To V or not To V
that's the question

Alex Nuijten

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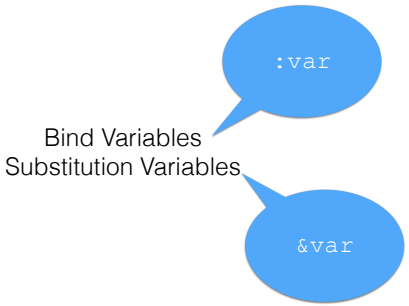


Substitution Variables

```
SQL> define ename = 'KING'
```

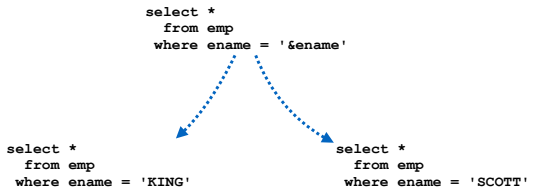
```
SQL> define ename = 'KING'
SQL>
SQL> select *
  2    from emp
  3   where ename = '&ename'
  4* /
```

```
SQL> define ename = 'KING'
SQL>
SQL> select *
  2    from emp
  3   where ename = '&ename'
  4* /
old:select *
  from emp
 where ename = '&ename'

new:select *
  from emp
 where ename = 'KING'

    EMPNO ENAME      JOB       MGR HIREDATE       SAL       COMM     DEPTNO
_________ _________ _________ _____ _____________ _____ _______ __________
     7839 KING      PRESIDENT       17-NOV-81      5000                   10
```

```
SQL> define ename = 'SCOTT'
SQL>
SQL> select *
  2    from emp
  3   where ename = '&ename'
  4* /
```

```
SQL> define ename = 'SCOTT'
SQL>
SQL> select *
  2    from emp
  3   where ename = '&ename'
  4* /
old:select *
  from emp
 where ename = '&ename'

new:select *
  from emp
 where ename = 'SCOTT'

    EMPNO ENAME      JOB       MGR HIREDATE       SAL       COMM     DEPTNO
_________ _________ _________ _____ _____________ _____ _______ __________
     7788 SCOTT     ANALYST    7566 19-APR-87      3000                   20
```

```
SQL> define ename = 'SCOTT'
```



Bind Variables

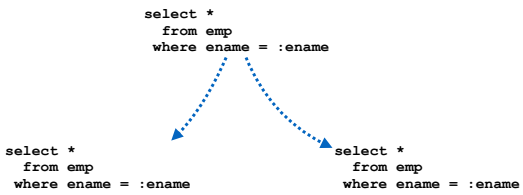
```
SQL> var ename varchar2(10)
```

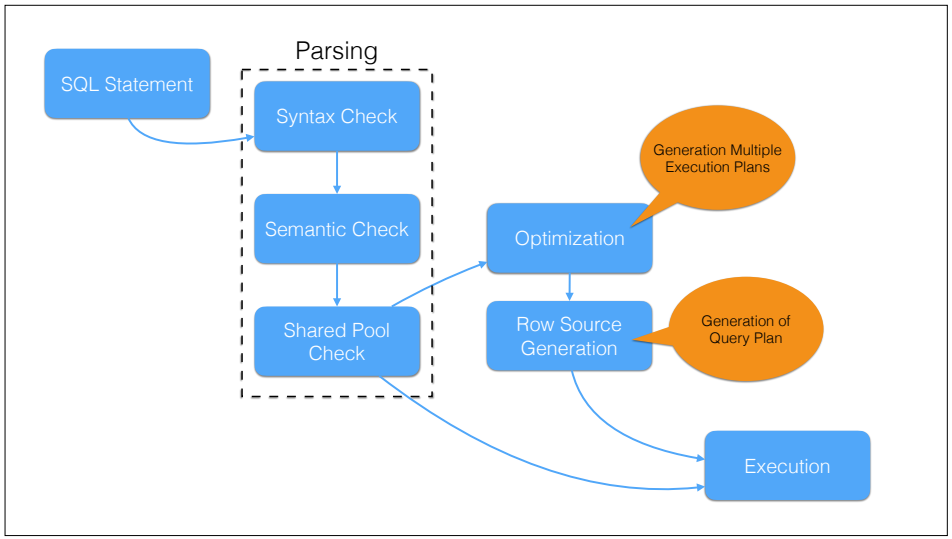
```
SQL> var ename varchar2(10)
SQL>
SQL> begin
  2     :ename := 'KING';
  3  end;
  4* /

PL/SQL procedure successfully completed.
```

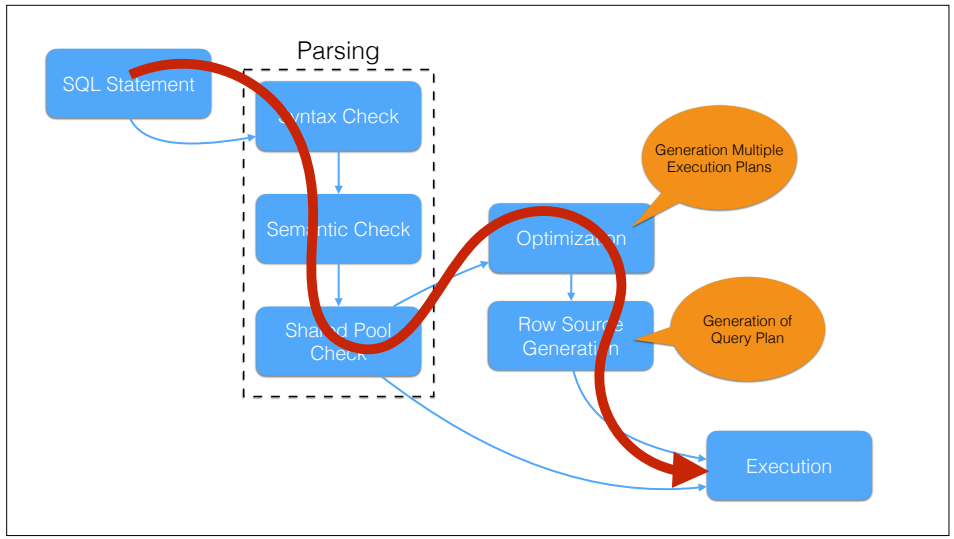
```
SQL> var ename varchar2(10)
SQL>
SQL> begin
  2     :ename := 'KING';
  3  end;
  4* /

PL/SQL procedure successfully completed.

SQL>
SQL> select *
  2    from emp
  3*  where ename = :ename;

    EMPNO ENAME      JOB       MGR HIREDATE       SAL       COMM     DEPTNO
_______ _____ _________ _______ _____________ _______ _________ __________
     7839 KING   PRESIDENT         17-NOV-81      5000                   10
```

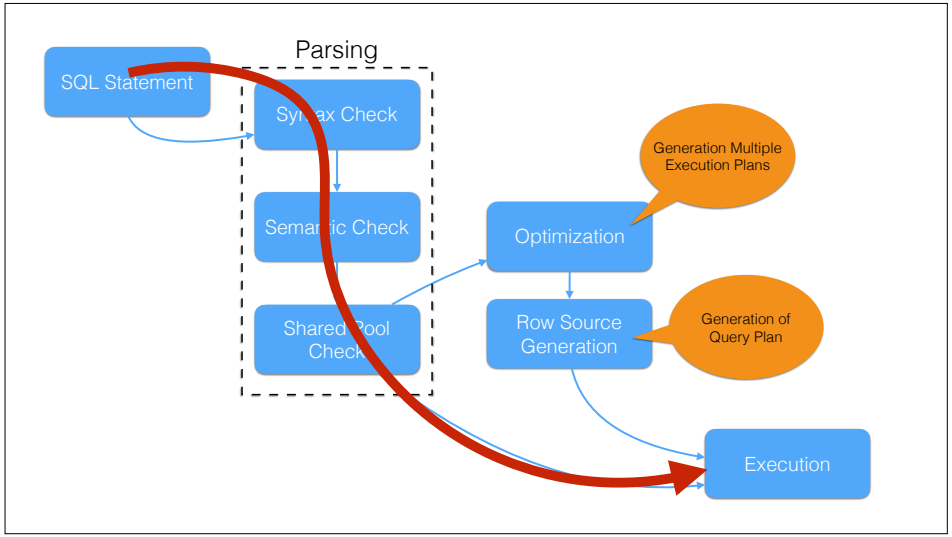
```
SQL> begin
  2     :ename := 'SCOTT';
  3  end;
  4* /

PL/SQL procedure successfully completed.
```

```
SQL> begin
  2     :ename := 'SCOTT';
  3  end;
  4* /

PL/SQL procedure successfully completed.

SQL> select *
  2    from emp
  3*  where ename = :ename;

    EMPNO ENAME      JOB       MGR HIREDATE       SAL       COMM     DEPTNO
_______ _____ _________ _______ _____________ _______ _________ __________
     7788 SCOTT   ANALYST      7566 19-APR-87      3000                   20
```










```
select *
  from &var
```

```
select *
  from :var
```

```
SQL> define tab = 'EMP'
```

```
SQL> define tab = 'EMP'
SQL> select *
  2    from &tab
  3* /
old:select *
  from &tab

new:select *
  from EMP

    EMPNO     ENAME          JOB      MGR     HIREDATE      SAL     COMM     DEPTNO
_________ _________ _________ _________ _____________ _________ ________ _________
     7839 KING      PRESIDENT           17-NOV-81        5000                   10
     7698 BLAKE     MANAGER          7839 01-MAY-81        2850                   30
     7782 CLARK     MANAGER          7839 09-JUN-81        2450                   10
     7566 JONES     MANAGER          7839 02-APR-81        2975                   20
     7788 SCOTT     ANALYST          7566 19-APR-87        3000                   20
     7902 FORD      ANALYST          7566 03-DEC-81        3000                   20
     7369 SMITH     CLERK            7902 17-DEC-80         800                   20
     7499 ALLEN     SALESMAN         7698 20-FEB-81        1600      300          30
     7521 WARD      SALESMAN         7698 22-FEB-81        1250      500          30
     7654 MARTIN    SALESMAN         7698 28-SEP-81        1250     1400          30
     7844 TURNER    SALESMAN         7698 08-SEP-81        1500        0          30
     7876 ADAMS     CLERK            7788 23-MAY-87        1100                   20
     7900 JAMES     CLERK            7698 03-DEC-81         950                   30
     7934 MILLER    CLERK            7782 23-JAN-82        1300                   10

14 rows selected.
```

```
SQL> define tab = 'DEPT'
```

