1. **Create DML triggers.**

**Trigger - a special type of stored procedure that starts when one of the DML-operations (INSERT, UPDATE, DELETE, and any their combination). Triggers are executed once for DML-operation regardless of the number of records affected by this command. In SQL Server, there are two types of trigger: AFTER-triggers that run after DML-operation, and I NSTEAD-triggers that start instead.**

Creating a database and table:

CREATE DATABASE University

CREATE TABLE Curriculum

(Spec\_no char(5) UNIQUE

CHECK(Spec\_no LIKE '[0-9][0-9].[0-9][0-9]') NOT NULL,

Discipline char(10) UNIQUE NOT NULL,

Semester char(6) CHECK(Semester='Autumn' OR

Semester='Spring') NOT NULL,

Start\_date DATETIME NOT NULL,

Total\_hours int NOT NULL,

Project bit NOT NULL,

Forms\_reporting CHAR(10) NOT NULL,

PRIMARY KEY (Spec\_no))

INSERT INTO Curriculum

VALUES ('01.01', 'SQL', 'Autumn', '09/27/08', 80, 1, 'exam')

INSERT INTO Curriculum

VALUES ('01.02', 'Oracle', 'Autumn', '09/30/08', 80, 0, 'offset')

INSERT INTO Curriculum

VALUES ('01.03', 'UID', 'Autumn', '09/27/08', 80, 1, 'exam')

INSERT INTO Curriculum

VALUES ('02.03', 'English', 'Autumn', '09/27/08', 100, 0, 'exam')

INSERT INTO Curriculum

VALUES ('03.01', 'Chemistry', 'Spring', '01/18/09', 90, 1, 'offset')

INSERT INTO Curriculum

VALUES ('03.02', 'Engineering', 'Spring', '01/20/09', 70, 0, 'offset')

INSERT INTO Curriculum

VALUES ('02.02', 'Kazakh', 'Spring', '01/18/09', 80, 1, 'exam')

INSERT INTO Curriculum

VALUES ('01.05', 'DIT', 'Spring', '01/18/09', 80, 1, 'exam')

**INSERT trigger creation**.

CREATE TRIGGER tr\_insert\_1 ON Curriculum

FOR INSERT

AS BEGIN DECLARE @Total\_hours int

SELECT @Total\_hours=Total\_hours

FROM inserted

IF(@Total\_hours<20)

BEGIN

PRINT 'THE TOTAL HOURS MUST BE MORE'

ROLLBACK TRANSACTION

END

RETURN

END

**Trigger existence in the database check:**

sp\_help tr\_insert\_1

tr\_insert\_1 dbo trigger 2008-11-19 09:38:08.543

**Add row into the table and trigger functionality check.**

INSERT Curriculum

VALUES('07.09', 'MicroEcon', 'Autumn', '08/27/08', 10, 0, 'offset')

THE TOTAL HOURS MUST BE MORE

Msg 3609, Level 16, State 1, Line 1

The transaction ended in the trigger. The batch has been aborted.

INSERT Curriculum

VALUES('07.10', 'Macro', 'Autumn', '08/27/08', 80, 0, 'offset')

(1 row(s) affected)

**DELETE trigger creation.**

CREATE TRIGGER tr\_delete1

ON Curriculum FOR DELETE

AS

PRINT 'Удаление данных о дисциплинах запрещена'

ROLLBACK TRANSACTION RETURN

**Trigger existence in the database check:**

sp\_help tr\_delete1

**Delete row from the table and trigger functionality check.**

delete Curriculum

where Spec\_no='07.10'

Удаление данных о дисциплинах запрещена

Msg 3609, Level 16, State 1, Line 1

The transaction ended in the trigger. The batch has been aborted.

**UPDATE trigger creation.**

CREATE TRIGGER tr\_update1

ON Curriculum FOR UPDATE

AS

BEGIN

DECLARE @Total\_hours int

SELECT @Total\_hours=Total\_hours+10

FROM inserted

IF (@Total\_hours>100)

BEGIN

PRINT 'Указанное количество часов должно быть меньше 100'

ROLLBACK TRANSACTION

END

RETURN

END

**Trigger existence in the database check:**

sp\_help tr\_update1

**Change the values in the table and trigger functionality check.**

UPDATE Curriculum

SET Total\_hours=Total\_hours+10

where Spec\_no='02.03'

Указанное количество часов должно быть меньше 100

Msg 3609, Level 16, State 1, Line 1

The transaction ended in the trigger. The batch has been aborted.

UPDATE Curriculum

SET Total\_hours=Total\_hours+10

where Spec\_no='02.02'

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| 02.02 | Kazakh | Spring | 1/18/2009 12:00:00 AM | 90 | True | exam |

**Trigger modification.**

ALTER TRIGGER tr\_update1 ON Curriculum

FOR INSERT

AS

BEGIN DECLARE @Total\_hours int

SELECT @Total\_hours=avg(Total\_hours)

FROM inserted

IF (@Total\_hours>100)

BEGIN

RAISERROR('Óêàçàííîå êîëè÷åñòâî ÷àñîâ äîëæíî áûòü ìåíüøå 100', 10, 1)

ROLLBACK TRANSACTION

END

RETURN

END

INSERT Curriculum

VALUES('07.11', 'MACROe', 'Autumn', '08/27/08', 100, 0, 'offset')

