Databases – the generations

Bipin C. DESAI

Pl. see: https://users.encs.concordia.ca/~bcdesai/CopyForward.pdf

FIRST GENERATION

1950s –Refinement of storage media, magnetic tape, drums, disks

Early 1960s: Disk access method based on
Index Sequential Access Method(ISAM)

Mid 1960s:Emergence - Information Management System(IMS)-IBM
developed in 1966 along with NASA(Rockwell and Caterpillar)
to support the Apollo/Saturn V program

Current version is IMS 15.4 and runs on IBM z platform

It is still being marketed, used in banking etc.
promises > $250*10^9$ transactions per day

1959 : CODASYL(**Conf./Committee on Data Systems Languages)**
later to become **Database Task Group (**DBTG),
DBTG developed the network model and its implementation
Integrated Data Store (IDS),
Integrated Database Management System (IDMS)
both still marketed and supported.

SECOND GENERATION

1970 Codd's paper about relations

1973/1974 Ingres(UC Berkley, M. Stonebraker, E.Wong)

System R(IBM), Berkley/DB (Sleepy Cat Software, Oracle)

QUEL, SEQUEL(Ingres) and SQL(System R)

1978 Oracle

1981 Informix (IBM)

1984 System R(IBM)

1987 Postgres

1993 mSQL (mini SQL by D. Hughes)

mSQL used in the development of early dynamic Web applications including CrsMgr and ConfSys

1995 MySQL - bought by Sun in 2008 price- $1billion

– Sun was taken over by Oracle

2009 Mariadb – a fork of MySQL

THIRD GENERATION

2004 MapReduce paradigm shift to lower level!
Map(distribute tasks to nodes to filter local data) and then Reduce(process result in parallel)
2005 Hadoop (Apache)
2008 Cassandra, Hbase,
2009 MongoDB

Simple SQLPlus & SQL

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Getting & Installing {Apache, Oracle, PHP} or, XAMPP

Consult:

http://www.oracle.com/technology/tech/php/htdocs/inst_php_apache_windows.html
or whatever is the currrent URL
For Oracle you need to register with OTN

MySQL/Mariadb

https://www.apachefriends.org/download.php

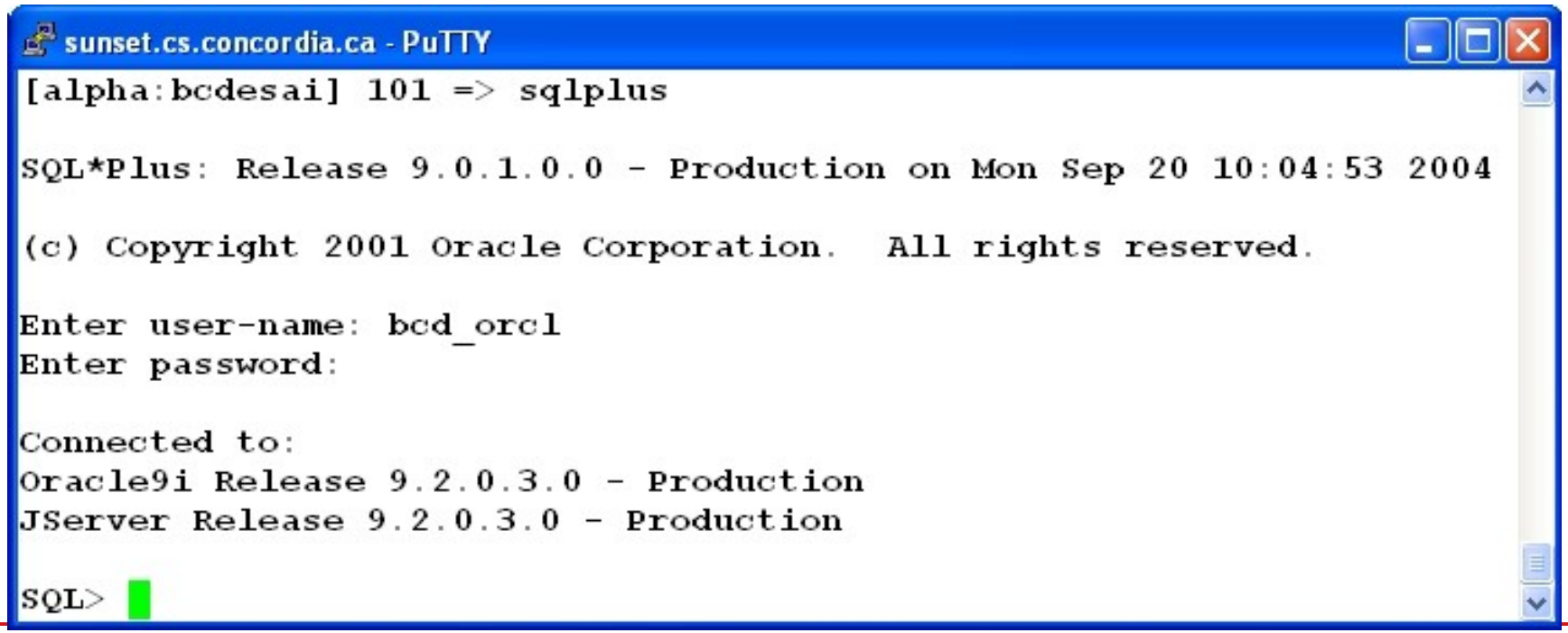
The projects are to be demonstrated on one of the systems in our labs.
So if you develop the projects on your own systems, make sure you could:

- Upload all the code to CrsMgr
- Have it run on one of AITS systems which has one of the above configurations
- It works as specified

These notes uses Oracle, MySQL, MariaDB

Connecting to SQLPlus

SQLPlus is a “user friendly interface” to ORACLE SQL to be used interactively.
You need Oracle USERID/PASSWORD and appropriate permission to a Oracle DB.
May connect remotely using a secure shell (e.g., Putty)

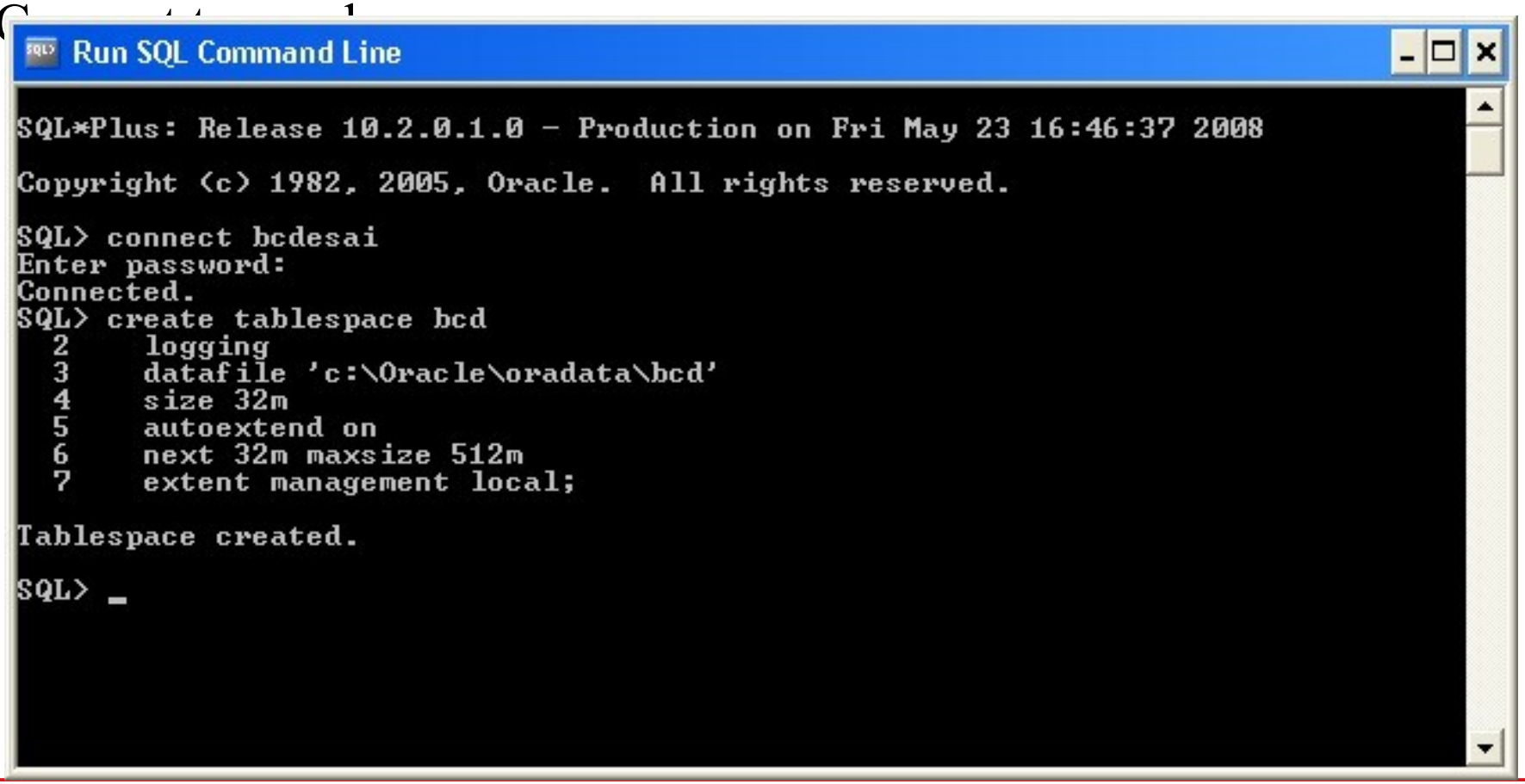


