Databases

Seminar 7

Indexes in SQL Server (II)

T-SQL - Control-of-Flow Language

Indexes in SQL Server (II)

- indexed views

SET options	required value	default server value
ANSI_NULLS	ON	ON
ANSI_PADDING	ON	ON
ANSI_WARNINGS	ON	ON
ARITHABORT	ON	ON
CONCAT_NULL_YIELDS_NULL	ON	ON
NUMERIC_ROUNDABORT	OFF	OFF
QUOTED_IDENTIFIER	ON	ON

- indexed views
  - restrictions
    - the view cannot reference other views
    - the definition of the view must be deterministic
    - AVG, MIN, MAX, STDEV, STDEVP, VAR, VARP - not allowed
    - the index must be clustered and unique
    - the SELECT statement in the definition of the view cannot contain: subqueries, outer joins, EXCEPT, INTERSECT, UNION, TOP, DISTINCT, ORDER BY, etc.

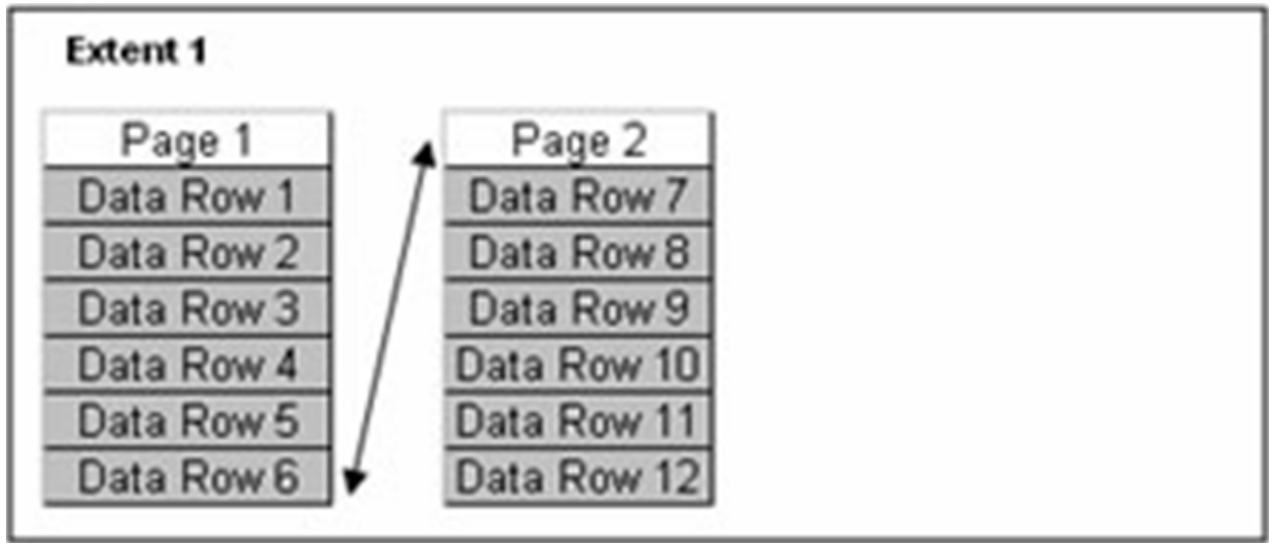
- indexing – rules
  - every table should have a clustered index
  - a clustered index should be small, selective, increasing, static
  - non-clustered indexes should be created on
    - foreign keys
    - columns often used in the WHERE clause
  - covering non-clustered indexes should be created for the most frequently executed queries
  - one shouldn’t create single-column indexes on all the columns in a table, as they incur high overhead
  - in multi-column indexes, the most selective columns (nearest to unique) should be placed on the first positions

- fragmentation
  - internal fragmentation
    - records are not stored in a contiguous area on the page, i.e., there is unused space between records in a page
    - the fullness of each page can vary over time; unused space => inefficient use of the cache & more page transfers between disk and main memory => impact on query performance
  - extent fragmentation
    - the extents* of a table are not contiguous

