

Measuring Of Data Base Performance Using Oracle

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ABSTRACT

Due to the tremendous increase in the manufacturing of computer and producing high speed and performance computers, it was very important to find new methods for distinguishing its efficiency, performance and characteristics.

Optimization method can be defined as a process of choosing the most efficient way to execute DML statements such as (select, insert, update and delete).

In this research, performance efficiency of two different computers specifications by using Oracle system (9i) has been measured, in addition to distinguishing the performance between these two computers, on different data sizes (1000, 5000, 80000,300000 and 600000 records). (SQL) as tools for any comparison can be achieved by the statistical performance parameters (Cpu time , Logical block read ,physical block read, physical block write, Process Global Area memory, Execution time). Update command effect on the parameters Cpu-time, logic_read, phy_read, Phy_Write was higher than select command specially at record number (600000) for both computers. Also, Values of these parameters increased by increasing data size (number of records). The parameters (PGA memory in use, exe_time) gave ununiform results by increasing data size.

The effect of selection and update commands in computer1 on (Cpu_time, logic_read, phy_read, Phy_Write) parameters values were significantly higher compared to computer2 . While, the values of (PGA memory in use, exe_time) parameters in computer2 for both select and update commands were higher compared with computer1, but it was not significant.

Keywords: Oracle system (9i), some measurement methods.

قياس أداء قاعدة البيانات باستخدام أوراكل

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المخلص

نظراً للتطور السريع الحاصل في صناعة أجهزة الحاسوب بحيث أصبح الأداء وسرعة تنفيذ الأوامر مهمة جداً، لذا من الضروري معرفة كفاءة أداء الحواسيب وأفضليتها في انجاز العمل وتنفيذ الأوامر للحصول على النتائج بالدقة والسرعة المطلوبة، تعد الأمثلية عملية اختيار أكفأ الطرائق في تنفيذ إيعازات لغة معالجة البيانات Data Manipulation Language مثل (select, insert, update, delete).

تم في هذا البحث قياس كفاءة الأداء لحاسبتين مختلفتين بالمواصفات باستخدام نظام أوراكل (9i)، ومعرفة الفرق بين الحاسبتين في الأداء، وعلى أحجام بيانات مختلفة (1000، 5000، 8000، 30000 و 600000) قيد. وتم تقييم لغة معالجة البيانات المتمثلة بإيعاز select وإيعاز update تقييماً إحصائياً بوصفها أداة من خلال المعلمات الآتية: [وقت تنفيذ وحدة المعالج المركزي (cpu_time)، القراءة المنطقية، القراءة الفيزيائية للكتل البيانية (logic_read, phy_read)، الكتابة الفيزيائية للكتل البيانية (Phy_Write)، المساحة المستخدمة لل Program Global Area (PGA) ووقت التنفيذ (exe_time)]. وكان تأثير الأمر (update) على المعلمات (Cpu-time،

logic_read, phy_read, Phy_Write] اكثر من الأمر (select) خاصة عند عدد القيود (600000) وفي
[PGAmemory اما المعلمتان (عدد القيود)، اما المعلمتان
in use, exe_time] فقد أعطتا نتائج متباينة بزيادة حجم البيانات.
وقد كان تأثير الأمرين select و update على الحاسبة الاولى (computer1) للمعلمتان
[Cpu_time, computer2) للمعلمتان (computer2)، حيث كانت
logic_read, phy_read, Phy_Write] اكبر من تأثيره على الحاسبة الثانية (computer2)، حيث كانت
القيم المأخوذة من (computer1) اكبر من القيم التي تم اخذها من الحاسبة الثانية (computer2) لكافة احجام
البيانات، اما المعلمتان [PGA memory in use, exe_time] فقد اخذتا قيم أعلى في الحاسبة الثانية
(computer2) مقارنة مع القيم المأخوذة من الحاسبة الاولى (computer1) ولكنها لم تكن مختلفة معنوياً.
الكلمات المفتاحية : نظام أوراكل (9i)، بعض طرائق القياس

1. Introduction

Oracle is designed to be a very portable database; it is available on every platform of relevance, from Windows to UNIX to mainframes. For this reason, the physical architecture of Oracle looks different on different operating systems. For example, on a UNIX operating system, Oracle implemented as many different operating system processes, with virtually a process per major function. On UNIX, this is the correct implementation, as it works on a multi-process foundation. On Windows, however, this architecture would be inappropriate and would not work very well (it would be slow and non_scalable). On the Windows platform, Oracle is implemented as a single, threaded process [1].

