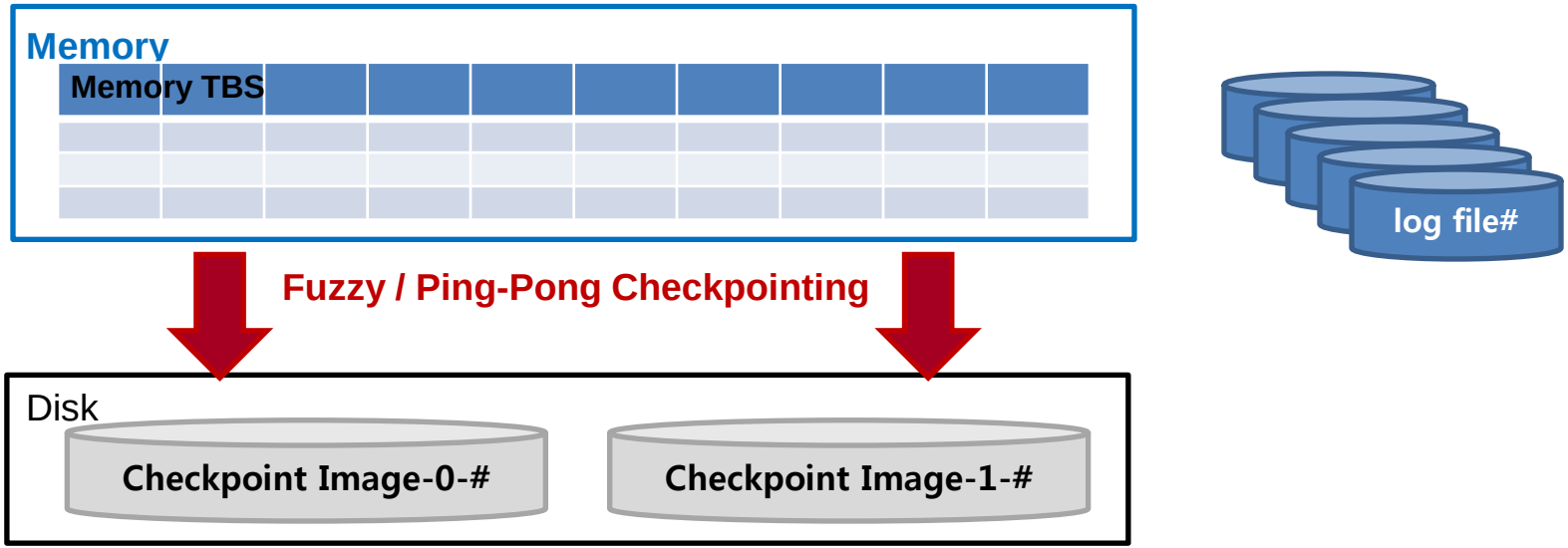
  - User Tablespaces
    - Can be created according to users' requirements
    - Further classified as either Temporary TBS or Data TBS (Memory TBS, Volatile TBS, Disk TBS)

Memory Tablespace

Memory Tablespaces

- Tablespaces in which memory-resident data is saved

Architecture (Memory TBS + Checkpoint Image Files)



Memory Tablespace

- **Allocation of space in a memory tablespace**
  Space is allocated in 32KB page units
- **Page Status: Free or Used**

Object	Free	Used
Tablespace	•Space that has not been allocated to any table •Can be allocated to a particular table in page units	•Space allocated to a particular table •Cannot be used by any other table until the table returns it
Table	•Space that has been allocated to a table but contains no data •Can be reused within that table	•Space that has been allocated to a table and contains data •Cannot be reused as long as the data is not deleted

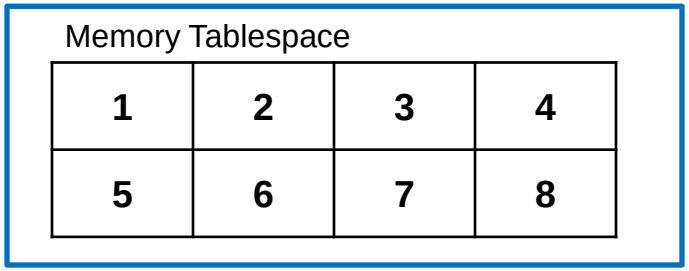
Memory Tablespace

Changes to the Status of Pages

- When a DELETE is executed on a table
  - The status of empty pages in the table changes from “Used” to “Free” (they are reusable within that table).
  - The pages are not returned to the tablespace.
  - When compaction is performed after a DELETE statement, empty pages are returned to the tablespace (they are usable by other tables) and their status in the tablespace changes from “Used” to “Free”.
- When TRUNCATE is executed on a table
  - All of the pages that were allocated to the table are returned to the tablespace.
  - The pages can be used by other tables, and their status in the tablespace changes from “Used” to “Free”.
- When MOVE is executed on a table
  - When data is transferred to another table using the MOVE statement, the empty pages are reusable only in the table from which the data were moved (same effect as DELETE execution).
  - The pages are returned to the tablespace when compaction is later performed.

Space Allocation of Memory Tablespace

- How spaces are allocated when table is created



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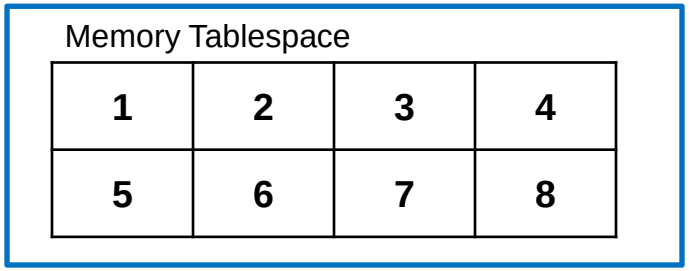

Create table T1

Space Allocation of Memory Tablespace

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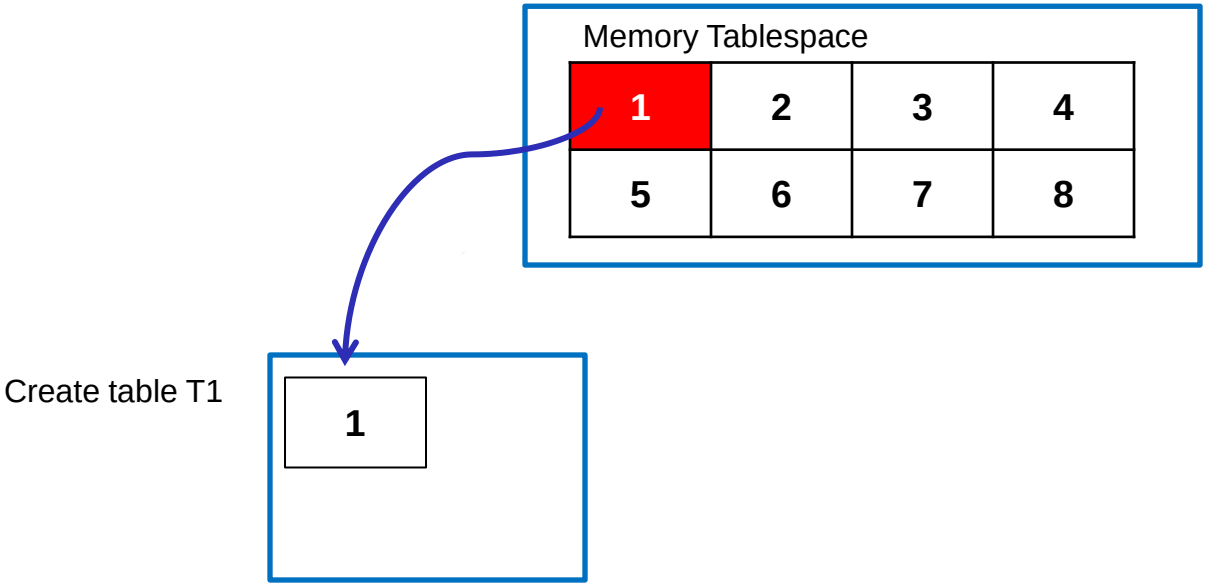

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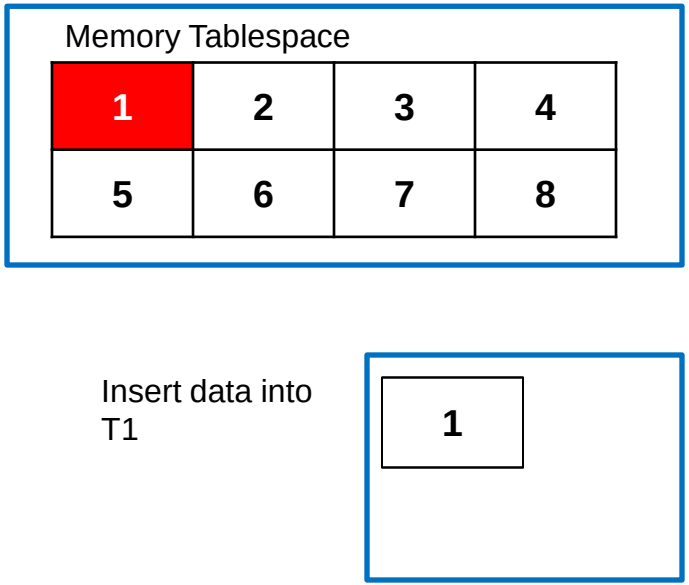

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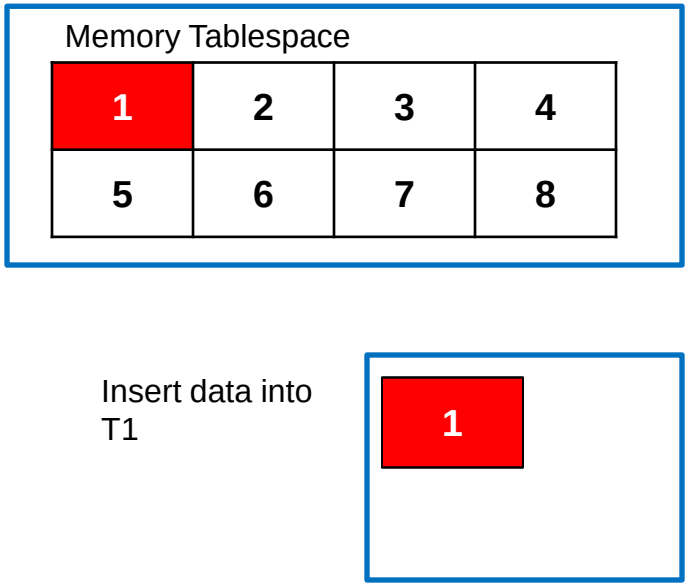

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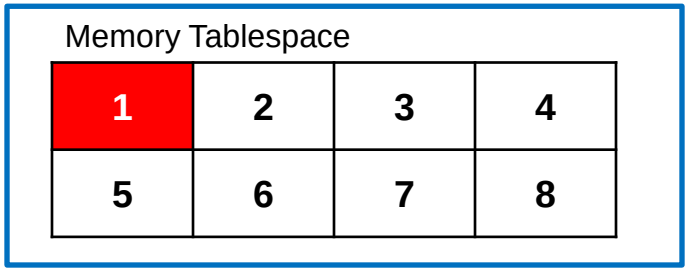
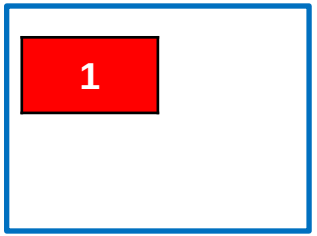


Insert additional data into T1



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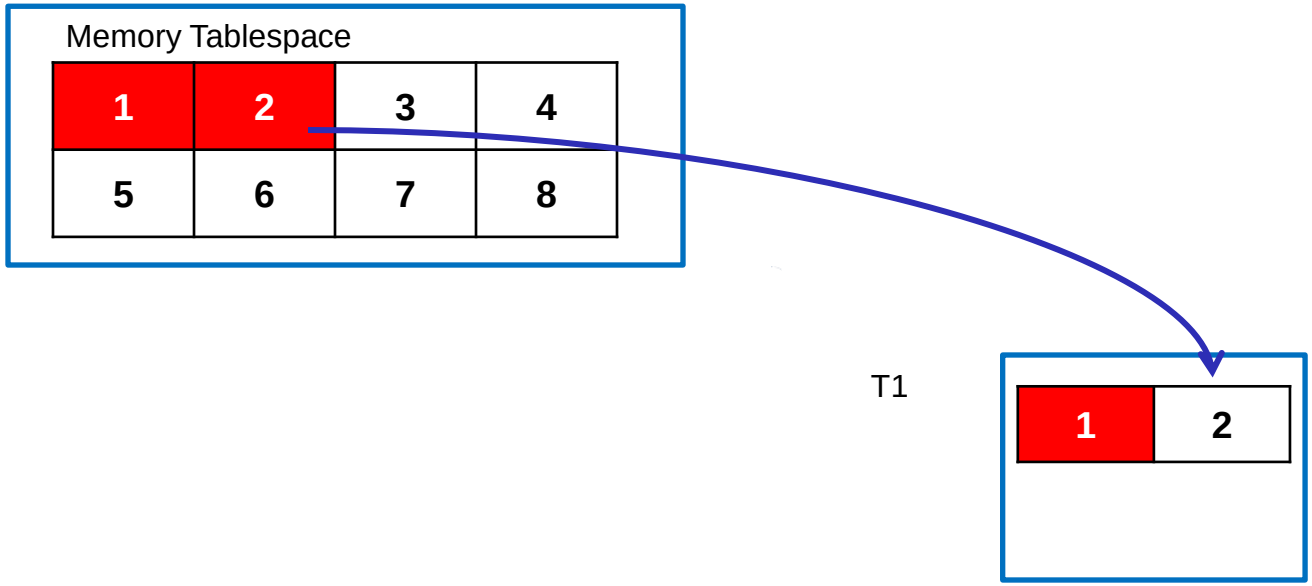

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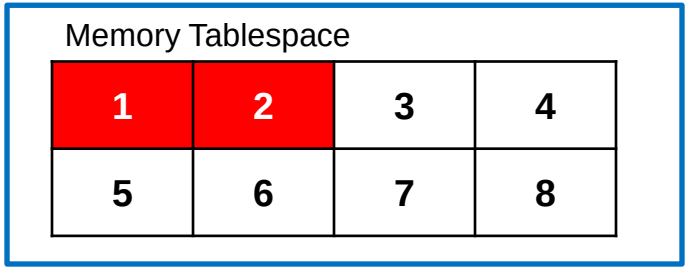
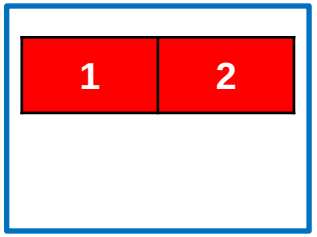


T1



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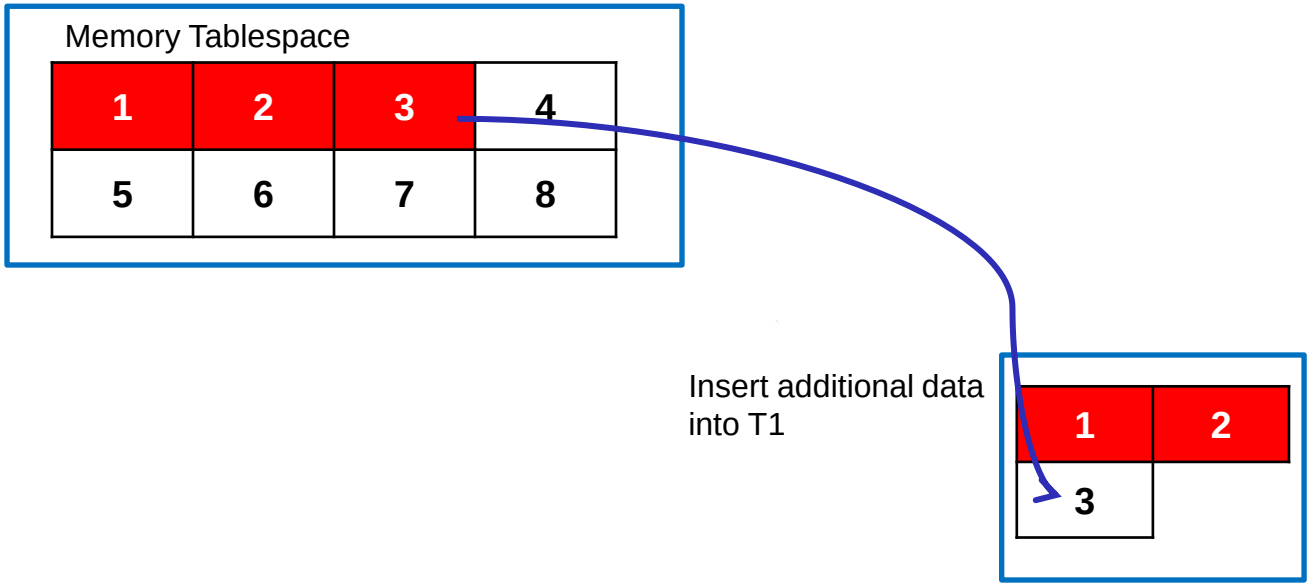

