

Homework 3 - Enrico Castelli s280124

Triggers

1) Switching on/off the phone

```
1 CREATE OR REPLACE TRIGGER UpdateTelephone
2 AFTER INSERT ON STATE_CHANGE
3 FOR EACH ROW
4 WHEN (NEW.ChangeType = 'O' OR NEW.ChangeType = 'F')
5 DECLARE
6     PhoneCellId NUMBER(38,0);
7 BEGIN
8     -- save CellId where the phone belongs
9     SELECT CellId INTO PhoneCellId
10    FROM CELL
11   WHERE x0<=:NEW.x AND :NEW.x<x1 AND y0<=:NEW.y AND :NEW.y<y1;
12
13    IF :NEW.ChangeType = 'O' THEN
14        -- add phone to TELEPHONE table
15        INSERT INTO TELEPHONE (PhoneNo, X, Y, PhoneState)
16        VALUES (:NEW.PhoneNo, :NEW.x, :NEW.y, 'On');
17        -- increase CurrentPhone# in corresponding cell
18        UPDATE CELL
19        SET CurrentPhone# = CurrentPhone# + 1
20        WHERE CellId=PhoneCellId;
21    ELSE
22        -- remove phone from TELEPHONE table
23        DELETE FROM TELEPHONE WHERE PhoneNo=:NEW.PhoneNo;
24        -- decrease CurrentPhone# in corresponding cell
25        UPDATE CELL
26        SET CurrentPhone# = CurrentPhone# - 1
27        WHERE CellId=PhoneCellId;
28    END IF;
29 END;
30 /
```

After running `create_db_telefoni_en.sql` and the script that contains the triggers:

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After running

```
1 | INSERT INTO STATE_CHANGE(ChangeId, TimeStamp, PhoneNo, x, y, ChangeType)
   | values (1, sysdate, '333000010', 3, 3, 'o');
```

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After running

```
1 | INSERT INTO STATE_CHANGE(ChangeId, TimeStamp, PhoneNo, x, y, ChangeType)
   | values (2, sysdate, '333000009', 15, 15, 'o');
```

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```
1 | INSERT INTO STATE_CHANGE(ChangeId, TimeStamp, PhoneNo, x, y, ChangeType)
   | values (3, sysdate, '333000009', 15, 15, 'F');
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We notice how the phone that was turned off has been removed from the `TELEPHONE` table.

2) Starting a phone call

```

1 CREATE OR REPLACE TRIGGER StartPhoneCall
2 AFTER INSERT ON STATE_CHANGE
3 FOR EACH ROW
4 WHEN (NEW.ChangeType = 'C')
5 DECLARE
6     PhoneCellId NUMBER(38,0);
7     CellMaxCalls NUMBER(38,0);
8     CellX0 NUMBER(7,2);
9     CellY0 NUMBER(7,2);
10    CellX1 NUMBER(7,2);
11    CellY1 NUMBER(7,2);
12    CurrentCellCalls NUMBER(38,0);
13    LastExId NUMBER(38,0);
14 BEGIN
15     -- save cell info to variables
16     SELECT CellId, MaxCalls, x0, y0, x1, y1 INTO PhoneCellId,
17    CellMaxCalls, CellX0, CellY0, CellX1, CellY1
18     FROM CELL
19     WHERE x0<=:NEW.x AND :NEW.x<x1 AND y0<=:NEW.y AND :NEW.y<y1;
20     -- save number of active phones in cell to variable

```

```

21     SELECT COUNT(*) INTO CurrentCellCalls
22     FROM TELEPHONE
23     WHERE PhoneState='Active' AND Cellx0<=x AND x<Cellx1 AND Celly0<=y AND
y<Celly1;
24
25     IF CurrentCellCalls < CellMaxCalls THEN
26         -- phone state becomes active
27         UPDATE TELEPHONE
28         SET PhoneState = 'Active'
29         WHERE PhoneNo=:NEW.PhoneNo;
30     ELSE
31         -- save biggest ExId to variable (or use 1 if no ExIds in table)
32         SELECT MAX(ExId) + 1 INTO LastExId
33         FROM EXCEPTION_LOG;
34         IF LastExId IS NULL THEN
35             LastExId := 1;
36         END IF;
37         -- insert exception in EXCEPTION_LOG
38         INSERT INTO EXCEPTION_LOG (ExId, CellId, ExceptionType)
39         VALUES (LastExId, PhoneCellId, 'C');
40     END IF;
41 END;
42 /

