# Basic Databases – Report02

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This task consists of 2 problems. If you cannot solve a problem, try to give at least a partial answer or partial solution. Remember to write your name, and identifier.

## Problem 1

**Based on the developed conceptual data model "Books" in previous lab classes:**

1. Define the structure of the database (tables, constraints: PRIMARY KEY, FOREIGN KEYS, CHECK - domain constraints
2. Introduce sample records to check the correctness of defined constraints

## Solution:

1. Structure of the database:

```
CREATE TABLE Publisher(
        NIP VARCHAR(11) CONSTRAINT pk_Publisher PRIMARY KEY,
        "name" VARCHAR(30)
 );

  CREATE TABLE Author(
        PESEL VARCHAR(15) CONSTRAINT pk_Author PRIMARY KEY,
        firstName VARCHAR(20),
        lastName VARCHAR(20)
 );

 CREATE TABLE Reader(
        PESEL VARCHAR(15) CONSTRAINT pk_Reader PRIMARY KEY,
        firstName VARCHAR(20),
        lastName VARCHAR(20),
        booksRead INT,
        CONSTRAINT chk_booksRead CHECK(booksRead >= 0)
 );

CREATE TABLE Book(
       ISBN VARCHAR(14) CONSTRAINT pk_Book PRIMARY KEY,
       title VARCHAR(100),
       category VARCHAR(30),
       rating FLOAT,
       formats VARCHAR(50),
       pages INT,
       NIP VARCHAR(11) CONSTRAINT fk_Publisher REFERENCES Publisher(NIP),
       PESEL_author VARCHAR(15) CONSTRAINT fk_Author REFERENCES Author(PESEL),
	PESEL_reader VARCHAR(15) CONSTRAINT fk_Reader REFERENCES Reader,
	CONSTRAINT chk_rating CHECK(rating >= 0 AND rating <= 6),
	CONSTRAINT chk_pages CHECK(pages > 0)
);
```

2.

```
INSERT INTO Publisher VALUES(
	5731006793,
	'Pwr Publishing'
);

INSERT INTO Publisher VALUES(
	5731006793,
	'Second Publisher'
);

INSERT INTO Publisher VALUES(
	5212319312,
	'Oxford'
);
```

Is invalid as two inputs have the same value of primary key. The error says:

```
Msg 2627, Level 14, State 1, Line 1
Violation of PRIMARY KEY constraint 'pk_Publisher'. Cannot insert duplicate key in object
'dbo.Publisher'. The duplicate key value is (5731006793).
The statement has been terminated.
```

I have also tried putting too big VARCHAR into table, but the error says:

```
Arithmetic overflow error converting numeric to data type varchar.
```

Publisher table obtained by query SELECT * FROM Publisher:

| NIP | name |
|---|---|
| 5212319312 | Oxford |
| 5731006793 | Pwr Publishing |

In the Author table I wanted to add too long VARCHAR, using this code:

```
INSERT INTO Author VALUES(
	81323491236,
	'Janerqreqrwqewerrewrqqeweqweqewq',
	'Nowak'
);
```

but an error occurred:

```
String or binary data would be truncated.
```

One took place as I set the maximum value for firstName VARCHAR to 20.

I added new entries using those queries:

```
INSERT INTO Author VALUES(
        98023491237,
        'Jan',
        'Kowalski'
);

INSERT INTO Author VALUES(
        81323491236,
        'Piotr',
        'Nowak'
);

INSERT INTO Author VALUES(
        7627481221,
        'James',
        'Bond'
);
```

The output for query:

```
SELECT *
FROM Author;
```

is following:

| PESEL | firstName | lastName |
|---|---|---|
| 7627481221 | James | Bond |
| 81323491236 | Piotr | Nowak |
| 98023491237 | Jan | Kowalski |

I wanted to add new entry into Reader table, but with incorrect booksRead amount. I check this using CHECK constraint (booksRead >= 0). Following was code and error:

```
INSERT INTO Reader VALUES(
        4367823912,
        'Andrzej',
        'Kowalczyk',
        -1
);
```

```
The INSERT statement conflicted with the CHECK constraint "chk_booksRead". The conflict
occurred in database "242363", table "dbo.Reader", column 'booksRead'.
```

I inserted three entries by this query:

```
INSERT INTO Reader VALUES(
       4367823912,
       'Andrzej',
       'Kowalczyk',
       2
);

INSERT INTO Reader VALUES(
       5512734912,
       'Anna',
       'Dąb',
       44
);

INSERT INTO Reader VALUES(
       9063813991,
       'Michael',
       'Jordan',
       23
);
```