Oracle's memory structure consists of two memory areas known as:

1-System Global Area (SGA): Allocated at instance startup, and is a fundamental component of an Oracle Instance.

2-Program Global Area (PGA): Allocated when the server process is started System Global Area [13].

1- System Global Area (SGA)

• **The SGA consists of several memory structures:**

- Shared Pool.
- Database Buffer Cache.
- Redo Log Buffer.
- Other structures (for example, lock and latch management, statistical data).

• **There are two additional memory structures that can be configured within the SGA:**

- Large Pool.
- Java Pool.

• **SGA is dynamic.**

• **Sized by the SGA_MAX_SIZE parameter.**

• **Used to store:**

- Most recently executed SQL statements
- Most recently used data definitions

• **It consists of two key performance-related memory structures:**

- Library Cache.
- Data Dictionary Cache.

• **Sized by the parameter SHARED_POOL_SIZE Library Cache.**

• **Stores information about the most recently used SQL and PL/SQL statements.**

• **Enables the sharing of commonly used statements.**

- **Is managed by a least recently used (LRU) algorithm.**
- **Consists of two structures:**
 - Shared SQL area.
 - Shared PL/SQL area.
- **Size determined by the Shared Pool sizing Data Dictionary Cache.**
- **A collection of the most recently used definitions in the database.**
- **Includes information about database files, tables, indexes, columns, users, privileges, and other database objects.**
- **During the parse phase, the server process looks at the data dictionary for information to resolve object names and validate access.**
- **Can be dynamically resized.**
- **DB_CACHE_ADVICE set to gather statistics for predicting different cache size behavior.**
- **Statistics displayed by V\$DB_CACHE_ADVICE Redo [13].**

2- Program Global Area

- Memory reserved for each user process connecting to an Oracle Database.
- Allocated when a process is created.
- Deallocated when the process is terminated.
- Used by only one process [13].

With the release of Oracle 9i, Oracle Corporation has provided database administrators powerful and efficient techniques to control instance memory. Database Administrators (DBAs) can now dynamically resize System Global Area (SGA) memory components on the fly without shutting down the database. DBAs can control the Program Global Area (PGA) memory utilization at the instance level using new SQL memory management techniques. For the first time, DBAs can use these novel SQL memory management techniques to prevent the PGA memory size from growing abnormally. The “optimal” settings previously used to set PGA configuration parameters are no longer flexible enough to accurately predict behavior such as the application workload over extended periods. Oracle has introduced a single configuration parameter `PGA_AGGREGATE_TARGET` that provides a comprehensive, adaptive and robust solution that allows DBA to control and automate SQL memory management. Oracle with the 9i release introduced a set of server-based advisories that help DBAs resize memory components optimally and dynamically [5].

The steps that SQL statements passing through can be summarized as follows:

- 1- Connecting to the instance and creating user process and servering process.
- 2-If the desired data is not available in the database buffer cache, then the server process will fetch the data from data files.
- 3-The server process puts locks on data that are modified, and the server process stores the genuine data (before the modifying) in region called (Rollback (segment)) block. So, the user can retrieve the genuine data if the rollback command is selected instead of commit command.
- 4-If commit command is selected, then the modifying data will be transferred to data files [6].

1.1 Aim and Objectives:

The aim of this research is to measure performance efficiency of two different computers specifications by using Oracle system (9i) on different data size and in addition to distinguishing the performance between these two computers. This study

supports the Corporation in making suitable decision to choose the best computer specifications that accommodate as much as possible of data size (number of records), and the faster in the execution. These results can be proved by using Statistical Analysis System (SAS).

A case study is the use of a number of DML commands such as (select and update):

to find the performance of reading and writing operations in Oracle system with using two computers which were different in their specifications:

1- select: a command used to retrieve data from tables (reading command).

2- update: a command used to modify existing data in the tables (writing command). On the following parameters:

1- Cpu time (cpu_time):

The amount of central processing unit time used by the session the call began [14].

2- Logical reads (logic_read):

It represents the number of logical readings per second during sample period. A logical readings is reading request for data block for the SGA. Logical readings may result in a physical reading if the requested block does not reside with buffer cache [14].

3- Physical read (phy_read):

This data item represents the number of data blocks reading from disk per second during the sample period [14].

4- Physical write (phy_write):

Number of times database write (DBWR) [14].

5- Process Global Area memory (PGA memory in use):

PGA memory is a memory region that contains data and controls information for a single process (server or background process). The PGA memory contains a number of parameters, and the value that it was taken is (PGA memory in use), measured by bytes [14].