```

After running

```

1  INSERT INTO STATE_CHANGE(ChangeId, TimeStamp, PhoneNo, x, y, ChangeType)
   values (4, sysdate, '333000001', 3, 3, 'O');

```

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After running

```
1 | INSERT INTO STATE_CHANGE(ChangeId, TimeStamp, PhoneNo, x, y, ChangeType)
   | values (5, sysdate, '333000004', 5, 5, 'o');
```

Tables

STATE_CHANGE

	CHANGEID	TIMESTAMP	PHONENO	X	Y	CHANGETYPE
1	1	06-DEC-20	333000010	3	3	0
2	2	06-DEC-20	333000009	15	15	0
3	3	06-DEC-20	333000009	15	15	F
4	4	06-DEC-20	333000001	3	3	0
5	5	06-DEC-20	333000004	5	5	0

EXCEPTION_LOG

	EXID	CELLID	EXCEPTIO...
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CELL

	CELLID	X0	Y0	X1	Y1	CURRENTPHONE#	MAXCALLS
1	1	0	0	10	10	3	3
2	2	10	0	20	10	0	20
3	3	0	10	10	20	0	20
4	4	10	10	20	20	0	20

TELEPHONE

	PHONENO	X	Y	PHONESTATE
1	333000010	3	3	0n
2	333000001	3	3	0n
3	333000004	5	5	0n

After running

```
1 | INSERT INTO STATE_CHANGE(ChangeId, TimeStamp, PhoneNo, x, y, ChangeType)
   | values (6, sysdate, '333000004', 5, 5, 'C');
```

Tables

STATE_CHANGE

CHANGEID	TIMESTAMP	PHONENO	X	Y	CHANGETYPE
1	1 06-DEC-20	333000010	3	3	0
2	2 06-DEC-20	333000009	15	15	0
3	3 06-DEC-20	333000009	15	15	F
4	4 06-DEC-20	333000001	3	3	0
5	5 06-DEC-20	333000004	5	5	0
6	6 06-DEC-20	333000004	5	5	C

EXCEPTION_LOG

EXID	CELLID	EXCEPTIO...
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CELL

CELLID	X0	Y0	X1	Y1	CURRENTPHONE#	MAXCALLS	
1	1	0	0	10	10	3	3
2	2	10	0	20	10	0	20
3	3	0	10	10	20	0	20
4	4	10	10	20	20	0	20

TELEPHONE

PHONENO	X	Y	PHONESTATE
1 333000010	3	3	0n
2 333000001	3	3	0n
3 333000004	5	5	Active

After running

```
1 | INSERT INTO STATE_CHANGE(ChangeId, TimeStamp, PhoneNo, x, y, ChangeType)
   | values (7, sysdate, '333000001', 3, 3, 'C');
```


Tables

STATE_CHANGE

	CHANGEID	TIMESTAMP	PHONENO	X	Y	CHANGETYPE
1	1	06-DEC-20	333000010	3	3	0
2	2	06-DEC-20	333000009	15	15	0
3	3	06-DEC-20	333000009	15	15	F
4	4	06-DEC-20	333000001	3	3	0
5	5	06-DEC-20	333000004	5	5	0
6	6	06-DEC-20	333000004	5	5	C
7	7	06-DEC-20	333000001	3	3	C

EXCEPTION_LOG

EXID	CELLID	EXCEPTIO...
------	--------	-------------

CELL

	CELLID	X0	Y0	X1	Y1	CURRENTPHONE#	MAXCALLS
1	1	0	0	10	10	3	3
2	2	10	0	20	10	0	20
3	3	0	10	10	20	0	20
4	4	10	10	20	20	0	20

TELEPHONE

	PHONENO	X	Y	PHONESTATE
1	333000010	3	3	On
2	333000001	3	3	Active
3	333000004	5	5	Active

After running

```
1 | INSERT INTO STATE_CHANGE(ChangeId, Timestamp, PhoneNo, x, y, ChangeType)
   | values (8, sysdate, '333000010', 3, 3, 'C');
```

Tables

STATE_CHANGE

	CHANGEID	TIMESTAMP	PHONENO	X	Y	CHANGETYPE
1	1	06-DEC-20	333000010	3	3	0
2	2	06-DEC-20	333000009	15	15	0
3	3	06-DEC-20	333000009	15	15	F
4	4	06-DEC-20	333000001	3	3	0
5	5	06-DEC-20	333000004	5	5	0
6	6	06-DEC-20	333000004	5	5	C
7	7	06-DEC-20	333000001	3	3	C
8	8	06-DEC-20	333000010	3	3	C