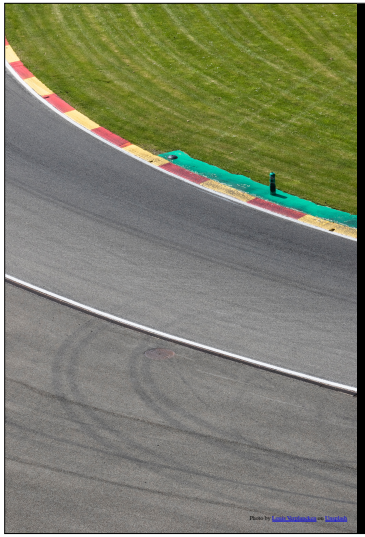
```
SQL> define tab = 'DEPT'
SQL> select *
  2    from &tab
  3* /
old:select *
  from &tab

new:select *
  from DEPT

    DEPTNO          DNAME          LOC
_________ _____________ _____________
        10 ACCOUNTING    NEW YORK
        20 RESEARCH      DALLAS
        30 SALES         CHICAGO
        40 OPERATIONS    BOSTON
```

```
select *
  from &tab
```

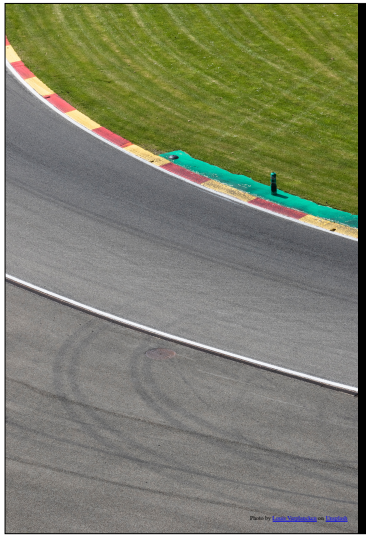
```
select *
  from emp
```

```
select *
  from dept
```

⚠️ SQL Injection! 😱



Variables in APEX



- Bind Variables
- Substitution Strings
- Context
- (N)V function
- Hash
- Shortcuts

- **Bind Variables**
- Substitution Strings
- Context
- (N)V function
- Hash
- Shortcuts

```
select ename
     ,job
     ,sal
     ,comm
  from emp
 where deptno = to_number (:P1_DEPTNO)
```

Bind Variables
Substitution Strings
Context
(N)V function
Hash
Shortcuts

```
Hello &APP_USER.
Your Department: &P10_DEPT.
```

Bind Variables
Substitution Strings
Context
(N)V function
Hash
Shortcuts

APEX$SESSION

WORKSPACE_ID
APP_SESSION
APP_USER
APP_ID

```
sys_context ('apex$session', 'app_user')
```

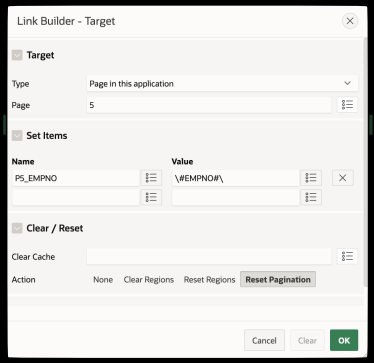
Bind Variables
Substitution Strings
Context
(N)V function
Hash
Shortcuts


```
insert into tbl
values (V  ('APP_USER')
       ,NV ('P1_DEPTNO')
       );
```

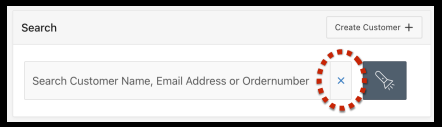
Bind Variables
Substitution Strings
Context
(N)V function
Hash
Shortcuts

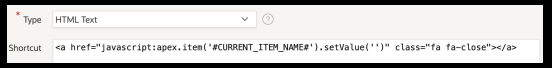
```
create or replace view vw
as
select ename
      ,job
      ,sal
  from emp
 where deptno = NV ('P1_DEPTNO');
```

Bind Variables
Substitution Strings
Context
(N)V function
Hash
Shortcuts



Bind Variables
Substitution Strings
Context
(N)V function
Hash
Shortcuts





SQL Macro

```
SQL> select *
  2    from demo_pkg.top (emp, 3)
  3  /

     EMPNO ENAME      JOB              MGR HIREDATE         SAL       COMM     DEPTNO
---------- ---------- --------- ---------- --------- ---------- ---------- ----------
      7839 KING       PRESIDENT            17-NOV-81       5000                    10
      7698 BLAKE      MANAGER           7839 01-MAY-81       2850                    30
      7782 CLARK      MANAGER           7839 09-JUN-81       2450                    10
```

```
SQL> select *
  2    from demo_pkg.top (emp, 3)
  3  /

    EMPNO     ENAME           JOB       MGR      HIREDATE       SAL      COMM     DEPTNO
_________ ________ _____________ _________ _____________ _________ _________ __________
     7839 KING     PRESIDENT             17-NOV-81        5000                       10
     7698 BLAKE    MANAGER            7839 01-MAY-81        2850                       30
     7782 CLARK    MANAGER            7839 09-JUN-81        2450                       10
```

```
SQL> select *
  2    from demo_pkg.top (emp, 3)
  3  /

    EMPNO     ENAME           JOB       MGR      HIREDATE       SAL      COMM     DEPTNO
_________ ________ _____________ _________ _____________ _________ _________ __________
     7839 KING     PRESIDENT             17-NOV-81        5000                       10
     7698 BLAKE    MANAGER            7839 01-MAY-81        2850                       30
     7782 CLARK    MANAGER            7839 09-JUN-81        2450                       10
```


```
SQL> select *
  2    from demo_pkg.top (emp, 3)
  3  /

    EMPNO     ENAME           JOB       MGR      HIREDATE       SAL      COMM     DEPTNO
_________ ________ _____________ _________ _____________ _________ _________ __________
     7839 KING     PRESIDENT             17-NOV-81        5000                       10
     7698 BLAKE    MANAGER            7839 01-MAY-81        2850                       30
     7782 CLARK    MANAGER            7839 09-JUN-81        2450                       10
```

```
SQL> select *
  2    from demo_pkg.top (dept, 2)
  3  /

    DEPTNO          DNAME          LOC
_________ _____________ _____________
        10 ACCOUNTING     NEW YORK
        20 RESEARCH       DALLAS
```

```
create or replace package demo_pkg
as
   function top (p_table in dbms_tf.table_t
                ,p_limit in number
                )
      return varchar2 sql_macro (type => table);
end demo_pkg;
/
```

```
create or replace package demo_pkg
as
   function top (p_table in dbms_tf.table_t
                ,p_limit in number
                )
      return varchar2 sql_macro (type => table);
end demo_pkg;
/
```

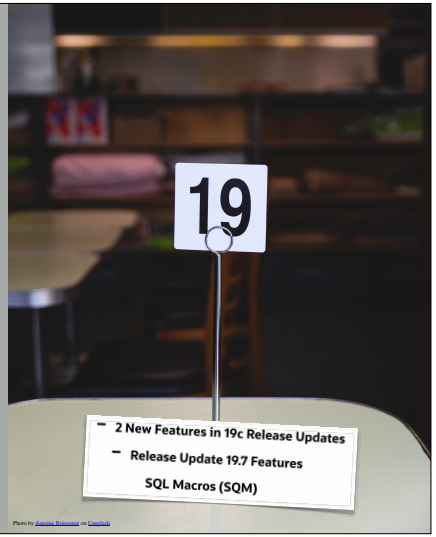
```
create or replace package demo_pkg
as
   function top (p_table in dbms_tf.table_t
                ,p_limit in number
                )
      return varchar2 sql_macro (type => table);
end demo_pkg;
/
```

