## DBA Certification Course (Summer 2008)

## Chapter 3: Database Components

- Tablespaces
- Buffer Pools
- Schemas
- Catalog

## Objectives

After completing this chapter, you should be able to:

- explain the different types of tablespaces
- create a tablespace and a buffer pool
- create a database
- specify tablespaces in a CREATE TABLE statement



• George Baklarz: DB2 9 Fundamentals exam 730 prep, Part 3: Accessing DB2 data

[http://www.ibm.com/developerworks/edu/dm-dw-db2-cert7303.html]

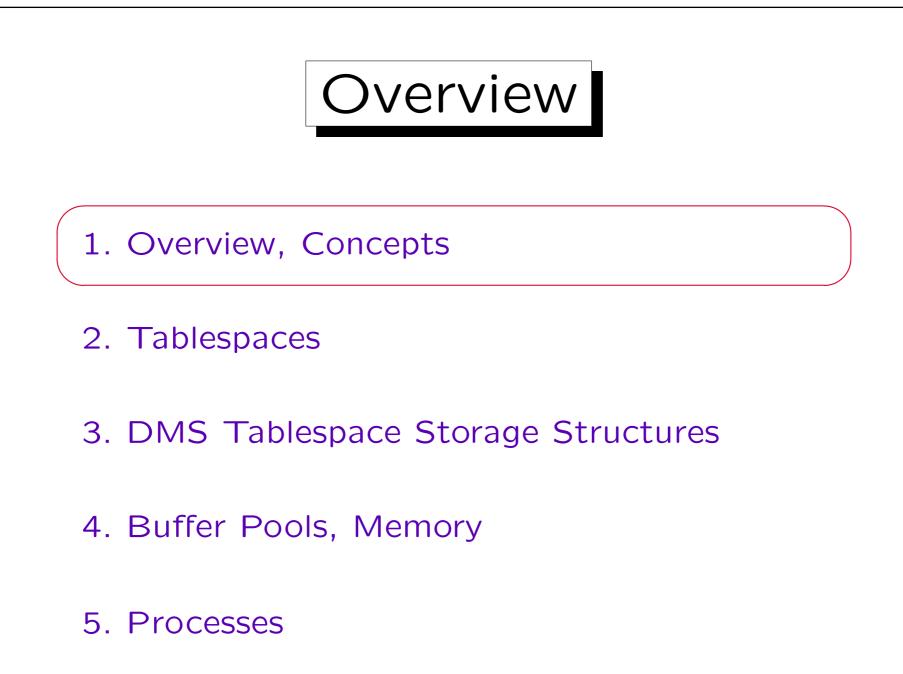
 Clara Liu, Raul Chong, Dwaine Snow, Sylvia Qi: Understanding DB2:

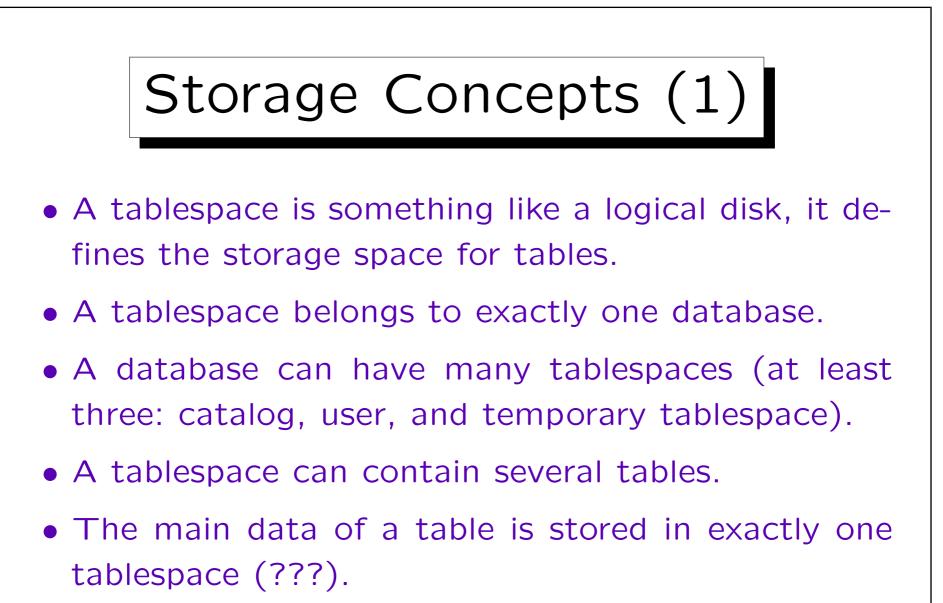
Learning Visually with Examples

IBM Press/Pearson, 2005, ISBN 0-13-185916-1, 895 pages.

• DB2 for Linux, UNIX, and Windows Version 9 Information Center

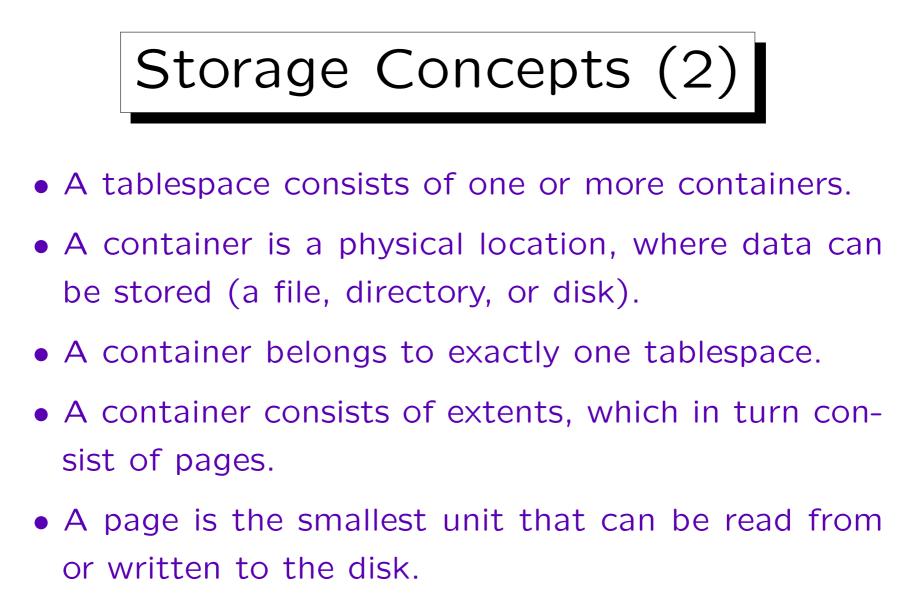
[http://publib.boulder.ibm.com/infocenter/db2luw/v9//index.jsp]





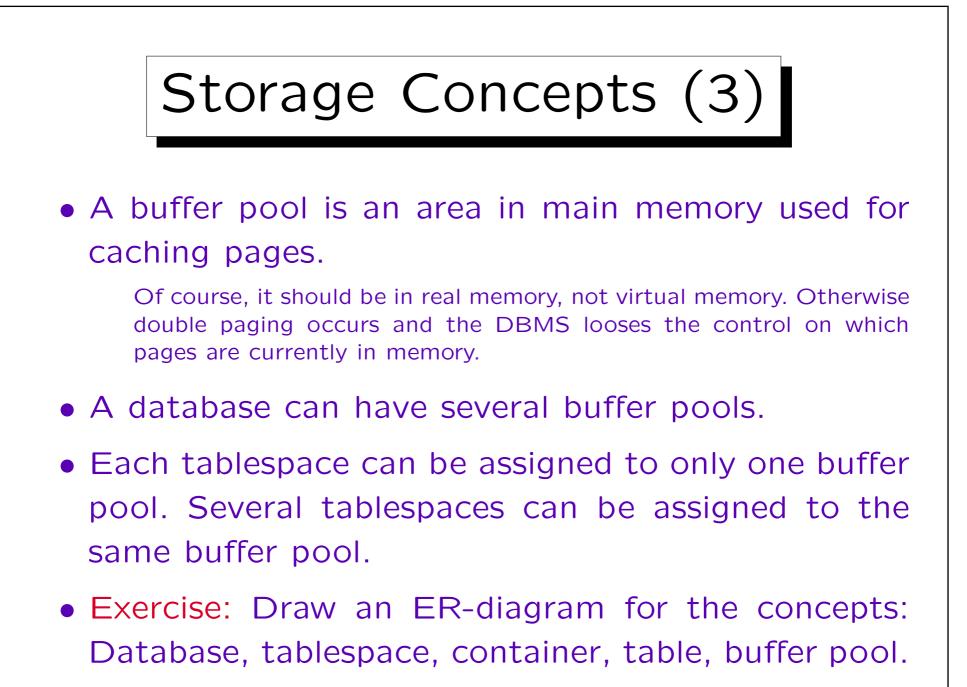
The indexes for a table can be stored in a second tablespace, the large objects (and possibly XML data) in a third.

