CSIT115 CSIT882

# SQL - Data Definition Language (DDL)

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# SQL - Data Definition Statements

## Outline

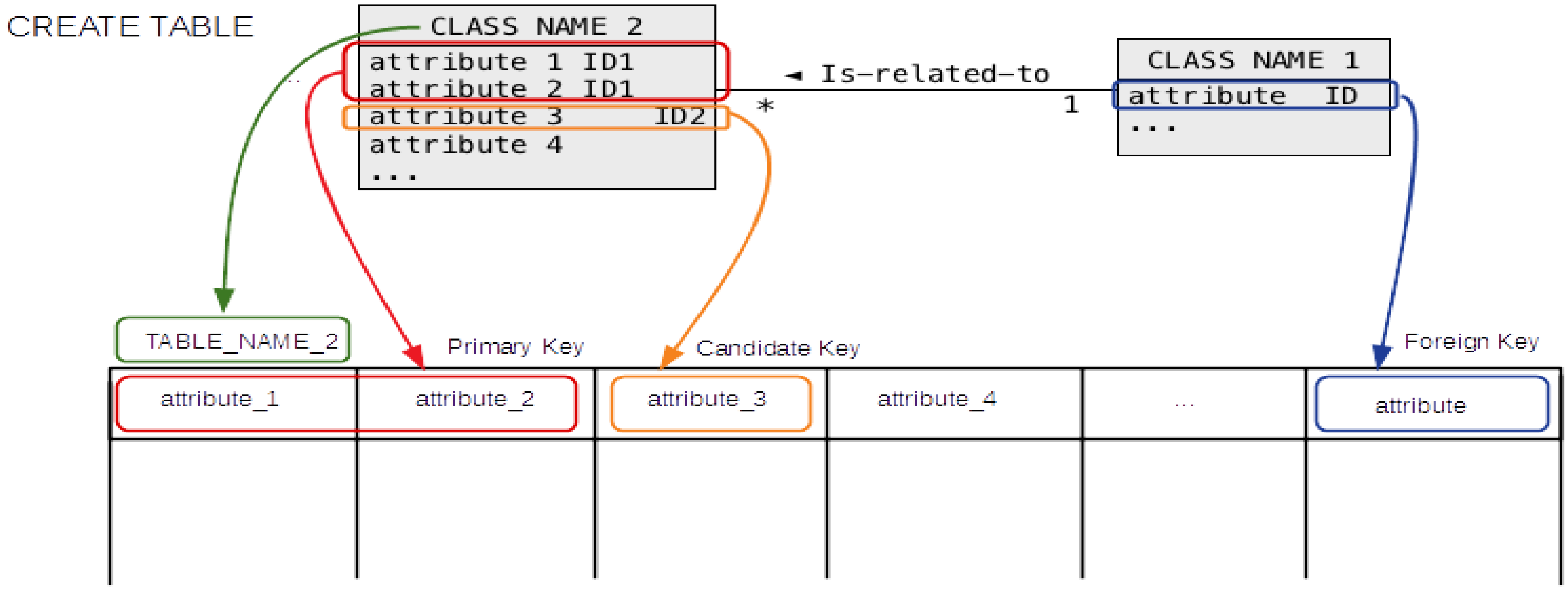
`CREATE TABLE` statement

`DROP TABLE` statement

`ALTER TABLE` statement

# CREATE TABLE statement

CREATE TABLE statement creates a new relational table with a given name, given attribute names and types and with the given logical consistency constraints



# CREATE TABLE statement

Example:

DEPARTMENT — Schema name

name | code | total staff | chair | budget — Attribute names

- name: primary key, variable size string, no more than 50 characters, mandatory
- code: candidate key, fixed size string, precisely 5 characters, mandatory
- total staff: total staff number, integer, range 1..50, mandatory
- chair: chaiperson, candidate key, variable size string, no more than 50 characters, optional
- budget: real number, no more than 9 digits, one position after decimal dot, mandatory

# CREATE TABLE statement

Example:

```
CREATE TABLE DEPARTMENT(                                                 Table name
name              VARCHAR(50)  NOT NULL,     Attribute name, type, and constraint
code              CHAR(5)      NOT NULL,     Attribute name, type, and constraint
total_staff_number DECIMAL(2)  NOT NULL,     Attribute name, type, and constraint
chair             VARCHAR(50)      NULL,     Attribute name, type, and constraint
budget            DECIMAL(9,1) NOT NULL,     Attribute name, type, and constraint
CONSTRAINT dept_pkey PRIMARY KEY(name),                    Primary key constraint
CONSTRAINT dept_ckey1 UNIQUE(code),                      Candidate key constraint
CONSTRAINT dept_ckey2 UNIQUE(chair),                     Candidate key constraint
CONSTRAINT dept_check1                                          Domain constraint
CHECK (total_staff_number BETWEEN 1 AND 50) );
```