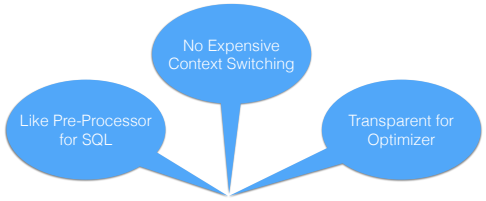
```
function top (p_table in dbms_tf.table_t
             ,p_limit in number
             )
   return varchar2 sql_macro (type => table)
is
   l_retval varchar2(2000);
begin
   l_retval := 'select *
                  from top.p_table
                 fetch first top.p_limit rows only';
   return l_retval;
end top;
```

```
function top (p_table in dbms_tf.table_t
             ,p_limit in number
             )
   return varchar2 sql_macro (type => table)
is
   l_retval varchar2(2000);
begin
   l_retval := 'select *
                 from top.p_table
                fetch first top.p_limit rows only';
   return l_retval;
end top;
```

```
function top (p_table in dbms_tf.table_t
             ,p_limit in number
             )
   return varchar2 sql_macro (type => table)
is
   l_retval varchar2(2000);
begin
   l_retval := 'select *
                 from top.p_table
                fetch first top.p_limit rows only';
   return l_retval;
end top;
```

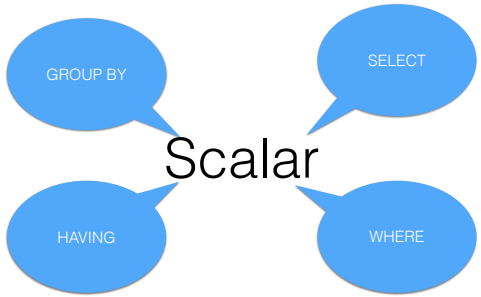
Backported





Common SQL Expression

Reusable, Parameterized Constructs

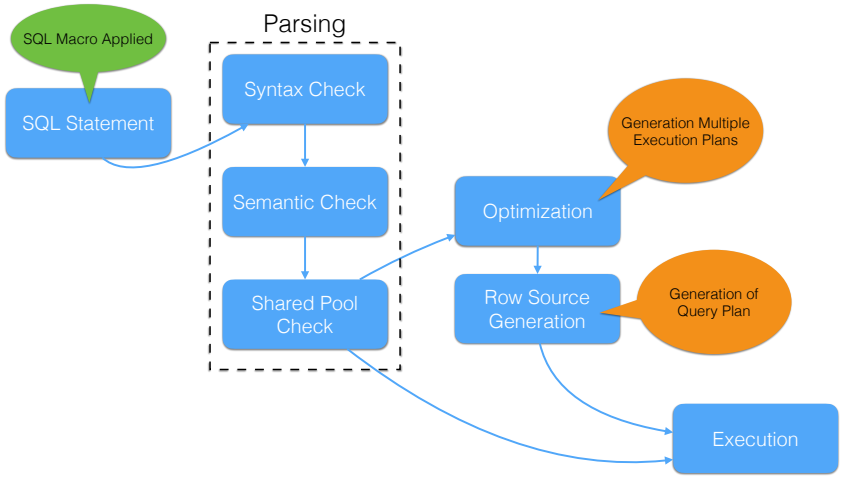


Table

Parameterized Views
Polymorphic Views


```
return varchar2 sql_macro
return varchar2 sql_macro (type => table)
return varchar2 sql_macro (type => scalar)
```

Default is TABLE




```
function injection (p_str in varchar2
                   ,p_num in number
                   ,p_dt  in date
                   )
   return varchar2 sql_macro
is
begin
   sys.dbms_output.put_line ('str: '||p_str);
   sys.dbms_output.put_line ('num: '||to_char (p_num));
   sys.dbms_output.put_line ('dt : '||to_char (p_dt, 'dd-mm-yyyy hh24:mi:ss'));
   return 'select * from dual';
end injection;
```

```
function injection (p_str in varchar2
                   ,p_num in number
                   ,p_dt  in date
                   )
   return varchar2 sql_macro
is
begin
   sys.dbms_output.put_line ('str: '||p_str);
   sys.dbms_output.put_line ('num: '||to_char (p_num));
   sys.dbms_output.put_line ('dt : '||to_char (p_dt, 'dd-mm-yyyy hh24:mi:ss'));
   return 'select * from dual';
end injection;
```

```
function injection (p_str in varchar2
                   ,p_num in number
                   ,p_dt  in date
                   )
   return varchar2 sql_macro
is
begin
   sys.dbms_output.put_line ('str: '||p_str);
   sys.dbms_output.put_line ('num: '||to_char (p_num));
   sys.dbms_output.put_line ('dt : '||to_char (p_dt, 'dd-mm-yyyy hh24:mi:ss'));
   return 'select * from dual';
end injection;
```

```
SQL> select *
  2    from test_pkg.injection (p_str => 'string'
  3                            ,p_num => 123
  4                            ,p_dt  => sysdate
  5*                           );
```

```
SQL> select *
  2    from test_pkg.injection (p_str => 'string'
  3                            ,p_num => 123
  4                            ,p_dt  => sysdate
  5*                           );

D
-
X
```

```
SQL> select *
  2    from test_pkg.injection (p_str => 'string'
  3                            ,p_num => 123
  4                            ,p_dt  => sysdate
  5*                           );

D
-
X

str:
num: 123
dt :
```

```
function injection (p_table in varchar2)
   return varchar2 sql_macro
is
begin
   return 'select * from '||p_table;
end injection;
```

```
SQL> select *
  2    from test_pkg.injection (p_table => 'emp')
  3* /
```

```
SQL> select *
  2    from test_pkg.injection (p_table => 'emp')
  3* /

Error starting at line : 1 in command -
select *
  from test_pkg.injection (p_table => 'emp')

Error at Command Line : 1 Column : 1
Error report -
SQL Error: ORA-64626: invalid SQL text returned from SQL macro:
ORA-00903: invalid table name
```

```
function injection (p_table in dbms_tf.table_t)
   return varchar2 sql_macro
is
begin
   return 'select * from '||p_table;
end injection;
```

Won't compile!

```
function injection (p_table in dbms_tf.table_t)
   return varchar2 sql_macro
is
begin
   return 'select * from '||p_table.table_name;
end injection;
```