EXCEPTION_LOG

EXID	CELLID	EXCEPTIO...
------	--------	-------------

CELL

	CELLID	X0	Y0	X1	Y1	CURRENTPHONE#	MAXCALLS
1	1	0	0	10	10	3	3
2	2	10	0	20	10	0	20
3	3	0	10	10	20	0	20
4	4	10	10	20	20	0	20

TELEPHONE

	PHONENO	X	Y	PHONESTATE
1	333000010	3	3	Active
2	333000001	3	3	Active
3	333000004	5	5	Active

After running

```
1 | INSERT INTO STATE_CHANGE(ChangeId, TimeStamp, PhoneNo, x, y, ChangeType)
   | values (9, sysdate, '333000020', 4, 4, 'o');
```

Tables

STATE_CHANGE

	CHANGEID	TIMESTAMP	PHONENO	X	Y	CHANGETYPE
1	1	06-DEC-20	333000010	3	3	0
2	2	06-DEC-20	333000009	15	15	0
3	3	06-DEC-20	333000009	15	15	F
4	4	06-DEC-20	333000001	3	3	0
5	5	06-DEC-20	333000004	5	5	0
6	6	06-DEC-20	333000004	5	5	C
7	7	06-DEC-20	333000001	3	3	C
8	8	06-DEC-20	333000010	3	3	C
9	9	06-DEC-20	333000020	4	4	0

EXCEPTION_LOG

EXID	CELLID	EXCEPTIO...
------	--------	-------------

CELL

	CELLID	X0	Y0	X1	Y1	CURRENTPHONE#	MAXCALLS
1	1	0	0	10	10	4	3
2	2	10	0	20	10	0	20
3	3	0	10	10	20	0	20
4	4	10	10	20	20	0	20

TELEPHONE

	PHONENO	X	Y	PHONESTATE
1	333000010	3	3	Active
2	333000001	3	3	Active
3	333000004	5	5	Active
4	333000020	4	4	On

After running

```
1 | INSERT INTO STATE_CHANGE(ChangeId, TimeStamp, PhoneNo, x, y, ChangeType)
   | values (10, sysdate, '333000020', 4, 4, 'C');
```

Tables																																																																			
STATE_CHANGE	<table><tr><th>CHANGEID</th><th>TIMESTAMP</th><th>PHONENO</th><th>X</th><th>Y</th><th>CHANGETYPE</th></tr><tr><td>1</td><td>1 06-DEC-20</td><td>333000010</td><td>3</td><td>3</td><td>0</td></tr><tr><td>2</td><td>2 06-DEC-20</td><td>333000009</td><td>15</td><td>15</td><td>0</td></tr><tr><td>3</td><td>3 06-DEC-20</td><td>333000009</td><td>15</td><td>15</td><td>F</td></tr><tr><td>4</td><td>4 06-DEC-20</td><td>333000001</td><td>3</td><td>3</td><td>0</td></tr><tr><td>5</td><td>5 06-DEC-20</td><td>333000004</td><td>5</td><td>5</td><td>0</td></tr><tr><td>6</td><td>6 06-DEC-20</td><td>333000004</td><td>5</td><td>5</td><td>C</td></tr><tr><td>7</td><td>7 06-DEC-20</td><td>333000001</td><td>3</td><td>3</td><td>C</td></tr><tr><td>8</td><td>8 06-DEC-20</td><td>333000010</td><td>3</td><td>3</td><td>C</td></tr><tr><td>9</td><td>9 06-DEC-20</td><td>333000020</td><td>4</td><td>4</td><td>0</td></tr><tr><td>10</td><td>10 06-DEC-20</td><td>333000020</td><td>4</td><td>4</td><td>C</td></tr></table>	CHANGEID	TIMESTAMP	PHONENO	X	Y	CHANGETYPE	1	1 06-DEC-20	333000010	3	3	0	2	2 06-DEC-20	333000009	15	15	0	3	3 06-DEC-20	333000009	15	15	F	4	4 06-DEC-20	333000001	3	3	0	5	5 06-DEC-20	333000004	5	5	0	6	6 06-DEC-20	333000004	5	5	C	7	7 06-DEC-20	333000001	3	3	C	8	8 06-DEC-20	333000010	3	3	C	9	9 06-DEC-20	333000020	4	4	0	10	10 06-DEC-20	333000020	4	4	C
	CHANGEID	TIMESTAMP	PHONENO	X	Y	CHANGETYPE																																																													
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	3	3 06-DEC-20	333000009	15	15	F																																																													
	4	4 06-DEC-20	333000001	3	3	0																																																													
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10	10 06-DEC-20	333000020	4	4	C																																																														
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1	1	1 C																																																																	
CELL	<table><tr><th>CELLID</th><th>X0</th><th>Y0</th><th>X1</th><th>Y1</th><th>CURRENTPHONE#</th><th>MAXCALLS</th></tr><tr><td>1</td><td>1</td><td>0</td><td>0</td><td>10</td><td>10</td><td>4</td><td>3</td></tr><tr><td>2</td><td>2</td><td>10</td><td>0</td><td>20</td><td>10</td><td>0</td><td>20</td></tr><tr><td>3</td><td>3</td><td>0</td><td>10</td><td>10</td><td>20</td><td>0</td><td>20</td></tr><tr><td>4</td><td>4</td><td>10</td><td>10</td><td>20</td><td>20</td><td>0</td><td>20</td></tr></table>	CELLID	X0	Y0	X1	Y1	CURRENTPHONE#	MAXCALLS	1	1	0	0	10	10	4	3	2	2	10	0	20	10	0	20	3	3	0	10	10	20	0	20	4	4	10	10	20	20	0	20																											
CELLID	X0	Y0	X1	Y1	CURRENTPHONE#	MAXCALLS																																																													
1	1	0	0	10	10	4	3																																																												
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3	3	0	10	10	20	0	20																																																												
4	4	10	10	20	20	0	20																																																												
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PHONENO	X	Y	PHONESTATE																																																																
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2 333000001	3	3	Active																																																																
3 333000004	5	5	Active																																																																
4 333000020	4	4	On																																																																

