Introduction to SQL

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https://sites.google.com/view/seoultech-bigdata

Most parts are based on slides used in Stanford (http://web.stanford.edu/class/cs145)

Today’s Lecture

1. SQL introduction & schema definitions

2. Basic single-table queries

3. Multi-table queries

1. SQL Introduction & Definitions

What you will learn about in this section

1. What is SQL?
2. Basic schema definitions
3. Keys & constraints intro
4. ACTIVITY: CREATE TABLE statements

SQL Motivation

- **Dark times 5 years ago.**
  - Are databases dead?

- **Now, as before: everyone sells SQL**
  - Pig, Hive, Impala

- **“Not-Yet-SQL?”**

Basic SQL

SQL Introduction

- **SQL is a standard language for querying and manipulating data**

- **SQL is a very high-level programming language**
  - This works because it is optimized well!

- **Many standards out there:**
  - ANSI SQL, SQL92 (a.k.a. SQL2), SQL99 (a.k.a. SQL3), ….
  - Vendors support various subsets

SQL stands for
Structured **Q**uery **L**anguage

SQL is a…

Data Definition Language (DDL)

- Define relational *schemata*
- Create/alter/delete tables and their attributes

Data Manipulation Language (DML)

- Insert/delete/modify tuples in tables
- Query one or more tables

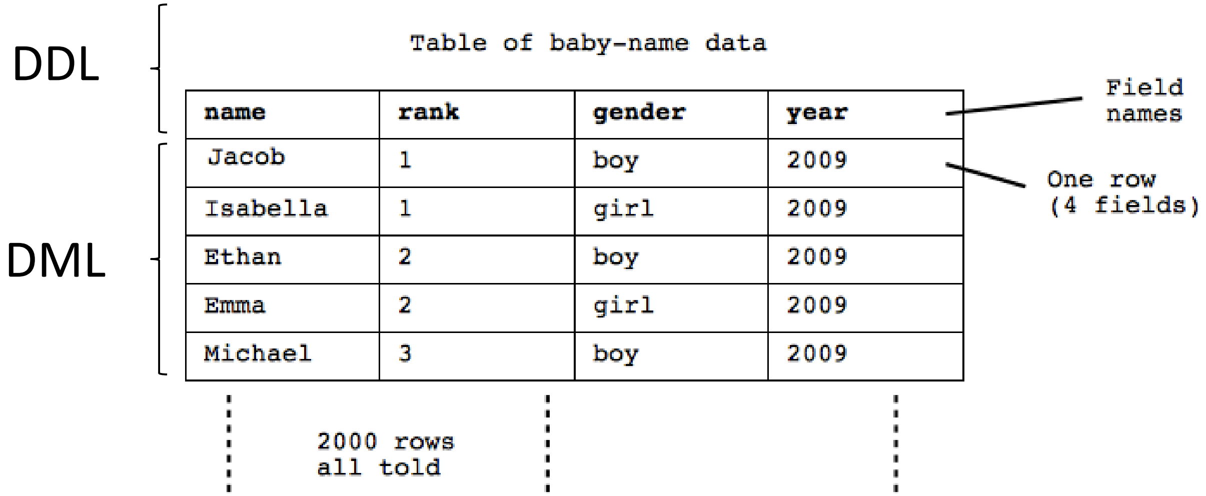

Table of baby-name data

name	rank	gender	year
Jacob	1	boy	2009
Isabella	1	girl	2009
Ethan	2	boy	2009
Emma	2	girl	2009
Michael	3	boy	2009

DDL
DML
Field names
One row (4 fields)
2000 rows all told

Tables in SQL

Product

PName	Price	Manufacturer
Gizmo	$19.99	GizmoWorks
Powergizmo	$29.99	GizmoWorks
SingleTouch	$149.99	Canon
MultiTouch	$203.99	Hitachi

A **relation** or **table** is a multiset of tuples having the attributes specified by the schema

Let's break this definition down

Tables in SQL

Product

PName	Price	Manufacturer
Gizmo	$19.99	GizmoWorks
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SingleTouch	$149.99	Canon
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A **multiset** is an unordered list (or: a set with multiple duplicate instances allowed)

List:	[1, 1, 2, 3]
Set:	{1, 2, 3}
Multiset:	{1, 1, 2, 3}

Tables in SQL

Product

PName	Price	Manufacturer
Gizmo	$19.99	GizmoWorks
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An **attribute** (or **column**) is a typed data entry present in each tuple in the relation

Attributes must have an ***atomic*** *type in standard SQL, i.e. not a list, set, etc.*

Tables in SQL

Product

PName	Price	Manufacturer
Gizmo	$19.99	GizmoWorks
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A **tuple** or **row** is a single entry in the table having the attributes specified by the schema

