SQL FOR DATABASE CONSTRUCTION AND APPLICATION PROCESSING

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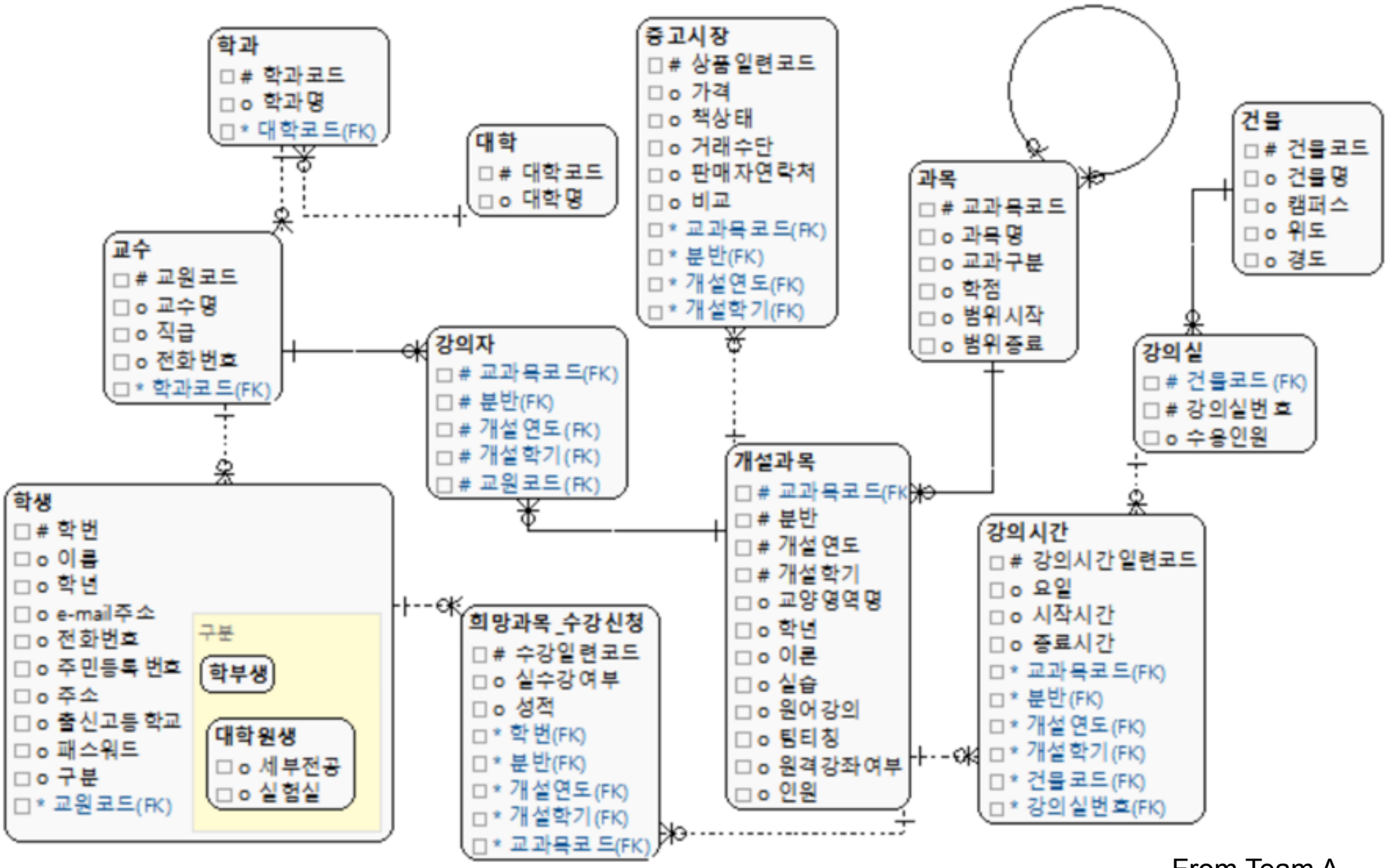
OBJECTIVES