Using query:

```
SELECT *
FROM Reader;
```

I obtained following result:

| PESEL | firstName | lastName | booksRead |
|---|---|---|---|
| 4367823912 | Andrzej | Kowalczyk | 2 |
| 5512734912 | Anna | Dab | 44 |
| 9063813991 | Michael | Jordan | 23 |

Finally, I started to create entries into Book table. Firstly, I decided to add entry with invalid foreign key. I created that query:

```
INSERT INTO Book VALUES(
       978-1-60309,
       'Java - Tutorial',
       'Computer Science',
       4.3,
       'PDF/TXT',
       452,
       5731006794,
       7627481221,
       9063813991
);
```

Foreign key for NIP is invalid as it doesn’t exist. Fortunately, the error occurred:

```
The INSERT statement conflicted with the FOREIGN KEY constraint "fk_Publisher". The
conflict occurred in database "242363", table "dbo.Publisher", column 'NIP'.
```

Next I tried to insert data with invalid pages(CHECK constraint pages > 0) and rating(CHECK constraint rating [0.0, 6.0]). Validation system works as the errors say:

```
The INSERT statement conflicted with the CHECK constraint "chk_rating". The conflict
occurred in database "242363", table "dbo.Book", column 'rating'.

The INSERT statement conflicted with the CHECK constraint "chk_pages". The conflict
occurred in database "242363", table "dbo.Book", column 'pages'.
```

I obtained these results by this query:

```sql
INSERT INTO Book VALUES(
       978-1-60309,
       'Java - Tutorial',
       'Computer Science',
       6.3,
       'PDF/TXT',
       0,
       5731006793,
       7627481221,
       9063813991
);
```

I added some correct entries using following query:

```sql
INSERT INTO Book VALUES(
       '978-1-60309',
       'Java - Tutorial',
       'Computer Science',
       4.3,
       'PDF/TXT',
       427,
       5731006793,
       7627481221,
       9063813991
);

INSERT INTO Book VALUES(
       '978-1-60308',
       'PHP IS not that EASY',
       'Computer Science',
       5.1,
       'PDF',
       315,
       5212319312,
       81323491236,
       4367823912
);

INSERT INTO Book VALUES(
       '978-1-60315',
       'Beach Safari',
       'Science Fiction',
       4.9,
       'PDF/Hard Cover',
       539,
       5731006793,
       98023491237,
       5512734912
);

INSERT INTO Book VALUES(
       '978-1-60241',
       'Any Empire',
       'Adventure',
       3.7,
       'TXT',
       994,
       5212319312,
       7627481221,
       5512734912
);

INSERT INTO Book VALUES(
       '978-1-51912',
       'Second Thoughts',
       'Romantic',
       4.9,
       'PDF/TXT/Hard Cover',
       207,
       5212319312,
       98023491237,
       5512734912
);

INSERT INTO Book VALUES(
       '978-1-914501',
       'Red Panda and Moon Bear',
       'Short story',
       5.0,
       'Hard Cover/TXT',
       51,
       5731006793,
       81323491236,
       9063813991
);
```

And by query:

```
SELECT *
FROM Book;
```

I got this result:

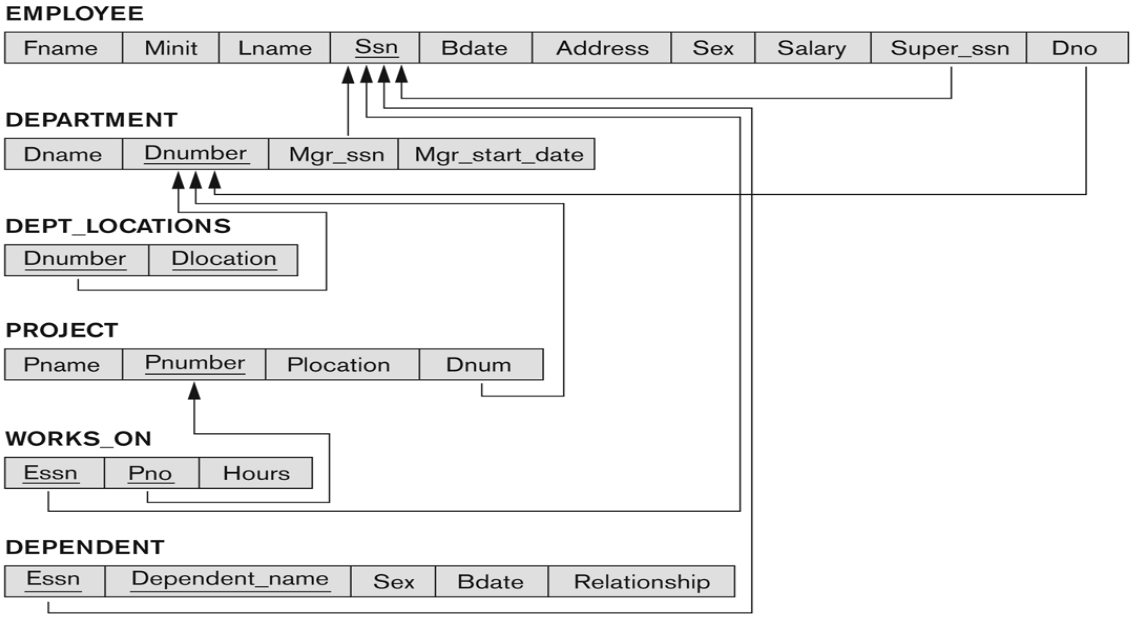
| ISBN | title | category | rating | formats | pages | NIP | PESEL_author | PESEL_reader |
|---|---|---|---|---|---|---|---|---|
| 978-1-51912 | Second Thoughts | Romantic | 4.9 | PDF/TXT/Hard Cover | 207 | 5212319312 | 98023491237 | 5512734912 |
| 978-1-60241 | Any Empire | Adventure | 3.7 | TXT | 994 | 5212319312 | 7627481221 | 5512734912 |
| 978-1-60308 | PHP IS not that EASY | Computer Science | 5.1 | PDF | 315 | 5212319312 | 81323491236 | 4367823912 |
| 978-1-60309 | Java - Tutorial | Computer Science | 4.3 | PDF/TXT | 427 | 5731006793 | 7627481221 | 9063813991 |
| 978-1-60315 | Beach Safari | Science Fiction | 4.9 | PDF/Hard Cover | 539 | 5731006793 | 98023491237 | 5512734912 |
| 978-1-914501 | Red Panda and Moon Bear | Short story | 5 | Hard Cover/TXT | 51 | 5731006793 | 81323491236 | 9063813991 |

Each book has its publisher, author, reader(s) and its unique primary key, which is ISBN.

## Problem 2

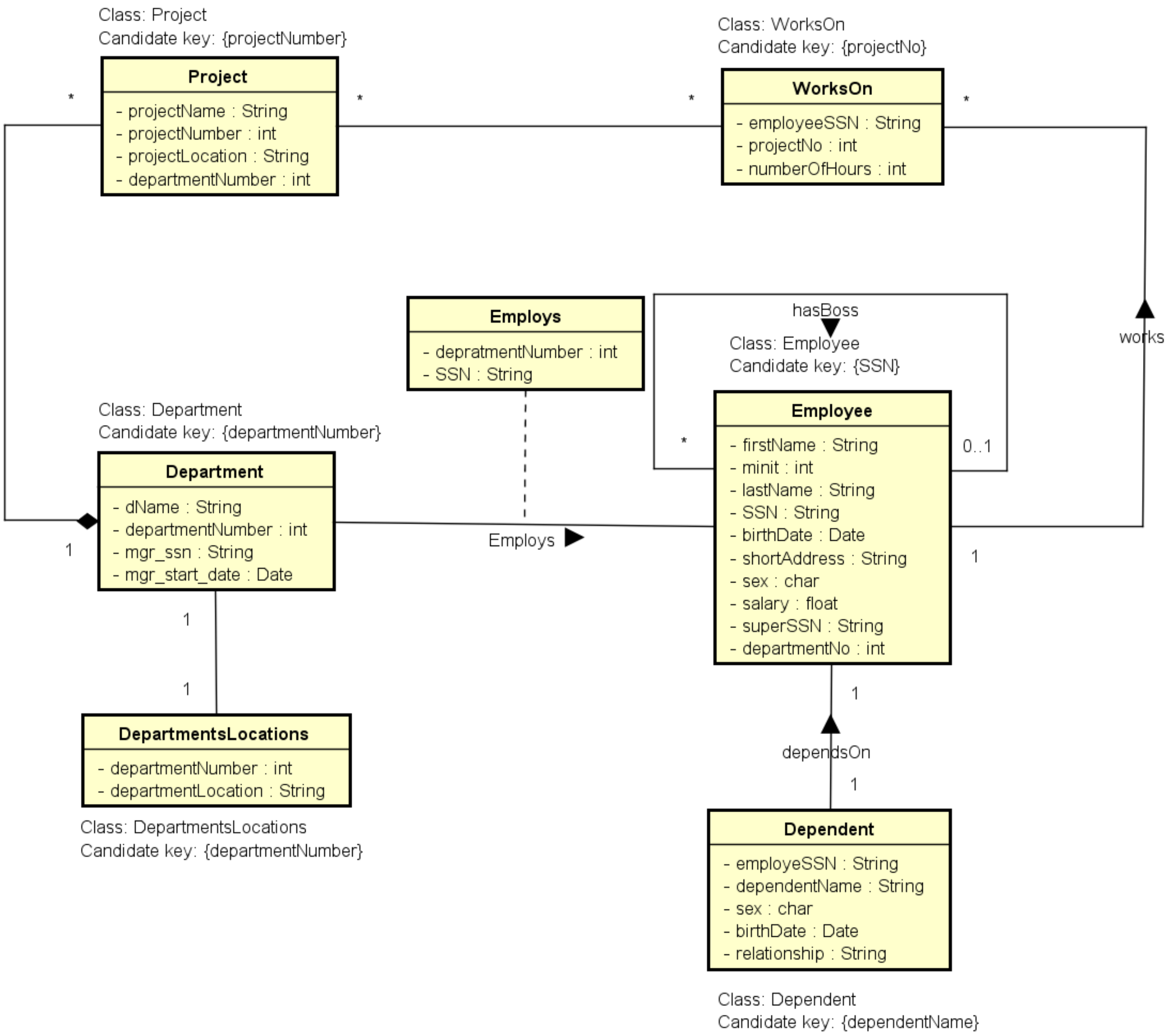
1. Define conceptual data model based on the following relational database schema (Company relational data model) using UML
2. Implement the Company relational database in MS SQL 2017