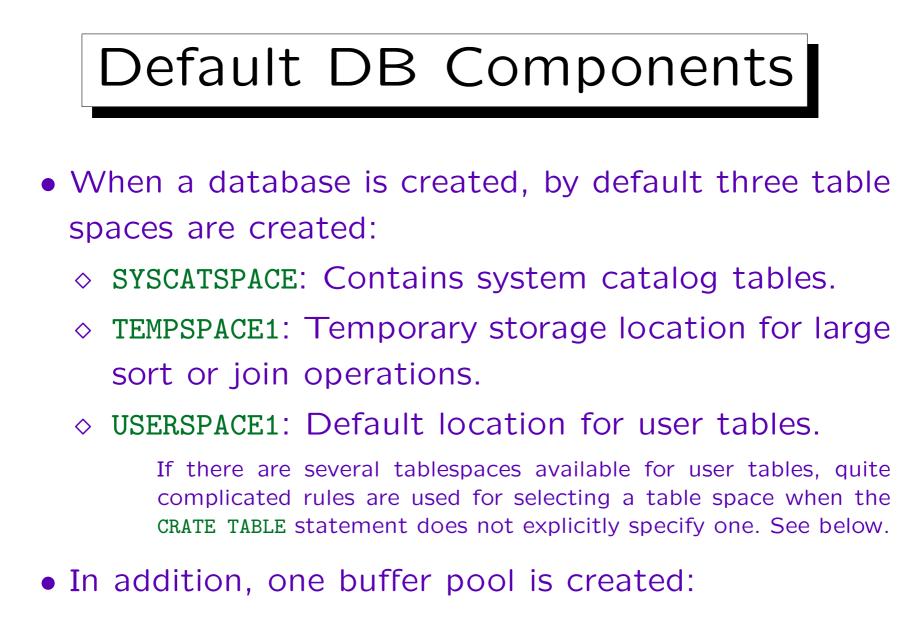
3 - 5



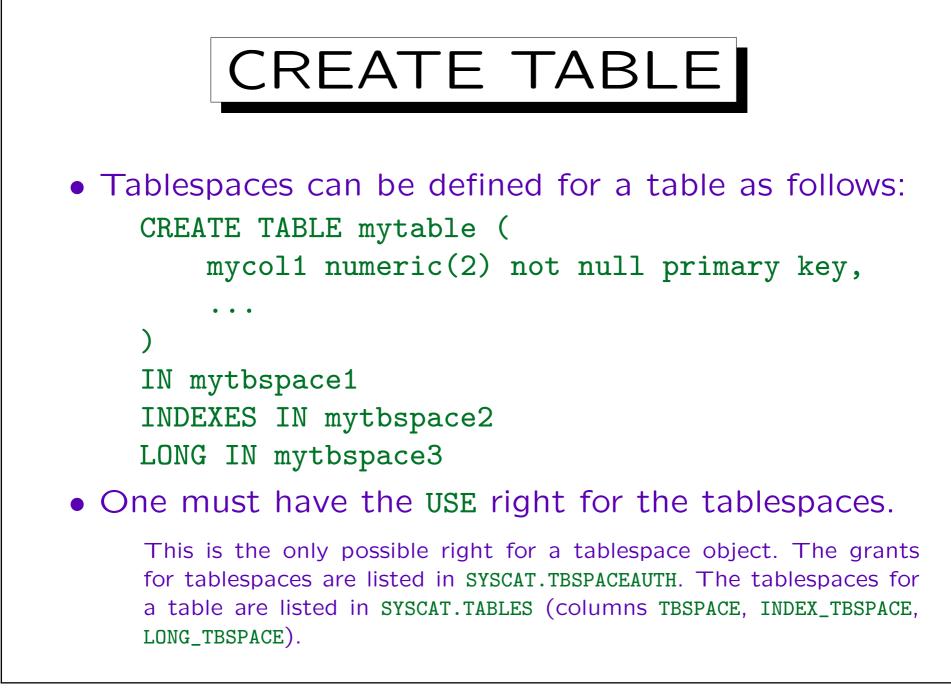
• An extent is a consecutive sequence of pages.

3 - 6





◊ IBMDEFAULTBP



Page Size (1)

- DB2 supports four page sizes: 4K, 8K, 16K, 32K. The default is 4K.
- The page size is important because each row must fit in a single page (with the exception of LOB columns and possibly XML columns).

With 4K page size, the maximum size of a row including all overhead is 4005 Byte. It can have at most 500 columns. With 8K page size, the maximum size of a row is 8101 Byte, and it can have 1012 rows.

• The page size is also important because there is a maximal number of pages in a tablespace.

So very large tables might need a larger pagesize. See Slide 3-29.

Page Size (2)

 For regular table spaces (see Slide 3-29), there can be only 255 rows per page.

Thus, a page size that is too large means that storage is wasted.

- Each tablespace has a fixed page size.
- A database can have tablespaces with different page sizes.
- Each buffer pool has a fixed page size.
- A tablespace can be assigned only to a buffer pool with the same page size.



- An extent is a sequence of consecutive pages. Sequential block access is much faster than random access.
- All extents in a table space have the same size.
- DB2 allocates storage in units of extents. For SMS tablespaces, this depends on multipage\_alloc, see below.
- Each extent belongs to only one database object (e.g., one table).
- If a table space has several containers, extents are allocated in a round robin fashion.

This gives striping if the containers are on different disks.