Actually works


```
function generate_dates (p_from in date
                        ,p_to   in date
                        )
   return varchar2 sql_macro
is
   l_retval varchar2(4000);
begin
   l_retval := 'select trunc (generate_dates.p_from) -1 + level as startdate
                  from dual
               connect by level <= (generate_dates.p_to - generate_dates.p_from) + 1';
   return l_retval;
end generate_dates;
```

```
function generate_dates (p_from in date
                        ,p_to   in date
                        )
   return varchar2 sql_macro
is
   l_retval varchar2(4000);
begin
   l_retval := 'select trunc (generate_dates.p_from) -1 + level as startdate
                  from dual
               connect by level <= (generate_dates.p_to - generate_dates.p_from) + 1';
   return l_retval;
end generate_dates;
```

```
SQL> select *
  2    from generate_dates (sysdate
  3                        ,sysdate + 3)
  4  /

   STARTDATE
____________
26-AUG-21
27-AUG-21
28-AUG-21
29-AUG-21
```

```
SQL> select cfe.naam
  2        ,cfe.startdatum
  3        ,cfe.einddatum
  4    from aa_conferenties cfe
  5   where cfe.naam = 'NLOUG APEX World 2021'
  6* /

NAAM                                               STARTDATU EINDDATUM
-------------------------------------------------- --------- ---------
NLOUG APEX World 2021                              29-SEP-21 30-SEP-21
```

```
SQL> select cfe.naam
  2        ,dates.dt
  3    from aa_conferenties cfe
  4   cross
  5    join lateral (select startdate as dt
  6                  from generate_dates (cfe.startdatum, cfe.einddatum)) dates
  7   where cfe.naam = 'NLOUG APEX World 2021'
  8* /

NAAM                                               DT
-------------------------------------------------- ---------
NLOUG APEX World 2021                              29-SEP-21
NLOUG APEX World 2021                              30-SEP-21
```

```
SQL> select cfe.naam
  2        ,dates.dt
  3    from aa_conferenties cfe
  4   cross
  5    join lateral (select startdate as dt
  6                  from generate_dates (cfe.startdatum, cfe.einddatum)) dates
  7   where cfe.naam = 'NLOUG APEX World 2021'
  8* /

NAAM                                               DT
-------------------------------------------------- ---------
NLOUG APEX World 2021                              29-SEP-21
NLOUG APEX World 2021                              30-SEP-21
```

```
SQL>  select cfe.naam
  2         ,dates.dt
  3     from aa_conferenties cfe
  4    cross
  5     join lateral (select startdate as dt
  6                     from generate_dates (cfe.startdatum, cfe.einddatum)) dates
  7   where trunc (cfe.startdatum, 'yy') = date '2021-01-01'
  8     and cfe.status = 'ACCEPTED'
  9   order by dates.dt
 10* /
```

```
SQL>  select cfe.naam
  2         ,dates.dt
  3     from aa_conferenties cfe
  4    cross
  5     join lateral (select startdate as dt
  6                     from generate_dates (cfe.startdatum, cfe.einddatum)) dates
  7   where trunc (cfe.startdatum, 'yy') = date '2021-01-01'
  8     and cfe.status = 'ACCEPTED'
  9   order by dates.dt
 10* /

NAAM                                               DT
-------------------------------------------------- ---------
RMOUG Training Days 2021                           08-FEB-21
RMOUG Training Days 2021                           09-FEB-21
RMOUG Training Days 2021                           10-FEB-21
RMOUG Training Days 2021                           11-FEB-21
NLOUG Zoom sessie                                  25-MAR-21
POUG 2021                                          10-SEP-21
POUG 2021                                          11-SEP-21
NLOUG APEX World 2021                              29-SEP-21
NLOUG APEX World 2021                              30-SEP-21
HrOUG 2021                                         13-OCT-21
HrOUG 2021                                         14-OCT-21
HrOUG 2021                                         15-OCT-21
UKOUG Together 2021                                29-NOV-21
UKOUG Together 2021                                30-NOV-21

14 rows selected.
```

```
declare
   l_clob clob;
begin
   dbms_utility.expand_sql_text (input_sql_text => q'[
select cfe.naam
      ,dates.dt
  from aa_conferenties cfe
 cross
  join lateral (select startdate as dt
                  from generate_dates (cfe.startdatum, cfe.einddatum)) dates
 where cfe.naam = 'NLOUG APEX World 2021']'
                               ,output_sql_text => l_clob
                               );
  sys.dbms_output.put_line (l_clob);
end;
/
```

```
declare
   l_clob clob;
begin
   dbms_utility.expand_sql_text (input_sql_text => q'[
select cfe.naam
      ,dates.dt
  from aa_conferenties cfe
 cross
  join lateral (select startdate as dt
                  from generate_dates (cfe.startdatum, cfe.einddatum)) dates
 where cfe.naam = 'NLOUG APEX World 2021']'
                               ,output_sql_text => l_clob
                               );
  sys.dbms_output.put_line (l_clob);
end;
/
```

```
declare
   l_clob clob;
begin
   dbms_utility.expand_sql_text (input_sql_text => q'[
select cfe.naam
      ,dates.dt
  from aa_conferenties cfe
 cross
  join lateral (select startdate as dt
                  from generate_dates (cfe.startdatum, cfe.einddatum)) dates
 where cfe.naam = 'NLOUG APEX World 2021']'
                                ,output_sql_text => l_clob
                                );
  sys.dbms_output.put_line (l_clob);
end;
/
```

```
declare
   l_clob clob;
begin
   dbms_utility.expand_sql_text (input_sql_text => q'[
select cfe.naam
      ,dates.dt
  from aa_conferenties cfe
 cross
  join lateral (select startdate as dt
                  from generate_dates (cfe.startdatum, cfe.einddatum)) dates
 where cfe.naam = 'NLOUG APEX World 2021']'
                                ,output_sql_text => l_clob
                                );
  sys.dbms_output.put_line (l_clob);
end;
/
```

```
select "A1"."NAAM_0" "NAAM"
      ,"A1"."DT_3" "DT"
  from (
   select "A3"."NAAM" "NAAM_0"
         ,"A3"."STARTDATUM" "STARTDATUM"
         ,"A3"."EINDDATUM" "EINDDATUM"
         ,"A2"."DT_0" "DT_3"
     from "ALEX"."AA_CONFERENTIES" "A3"
         ,lateral (
      ( select "A4"."STARTDATE" "DT_0"
        from (
         select "A5"."STARTDATE" "STARTDATE"
           from (
            select trunc(
               "A3"."STARTDATUM"
            ) - 1 + level "STARTDATE"
              from "SYS"."DUAL" "A6" connect by
               level <= "A3"."EINDDATUM" - "A3"."STARTDATUM" + 1
         ) "A5"
      ) "A4"
      )
   ) "A2"
) "A1"
 where "A1"."NAAM_0" = 'NLOUG APEX World 2021'
```

```
select "A1"."NAAM_0" "NAAM"
      ,"A1"."DT_3" "DT"
  from (
   select "A3"."NAAM" "NAAM_0"
         ,"A3"."STARTDATUM" "STARTDATUM"
         ,"A3"."EINDDATUM" "EINDDATUM"
         ,"A2"."DT_0" "DT_3"
     from "ALEX"."AA_CONFERENTIES" "A3"
         ,lateral (
      ( select "A4"."STARTDATE" "DT_0"
        from (
         select "A5"."STARTDATE" "STARTDATE"
           from (
            select trunc(
               "A3"."STARTDATUM"
            ) - 1 + level "STARTDATE"
              from "SYS"."DUAL" "A6" connect by
               level <= "A3"."EINDDATUM" - "A3"."STARTDATUM" + 1
         ) "A5"
      ) "A4"
      )
   ) "A2"
) "A1"
 where "A1"."NAAM_0" = 'NLOUG APEX World 2021'
```

No PL/SQL
No Context Switch

```
    DEPTNO DNAME          LOC
---------- -------------- -------------
        10 ACCOUNTING     NEW YORK
        20 RESEARCH       DALLAS
        30 SALES          CHICAGO
        40 OPERATIONS     BOSTON
```

```
DEPTNO      10
DNAME       ACCOUNTING
LOC         NEW YORK
DEPTNO      20
DNAME       RESEARCH
LOC         DALLAS
DEPTNO      30
DNAME       SALES
LOC         CHICAGO
DEPTNO      40
DNAME       OPERATIONS
LOC         BOSTON
```

```
function print_table (t in dbms_tf.table_t)
   return varchar2 sql_macro
as
   l_cols      clob ;
   l_unpivot   clob ;
   l_str       varchar2(200);
   l_delimiter varchar2(1):= ',';
   l_name      dbms_id;
   l_sql       clob;
begin
   for i in 1..t.column.count
   loop
      l_name := t.column(i).description.name;
      if t.column(i).description.type = dbms_tf.type_varchar2
      then
         l_str := l_name;
      elsif t.column(i).description.type = dbms_tf.type_number
      then
         l_str := 'to_char('||l_name||') as '||l_name;
      elsif t.column(i).description.type = dbms_tf.type_date
      then
         l_str := 'to_char('||l_name||','''yyyy-mm-dd hh24:mi:ss''') as '||l_name;
      end if;
      l_cols := l_cols || l_delimiter || l_str;
      l_unpivot := l_unpivot || l_delimiter || l_name;
   end loop;
   l_cols := ltrim (l_cols, ',');
   l_unpivot := ltrim (l_unpivot, ',');
   l_sql := 'select col_name, nvl(col_value,''(NULL)'') as col_value '||
     'from (select '|| l_cols ||' from print_table.t'
    ||')'||
     ' unpivot include nulls (col_value for col_name
   in ('||l_unpivot||') )';
   return l_sql;
end print_table;
```

```
function print_table (t in dbms_tf.table_t)
   return varchar2 sql_macro
as
   l_cols      clob ;
   l_unpivot   clob ;
   l_str       varchar2(200);
   l_delimiter varchar2(1):= ',';
   l_name      dbms_id;
   l_sql       clob;
begin
   for i in 1..t.column.count
   loop
      l_name := t.column(i).description.name;
      if t.column(i).description.type = dbms_tf.type_varchar2
      then
         l_str := l_name;
      elsif t.column(i).description.type = dbms_tf.type_number
      then
         l_str := 'to_char('||l_name||') as '||l_name;
      elsif t.column(i).description.type = dbms_tf.type_date
      then
         l_str := 'to_char('||l_name||','''yyyy-mm-dd hh24:mi:ss''') as '||l_name;
      end if;
      l_cols := l_cols || l_delimiter || l_str;
      l_unpivot := l_unpivot || l_delimiter || l_name;
   end loop;
   l_cols := ltrim (l_cols, ',');
   l_unpivot := ltrim (l_unpivot, ',');
   l_sql := 'select col_name, nvl(col_value,''(NULL)'') as col_value '||
     'from (select '|| l_cols ||' from print_table.t'
    ||')'||
     ' unpivot include nulls (col_value for col_name
   in ('||l_unpivot||') )';
   return l_sql;
end print_table;
```

```
SQL> select *
  2    from print_table (dept)
  3  /

   COL_NAME     COL_VALUE
___________ _____________
DEPTNO      10
DNAME       ACCOUNTING
LOC         NEW YORK
DEPTNO      20
DNAME       RESEARCH
LOC         DALLAS
DEPTNO      30
DNAME       SALES
LOC         CHICAGO
DEPTNO      40
DNAME       OPERATIONS
LOC         BOSTON

12 rows selected.
```


```
SQL> select *
  2    from print_table (dept)
  3  /

   COL_NAME     COL_VALUE
___________ _____________
DEPTNO      10
DNAME       ACCOUNTING
LOC         NEW YORK
DEPTNO      20
DNAME       RESEARCH
LOC         DALLAS
DEPTNO      30
DNAME       SALES
LOC         CHICAGO
DEPTNO      40
DNAME       OPERATIONS
LOC         BOSTON

12 rows selected.
```