**Figure 5.7**
Referential integrity constraints displayed on the COMPANY relational database schema.



**Solution:**

Database schema in UML:



Structure of the database:

```
CREATE TABLE Department(
	departmentNumber INT CONSTRAINT pk_Department PRIMARY KEY,
	dName VARCHAR(40),
	mgr_start_date DATE,
	CONSTRAINT chk_departmentNumber CHECK(departmentNumber >= 0)
);

CREATE TABLE DepartmentsLocations(
	departmentLocation VARCHAR(40),
	departmentNo INT CONSTRAINT fk_Department REFERENCES Department
);
```

```
CREATE TABLE Project(
        projectNumber INT CONSTRAINT pk_Project PRIMARY KEY,
        projectName VARCHAR(40),
        projectLocation VARCHAR(30),
        departmentNumber INT CONSTRAINT fk_projectDepartment REFERENCES Department,
        CONSTRAINT chk_projectNumber CHECK(projectNumber >= 0)
 );

 CREATE TABLE Employee(
       SSN VARCHAR(20) CONSTRAINT pk_Employee PRIMARY KEY,
       firstName VARCHAR(25),
       minit INT,
       lastName VARCHAR(25),
       birthDate DATE,
       shortAddress VARCHAR(30),
       sex CHAR,
       salary FLOAT,
       superSSN VARCHAR(20) CONSTRAINT fk_Employee REFERENCES Employee,

       CONSTRAINT chk_salary CHECK(salary >= 0)
 );

 CREATE TABLE Employs(
       mgr_SSN VARCHAR(20) CONSTRAINT fk_employsEmployee REFERENCES Employee,
       departmentNo INT CONSTRAINT fk_employsDepartment REFERENCES Department
 );

 CREATE TABLE Dependent(
       dependentName VARCHAR(20) CONSTRAINT pk_Dependent PRIMARY KEY,
       sex CHAR,
       birthDate DATE,
       relationship VARCHAR(15),
       employeeSSN VARCHAR(20) CONSTRAINT fk_dependentEmployee REFERENCES Employee
 );

 CREATE TABLE WorksOn(
       numberOfHours INT,
       projectNo INT CONSTRAINT fk_Project REFERENCES Project,
       employeeSSN VARCHAR(20) CONSTRAINT fk_wokrsOnEmployee REFERENCES Employee,
       CONSTRAINT chk_numberOfHours CHECK(numberOfHours >= 0)
        );
```