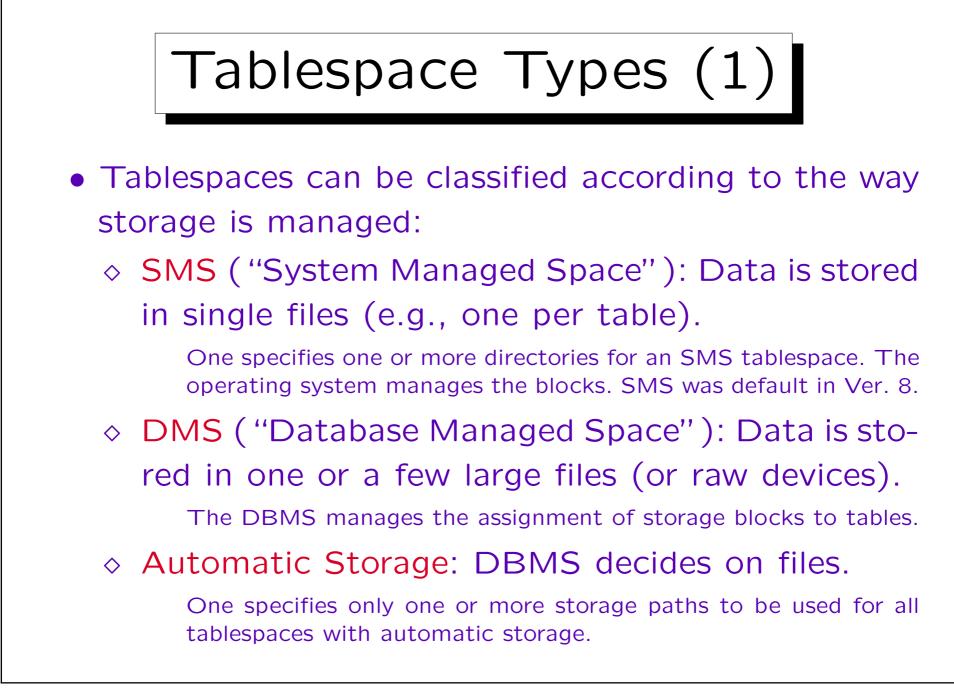


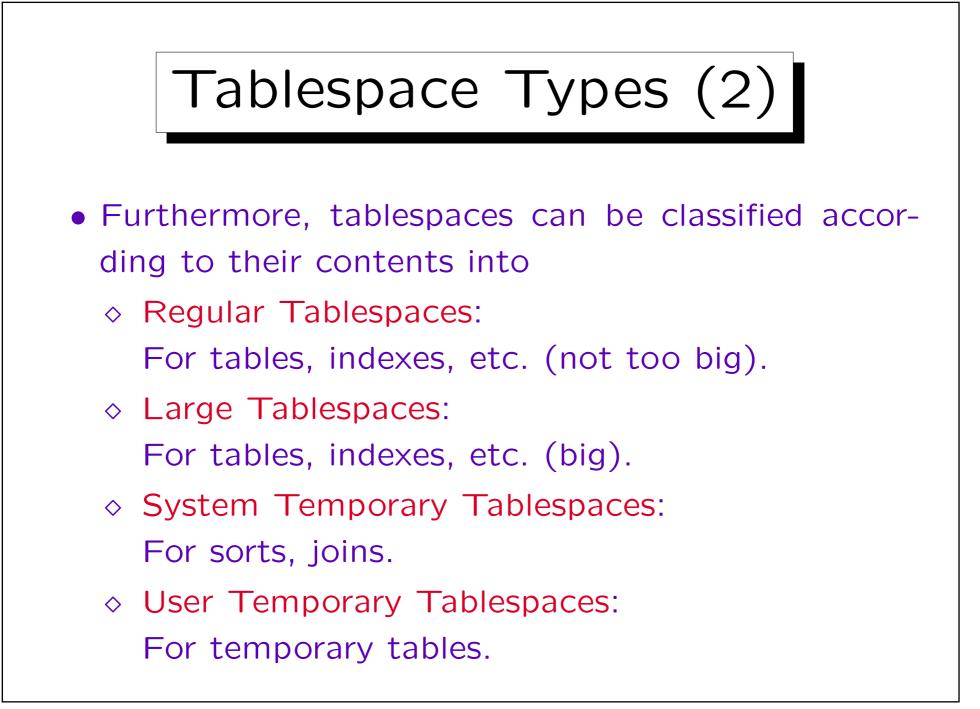
1. Overview, Concepts

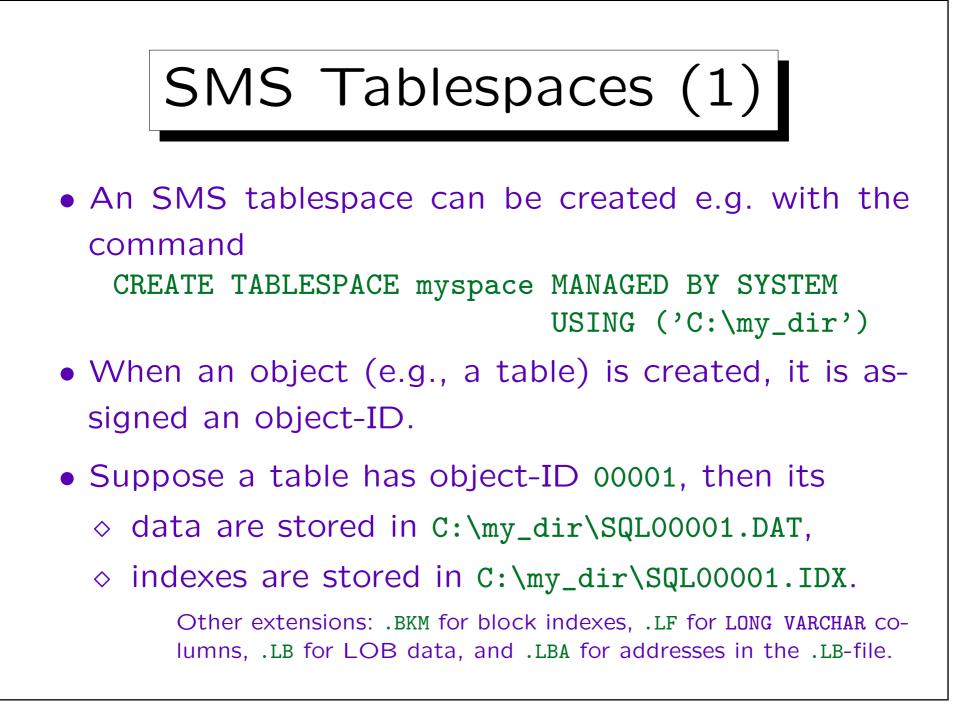
2. Tablespaces

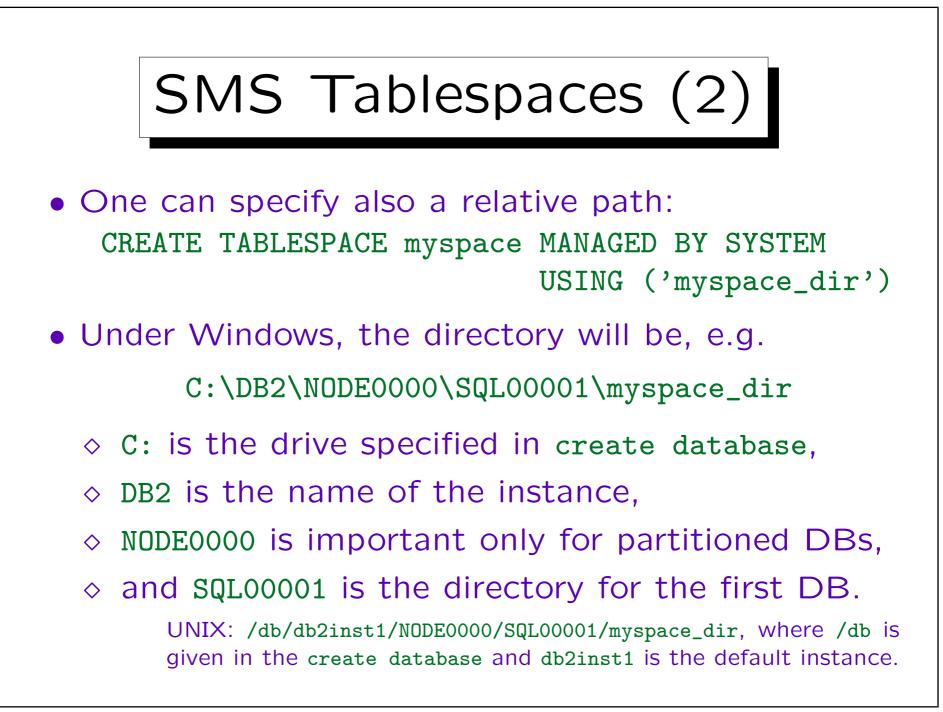
- 3. DMS Tablespace Storage Structures
- 4. Buffer Pools, Memory