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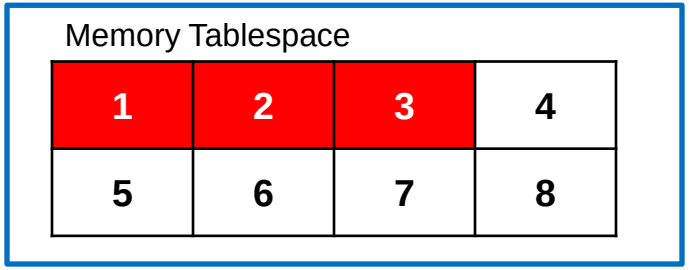
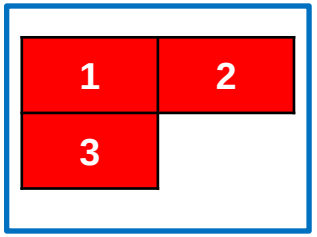
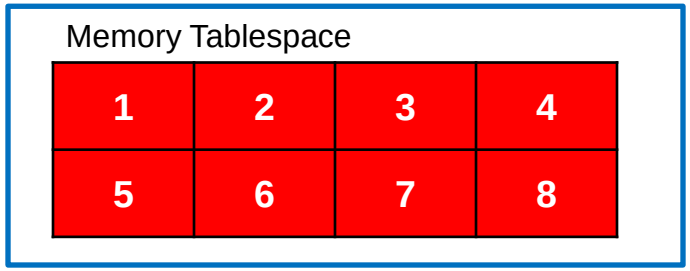


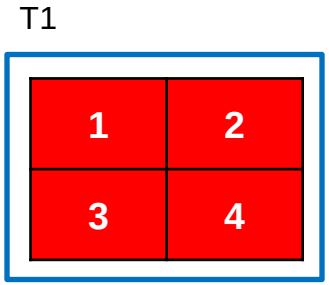
T1

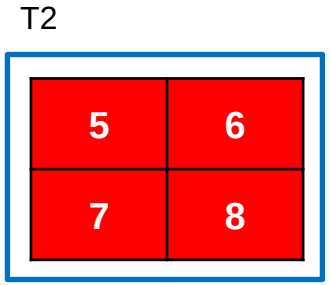


Space Allocation of Memory Tablespace

- How spaces are returned

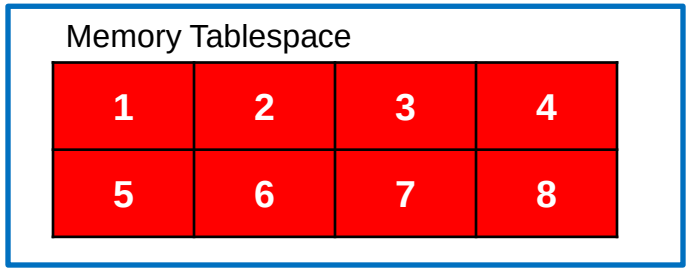


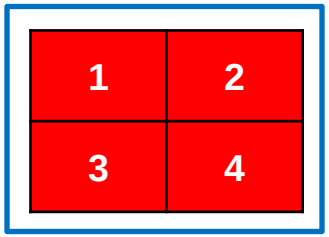


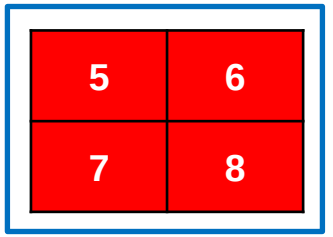


Space Allocation of Memory Tablespace

- **How spaces are returned**







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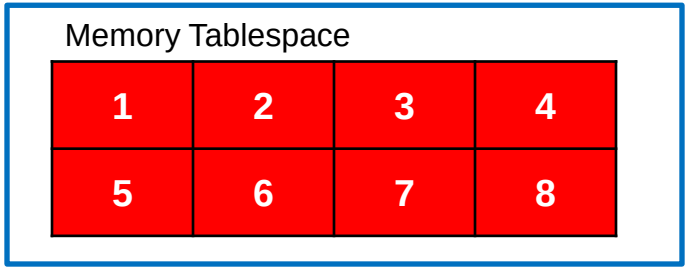
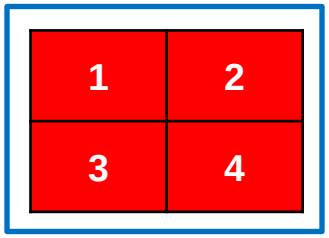
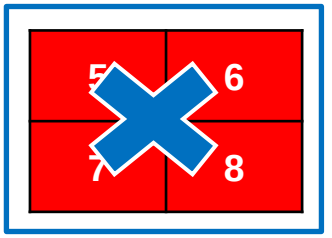


T1



INSERT data into T2



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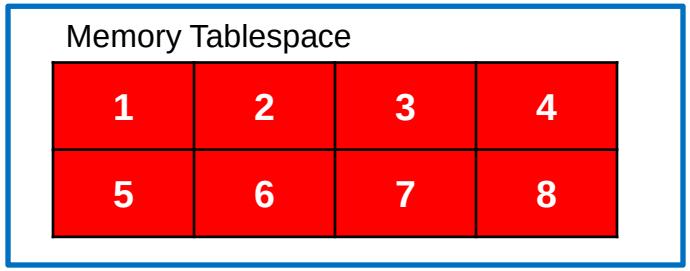

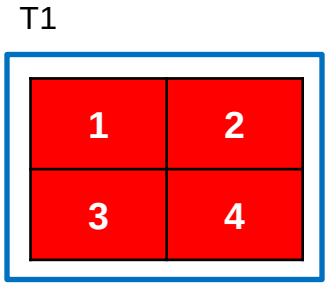

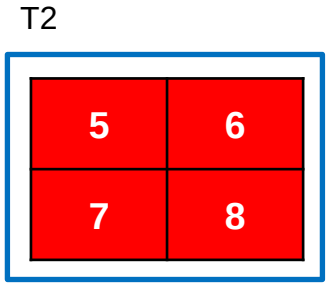

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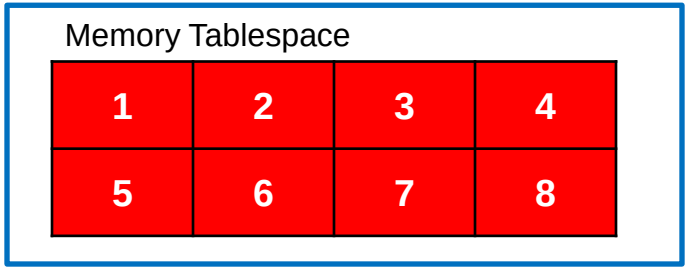
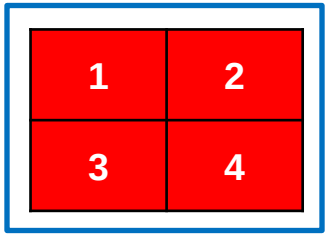
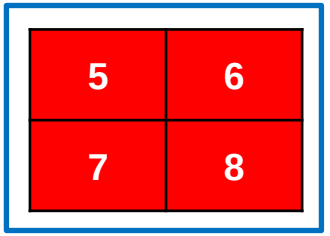


DELETE ON T1



T2



Space Allocation of Memory Tablespace

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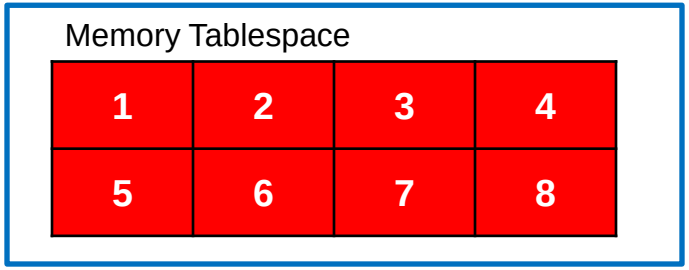

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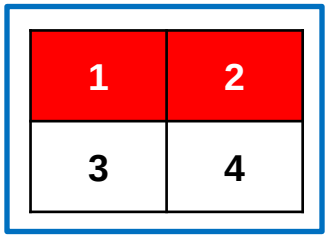
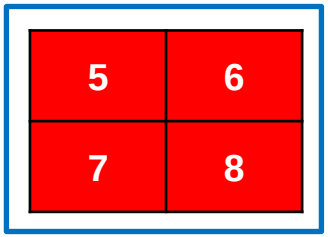


T2



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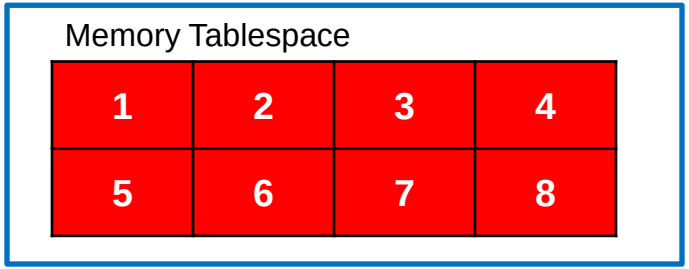

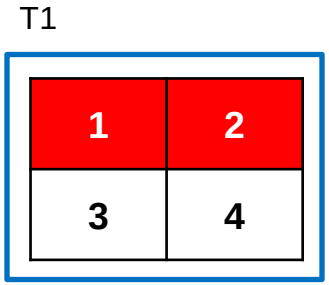

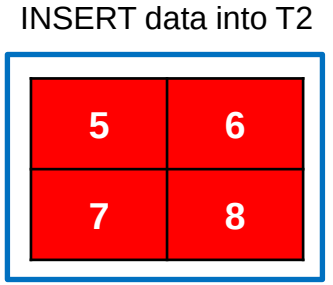

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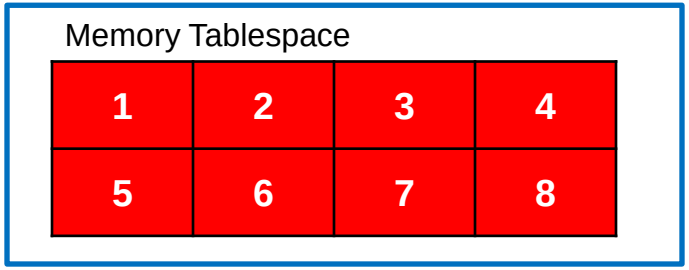

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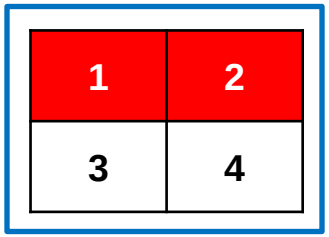
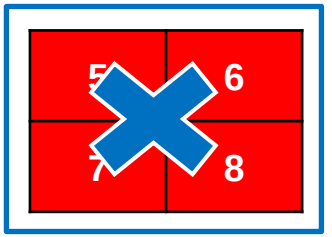


INSERT data into T2



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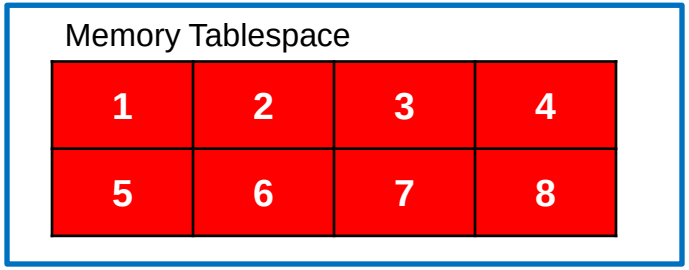

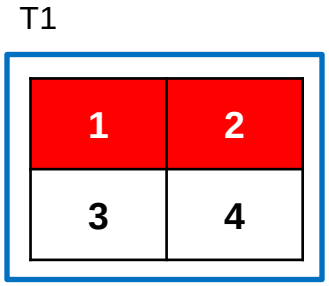

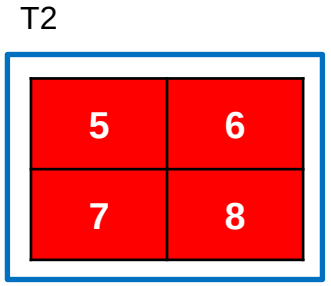

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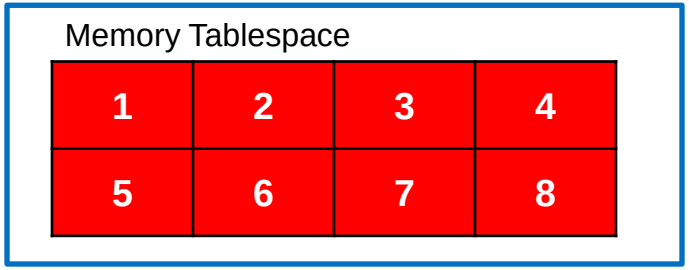
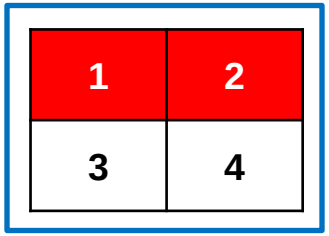
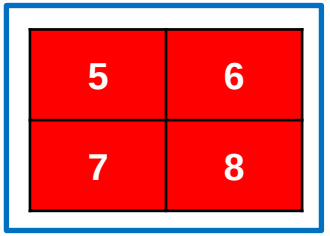


COMPACTION on T1



T2



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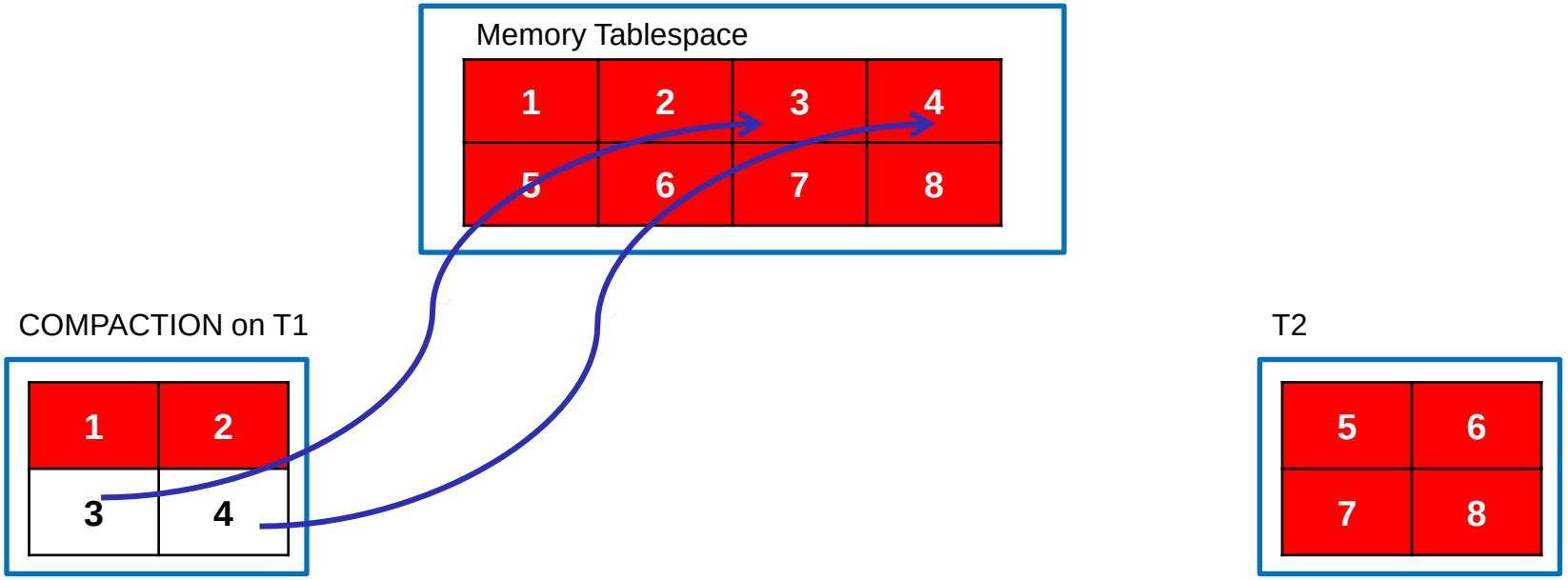