6- Execution time (exe_time):

The execution amount of time it took the statement to execute. [7]. It was taken from Toad software, measured by millisecond.

The limiting ability of using another database system such as access, could not be used to test and determine the efficiency of any DML statements by using special commands to bring out the values of the desired parameters. Also, there are no tools which can connect the user with Data Base system as in Oracle.

2. Data:

Data consist of facts, text, graphics, images, sound and video segments that have meaning in the user's environment [12].

A database is a place where you store data. Databases can store three different types of data:

_ **Common data:** Which can include numbers, dates, and strings of characters, such as names and addresses.

_ **Complex and large data:** There are many data types that can be stored and managed by a database, such as sound, geographical data such as maps, pictures, graphics, and even videos.

_ **User defined data:** Most modern database systems also allow the user to store new data types that they define and want to manipulate, as objects [9].

The language is used to describe what data the applications require and the relationship is called Structured Query Language (SQL).

SQL is a database computer language designed for managing data in relational database management systems (RDBMS), and originally based upon relational Algebra [8 and 3].

3. Procedure and Methods:

In this research, two computers have been used, they were different in their specifications:

Computer1

Name : Acer Laptop
Pentium (R) Dual – core cpu,
1 M cache L2 T4300 @ 2.10 GHZ, 2.09GH
(2 GB of Ram)
HDD : 250 G

Computer2

Name : Dell Laptop
Intel (R) core (TM02 Duo Cpu,
2M cache L2 T7250 @ 2.00 GHZ, 778 MHZ
(2 GB of Ram)
HDD : 120 G

The following steps have been performed in both computers:

- 1- Installing windows XP SP2 system (32 bit).
- 2- Installing Oracle 9i Release 1 (9.0.1) system.
- 3- Creating a new user name by using SQL Plus 8.0 tool, by using the following commands:

```
create user optim identified by a;  
grant dba to optim;  
grant connect to optim;
```

- 4- Creation the tables by using SQL Plus 8.0 tool for getting the differentiation in size (1000, 5000, 80000,300000 and 600000 records), measured by kilo byte (KB), to find the effect of the data size on the studied parameters. The following statement shows the creation of the first table:

```
create table enr_info1(  
std_no number(20),  
std_name varchar2(50),  
std_id number(10),  
std_address varchar2(50),  
std_examno number(30),  
std_enryear date,  
std_bran varchar2(20),  
std_sucrol varchar2(30),  
std_schname varchar2(30),  
std_totbef number(10,5),  
std_totaft number(10,5));
```

- 5- Inserting data into the created tables, by using the following statements:

```
declare  
i number(10):=0;  
begin  
while i <1000  
loop
```

```
i:=i+1;  
insert into enr_info1 (std_no, std_name, std_id, std_address, std_examno,  
std_enryear, std_bran, std_sucrol, std_schname, std_totbef, std_totaft)  
values (i, 'Ahmed Mohammed Ali', 2440, 'Iraq-mosul', 1233432400, '1-10-  
2010', 'scientific', 'first', 'Omar-Ben Abd Al-Azeez', 80, 82 );  
commit;  
end loop;  
exception  
when others then null;  
end;
```

6-Using (Toad for Oracle 9.5 software) to contact with Oracle system. Toad (Tool for Oracle Application Developers) is a powerful application development tool, which can be used to build and test pl/SQL packages, procedures, triggers, and functions, also creates and edits database tables, views, indexes, constraints, and users. Code can be created from shortcuts and code templates [4]. Before performing the measurement of the studied parameters, the size of the created tables will be taken by the following sequence:

Database —→ **schema Browser** —→ **Enr-info1** —→ **Status size**

7-By using the SQL-style editors, the select and update commands have been written. Then, the desired values for each parameter (cpu_time, logic_read, phy_read, Phy_Write, PGA memory in use and exe-time) will be appeared. For example: to execute the value of (cpu_time) parameter for the selection of commands, the following statement was used:

```
select std_no, std_name from enr_info1;
```

After this command has been executed by using Execute Statement bottom, then,

1. cpu_time parameter measuring will be written:

```
select value cpu from v$sysstat where name='CPU used by this session';
```

After this command has been executed, the value of (cpu_time) parameter will appear.

The same operation applied on the studied parameters instructions:

2. logic_read parameter:

```
select value logic_read from v$sysstat where name='session logical reads' ;
```

3. phy_read parameter:

```
select value phy_read from v$sysstat where name='physical reads' ;
```

4. phy_write parameter:

```
select value phy_wr from v$sysstat where name='physical writes';
```

5. PGA memory in the use of parameter: **select * from V\$PGASTAT;**

6. The (exe_time) parameter: was executed by Toad software without applying any statement to execute its value (as have been done with other parameters).