Reusable Pattern Matching

Statement 15

Using Pattern Matching in SQL Macros

```
create or replace function get_consecutive_rows (
  tab dbms_tf.table_t, col dbms_tf.columns_t
)
  return varchar2 sql_macro
as
begin
  return 'get_consecutive_rows.tab
match_recognize (
  order by ' || get_consecutive_rows.col ( 1 ) || '
  measures
    first ( ' || get_consecutive_rows.col ( 1 ) || ' ) as start_value,
    count (*) as num_rows
  pattern ( init consecutive* )
  define
    consecutive as ' || get_consecutive_rows.col ( 1 ) || ' = (
      prev ( ' || get_consecutive_rows.col ( 1 ) || ' ) + 1
    )
)';
end get_consecutive_rows;
```

https://bit.ly/3Du3bb8

String Splitting Utility


```
create or replace package string_macros_pkg
  function split_string (
    tab dbms_tf.table_t,
    col dbms_tf.columns_t,
    separator varchar2 default ','
  ) return clob sql_macro;

  function split_string (
    delimited_string varchar2,
    separator        varchar2 default ','
  ) return clob sql_macro;
end;
/
```

https://bit.ly/3CwrvYM


```
function sales_tax (p_price_incl_vat in number
                   ,p_vat_percentage in number
                   )
   return varchar2 sql_macro (type => scalar)
as
begin
   return 'round(((sales_tax.p_price_incl_vat /
             (100 + sales_tax.p_vat_percentage)) * 100),2)';
end;
```

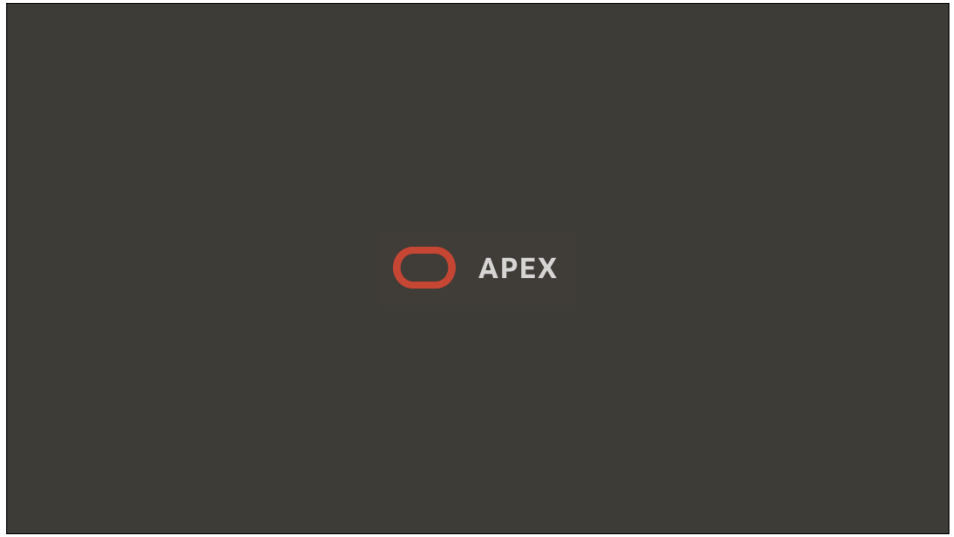
```
function sales_tax (p_price_incl_vat in number
                   ,p_vat_percentage in number
                   )
   return varchar2 sql_macro (type => scalar)
as
begin
   return 'round(((sales_tax.p_price_incl_vat /
             (100 + sales_tax.p_vat_percentage)) * 100),2)';
end;
```


```
function sales_tax (p_price_incl_vat in number
                   ,p_vat_percentage in number
                   )
   return varchar2 sql_macro (type => scalar)
as
begin
   return 'round(((sales_tax.p_price_incl_vat /
             (100 + sales_tax.p_vat_percentage)) * 100),2)';
end;
```

```
function sales_tax (p_price_incl_vat in number
                   ,p_vat_percentage in number
                   )
   return varchar2 sql_macro (type => scalar)
as
begin
   return 'round(((sales_tax.p_price_incl_vat /
             (100 + sales_tax.p_vat_percentage)) * 100),2)';
end;
```

```
SQL> select ole.price_incl_vat
  2        ,ole.vat_percent
  3        ,sales_tax (p_price_incl_vat => ole.price_incl_vat
  4                   ,p_vat_percentage => ole.vat_percent
  5                   ) as price_excl_vat
  6    from orderlines ole
  7   fetch first 10 rows only
  8  /

   PRICE_INCL_VAT    VAT_PERCENT    PRICE_EXCL_VAT
_________________ _______________ _________________
           229.95              19            193.24
           219.95              19            184.83
           769.95              19            647.02
            31.95              19             26.85
            27.95              19             23.49
           249.95              25            199.96
           219.95              25            175.96
            42.95              21              35.5
           559.95              19            470.55
               10              20              8.33

10 rows selected.
```

```
SQL> select ole.price_incl_vat
  2        ,ole.vat_percent
  3        ,sales_tax (p_price_incl_vat => ole.price_incl_vat
  4                   ,p_vat_percentage => ole.vat_percent
  5                   ) as price_excl_vat
  6    from orderlines ole
  7   fetch first 10 rows only
  8  /

   PRICE_INCL_VAT    VAT_PERCENT    PRICE_EXCL_VAT
_________________ _______________ _________________
           229.95              19            193.24
           219.95              19            184.83
           769.95              19            647.02
            31.95              19             26.85
            27.95              19             23.49
           249.95              25            199.96
           219.95              25            175.96
            42.95              21              35.5
           559.95              19            470.55
               10              20              8.33

10 rows selected.
```



APEX

Parameterized View

APEX

Parameterized View

SYS_CONTEXT

V

SYS_CONTEXT

```
SQL> create or replace context ctx using ctx_api
  2* /

Context CTX created.
```

SYS_CONTEXT

```
SQL> create or replace package ctx_api as
  2
  3    procedure set_filter (p_jobname in varchar2);
  4
  5  end ctx_api;
  6* /

Package CTX_API compiled
```

SYS_CONTEXT

```
SQL> create or replace package ctx_api as
  2
  3    procedure set_filter (p_jobname in varchar2);
  4
  5  end ctx_api;
  6* /

Package CTX_API compiled
```

SYS_CONTEXT

```
SQL> create or replace package body ctx_api
  2  is
  3
  4     procedure set_filter (p_jobname in varchar2)
  5     is
  6     begin
  7       sys.dbms_session.set_context
  8          (namespace => 'CTX'
  9          ,attribute => 'JOB'
 10          ,value     => p_jobname
 11          );
 12     end set_filter;
 13
 14  end ctx_api;
 15* /

Package Body CTX_API compiled
```

SYS_CONTEXT

```
create or replace view v_dept_job_salaries
as
select deptno
      ,sum (sal) as sum_sal
  from emp
 where job = sys_context ('CTX','JOB')
 group by deptno
/
```

SYS_CONTEXT

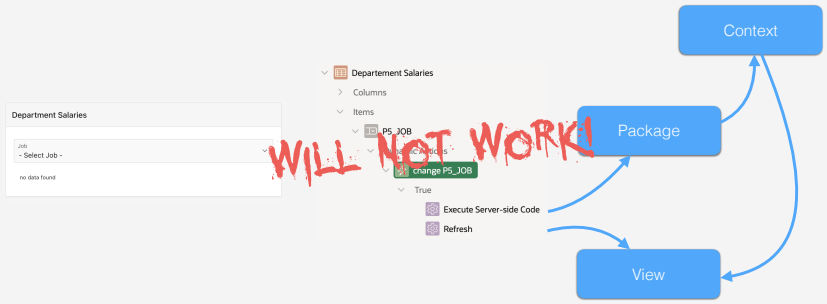
```
SQL> select *
  2    from v_dept_job_salaries
  3* /
no rows selected
```

