Int. J. Nonlinear Anal. Appl. 15 (2024) 1, 137–150
ISSN: 2008-6822 (electronic)
http://dx.doi.org/10.22075/ijnaa.2023.28139.4207

Automated recommendation backend web database tier architecture benchmarking

Govan Anwar Hassan[a], Kamaran Hama Ali Faraj[b,c,*], Haval Sidqi[d]

[a]Department of Applied Computer, College of Informatics, Polytechnic University, Sulaymaniyah, Iraq

[b]Department of Computer, College of Science, Sulamani university, Sulamani, KRI

[c]Department of Computer Engineering, College of Engineering and Computer Science, Lebanese French University, Erbil, Iraq

[d]Technical College of informatics, Sulaimani Polytechnic University, Iraq

(Communicated by Ehsan Kozegar)

Abstract

The database management system (DBMS) for any application is crucial for developers because each application needs high performance to run efficiently. Therefore, database Benchmarking is the process of performing several Defined tests on those databases to evaluate their performance. The electronic benchmarking System (EBS) facilitates and improves human resource management (HRM) in all aspects of real life. EBS designed by four different database backends and three different web technology. This paper presents a comparative evaluation of the performance of the top DBMS systems namely (MySQL, SQL Server, Oracle, and MS Access). The middleware is designed using three dynamic web technologies (PHP, ASP, and PYTHON). In order to evaluate the backend performance for the four mentioned databases system by using two Parameters Response Time (RT) and Throughput (TT) over different Tire Architectures namely: One-Tier Architecture (1TA), Two-Tier Architecture (2TA). This paper will show which of the database has a better Response time (RT) and Throughput (TT).

Keywords: SQL Server, Oracle, MYSQL, MS-Access, TT, RT
2020 MSC: 97P10

1 Introduction

Benchmarking is a method used to improve business processes by comparing them with other relevant organizations [1]. Recently, backend web database tier architecture benchmarking (BWDTAB) has become a significant research area for real-life performance analysis. Also, it's a hot topic for the researchers to let the developers know the best database backend. Databases were the backbone of any application. Database stores critical and confidential information and this paper discussed that choosing the best database management system (DBMS) for any project is a crucial decision for developers because each application asks for high performance and run efficiently [11, 12]. Benchmarking any database is the process of doing a number of tests on that particular database for the purpose of evaluating its performance of the databases [4]. There are several database types that used as a backend for

*Corresponding author
Email addresses: govan.hassan@univsul.edu.iq (Govan Anwar Hassan), kamaranfaraj@yahoo.com (Kamaran Hama Ali Faraj), haval.sidqi@spu.edu.iq (Haval Sidqi)

Received: November 2022 *Accepted:* January 2023

our proposal system (SQL Server, MYSQL, Oracle, MS-Access) and selecting the best database management system (DBMS) in respect of using two parameters (i.e., Response time and Throughput). The efficiency of our proposed system is the backed of the tier architecture either One-tier architecture (1-TA) or Two-tier architecture (2-TA). Except the backend ,electronic operational benchmarking(EOB) study the middleware in the website architecture, the middleware between frontend and backend, the middleware was (PHP, ASP, PYTHON). The web server is an important part of middleware. There are three different types of web servers; internet information system (IIS) for ASP web technology language, web server Gateway Interface (WSGI) for python web technology language, and Apache webserver for PHP [5]. Performance measurement tools are important for users of (DBMSs) and designers [4]. The Performance measurement tools are various for performance analysis, such as TT, RT, number of input/outputs, disk or memory usage, CPU Utilization, Request per second, Multiuser Support, Transaction Support, failed requests, and concurrency. The two performance factors finalized after a review of the literature: RT and TT. The RT and the TT are two main parameters and criteria for the performance of a database measurement. These two variables were taken into account by concentrating on the demands of industry in terms of efficient and cost-effective applications [11, 16, 7]. The three categories of E-benchmarking in our proposed system are concentrated on E-operational. The E-operational is an important and hot topic in our proposed system, which consists of the following: Frontend (JS, HTML, and CSS), Web technologies (PHP, PYTHON, ASP), Web server (Apache, IIS, WSGI), and Backend: Databases (SQL Server, MYSQL, Oracle, MS-Access). Figure 1 shows categories of benchmarking.

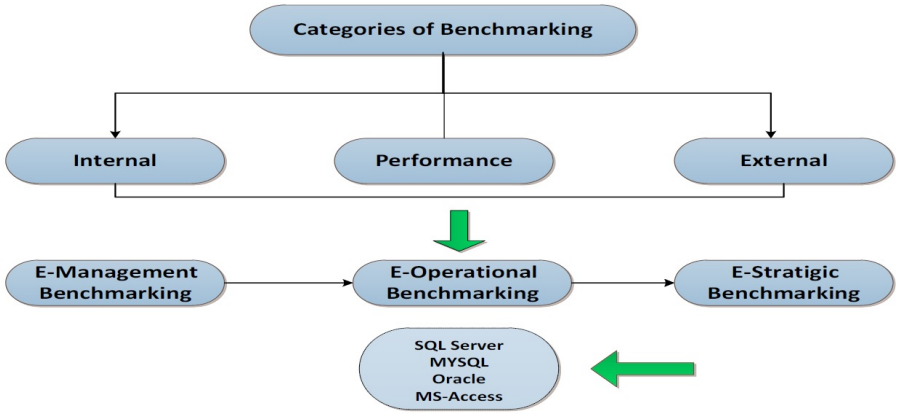

Figure 1: Classification and categories of benchmarking.

The E-operational category benchmarking is our objective for the RT and TT. At the same time, the E-management benchmark is enhanced by the E-operational benchmark, the E-strategic classification benchmark [**?**]. Three categories of the benchmarking system are shown in Figure 2.

Figure 2: Categories of benchmarking.

2 Literature review

In 2008 [11], Margesh Naik The main goal of their study was to compare the performance of two famous database management systems widely used. SQL Server is one of them, and Oracle is the other. Both technologies have been put to the test in a variety of scenarios. The project evaluated two Databases through two parameters Memory Requirements and Execution Time. The measurements have been performed via different database queries such as (insert, select, join query, update, and delete), the author tries to analyze the same set of queries by gradually increasing the database's record count, and their results have been studied. In most cases, Oracle was better than SQL Server, but in terms of memory, Oracle was better compared to SQL Server.