Also referred to sometimes as a ***record***

Tables in SQL

Product

PName	Price	Manufacturer
Gizmo	$19.99	GizmoWorks
Powergizmo	$29.99	GizmoWorks
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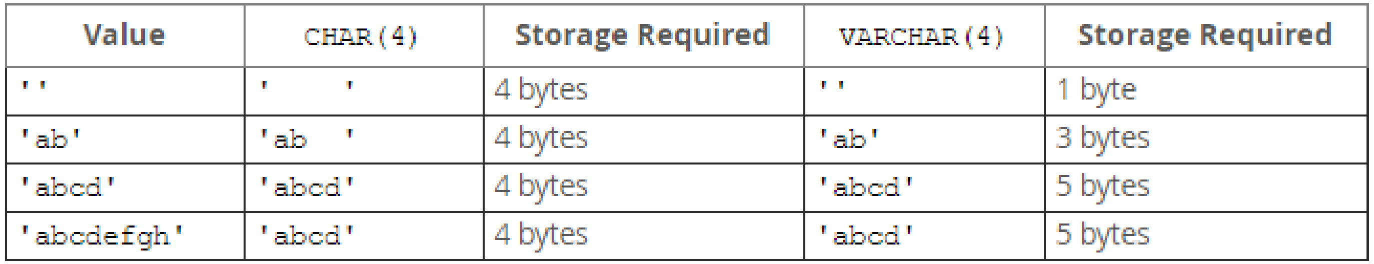
The number of tuples is the **cardinality** of the relation

The number of attributes is the **arity** of the relation

Data Types in SQL

- **Atomic types:**
  - Characters: CHAR(20), VARCHAR(50)
  - Numbers: INT, BIGINT, SMALLINT, FLOAT
  - Others: MONEY, DATETIME, …

- **Every attribute must have an atomic type**
  - Hence tables are flat



Value	CHAR(4)	Storage Required	VARCHAR(4)	Storage Required
''	' '	4 bytes	''	1 byte
'ab'	'ab '	4 bytes	'ab'	3 bytes
'abcd'	'abcd'	4 bytes	'abcd'	5 bytes
'abcdefgh'	'abcd'	4 bytes	'abcd'	5 bytes

Study more: https://dev.mysql.com/doc/refman/5.7/en/char.html

Table Schemas

- **The schema of a table is the table name, its attributes, and their types:**

Product(Pname: *string*, Price: *float*, Category: *string*, Manufacturer: *string*)

- **A key is an attribute whose values are unique; we underline a key**

Product(Pname: *string*, Price: *float*, Category: *string*, Manufacturer: *string*)

NULL and NOT NULL

- **To say “don’t know the value” we use NULL**
  - NULL has (sometimes painful) semantics, more detail later

Students(sid:string, name:string, gpa: float)

sid	name	gpa
123	Bob	3.9
143	Jim	NULL

Say, Jim just enrolled in his first class.

In SQL, we may constrain a column to be NOT NULL, e.g., “name” in this table

General Constraints

- **We can actually specify arbitrary assertions**
  - E.g. *“There cannot be 25 people in the DB class”*

- **In practice, we don’t specify many such constraints. Why?**
  - Performance!

Whenever we do something ugly (or avoid doing something convenient) it’s for the sake of performance

Summary of Schema Information

- **Schema and Constraints are how databases understand the semantics (meaning) of data**

- **They are also useful for optimization**

- **SQL supports general constraints:**
  - Keys and foreign keys are most important

Oracle Practice #1

Install Oracle databases

- Recommend desktop environments
- Windows version
  - https://www.oracle.com/database/technologies/oracle12c-windows-downloads.html
- Try to choose other installation options