7- For update command, the following statement was written:

```
update enr_info1
```

```
set std_name= 'Ahmed Mohammed zaki' where std_id=2440;
```

This process was repeated for three times (to get three replications) for each variable of select and update commands, this is because of the difference between the replications implemented experimental error. This process is repeated for each study of parameters for this research, and for all the created tables.

8- The values that are extracted from toad software have been recorded in tables (table 1), and analyzed statistically by using Statistical Analysis System [10], tables of

Analysis of Variance (ANOVA), which is obtained to indicate the significant differences between the following variables:

- 1- size of data table.
- 2-computer specifications.

Duncan’s multiple range test [15], was used to distinguish the significant differences between level means of each variable (size of data (table 2) and computer specifications (table3)), by giving them letters (A,B,C,D...etc) levels values of each variable (parameter) containing different letters which means that were significant differences between these level. Such as in (table 2), the number of records of (cpu_time) parameter of select command contain different letters which means that these were significant difference between them, while (logic_read) parameter of select command contains the same letter for all record number levels which means that there were no significant differences between theme. Used SAS statement was used as follows:

```
proc anova; class a r;
model exectime cputime logread phyread phywrit pgamem=a;
means a /duncan;
run;quit;
```

By using the Excel system, the means was converted into curves.

Table (1): data of studied parameters for computer1:

No. rec.	SQL inst.	Size (byte)	Exe_time (msecs)	Cpu_time (msecs)	Logic_read (per sec)	Phy_read (per sec)	Phy_write (number)	PGA_mem (byte)
1000	select	144 KB	1	8228	4565641	117688	236309	7788544
	Select		15	8228	4565660	117688	236309	7767040
	Select		1	8228	4565679	117688	236309	7767040
	update		31	8233	4566821	117688	236309	7767040
	update		47	8236	4569097	117688	236309	7767040
	update		32	8239	4570102	117688	236309	7767040
5000	Select	8.4 MB	1	8270	4740502	119191	249931	7768064
	Select		1	8271	4740568	119191	249931	7769088
	Select		15	8271	4740587	119191	249931	7769088
	update		875	8360	4795101	119193	251899	7769088
	update		1000	8449	4849615	119195	252884	7769088
	update		1000	8539	4904133	119205	254593	7769088
80000	Select	13 MB	15	9476	5547613	121577	282358	7770112
	Select		1	9476	5547632	121577	282358	7770112
	Select		15	9476	5547651	121577	282358	7770112
	update		1000	9629	5634863	121585	286212	7770112
	update		1000	9764	5722077	121585	288637	7770112
	update		1000	9903	5809303	121585	291917	7770112
300000	Select	42 MB	15	11354	7401268	174589	456928	7771136
	Select		1	11354	7401287	174589	456928	7771136
	Select		16	11354	7401306	174589	456928	7771136
	update		9000	11898	7728386	183399	473227	7771136
	update		11000	12464	8055451	192226	491963	7771136

	update		9000	13039	8382531	201054	507578	7771136
600000	Select	95 MB	16	18698	12634176	342337	849246	7775232
	Select		1	18698	12634195	342337	849246	7775232
	Select		15	18698	12634214	342337	849246	7775232
	update		19000	19809	13288240	359981	883769	7775232
	update		19000	20870	13942309	377640	921239	7775232
	update		19000	21935	14596335	395299	957410	7775232

4. Results of Work and Discussion:

1-Effect of the data size on the studied parameters

As in the flowing Duncan’s multiple range test for means table:

Table(2): Duncan analysis showing the effect of number of record of select and update commands on the studied parameters of computer1.

SQL	PARAMETERS	NUMBER OF RECORD				
		1000	50000	80000	300000	600000
select	Exe_time (msecs)	1.000 B	15.333 A	10.667 AB	15.000 A	6.000 AB
	Cpu_time (msecs)	9075 E	9114 D	10407 C	12641 B	20293 A
	Logic_read (per sec)	5084014 A	5258108 A	6119778 A	8147911 A	10053521 A
	Phy_read (per sec)	134176 E	135363 D	14341767 C	201944 B	396406 A
	Phy_write (number)	260677 E	283915 D	341730 C	524078 B	972037 A
	PGA_mem (byte)	7653264 A	7560192 A	7561216 A	7564971 A	7568043 A
update	Exe_time (msecs)	47 D	1000 D	4000 C	11000 B	21000 A
	Cpu_time (msecs)	9083.0 D	9315.7 D	10717.3 C	13783.3 B	23556 A
	Logic_read (per sec)	5085146 D	5367189 D	6294228 C	8802110 B	15670274 A
	Phy_read (per sec)	134176 C	135413 C	145600 C	219585 B	431725 A
	Phy_write (number)	260677 D	288744 D	349100 C	560174 B	1044730 A
	PGA_mem (byte)	7556096 E	7560192 D	7561216 C	7565312 B	7568384 A