# CREATE TABLE statement

Table name

Table name

```
CREATE TABLE DEPARTMENT(
```

Attribute names

Attribute names

```
name              VARCHAR(50)       NOT NULL,
code              CHAR(5)           NOT NULL,
total_staff_number DECIMAL(2)       NOT NULL,
chair             VARCHAR(50)           NULL,
budget            DECIMAL(9,1)      NOT NULL,
```

Attribute types

Attribute types

```
name              VARCHAR(50)       NOT NULL,
code              CHAR(5)           NOT NULL,
total_staff_number DECIMAL(2)       NOT NULL,
chair             VARCHAR(50)           NULL,
budget            DECIMAL(9,1)      NOT NULL,
```

# CREATE TABLE statement

## NULL/NOT NULL constraints

NULL/NOT NULL constraints

```
name               VARCHAR(50)        NOT NULL,
code               CHAR(5)            NOT NULL,
total_staff_number DECIMAL(2)         NOT NULL,
chair              VARCHAR(50)            NULL,
budget             DECIMAL(9,1)       NOT NULL,
```

## Primary key constraint

Primary key constraint

```
CONSTRAINT dept_pkey PRIMARY KEY(name),
```

## Candidate key constraints

Candidate key constraint

```
CONSTRAINT dept_ckey1 UNIQUE(code),
CONSTRAINT dept_ckey2 UNIQUE(chair),
```

## Domain constraint

Domain constraint

```
CONSTRAINT dept_check1 CHECK (total_staff_number BETWEEN 1 AND 50) );
```

# CREATE TABLE statement

"Bird's eye view"

CREATE TABLE statement

```
CREATE TABLE DEPARTMENT(
 name               VARCHAR(50)        NOT NULL,
 code               CHAR(5)            NOT NULL,
 total_staff_number DECIMAL(2)         NOT NULL,
 chair              VARCHAR(50)            NULL,
 budget             DECIMAL(9,1)       NOT NULL,
  CONSTRAINT dept_pkey PRIMARY KEY(name),
  CONSTRAINT dept_ckey1 UNIQUE(code),
  CONSTRAINT dept_ckey2 UNIQUE(chair),
  CONSTRAINT dept_check1 CHECK (total_staff_number BETWEEN 1 AND 50) );
```

# CREATE TABLE statement

## Another example

COURSE Schema name

cnum | title | credits | offered_by Attributes

- cnum: primary key, fixed size string, 7 characters
- title: variable size string no longer than 200 characters, is mandatory
- credits: integer, either 6 or 12, is mandatory
- offered_by: foreign key, references department name, variable size string, no longer than 50 characters, is optional

# CREATE TABLE statement

## Another example

```
CREATE TABLE COURSE(                                                          Table name
cnum        CHAR(7)      NOT NULL,                      Attribute name, type, and constraint
title       VARCHAR(200) NOT NULL,                      Attribute name, type, and constraint
credits     DECIMAL(2)   NOT NULL,                      Attribute name, type, and constraint
offered_by  VARCHAR(50)      NULL,                      Attribute name, type, and constraint
CONSTRAINT course_pkey PRIMARY KEY(cnum),                         Primary key constraint
CONSTRAINT course_check1 CHECK (credits IN (6, 12)),                  Domain constraint
CONSTRAINT course_fkey1 FOREIGN KEY(offered_by)                             Foreign key
                        REFERENCES DEPARTMENT(name));
```

# CREATE TABLE statement

Table name

Table name

```
CREATE TABLE COURSE(
```

Attribute names

Attribute names

```
cnum                CHAR(7)          NOT NULL,
title               VARCHAR(200)     NOT NULL,
credits             DECIMAL(2)       NOT NULL,
offered_by          VARCHAR(50)          NULL,
```

Attribute types

Attribute types

```
cnum                CHAR(7)          NOT NULL,
title               VARCHAR(200)     NOT NULL,
credits             DECIMAL(2)       NOT NULL,
offered_by          VARCHAR(50)          NULL,
```