- To create and manage table structures using SQL statements
- To understand how referential integrity actions are implemented in SQL statements
- To create and use SQL constraints
- To understand several uses for SQL views
- To use SQL statements to create and use views
- To gain an understanding of how SQL is used in an application program
- To understand how to create and use triggers
- To understand how to create and use stored procedures

SQL CATAGORIES

- SQL statements can be divided into five categories:
  - Data definition language (DDL)
    - Used for creating tables, relationships, and other structures
    - Covered in this chapter Chapter 7
  - SQL/Persistent Stored Modules (SQL/PSM) statements
    - Add procedural programming capabilities: Variables and Control-of-flow statements
    - Covered in this chapter Chapter 7 and 10C (MySQL 5.6)
- Data manipulation language (DML) statements
  - Used for queries and data modification
  - Covered in this chapter and Chapter 2
- Transaction control language (TCL) statements
- Data control language (DCL) statements

ENROLLMENT DATABASE DESIGN



From Team A

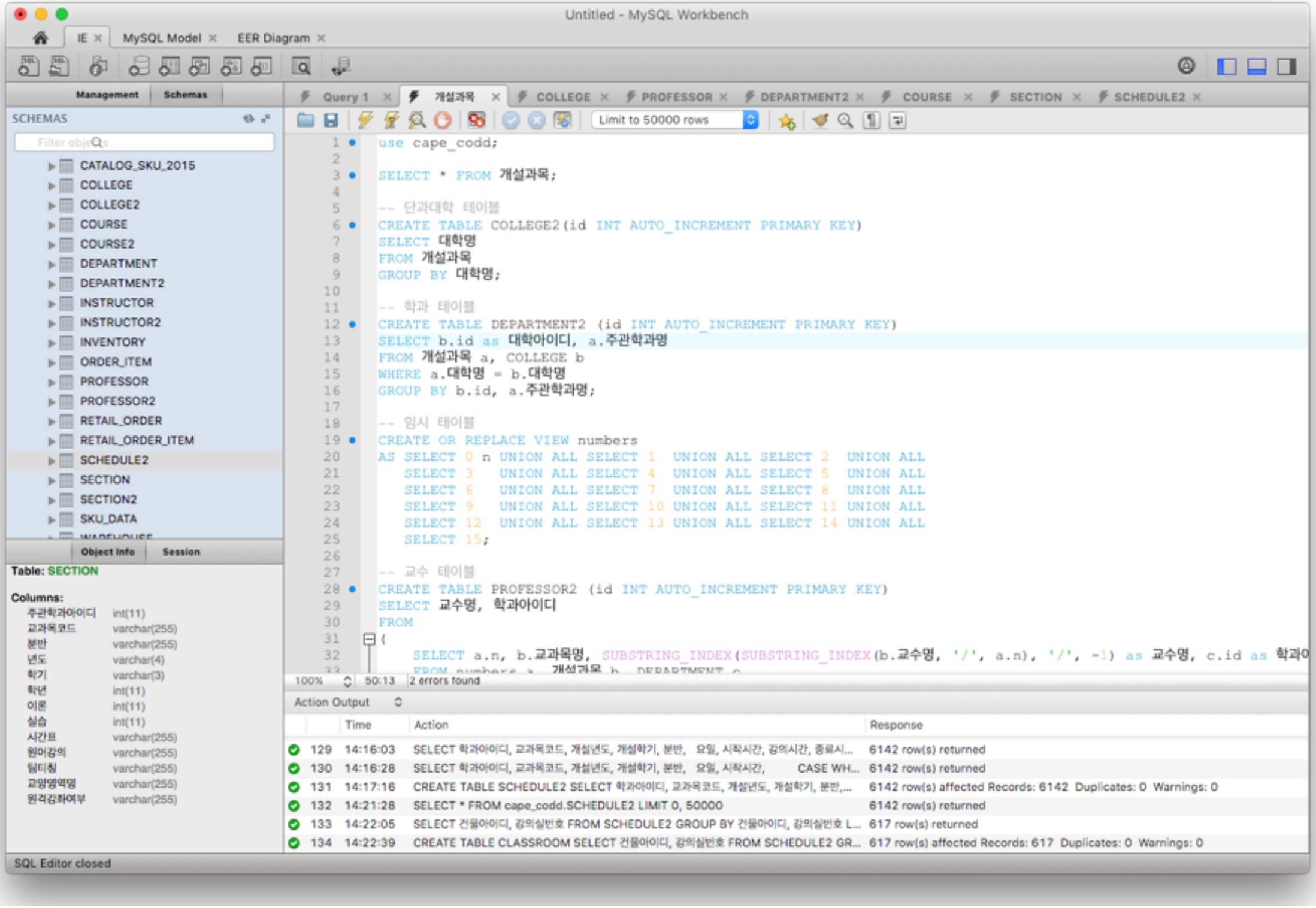
SQL ELEMENTS

- The figure summarizes the new SQL DDL and DML statements described in this chapter.

SQL Elements Discussed in Chapter 7
• SQL Data Definition Language (DDL)
— CREATE TABLE
— ALTER TABLE
— DROP TABLE
— TRUNCATE TABLE
• SQL Data Manipulation Language (DML)
— INSERT
— UPDATE
— DELETE
— MERGE

• SQL Views
— CREATE VIEW
— ALTER VIEW
— DROP VIEW
• SQL/Persistent Stored Modules (SQL/PSM)
— Functions
— Triggers
— Stored Procedures

ORACLE MYSQL WORKBENCH



CREATE TABLE STATEMENT IN MYSQL

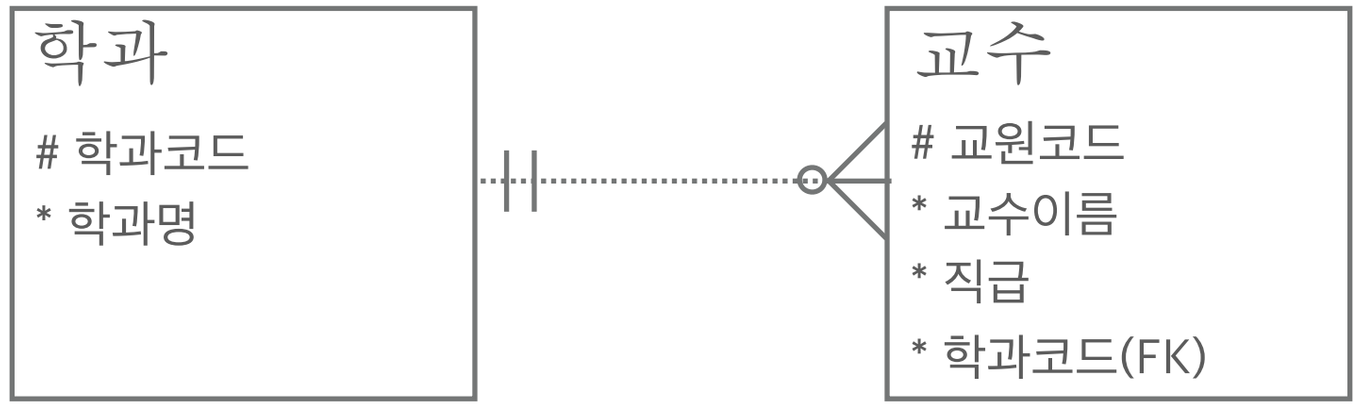
```
CREATE [TEMPORARY] TABLE [IF NOT EXISTS] tbl_name
    (create_definition,...)
    [table_options]
    ...
```