In 2011 [2], Youssef Bassil their study explained that database management systems are very important for organizing data into collections that can be easily searched and updated. Many DBMS systems are available on the

market, each having properties in the aspect of reliability, usability, security, and performance. their study compared the performance of five databases: MS SQL Server 2008, Oracle 11g, IBM DB2, MySQL 5.5, and MS Access 2010. The evaluation was performed by executing different SQL queries over the five different DBMSs. The result was showed by graphic chart; the first graphic chart showed that IBM DB2 is the fastest and most consumed primary memory. DBMS, however, MS Access has lower CPU utilization than other DBMSs.

In 2021 [10], Kamaran Faraj and Hataw Jalal Mohammed Their study concluded that performance was the backbone of any application. Their study compared between two web servers (WSGI-Python) and (PHP-Apache) in middleware tier architecture over two different operating systems (OS)s and a common backend MySQL web database for both of them. This comparison was performed by creating E-Learning systems designed by two dynamic web technologies. Python-WSGI is the first, while Personal Home Page is the second (PHP-Apache). Over two distinct operating systems (OSs), Windows and Linux-Ubuntu, their study were to determine which of them has a faster response time; the result showed that Python are more accurate and flexible than PHP.

In 2019 [15], Ayman Hussein Odeh Their study compared the performance of two common web programming languages (PHP and ASP), there is no clear suggestion to use ASP or PHP for all projects, and there are a lot of things to take into account before making a decision. For example, ASP is more suitable for developers who are more familiar with Microsoft products. From another point of view, PHP is better for developers who prefer direct work with the script. The result showed that PHP codes are considered to be unsafe languages and weak. ASP is more reliable and efficient than PHP; finally, the developer can select the preferred one depending on their knowledge, application domain, used platform, and other factors.

3 Quality of benchmark

Before internet technology, manual benchmarking (MB) was common. Traditional benchmarking has many disadvantages, such as complexity, performance, Availability, Reliability, Safety, Confidentiality, Integrity, and Maintainability. Today, information technology (IT) has a great strategic partnership between management and operations. The word quality returns to several types and benchmarks [5]. An overview of some of the quality of benchmarking is provided in follows:

- Quality of Service (QoS): is the definition or measurement of the overall performance of a service, reducing loss, and delay.
- Quality improvement (QI): refer to the process that makes a change to improve the quality of service.
- Quality of information (QoI): ensure the accuracy, relevant, comprehensive, reliability information about the quality of products or services produced by organizations.
- Quality of Cost (QoC): is defined as a quality of the less cost with higher quality.

All qualities mentioned are returned to the E-Operational benchmark with several new parameters contributing and a target for investigation. Figure 3 shows E-benchmarking with the Quality of the Benchmark.

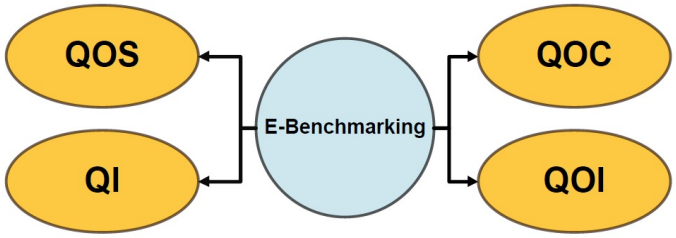

Figure 3: E-benchmarking with Quality of Benchmark

4 EOB Terminologies

Figure 4 shows the main parts of the adopted architecture of the established web application. The three-tiered architecture (3TA) is shown in the following Figure, clarifying the layers and logical architecture. Whichever hardware

increases or decrease create tired architecture, but the software creates the logical architecture. EOB classified into three phases' frontend, middleware, and back-end. This section discusses the middleware, backend, and features of the different DBMSs and web technology under test.

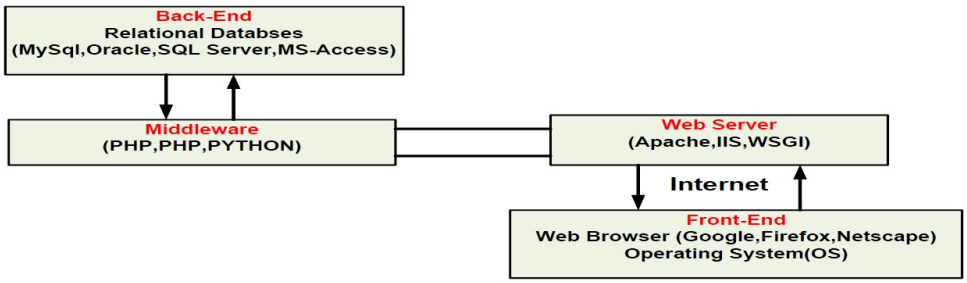

Figure 4: The architecture of the developed web-based backend application

4.1 The middleware

The middleware consists of two parts: web technology (PHP, ASP, and PYTHON) and web server (apache, IIS, WSGI)

4.1.1 Web technologies tools

There are different types of web technology, and each day, the new one is introduced for designing websites. It was difficult for developers to select the best web technology programming language. Several resources compare web programming languages in general, such as; official and unofficial. However, most of these comparisons focus on the characteristics [12]. This thesis performs a practical comparison between PHP and ASP.net, and PYTHON. Figure 5 shows web technologies application components.

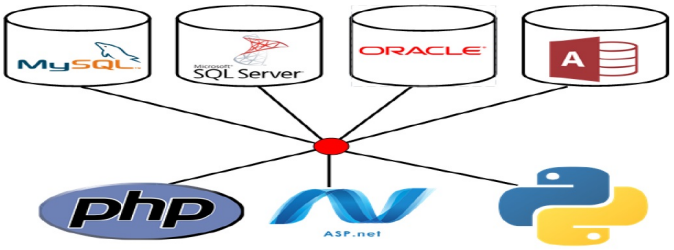

Figure 5: Different web technologies with blackened databases

Personal Home Page (PHP) PHP is a popular scripting web programming language, The Hypertext Preprocessor (PHP), and it is a server-side scripting language; namely, PHP is particularly well-suited for developing dynamic web pages with connectivity to a variety of database systems [8]. However, it is cross-platform and can be run on different platforms such as Linux, UNIX, and Windows platforms and using an apache server. PHP scripts may be modified with any text editor, such as Notepad++ for WOS, visual instrument (VI), or Virtualized Infrastructure Manager (VIM) for LOS. The MySQL backend database is built-in and supported by PHP. PHP is open-source, which means that any developer or programmer can edit the functionality of PHP. PHP are completely free and compatible with different operating systems [12].

