VE482 Lab4

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1. Database

1.1 Database creation

```
git log --pretty="%H|%aN|%aI|%at" > timestamp.csv

git log --pretty="%H|%aN|%s" > db.csv
```

1.2 Database system installation

- Most common database systems:
  - Oracle Database, MySQL, Microsoft SLQ Server, MongoDB, PorstgreSQL
- Pros and cons of the three most common ones:
  - Oracle Database:
    - pros: robust, one of the most advanced, offers lots of functionality
    - cons: expensive, the database may require extensive hardware resources
  - MySQL:
    - pros: free of cost, a variety of user interfaces, can work with other databases
    - cons: support is not free, some common features missing
  - Microsoft SQL Server:
    - pros: fast, stable, can adjust performance levels to reduce resource usage
    - cons: expensive, resource-consuming even with performance tuning
- Create an empty SQLite database, prepare empty tables and import the `.csv` files:

```
sqlite3 l4.db

CREATE TABLE db
(
    hash TEXT NOT NULL,
    name TEXT NOT NULL,
    comment TEXT NOT NULL
);

CREATE TABLE time_stamp
(
    hash TEXT NOT NULL,
    name TEXT NOT NULL,
    dates TEXT,
    tstamps INT
);

.separator "|"
.import db.psv db
.import demo.psv demo
```

1.3 Database queries

- **Who are the top five contributors to the Linux kernel since the beginning?**

```
SELECT name, COUNT(name) as contrib_cnt
FROM time_stamp
GROUP BY name
ORDER BY contrib_cnt DESC
LIMIT 5;

/*
OUTPUT:
name             contrib_cnt
---------------  -----------
Linus Torvalds   30702
David S. Miller  13180
Takashi Iwai     7726
Mark Brown       7670
Arnd Bergmann    7520
*/
```

- **Who are the top 5 contributors to the Linux kernel each year over the past 5 years?**

```
-- 2016 --
SELECT name, COUNT(name) as contrib_cnt
FROM time_stamp
WHERE dates BETWEEN '2016-01-01' AND '2016-12-31'
GROUP BY name
ORDER BY contrib_cnt DESC
LIMIT 5;
-- 2017 --
SELECT name, COUNT(name) as contrib_cnt
FROM time_stamp
WHERE dates BETWEEN '2017-01-01' AND '2017-12-31'
GROUP BY name
ORDER BY contrib_cnt DESC
LIMIT 5;
-- 2018 --
SELECT name, COUNT(name) as contrib_cnt
FROM time_stamp
WHERE dates BETWEEN '2018-01-01' AND '2018-12-31'
GROUP BY name
ORDER BY contrib_cnt DESC
LIMIT 5;
-- 2019 --
SELECT name, COUNT(name) as contrib_cnt
FROM time_stamp
WHERE dates BETWEEN '2019-01-01' AND '2019-12-31'
GROUP BY name
ORDER BY contrib_cnt DESC
LIMIT 5;
-- 2020 --
SELECT name, COUNT(name) as contrib_cnt
FROM time_stamp
WHERE dates BETWEEN '2020-01-01' AND '2020-12-31'
```

```
GROUP BY name
ORDER BY contrib_cnt DESC
LIMIT 5;
```

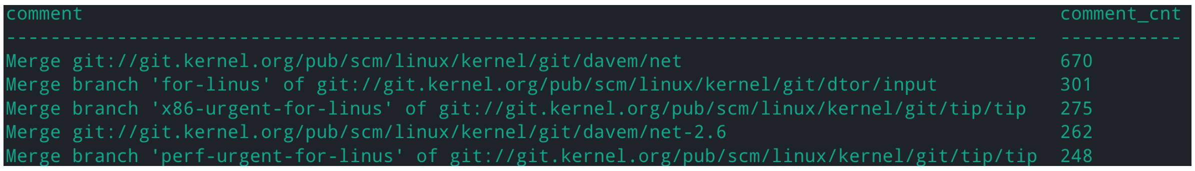
Output:

```
/*
2016:
name                   contrib_cnt
---------------------  -----------
Linus Torvalds         2273
Arnd Bergmann          1185
David S. Miller        1150
Chris Wilson           988
Mauro Carvalho Chehab  975

2017:
name             contrib_cnt
---------------  -----------
Linus Torvalds   2288
David S. Miller  1420
Arnd Bergmann    1123
Chris Wilson     1028
Arvind Yadav     827

2018:
name               contrib_cnt
-----------------  -----------
Linus Torvalds     2163
David S. Miller    1405
Arnd Bergmann      919
Christoph Hellwig  818
Colin Ian King     798

2019:
name               contrib_cnt
-----------------  -----------
Linus Torvalds     2380
David S. Miller    1205
Chris Wilson       1170
YueHaibing         929
Christoph Hellwig  911

2020:
name                   contrib_cnt
---------------------  -----------
Linus Torvalds         1886
David S. Miller        923
Christoph Hellwig      806
Mauro Carvalho Chehab  770
Chris Wilson           644
*/
```