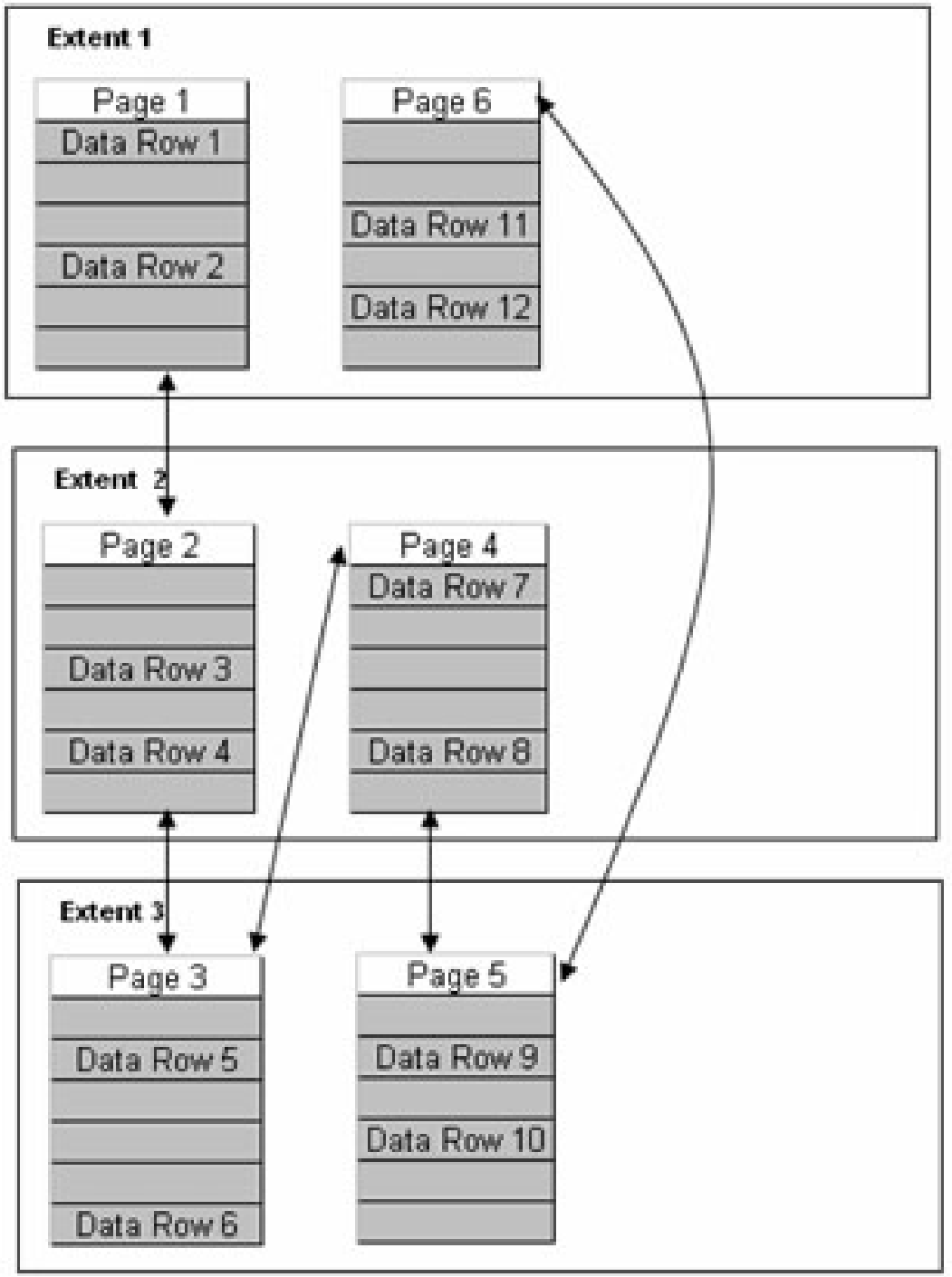
*extent – group of 8 contiguous pages

- fragmentation
  - logical fragmentation
    - every index page is linked with the previous and the next page based on the logical order of the key values
    - when pages are full and there's no room for new data, values are redistributed (*Page Split)* => out-of-order pages
    - out-of-order page
      - a page for which the next physical page in the index is not the next logical page

- fragmentation
  - read operation - page requests: 2
  - extent switches: 0
  - disk space (used by table): 16 KB
  - avg_fragmentation_in_percent: 0
  - avg_page_space_used_in_percent: 100