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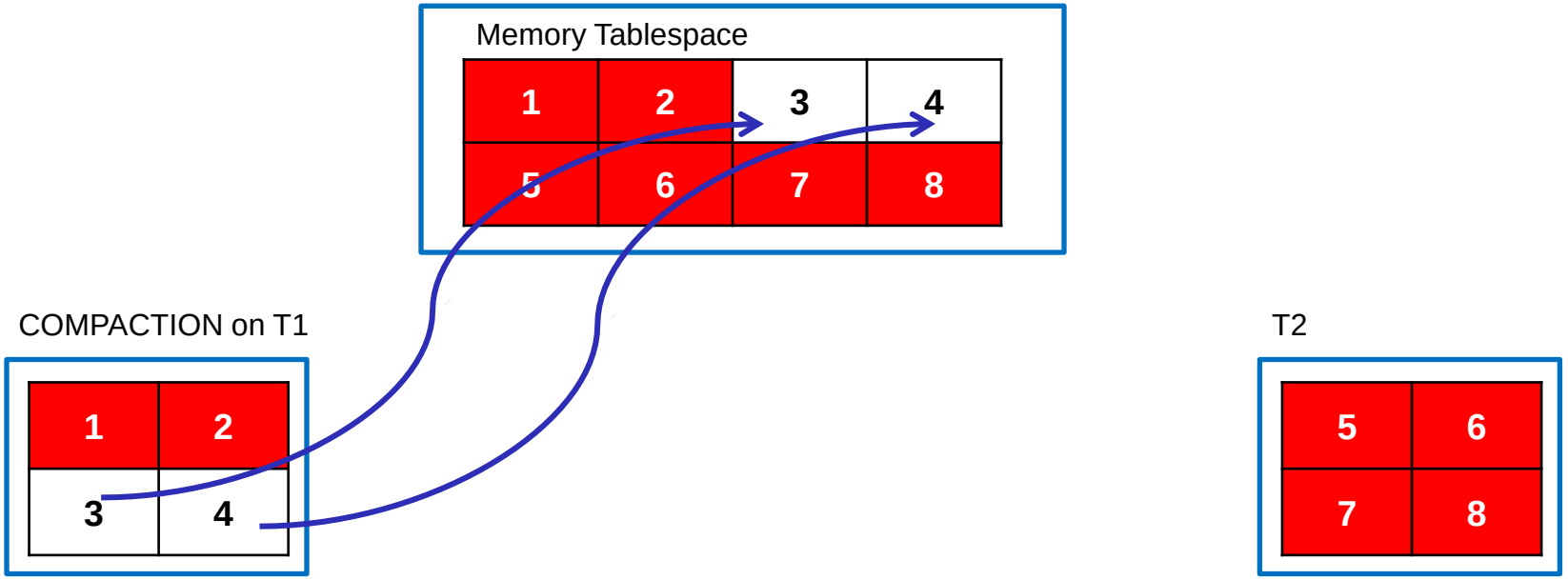

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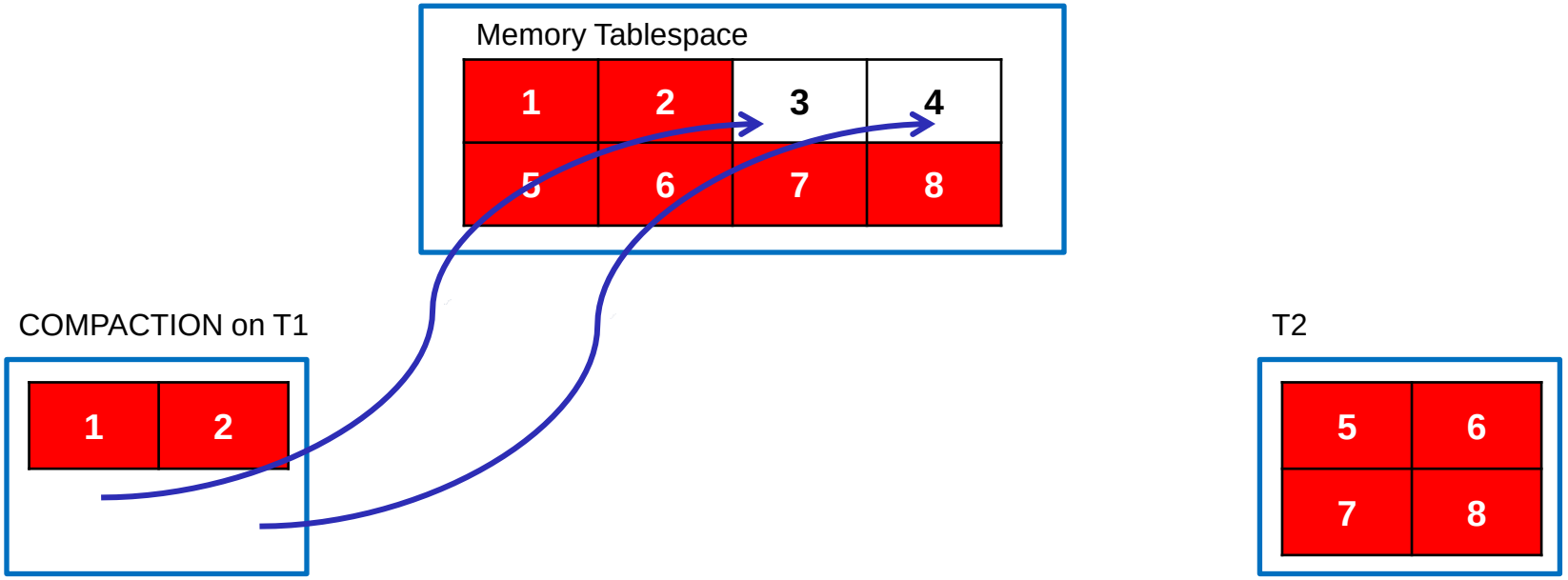

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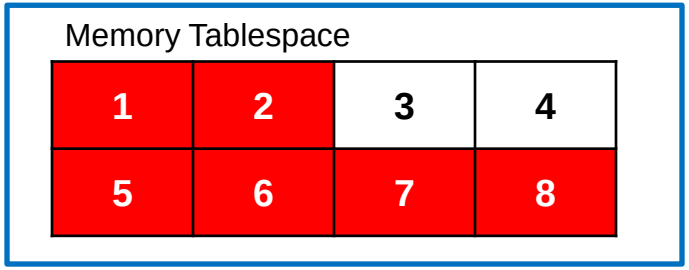

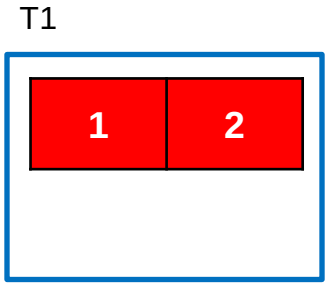

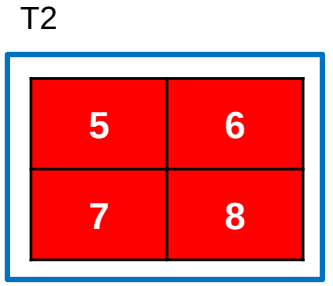

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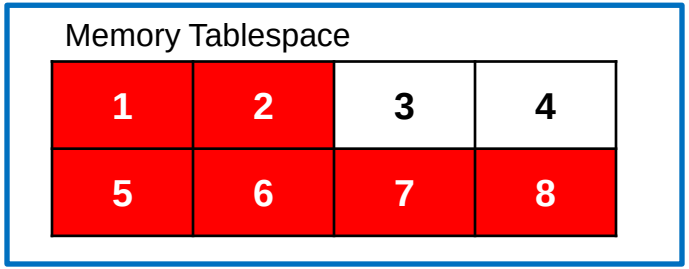
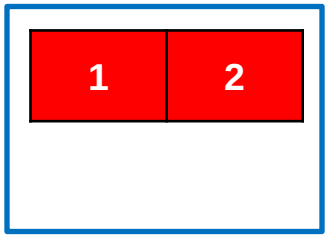
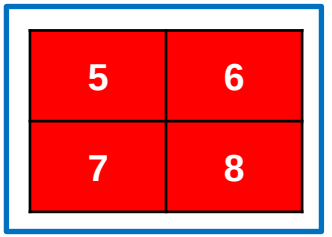


