

Oracle DBMS Scheduler Package for Data Integrity Test on Web-Based Application

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Abstract—DBMS Scheduler Package is one of Oracle DBMS Packages that has the ability to perform automatic execution of data management at a predefined time. Oracle DBMS Scheduler is able to be integrated with Oracle Application Express on a web-based application. Web-based application can be accessed by a huge number of concurrent users that uses the same data on the database. On some conditions, users will not be allowed to change their data until the state of the current data is closed to maintain the data integrity, for example the scheduling data on university scheduling guidance between lecturers and students, where the student must not create another schedule until the existing schedule is closed. Data Integrity test is done by implementing web testing. This research found that the Oracle DBMS Scheduler Package is able to maintain data integrity on Web Based Application by closing the reservation schedule slot automatically.

Index Terms—Data Integrity Test; Oracle Application Express; Oracle DBMS Scheduler Package; Web Testing.

I. INTRODUCTION

It is common for lecturers to have a regular schedule in a semester, although there are times when the schedule is changed for some reasons. Besides indicating the lecturer's teaching slots, this schedule, which is repeated every week, also shows the lecturer's free time. These free time slots are not fixed, as sometimes they are utilized by unplanned or incidental activities. However, it is important for students to be informed of the lecturer's free time so that they can utilize this time for consultation with the lecturers. Empty slots owned by lecturers if published and known to students will facilitate the process of student's guidance without interrupting the work time of the lecturer. Nowadays, web-based application has been used to handle these activities [1].

Web-based application is a computer application that is run by a computer network, on internet or intranet. Web-based application consists of n-tier architecture, usually a 3-tier architecture. The first tier is a client tier, the second is a middle tier and the third is an information system tier [2]. A web server is located at the middle tier and the database is located at the information system tier.

Several techniques have already been used to ensure the functionality of a web-based application. Web testing is a technique to make a test on a website components and functionalities. There are several types of test usually implemented on a website, which are the user interface test, functional test, database test, installation test, configuration and compatibility test, and performance test. Data integrity test is a part of database test [3].

Oracle Database Management System (DBMS) has a built-in package that is able to execute SQL or PL/SQL objects automatically. This package is called DBMS Scheduler

Package. Like other database packages, DBMS Scheduler Package have names, created, modified or deleted actions. DBMS Scheduler Package can be run manually or automatically [4-7]. The Oracle DBMS is able to execute SQL commands; hence, it is able to implement OLTP actions along with the web server and the server side scripting. One of the problems of the OLTP is the existence of high-contention workloads that will disturb the system performance, when DBMS fails to handle the contention workloads due to unsuccessful handling of the data integrity, resulting from bad database design.

Oracle DBMS can be executed inside an Oracle APEX. Oracle APEX (Application Express) is a rapid application development tool that uses SQL and PL/SQL as its main programming language. Oracle APEX is able to develop web-based application and performs data management on the database directly, indicating that no programming language or other intermediaries are required to interact with the data. Oracle APEX has a calendar view feature that can be used to perform scheduling [8][9]. Based on my knowledge, there is a scarcity on the research of the usability of using DBMS Scheduler to handle data integrity on bad database design.

II. RELATED WORK

D.Chen and H. Zhou already make a research about 7 stages of data life cycle which are generation, transfer, use, share, storage, archival, and destruction. The data generation is the first stage that will influence the next stage. On web-based application this stage comes when user entering their data [3].

M. Alqahtani already create an online lecturer appointment system. This system able for arranging appointment between lecturer and student by a web-based application. In this application students able to book an appointment or cancel the appointment [1].

D. Parchment and S. Sankaranarayanan create a mobile student-staff scheduling system. It able for scheduling students and lecturers, scheduling HOD and lecturers and scheduling between lecturers. The system stored the appointments of the staff on their personal mobile handset into a database to prevent any failure in appointment negotiation [10].

III. RESEARCH METHODS

The conduct of this research involves four phases: The first phase was creating web-based application by using Oracle Application Express. Several design processes need to be done before creating the web-based application, which are designing the business process with Data Flow Diagram

(DFD) and Flow Chart.

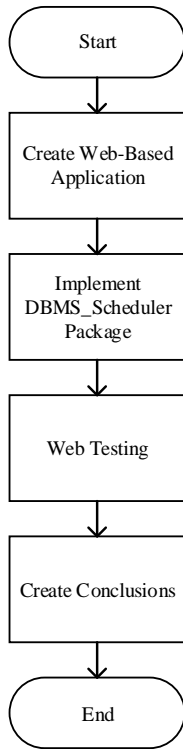


Figure 1: Research methods

The second phase was implementing DBMS Scheduler Package into the application. This phase was done by creating some PL/SQL scripts and placing them into the application workflow.