Download and install Oracle (the version changes over time)

Typically - start database (unless it has been installed as service which starts on boot)

From Start select RunSQL command line

C



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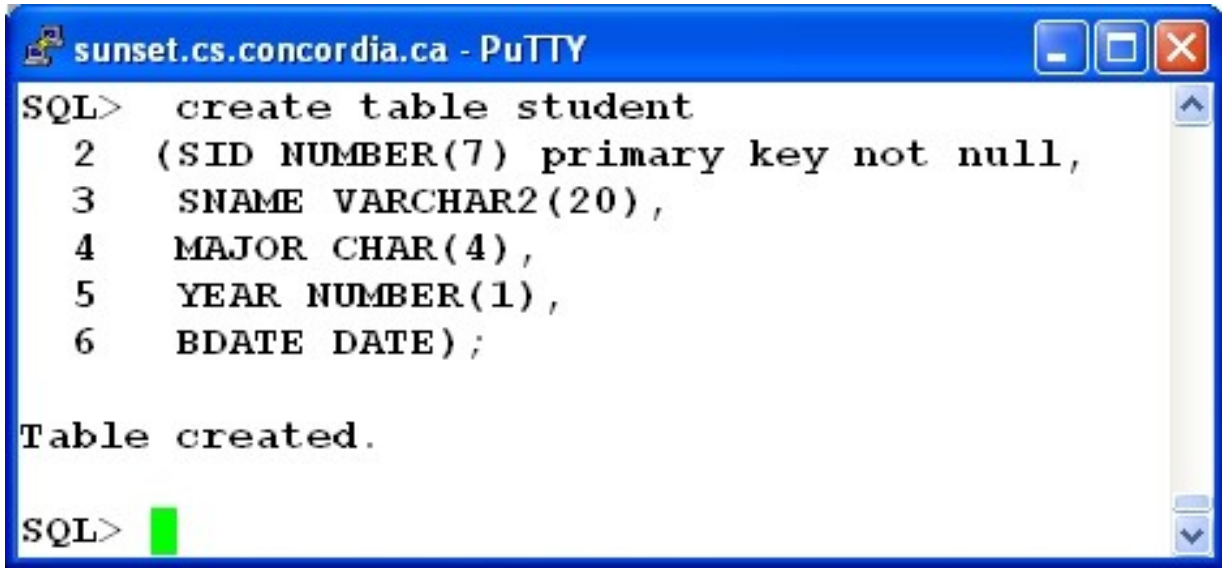
```
create table student
(SID NUMBER(7) primary key not null,
 SNAME VARCHAR2(20),
 MAJOR CHAR(4),
 YEAR NUMBER(1),
 BDATE DATE)
 tablespace bcd pctfree 2;
```