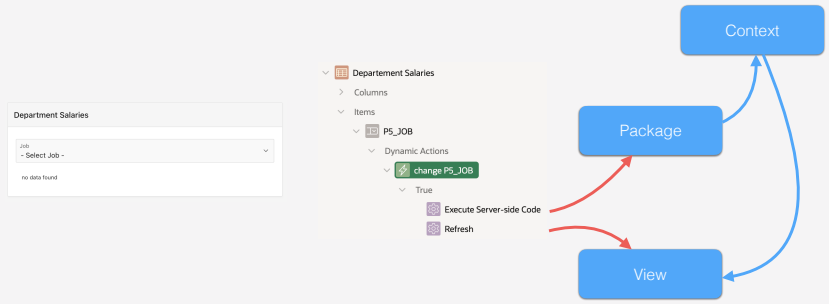
SYS_CONTEXT

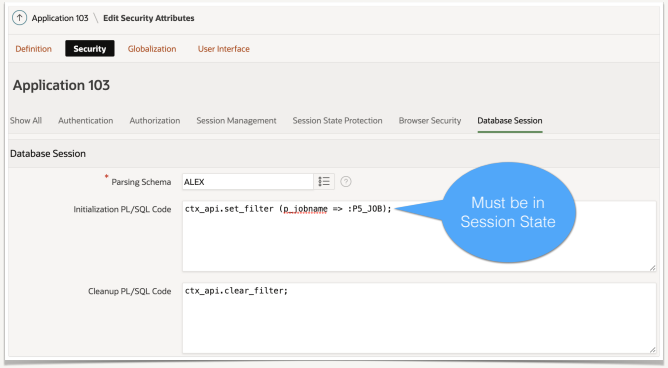
```
SQL> begin
  2     ctx_api.set_filter
  3         (p_jobname => 'MANAGER');
  4  end;
  5* /

PL/SQL procedure successfully completed.
```

SYS_CONTEXT

```
SQL> select *
  2    from v_dept_job_salaries
  3* /

    DEPTNO    SUM_SAL
---------- ----------
        30       2850
        10       2450
        20       2975
```







V

```
create or replace view v_dept_job_salaries
as
select deptno
      ,sum (sal) as sum_sal
  from emp
 where job = v('P5_JOB')
 group by deptno
/
```

References Page Item

V

```
SQL> select *
  2    from v_dept_job_salaries
  3* /
no rows selected
```

V

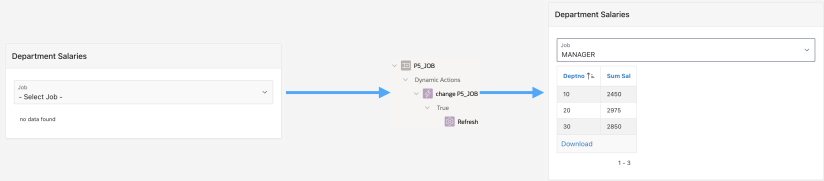
```
SQL> begin
  2     apex_session.create_session
  3        (p_app_id => 156929
  4        ,p_page_id => 1
  5        ,p_username => 'alex'
  6        );
  7     apex_util.set_session_state
  8        (p_name  => 'P5_JOB'
  9        ,p_value => 'MANAGER'
 10        );
 11  end;
 12* /

PL/SQL procedure successfully completed.
```

V

```
SQL> begin
  2     apex_session.create_session
  3        (p_app_id => 156929
  4        ,p_page_id => 1
  5        ,p_username => 'alex'
  6        );
  7     apex_util.set_session_state
  8        (p_name  => 'P5_JOB'
  9        ,p_value => 'MANAGER'
 10        );
 11  end;
 12* /

PL/SQL procedure successfully completed.
```

V

```
SQL> select *
  2    from v_dept_job_salaries
  3* /

    DEPTNO    SUM_SAL
---------- ----------
        30       2850
        10       2450
        20       2975
```



SYS_CONTEXT

- ⊕ Bind Variable
- ⊖ Lots of Components
- ⊖ Difficult in APEX

V

- ⊕ Easy in APEX
- ⊖ APEX Session
- ⊖ Performance

```
SQL> create or replace
function dept_job_salaries (p_job in varchar2)
   return varchar2 sql_macro
is
begin
  return '
     select deptno
           ,sum (sal)
       from emp
      where job = dept_job_salaries.p_job
      group by deptno';
end dept_job_salaries;
/
```

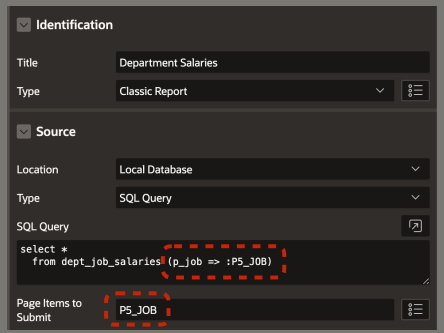
```
SQL> create or replace
function dept_job_salaries (p_job in varchar2)
   return varchar2 sql_macro
is
begin
  return '
     select deptno
           ,sum (sal)
       from emp
      where job = dept_job_salaries.p_job
      group by deptno';
end dept_job_salaries;
/
```

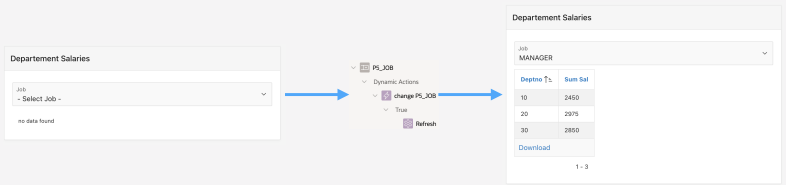
```
SQL> create or replace
function dept_job_salaries (p_job in varchar2)
   return varchar2 sql_macro
is
begin
  return '
     select deptno
           ,sum (sal)
       from emp
      where job = dept_job_salaries.p_job
      group by deptno';
end dept_job_salaries;
/
```

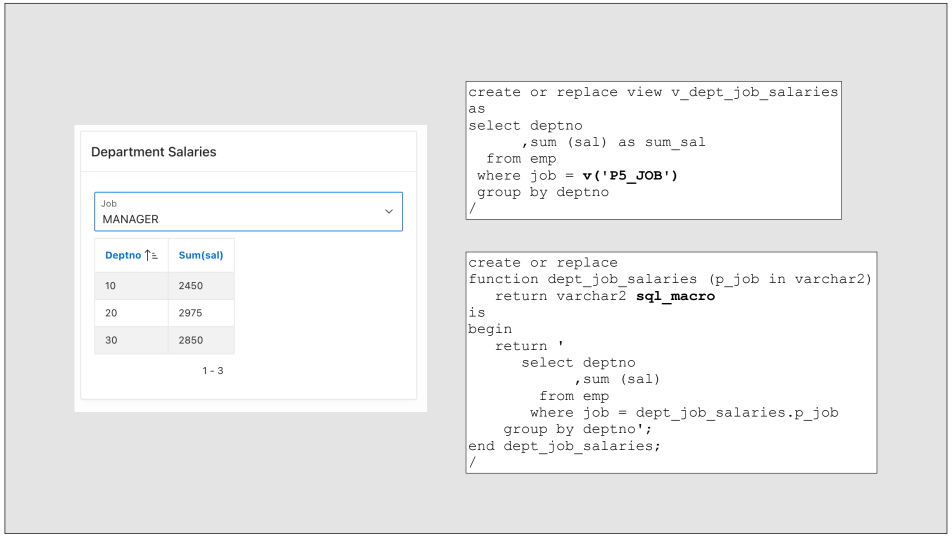
```
SQL> create or replace
function dept_job_salaries (p_job in varchar2)
   return varchar2 sql_macro
is
begin
  return '
     select deptno
           ,sum (sal)
       from emp
      where job = dept_job_salaries.p_job
      group by deptno';
end dept_job_salaries;
/
```

```
SQL> var job varchar2(10)
SQL> exec :job := 'MANAGER';

PL/SQL procedure successfully completed.
```

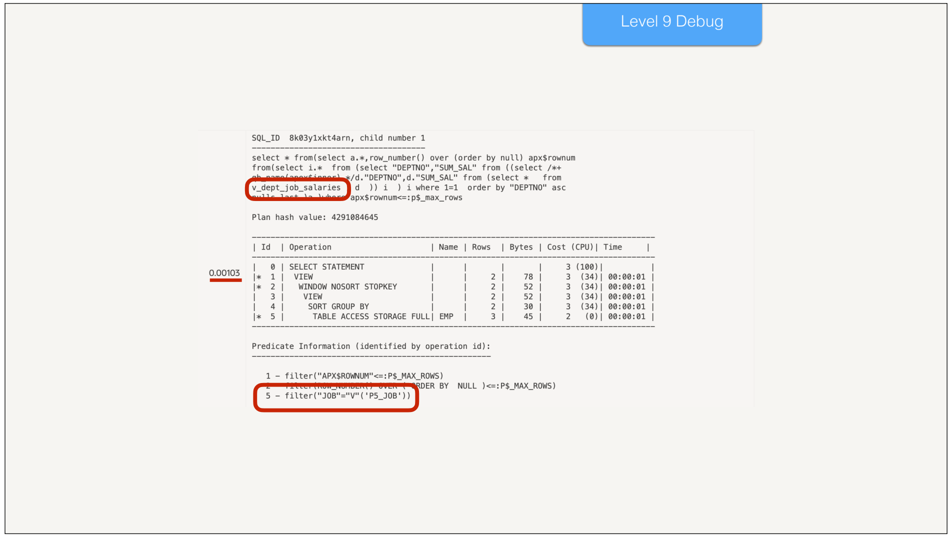
```
SQL> var job varchar2(10)
SQL> exec :job := 'MANAGER';

PL/SQL procedure successfully completed.

SQL> select *
  2    from dept_job_salaries (p_job => :job)
  3  /

    DEPTNO   SUM(SAL)
---------- ----------
        30       2850
        10       2450
        20       2975
```