- Variations in SQL Data Types (INT, VARCHAR, DATETIME)
  - [MySQL 5.6 Data types] (http://dev.mysql.com/doc/refman/5.6/en/data-types.html)
- Optional Constraint (NOT NULL, DEFAULT, AUTO_INCREMENT)
  - [MySQL 5.6 Data Properties] (http://dev.mysql.com/doc/refman/5.6/en/create-table.html#create-table-types-attributes)
- Optional Table constraint (PRIMARY KEY, UNIQUE, FOREIGN KEY, INDEX)
  - [MySQL 5.6 Indexes and Foreign Keys] (http://dev.mysql.com/doc/refman/5.6/en/create-table.html#create-table-indexes-keys)

CONSTRAINTS

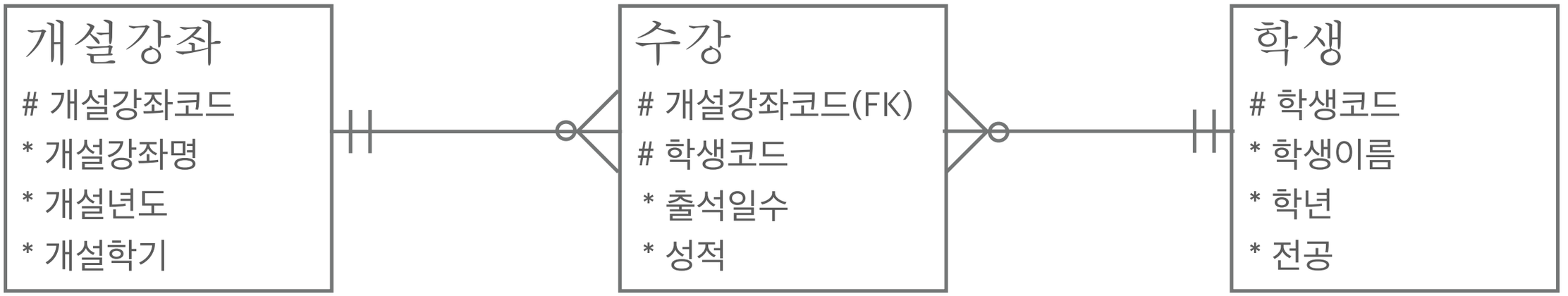
- Constraints can be defined within the CREATE TABLE statement, or they can be added to the table after it is created using the ALTER table statement.
- Five types of constraints:
  - PRIMARY KEY may not have null values
  - UNIQUE may have null values
  - NULL/NOT NULL
  - FOREIGN KEY
  - CHECK
    - The CHECK clause is parsed but ignored by all storage engines in MySQL 5.6.

INDEX




```
SELECT a.교수이름, a.직급, b.학과명
FROM 교수 a, 학과 b
WHERE a.학과코드 = b.학과코드
```

```
Index
1. 학과 PRIMARY KEY 학과코드
2. 교수 PRIMARY KEY 교원코드
```




```
SELECT b.학생이름, a.출석일수, a.성적
FROM 수강 a LEFT OUTER JOIN 학생 b
        ON a.학생코드 = b.학생코드
WHERE b.전공 = '산업공학과'
AND a.성적 > '90'
```

```
Index
1. 학생 PRIMARY KEY 학생코드
2. 학생 INDEX 전공
3. 수강 PRIMARY KEY
        (개설강좌코드, 학생코드)
4. 수강 INDEX (학생코드, 성적)
```

RELATIONSHIP

- The parent were required: you must define the referential integrity constraint and set the foreign key to NOT NULL in the child table.
- The parent were not required: you would specify the foreign key in the child table as NULL.
- It is appropriate to create a foreign key column but not specify a FOREIGN KEY constraint.

Relationship Type	CREATE TABLE Constraints
1:N relationship, parent optional	Specify FOREIGN KEY constraint. Set foreign key NULL.
1:N relationship, parent required	Specify FOREIGN KEY constraint. Set foreign key NOT NULL.
1:1 relationship, parent optional	Specify FOREIGN KEY constraint. Specify foreign key UNIQUE constraint. Set foreign key NULL.
1:1 relationship, parent required	Specify FOREIGN KEY constraint. Specify foreign key UNIQUE constraint. Set foreign key NOT NULL.
Casual relationship	Create a foreign key column, but do not specify FOREIGN KEY constraint. If relationship is 1:1, specify foreign key UNIQUE.