To execute a text file containing sql statements interactively from the sql prompt use @ followed by the full path to file

sql>@student.sql



Connecting to MySQL/MariaDB

MySQl/Mariadb has a simpler text based interface
used for connecting to the database
running locally or on a server accessed using a terminal emulator
Putty is one used in WinX

Again the DB server must be running and one needs
a user ID and password for the database to be used

shell> mysql –u username –p password

If the ID/PW are correct, one gets the prompt from the database

```
Enter password:
Welcome to the MariaDB monitor.  Commands end with ; or \g.
Your MariaDB connection id is 96773
Server version: 10.3.17-MariaDB MariaDB Server

Copyright (c) 2000, 2018, Oracle, MariaDB Corporation Ab and
others.

Type 'help;' or '\h' for help. Type '\c' to clear the current input
statement.

MariaDB [(none)]> connect test;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Connection id:    29348
Current database: test
```

```
mysql> create table student
(SID DECIMAL(7) primary key not null,
 SNAME VARCHAR (20),
 MAJOR CHAR(4),
 YEAR DEC(1),
 BDATE DATE);
```

To execute a text file containing sql statements interactively from the sql prompt use @ followed by the full path to file

sql>@student.sql

in MySQL use "source student.sql"

```
mysql> desc student;
+-------+-------------+------+-----+---------+-------+
| Field | Type        | Null | Key | Default | Extra |
+-------+-------------+------+-----+---------+-------+
| SID   | decimal(7,0) | NO   | PRI | NULL    |       |
| SNAME | varchar(20)  | YES  |     | NULL    |       |
| MAJOR | char(4)      | YES  |     | NULL    |       |
| YEAR  | decimal(1,0) | YES  |     | NULL    |       |
| BDATE | date         | YES  |     | NULL    |       |
+-------+-------------+------+-----+---------+-------+
5 rows in set (0.00 sec)
```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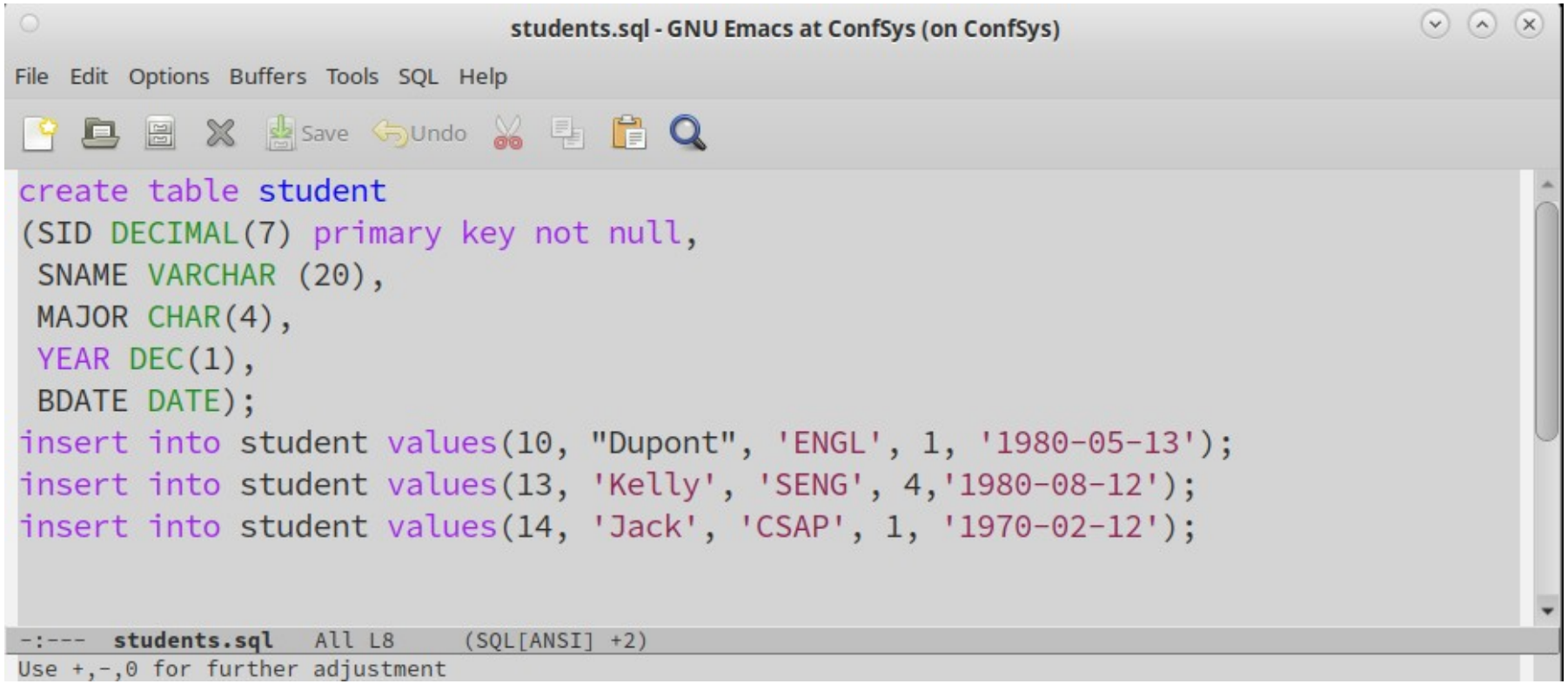
Inserting Data in a table – table must exist!