T1

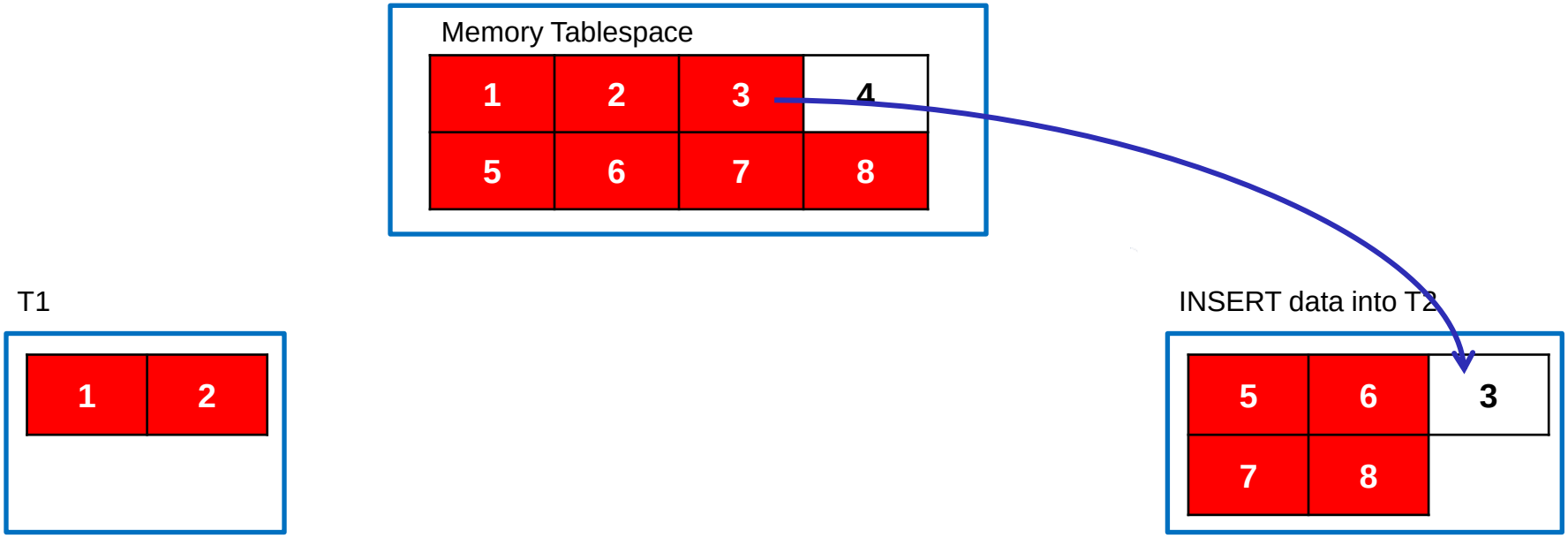


INSERT data into T2



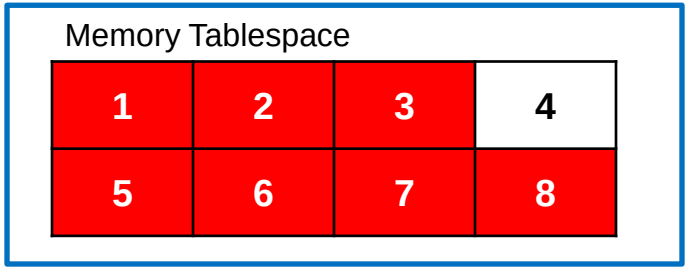
Space Allocation of Memory Tablespace

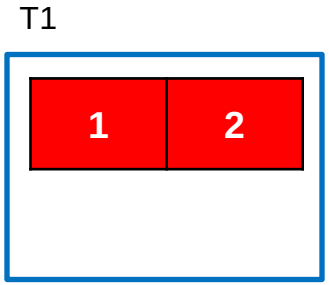
- How spaces are returned

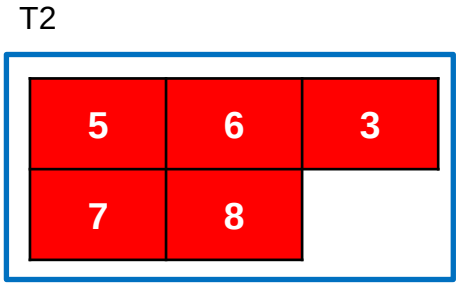


Space Allocation of Memory Tablespace

- How spaces are returned

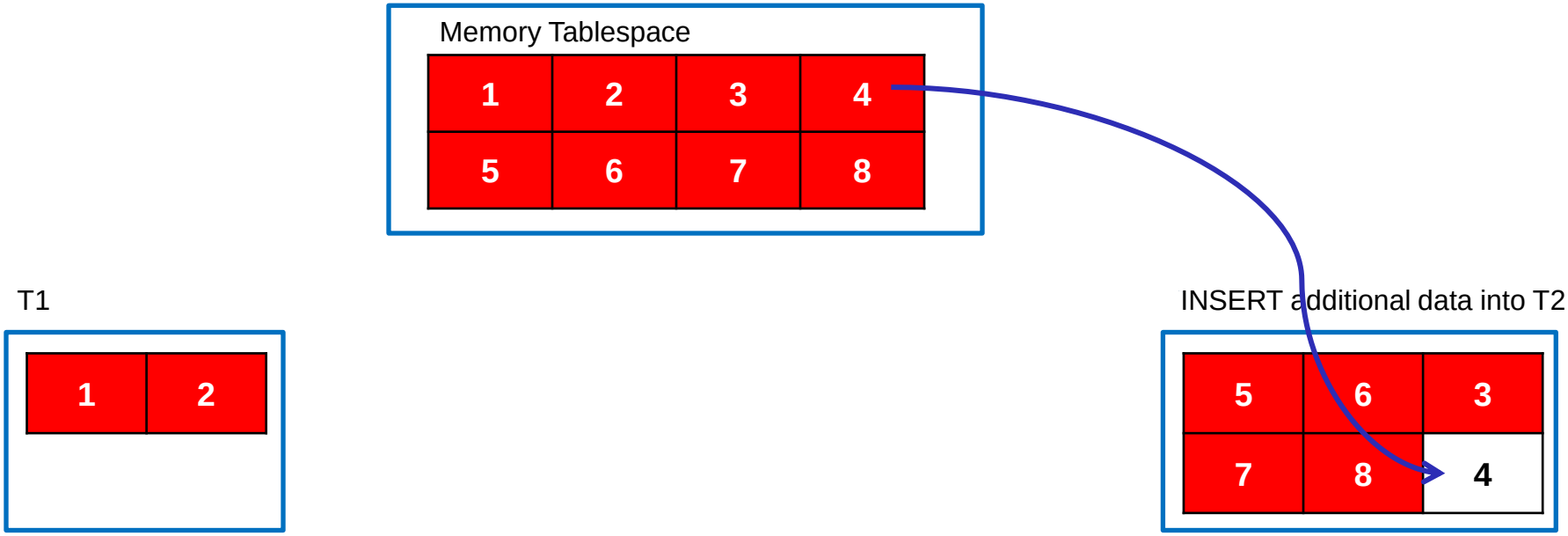






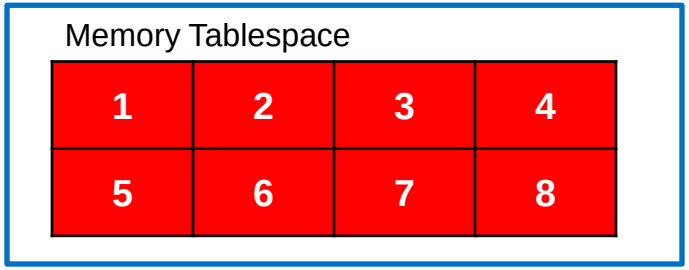
Space Allocation of Memory Tablespace

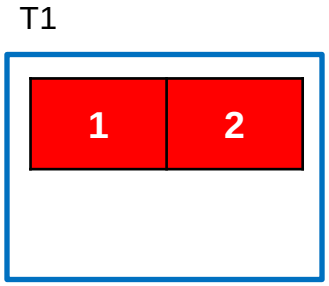
- **How spaces are returned**

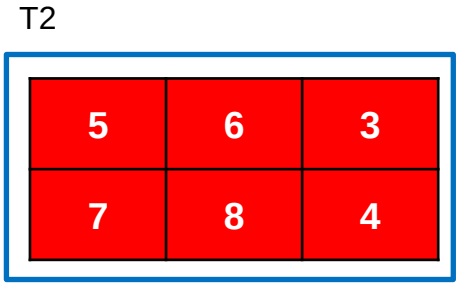


Space Allocation of Memory Tablespace

- How spaces are returned

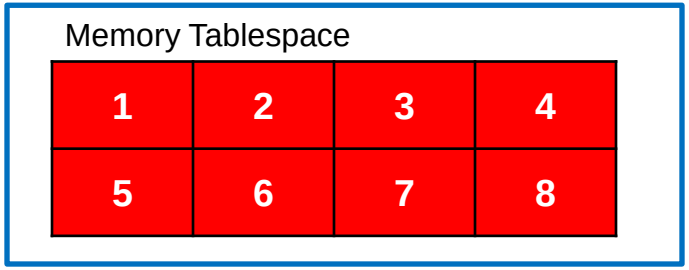




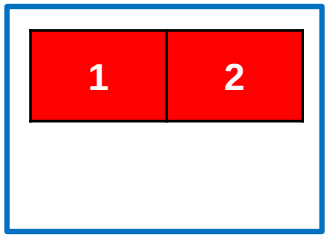


Space Allocation of Memory Tablespace

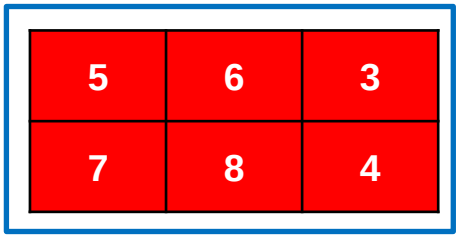
- How spaces are returned



TRUNCATE on T1

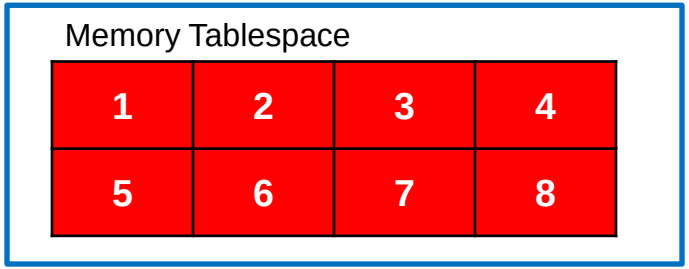


T2

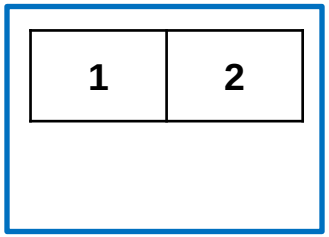


Space Allocation of Memory Tablespace

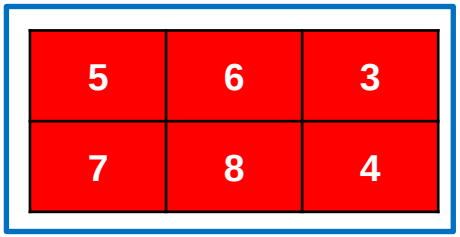
- How spaces are returned



TRUNCATE on T1

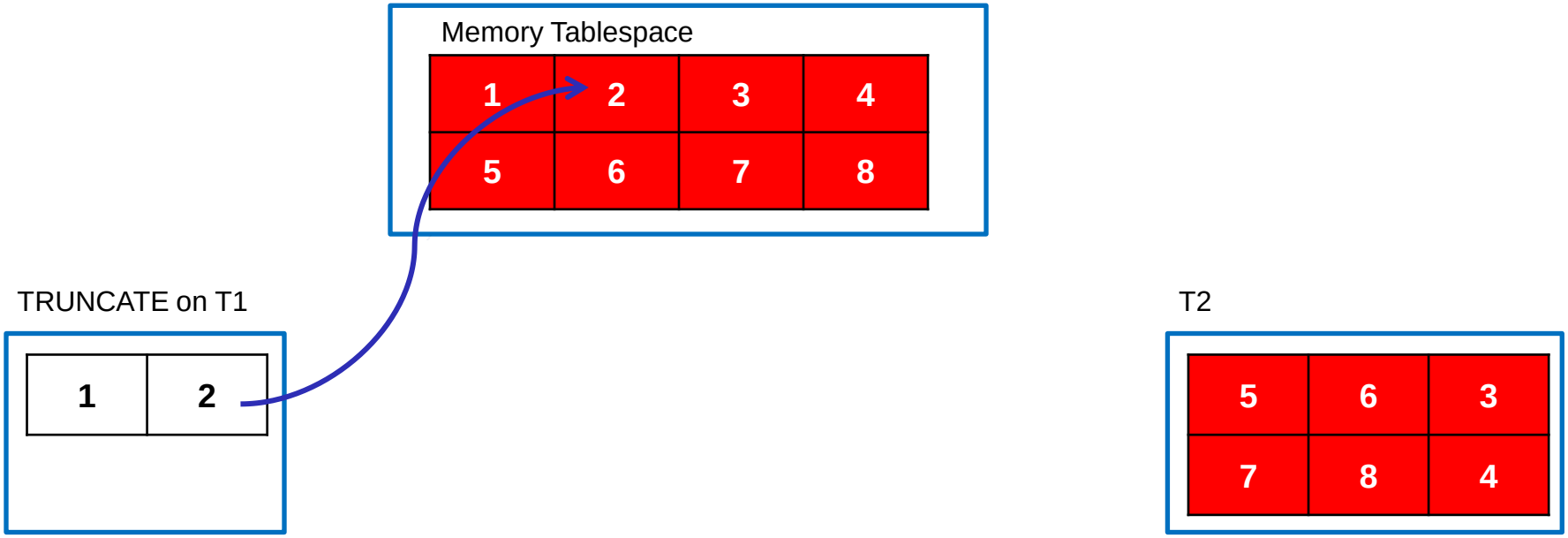


T2



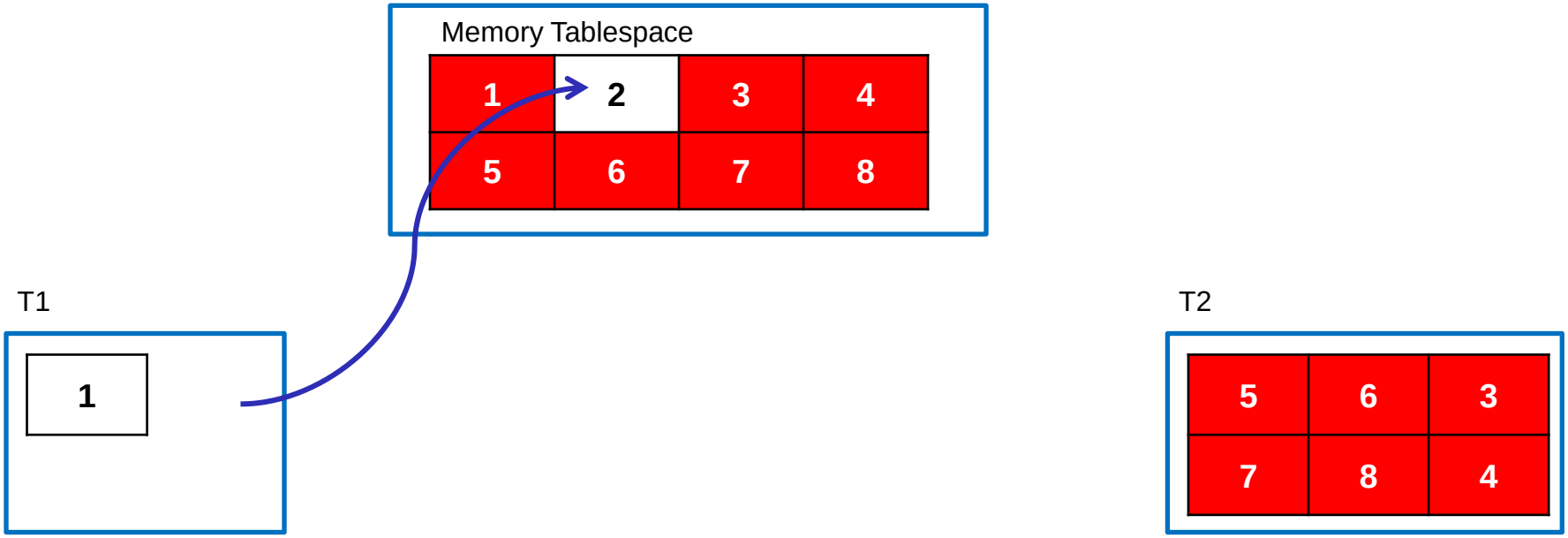
Space Allocation of Memory Tablespace

- How spaces are returned



Space Allocation of Memory Tablespace

- How spaces are returned



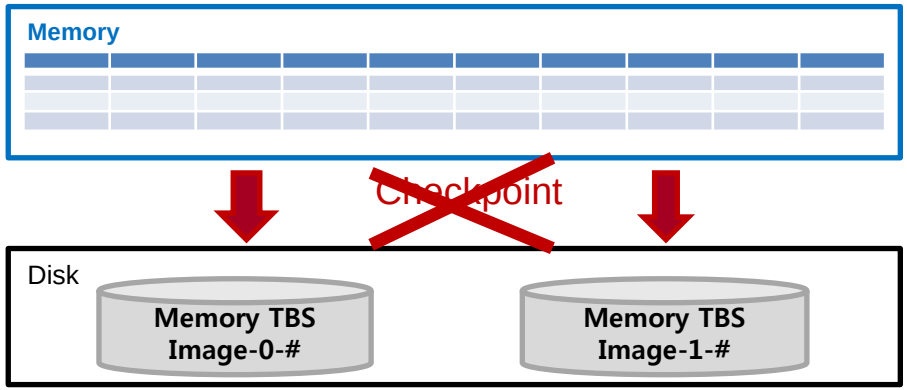
Volatile Tablespace

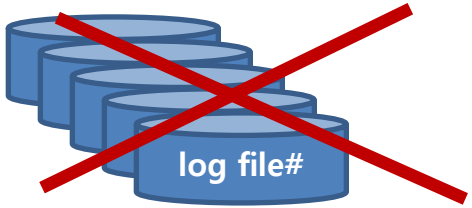
Volatile Tablespace

- Data exist only in memory
- There are no disk-resident components (checkpoint image files and logs)

Features

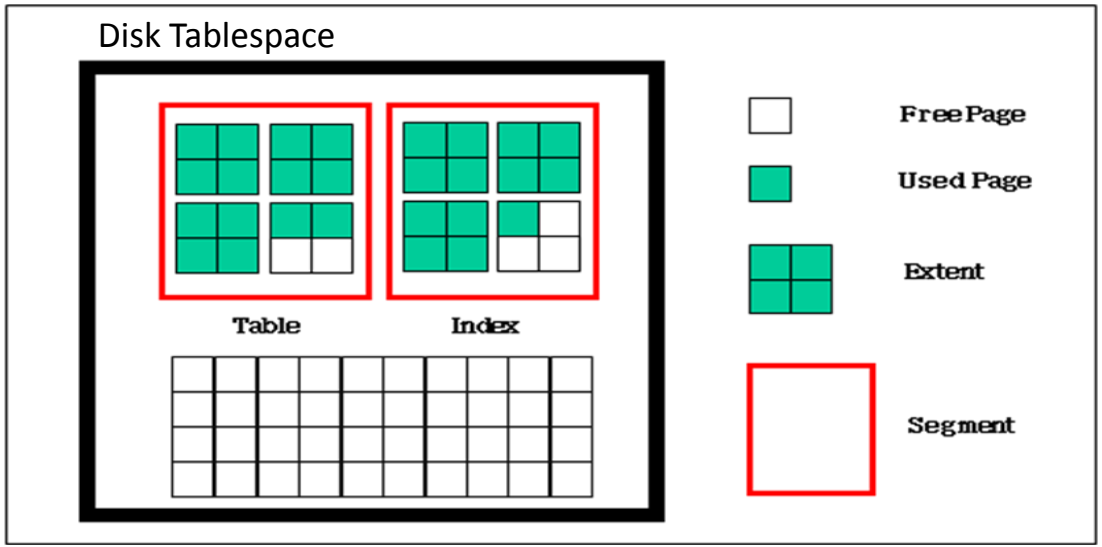
- No checkpoint, No disk logging
- No Disk I/O
- Highest performance of DML compared to memory tablespace





Disk Tablespace

- **Disk Tablespaces**
  All data on disk is stored in disk tablespaces.
- **Structure of Disk Tablespace**



- Page
  - The minimum unit for saving table records and indexes
  - Default disk page size: 8KB
- Extent
  - The allocation unit for contiguous pages
  - Allocated from the tablespace if there are not enough free pages when saving data
  - Default extent size: 64 pages (512KB)
- Segment
  - A set of extents
  - A single table or index is logically the same as one segment

Disk Tablespace

- **Allocation of space in a disk tablespace**
  Space is allocated to tables in 512KB extent units
- **Page status: Free or Used**

Object	Free	Used
Tablespace	•Space that has not been allocated to any table •Can be allocated to a particular table in extent units	•Space that has been allocated to a particular table •Cannot be used by any other table until the table returns it
Table	•Space that has been allocated to a table but contains no data •Can be reused within that table	•Space that has been allocated to a table and contains data •Cannot be reused as long as the data is not deleted

Disk Tablespace

Changes to the Page Status

- When a DELETE is executed
  - The status of empty pages in the table changes from “Used” to “Free” (they are reusable within that table).
  - The pages are not returned to the tablespace.
- When TRUNCATE is executed
  - All of the pages that were allocated to the table are returned to the tablespace.
  - The pages can be used by other tables, and their status in the tablespace changes from “Used” to “Free”.
- When MOVE is executed
  - The pages can only be reused within the table(Same effect as DELETE) even though the data is moved to other table by MOVE command

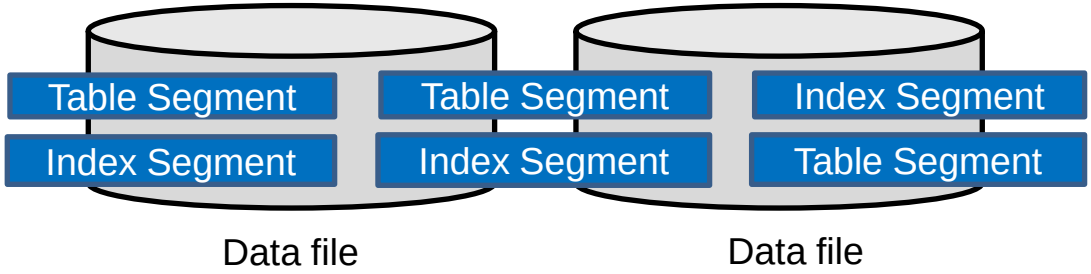
COMPACTION cannot be performed on a disk table

Disk Tablespace

Types of Segments

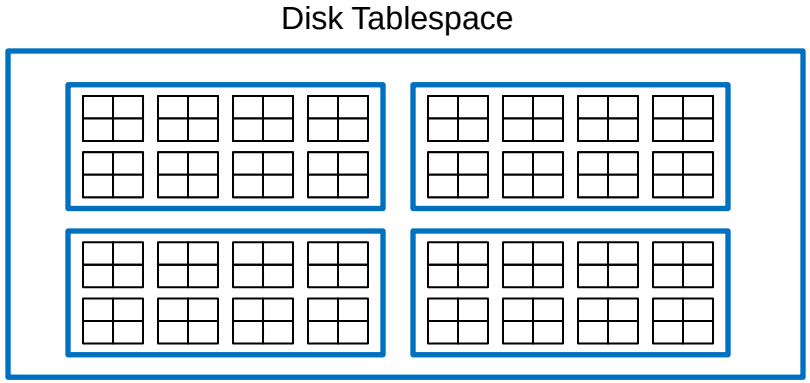
Type	Description
Table segment	This is the most basic means of storing data within a database.
Index segment	A single index segment contains all of the data for one index. The purpose of an index is to find data in a table using a key.
Undo segment	Undo segments are used by transactions that change the database. Before a table or index is changed, the original value is stored in an undo segment so that the change can be undone if the transaction is rolled back.