Values with the same letter in each row are not significantly different

1. (cpu_time) parameter:

Figure (2) shows that (cpu_time) parameter had the same behavior for select and update commands for computer1 and increased significantly with the increasing data size. Since by enlarging data size, more time was needed for execution and handling this data from the microprocessor. These increases were the highest at number of records (600000) and the effect of update command was higher than select command specially at record number (600000). The same behavior was obtained from computer2.

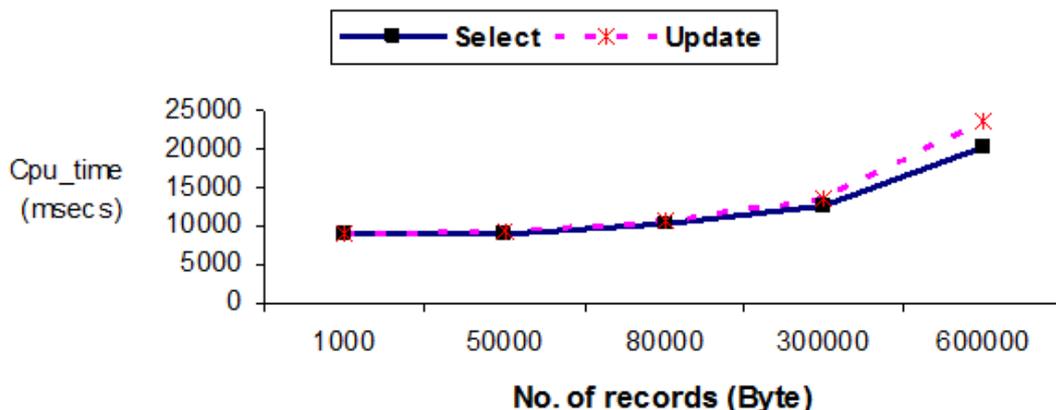


Figure (2): The effect of number of records on the (cpu_time) parameter, for select and update commands for computer1.

2. (logic_read) parameter:

From figure (3) values of the amount of logic read per second increased by increasing size of data for computer1 and, this increase may be due to the requested reading for a data block from the SGA (memory found in Oracle) which may cause physical reading from the disk if the requested block does not exist in the buffer cache (temporary storage in the SGA), this will increase the value by increasing data size. The same behavior was obtained from computer2.

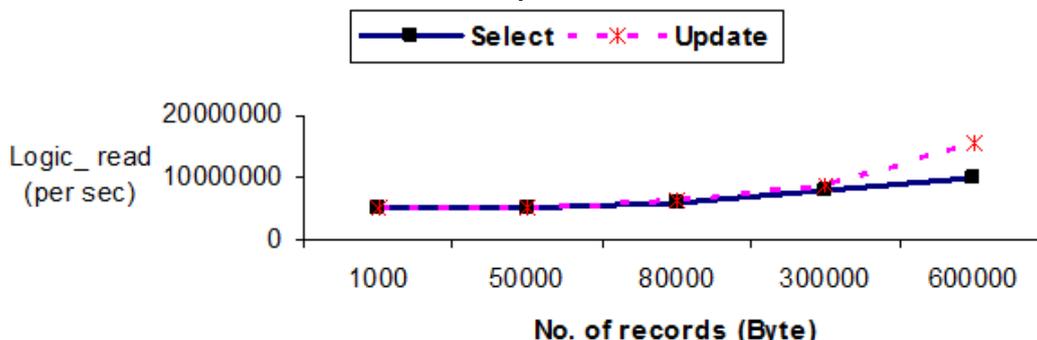


Figure (3): The effect of number of records on (logic_read) parameter, for select and update commands for computer1.

3. (phy_read) parameter:

Figure (4) indicates that the number of records of reading blocks from disk per second increased by increasing of data size for computer1. When SQL statement is executed, Oracle tries to retrieve the data from the buffer cache if it is not existed then, Oracle search from the disk, and this may be the reason for the increasing of the values by increasing data size. But, reading from the disk will be inefficient comparing with the reading from memory, and the goal of Oracle is to maximize memory utilization. The same behavior was obtained from computer2.

