Article

Comparison of Stored Procedures on Relational Database Management Systems

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A B S T R A C T

A stored procedure is a group of query stored in a database catalogue which allows it to be recalled. Insert, update and delete data could be performed using store procedure. A stored procedure is an alternative to optimize query performance and reduce the security gap at the interface level of a system. This study provides an overview of insertion, update, and deletion using Stored Procedure in MariaDB and PostgreSQL. Software developers prefer MariaDB and PostgreSQL because it is open-source, which means free. This research is an experimental research and descriptive analysis. This study uses student data with the amount of data 25000, 15000 and 5000 data. The results showed that the stored procedure processing time at PostgreSQL was faster than the stored procedure processing time at MariaDB. This research can reference design application programs that sometimes choose a DBMS is not a developer's concern.

INTRODUCTION

Relational Database Management System (RDBMS) collects related data with programs to access the data. The database system is designed to manage data in information systems; a database management system allows user to organize, store and retrieve data from the computer. Database Management System linked the program application with a data source so that existing data on data sources can be viewed as informative.The database is a data collection that still needs to be processed. DBMS allows users to access data in the database, manage and manipulate data.

Those are three factors to calculate the application program's performance. Firstly, database design and implementation. Secondly, application design and implementation. Lastly, administrative procedures [1]. These factors indicate the database is an essential component because the database is role as a source of information for program application.To getuseful information, the right information, and a quick process, a quality database is needed. Still, sometimes in the program application database, it is less of a concern to the programmer.

SQL Command (Query) is the syntax to manage data in a database.In addition to a database structure, a query is also an essential part of a database because it can affect a program application's performance. A large amount of data lead to slow data processing. Query Optimization is a solution

to overcome the problem [2]. Many research has been done regarding query optimization,research about optimizing query conducted by Ridho Pamungkas entitled "Optimasi Query Dalam Basis Data MySQL Menggunakan Index", In this research,the MySQL index function is used to speed up the process of searching for data in the database [3]. But as we know,a transaction in the database is about searching data and insert, update, and deletedata.Insert, update and delete transaction cannotperform using the MYSQL index function. Another research is conducted by Febrianta Surya Nugraha, entitled "Optimasi Query pada Laporan Transaksi Penjualan Menggunakan Materialized View (Studi Kasus : Moonly Café)". This researchabout optimization query using a materialized view [4]. Generally, optimization querycan dobychanging the query writing, as in research entitled "Migrasi dan Optimalisasi Database Sistem Informasi Manajemen Universitas Cokroaminoto Palopo". That research about optimized join query by doing modifying of join query [5]. Optimization querycan do using stored procedures, as shown in the research entitled "Keuntungan Penggunaan *External Function* pada Database PostgreSQL". In this research,insert data using two methods by using native query and stored procedure functions. The research results indicateexecution time stored procedure function faster than native question [6].

A stored procedure is a group of queries stored in a database catalogue that allows it to be recalled [7]. Insert, update and delete data can use stored procedures. Based on previous research, the execution time stored procedure to insert and store the process tends to increase with increasing data. In contrast, for stored procedure update and stored procedure delete, execution time varies[8]. Choosing a database management system application is also essential in designing program application. There are many choices of database applications that are licensed free licensed. Due to consideration in terms of cost, of course, that is free licensed preferred.A study compares query performance of database management applications entitled "Analisis Perbandingan Kinerja Query Database Management System (DBMS) Antara MySQL 5.7.16 Dan MariaDB 10.1". Results research indicate MariaDB query performance is better than MySQL. The query tested is query insert, query update, query delete, query aggregate, stored procedure, and trigger event [9].

This research aims to compare the performance of a database management application between PostgreSQL and MariaDB.

I. LITERATURES REVIEW

Structured Query Language (SQL)

The main components database are tables, field/columns and data/records. An application is required to create a table structure, insert, update and delete data. This application is known as Relational Database Management System (RDBMS). The command used to manage database structures, and data in a database is Structured Query Language (SQL)[10]. SQL is a set of commands that used to access data in a relational database. SQL is a programming language that has been standardized by the American National Standards Institute (ANSI) used in relational database management [11].

Stored Procedure

A storedprocedure is a set of commands stored in a database. Generally, a stored procedure is written in SQL [12]. The storedprocedure is executed based on user-executed orders and can accept several input and output parameters[13].

II. FRAMEWORK

This research is an experimental study to compare the performance of stored procedures database management system. Stored procedure tested is stored procedure Insert, update and delete. This research use student data, the amount of data used is 25000, 15000 and 5000 data. Each amount of data is executed using stored procedure insert, update and delete. A stored procedure is performed in two database management applications are MariaDB and PostgreSQL. The stored procedure completed ten times, then the average execution time is recorded.