We notice how initiating the fourth call triggers an exception to be recorded and does not allow the fourth phone to become active.

3) Changing the maximum number of active calls

```

1 CREATE OR REPLACE TRIGGER ChangeMaxCalls
2 BEFORE UPDATE OF MaxCalls ON CELL
3 FOR EACH ROW
4 WHEN (NEW.MaxCalls < OLD.MaxCalls)
5 DECLARE
6     CurrentCellCalls NUMBER(38,0);
7 BEGIN
8     -- save number of active phones in cell to variable
9     SELECT COUNT(*) INTO CurrentCellCalls
10    FROM TELEPHONE
11    WHERE PhoneState='Active' AND :NEW.x0<=x AND x<:NEW.x1 AND :NEW.y0<=y
    AND y<:NEW.y1;

```

```

12
13     IF CurrentCellCalls > :NEW.MaxCalls THEN
14         :NEW.MaxCalls := CurrentCellCalls;
15     END IF;
16 END;
17 /

```

After running

```

1 | UPDATE CELL SET MaxCalls = MaxCalls-2;

```

Tables

STATE_CHANGE

	CHANGEID	TIMESTAMP	PHONENO	X	Y	CHANGETYPE
1	1	06-DEC-20	333000010	3	3	0
2	2	06-DEC-20	333000009	15	15	0
3	3	06-DEC-20	333000009	15	15	F
4	4	06-DEC-20	333000001	3	3	0
5	5	06-DEC-20	333000004	5	5	0
6	6	06-DEC-20	333000004	5	5	C
7	7	06-DEC-20	333000001	3	3	C
8	8	06-DEC-20	333000010	3	3	C
9	9	06-DEC-20	333000020	4	4	0
10	10	06-DEC-20	333000020	4	4	C

EXCEPTION_LOG

	EXID	CELLID	EXCEPTIONTYPE
1	1	1	C

CELL

	CELLID	X0	Y0	X1	Y1	CURRENTPHONE#	MAXCALLS
1	1	0	0	10	10	4	3
2	2	10	0	20	10	0	18
3	3	0	10	10	20	0	18
4	4	10	10	20	20	0	18

TELEPHONE

	PHONENO	X	Y	PHONESTATE
1	333000010	3	3	Active
2	333000001	3	3	Active
3	333000004	5	5	Active
4	333000020	4	4	On

We notice how only the values of cells 2, 3 and 4 are updated.