Logical Structure



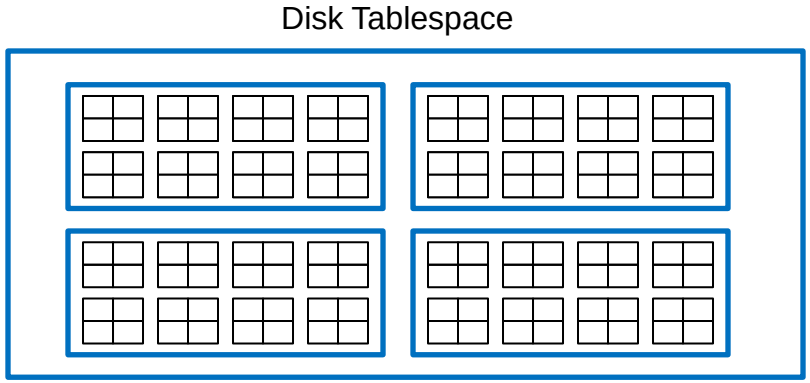
Space Allocation of Disk Tablespace

- **How spaces are allocated**



Space Allocation of Disk Tablespace

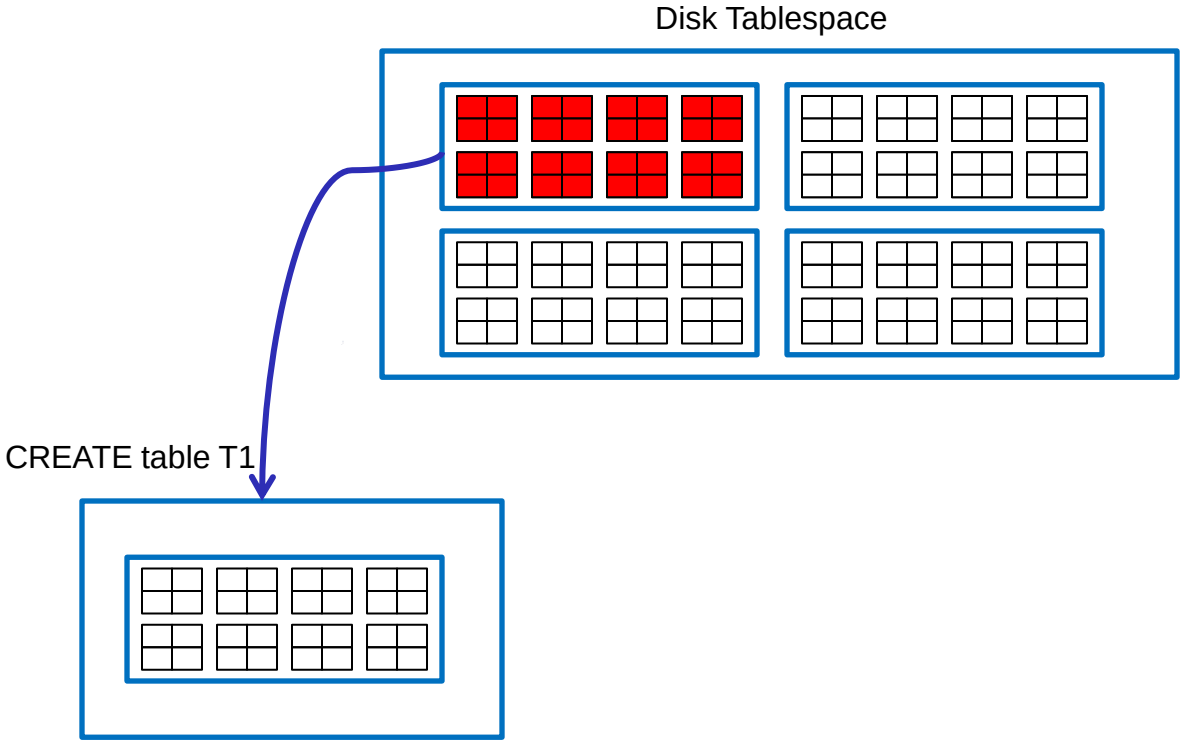
- **How spaces are allocated**



CREATE table T1

Space Allocation of Disk Tablespace

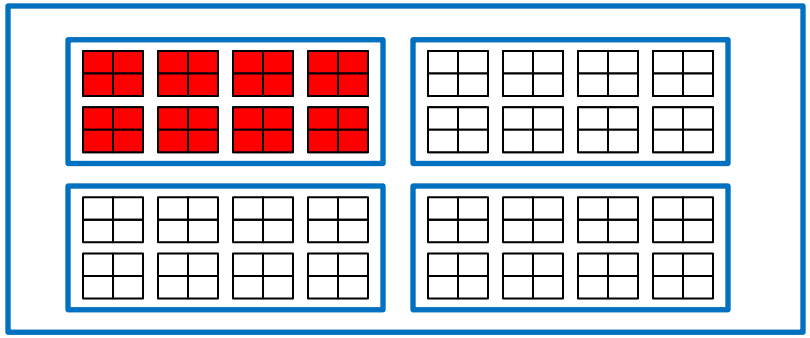
- **How spaces are allocated**



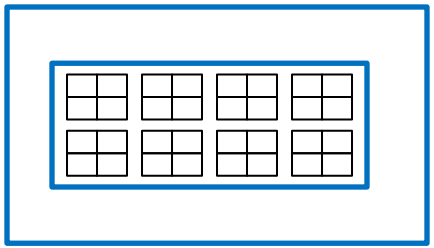
Space Allocation of Disk Tablespace

- **How spaces are allocated**

Disk Tablespace

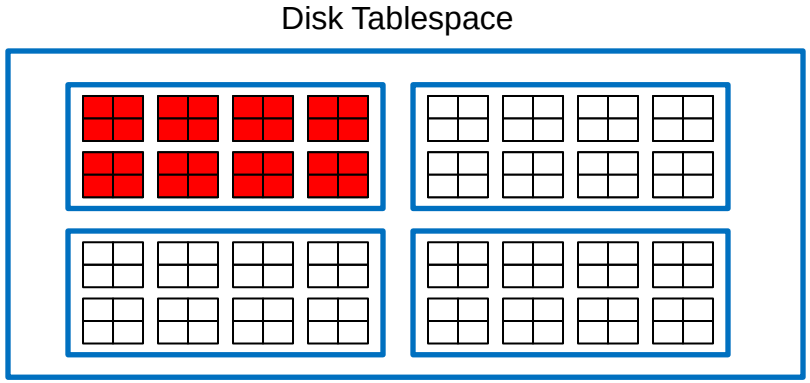


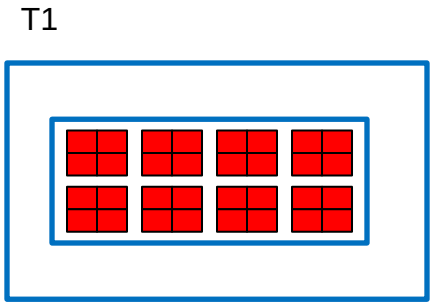
INSERT data into T1



Space Allocation of Disk Tablespace

- **How spaces are allocated**

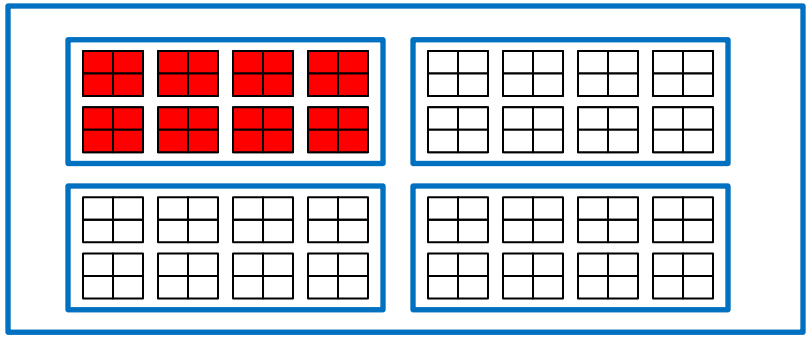




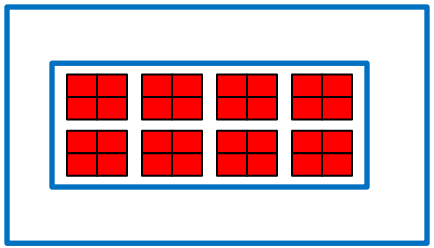