Hardware specifications used in this research are: 1) Core i5 Processor, 1.60 - 3.90 GHz, 6 MB Smart Cache, 2) Memory 4 GB 2133 MHz LPDDR3, 3) 256 GB PCIe SSDand software used: 1) Windows 10 Home Operating System, 2) PostgreSQL Version 13, 3) MariaDB 10.1, 4) Navicat Version 12.

A database is needed to test a stored procedure. The database is created in both database management applications (MariaDB and PostgreSQL). A table and field/column ismade in the database to store previously prepared data.

Table structure used in this research show in table 1 :

Tabel 1. Tabel of Stored procedure testing

Nama Tabel: tbl_mahasiswa		
Field	Type/Length	Constraint
nim	Character (11)	Primary Key, Check Constraint
Nama	Variable Character (45)	Check Constraint
gender	Enum	Default :'L', 'P'
tempat_lahir	Variable Character (35)	Check Constraint
tanggal_lahir	Date	Check Constraint
jurusan	Variable Character (35)	Check Constraint

Table 1 shows the structure of the table uses to test the stored procedure. In Table 1 can see there is a table with the name tbl_mahasiswa, and there are several columns /fields: nim, name, gender, tempat_lahir, tanggal_lahir, jurusan. Column nimhas data type CHAR (11) and use Primary Key (PK) and Check constraint. Primary Key (PK) in the nim column ensures that the queue's data is not duplicated. In contrast, the check constraint is used to providedata entered in column nim is numeric characters with 11 characters. Check to constrain in column nama, tempat_lahir and jurusan are to ensure inputted character of letters and numbers only, and symbol characters are not accepted. Constraint check-in column tanggal_lahir is to provide the age of a student is not less than 20 years old. Check constraints are data entry rules assigned to each column in the database to ensure validity data entered into the database. Using check constraint, users are forced to enter data based on predetermined rules. This can reduce data input errors in the database.

III. METHODS

This research is experimental with descriptive analysis. This research compares stored procedure performance in database management applications (MariaDB and PostgreSQL). Comparisons were made by executing stored procedure commands created in two database management systems. Stored procedure performed is held procedure insert, update and delete data; each stored procedureperformedten times with different amounts of data in two database management applications. The execution time is recorded and calculated as the average execution time. Figure 1 shows a flowchart of this research:
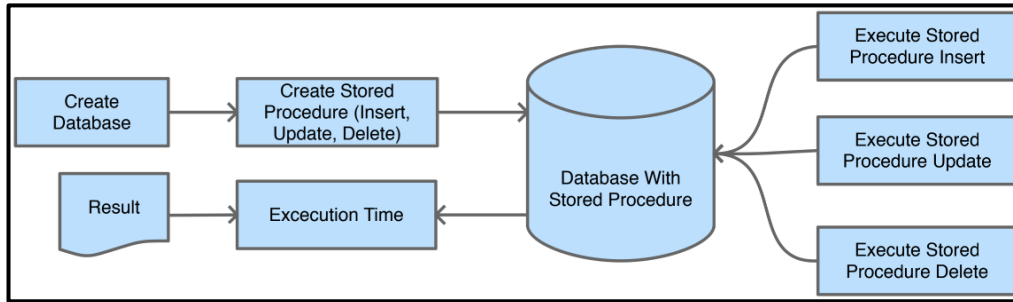
Figure 1: Research Flowchart

Figure 1 shows the flowchart of this research. The first step is to create a database for testing.Database created in two database management applications, MariaDB and PostgreSQL.The databaseis designedto have the same structure and is equipped with stored procedures to insert, update, and delete data.Because ofthe difference in creatinga stored procedure, there are differences in the stored procedure's writing, but the difference does not affect the stored procedure results. Data in this research used student data amount 25000, 15000 and 5000 data.