I inserted data using those queries:

```
INSERT INTO Employee VALUES(
       '123456789',
       'Jan',
       5,
       'Kowalski',
       '1974-10-09',
       'Wroclaw',
       'M',
       2400.50,
       NULL
);
```

```
INSERT INTO Employee VALUES(
       '987654321',
       'Piotr',
       3,
       'Nowak',
       '1993-03-15',
       'Warszawa',
       'M',
       1000.30,
       '123456789'
);

INSERT INTO Employee VALUES(
       '513924591',
       'Anna',
       3,
       'Kowalczyk',
       '1996-02-15',
       'Gdansk',
       'F',
       1350.30,
       '123456789'
);

INSERT INTO Employee VALUES(
       '894023817',
       'John',
       7,
       'Newman',
       '1956-07-15',
       'London',
       'M',
       3450.30,
       NULL
);

INSERT INTO Department VALUES(
       2,
       'Wydzial Budowniczy',
       '1953-12-18'
);

INSERT INTO Department VALUES(
       1,
       'Wydzial Architektury',
       '1976-03-19'
);

INSERT INTO Employs VALUES(
       '123456789',
       2
);

INSERT INTO Employs VALUES(
       '987654321',
       2
);
```

```
INSERT INTO Employs VALUES(
        '513924591',
        2
);

INSERT INTO Employs VALUES(
        '894023817',
        1
);

INSERT INTO Project VALUES(
        1,
        'Budowa mostu',
        'Wroclaw',
        2
);

INSERT INTO Project VALUES(
        2,
        'Szkic palacu',
        'Czestochowa',
        1
);

INSERT INTO WorksOn VALUES(
        32,
        2,
        '123456789'
);

INSERT INTO WorksOn VALUES(
        48,
        2,
        '987654321'
);

INSERT INTO WorksOn VALUES(
        42,
        2,
        '513924591'
);

INSERT INTO WorksOn VALUES(
        16,
        1,
        '894023817'
);

INSERT INTO DepartmentsLocations VALUES(
        'Wroclaw',
        1
);

INSERT INTO DepartmentsLocations VALUES(
        'Legnica',
        2
);
```

```
INSERT INTO [dbo].[Dependent] VALUES(
       'Dependent One',
       'F',
       '1998-09-10',
       'Single',
       '123456789'
);

INSERT INTO [dbo].[Dependent] VALUES(
       'Dependent Two',
       'M',
       '1974-10-15',
       'Married',
       '987654321'
);

INSERT INTO [dbo].[Dependent] VALUES(
       'Dependent Three',
       'F',
       '2001-03-15',
       'Married',
       '513924591'
);

INSERT INTO [dbo].[Dependent] VALUES(
       'Dependent Four',
       'F',
       '1974-03-23',
       'Single',
       '894023817'
       );
```

By query:

```
SELECT *
FROM Employee;
```

I obtained those results:

| SSN | firstName | minit | lastName | birthDate | shortAddress | sex | salary | superSSN |
|---|---|---|---|---|---|---|---|---|
| 123456789 | Jan | 5 | Kowalski | 1974-10-09 | Wroclaw | M | 2400.5 | NULL |
| 513924591 | Anna | 3 | Kowalczyk | 1996-02-15 | Gdansk | F | 1350.3 | 123456789 |
| 894023817 | John | 7 | Newman | 1956-07-15 | London | M | 3450.3 | NULL |
| 987654321 | Piotr | 3 | Nowak | 1993-03-15 | Warszawa | M | 1000.3 | 123456789 |

If the value in superSSN field is NULL that means that this is the boss.

Now, I will check Department table. I select it using query:

```
SELECT *
FROM Department;
```

That is the result:

| departmentNumber | dName | mgr_start_date |
|---|---|---|
| 1 | Wydzial Architektury | 1976-03-19 |
| 2 | Wydzial Budowniczy | 1953-12-18 |

In addition, let me check Employs table as it is important in that database. I use that query:

```
SELECT *
FROM Employs;
```

I receive that output:

| mgr_SSN | departmentNo |
|---|---|
| 123456789 | 2 |
| 987654321 | 2 |
| 513924591 | 2 |
| 894023817 | 1 |

That is what I wanted to get.

## Conclusions

Before creating database in DBMS, we should make UML schema. Creating UML diagram makes things easier as we can see the concept of a database. In first task, I have checked CHECK constraints and some other protections. Sometimes, we will need an additional table to hold foreign keys, as in the second task where I created ‘Employes’ association class which holds foregin keys for Department and Employee. I also added some similar CHECK constraints in this task. After inserting data, I have shown some final results which appeared as intended.

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**Please do not forget about the conclusions being a summary of considered problems and proposed solutions!**

**Remarks:**

1. **Students' reports (as one package) should be sent by the leader of the group via e-mail before the next lab**
2. **The rule of naming student's file report is defined below**

| | |
|---|---|
| Name of the file: **Rep01-StudId-Last name.pdf** | Example: **Rep01-1951355-Turan.pdf** |