Active Service Page (ASP) ASP is a dynamic server-side scripting language. One of the most common web languages and Open source software, ASP stands for (Active Server Page) .ASP.NET web framework for creating web apps, ASP which works with Microsoft Windows and creates webpages using Hypertext Markup Language HTML5, CSS, and JavaScript that users will find extremely easy to utilize. ASP.net uses Microsoft Visual Studio editing tools and can be run on Windows platforms using IIS servers. ASP programing language syntax is derived from visual basic and C# [12].

Python It is an object-oriented programming language. It has been written in C or C++ and offers interfaces for numerous OS system functions and libraries. Also, Python is a popular and high-level programming language that allows programmers to write code in fewer lines if compared to the others scripting languages. The Python

programming language has powerful features for database programming, and it supports various databases like SQLite, MySQL, Oracle, Sybase etc. Other Python characteristics key includes simplicity, simple to use, open source, free High-level source, interactive. It is also utilized in parallel computing systems. Python is mostly used in Artificial intelligence (AI) and Machine Learning [13].

4.1.2 Web Server

A web server is a computer that handles receiving HTTP requests from web clients and providing HTTP responses in the form of web pages with static (text, graphics, etc.) Any website on the internet must have a Web server program. The most common Web server was Microsoft's Internet Information Server (IIS), Apache, and web server Gateway Interface (WSGI) [3]. ASP web server is compatible with the IIS web server, which shows in Figure (6A), the PHP web server is apache, shown in Figure (6B), and the Python web server is compatible with the WSGI webserver which shows in Figure (6C).

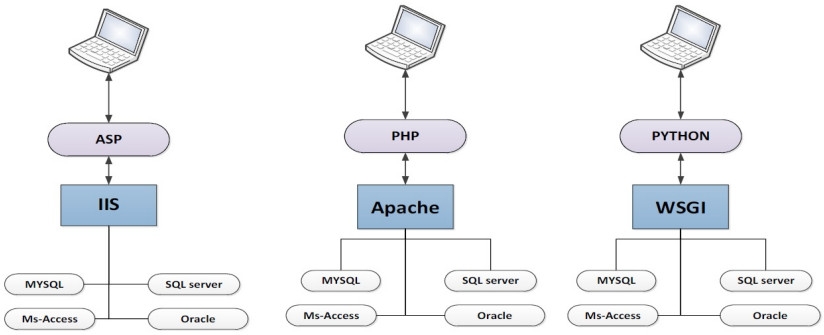

Figure 6: A. ASP web server, B. PHP webserver, C. Python webserver.

4.2 The Backend

The database is a collection of organized information saved on a computer system's hard drive. It can be easily accessed, managed, and updated. Data is organized into rows, columns, and tables; a Database management system is software used to manage the database. For example, MySQL, Oracle [9], etc. The best database is selected according to the speed of loading, updating, and retrieving stored data from the database. The RT and the TT are the two methods that are used to compare the performance of four database backends. Figure 7 shows four different database backend in our proposed system.

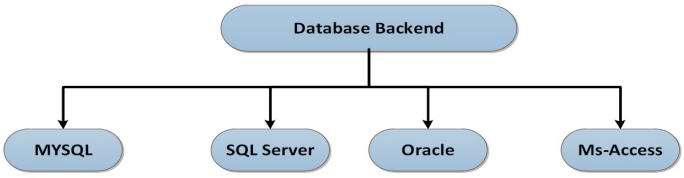

Figure 7: Different database backend types

4.2.1 MySQL

MySQL is a database program that can store huge amounts of information in an organized format that is easily accessible from scripting languages. MySQL is an Open Source DBMS and the history goes back to 1985. The main aim of the developer is to provide secure and effective data management; MySQL is used by large companies and large numbers of internet technology mostly used for web applications and online publication. MySQL is based on Structured Query Language (SQL) and runs on a variety of Operating system, including Linux, UNIX, and windows. MySQL is part of LAMP (Linux, Apache, MySQL, and PHP) [14].

4.2.2 MS SQL Server

Microsoft SQL Server is relational database management systems SQL was developed by Microsoft Corporation. SQL Server only supports two operating systems, Windows and Linux. SQL Server Management Studio is the main tool for server and database administration. Microsoft SQL Server is suitable for both large and small businesses and can easily grow. SQL language performs different actions like creating, modifying, updating, and deleting databases; SQL syntax is simpler and easier [6]; Microsoft SQL Server supports consistent, atomic, isolated transactions, mirroring, and clustering. All operations in SQL Server are managed using T-SQL. The stored procedures were one of the SQL Server's greatest points [2]. SQL Server provided high security and allows the administrator to grant or deny user access [11].

4.2.3 Oracle

One of the most reliable and popular relational database management systems was created by Oracle Corporation. Oracle provides security, scalability, and high performance used By the Largest Company around the world. The large company used oracle database for storing data, organizing transaction processes, and retrieving data business analytics. Compared to SQL Server databases, oracle syntax is more complex and difficult, but oracle is more secure than SQL Servers; it is supported by many different languages C, C#, C++, Cobol, PHP, Python, Java, Delphi, ruby Visual Basic and etc. Oracle is supported by different operating systems like Windows, Linux, and MacOS [6]. Oracle has separate (physical and logical) storage; the physical structures can be changed without affecting the logical structure [2].

4.2.4 Microsoft Access (MS ACCESS)

It is a relational database management system used to store and collect data. Access allows users to sort, retrieve, summarize, and report results effectively. It can merge data from several files by creating relationships; it is more efficient and accurate for data entry. MS-Access was suitable for small organizations or departments of large organizations. MS-Access combines a graphical user interface. One of the crucial points of MS access for a developer was compatibility with SQL queries. Visual Basic for Applications (VBA) language is used for evolving [2].

5 Testing and evaluation DB

The Four databases were tested through the application is called benchmarking application; the DBMS was tested by uploading the different files (IMAGE, VIDEO, WORD FILE, EXCEL FILE, PDF FILE) in 1TA and 2TA. Figure 8 shows the tester interface of Benchmarking Application website.