IV. RESULT

Structure table to testing stored procedure show in table 1,a table created in the two database management system applications (MariaDB and PostgreSQL). After the test table made, the next step is to create a stored procedure insert, stored procedure update and stored procedure delete.
Figure 2 to 4 show the source code stored procedure:

```
//Procedure Tambah Data MariaDB
CREATE PROCEDURE `tambah_data_mariadb`
( IN `nim_mhsw`          CHAR(10),
  IN `nama_mhsw`          VARCHAR(45),
  IN `gender_mhsw`        CHAR(3),
  IN `tempat_lahir_mhsw`  VARCHAR(35),
  IN `tanggal_lahir_mhsw` DATE,
  IN `jurusan_mhsw`       CHAR(50))
no SQL
begin
  INSERT INTO tbl_mahasiswa
( nim,
  nama,
  gender,
  tempat_lahir,
  tanggal_lahir,
  jurusan)
  VALUES      (nim_mhsw,
  nama_mhsw,
  gender_mhsw,
  tempat_lahir_mhsw,
  tanggal_lahir_mhsw,
  jurusan_mhsw);
end
```

```
//Procedure Tambah Data PostreSQL
CREATE OR replace PROCEDURE
PUBLIC.tambah_data_psql
( nim_mhsw CHARACTER,
  nama_mhsw CHARACTER varying,
  gender_mhsw CHARACTER,
  tempat_lahir_mhsw CHARACTER varying,
  tanggal_lahir_mhsw DATE,
  jurusan_mhsw CHARACTER varying) LANGUAGE 'sql'
AS
  $body$
  INSERT INTO tbl_mahasiswa
  (
  nim,
  nama,
  gender,
  tempat_lahir,
  tanggal_lahir,
  jurusan
  )
  VALUES
  (
  nim_mhsw,
  nama_mhsw,
  gender_mhsw,
  tempat_lahir_mhsw,
  tanggal_lahir_mhsw,
  jurusan_mhsw
  );
  $body$;
```

Figure 2: Stored procedure insert data in MariaDB and PostgreSQL

```
//Stored Procedure Ubah Data MariaDB
CREATE PROCEDURE ubah_data_mariadb
(IN gender_mhsw  CHAR(1),
 IN jurusan_mhsw VARCHAR(50))
begin
  UPDATE tbl_mahasiswa
  SET    gender = gender_mhsw,
         jurusan = jurusan_mhsw;
end:
```

```
//Stored Procedure Ubah Data PostgreSQL
 CREATE OR replace PROCEDURE
 PUBLIC.ubah_data_psql
  (gender_mhsw CHARACTER,
  jurusan_mhsw CHARACTER varying) LANGUAGE 'sql'
AS
  $body$
  UPDATE tbl_mahasiswa
  SET    gender = gender_mhsw,
         jurusan = jurusan_mhsw;
  $body$:
```

Figure 3: Stored procedure update data in MariaDB dan PostgreSQL

```
//Stored Procedure Hapus Data MariaDB
CREATE PROCEDURE `hapus_data_mariadb`()
no SQL
begin
  DELETE FROM tbl_mahasiswa;
end
```

```
//Stored Procedure Hapus Data PostgreSQL
 CREATE OR replace PROCEDURE
 PUBLIC.hapus_data_psql( ) LANGUAGE 'sql'
AS
  $body$
  DELETE
  FROM tbl_mahasiswa ;
  $body$:
```

Figure 4: Stored procedure delete data in MariaDB and PostgreSQL

Figures 2 to 4 are the source code stored procedure in two database management applications; source code is show there are differences in writing source code of stored procedure between MariaDB and PostgreSQL. Still, these differences do not affect the results of the stored procedure. After creating the stored procedure, the next step is to test each stored procedure in each database management application. The first test is to insert data using stored procedures. The amount of data record is 25000, 15000 and 5000.Process insert data using stored

procedures repeated ten times for each amount of data in each application. Each time the stored procedure was executed, the average time recorded. Results of the test for insert data using a stored procedure can be seen in Figure 5:
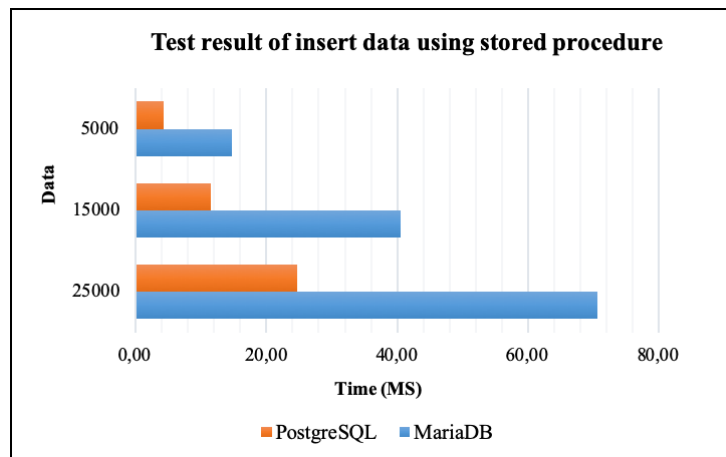

Figure 5: A test result of insert data using a stored procedure

Figure 5 shows a test result stored procedure to insert data. The amount of data used in this test is 25000, 15000 and 5000 data. In figure 5 show MariaDB required a longer

execution time compared to PostgreSQL. For 25000 data, MariaDB takes an average execution time of 70.61 ms, while PostgreSQL requires 24.72 ms. Whereas for