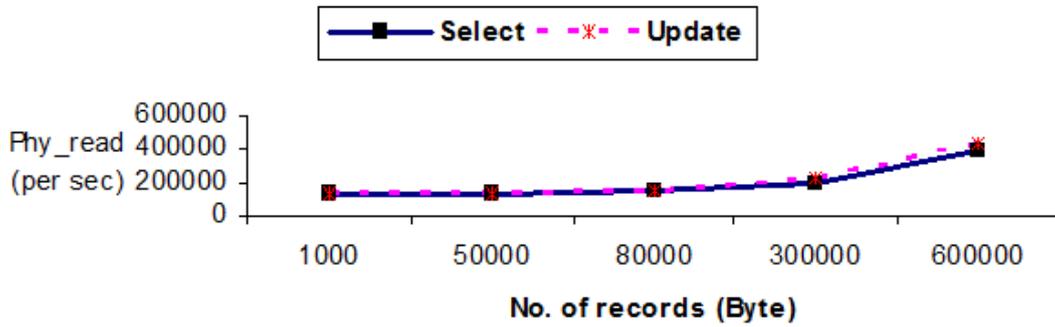


Figure (4): The effect of number of records on (phy_read) parameter for select and update commands for computer1.

4. (phy_write) parameter:

Figure (5) shows the behavior of the parameter (phy_write) when increasing data size, the values increased with the increasing data size for computer1. The same behavior was obtained from computer2.

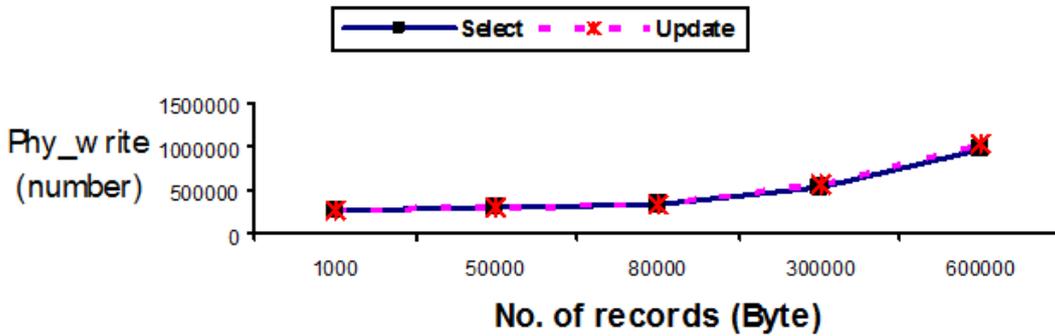


Figure (5): The effect of number of records on the (phy_write) parameter, for select and update commands for computer1.

5. (PGA memory in use) parameter:

PGA memory in the use of parameters values gives non_uniform and fluctuated results by increasing table size for computer1. As shown in the following figures:

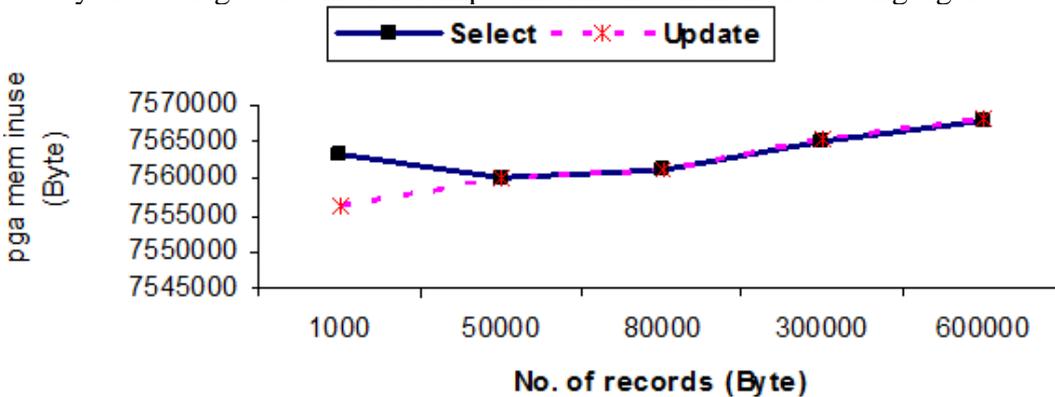


Figure (6) The effect of number of records on (PGA memory in use) parameter for select and update commands of computer1.

The reason for this behavior is that the PGA memory in the use of parameters was not affected by select command. The same behavior was obtained from computer2.