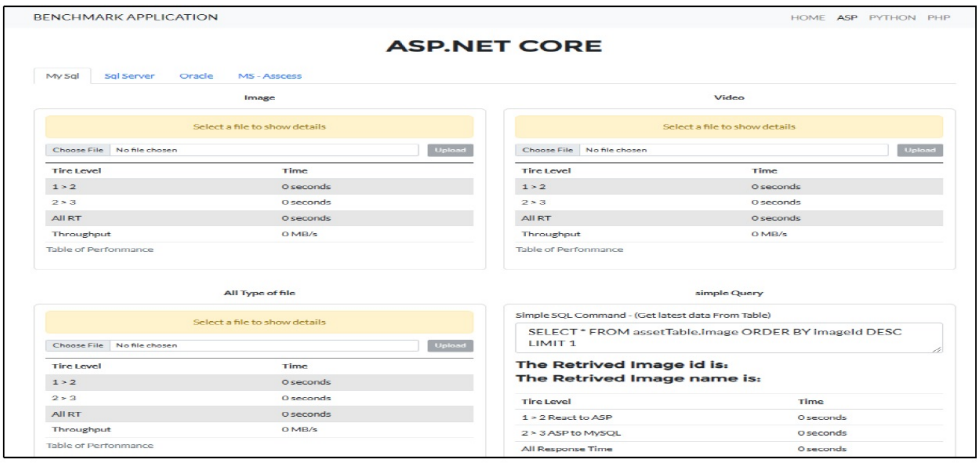

Figure 8: Benchmarking Application Tester interface

5.1 Testing and Evaluation Databases in 1TR

The EOB benchmarking in 1TA only showed in one computer, and table 1 explains computer specifications. This means that the computer becomes a client and server; the users using the front end (Web browser, HTML), on the other hand, administer will manipulate data to the databases type.

Table 1: Computer Specification.

Device	specification
Ram	16G
Hard	512 SSD
CPU	Core i7
Windows	10
Generation	7

In 1TA, the three web technologies languages (PHP, ASP, PYTHON) are connected to the four-database backend (SQL Server, Oracle, MYSQL, MS-Access) in a single computer. The direct and indirect relations are discovered by two parameters, RT and TT. Figure 9 shows One Tier architecture.

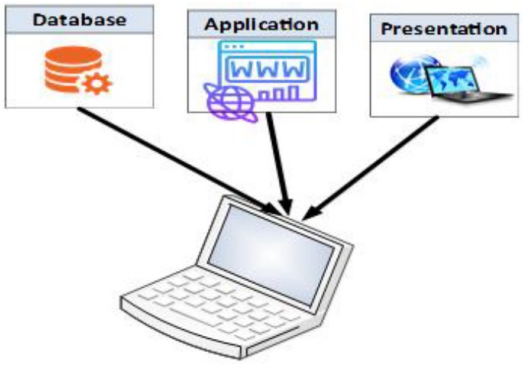

Figure 9: One-Tier architecture

5.1.1 Testing and Evaluation Databases in (1TA) by ASP middleware

The four databases tested by ASP middleware in 1TA for different files such as (image, video, PDF, word, excel, and select query). Table 2 shows the average RT and TT for each database in 1TA by ASP middleware.

Table 2: Average RT and TT for each DBMS in 1TA by ASP middleware

N	File type	Size	Middleware	Databases	Response time	Throughput
1	EXCEL FILE	26KB	ASP	MS-ACCESS	0.048 S	0.703 MB/S
2	IMAGE	425KB	ASP	MS-ACCESS	0.613 S	1.007 MB/S
3	PDF FILE	2.06 MB	ASP	MS-ACCESS	1.434 S	1.528 MB/S
4	SELECT QUERY		ASP	MS-ACCESS	0.158 S	0
5	VIDEO	614KB	ASP	MS-ACCESS	0.445 S	1.483 MB/S
6	WORD FILE	384KB	ASP	MS-ACCESS	0.374 S	1.243 MB/S
7	EXCEL FILE	26 KB	ASP	MYSQL	0.056 S	0.582 MB/S
8	IMAGE	425KB	ASP	MYSQL	1.744 S	0.888 MB/S
9	PDF FILE	2.06 MB	ASP	MYSQL	0.98 S	2.21 MB/S
10	SELECT QUERY		ASP	MYSQL	0.14 S	0
11	VIDEO	614KB	ASP	MYSQL	0.459 S	1.362 MB/S
12	WORD FILE	384KB	ASP	MYSQL	1.023 S	1.226 MB/S
13	EXCEL FILE	26 KB	ASP	Oracle	0.05 S	0.59 MB/S
14	IMAGE	425KB	ASP	Oracle	1.568 S	0.344 MB/S
15	PDF FILE	2.06 MB	ASP	Oracle	5.902 S	0.367 MB/S
16	SELECT QUERY		ASP	Oracle	1.905 S	0 MB/S
17	VIDEO	614KB	ASP	Oracle	1.555 S	0.408 MB/S
18	WORD FILE	384KB	ASP	Oracle	0.559 S	0.824 MB/S
19	EXCEL FILE	26 KB	ASP	SQL Server	0.092 S	0.733 MB/S
20	IMAGE	425KB	ASP	SQL Server	0.672 S	1.141 MB/S
21	PDF FILE	2.06 MB	ASP	SQL Server	1.191 S	2.439 MB/S
22	SELECT QUERY		ASP	SQL Server	0.133 S	0
23	VIDEO	614KB	ASP	SQL Server	0.89 S	1.57 MB/S
24	WORD FILE	384KB	ASP	SQL Server	0.217 S	2.065 MB/S

5.1.2 Testing and Evaluation Databases in 1TA by PHP middleware

The four databases tested by PHP middleware in 1-TA for the different files such as (image, video, PDF, word, excel, and select query). Table 3 shows the average RT and TT for each database in 1TA by PHP middleware.