DATABASE DESIGN RELATIONSHIP

Relationship		Cardinality		
Parent	Child	Type	Max	Min
과목	개설과목	Identifying	1:N	M-O
교수	학생	Nonidentifying	1:N	M-O
학과	교수	Nonidentifying	1:N	M-O
교수	강의자	Identifying	1:N	M-O
대학	학과	Nonidentifying	1:N	M-O

대학 is Required Parent	Action on 대학 (parents)	Action on 학과 (child)
Insert	None	Get a parent
Modify key or foreign key	Prohibit – 대학 uses a surrogate key.	Prohibit – 대학 uses a surrogate key.
Delete	Prohibit if 학과 exists – data about a 학과 and its related transaction is never deleted (business rule). Allow if no 학과 exists (business rule).	None.

From Team A

CREATE TABLE STATEMENT

```
CREATE TABLE `대학` (
  `id` int(11) NOT NULL AUTO_INCREMENT,
  `대학명` varchar(255) NOT NULL DEFAULT '미정',
  PRIMARY KEY (`id`),
  UNIQUE KEY `대학명_UNIQUE` (`대학명`)
) ENGINE=InnoDB AUTO_INCREMENT=1 DEFAULT CHARSET=utf8;
```

```
CREATE TABLE `학과` (
  `id` int(11) NOT NULL AUTO_INCREMENT,
  `대학아이디` int(11) NOT NULL DEFAULT '0',
  `주관학과명` varchar(45) NOT NULL DEFAULT '미정',
  PRIMARY KEY (`id`),
  UNIQUE KEY `주관학과명_UNIQUE` (`주관학과명`),
  KEY `fk_DEPARTMENT_COLLEGE_idx` (`대학아이디`),
  CONSTRAINT `fk_DEPARTMENT_COLLEGE` FOREIGN KEY (`대학아이디`) REFERENCES
`COLLEGE` (`id`) ON DELETE NO ACTION ON UPDATE NO ACTION
) ENGINE=InnoDB AUTO_INCREMENT=165 DEFAULT CHARSET=utf8;
```

ALTER TABLE STATEMENT

- ALTER TABLE statement changes table structure, properties, or constraints after it has been created.

```
ALTER TABLE ASSIGNMENT
    ADD CONSTRAINT EmployeeFK
        FOREIGN KEY (EmployeeNumber)
        REFERENCES EMPLOYEE (EmployeeNumber)
            ON UPDATE CASCADE ON DELETE NO ACTION;
```

- Adding and Dropping Columns
  - The following statement will add a column named MyColumn to the CUSTOMER table:

```
ALTER TABLE CUSTOMER DROP COLUMN MyColumn;
```

  - You can drop an existing column with the statement:

```
ALTER TABLE CUSTOMER ADD MyColumn Char(5) NULL;
```

REMOVING TABLES

- SQL DROP TABLE:

```
DROP TABLE TRANS;
```

- If there are constraints:

```
ALTER TABLE CUSTOMER_ARTIST_INT
        DROP CONSTRAINT  Customer_Artist_Int_CustomerFK;
ALTER TABLE TRANS
        DROP CONSTRAINT  TransactionCustomerFK;
DROP TABLE CUSTOMER;
```

- Removing Data Only

```
TRUNCATE TABLE TRANS;
```

  - Cannot be used with a table that is referenced by a foreign key constraint.