INSERT Curriculum

VALUES('07.12', 'sql2', 'Autumn', '08/27/08', 120, 0, 'offset')

Указанное количество часов должно быть меньше 100

Msg 3609, Level 16, State 1, Line 2

The transaction ended in the trigger. The batch has been aborted.

sp\_helptext tr\_update1

Text

-------------------------------------------------------------------------------------------------CREATE TRIGGER tr\_update1 ON Curriculum

FOR INSERT

AS

BEGIN DECLARE @Total\_hours int

SELECT @Total\_hours=avg(Total\_hours)

FROM inserted

IF (@Total\_hours>100)

BEGIN

RAISERROR('Указанное количество часов должно быть меньше 100', 10, 1)

ROLLBACK TRANSACTION

END

RETURN

END

**Trigger removal.**

DROP TRIGGER tr\_delete1

sp\_help tr\_delete1

Msg 15009, Level 16, State 1, Procedure sp\_help, Line 66

The object 'tr\_delete1' does not exist in database 'University' or is invalid for this operation.

**Change the sequence of triggers execution.**

CREATE TRIGGER tr\_insert3 ON Curriculum

FOR INSERT

AS BEGIN DECLARE @Forms\_reporting char(10)

SELECT @Forms\_reporting=Forms\_reporting

FROM inserted

IF(@Forms\_reporting='offset')

BEGIN

PRINT ('THE Forms of reporting must NOT be offset')

ROLLBACK TRANSACTION

END

RETURN

END

sp\_settriggerorder 'tr\_insert3', 'first', 'insert'

sp\_settriggerorder 'tr\_insert\_1', 'last', 'insert'

INSERT Curriculum

VALUES('12.12', 'Book', 'Autumn', '08/27/08', 10, 0, 'offset')

THE Forms of reporting must not be offset

Msg 3609, Level 16, State 1, Line 2

The transaction ended in the trigger. The batch has been aborted.

INSERT Curriculum

VALUES('12.12', 'Book', 'Autumn', '08/27/08', 10, 0, 'exam')

THE TOTAL HOURS MUST BE MORE

Msg 3609, Level 16, State 1, Line 2

The transaction ended in the trigger. The batch has been aborted.

**AFTER trigger.**

CREATE TRIGGER tr1update ON Discipline AFTER UPDATE

AS

DECLARE @tr Int

SET @tr=@@rowcount

IF @tr=0 RETURN

IF @tr > 1 BEGIN

RAISERROR('Можно изменять только одну строку',16,10)

ROLLBACK

RETURN

END

IF ((COLUMNS\_UPDATED() & 4)<>0) BEGIN

IF EXISTS (SELECT \* FROM Curriculum c JOIN inserted i ON c.Spec\_no=i.Spec\_no

WHERE c.Discipline=i.Discipline)

BEGIN

RAISERROR('Столбцу Discipline должно быть одинаковым ',16,10)

ROLLBACK

RETURN

END

END

Result:

UPDATE Discipline

SET Lecturer='Alekseev'

where Total\_students=12

Msg 50000, Level 16, State 10, Procedure tr1update, Line 7

Можно изменять только одну строку

Msg 3609, Level 16, State 1, Line 2

The transaction ended in the trigger. The batch has been aborted.

**INSTEAD OF trigger.**

CREATE VIEW vdis AS

SELECT number, Lecturer FROM Discipline

CREATE TRIGGER tr\_vdis ON vdis INSTEAD OF INSERT

AS

INSERT Discipline(number, Lecturer)

SELECT number, UPPER(Lecturer)

FROM inserted

INSERT vdis VALUES (9, 'Tokmagambetov')

SELECT \* FROM vdis

Аудит

CREATE TABLE tb1

(id int identity,

sort int,

vid int)

CREATE TABLE tb2

(number int identity,

Operation varchar(20),

id int,

sort int,

vid int)

INSERT tb1 (sort, vid) VALUES (1, 50)

INSERT tb1 (sort, vid) VALUES (2, 50)

INSERT tb1 (sort, vid) VALUES (3, 50)

INSERT tb1 (sort, vid) VALUES (4, 50)

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)

(1 row(s) affected)

**Trigger creation:**

CREATE TRIGGER tb1\_UPDATE ON tb1 AFTER UPDATE

AS

IF @@rowcount=0 RETURN

INSERT tb2 (Operation, id, sort, vid)

SELECT 'UPDATE--BEFORE', \* FROM deleted

INSERT tb2 (Operation, id, sort, vid)

SELECT 'UPDATE-AFTER', \* FROM inserted

UPDATE tb1 SET vid=49

(4 row(s) affected)

(4 row(s) affected)

(4 row(s) affected)

SELECT \* FROM tb2 ORDER BY id, Operation, number

number Operation id sort vid

----------- -------------------- ----------- ----------- -----------

8 UPDATE-AFTER 1 1 49

4 UPDATE--BEFORE 1 1 50

7 UPDATE-AFTER 2 2 49

3 UPDATE--BEFORE 2 2 50

6 UPDATE-AFTER 3 3 49

2 UPDATE--BEFORE 3 3 50

5 UPDATE-AFTER 4 4 49

1 UPDATE--BEFORE 4 4 50

(8 row(s) affected)