Table 3: Average RT and TT for each DBMS in 1TA by PHP middleware

N	File type	Size	Middleware	Databases	Response time	Throughput
1	EXCEL FILE	26KB	PHP	MS-ACCESS	0.173 S	0.154 MB/S
2	IMAGE	425KB	PHP	MS-ACCESS	0.21 S	2.078 MB/S
3	PDF FILE	2.06 MB	PHP	MS-ACCESS	0.231 S	9.396 MB/S
4	SELECT QUERY		PHP	MS-ACCESS	0.309 S	0
5	VIDEO	614KB	PHP	MS-ACCESS	0.236 S	2.68 MB/S
6	WORD FILE	384KB	PHP	MS-ACCESS	0.223 S	1.82 MB/S
7	EXCEL FILE	26KB	PHP	MYSQL	0.253 S	0.126 MB/S
8	IMAGE	425KB	PHP	MYSQL	0.247 S	1.778 MB/S
9	PDF FILE	2.06 MB	PHP	MYSQL	0.384 S	5.668 MB/S
10	SELECT QUERY		PHP	MYSQL	0.218 S	0
11	VIDEO	614KB	PHP	MYSQL	0.311 S	2.113 MB/S
12	WORD FILE	384KB	PHP	MYSQL	0.237 S	1.665 MB/S
13	EXCEL FILE	26 KB	PHP	Oracle	0.189 S	0.142 MB/S
14	IMAGE	425KB	PHP	Oracle	0.23 S	1.893 MB/S
15	PDF FILE	2.06 MB	PHP	Oracle	0.244 S	6.926 MB/S
16	SELECT QUERY		PHP	Oracle	0.315 S	0 MB/S
17	VIDEO	614KB	PHP	Oracle	0.237 S	2.662 MB/S
18	WORD FILE	384KB	PHP	Oracle	0.247 S	1.595 MB/S
19	EXCEL FILE	26 KB	PHP	SQL Server	0.169 S	0.158 MB/S
20	IMAGE	425KB	PHP	SQL Server	0.3 S	1.459 MB/S
21	PDF FILE	2.06 MB	PHP	SQL Server	1.184 S	2.835 MB/S
22	SELECT QUERY		PHP	SQL Server	0.226 S	0
23	VIDEO	614KB	PHP	SQL Server	0.342 S	1.841 MB/S
24	WORD FILE	384KB	PHP	SQL Server	0.294 S	1.362 MB/S

5.1.3 Testing and Evaluation Databases in 1TA by PYTHON middleware

The four databases tested by PYTHON middleware in 1TA for the different files such as (image, video, PDF, word, excel, and select query). Table 4 shows the average RT and TT for different databases by python middleware.

Table 4: Average RT and TT for each DBMS in 1TA by PYTHON middleware

N	File type	Size	Middleware	Databases	Response time	Throughput
1	EXCEL FILE	26KB	PYTHON	MS-ACCESS	0.732 S	0.038 MB/S
2	IMAGE	425KB	PYTHON	MS-ACCESS	1.315 S	0.332 MB/S
3	PDF FILE	2.06 MB	PYTHON	MS-ACCESS	47.78 S	0.045 MB/S
4	SELECT QUERY		PYTHON	MS-ACCESS	0.379 S	0
5	VIDEO	614KB	PYTHON	MS-ACCESS	3.294 S	0.191 MB/S
6	WORD FILE	384KB	PYTHON	MS-ACCESS	0.757 S	0.53 MB/S
7	EXCEL FILE	26KB	PYTHON	MYSQL	0.023 S	1.187 MB/S
8	IMAGE	425KB	PYTHON	MYSQL	0.069 S	6.799 MB/S
9	PDF FILE	2.06 MB	PYTHON	MYSQL	0.263 S	8.22 MB/S
10	SELECT QUERY		PYTHON	MYSQL	0.027 S	0
11	VIDEO	614KB	PYTHON	MYSQL	0.083 S	7.685 MB/S
12	WORD FILE	384KB	PYTHON	MYSQL	0.059 S	6.833 MB/S
13	EXCEL FILE	26 KB	PYTHON	Oracle	0.016 S	1.847 MB/S
14	IMAGE	425KB	PYTHON	Oracle	0.039 S	11.805 MB/S
15	PDF FILE	2.06 MB	PYTHON	Oracle	0.109 S	19.905 MB/S
16	SELECT QUERY		PYTHON	Oracle	0.04 S	0
17	VIDEO	614KB	PYTHON	Oracle	0.043 S	14.758 MB/S
18	WORD FILE	384KB	PYTHON	Oracle	0.027 S	14.28 MB/S
19	EXCEL FILE	26 KB	PYTHON	SQL Server	0.033 S	1.495 MB/S
20	IMAGE	425KB	PYTHON	SQL Server	0.859 S	4.961 MB/S
21	PDF FILE	2.06 MB	PYTHON	SQL Server	0.826 S	2.651 MB/S
22	SELECT QUERY		PYTHON	SQL Server	0.031 S	0
23	VIDEO	614KB	PYTHON	SQL Server	0.052 S	12.534 MB/S
24	WORD FILE	384KB	PYTHON	SQL Server	0.059 S	6.986 MB/S

5.2 Testing and Evaluation Databases in 2TA

EOB benchmarking in 2TA showed in the form of client and server; the server contains both applications and Databases. Figure 10 shows Two Tier architecture.

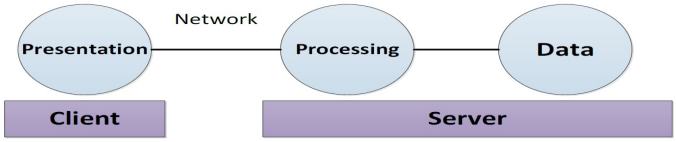

Figure 10: Two Tier architecture.

5.2.1 Testing and Evaluation databases in 2TA by ASP middleware

The four databases tested by ASP middle in 2TA for the different files such as (image, video, PDF, word, excel, and select query). Table 5 explains the average RT and TT for each database by ASP web technology in 2TA.