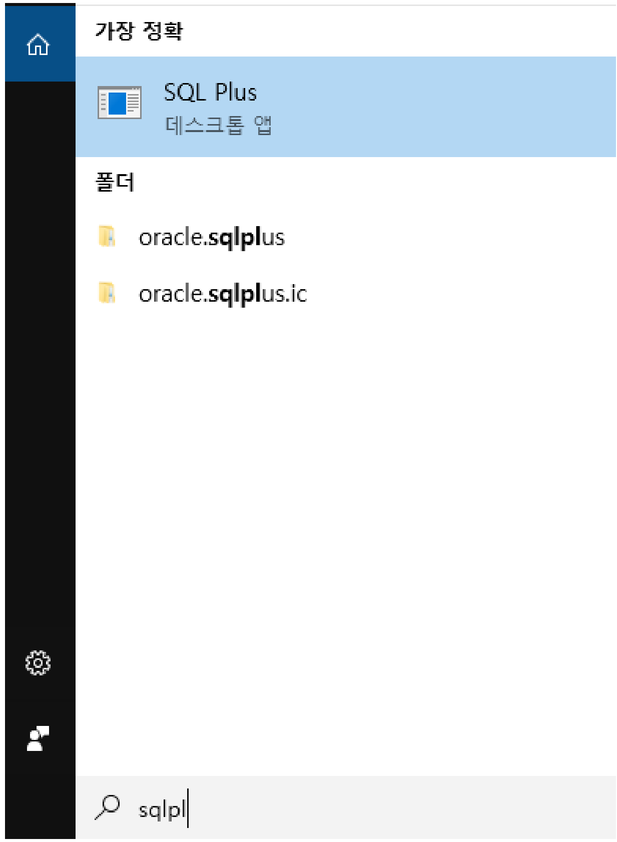
Alternatives

- Find new environments
  - E.g., laptop -> desktop, having more memories
- Virtual machines
  - If you want to use different operating systems such as Windows or Linux, e.g., from Mac, install virtual machines such as VMware or VirtualBox where you can install Windows or Linux and then install Oracle databases
- Use cloud services such as Amazon AWS, Google GCP, MS Azure with free credit
  - E.g., Amazon RDS for Oracle