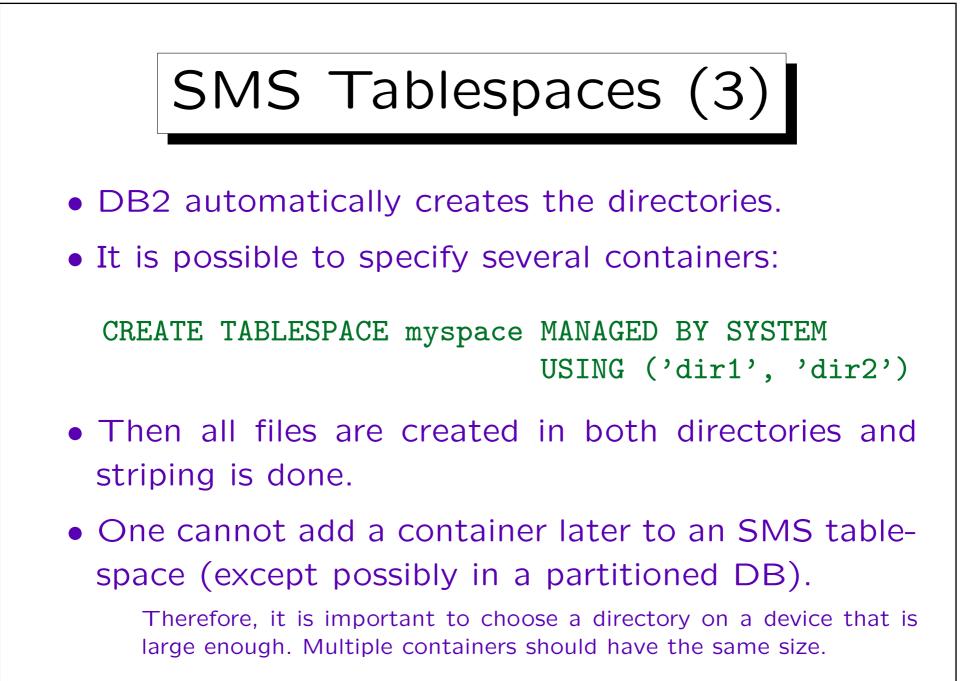
## 5. Processes

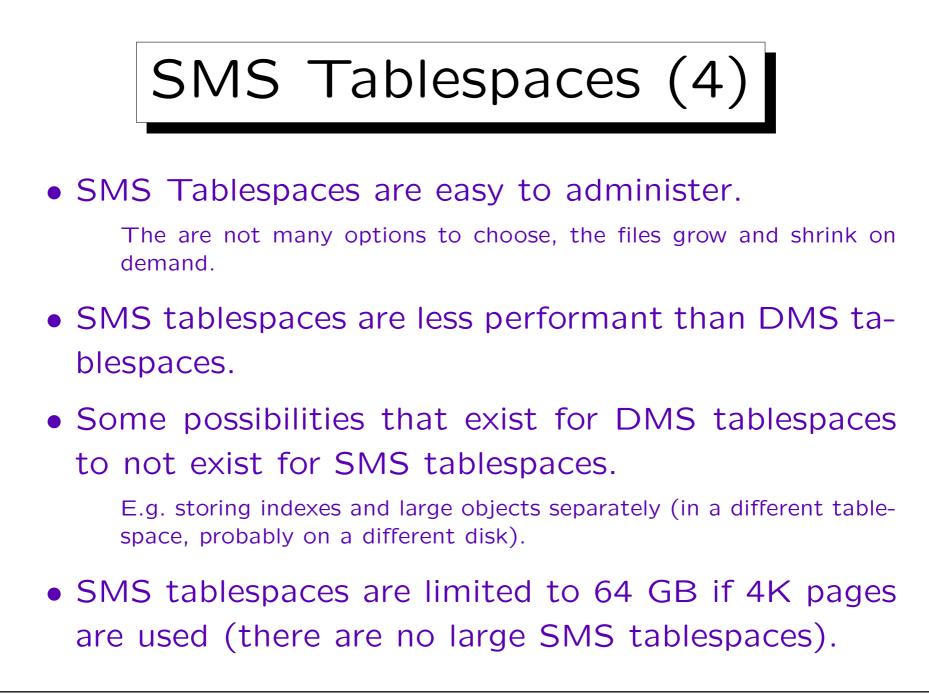


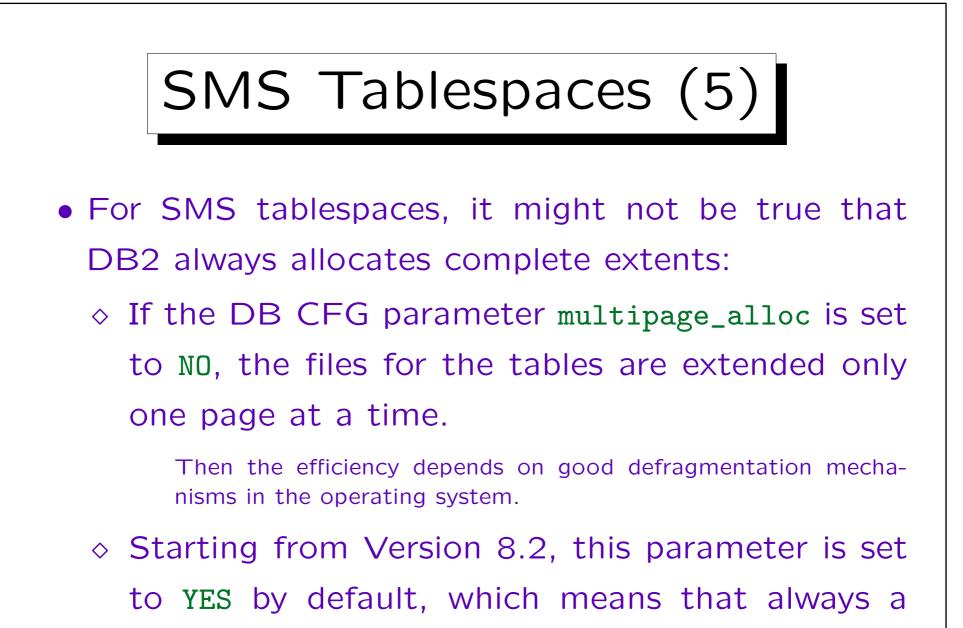




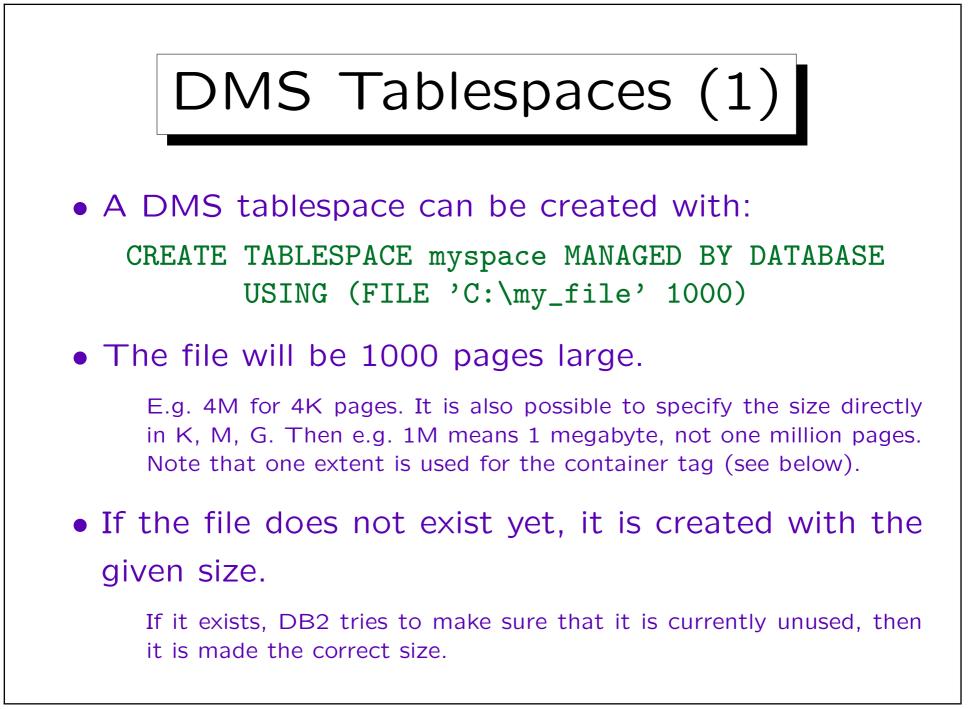


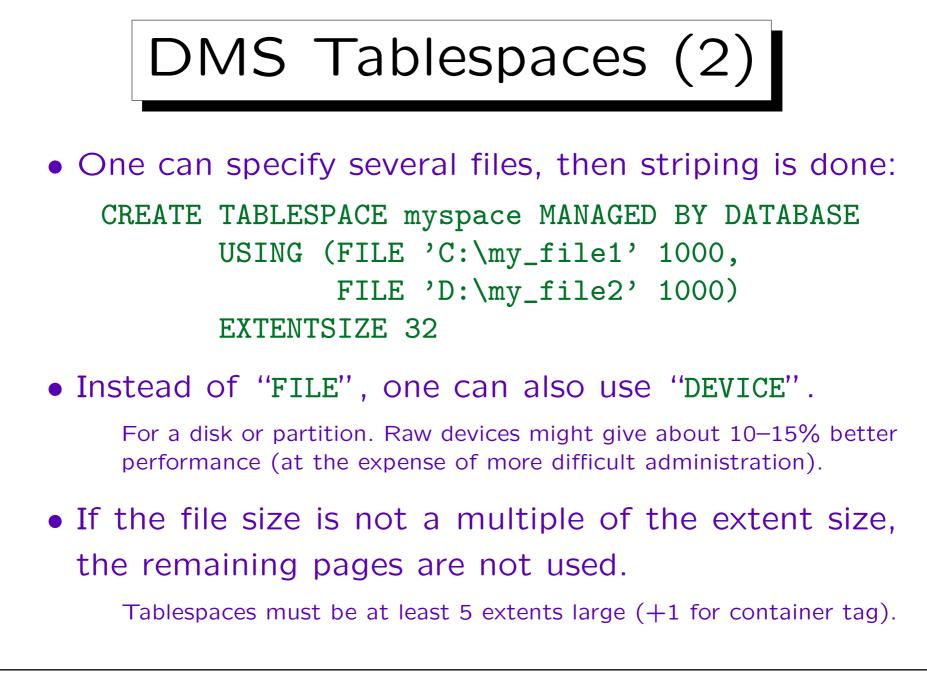


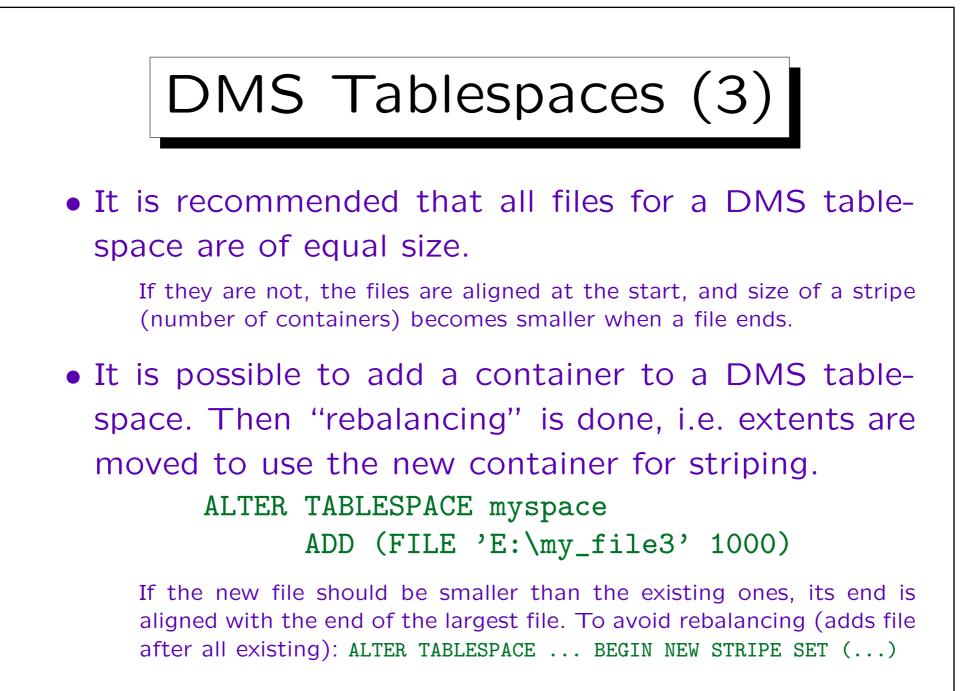


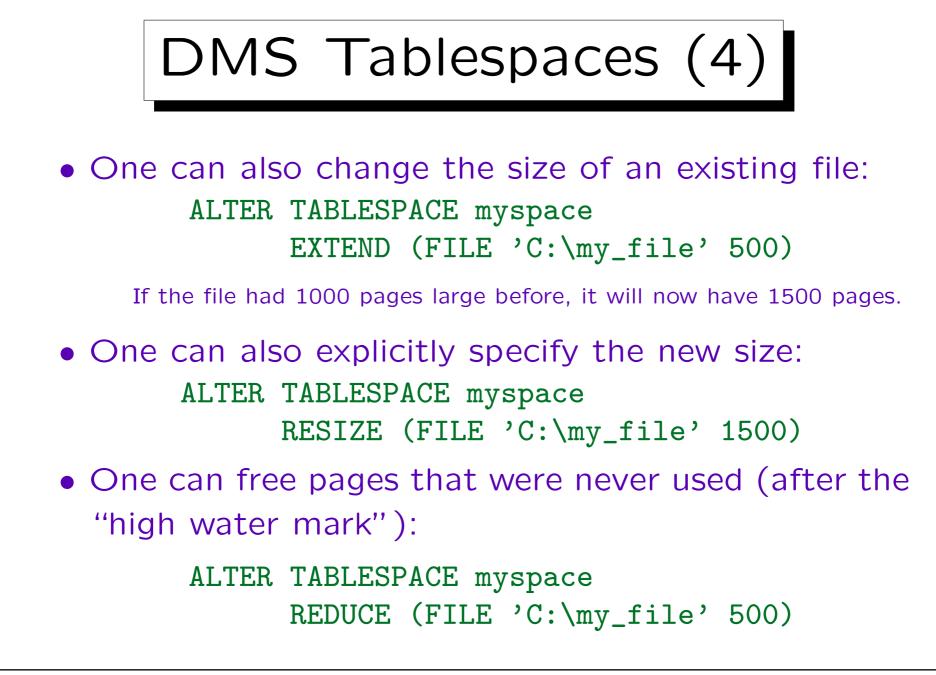


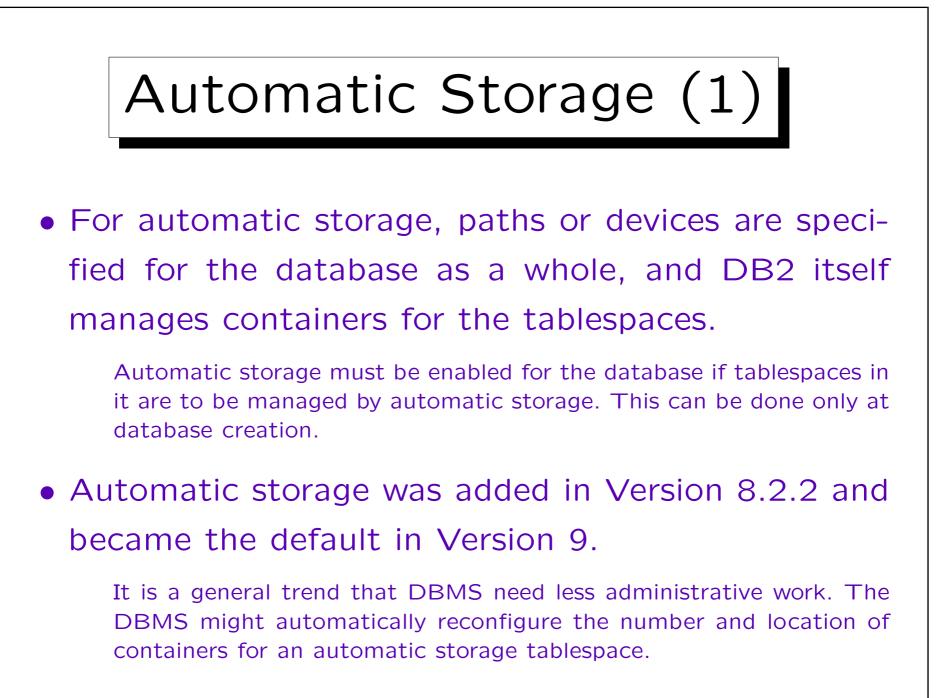
complete extent is added to the files.