Table 5: Average RT and TT for each DBMS in 2TA by ASP middleware

N	File type	Size	Web Technology	Databases	Response time	Throughput
1	EXCEL FILE	26KB	ASP	MS-ACCESS	0.358 S	0.121 MB/S
2	IMAGE	425KB	ASP	MS-ACCESS	1.621 S	0.332 MB/S
3	PDF FILE	2.06 MB	ASP	MS-ACCESS	3.708 S	0.607 MB/S
4	SELECT QUERY		ASP	MS-ACCESS	0.209 S	0
5	VIDEO	614KB	ASP	MS-ACCESS	0.59 S	1.058 MB/S
6	WORD FILE	384KB	ASP	MS-ACCESS	0.691 S	0.682 MB/S
7	EXCEL FILE	26KB	ASP	MYSQL	1.166 S	0.109 MB/S
8	IMAGE	425KB	ASP	MYSQL	0.826 S	0.529 MB/S
9	PDF FILE	2.06 MB	ASP	MYSQL	3.234 S	1.414 MB/S
10	SELECT QUERY		ASP	MYSQL	0.071 S	0
11	VIDEO	614KB	ASP	MYSQL	1.906 S	0.333 MB/S
12	WORD FILE	384KB	ASP	MYSQL	1.022 S	0.385 MB/S
13	EXCEL FILE	26 KB	ASP	Oracle	0.1 S	0.267 MB/S
14	IMAGE	425KB	ASP	Oracle	2.668 S	0.167 MB/S
15	PDF FILE	2.06 MB	ASP	Oracle	10.976 S	0.197 MB/S
16	SELECT QUERY		ASP	Oracle	1.996 S	0
17	VIDEO	614KB	ASP	Oracle	3.962 S	0.159 MB/S
18	WORD FILE	384KB	ASP	Oracle	3.295 S	0.119 MB/S
19	EXCEL FILE	26 KB	ASP	SQL Server	0.093 S	0.285 MB/S
20	IMAGE	425KB	ASP	SQL Server	0.988 S	0.444 MB/S
21	PDF FILE	2.06 MB	ASP	SQL Server	2.857 S	0.758 MB/S
22	SELECT QUERY		ASP	SQL Server	0.139 S	0
23	VIDEO	614KB	ASP	SQL Server	1.622 S	0.388 MB/S
24	WORD FILE	384KB	ASP	SQL Server	1.014 S	0.39 MB/S

5.2.2 Testing and Evaluation Databases in 2TA by PHP middleware

The four databases were tested by PHP middle in 2TA for the different files such as (image, video, PDF, word, excel, and select query). Table 6 explains the average RT and TT for each database by PHP web technology in 2Tier.

5.2.3 Testing and Evaluation databases in 2TA by PYTHON middleware

Meaning that the 4 databases tested by PYTHON middleware in 2TA for the different files such as (image, video, PDF, word, excel, and select query). Table 7 explains each database's average response time and throughput by python web technology in 2TA.

6 Results and Discussion

In 1TA and 2TA, the testing results are represented using graphical charts and statistical histograms. The charts clearly show that MS Access has a higher response time and MYSQL has a lower response time, in respect throughput, oracle has higher throughput, and MS-Access has a lower throughput rate than other DBMSs; Figure 11 represents

Table 6: Average RT and TT for each DBMS in 2TA by PHP middleware

N	File type	Size	Web Technology	Databases	Response time	Throughput
1	EXCEL FILE	26KB	PHP	MS-ACCESS	0.399 S	0.068 MB/S
2	IMAGE	425KB	PHP	MS-ACCESS	0.729 S	0.602 MB/S
3	PDF FILE	2.06 MB	PHP	MS-ACCESS	6.763 S	0.324 MB/S
4	SELECT QUERY		PHP	MS-ACCESS	0.272 S	0
5	VIDEO	614KB	PHP	MS-ACCESS	1.633 S	0.431 MB/S
6	WORD FILE	384KB	PHP	MS-ACCESS	0.638 S	0.616 MB/S
7	EXCEL FILE	26KB	PHP	MYSQL	0.378 S	0.071 MB/S
8	IMAGE	425KB	PHP	MYSQL	1.226 S	0.455 MB/S
9	PDF FILE	2.06 MB	PHP	MYSQL	10.29 S	0.432 MB/S
10	SELECT QUERY		PHP	MYSQL	0.585 S	0
11	VIDEO	614KB	PHP	MYSQL	1.028 S	0.627 MB/S
12	WORD FILE	384KB	PHP	MYSQL	1.442 S	0.35 MB/S
13	EXCEL FILE	26 KB	PHP	Oracle	0.33 S	0.081 MB/S
14	IMAGE	425KB	PHP	Oracle	1.417 S	0.425 MB/S
15	PDF FILE	2.06 MB	PHP	Oracle	5.389 S	0.641 MB/S
16	SELECT QUERY		PHP	Oracle	0.629 S	0
17	VIDEO	614KB	PHP	Oracle	1.9 S	0.473 MB/S
18	WORD FILE	384KB	PHP	Oracle	1.421 S	0.369 MB/S
19	EXCEL FILE	26 KB	PHP	SQL Server	0.411 S	0.065 MB/S
20	IMAGE	425KB	PHP	SQL Server	0.765 S	0.582 MB/S
21	PDF FILE	2.06 MB	PHP	SQL Server	11.275 S	0.263 MB/S
22	SELECT QUERY		PHP	SQL Server	0.623 S	0
23	VIDEO	614KB	PHP	SQL Server	1.6 S	0.584 MB/S
24	WORD FILE	384KB	PHP	SQL Server	1.513 S	0.342 MB/S