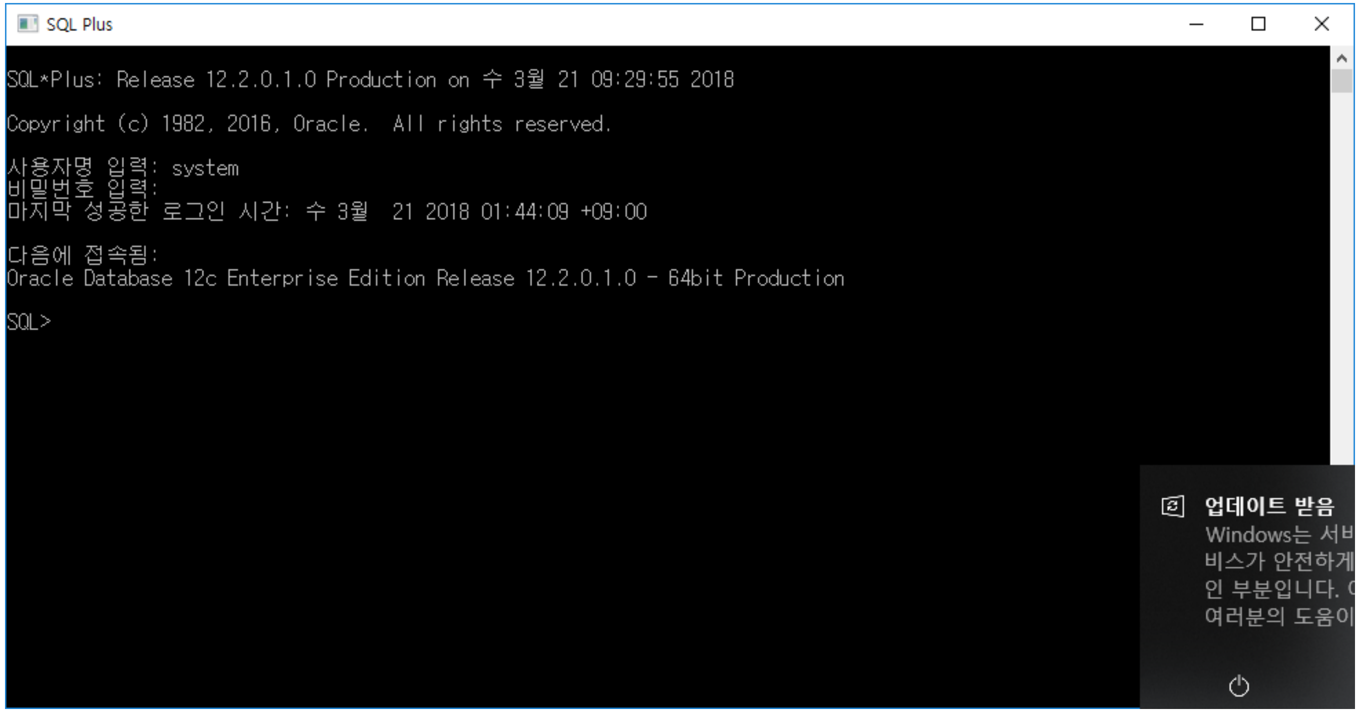
Oracle Practice #1

Start Oracle

- Execute SQL Plus



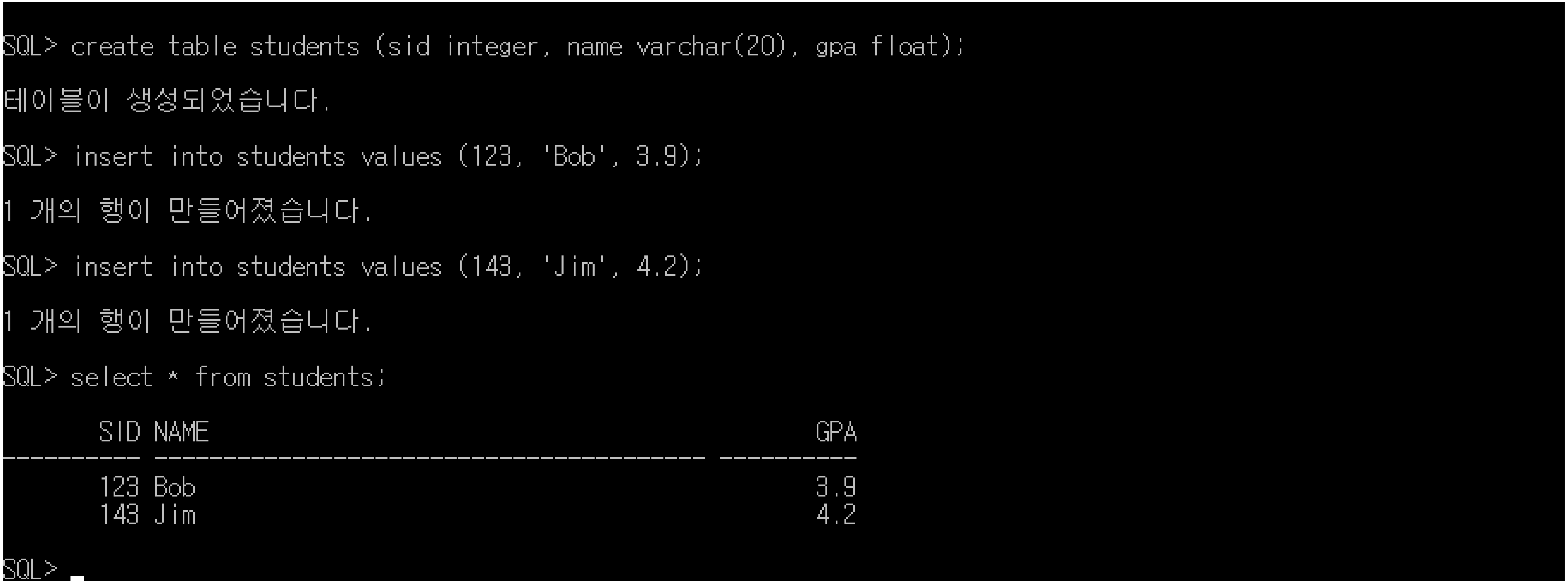
- User Authentication
  - ID: system
  - Password: oraclepractice



```
SQL*Plus: Release 12.2.0.1.0 Production on 수 3월 21 09:29:55 2018

Copyright (c) 1982, 2016, Oracle.  All rights reserved.

사용자명 입력: system
비밀번호 입력:
마지막 성공한 로그인 시간: 수 3월  21 2018 01:44:09 +09:00

다음에 접속됨:
Oracle Database 12c Enterprise Edition Release 12.2.0.1.0 - 64bit Production

SQL>
```

Oracle Practice #1

Test Oracle



```
SQL> create table students (sid integer, name varchar(20), gpa float);

테이블이 생성되었습니다.

SQL> insert into students values (123, 'Bob', 3.9);

1 개의 행이 만들어졌습니다.

SQL> insert into students values (143, 'Jim', 4.2);

1 개의 행이 만들어졌습니다.

SQL> select * from students;

       SID NAME                                            GPA
---------- ---------------------------------------- ----------
       123 Bob                                             3.9
       143 Jim                                             4.2

SQL>
```

Oracle Practice #1

Test yourself

- Make the following table using CREATE TABLE

Product

PName	Price	Manufacturer
Gizmo	$19.99	GizmoWorks
Powergizmo	$29.99	GizmoWorks
SingleTouch	$149.99	Canon
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Oracle Practice #1

Build database with real data

1. Download ACDB.sql from e-class
2. Copy ACDB.sql into a specific folder (e.g., c:/work/ACDB.sql)
3. In SQLPlus, execute the following command
   - @c:/work/ACDB.sql
   - If some problems occur, execute the following command, and then execute the command above again
     - alter session set nls_language="AMERICAN";
4. Check if data are stored correctly
   - select * from ACDB_SECTORS;
   - select * from ACDB_PACKAGES;
   - select * from ACDB_CUSTOMERS;