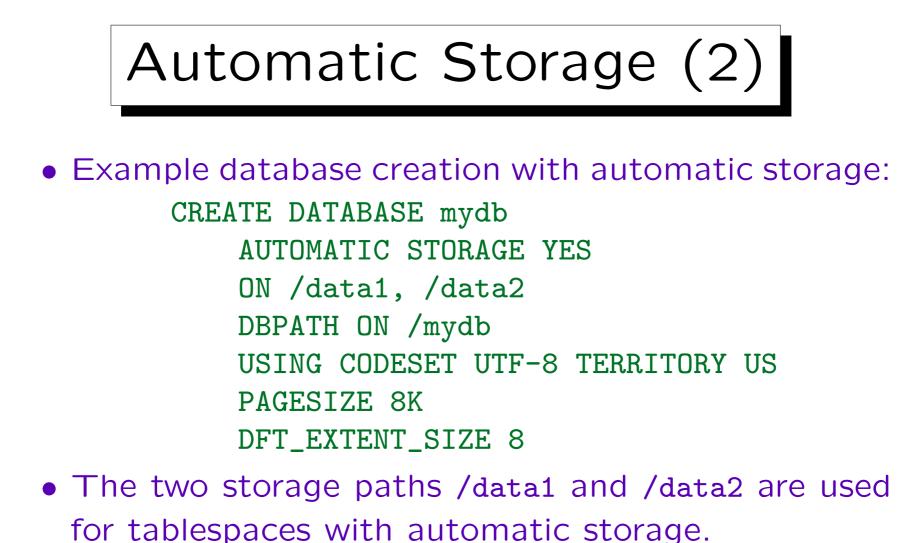




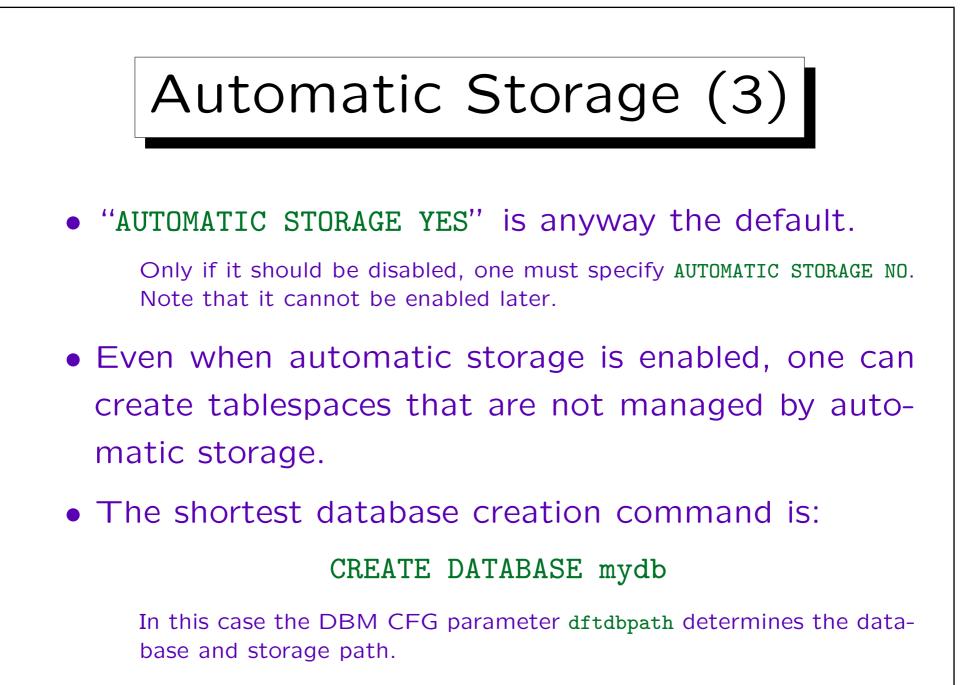


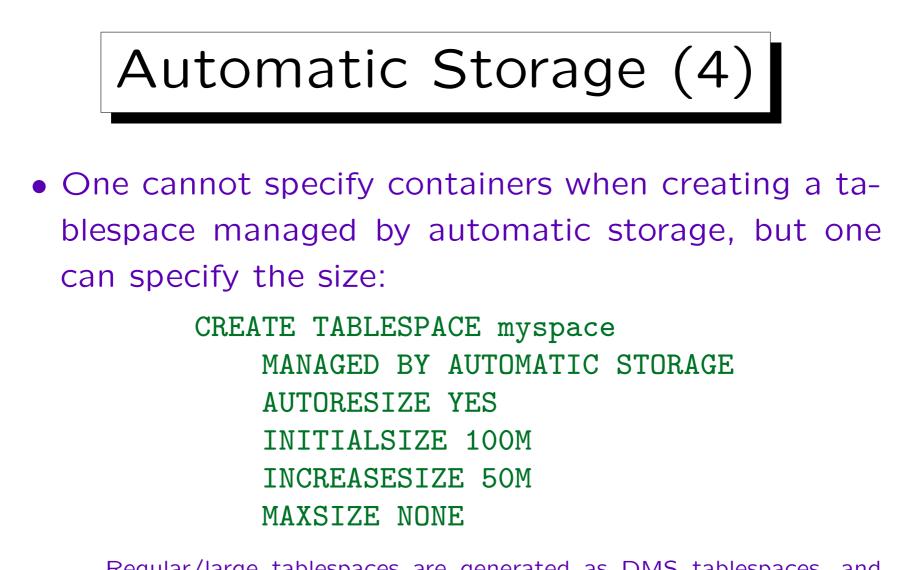




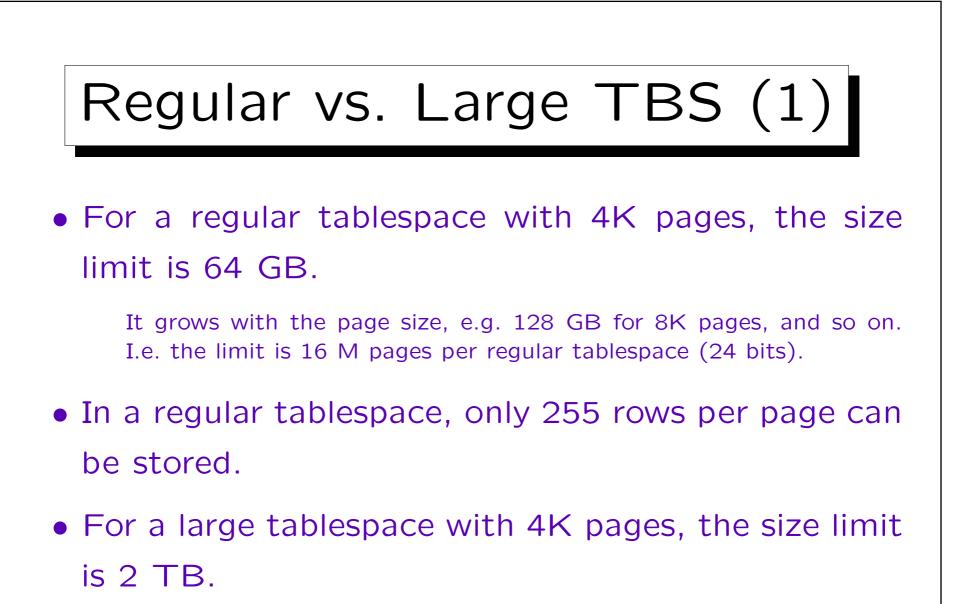


• The path /mydb is used for various control files. If one does not specify a DB path, the first storage path is used.



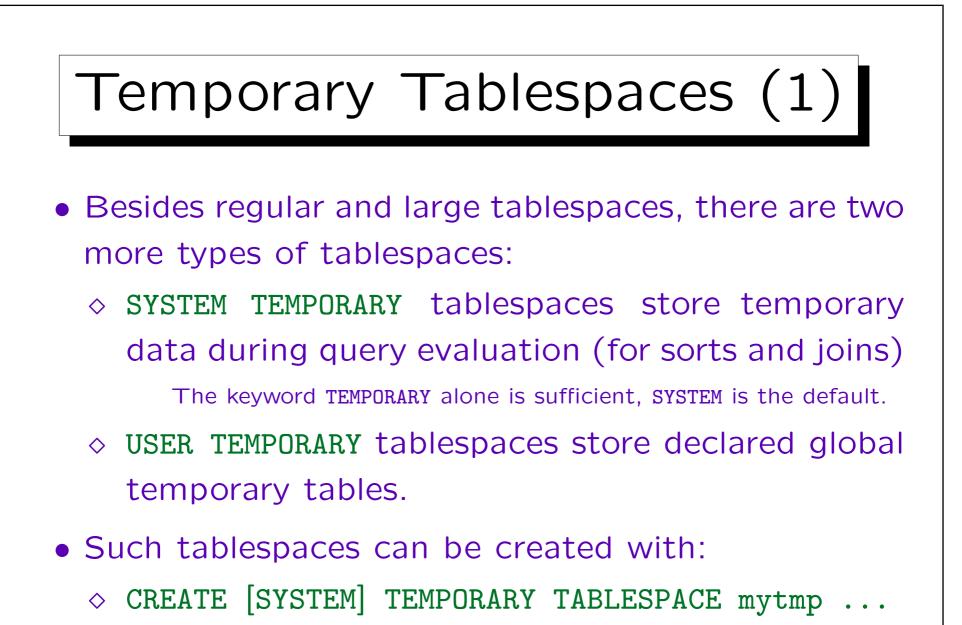


Regular/large tablespaces are generated as DMS tablespaces, and temporary tablespaces are generated as SMS tablespaces. This might change in a future release.

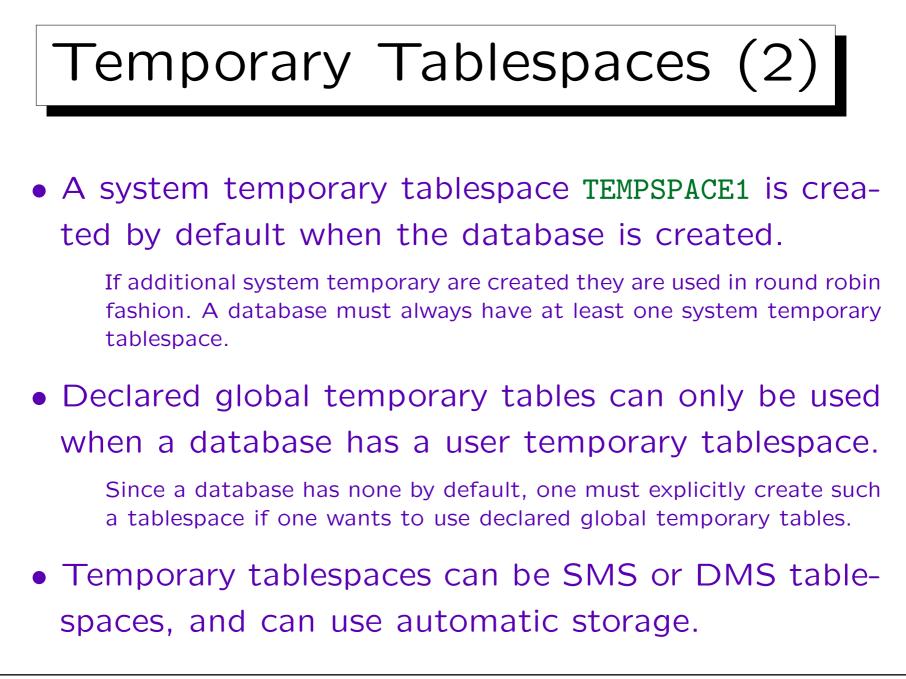


The limit is now 512 M pages. With 32K pages, this gives 16 TB.

Regular vs. Large TBS (2)
• There is a price to pay:
◊ Indexes need two additional bytes per entry in a large tablespace.
<ul> <li>Dropped table recovery is supported only for re- gular tablespaces.</li> </ul>
<ul> <li>SMS tablespaces can only be regular.</li> </ul>
<ul> <li>For DMS tablespaces, one can choose:</li> </ul>
$\diamond$ CREATE REGULAR TABLESPACE myspace
$\diamond$ CREATE LARGE TABLESPACE myspace
The default for DMS tablespaces is LARGE, for SMS REGULAR.