Table 7: Average RT and TT for each DBMS in 2TA by PYTHON middleware

N	File type	Size	Web Technology	Databases	Response time	Throughput
1	EXCEL FILE	26KB	PYTHON	MS-ACCESS	0.347 S	0.077 MB/S
2	IMAGE	425KB	PYTHON	MS-ACCESS	2.462 S	0.205 MB/S
3	PDF FILE	2.06 MB	PYTHON	MS-ACCESS	22.653 S	0.096 MB/S
4	SELECT QUERY		PYTHON	MS-ACCESS	0.66 S	0
5	VIDEO	614KB	PYTHON	MS-ACCESS	1.881 S	0.343 MB/S
6	WORD FILE	384KB	PYTHON	MS-ACCESS	1.095 S	0.368 MB/S
7	EXCEL FILE	26KB	PYTHON	MYSQL	0.269 S	0.101 MB/S
8	IMAGE	425KB	PYTHON	MYSQL	0.949 S	0.556 MB/S
9	PDF FILE	2.06 MB	PYTHON	MYSQL	3.96 S	0.632 MB/S
10	SELECT QUERY		PYTHON	MYSQL	0.636 S	0
11	VIDEO	614KB	PYTHON	MYSQL	0.843 S	0.748 MB/S
12	WORD FILE	384KB	PYTHON	MYSQL	0.576 S	0.683 MB/S
13	EXCEL FILE	26 KB	PYTHON	Oracle	0.267 S	0.101 MB/S
14	IMAGE	425KB	PYTHON	Oracle	0.736 S	0.631 MB/S
15	PDF FILE	2.06 MB	PYTHON	Oracle	1.285 S	1.813 MB/S
16	SELECT QUERY		PYTHON	Oracle	0.611 S	0
17	VIDEO	614KB	PYTHON	Oracle	1.521 S	0.716 MB/S
18	WORD FILE	384KB	PYTHON	Oracle	0.808 S	0.565 MB/S
19	EXCEL FILE	26 KB	PYTHON	SQL Server	0.3 S	0.095 MB/S
20	IMAGE	425KB	PYTHON	SQL Server	0.93 S	0.584 MB/S
21	PDF FILE	2.06 MB	PYTHON	SQL Server	5.247 S	0.425 MB/S
22	SELECT QUERY		PYTHON	SQL Server	0.638 S	0
23	VIDEO	614KB	PYTHON	SQL Server	0.853 S	0.754 MB/S
24	WORD FILE	384KB	PYTHON	SQL Server	0.619 S	0.643 MB/S

the average Response Time and Throughput for each database in 1TA. Figure 12 represents the average Response Time and Throughput for each database in 2TA.

Figure 13 represents the average execution time and Throughput for the MS-Access database by three different web technology in 1TA, Figure 14 represents the average execution time and Throughput for the MYSQL database by three different web technology in 1TA, Figure 15 represents the average execution time and Throughput for ORACLE database by three different web technology in 1TA, Figure 16 represents the average execution time and Throughput for SQL Server databases by three different web technology in 1TA.

Figure 17 represents the average execution time and Throughput for the MS-Access database by three different web technology in 2TA, Figure 18 represents the average execution time and Throughput for the MYSQL database by

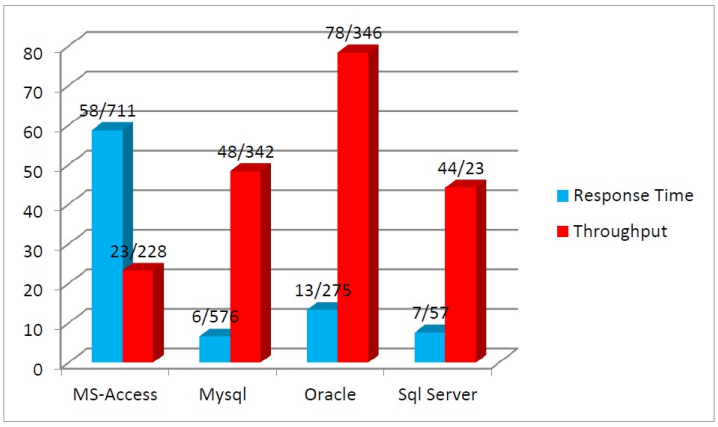

Figure 11: Average Response time and Throughput in 1TA

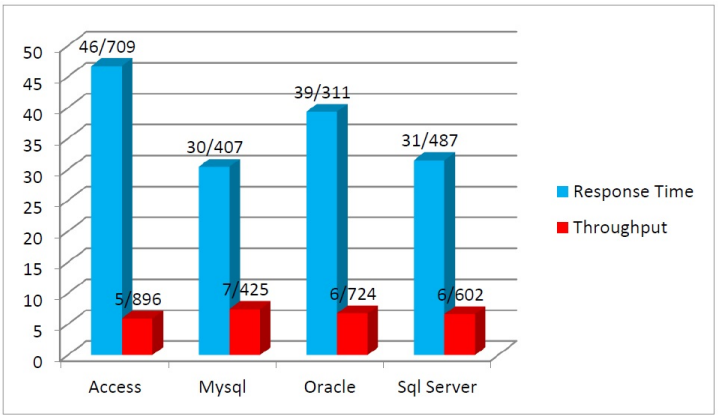

Figure 12: Average Response time and Throughput in 2TA

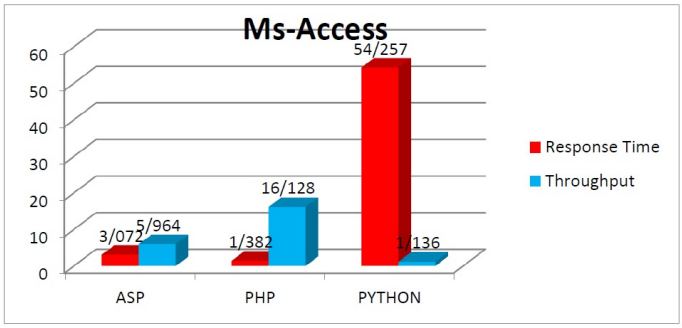

Figure 13: Average Response time and throughput for MS-Access in 1TA

three different web technology in 2TA, Figure 19 represents the average execution time and Throughput for ORACLE database by three different web technology in 2TA, Figure 20 represents the average execution time and Throughput for SQL Server databases by three different web technology in 2TA.

7 Conclusion

The Conclusion shows that the new modifications have occurred in database backend for general evaluation by TT and RT parameters: the results showed that the MYSQL is the fastest in DBMS because it has less RT (in seconds) in One-Tier architecture 1TA and 2TA. Nevertheless, MYSQL with Python over 1TA outcome is best. Furthermore, the MYSQL with Python over 2TA outcome is another best result. Hence, the Python-MYSQL is run over 1TA and 2TA in best results if compared to others DBMSs. From that, found out the Python-MYSQL is best of the web