The third phase was doing a web testing. Functional test, usually called black box test was implemented in this phase. Test scenario should be arranged before doing the test. Each point of the test scenario was implemented against the application. In this phase, a database with loose data integrity constraint was used. Some table attributes with high contention workloads were evaluated by implementing DBMS Scheduler.

The final step was creating the conclusions. All of the test scenario points were evaluated to determine whether they meet the expectation or not.

IV. ORACLE PL/SQL

Oracle PL/SQL is a Procedural Language that integrates SQL (Structured Query Language) with algorithmic structure to manage data in the database. Oracle PL/SQL has the advantages of other programming languages because it is embedded in the database during the database installation process (DBMS)[5].

Table 1
Mydata Table

ID	Name	Score
1	Andrew	70
2	John	90
3	Susan	80

There are three types of block of PL/SQL, which are the anonymous block, named block and nested block. The

anonymous block PL/SQL has no name, but it has DECLARE-BEGIN-END structure. The named block PL/SQL is stored as a database object for example, it is stored function, stored procedure and trigger. The nested block PL/SQL is a block created inside another PL/SQL block [4].

```

    DECLARE
        rst NUMBER;
    BEGIN
        SELECT COUNT(*) INTO rst FROM mydata;
    END;
  
```

Figure 2: Basic PL/SQL example

```

    CREATE PROCEDURE numEmployees AS
        rst NUMBER;
    BEGIN
        SELECT COUNT(*) INTO rst FROM mydata;
    END;
  
```

Figure 3: Stored procedure example

To execute, a procedure on Oracle PL / SQL was conducted by giving the EXECUTE command or calling the name of the procedure in another PL / SQL block.

```

    BEGIN
        numEmployees;
    END;
  
```

Figure 4: PL/SQL execution

Figures 2, 3, 4 and 5 used Mydata table on Table 1. Figure 2 shows the basic example of PL/SQL, it counted all records available on Mydata and stored it into rst variable. Figure 3 is an example of PL/SQL stored procedure, it was executed by using script in Figure 4. Figure 5 shows the nested PL/SQL block , which has another block inside its main block.

```

    DECLARE
        rst NUMBER;
    BEGIN
        SELECT COUNT(*) INTO rst FROM mydata;
        DECLARE
            rst2 NUMBER;
        BEGIN
            rst2 := rst + 10;
        END;
    END;
  
```

Figure 5: Nested PL/SQL block

V. DBMS SCHEDULER PACKAGE

PL/SQL DBMS_Scheduler Package is a built-in Oracle database package that works to run SQL commands automatically. The SQL commands executed by the DBMS Scheduler is an anonymous PL/SQL block or stored procedure [4][11-12].

```

    BEGIN
        DBMS_SCHEDULER.CREATE_JOB(
            job_name => 'NAME_JOB',
            job_type => 'PLSQL_BLOCK',
            job_action => 'BEGIN
                INSERT INTO t1 VALUES(SYSDATE); END;',
            start_date => SYSTIMESTAMP,
            repeat_interval=>'FREQUENCY=SECONDLY;
            INTERVAL=5',
            enabled => TRUE);
    END;
  
```

Figure 6: DBMS scheduler job example

The main parts of DBMS_Scheduler Package PL/SQL are jobname, jobtype, jobaction, startdate, repeat_interval and enable status. A job that has been created with DBMS_Scheduler can have two states that are enabled and disabled. When the Status is enabled, it means that the scheduler is able to operate; Otherwise scheduler will not be able to operate. A job can be deleted with the Drop_Job command.

VI. ORACLE APEX

Oracle Application Express (APEX) is a development tool that can be integrated with Oracle database. Oracle APEX has the ability to create applications in express, implying that only the query command can create a web component such as form, report or calendar. Form, report and calendar are the features available on Oracle APEX, as shown in Figure 7 [8].

Oracle APEX can be used online or offline for free; thus, users can access apex.oracle.com to use online. Offline usage is done by downloading the installer file from the www.oracle.com website and installing it on the Oracle database on the local computer. Currently, the latest version of Oracle APEX is 20.

Table 2
Oracle APEX Versions

Version	Year
3.2	2009
4.0	2010
4.1	2011
4.2	2012
5.0	2015
5.1	2016
18.1	2018
18.2	2018
19.1	2019
20.1	2020

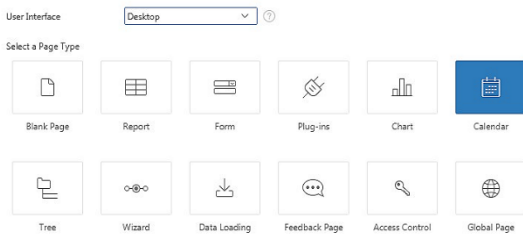


Figure 7: Oracle APEX features

VII. IMPLEMENTATION

The research methodology was implemented by designing and creating a web-based application of guidance scheduling system [13][14]. Figure 8 shows the flow charts of the interactions between admin, lecturer and student on guidance scheduling system.