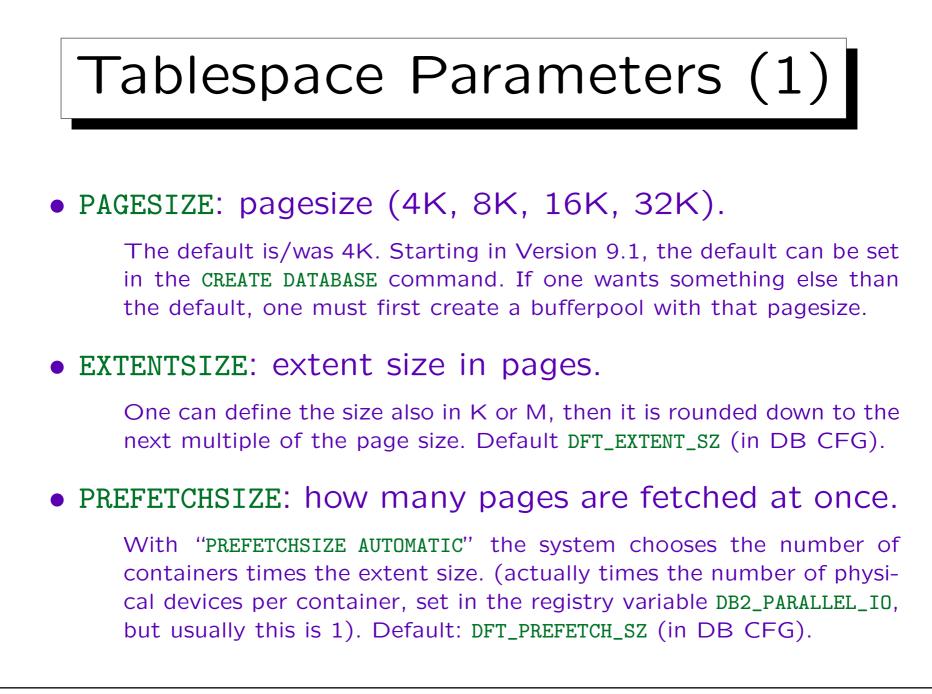
◇ CREATE USER TEMPORARY TABLESPACE mytmp ...



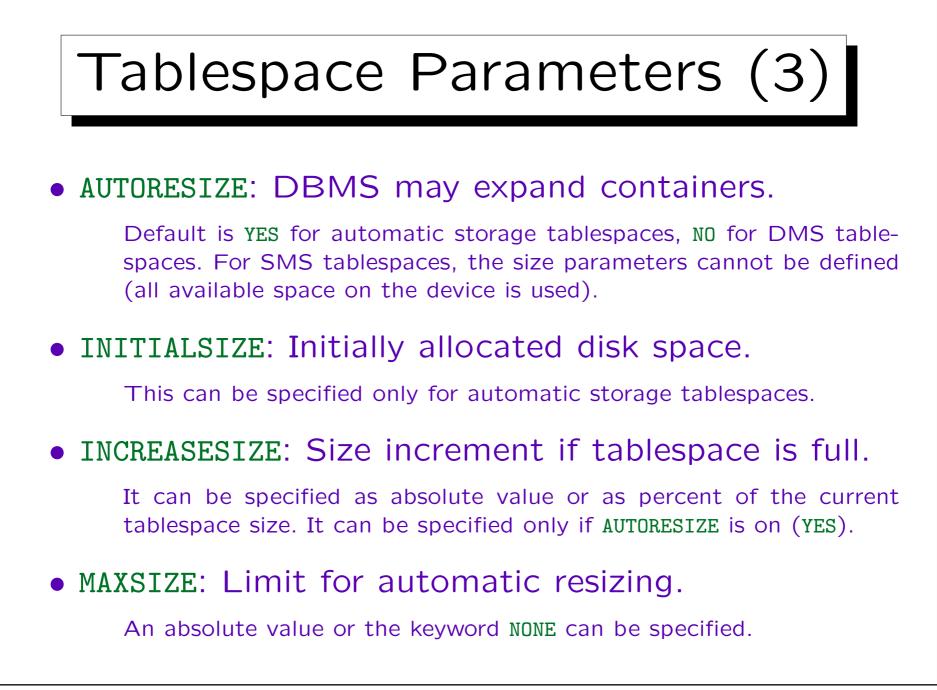


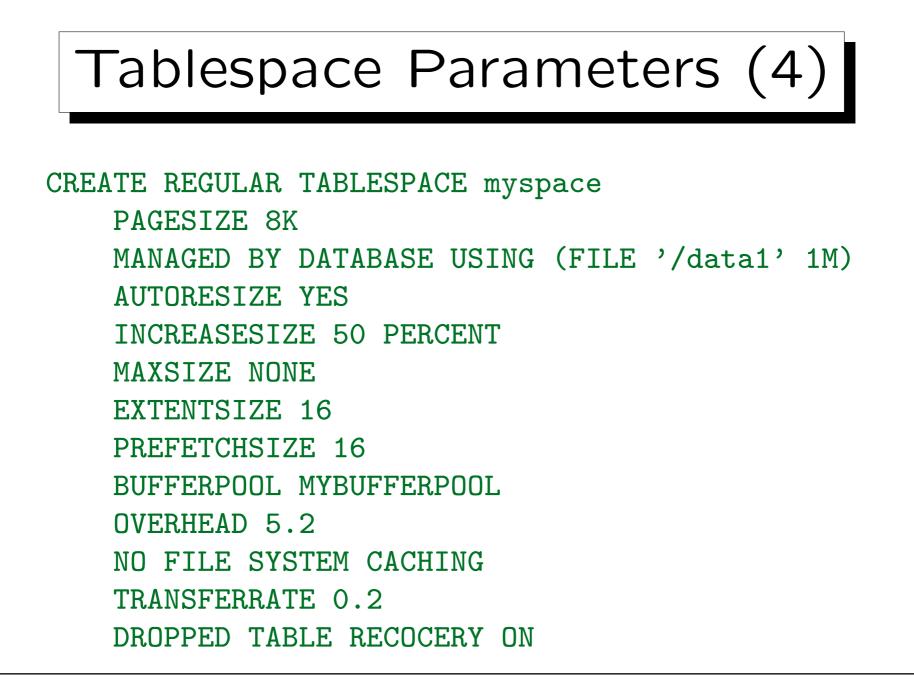
- DB2 tries to get pages into the buffer pool that are very likely needed in the near future.
- E.g., for a sequential table scan, it is clear that the pages that follow the currently requested page will also be needed.
- When multiple row identifiers (RIDs) are returned from an index scan, all pages that contain these rows will be needed.

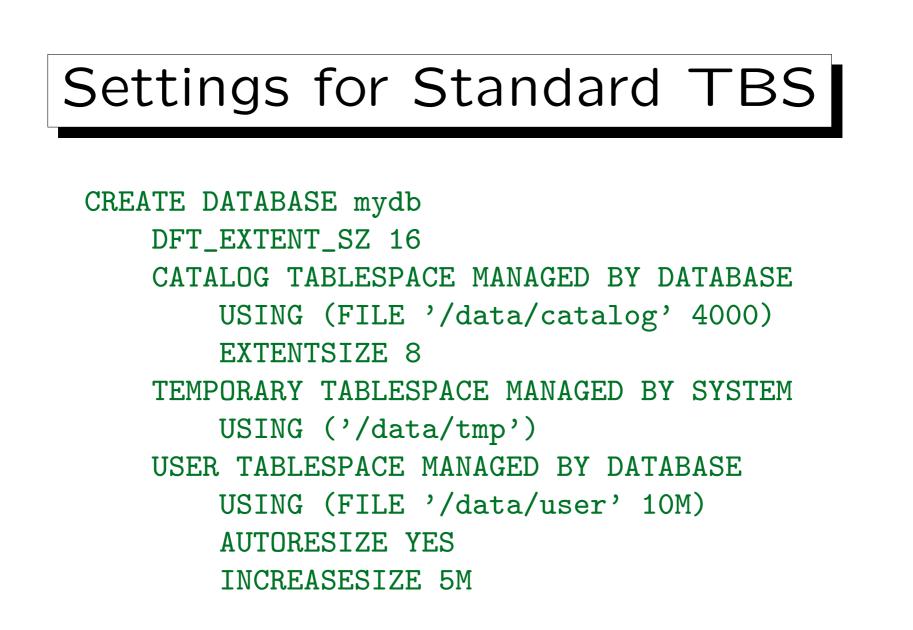
DB2 sorts the RIDs (by page number), and then fetches the pages.