sunset.cs.concordia.ca - PuTTY

```
SQL> insert into student values(8,'Brenda','COMP','2','13-AUG-77');

1 row created.

SQL> insert into student values(10,'Dupont','ENGL','1','13-MAY-80');

1 row created.

SQL> insert into student values(13,'Kelly','SENG','4','12-AUG-80');

1 row created.

SQL> insert into student values(14,'Jack','CSAP','1','12-FEB-77');

1 row created.

SQL>
```

Date format in MySQL is yyyy-mm-dd;
Value order as in schema for the table
MariaDB [test]> insert into student values(8, 'Brenda', 'COMP', 2, '1977-8-13');

```
MariaDB [test]> \! tcsh   -- escape to interative shell (tcsh)
101 => emacs -nw students.sql
 104 => more students.sql
insert into student values(10, "Dupont", 'ENGL', 1, '1980-05-13');
insert into student values(13, 'Kelly', 'SENG', 4,'1980-08-12');
insert into student values(14, 'Jack', 'CSAP', 1, '1970-02-12');
 105 => exit
exit
MariaDB [test]>system cat students.sql;
create table student
(SID DECIMAL(7) primary key not null,
 SNAME VARCHAR (20),
 MAJOR CHAR(4),
 YEAR DEC(1),
 BDATE DATE);
insert into student values(10, "Dupont", 'ENGL', 1, '1980-05-13');
insert into student values(13, 'Kelly', 'SENG', 4,'1980-08-12');
insert into student values(14, 'Jack', 'CSAP', 1, '1970-02-12');
MariaDB [test]>
```


students.sql - GNU Emacs at ConfSys (on ConfSys)
File Edit Options Buffers Tools SQL Help
Save Undo
create table student
(SID DECIMAL(7) primary key not null,
SNAME VARCHAR (20),
MAJOR CHAR(4),
YEAR DEC(1),
BDATE DATE);
insert into student values(10, "Dupont", 'ENGL', 1, '1980-05-13');
insert into student values(13, 'Kelly', 'SENG', 4,'1980-08-12');
insert into student values(14, 'Jack', 'CSAP', 1, '1970-02-12');
-:--- students.sql All L8 (SQL[ANSI] +2)
Use +,-,0 for further adjustment

```
MariaDB [test]>
MariaDB [test]> source students.sql;
Query OK, 1 row affected (0.028 sec)
Query OK, 1 row affected (0.050 sec)
Query OK, 1 row affected (0.050 sec)

MariaDB [test]> select * from student;
+-----+--------+-------+------+------------+
| SID | SNAME  | MAJOR | YEAR | BDATE      |
+-----+--------+-------+------+------------+
|  10 | Dupont | ENGL  |    1 | 1980-05-13 |
|  13 | Kelly  | SENG  |    4 | 1980-08-12 |
|  14 | Jack   | CSAP  |    1 | 1970-02-12 |
+-----+--------+-------+------+------------+
3 rows in set (0.001 sec)

MariaDB [test]>
```