6. (exe_time) parameter:

Figure (7A) indicates that there was irregular behavior of (exe_time) parameter by increasing data size for select command for computer1. While, Figure (7B) shows steady increase of (exe_time) parameter by increasing data size when using update command specially after No. of records 80000 , this behavior may be related to the normally statement processing which consists of the parsing time (can occur once), the execution time and the fetching time (amount of time it took the user application to fetch records returned) usually cannot be accurately determined, who knows how one application performs a fetch, it may fetch one record, and another record two hours later). The "execution time" value is a second of the above three, a number of milliseconds that it took for the instruction OCISstmtExecute() to return, without taking into account fetching time. As to Explain Plan, SQL Monitor has a built-in execution plan display for quite some time [7]. The same behavior was obtained from computer2.

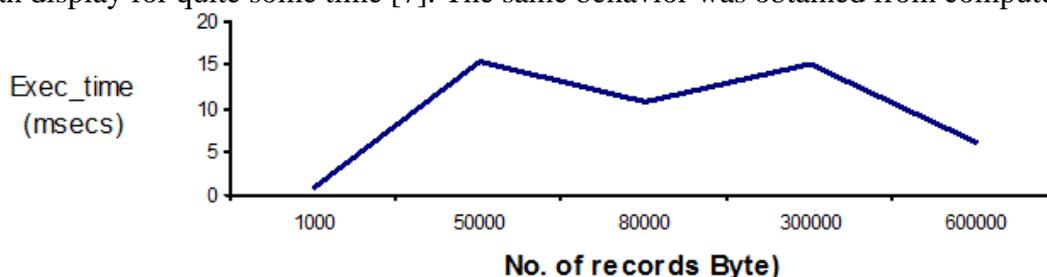


Figure (7A): The effect of number of records on (exe_time) parameter for select command of computer1.

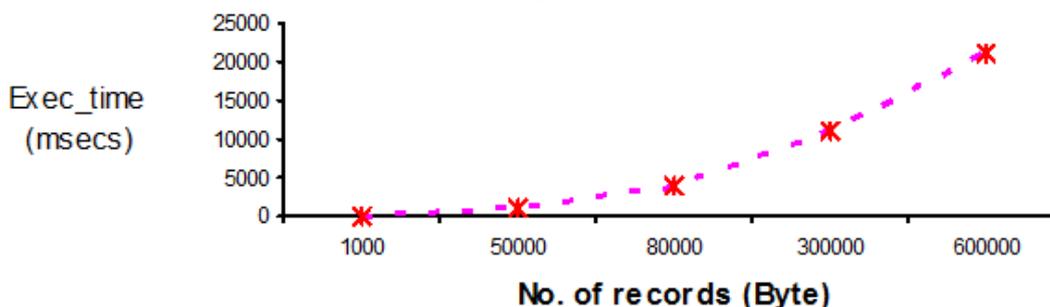


Figure (7B): The effect of number of records on (exe_time) parameter for update command of computer1.

Generally, these increases were the highest at number of records (300000) for (cpu_time, logic_read, phy_read, Phy_Write) parameters and the effect of update command was higher than select command specially at record number (600000) for both computers.

These parameters can be used in the evaluation of the performance of database by using Oracle language [2].

The two parameters (PGA memory in use, exe_time) cannot be used for the evaluation of database performance. The PGA memory in use parameters is not affected by select command because it is memory region that contains data and control information for a single process (server or background process) [14].

The (exe_time) parameter was executed by Toad software without applying any statement to execute its value (as have been done with other parameters) [7].

2- Effect of computer specifications on the studied parameters:

As in the flowing Duncan’s multiple range test for means table:

Table(3): Duncan analysis showing the significant differences on computer type on the studied parameters for select and update commands.

SQL	PARAMETERS	COMPUTER TYPE	
		Computer1	Computer2
select	Exe_time (msecs)	8.7 A	10.8 A
	Cpu_time (msecs)	16461 A	10782 B
	Logic_read (per sec)	9887242 A	6772881 B
	Phy_read (per sec)	246970 A	169320 B
	Phy_write (number)	511116 A	420102 A
	PGA_mem (byte)	7708371 A	7718566 A
update	Exe_time (msecs)	6473 A	6801 A
	Cpu_time (msecs)	17730 A	11590 B
	Logic_read (per sec)	10574929 A	7219777 B
	Phy_read (per sec)	257257 A	179089 B
	Phy_write (number)	534587 A	444490 A
	PGA_mem (byte)	7706470 A	7717213 A

Values same letter row are

significantly different.