Space Allocation of Disk Tablespace

- **How spaces are allocated**

Disk Tablespace

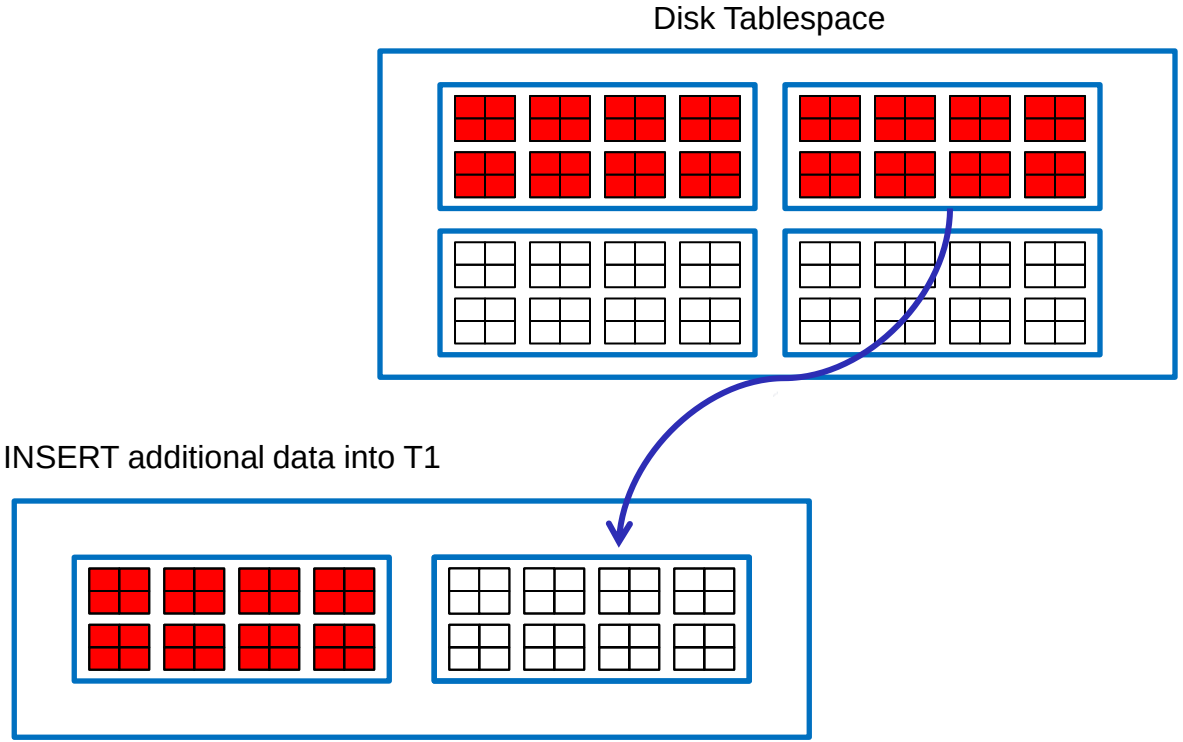


INSERT additional data into T1



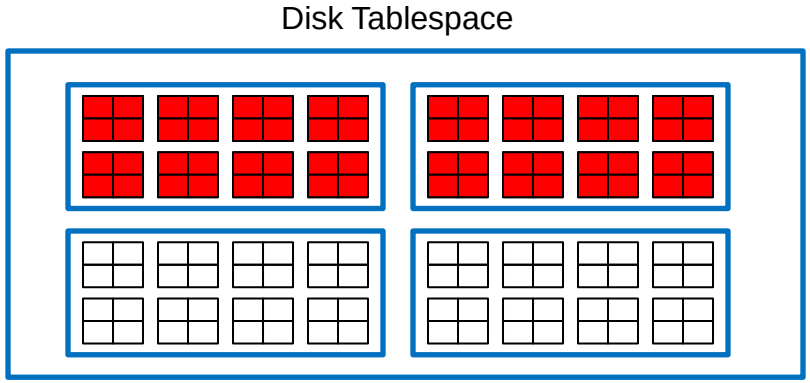
Space Allocation of Disk Tablespace

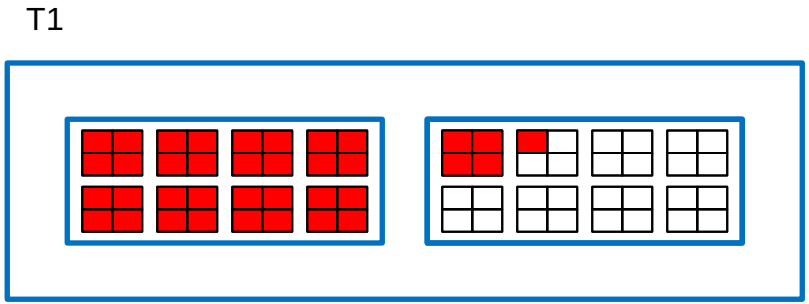
- **How spaces are allocated**



Space Allocation of Disk Tablespace

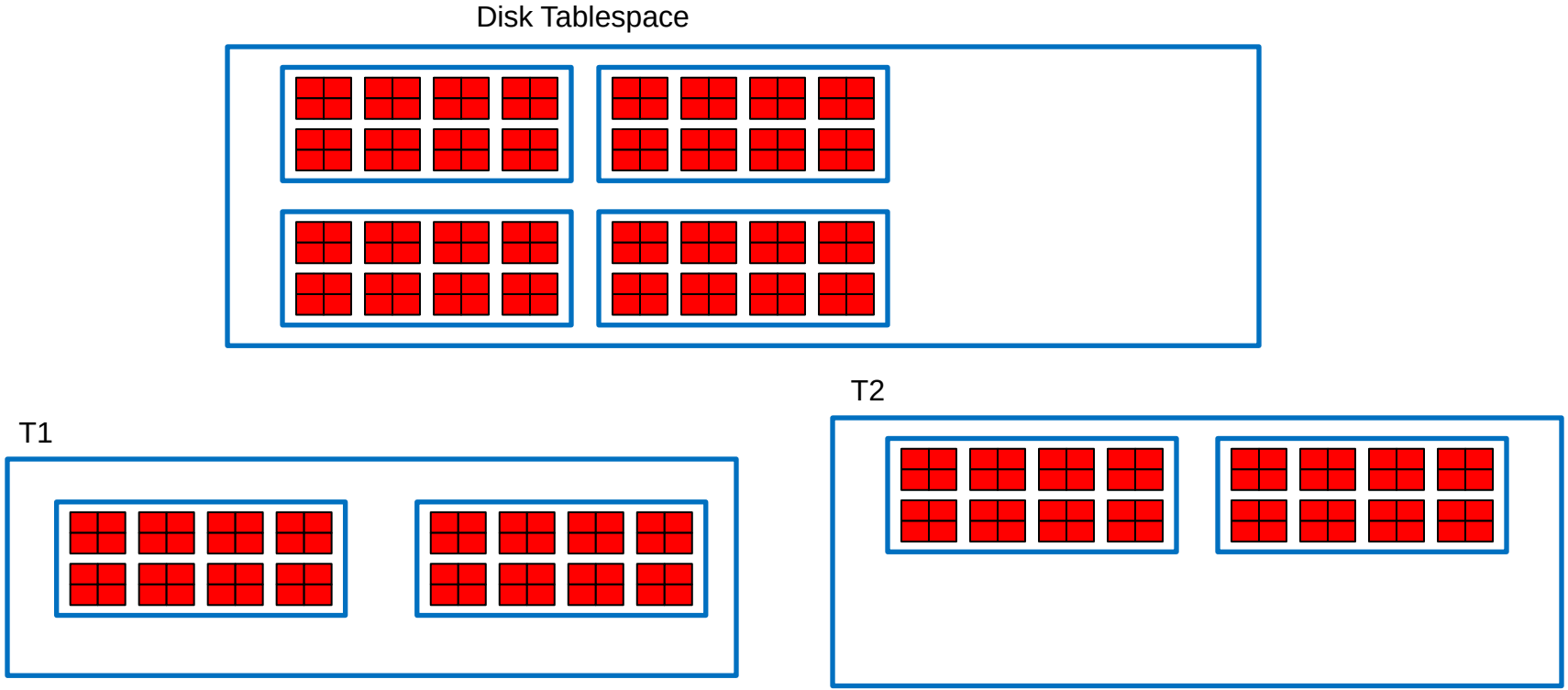
- **How spaces are allocated**





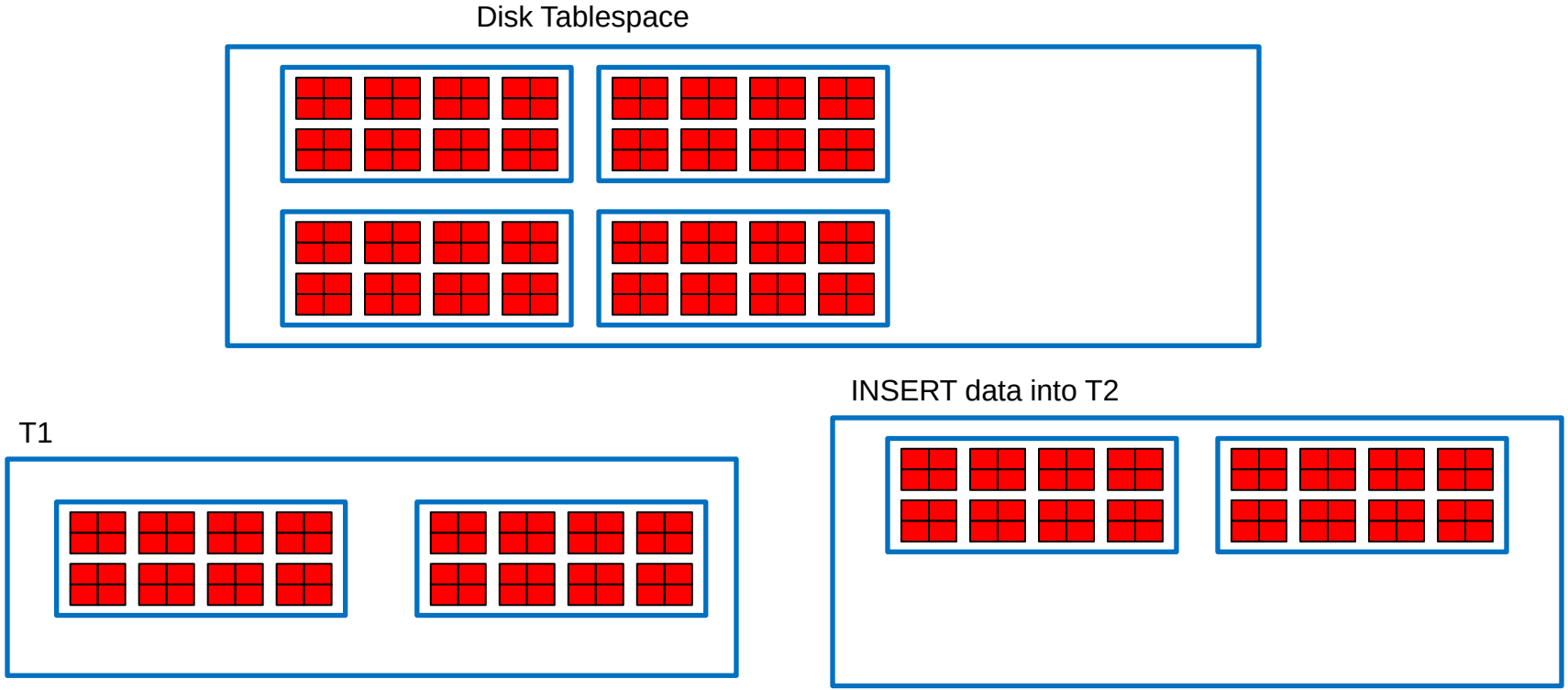
Space Allocation of Disk Tablespace

- **How spaces returned**



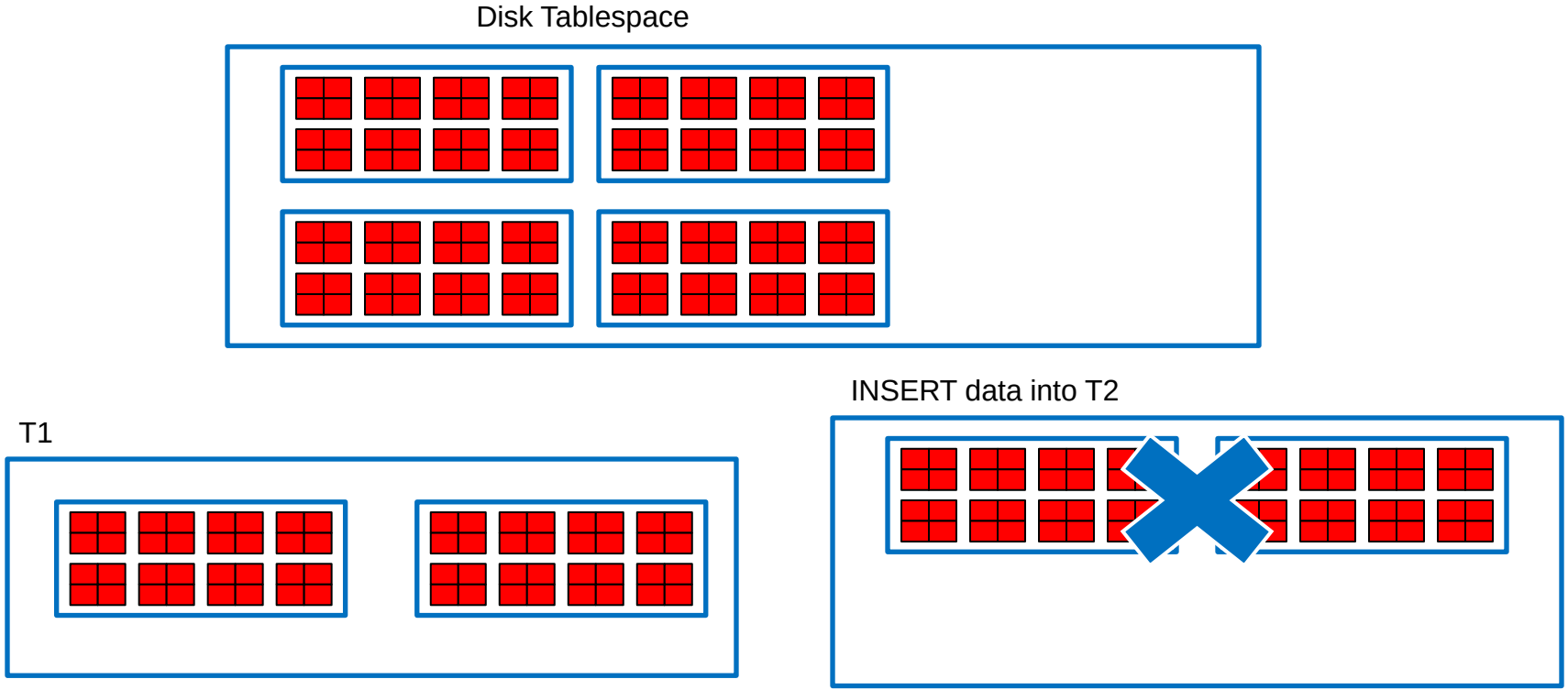
Space Allocation of Disk Tablespace

- **How spaces returned**



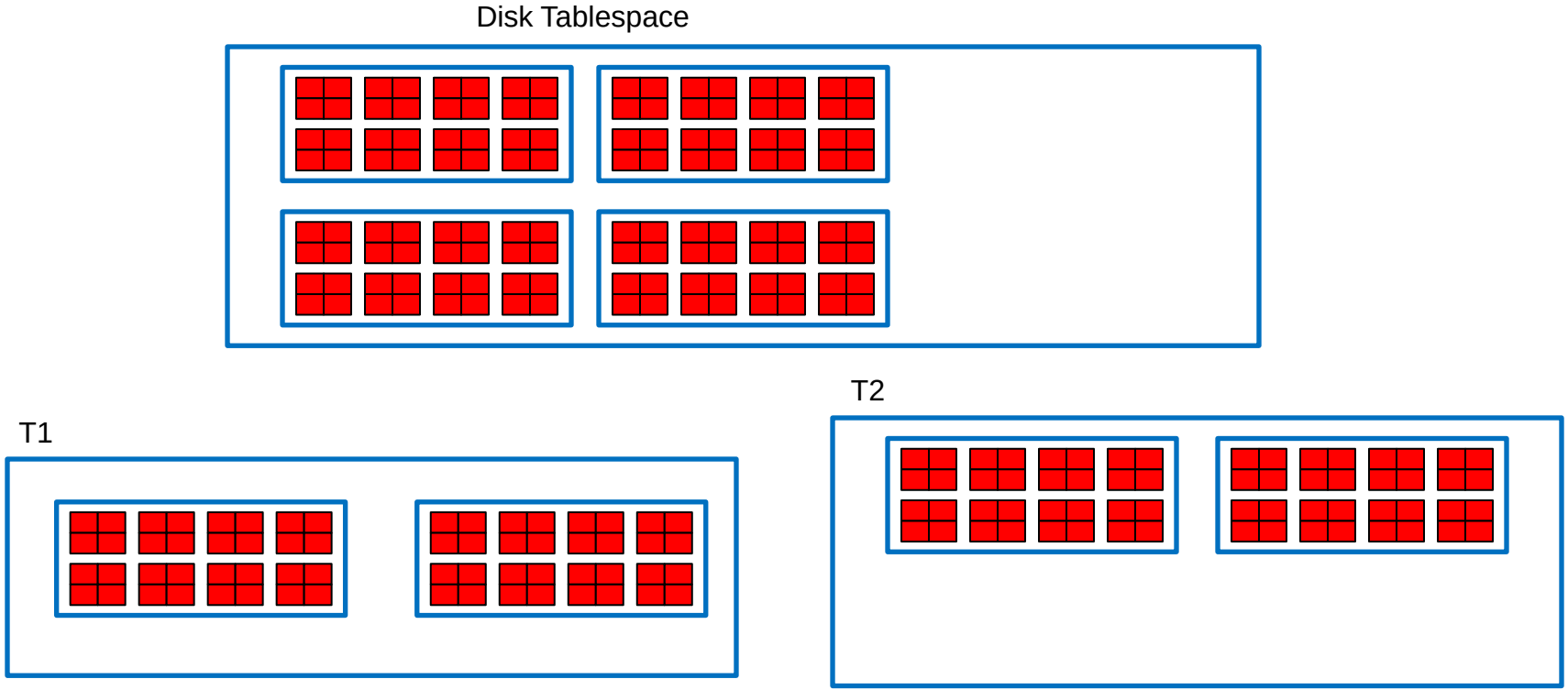
Space Allocation of Disk Tablespace

- **How spaces returned**



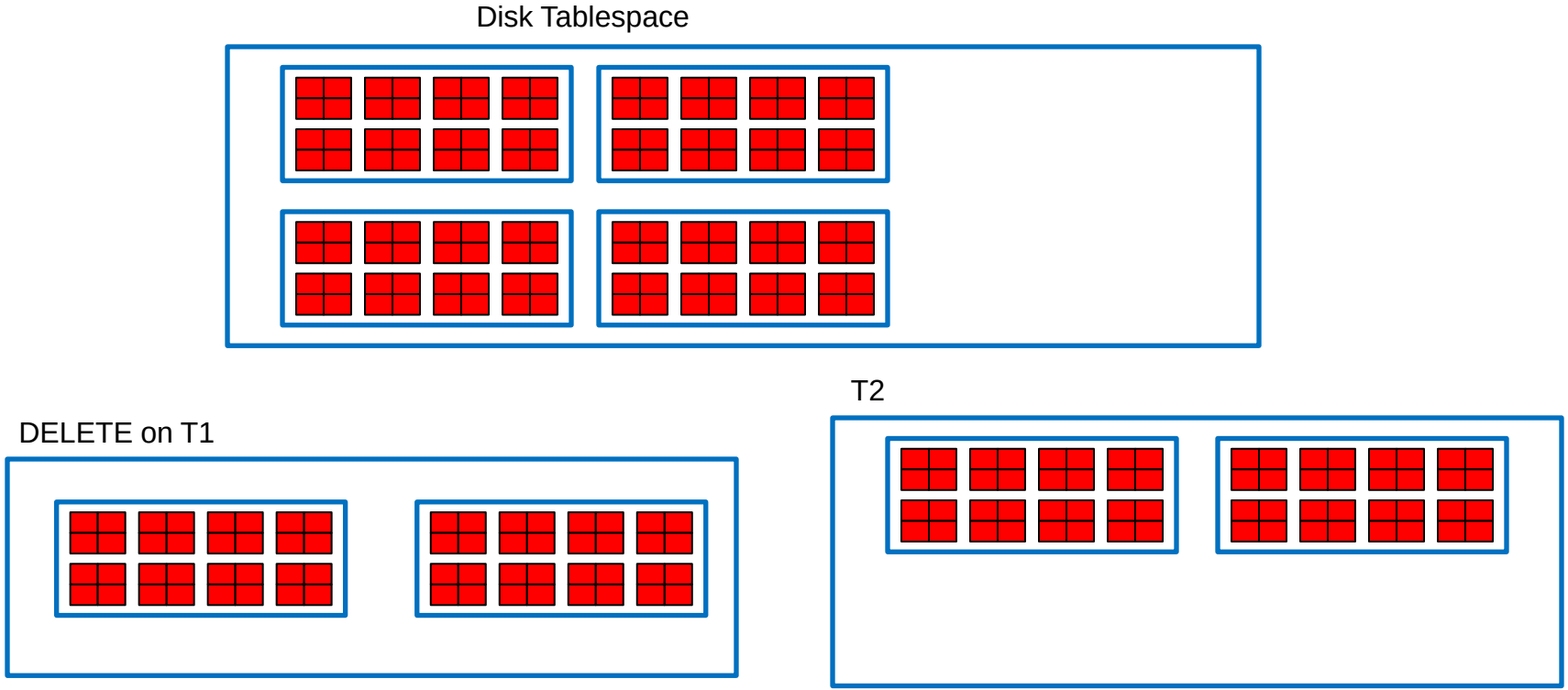