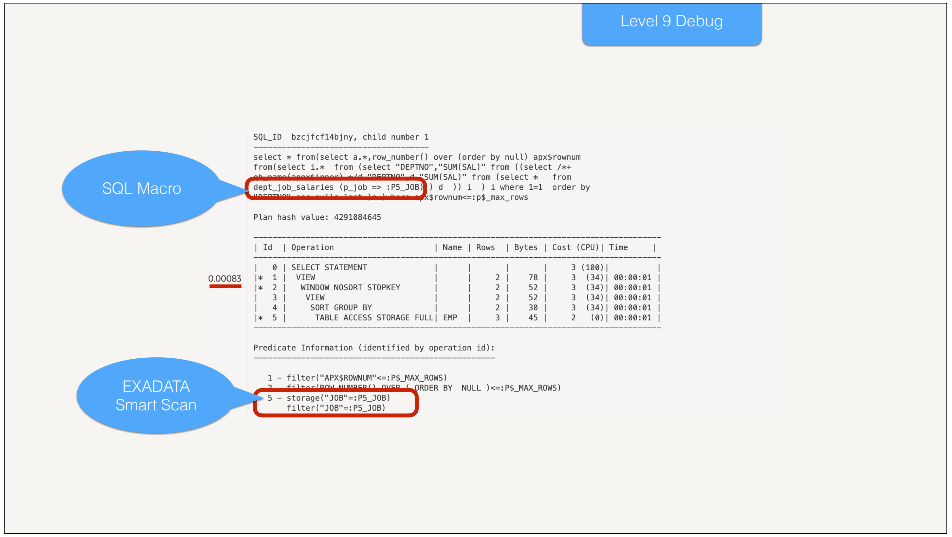




Department Salaries
Job
MANAGER
Deptno
Sum(sal)
10
2450
20
2975
30
2850
1 - 3
create or replace view v_dept_job_salaries
as
select deptno
,sum (sal) as sum_sal
from emp
where job = v('P5_JOB')
group by deptno
/
create or replace
function dept_job_salaries (p_job in varchar2)
return varchar2 sql_macro
is
begin
return '
select deptno
,sum (sal)
from emp
where job = dept_job_salaries.p_job
group by deptno';
end dept_job_salaries;
/



Level 9 Debug
SQL_ID 8k03y1xkt4arn, child number 1
select * from(select a.*,row_number() over (order by null) apx$rownum
from(select i.* from (select "DEPTNO","SUM_SAL" from ((select /*+
*/d."DEPTNO",d."SUM_SAL" from (select * from
v_dept_job_salaries d)) i) i where 1=1 order by "DEPTNO" asc
apx$rownum<=:p$_max_rows
Plan hash value: 4291084645
0.00103
Id	Operation	Name	Rows	Bytes	Cost (CPU)	Time
0	SELECT STATEMENT				3 (100)	
* 1	VIEW		2	78	3 (34)	00:00:01
* 2	WINDOW NOSORT STOPKEY		2	52	3 (34)	00:00:01
3	VIEW		2	52	3 (34)	00:00:01
4	SORT GROUP BY		2	30	3 (34)	00:00:01
* 5	TABLE ACCESS STORAGE FULL	EMP	3	45	2 (0)	00:00:01
Predicate Information (identified by operation id):
1 - filter("APX$ROWNUM"<=:P$_MAX_ROWS)
RDER BY NULL)<=:P$_MAX_ROWS)
5 - filter("JOB"="V"('P5_JOB'))



Level 9 Debug
SQL Macro
EXADATA
Smart Scan
SQL_ID bzcjfcf14bjny, child number 1
select * from(select a.*,row_number() over (order by null) apx$rownum
from(select i.* from (select "DEPTNO","SUM(SAL)" from ((select /*+
"SUM(SAL)" from (select * from
dept_job_salaries (p_job => :P5_JOB)) d)) i) i where 1=1 order by
x$rownum<=:p$_max_rows
Plan hash value: 4291084645
0.00083
Id	Operation	Name	Rows	Bytes	Cost (CPU)	Time
0	SELECT STATEMENT				3 (100)	
* 1	VIEW		2	78	3 (34)	00:00:01
* 2	WINDOW NOSORT STOPKEY		2	52	3 (34)	00:00:01
3	VIEW		2	52	3 (34)	00:00:01
4	SORT GROUP BY		2	30	3 (34)	00:00:01
* 5	TABLE ACCESS STORAGE FULL	EMP	3	45	2 (0)	00:00:01
Predicate Information (identified by operation id):
1 - filter("APX$ROWNUM"<=:P$_MAX_ROWS)
ORDER BY NULL)<=:P$_MAX_ROWS)
5 - storage("JOB"=:P5_JOB)
filter("JOB"=:P5_JOB)

SYS_CONTEXT

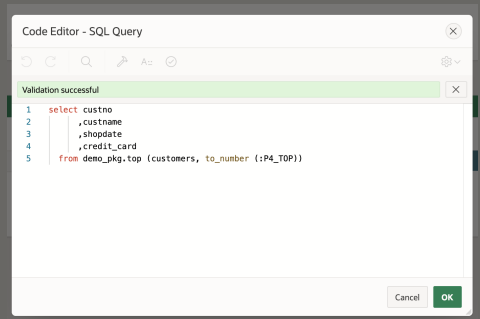
- ➕ Bind Variable
- ➖ Lots of Components
- ➖ Difficult in APEX

V

- ➕ Easy in APEX
- ➖ APEX Session
- ➖ Performance

SQL Macro

- ➕ Easy in APEX
- ➕ Easy in SQL
- ➕ Performance



Top 5 Refresh

Custno	Custname	Shopdate	Credit Card
7566	JONES	4/2/2021	XXXXXXXXXXXXXXX
7698	BLAKE	5/1/2021	XXXXXXXXXXXXXXX
7782	CLARK	6/9/2021	XXXXXXXXXXXXXXX
7788	SCOTT	4/19/2027	XXXXXXXXXXXXXXX
7839	KING	11/17/2021	XXXXXXXXXXXXXXX