# CREATE TABLE statement

## NULL/NOT NULL constraints

NULL/NOT NULL constraints

```
cnum               CHAR(7)          NOT NULL,
title              VARCHAR(200)     NOT NULL,
credits            DECIMAL(2)       NOT NULL,
offered_by         VARCHAR(50)          NULL,
```

## Primary key constraint

Primary key constraint

```
CONSTRAINT course_pkey PRIMARY KEY(cnum),
```

## Domain constraint

Domain constraint

```
CONSTRAINT course_check1 CHECK (credits IN (6, 12)),
```

## Foreign key constraint

Foreign key constraint

```
CONSTRAINT course_fkey1 FOREIGN KEY(offered_by)
                        REFERENCES DEPARTMENT(name);
```

# `CREATE TABLE` statement

"Bird's eye view"

CREATE table statement

```
CREATE TABLE COURSE(
 cnum               CHAR(7)           NOT NULL,
 title              VARCHAR(200)      NOT NULL,
 credits            DECIMAL(2)        NOT NULL,
 offered_by         VARCHAR(50)           NULL,
  CONSTRAINT course_pkey PRIMARY KEY(cnum),
  CONSTRAINT course_check1 CHECK (credits IN (6, 12)),
  CONSTRAINT course_fkey1 FOREIGN KEY(offered_by)
                          REFERENCES DEPARTMENT(name));
```

Sometimes, you may see a clause appending to the fkey constraint:

... FOREIGN KEY(offered_by) REFERENCES DEPARTMENT(name) ON DELETE CASCADE;

A clause `ON DELETE CASCADE` means that if a row with a value of primary key referenced by a row with a value of foreign key in another or the same relational table is deleted ...

... then a row with a foreign key in another or the same relational table is automatically deleted

# `CREATE TABLE` statement

Some of the attribute types:

- `VARCHAR(size)` Variable length string, maximum size 65535 bytes
- `CHAR(size)` Fixed length string, maximum size 255 bytes
- `DECIMAL(M)` Integer numbers with total M digits stored with exact precision
- `DECIMAL(M,D)` Real numbers with total M digits and D digits after decimal point stored with exact precision
- `DATE` dates, default entry format 'YYYY-MM-DD'
- `TIME` times, default entry format 'HH:MI:SS;
- `DATETIME` dates and times, default entry format 'YYYY-MM-DD HH:MI:SS'