15000 data, MariaDB takes 40.47 ms while PostgreSQL takes 11.49 ms, and for 5000 data, MariaDB takes 14.73 ms while PostgreSQL takes 4.24 ms. The next test is testing stored procedure update data. The amount of data changed is 25000, 15000, and 5000 data. As previously held, data insert data, stored procedure update data is executed ten times, and the average execution time is recorded. Data updating is done in the gender column gender and jurusan column. Because the gender column's value and jurusan column, not uniform, it is necessary to unify data first. All values in the gender column changed to 'P' and in the jurusan column changed into "INFORMATIKA". After all the values in the gender column and jurusan column change, the next step is to run the stored procedure update data. Stored procedure update data will change the value of the gender column to "L" and the importance of the jurusan column to "PENDIDIKAN PANCASILA DAN KEWARGANEGRAAN". After executing the stored procedure update in the gender column and jurusan column, the value in that column is returned to its original value and performed ten times.

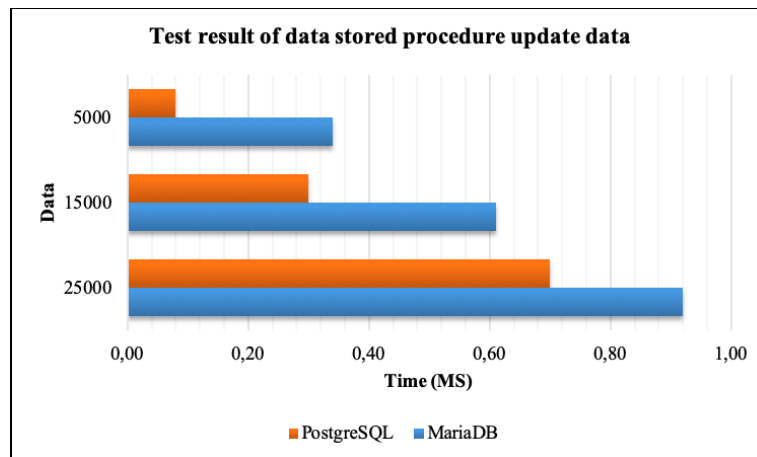Figure 6 show the results of testing stored procedure update data:

Figure 6: A test result of stored procedure update

Figure 6 shows the test results of the stored procedure update data. Seen average time needed for executing stored procedure update data is 0.92 ms for MariaDB and 0.70 ms for PostgreSQL in 25000 data. For 15000 information MariaDB takes 0.61 ms while PostgreSQL takes 0.30 ms. For 5000 data, MariaDB takes 0.34 ms while PostgreSQL takes 0.08 ms.

The next stage is testing stored procedure delete data. The amount of deleted data is 25000, 15000 and 5000 data. As in the previous test, the stored procedure delete was also performed ten times for each amount of data, then the average value of execution time recorded. Before running the stored procedure delete data, it is necessary to insert data as much as the amount of data that has been determined.

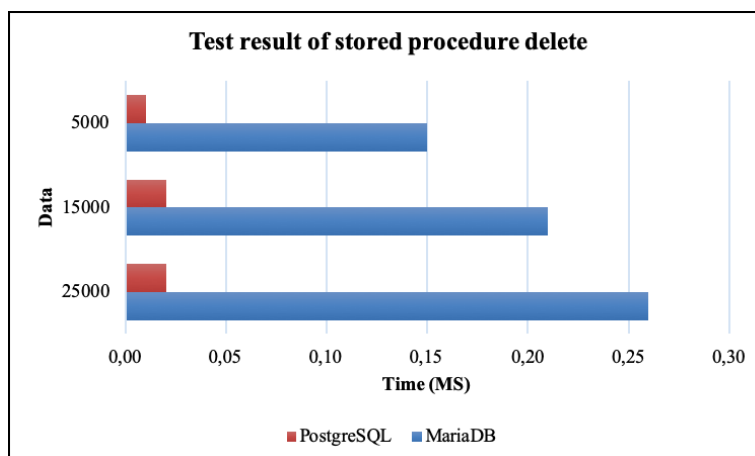Figure 7 show the test result of stored procedure delete:

Figure 7: A test result of stored procedure delete data

Figure 7 shows the results of average execution time stored procedure delete data. Seen time is taken to execute a stored procedure in MariaDB 0.26 ms and PostgreSQL 0.02 ms for 25000 data. For the amount of 15000 data, average execution time stored procedure delete using MariaDB 0.21 and PostgreSQL 0.02. As for the amount of 5000 data, MariaDB requires an average execution time of 0.15 ms, and PostgreSQL takes an average execution time of 0.01 ms.

V. CONCLUSION

Overall, the results of testing stored procedure concluded that the execution time of stored procedures in PostgreSQL is faster when compared to the execution time of stored procedures in MariaDB.

A very significant difference is shown in the stored procedure delete data with a time difference of 0.24, 0.19, 0.14 for 25000, 15000 and 5000 data.

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