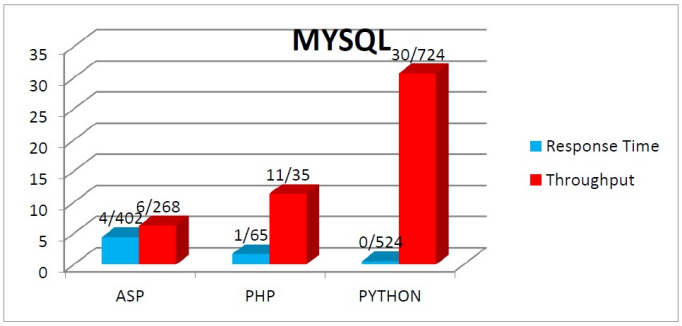

Figure 14: Average Response time and throughput for MYSQL in 1TA

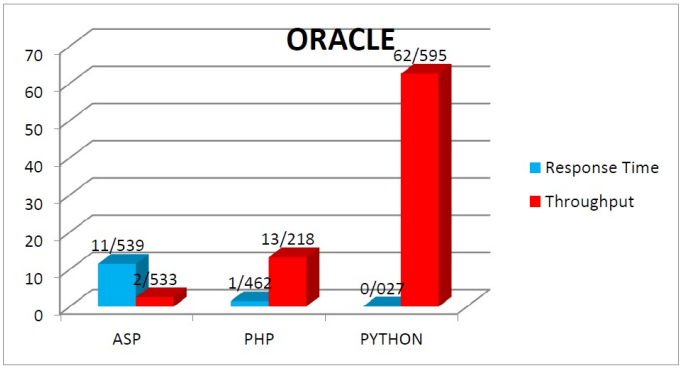

Figure 15: Average Response time and throughput for Oracle in 1TA

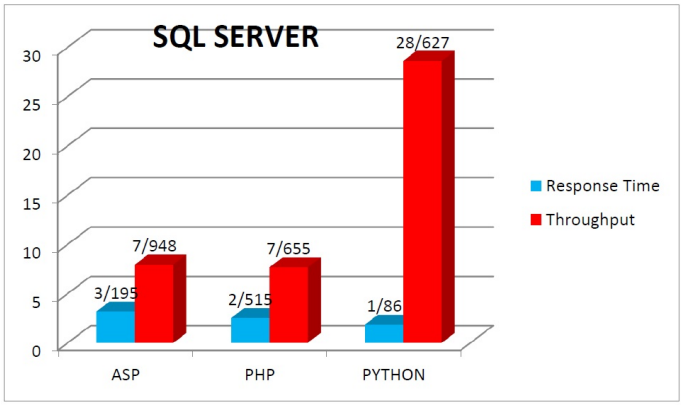

Figure 16: Average Response time and throughput for SQL Server in 1TA

technologies in seconds RT parameter. Nevertheless, the MS Access backend database quality of performance has a higher/OR more Response time in seconds than other DBMSs in both (1TA) and (2TA) and means that is not good enough then the other. The TT was different, and Oracle is the best DBMS that has the large throughput rate in 1TA. But in 2TA the MYSQL came in first on the list. However, MS Access has lower throughput in both 1TA and 2TA. In the Oracle database, backend results show indirect relation between throughput and Response time; thus, the TT is very large but still not first and not before other databases in RT.

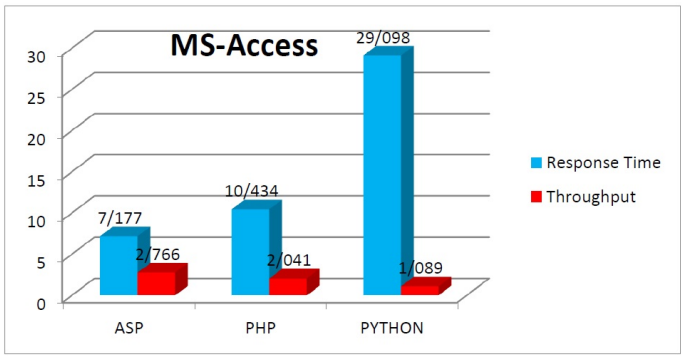

Figure 17: Average Response time and throughput for MS-Access in 2TA

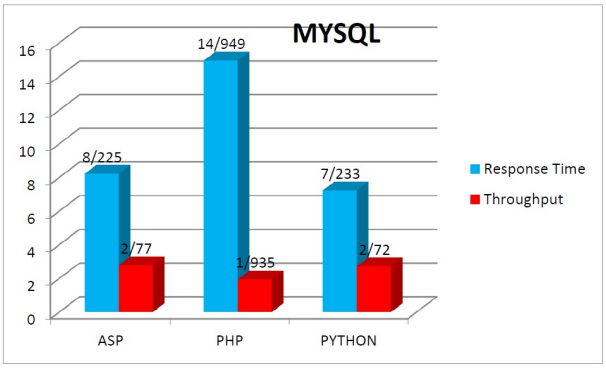

Figure 18: Average Response time and throughput for MYSQL in 2TA

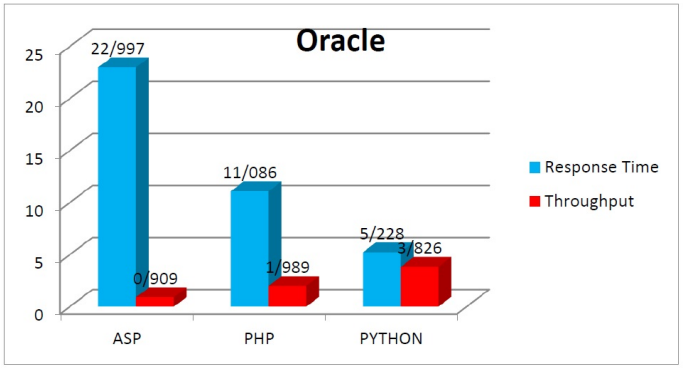

Figure 19: Average Response time and throughput for Oracle in 2TA

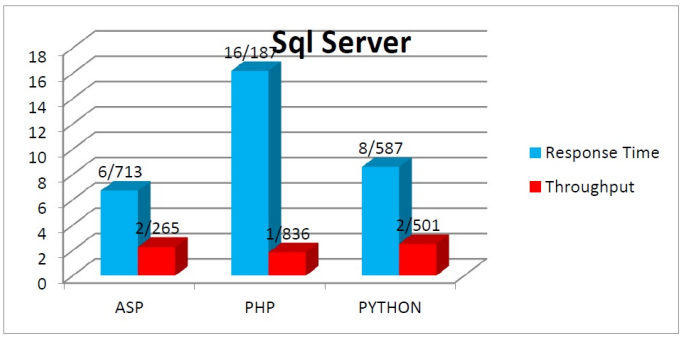

Figure 20: Average Response time and throughput for Oracle in 2TA

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