# SQL - Data Definition Statements

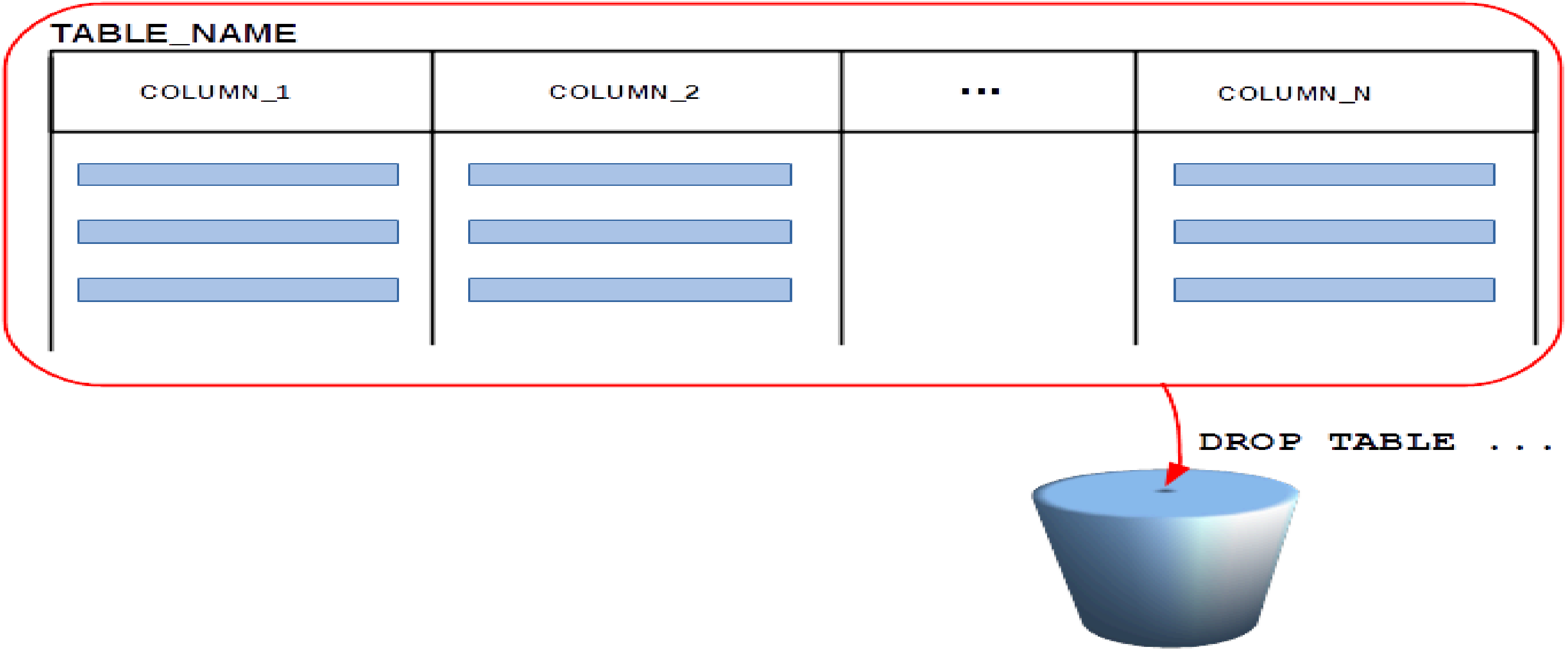
## Outline

- `CREATE TABLE` statement
- `DROP TABLE` statement
- `ALTER TABLE` statement

# DROP TABLE statement

Functionality:

- DROP TABLE statement permanently deletes the contents of relational table and removes its definition from a database
- A relational table that has been dropped can be recreated as an empty table by the execution of CREATE TABLE statement



# DROP TABLE statement

Examples:

CREATE TABLE statement

```
CREATE TABLE DEPARTMENT(
 name               VARCHAR(50)        NOT NULL,
 code               CHAR(5)            NOT NULL,
 total_staff_number DECIMAL(2)         NOT NULL,
 chair              VARCHAR(50)            NULL,
 budget             DECIMAL(9,1)       NOT NULL,
  CONSTRAINT dept_pkey PRIMARY KEY(name),
  CONSTRAINT dept_ckey1 UNIQUE(code),
  CONSTRAINT dept_ckey2 UNIQUE(chair),
  CONSTRAINT dept_check1 CHECK (total_staff_number BETWEEN 1 AND 50) );
```

CREATE TABLE statement

```
CREATE TABLE COURSE(
 cnum               CHAR(7)           NOT NULL,
 title              VARCHAR(200)      NOT NULL,
 credits            DECIMAL(2)        NOT NULL,
 offered_by         VARCHAR(50)           NULL,
  CONSTRAINT course_pkey PRIMARY KEY(cnum),
  CONSTRAINT course_check1 CHECK (credits IN (6, 12)),
  CONSTRAINT course_fkey1 FOREIGN KEY(offered_by)
                        REFERENCES DEPARTMENT(name));
```

# DROP TABLE statement

Examples:

DROP TABLE statement

```
DROP TABLE COURSE;
```

DROP TABLE statement

```
DROP TABLE DEPARTMENT;
```

BEWARE !!!

DROP TABLE statement

```
DROP TABLE DEPARTMENT;
```

Feedback message

```
---------------
DROP TABLE DEPARTMENT
---------------

ERROR 1217 (23000): Cannot delete or update a parent row: a foreign key
constraint fails
```

- An order in which the relational tables are dropped is important !!!