- **What is the most common “commit subject”?**

```sql
SELECT COUNT(comment) AS comment_cnt
FROM db
GROUP BY comment
ORDER BY comment_cnt DESC
LIMIT 5;
```

Result:



```
comment                                                                              comment_cnt
-----------------------------------------------------------------------------------  -----------
Merge git://git.kernel.org/pub/scm/linux/kernel/git/davem/net                        670
Merge branch 'for-linus' of git://git.kernel.org/pub/scm/linux/kernel/git/dtor/input 301
Merge branch 'x86-urgent-for-linus' of git://git.kernel.org/pub/scm/linux/kernel/git/tip/tip   275
Merge git://git.kernel.org/pub/scm/linux/kernel/git/davem/net-2.6                    262
Merge branch 'perf-urgent-for-linus' of git://git.kernel.org/pub/scm/linux/kernel/git/tip/tip  248
```

```
/*
Most common commit subject:
Merge git://git.kernel.org/pub/scm/linux/kernel/git/davem/net
*/
```

- **On which day is the number of commits highest?**

```sql
SELECT DATE(dates), COUNT(dates) as commit_cnt
FROM time_stamp
GROUP BY DATE(dates)
ORDER BY commit_cnt DESC
LIMIT 5;
```

Result:

```
/*
2008-01-30 is the day with highest number of commits.

DATE(dates)  commit_cnt
-----------  ----------
2008-01-30   1031
2006-12-07   683
2007-05-08   649
2013-07-03   626
2007-10-16   613
*/
```

- **Determine the average time between two commits for the five main contributor.**

```sql
SELECT name, (MAX(tstamp) - MIN(tstamp)) / (COUNT(name) - 1) AS interval
FROM time_stamp
WHERE name = "Linus Torvalds";

SELECT name, (MAX(tstamp) - MIN(tstamp)) / (COUNT(name) - 1) AS interval
FROM time_stamp
WHERE name = "David S. Miller";

SELECT name, (MAX(tstamp) - MIN(tstamp)) / (COUNT(name) - 1) AS interval
FROM time_stamp
WHERE name = "Takashi Iwai";
```

```
SELECT name, (MAX(tstamp) - MIN(tstamp)) / (COUNT(name) - 1) AS interval
FROM time_stamp
WHERE name = "Mark Brown";

SELECT name, (MAX(tstamp) - MIN(tstamp)) / (COUNT(name) - 1) AS interval
FROM time_stamp
WHERE name = "Arnd Bergmann";
```

Results:

```
/*
name            interval
--------------  --------
Linus Torvalds  15880

name             interval
---------------  --------
David S. Miller  36956

name          interval
------------  --------
Takashi Iwai  63301

name        interval
----------  --------
Mark Brown  59933

name           interval
-------------  --------
Arnd Bergmann  63807
*/
```

2. Debugging

- **How to enable built-in debugging in `gcc`?**

  Add the option `-g`

- **What is the meaning of `GDB`?**

  GDB: the GNU project debugger. It can:

  - Execute the program
  - Stop the program on specified conditions
  - Examine why it stopped
  - Change the program to detect bugs

- **Compile the master branch of you `mumsh` with debugging enabled.**

  Add the flag `-g` to `CFLAGS`, for example

  ```
  CFLAGS = -std=gnu11 -O2 -Wall -Wextra -Werror -pedantic -Wno-unused-result -g
  ```

  Then, `make all`

2.1 Basic GDB usage

- **Homapage of GDB project:**
  - https://www.gnu.org/software/gdb/
- **What languages are supported by GDB?**
  - Ada
  - Assembly
  - C
  - C++
  - D
  - Fortran
  - Go
  - Objective-C
  - OpenCL
  - Modula-2
  - Pascal
  - Rust
- **What are thr following GDB commands doing**
  - `backtrace`: print a backtrace of the entire stack, starting with the currently executing trace, followed by its caller and on up the stack.
  - `where`: exactly the same as `backtrace`
  - `finish`: continue running in the current frame until it returns
  - `delete`: delete a specific or all breakpoints
  - `info breakpoints`: info of existing break points and watch points
- **Conditional breakpoints**
  - `condition <breakpoint_number> expression`, where we can specify `expression`, such as `i < 100`
- **What is `-tui` option for GDB?**
  - `-tui`: "text user interface", short cut: `CTRL-XA`
- **What is the “reverse step” in GDB and how to enable it.**
  1. set two breakpoints 2, 3
  2. set the rule when we hit break points 2 and 3

     ```
     command 3 run end
     # rerun the program when hitting break point 3
     command 2 record continue end
     # enable record when hitting break point
     ```

  3. Disable pagination for tidiness: `set pagination off`
  4. Rerun and when error occurs, the program will stop
  5. Reverse one instruction and we are back: `reverse-stepi`