Find all students (ORACLE)

SQL> select * from student;

```
       SID  SNAME                MAJO       YEAR BDATE
---------- -------------------- ---- ---------- ---------
         8 Brenda               COMP          2 13-AUG-77
        10 Dupont               ENGL          1 13-MAY-80
        13 Kelly                SENG          4 12-AUG-80
        14 Jack                 CSAP          1 12-FEB-77
```

```
SQL>column major format a5
SQL>column sid format 9,9
SQL>column sname format a12
SQL>column major format a5
SQL>column year format 999
SQL>column bdate format a12
```

format not available in MySQL

```
SID  SNAME        MAJOR YEAR BDATE
---- ---------- ----- ---- ---------
   8 Brenda     COMP     2 13-AUG-77
 1,0 Dupont     ENGL     1 13-MAY-80
 1,3 Kelly      SENG     4 12-AUG-80
 1,4 Jack       CSAP     1 12-FEB-77
```

```
MariaDB [test]> select * from student;
+-----+--------+-------+------+------------+
| sid | sname  | major | year | bdate      |
+-----+--------+-------+------+------------+
|   8 | Brenda | COMP  |    2 | 1997-08-13 |
|  10 | Dupont | ENGL  |    1 | 1980-05-13 |
|  13 | Kelly  | SENG  |    4 | 1980-08-12 |
|  14 | Jack   | CSAP  |    1 | 1970-02-12 |
+-----+--------+-------+------+------------+
4 rows in set (0.001 sec)
```

```
select s.sname
from student s
where to_date(s.bdate) like '%13%';
```

```
SNAME
----------
Brenda
Dupont
```

```
select s.sname
from student s
where s.bdate like '%13%';
+--------+
| sname  |
+--------+
| Brenda |
| Dupont |
+--------+
2 rows in set (0.000 sec)
```

SQL script: date.sql

Find students born in August

```
select s.sname
from student s
where to_date(s.bdate) like '%AUG%';
```

```
SNAME
----------
Brenda
Kelly
```

```
select s.sname
from student s
where s.bdate like '%-08-%';
+--------+
| sname  |
+--------+
| Brenda |
| Kelly  |
+--------+
2 rows in set(0.000 sec)
```

SQL script: month.sql

Find student born in 1977

```
select s.sname
from student s
where to_date(s.bdate) like '%77%';
```

```
SNAME
-----------
Brenda
Jack
```