with the in each not

a- The effect of select and update commands in computer1 on (Cpu_time, logic_read, phy_read, Phy_Write) parameters values was significantly higher compared to computer2, for example, the following figure:

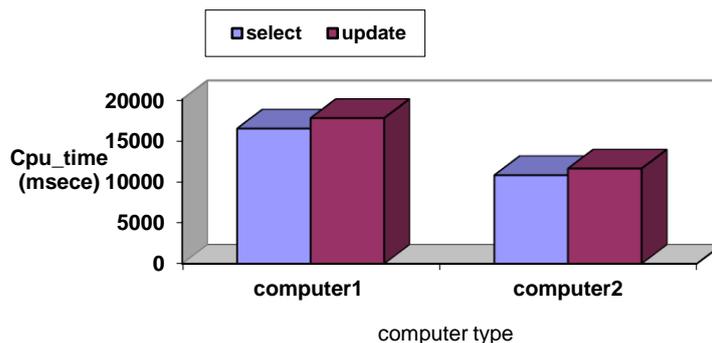


Figure (8): The effect of computer specifications on (cpu_time) parameter for select and update commands.

b- The values of (PGA memory in use, exe_time) parameters in computer2 for both select and update commands were higher compared with computer1, but these differences were not significant. For example, the following figure:

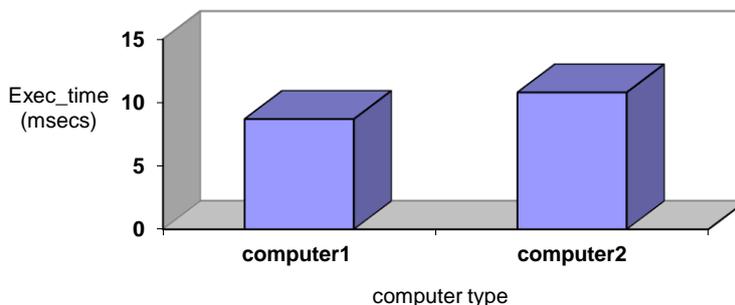


Figure (9A): The effect of computer specifications on (exe_time) parameter for select commands.

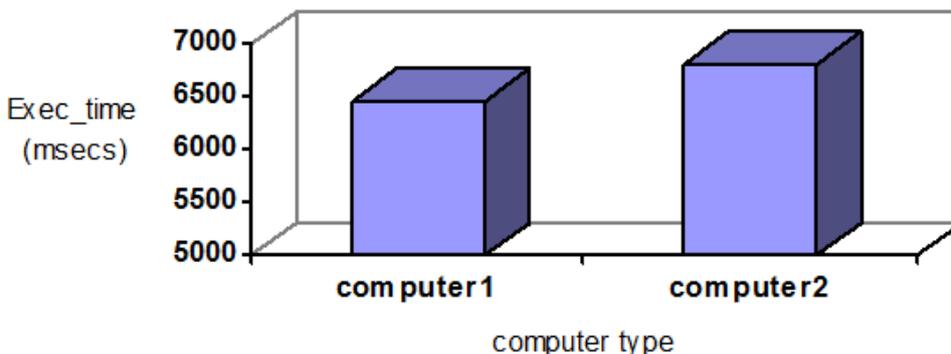


Figure (9 B): The effect of computer specifications on (exe_time) parameter for update commands.

From the results mentioned previously, it can be concluded that computer2 performs better than computer1 in CPU time consuming and in utilizing the memory comparing with computer1; this may refer to the better and higher specifications of computer2 such as (2 pieces of micro-processor, larger cache) compared with computer1 specifications [11].

5. Conclusions:

- 1- The values of the parameters (cpu_time, logic_read, phy_read, phy_write) will be increased by increasing the table size (number of records), these parameters can be used in the evaluation of the performance of database by using Oracle language. While, (PGA memory in use, exe_time) parameters values give non _uniform and

fluctuated results by increasing table size, so these two parameters cannot be used for the evaluation database performance for select command.

- 2- Computer2 is superior comparing with computer1 in executing-time speed and in utilizing the memory for obtaining the best values for the studied parameters. This result referred to the higher specifications of computer2 compared with computer1.
- 3- From the results obtained, it can be concluded that Oracle system is one of the most efficient and useful way to test and determine the efficiency of any SQL-statements by using special commands to bring out the values of the desired parameters.
- 4- Oracle system can be used to determine the best computer performance between different computer specifications.
- 5- Using oracle statistical analysis represented by Duncan's multiple range test for means table are very helpful in judgment between compromises, it enables to group the effect of data size and SQL language individually.

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