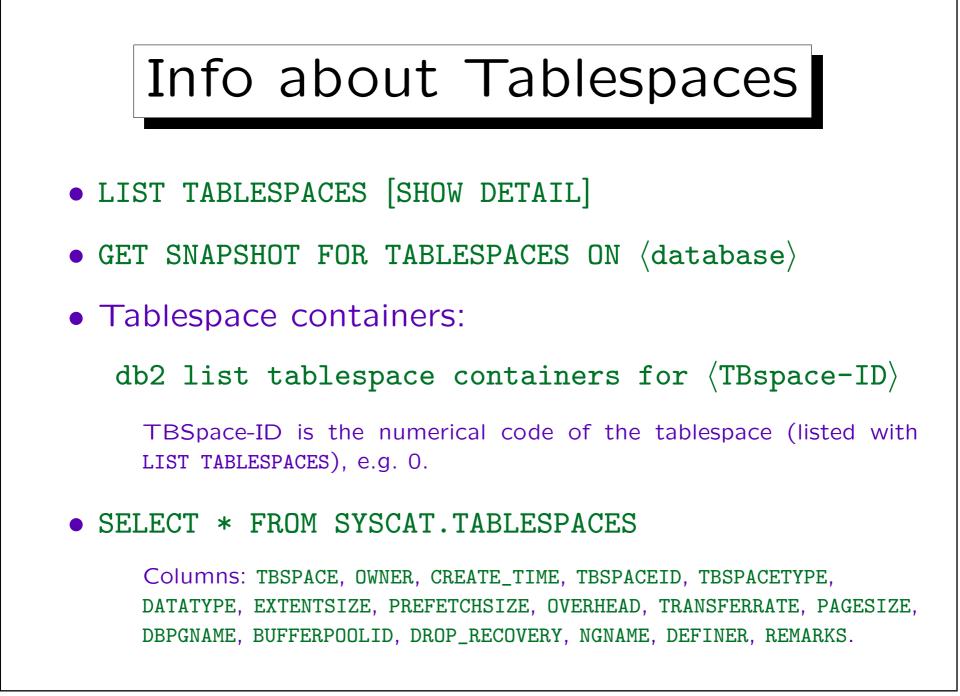


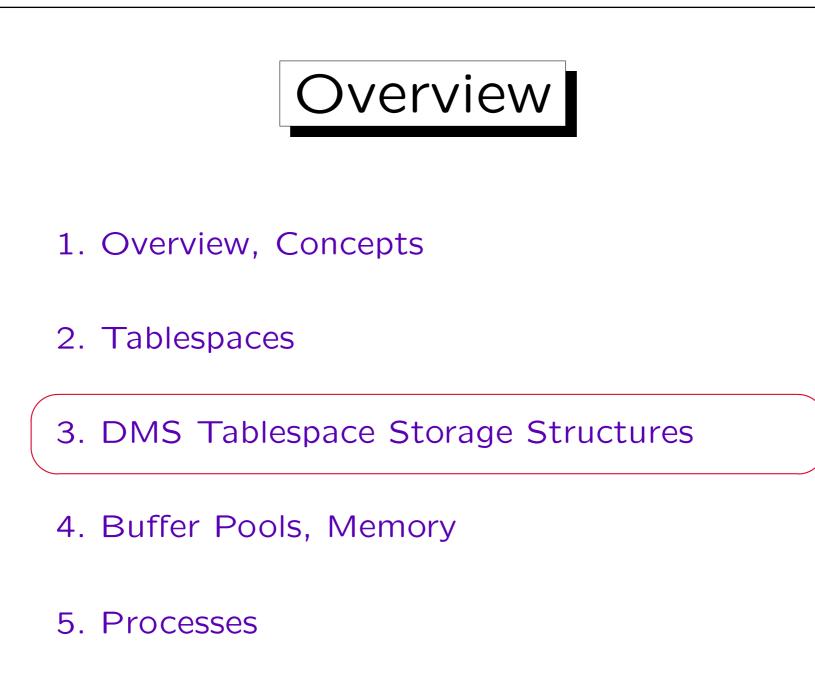
<ul> <li>OVERHEAD: Seek and latency time in milliseconds. For optimizer estimates. Default (in Version 9): 7.5</li> <li>TRANSFERRATE: Time for one block in milliseconds.</li> </ul>
For optimizer estimates. Default (in Version 9): 7.5
• TRANSFERRATE: Time for one block in milliseconds.
For optimizer estimates. Default (in Version 9): 0.06
• NO FILESYSTEM CACHING: I/O bypasses the OS cache.
The default is FILESYSTEM CACHING, i.e. the OS cache is used.
• DROPPED TABLE RECOVERY: Whether dropped tables
can be restored during recovery.
ON or OFF. Since Version 8, the default is ON.