- fragmentation
  - page requests: 6
  - extent switches: 5
  - disk space: 48 KB
  - avg_fragmentation_in_percent > 80
  - avg_page_space_used_in_percent: 33



- fragmentation
  - sys.dm_db_index_physical_stats
  - avg_fragmentation_in_percent
    - percentage value
    - heaps – extent fragmentation
    - indexes – logical fragmentation
  - avg_page_space_used_in_percent
    - average percentage of available space in all pages

- reduce fragmentation
  - in a heap
    - create a clustered index on the table, then drop it
    - creating the clustered index => records are redistributed

- reduce fragmentation
  - in an index
    - if avg_fragmentation_in_percent > 5% and <= 30%
      - reorder the leaf pages of the index based on the key: ALTER INDEX REORGANIZE
    - if avg_fragmentation_in_percent > 30%
      - use ALTER INDEX REBUILD (replacement for DBCC DBREINDEX)
      - similar effect: drop and recreate the index
    - drop and recreate a clustered index
      - when a clustered index is recreated, the data is redistributed => full data pages
      - the level of fullness can be configured with the FILLFACTOR option in CREATE INDEX

T-SQL - Control-of-Flow Language

- BEGIN...END
- BREAK
- CONTINUE
- GOTO label
- IF...ELSE
- RETURN
- THROW
- TRY...CATCH
- WAITFOR
- WHILE

- RETURN
  - RETURN [integer_expression]
  - exits from a procedure / batch / statement block
  - returning status codes
  - unless specified otherwise, system stored procedures return:
    - 0 - success
    - a nonzero value – failure

->

- RETURN

```
CREATE PROCEDURE uspCheckCountry @country varchar(50)
AS
  IF @country = 'Romania'
    RETURN 1
  ELSE
    RETURN 2;
GO
------------------------------
DECLARE @ret_status_code int;
EXEC @ret_status_code = uspCheckCountry 'Romania';
SELECT @ret_status_code
GO
```

- WHILE
  - WHILE boolean_expression

    { sql_statement | statement_block | BREAK | CONTINUE }
  - repeated execution of a SQL statement or statement block while the specified condition is true
- BREAK
  - exits current WHILE loop (if the latter is nested inside another WHILE loop, BREAK exits only the current loop)
  - can appear in an IF statement
- CONTINUE
  - restarts a WHILE loop
  - any statements after CONTINUE are ignored

- GOTO
  - execution continues at the label

  Label:
  GOTO Label

- WAITFOR
  - WAITFOR { DELAY 'time_to_pass' |
    TIME 'time_to_execute' }
  - blocks the execution of a batch / stored procedure / transaction
  - execution continues at 07:15
    - WAITFOR TIME '07:15';
  - execution continues after 3 hours
    - WAITFOR DELAY '03:00';
  - if the server is busy, the counter may not start immediately => the delay may be longer than the specified one

- THROW
  - THROW [
    { error_number | @local_variable},
    { message | @local_variable},
    { state | @local_variable }] [;]

  - error_number: >= 50000
  - message: nvarchar(2048)
  - state: 0 - 255

  - raises an exception, transfers execution to the CATCH block of a TRY…CATCH construct

  - THROW 51000, '50 rows have been modified.', 1;

- THROW
  - THROW [
    { error_number | @local_variable},
    { message | @local_variable},
    { state | @local_variable }] [;]

  - severity - always 16

  - RAISERROR
    - can specify one of 26 severity levels
    - severity level between 20 and 25 => fatal error, the connection is terminated

- TRY … CATCH
  - BEGIN TRY

    { sql_statement | statement_block }

    END TRY

    BEGIN CATCH

    [{ sql_statement | statement_block }]

    END CATCH [;]

  - implements error handling in Transact-SQL
  - catches execution errors with severity >10 and that do not close the database connection

- TRY … CATCH
  - ERROR_NUMBER() - returns the error number
  - ERROR_SEVERITY() - returns the error severity
  - ERROR_STATE() - returns the error state number
  - ERROR_PROCEDURE() - returns the name of the stored procedure / trigger where the error occurred
  - ERROR_LINE() - returns the number of the line where the error occurred
  - ERROR_MESSAGE() - returns the error message