# SQL - Data Definition Statements

## Outline

`CREATE TABLE` statement

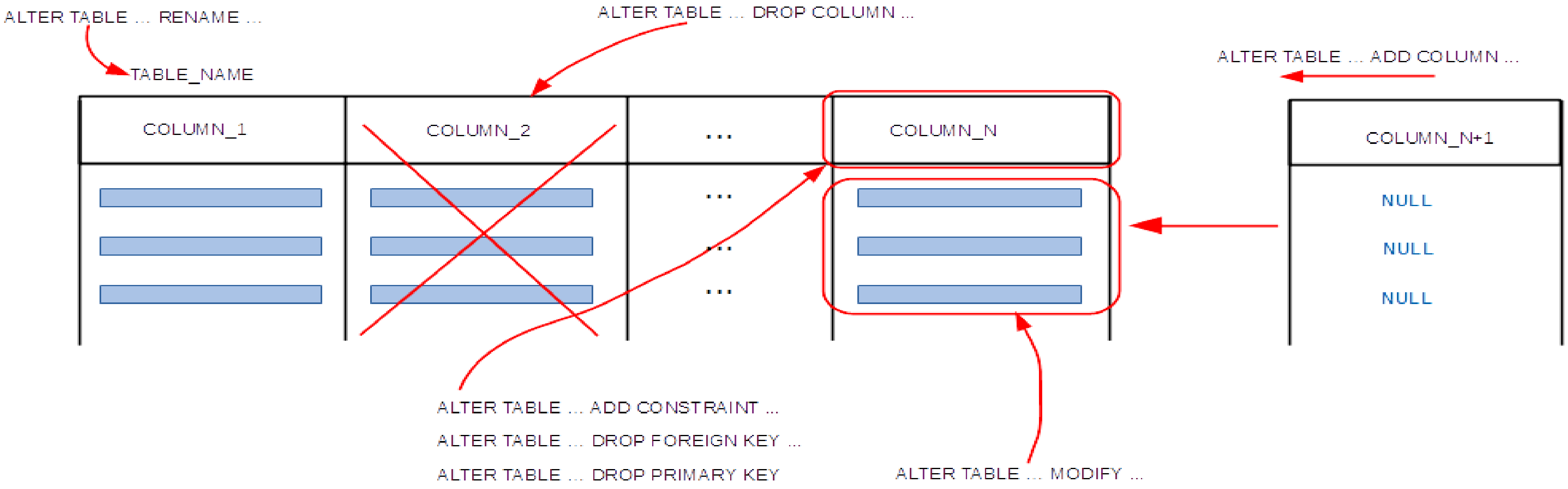
`DROP TABLE` statement

`ALTER TABLE` statement

# ALTER TABLE statement

Functionality

- ALTER TABLE statement permanently changes a definition of relational table
- ALTER TABLE statement can be used to:
  - add or drop a column,
  - modify a type of column,
  - add or drop a consistency constraint,
  - rename a relational table


ALTER TABLE ... RENAME ...
TABLE_NAME
ALTER TABLE ... DROP COLUMN ...
ALTER TABLE ... ADD COLUMN ...
COLUMN_1
COLUMN_2
...
COLUMN_N
COLUMN_N+1
NULL
NULL
NULL
ALTER TABLE ... ADD CONSTRAINT ...
ALTER TABLE ... DROP FOREIGN KEY ...
ALTER TABLE ... DROP PRIMARY KEY
ALTER TABLE ... MODIFY ...

# ALTER TABLE statement

## Adding the attributes

CREATE TABLE statement

```
CREATE TABLE DEPARTMENT(
 name               VARCHAR(50)        NOT NULL,
 code               CHAR(5)            NOT NULL,
 total_staff_number DECIMAL(2)         NOT NULL,
 chair              VARCHAR(50)            NULL,
 budget             DECIMAL(9,1)       NOT NULL,
  CONSTRAINT dept_pkey PRIMARY KEY(name),
  CONSTRAINT dept_ckey1 UNIQUE(code),
  CONSTRAINT dept_ckey2 UNIQUE(chair),
  CONSTRAINT dept_check1 CHECK (total_staff_number BETWEEN 1 AND 50) );
```

ALTER TABLE statement that adds an attribute

```
ALTER TABLE DEPARTMENT ADD COLUMN category VARCHAR(20);
```

ALTER TABLE statement that adds an attribute

```
ALTER TABLE DEPARTMENT ADD COLUMN vision_stmt VARCHAR(5000);
```

# ALTER TABLE statement

## Dropping an attribute

CREATE TABLE statement

```
CREATE TABLE DEPARTMENT(
 name              VARCHAR(50)        NOT NULL,
 code              CHAR(5)            NOT NULL,
 total_staff_number DECIMAL(2)        NOT NULL,
 chair             VARCHAR(50)            NULL,
 budget            DECIMAL(9,1)       NOT NULL,
  CONSTRAINT dept_pkey PRIMARY KEY(name),
  CONSTRAINT dept_ckey1 UNIQUE(code),
  CONSTRAINT dept_ckey2 UNIQUE(chair),
  CONSTRAINT dept_check1 CHECK (total_staff_number BETWEEN 1 AND 50) );
```

ALTER TABLE statement that drops an attribute

```
ALTER TABLE DEPARTMENT DROP COLUMN budget;
```