4) Service guarantee

```
1 CREATE OR REPLACE TRIGGER ServiceGuarantee
2 AFTER UPDATE OF MaxCalls ON CELL
3 DECLARE
4     TotalMaxCalls NUMBER(38,0);
5 BEGIN
6     -- save the total number of MaxCalls for each cell to variable
7     SELECT SUM(MaxCalls) INTO TotalMaxCalls
8     FROM CELL;
9
10    -- apply constraint
11    IF TotalMaxCalls <= 30 THEN
12        RAISE_APPLICATION_ERROR(-20000, 'The updated MaxCalls value does
13        not respect the constraint of service guarantee: >30 total MaxCalls');
14    END IF;
15 END;
```

After running

```
1 UPDATE CELL SET MaxCalls = MaxCalls-1;
```

Tables

STATE_CHANGE

	CHANGEID	TIMESTAMP	PHONENO	X	Y	CHANGETYPE
1	1	06-DEC-20	333000010	3	3	0
2	2	06-DEC-20	333000009	15	15	0
3	3	06-DEC-20	333000009	15	15	F
4	4	06-DEC-20	333000001	3	3	0
5	5	06-DEC-20	333000004	5	5	0
6	6	06-DEC-20	333000004	5	5	C
7	7	06-DEC-20	333000001	3	3	C
8	8	06-DEC-20	333000010	3	3	C
9	9	06-DEC-20	333000020	4	4	0
10	10	06-DEC-20	333000020	4	4	C

EXCEPTION_LOG

	EXID	CELLID	EXCEPTIONTYPE
1	1	1	C

CELL

	CELLID	X0	Y0	X1	Y1	CURRENTPHONE#	MAXCALLS
1	1	0	0	10	10	4	3
2	2	10	0	20	10	0	17
3	3	0	10	10	20	0	17
4	4	10	10	20	20	0	17

TELEPHONE

	PHONENO	X	Y	PHONESTATE
1	333000010	3	3	Active
2	333000001	3	3	Active
3	333000004	5	5	Active
4	333000020	4	4	On

We notice how no error is raised because the constraint is respected.

After running

```
1 | UPDATE CELL SET MaxCalls = MaxCalls-10;
```

Tables																																																																			
STATE_CHANGE	<table><tr><th>CHANGEID</th><th>TIMESTAMP</th><th>PHONENO</th><th>X</th><th>Y</th><th>CHANGETYPE</th></tr><tr><td>1</td><td>1 06-DEC-20</td><td>333000010</td><td>3</td><td>3</td><td>0</td></tr><tr><td>2</td><td>2 06-DEC-20</td><td>333000009</td><td>15</td><td>15</td><td>0</td></tr><tr><td>3</td><td>3 06-DEC-20</td><td>333000009</td><td>15</td><td>15</td><td>F</td></tr><tr><td>4</td><td>4 06-DEC-20</td><td>333000001</td><td>3</td><td>3</td><td>0</td></tr><tr><td>5</td><td>5 06-DEC-20</td><td>333000004</td><td>5</td><td>5</td><td>0</td></tr><tr><td>6</td><td>6 06-DEC-20</td><td>333000004</td><td>5</td><td>5</td><td>C</td></tr><tr><td>7</td><td>7 06-DEC-20</td><td>333000001</td><td>3</td><td>3</td><td>C</td></tr><tr><td>8</td><td>8 06-DEC-20</td><td>333000010</td><td>3</td><td>3</td><td>C</td></tr><tr><td>9</td><td>9 06-DEC-20</td><td>333000020</td><td>4</td><td>4</td><td>0</td></tr><tr><td>10</td><td>10 06-DEC-20</td><td>333000020</td><td>4</td><td>4</td><td>C</td></tr></table>	CHANGEID	TIMESTAMP	PHONENO	X	Y	CHANGETYPE	1	1 06-DEC-20	333000010	3	3	0	2	2 06-DEC-20	333000009	15	15	0	3	3 06-DEC-20	333000009	15	15	F	4	4 06-DEC-20	333000001	3	3	0	5	5 06-DEC-20	333000004	5	5	0	6	6 06-DEC-20	333000004	5	5	C	7	7 06-DEC-20	333000001	3	3	C	8	8 06-DEC-20	333000010	3	3	C	9	9 06-DEC-20	333000020	4	4	0	10	10 06-DEC-20	333000020	4	4	C
	CHANGEID	TIMESTAMP	PHONENO	X	Y	CHANGETYPE																																																													
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CELLID	X0	Y0	X1	Y1	CURRENTPHONE#	MAXCALLS																																																													
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Error starting at line : 17 in command -

UPDATE CELL SET MaxCalls = MaxCalls-10

Error report -

ORA-20000: The updated MaxCalls value does not respect the constraint of service guarantee: >30 total MaxCalls

ORA-06512: at "SYSTEM.SERVICEGUARANTEE", line 11

ORA-04088: error during execution of trigger 'SYSTEM.SERVICEGUARANTEE'

We notice how the CELL table does not change.