Space Allocation of Disk Tablespace

- **How spaces returned**



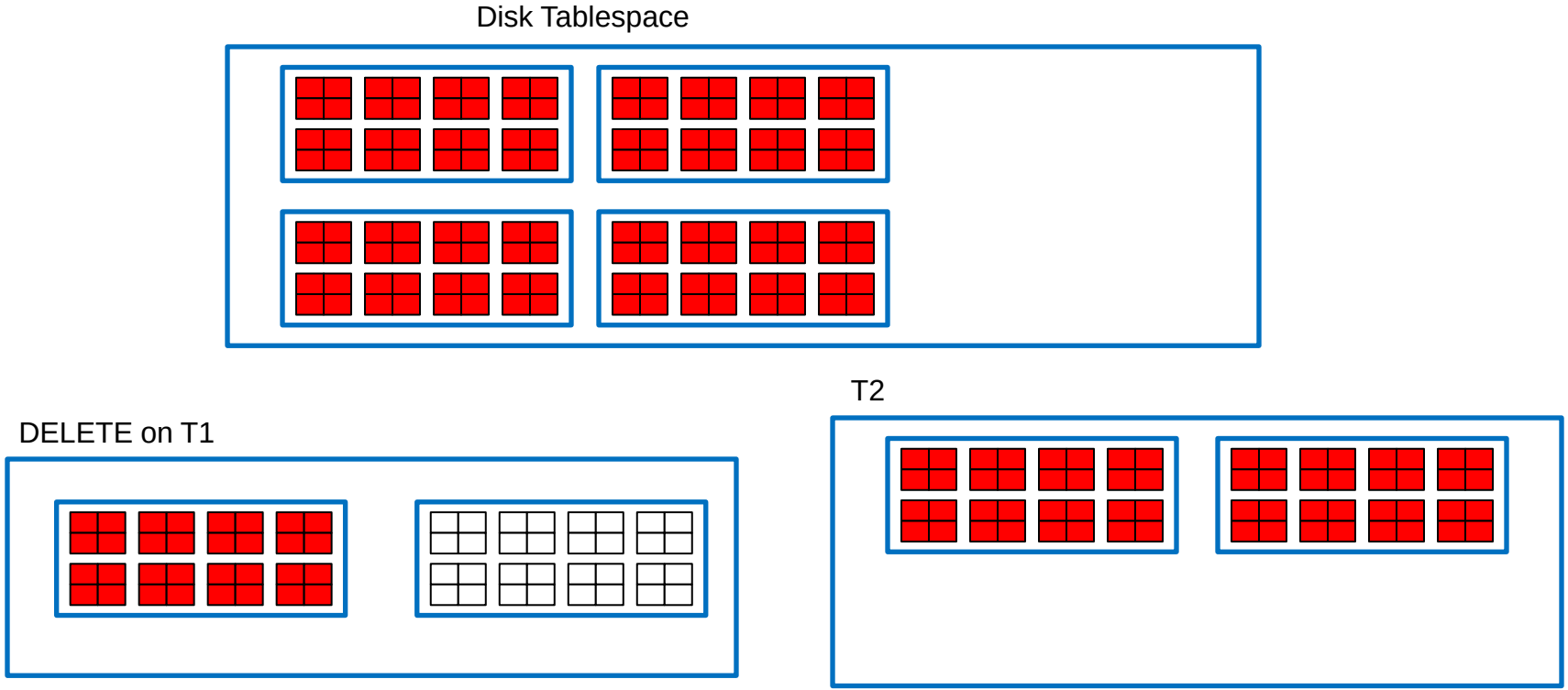
Space Allocation of Disk Tablespace

- **How spaces returned**



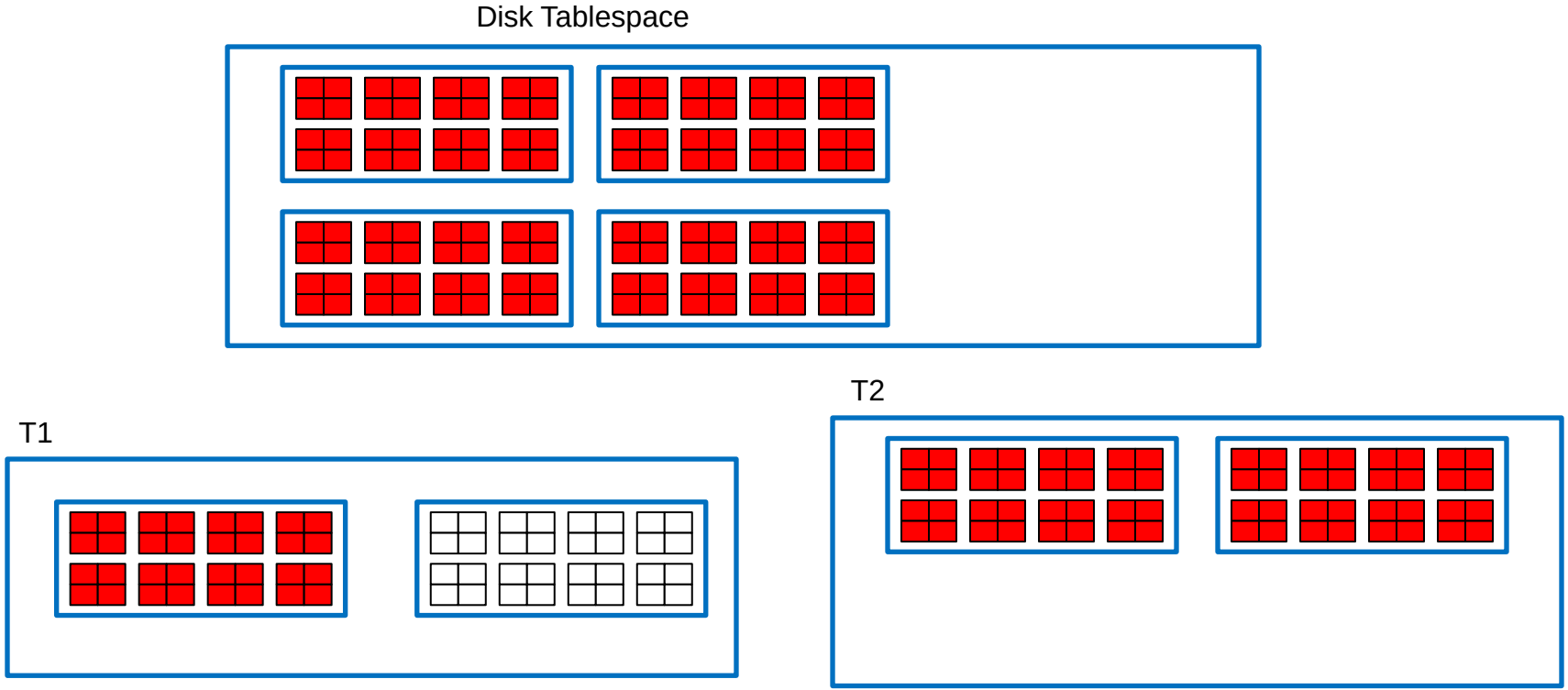
Space Allocation of Disk Tablespace

- **How spaces returned**



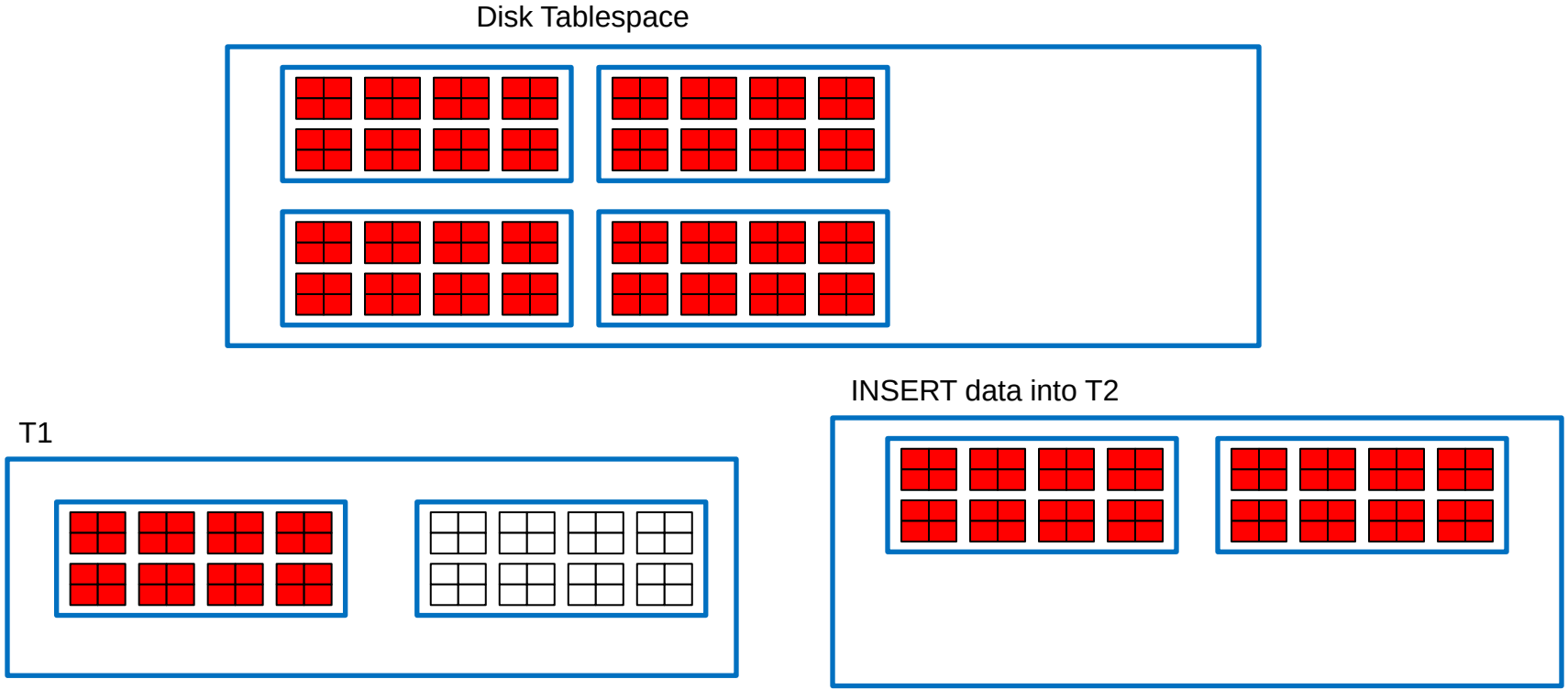
Space Allocation of Disk Tablespace

- **How spaces returned**



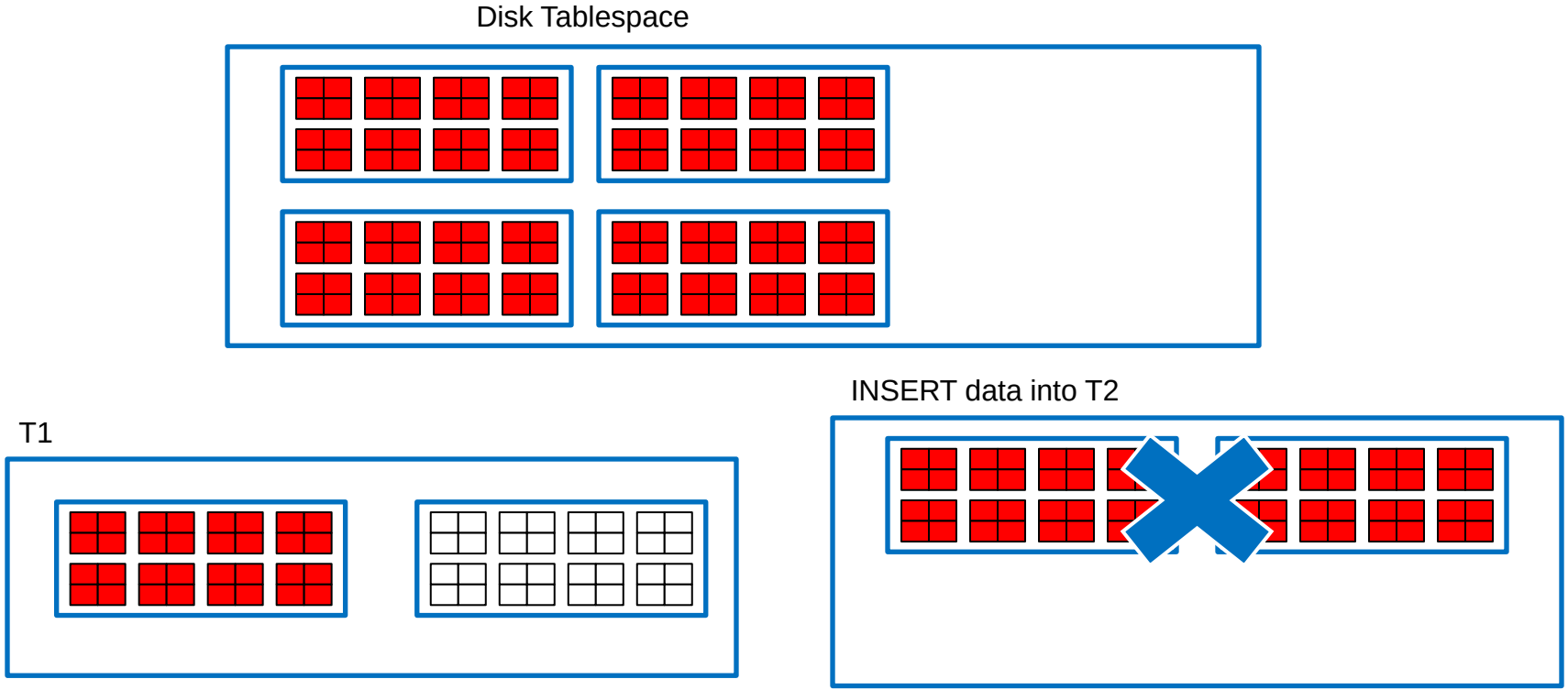
Space Allocation of Disk Tablespace

- **How spaces returned**



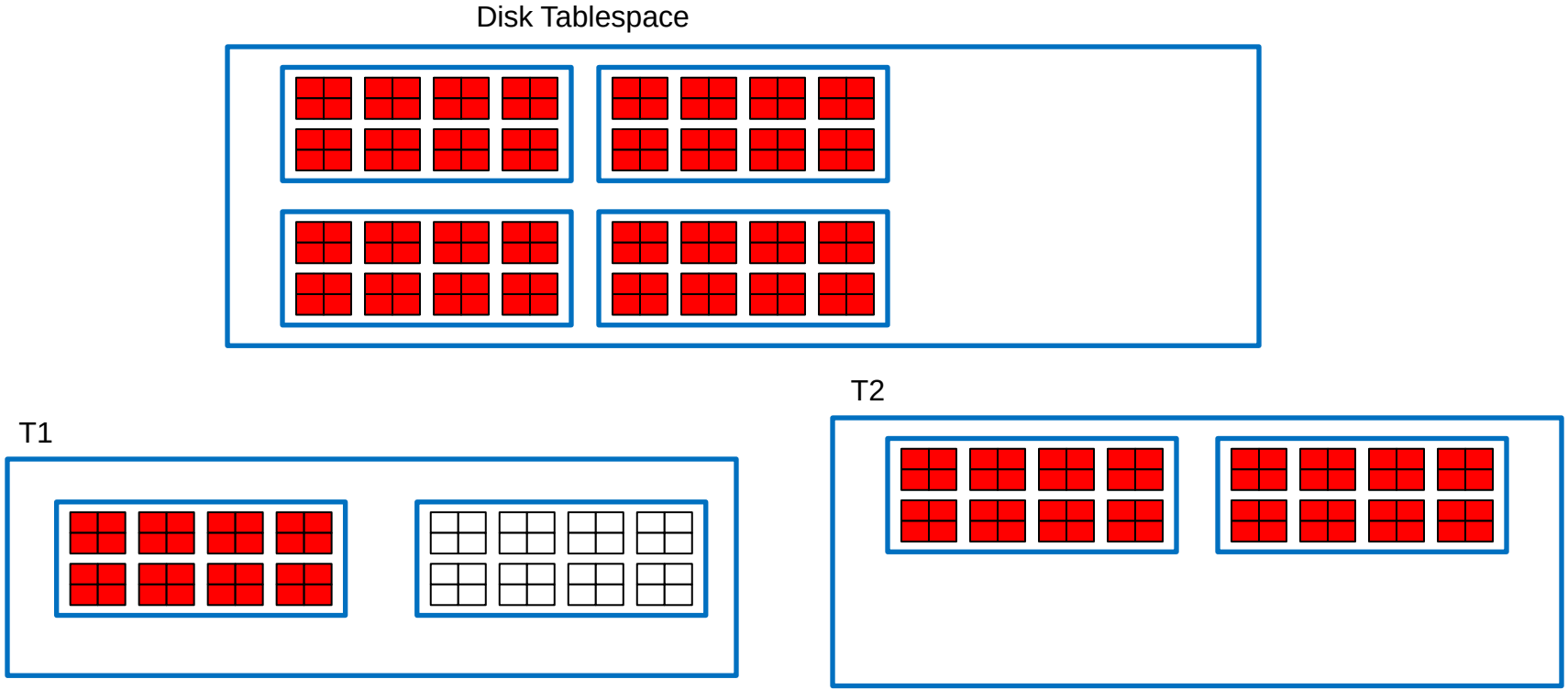
Space Allocation of Disk Tablespace

- **How spaces returned**



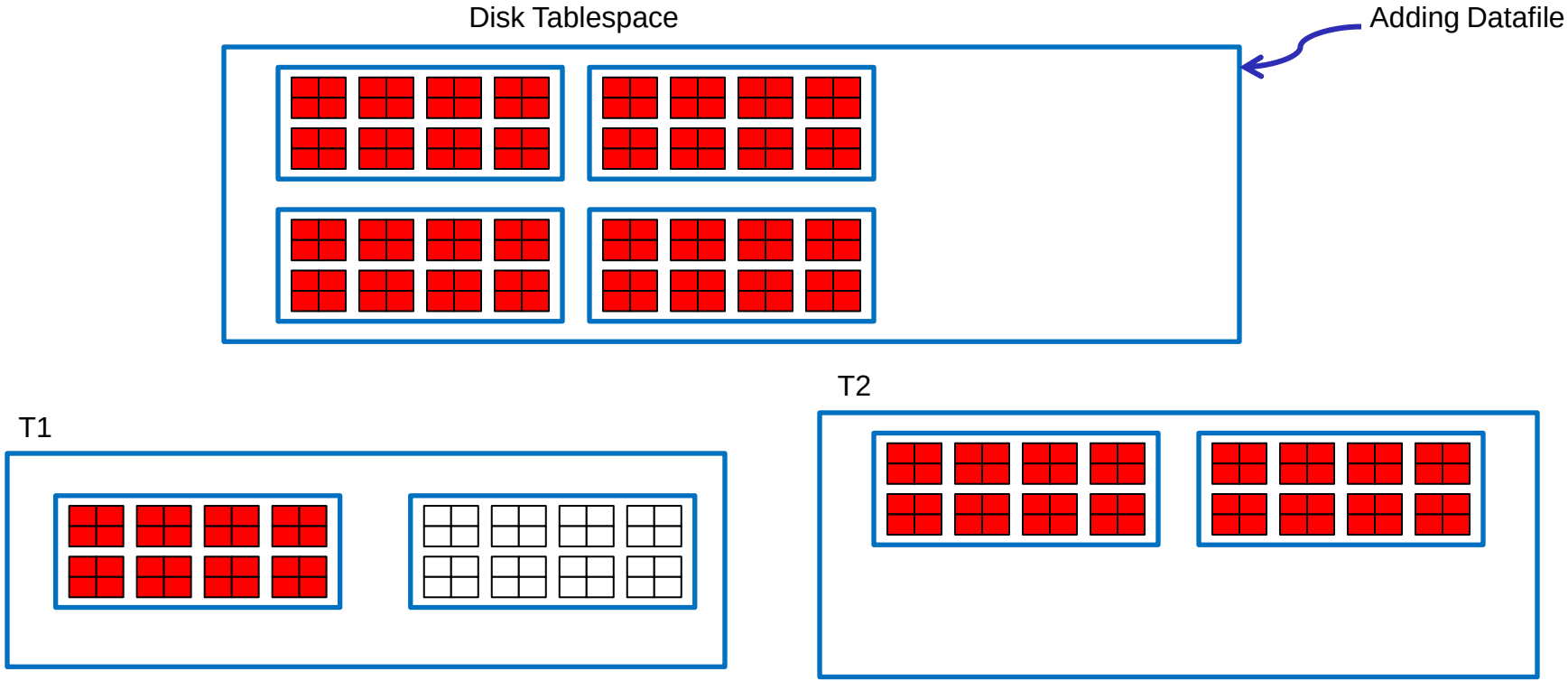
Space Allocation of Disk Tablespace

- **How spaces returned**



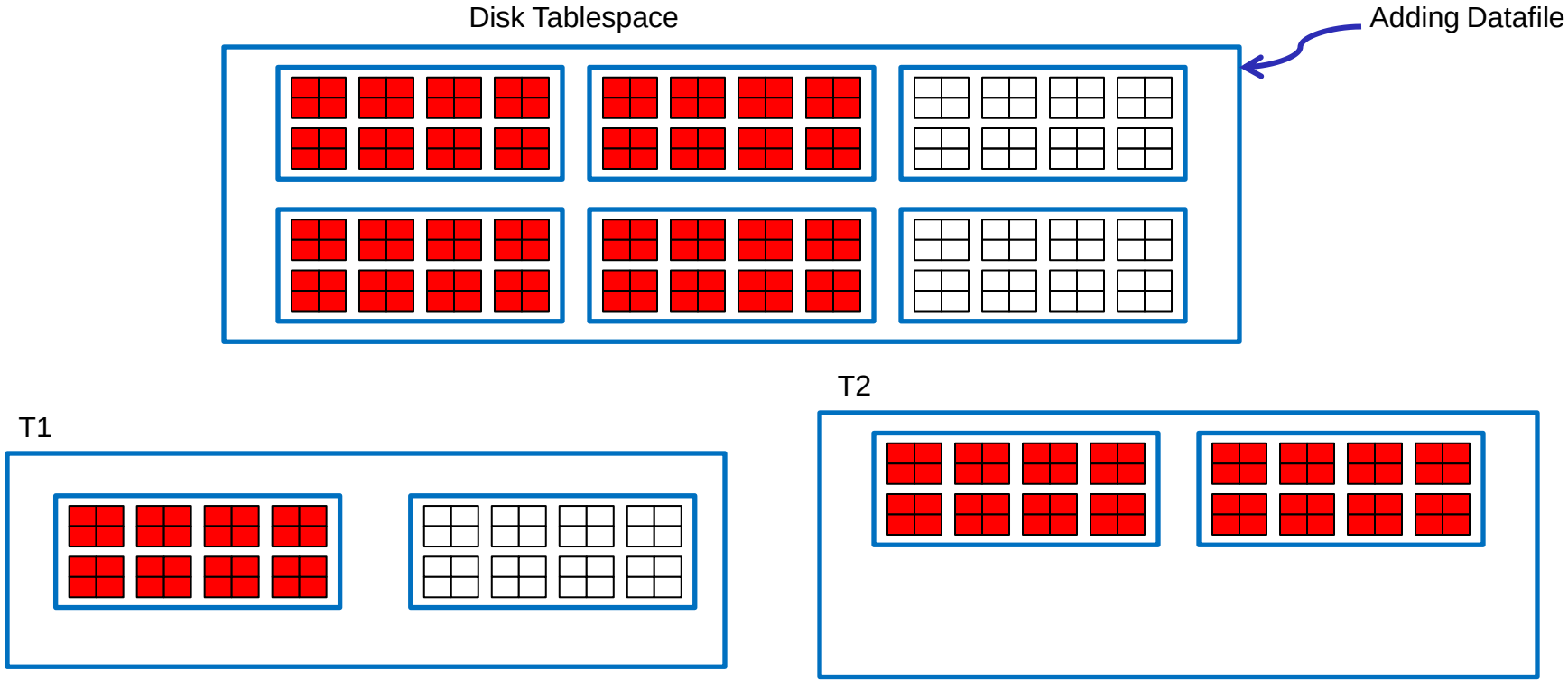
Space Allocation of Disk Tablespace