SQL script: year.sql

```
select s.sname  from student s
where s.bdate like '%80-%';
+---------+
| sname   |
+---------+
| Dupont  |
| Kelly   |
+---------+
2 rows in set (0.001 sec)
```

```
create table dept
(DEPT CHAR(20) not null,
 CODE CHAR(4) primary key not null);

insert into dept values('Computer Science', 'COMP');
insert into dept values('Decision Science', 'DISC');

create table deptmajor
(CODE CHAR(4),
 MAJOR CHAR(20),
primary key (CODE, MAJOR))

insert into deptmajor values('COMP', 'COTH');
insert into deptmajor values('COMP', 'SENG');
insert into deptmajor values('COMP', 'CSAP');
insert into deptmajor values('DISC', 'OPRS');
```

```
create table course
(CNAME CHAR(20),
 CNUMBER CHAR(8) primary key NOT NULL,
 CREDITS NUMBER(2),
 ODEPT CHAR(4),
 foreign key (ODEPT) references dept(code)
 on delete cascade)

insert into course values('C++','COMP248',3,'COMP');
insert into course values('DATA STRUCTURES ','COMP352',3,
 'COMP');
insert into course values('OPERATING SYSTEMS','COMP346',4
,'COMP');
insert into course values('DATABASE','COMP353',4,'COMP');
insert into course values('Operation Research','DISC253',4,'DISC');
```

```
create table crs_section
(SECID NUMBER(6) primary key NOT NULL,
 COURSE_NUM CHAR(8),
 SECTION CHAR(2),
 SEMESTER CHAR(4),
 YEAR CHAR(4),
 SCHEDULE CHAR(10),
 ROOM CHAR(7));

insert into crs_section values
(85,'COMP352','A','FALL', '1998','TH16001715','H123');
insert into crs_section values
(90,'COMP353','B','FALL','1999','MW08451000','H631');
insert into crs_section values
(95,'DISC253','B','FALL','1999','MW10151130','H631');
```

```
create table prereq
(COURSE_Number CHAR(8),
 PREREQ CHAR(8),   primary key (course_number, prereq));
insert into prereq values('COMP353','COMP352');

insert into prereq values('COMP353','COMP346');
insert into prereq values('COMP352','COMP248');

create table enrollment
(STUDENT_NUMBER NUMBER(3) not null,
 SECTION_ID NUMBER(6) not null,  GRADE CHAR(1),
 primary key(student_number, section_id));
insert into enrollment values(8,85,null);
insert into enrollment values(10,90,null);
insert into enrollment values(8,90,null);
insert into enrollment values(14,90,null);
insert into enrollment values(14,95,null);
```

Find details of studs. taking a course offered by the "DISC" dept.

```
select s.SID, s.SNAME, s.MAJOR, s.YEAR, s.BDATE
from student s, dept d, course c, crs_section r, enrolment e
where  c.ODEPT=d.CODE and
       r.COURSE_NUM=c.CNUMBER and
       r.SECID=e.SECTION_ID and
       e.STUDENT_NUMBER = s.SID and
       d.CODE= 'DISC';
```

```
SID SNAME          MAJOR YEAR BDATE
---- ------------ ----- ---- -------------
 1,4 Jack          CSAP     1 12-FEB-77
```

SQL script: ex-select3.sql

Find student who are registered in a course offered by their majoring dept.

```
select * from student
where student.sid in
(select s.sid from student s, dept d, course c, crs_section r, enrollment e
where
c.ODEPT=d.CODE and          -- c Offering Dept same as the d dept
s.MAJOR=c.ODEPT and         -- s major Dept same as the c.ODEPT
r.COURSE_NUM=c.CNUMBER and  -- the section is for the course c
r.SECID=e.SECTION_ID and    -- r course section same as e section
e.STUDENT_NUMBER = s.SID);
```

SID	SNAME	MAJOR	YEAR	BDATE
8	Brenda	COMP	2	13-AUG-80

Find students who are currently registered.

sql > @ex-select1.sql

```
select * from student
where student.sid in
        (select s.sid
        from student s, dept d, course c, crs_section r, enrolment e
        where  c.ODEPT=d.CODE and
r.COURSE_NUM=c.CNUMBER and
r.SECID=e.SECTION_ID and        e.STUDENT_NUMBER =
s.SID);
```

```
SID SNAME        MAJOR YEAR BDATE
---- ------------ ----- ---- ------------
   8 Brenda       COMP     2 13-AUG-80
 1,0 Dupont       ENGL     1 13-MAY-80
 1,4 Jack         CSAP     1 12-FEB-77
```

```
select s.SID, s.SNAME, s.MAJOR, s.YEAR, s.BDATE
from student s, dept d, course c, crs_section  r, enrolment e
where  c.ODEPT=d.CODE and
       r.COURSE_NUM=c.CNUMBER and
       r.SECID=e.SECTION_ID and
       e.STUDENT_NUMBER = s.SID and
       d.CODE= 'COMP';
```

```
SQL> @ex-select2.sql
 SID SNAME         MAJOR YEAR BDATE
---- ------------ ----- ---- ------------
   8 Brenda       COMP     2 13-AUG-80
 1,0 Dupont       ENGL     1 13-MAY-80
   8 Brenda       COMP     2 13-AUG-80
 1,4 Jack         CSAP     1 12-FEB-77
```