The design was made by using Data Flow Diagrams (DFD) and Entity Relationship Diagram (ERD). There are three main processes, which are the set period, set availability of lecturer and the reserve availability by student. Defined by five sets of ERD entities, namely the department, lecturer,

student, availability and availability detail.

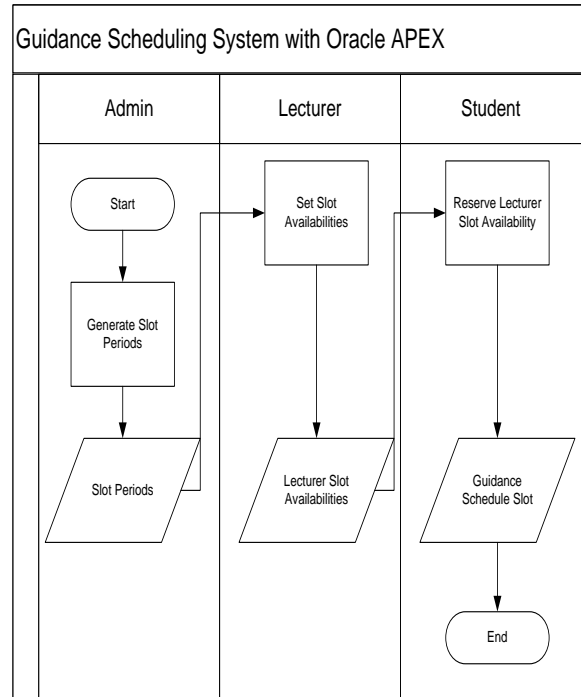


Figure 8: Flow chart of guidance scheduling system

```
SELECT siad.id,instructor_id, getTime(siad.times) status,
dates FROM sch_instructor_av sia LEFT OUTER JOIN
sch_inst_av_detail siad ON sia.id=siad.ins_av_id WHERE
instructor_id=:P2_INSTRUCTOR_ID ORDER BY
siad.times;
```

Figure 9: Oracle APEX calendar query

Figure 9 shows the SQL script to generate Oracle APEX calendar. The results in Figure 12 shows that there already been some data values stored in the database. Figure 11 is the main script that maintains the data integrity of guidance scheduling system. The script operates every day at midnight by changing the status of the reservation to CLOSED. If the status is still OPEN, it means the guidance has not be done and student will not be able to create new reservation. After the status is CLOSED, student will be able to create new reservation.

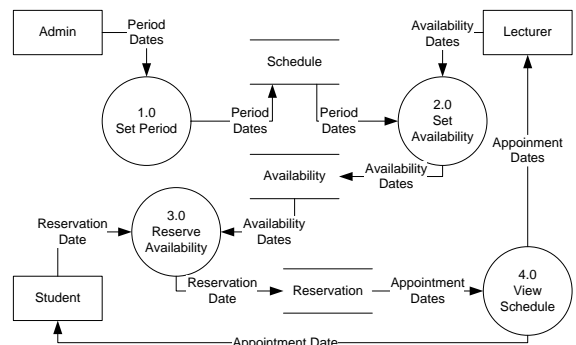


Figure 10: DFD of guidance scheduling system

```

BEGIN
  DBMS_SCHEDULER.CREATE_JOB(
    job_name => 'CLOSE_RESERVATION',
    job_type => 'PLSQL_BLOCK',
    job_action => 'BEGIN UPDATE sch_reservation SET
      status="CLOSED" WHERE dates=SYSDATE; END;',
    start_date => SYSTIMESTAMP,
    repeat_interval=> 'FREQUENCY=WEEKLY;BYHOUR=23;
      BYMINUTE=59; BYSECOND=59',
    enabled => TRUE);
END;
```

Figure 11: DBMS scheduler to close the slot automatically

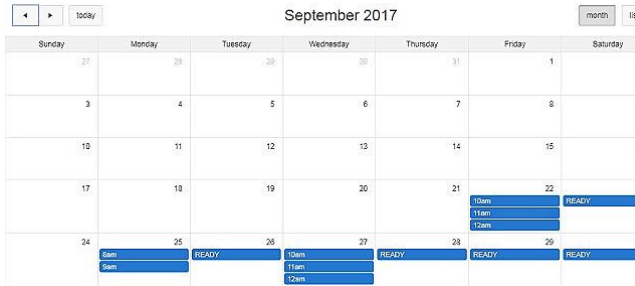


Figure 12: Web based application result

VIII. WEB TESTING

The application flows created by DFD and Flow chart can be seen in Figures 10 and 8. The transaction data were recorded on reservation table. DBMS Scheduler Package script is shown in Figure 11. The methods tested by implementing black-box testing [2][15] are shown in Table 3.