- **How spaces returned**



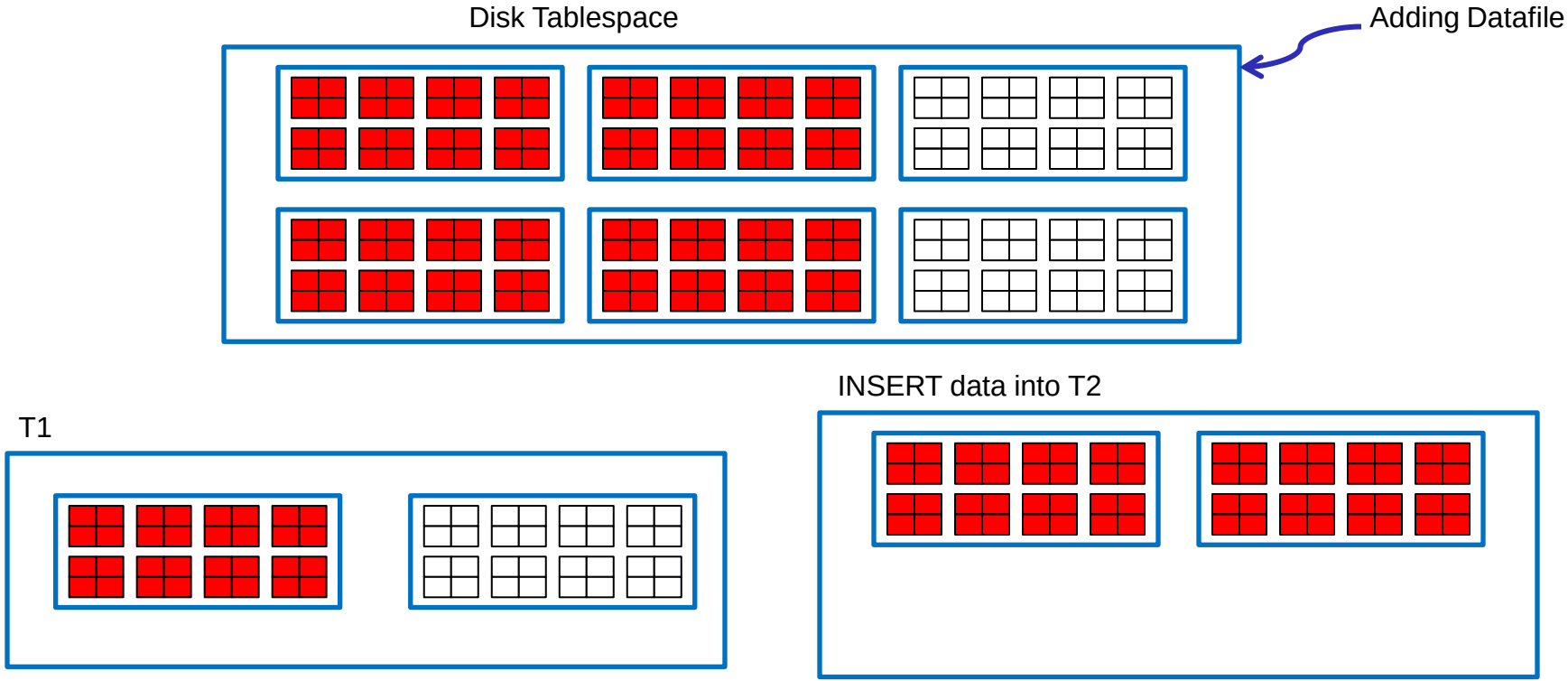
Space Allocation of Disk Tablespace

- **How spaces returned**



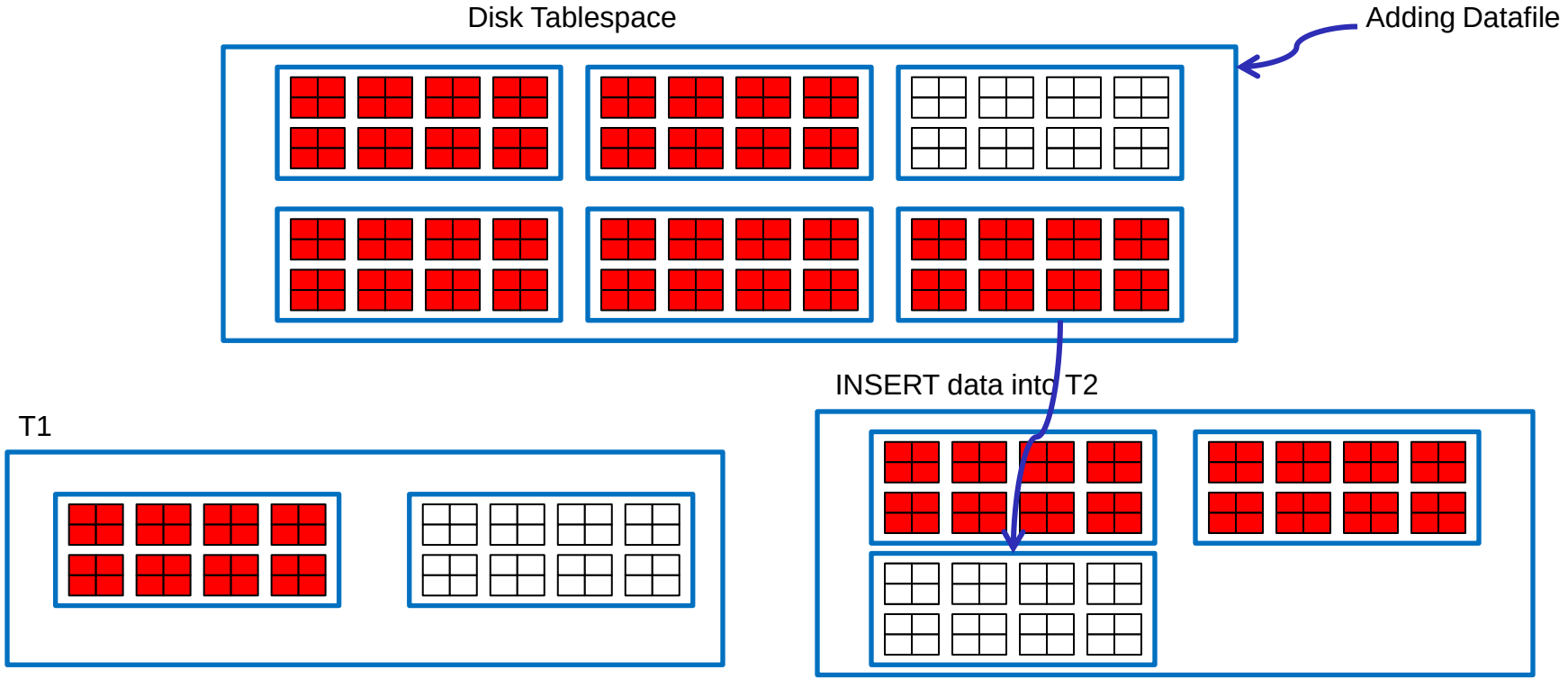
Space Allocation of Disk Tablespace

- **How spaces returned**



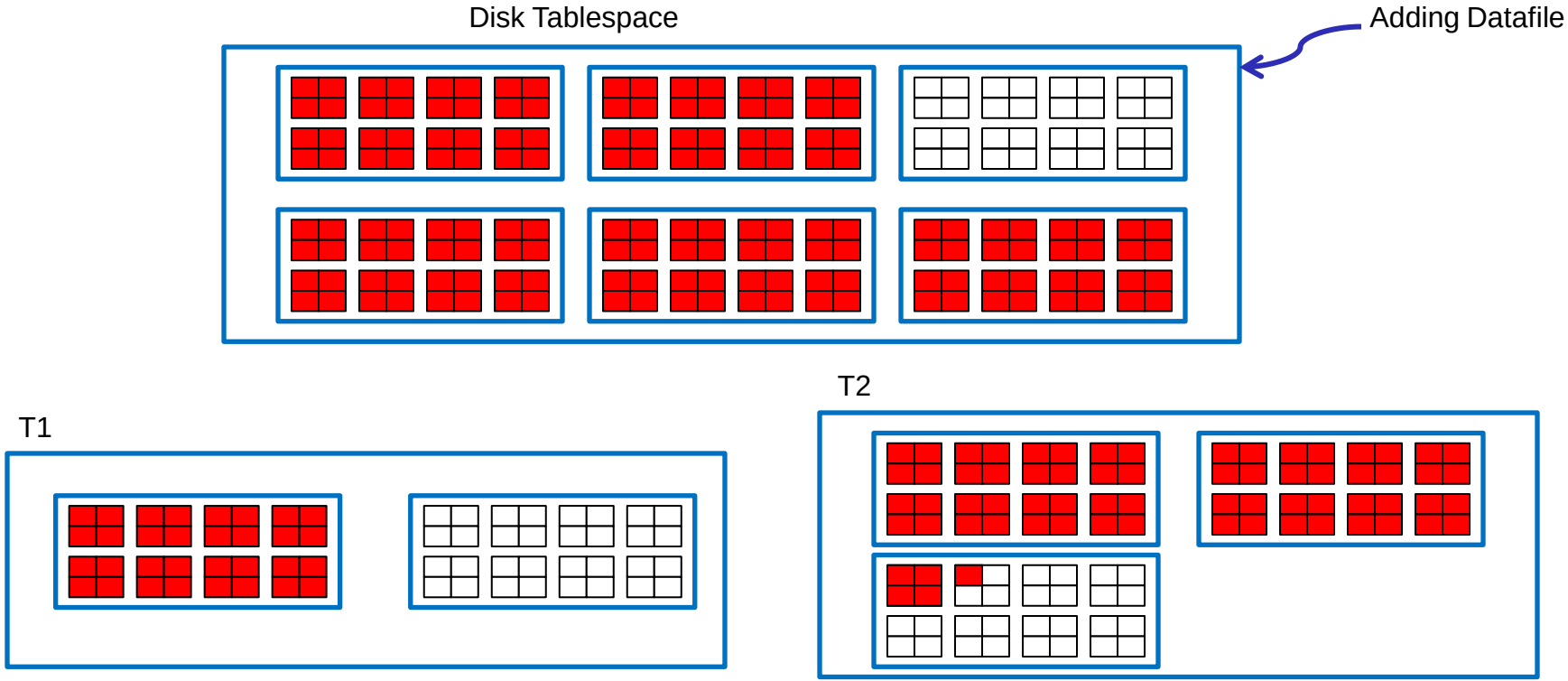
Space Allocation of Disk Tablespace

- **How spaces returned**



Space Allocation of Disk Tablespace

- **How spaces returned**



Summary

	Disk Tablespace	Memory Tablespace
Tablespace Types	Disk	Memory
Purpose	Large amount of data processing	High performance
Storage architecture	Tablespace-Segment-Extent-Page	Tablespace-Page
Recovery	Disk datafile & Redo logfile	Checkpoint image file& Redo logfile
Page size	8KB	32KB
Allocation unit	Extent	Page
Compaction	No(Adding datafile etc)	Yes