The DUAL table in Oracle

```
SQL> describe dual;
 Name                      Null?    Type
 ------------------------- -------- -------------
 DUMMY                              VARCHAR2(1)
```

Contains one row and one column. Can be used to put results

```
SQL> select power(2,10) from dual;

POWER(2,10)
-----------
       1024
```

select sysdate from dual;

```
SQL> select to_date(sysdate) from dual;

TO_DATE(S
---------
29-SEP-02
```

```
SQL> select add_months(sysdate,2) from dual;
ADD_MONTH
---------
29-NOV-02
```

Lets make Brenda younger

```
SQL> update student
set bdate=(select add_months(bdate,36)from dual)
where sid=8
```

```
update student
set bdate= add_months(bdate,36)
where sid=8
```

```
SQL> select * from student where sid=8;

 SID SNAME          MAJOR YEAR BDATE
---- -------------- ----- ---- -------------
   8 Brenda         COMP     2 13-AUG-80
```

13-AUG-77

Editing SQL Buffer

Command	abbrev.	Operation on crnt. line/all lines
append txt	a text	adds text at the end of a line
change /old/new/	c /old/new/	change old to new in a line
change /txt	c /txt	delete text from a line
clear buffer	cl buff	delete all lines in the buffer
delete	del	delete the current line
delete n	del n	delete line n
delete last	del last	delete the last line of the buffer
delete n,m	del n,m	delete lines n - m from buffer
ed	ed	edit the buffer or a file
get file		load file into buffer
input	i	add one or more lines
input txt	i txt	add text as a line
host		exit temp to OS, exit back to SQLPlus
list	l	list all lines of buffer
list n	l n (n)	list line n and make it current
list *	l *	list current. line

Editing SQL Buffer

Command	abbrev.	Operation on crnt. line/all lines
list last	l last	list last line
list m n	l m n	list lines m – n
save file	sav file	save buffer to file
run	/	execute the commands in buffer

Other useful commands:

alter user *userid* **identified by** *newpasswor***d**

spool nameoffile

Comments

/* for multi-line comments */

rem for a single line comment

-- comments that can start anywhere in a line up to the eol

```
create table student  -- we will create a table for students
(SID NUMBER(7) primary key not null, --not null is redundant
 SNAME VARCHAR2(20),  --varchar2 is a variable length string
 /*
  We will now define
  the student's major and year
 */
MAJOR CHAR(4),
YEAR NUMBER(1),
rem BDATE is his/her birth date
rem It can be used to compute the age which is not stored.
BDATE DATE)
```

The editor used for the ed command is the default editor set using

setenv EDITOR {emas| vi | gedit | xemacs | ndedit} for tcsh/csh
export EDITOR={ emas| vi | gedit | xemacs | ndedit} for bash

Alternatively, you can set up your editor using the define command:

SQL> define _editor=emacs

```
SQL> define _USER=scott
SQL> define _PW=tiger
SQL> define
DEFINE _CONNECT_IDENTIFIER = "cind" (CHAR)
DEFINE _SQLPLUS_RELEASE = "902000100" (CHAR)
DEFINE _EDITOR        = "emacs" (CHAR)
DEFINE _O_VERSION     = "Oracle9i Enterprise Edition Release
9.2.0.1.0 - Production
With the Partitioning, OLAP and Oracle Data Mining options
JServer Release 9.2.0.1.0 - Production" (CHAR)
DEFINE _O_RELEASE     = "902000100" (CHAR)
DEFINE _RC            = "0" (CHAR)
DEFINE _USER          = "scott" (CHAR)
DEFINE _PW            = "tiger" (CHAR)
```

Show user defined varaibles

MySQL/Mariadb do not have, to date some of these interactive terminal based features

For most of the current versions of DB server have added web based functions

One can use phpMyadmin mySQLweb