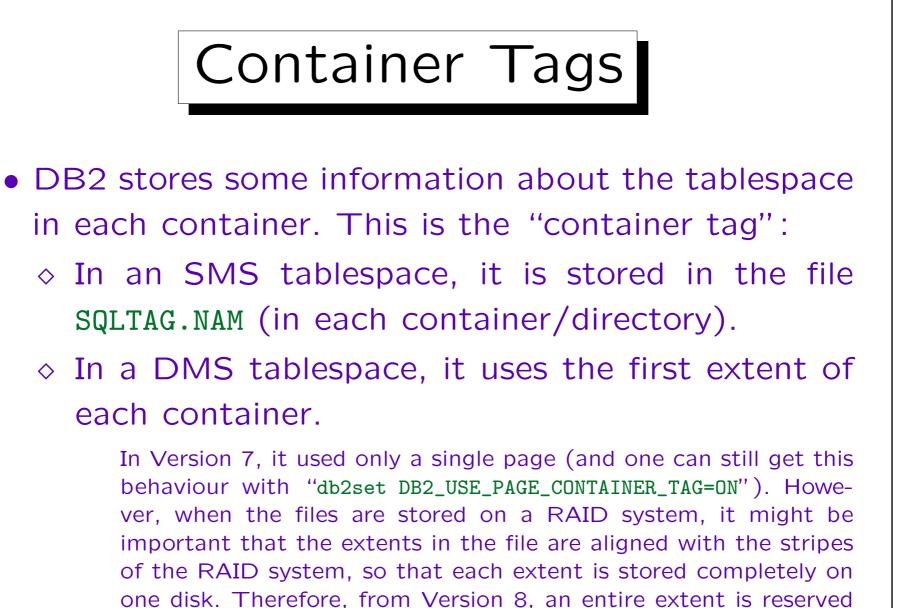


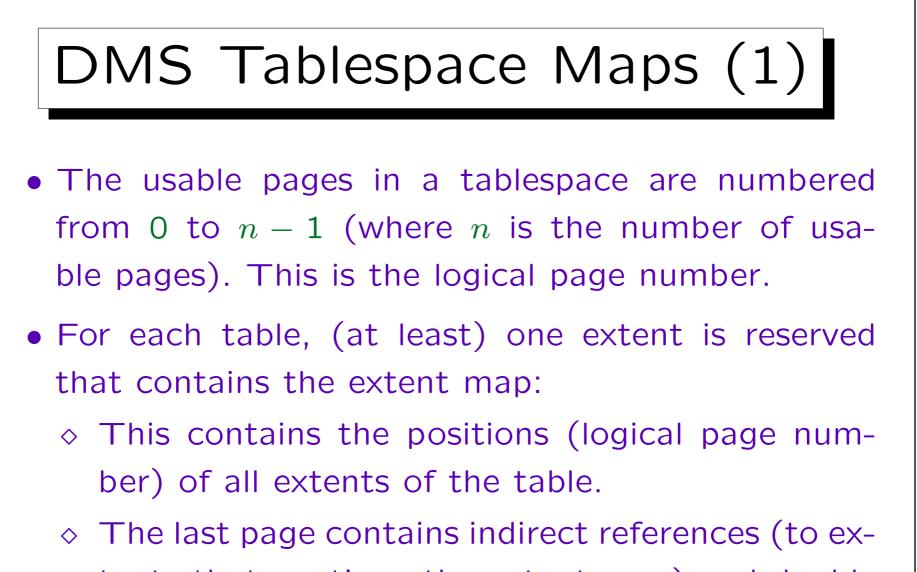


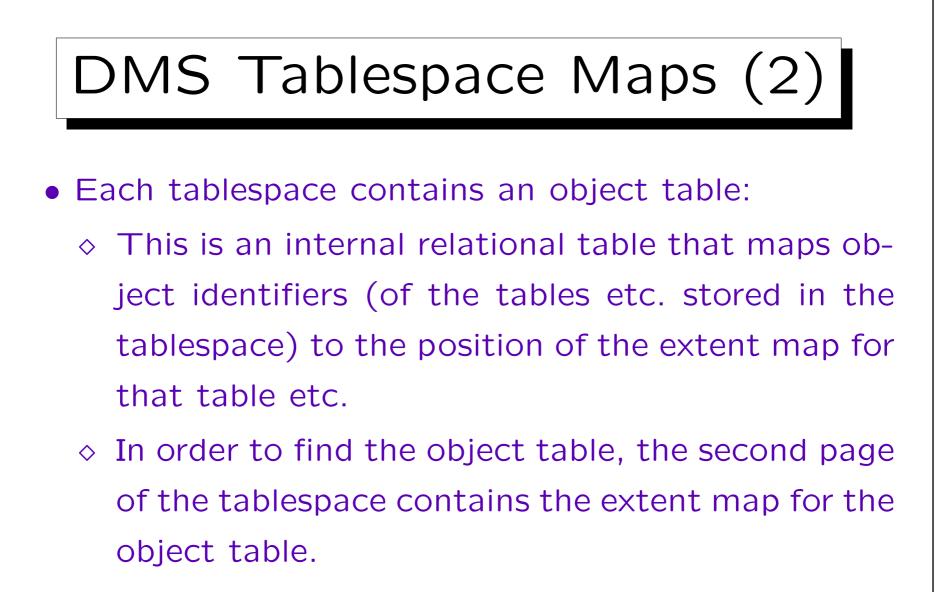




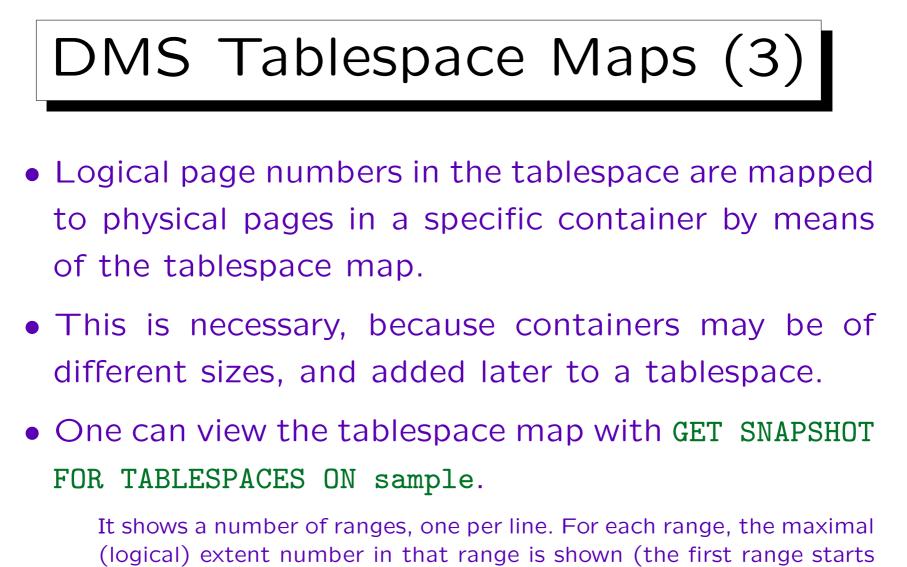


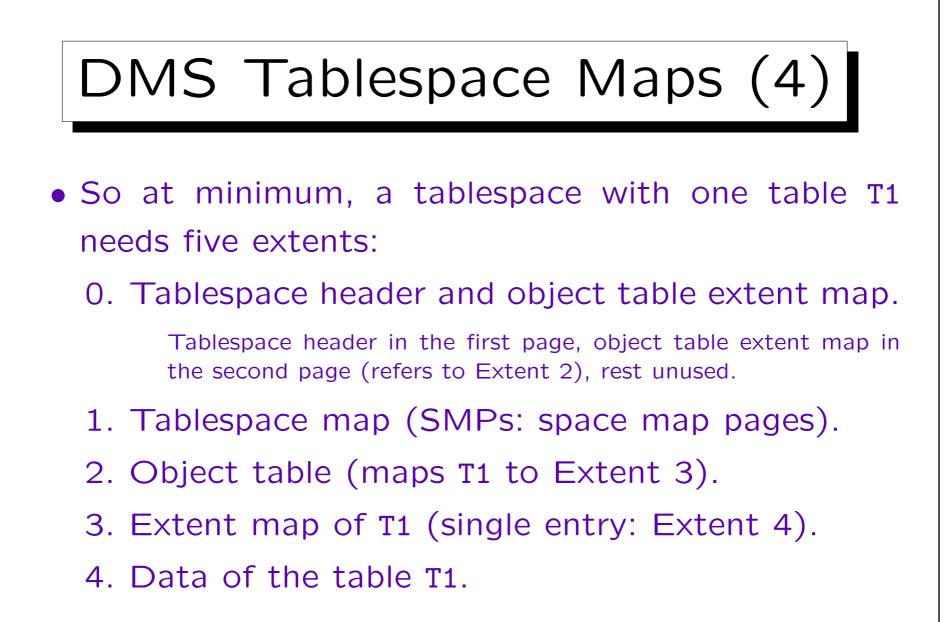




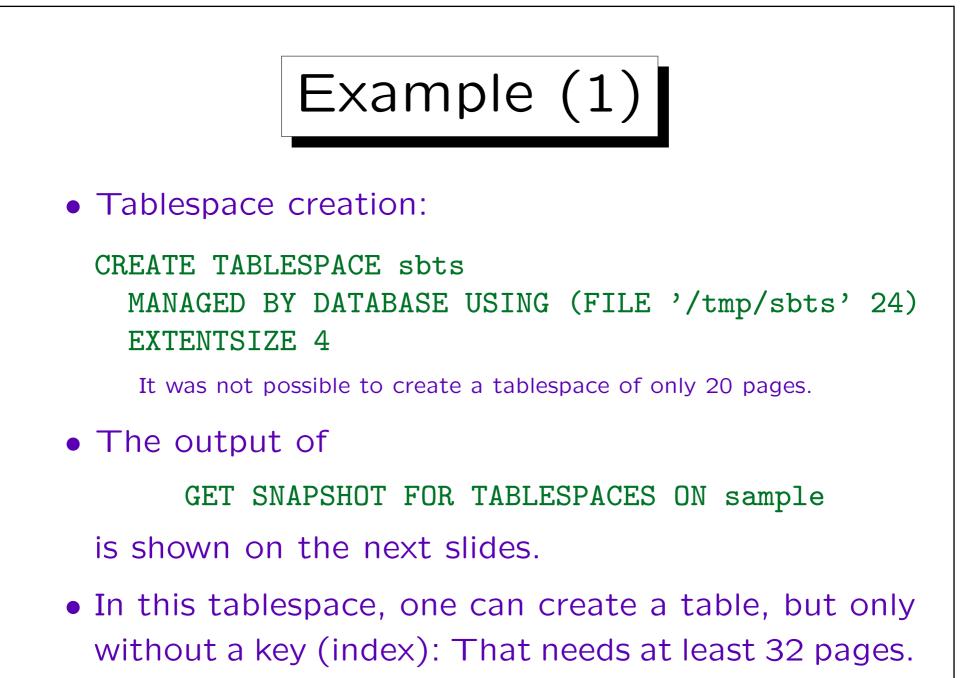


The first page contains a tablespace header. I assume that these are logical page numbers, which start only after the container tag.





• Plus one extent is needed for the container tag.





Tablespace name Tablespace ID Tablespace Type Tablespace Content Type

Tablespace Page size (bytes) = Tablespace Extent size (pages) = Automatic Prefetch size enabled = Buffer pool ID currently in use = Buffer pool ID next startup = Using automatic storage = Auto-resize enabled = File system caching = Tablespace State = Detailed explanation: Normal

- = SBTS
- = 7
- = Database managed space
- = All permanent data. Large table space.
- = 4096

= No

= No

= Yes

= 0x',00000000',



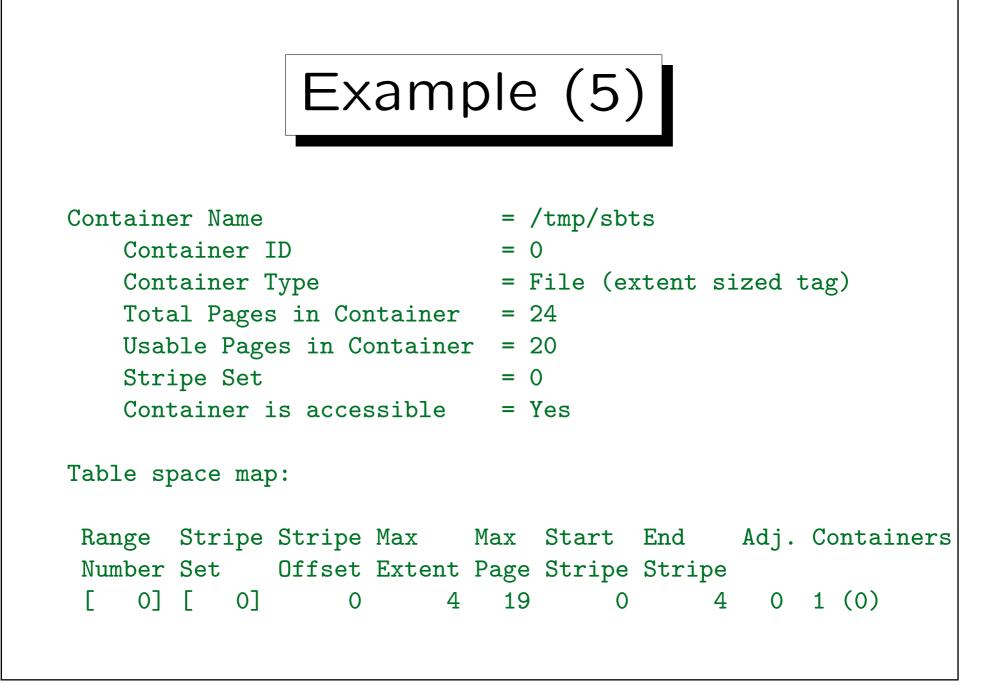
## Empty Tablespace:

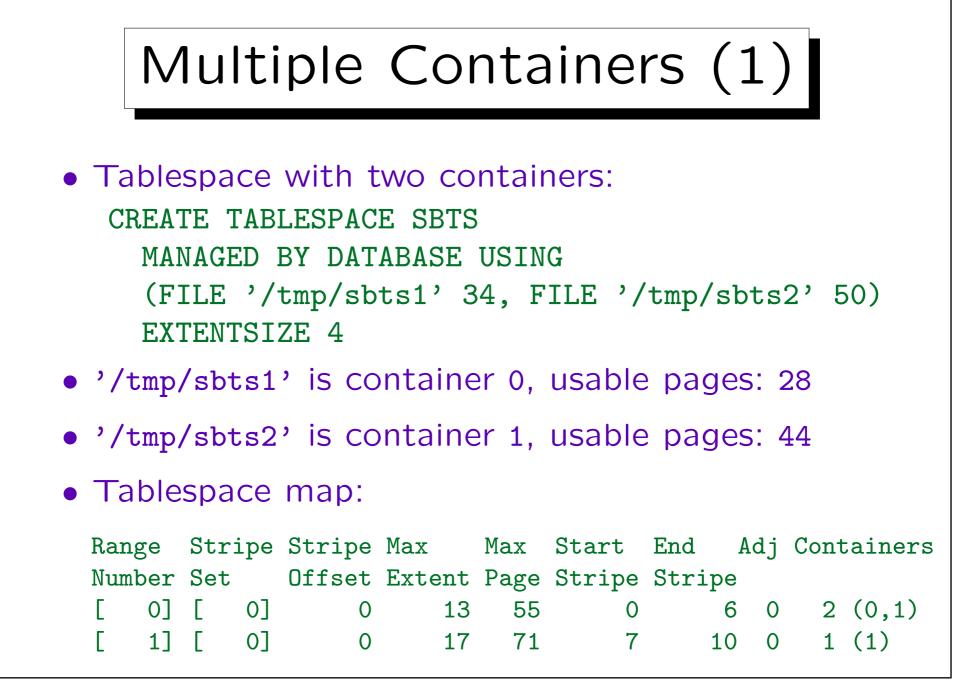
Tablespace Prefetch size (pages) = 4 Total number of pages = 24 Number of usable pages = 20 Number of used pages = 12Number of pending free pages = 0Number of free pages = 8 High water mark (pages) = 12 Current tablespace size (bytes) = 98304 = No Rebalancing Rebalancer Mode Minimum Recovery Time Number of quiescers = 0Number of containers 1 =

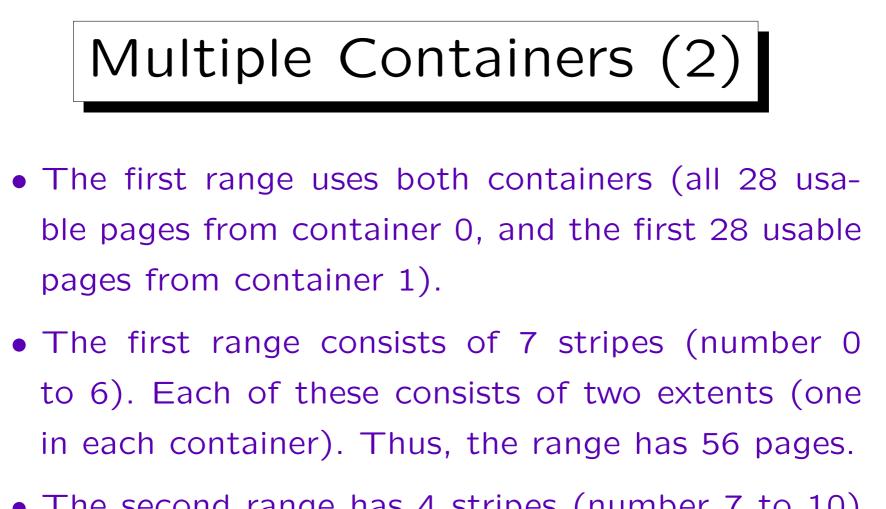
Example (4)

After creating a table (without index):

Tablespace Prefetch size (pages) = 4 Total number of pages = 24 Number of usable pages = 20 Number of used pages = 20Number of pending free pages = 0Number of free pages = 0High water mark (pages) = 20 Current tablespace size (bytes) = 98304= No Rebalancing Rebalancer Mode Minimum Recovery Time Number of quiescers = 0Number of containers 1 =







• The second range has 4 stripes (number 7 to 10) of one extent each (using only container 1). Thus, this range has 16 pages (pages 56 to 71).