IX. RESULT AND DISCUSSION

The process always starts from the administrator who initializes the availability of the slot every semester. Lecturers gave input on their schedule each week, marked by the hour displayed on the specified date. Students then will choose the meeting slot with lecturer based on the lecturers' willingness time, slot that has been filled cannot be selected again and will be closed automatically by DBMS Scheduler.

A student cannot change the meeting slot with the lecturer until the meeting is completed or the time has been entered the following week. The process of closing the slot is done automatically by DBMS Scheduler, if the meeting time has been exceeded.

Table 3
Web Testing Results

Description	Expected Results	Actual Results
Admin Generate Periods	Range of periods generated	Range of periods generated
Lecturer Set Availabilities	Date of availabilities set	Date of availabilities set
Students Reserve Lecturer's availability	Reservations scheduled	Reservations scheduled
Students Reserve Lecturer's availability	Reservation Rejected by System	Reservation Rejected by System

Description	Expected Results	Actual Results
Auto close reservation date	Date of reservations will automatically closed after the week change	Date of reservations will automatically closed after the week change
Students Reserve Lecturer's availability	Reservations scheduled	Reservations scheduled

X. CONCLUSION

Based on the web testing done on Table 3, the guided scheduling system application is operated as it should be. The normal process of the database allows the OLTP, executed by the system by inserting new record for the new appointment. This process might create an uncomfortable appointment for the lecturer due to some multiple appointments with the same student that can be found during the one week period. By implementing the Oracle DBMS, it was found that Oracle DBMS Scheduler Package is able to maintain data integrity on the system by creating a restriction for student to make new appointment with the status OPEN. DBMS Scheduler will automatically change the status to CLOSED to allow a student to make a new appointment.

REFERENCES

- [1] M. Alqahtani, "Online Lecturer Appointment System for Project Students", University of Hertfordshire, 2010.
- [2] A. M. Sinaga, "Case Study on Testing of Web-Based Application: Del's Students Information System," Journal of Telecommunication, Electronic and Computer Engineering, vol. 9, no. 2-4, pp. 1-5, 2017.
- [3] D. Chen and H. Zhao, "Data Security and Privacy Protection Issues in Cloud Computing," in International Conference on Computer Science and Electronics Engineering, 2012.
- [4] S. Fuerstein and B. Pribyl, Oracle PL/SQL Programming, Fifth Edition, California: O'Reilly Media, Inc., 2009.
- [5] V. K. Myalapalli and B. L. R. Teja, "High Performance PL/SQL Programming," in International Conference on Pervasive Computing (ICPC), 2015.
- [6] Prabhjot and N. Sharma, "Overview of the Database Management System," International Journal of Advanced Research in Computer Science, pp. 262-269, 2017.
- [7] D. Saisanguansat and P. Jeatrakul, "Optimization Techniques for PL/SQL," in Fourteenth International Conference on ICT and Knowledge Engineering, 2016.
- [8] M. van der Plas and M. van Zoest, Oracle APEX 4.0 Cookbook, Birmingham: Packt Publishing, 2010.
- [9] V. Pathak, Oracle APEX 4.2 Reporting, Birmingham: Packt Publishing Ltd, 2013.
- [10] D. Parchment and S. Sankaranarayanan, "Intelligent Agent based Student-Staff Scheduling System", International Journal of Computer Information Systems and Industrial Management Applications, vol. 5, pp. 383-404, 2012.
- [11] R. Ramakrishnan and J. Gehrke, Database Management Systems Second Edition, New York: McGraw-Hill College, 2000.
- [12] A. Silberschatz and H. F. Korth, Database System Concepts Sixth Edition, New York: McGraw-Hill, 2011.
- [13] Y. Yan, X. Han, J. Yang and Q. Zhou, "On the Design of an Advanced Web-Based System for Supporting Thesis Research Process and Knowledge Sharing," Journal of Educational Technology Development and Exchange, vol. 5, no. 2, pp. 111-121, 2012.
- [14] R. S. Pressman, Software Engineering A Practitioner's Approach 5th Edition, New York: McGraw-Hill, 2001.
- [15] S. R. Jan, S. T. U. Shah, Z. U. Johar, Y. Shah and F. Khan, "An Innovative Approach to Investigate Various Software Testing Techniques and Strategies," International Journal of Scientific Research in Science, Engineering and Technology, pp. 682-689, 2016.