# ALTER TABLE statement

## Changing a type of attribute

CREATE TABLE statement

```
CREATE TABLE DEPARTMENT(
 name              VARCHAR(50)        NOT NULL,
 code              CHAR(5)            NOT NULL,
 total_staff_number DECIMAL(2)        NOT NULL,
 chair             VARCHAR(50)            NULL,
 budget            DECIMAL(9,1)       NOT NULL,
  CONSTRAINT dept_pkey PRIMARY KEY(name),
  CONSTRAINT dept_ckey1 UNIQUE(code),
  CONSTRAINT dept_ckey2 UNIQUE(chair),
  CONSTRAINT dept_check1 CHECK (total_staff_number BETWEEN 1 AND 50) );
```

ALTER TABLE statement that modifies a domain constraint

```
ALTER TABLE DEPARTMENT MODIFY code CHAR(6) NOT NULL;
```

ALTER TABLE statement that modifies NULL/NOT NULL constraint

```
ALTER TABLE DEPARTMENT MODIFY chair VARCHAR(80) NOT NULL;
```

# ALTER TABLE statement

## Adding a constraint

CREATE TABLE statement

```
CREATE TABLE DEPARTMENT(
 name              VARCHAR(50)        NOT NULL,
 code              CHAR(5)            NOT NULL,
 total_staff_number DECIMAL(2)        NOT NULL,
 chair             VARCHAR(50)            NULL,
 budget            DECIMAL(9,1)       NOT NULL,
  CONSTRAINT dept_pkey PRIMARY KEY(name),
  CONSTRAINT dept_ckey1 UNIQUE(code),
  CONSTRAINT dept_ckey2 UNIQUE(chair),
  CONSTRAINT dept_check1 CHECK (total_staff_number BETWEEN 1 AND 50) );
```

ALTER TABLE statement that adds a domain constraint

```
ALTER TABLE DEPARTMENT ADD CONSTRAINT dept_check2
                       CHECK (code = UPPER(code));
```

# ALTER TABLE statement

## Dropping a constraint

CREATE TABLE statement

```
CREATE TABLE COURSE(
 cnum                 CHAR(7)          NOT NULL,
 title                VARCHAR(200)     NOT NULL,
 credits              DECIMAL(2)       NOT NULL,
 offered_by           VARCHAR(50)          NULL,
  CONSTRAINT course_pkey PRIMARY KEY(cnum),
  CONSTRAINT course_check1 CHECK (credits IN (6, 12)),
  CONSTRAINT course_fkey1 FOREIGN KEY(offered_by)
                      REFERENCES DEPARTMENT(name) ON DELETE CASCADE );
```

ALTER TABLE statement that drops a foreign key

```
ALTER TABLE COURSE DROP FOREIGN KEY course_fkey1;
```

ALTER TABLE statement that drops a primary key

```
ALTER TABLE DEPARTMENT DROP PRIMARY KEY;
```

ALTER TABLE statement that drops a domain constraint

```
ALTER TABLE COURSE DROP CHECK COURSE_CHECK1;
```

# ALTER TABLE statement

## Renaming a relational table

CREATE TABLE statement

```
CREATE TABLE DEPARTMENT(
 name              VARCHAR(50)       NOT NULL,
 code              CHAR(5)           NOT NULL,
 total_staff_number DECIMAL(2)       NOT NULL,
 chair             VARCHAR(50)           NULL,
 budget            DECIMAL(9,1)      NOT NULL,
  CONSTRAINT dept_pkey PRIMARY KEY(name),
  CONSTRAINT dept_ckey1 UNIQUE(code),
  CONSTRAINT dept_ckey2 UNIQUE(chair),
  CONSTRAINT dept_check1 CHECK (total_staff_number BETWEEN 1 AND 50) );
```

ALTER TABLE statement that renames a table

```
ALTER TABLE DEPARTMENT RENAME TO NEWDEPARTMENT;
```

# References

C. Coronel, S. Morris, A. Basta, M. Zgola, Data Management and Security, Chapter 5 Introduction to Structured Query Language, Cengage Compose eBook, 2018, eBook: Data Management and Security, 1st Edition

T. Connoly, C. Begg, Database Systems, A Practical Approach to Design, Implementation, and Management, Chapters 7.1, 7.2, 7.3 (except 7.3.5, 7.3.6) SQL: Data Definition, Pearson Education Ltd, 2015

D. Darmawikarta, SQL for MySQL A Beginner's Tutorial, Chapter 1, pages 5-8, Brainy Software Inc. First Edition: June 2014

How to ... ? Cookbook, How to use data definition and basic data manipulation statements of SQL ? Recipe 4.1 How to create and how to alter the relational tables ?