SQL DML—INSERT, UPDATE, DELETE

- SQL INSERT statement:

```
INSERT INTO ARTIST (LastName, FirstName, Nationality, DateOfBirth, DateDeceased)
VALUES ('Tamayo', 'Rufino', 'Mexican', 1899, 1991);
```

- Bulk INSERT:

```
INSERT INTO ARTIST (LastName, FirstName, Nationality, DateOfBirth)
SELECT LastName, FirstName, Nationality, DateOfBirth
FROM    IMPORTED_ARTIST;
```

- SQL UPDATE statement:

```
UPDATE  CUSTOMER SET City = 'New York City' WHERE CustomerID = 1000;
```

- SQL DELETE statement:

```
DELETE FROM CUSTOMER WHERE   CustomerID = 1000;
```

  - If you omit the WHERE clause, you will delete every row in the table.

VIEW

```
CREATE VIEW view_name [(column_list)]
    AS select_statement
```

- An SQL view is a virtual table that is constructed from other tables or views.
- It has no data of its own, but obtains data from tables or other views.
- SELECT statements are used to define views:
  - A view definition may not include an ORDER BY clause.
- CREATE VIEW Syntax in MySQL 5.6 (http://dev.mysql.com/doc/refman/5.6/en/create-view.html)

USING SQL VIEWS

- **Hide Columns and Rows**: to hide columns to simplify results or to prevent the display of sensitive data.
- **Computed Columns**: to show the results of computed columns without requiring the user to enter the computation expression.
- **Hide Complicated SQL**: Developers need not enter a complex SQL statement when they want a particular result.
- **Built-in Function**: to compute a variable and then write an SQL statement on that view that uses the computed variable in a WHERE clause.
- SQL Views also have three other important uses.
  - To isolate source data tables from application code
  - To give different sets of processing permissions to the same table
  - to enable the definition of multiple sets of triggers on the same data source

EMBEDDING SQL IN PROGRAM CODE

- SQL statements can be embedded in application programs, triggers, and stored procedures.
- There are two problems to be solved
  - Problem 1: assigning SQL table columns with program variables
  - Solution: object-oriented programming, PL/SQL
  - Problem 2: paradigm mismatch between SQL and application programming language:
    - SQL statements return sets of rows; an application works on one row at a time
  - Solution: process the SQL results as pseudo-files:
    - SQL cursors are used to select one row at a time from pseudo-files.

USER-DEFINED FUNCTIONS

```
CREATE FUNCTION function_name (arguments)
     RETURNS data_type
```

- SPLIT Function (UDF) in MySQL 5.6

```
CREATE FUNCTION `SPLIT`(
  x VARCHAR(255),
  delimiter VARCHAR(12),
  pos INT
) RETURNS VARCHAR(255) CHARSET utf8
RETURN REPLACE(SUBSTRING(SUBSTRING_INDEX(x, delimiter, pos),
       CHAR_LENGTH(SUBSTRING_INDEX(x, delimiter, pos -1)) + 1),
       delimiter, '')
```

- CREATE FUNCTION Syntax in MySQL 5.6 (http://dev.mysql.com/doc/refman/5.6/en/create-function-udf.html)

TRIGGERS

- A trigger is a stored program that is executed by the DBMS whenever a specified event occurs on a specified table or view.
- Three trigger types:
  BEFORE, INSTEAD OF, and AFTER
  - Each type can be declared for Insert, Update, and Delete.
  - Resulting in a total of nine trigger types.
  - MySQL 5.6 supports two trigger types (BEFORE and AFTER).
- The four uses are as follows:
  - Providing default values
  - Enforcing data constraints
  - Updating SQL views
  - Performing referential integrity actions

STORED PROCEDURES

- A stored procedure is a program that is stored within the database and is compiled when used.
  - In Oracle, it can be written in PL/SQL or Java.
  - In SQL Server, it can be written in TRANSACT-SQL.
- Stored procedures can receive input parameters and they can return results.
- Stored procedures can be called from many program languages
- Greater security as stored procedures are always stored on the database server
- Decreased network traffic
- SQL can be optimized by the DBMS compiler
- Code sharing resulting in:
  - Less work
  - Standardized processing
  - Specialization among developers