Download

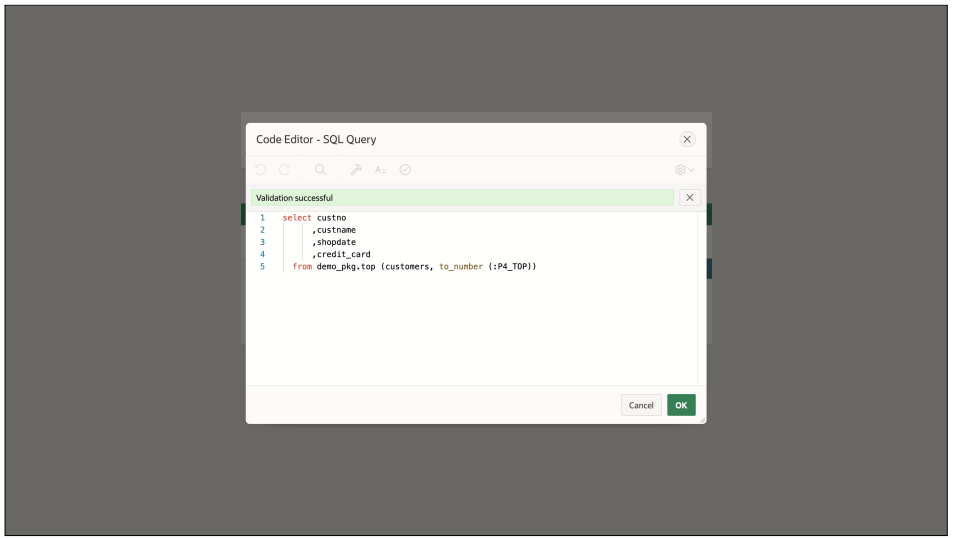
1 - 5

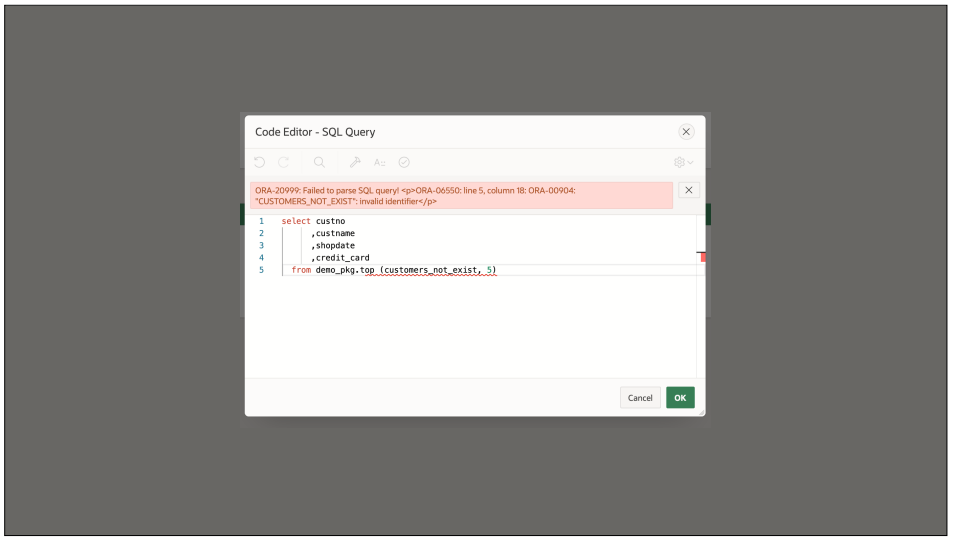
Top 3 Refresh

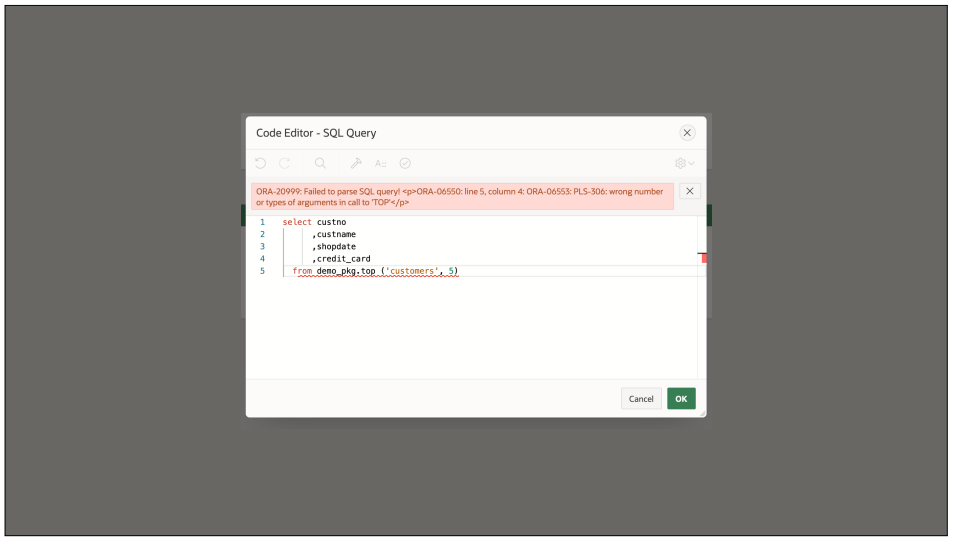
Custno	Custname	Shopdate	Credit Card
7698	BLAKE	5/1/2021	XXXXXXXXXXXXXXX
7782	CLARK	6/9/2021	XXXXXXXXXXXXXXX
7839	KING	11/17/2021	XXXXXXXXXXXXXXX

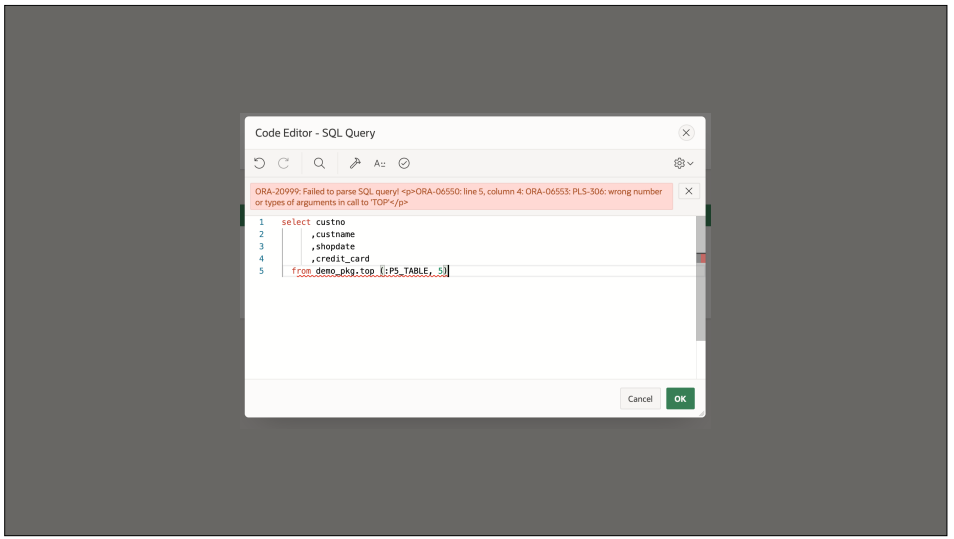
Download

1 - 3


Code Editor - SQL Query
Validation successful
1 select custno
2 ,custname
3 ,shopdate
4 ,credit_card
5 from demo_pkg.top (customers, to_number (:P4_TOP))
Cancel
OK


Code Editor - SQL Query
ORA-20999: Failed to parse SQL query! ORA-06550: line 5, column 18: ORA-00904: "CUSTOMERS_NOT_EXIST": invalid identifier
1 select custno
2 ,custname
3 ,shopdate
4 ,credit_card
5 from demo_pkg.top (customers_not_exist, 5)
Cancel
OK


Code Editor - SQL Query
ORA-20999: Failed to parse SQL query! ORA-06550: line 5, column 4: ORA-06553: PLS-306: wrong number or types of arguments in call to 'TOP'
1 select custno
2 ,custname
3 ,shopdate
4 ,credit_card
5 from demo_pkg.top ('customers', 5)
Cancel
OK


Code Editor - SQL Query
ORA-20999: Failed to parse SQL query! ORA-06550: line 5, column 4: ORA-06553: PLS-306: wrong number or types of arguments in call to 'TOP'
1 select custno
2 ,custname
3 ,shopdate
4 ,credit_card
5 from demo_pkg.top (:P5_TABLE, 5)
Cancel
OK

Code Editor - SQL Query

ORA-20999: Failed to parse SQL query! ORA-06550: line 5, column 28: ORA-00919: invalid function

```
1  select custno
2        ,custname
3        ,shopdate
4        ,credit_card
5  from demo_pkg.top (&P5_TABLE., 5)
```

Cancel OK

Carrier

Carriername Nellen und Quack

Carriercode NUQ

Variables

Country Germany

Transport Method GROUPAGE

Check Date 25.08.2021

Show Transport Cost Matrix

Search

Zipcode	Valid from	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1000	1100	1200	1300	1400	1500	1600	1700	18
01	01.01.2021	19.40	32.24	44.96	52.16	63.22	72.09	77.62	84.30		99.84		110.90		122.06		133.12		144.18		155.34					233.01			
02	01.01.2021	23.13	38.42	53.59	62.17	75.35	85.91	92.50	100.46		118.99		132.17		145.47		158.65		171.83		185.13					277.70			
03	01.01.2021	23.13	38.42	53.59	62.17	75.35	85.91	92.50	100.46		118.99		132.17		145.47		158.65		171.83		185.13					277.70			
04	01.01.2021	19.07	31.67	44.18	51.25	62.12	70.83	76.26	82.82		98.09		108.96		119.93		130.79		141.66		152.62					228.93			
06	01.01.2021	19.07	31.67	44.18	51.25	62.12																				228.93			
07	01.01.2021	19.63	32.61	45.49	52.77	63.96																				235.72			

```
function transportcosts_matrix (p_carrier_id        in number
                                ,p_country_id       in number
                                ,p_transport_method in varchar2
                                )
  return varchar2 sql_macro
```

- 1 x MultiFlyer BLAU *mit Doppelschaukel*-*mit Holzdach*
  - 1 x PFP 9E
    - 1 x B 153 - Brett 1530x140x18mm
    - 15 x B 71 - Brett 710x140x18mm
    - 15 x B 80 - Brett 800x140x18mm
    - 2 x B 89 - Brett 890x140x18mm
    - 1 x BG 13 - Balken 130x44x88mm
    - 4 x BG 151- Balken 1510x44x88mm
    - 2 x BG 36 - Balken 360x44x88mm
    - 2 x BG195 1950*87*44
    - 6 x BG220 2190*87*44
    - 2 x BK 140 - Balken 1400x68x44mm
    - 2 x BK 16 - Balken 160x68x44mm
    - 2 x BK 34 - Balken 340x68x44mm
    - 4 x BK 51 - Balken 510x68x44mm
    - 4 x BK 70 - Balken 700x68x44mm
    - 1 x Fun Rutsche ---BLAU---
    - 1 x P 220 - Pfosten 2200x88x88mm
    - 1 x Zubehörbox 71Z
      - 1 x Kletterssteine SMART-LINE MIXFARBEN
      - 2 x Kunststoffsitz BLAU 0,88 KG 420x170x85 mm, 2 Seile
      - 1 x Lenker ROT
      - 2 x SET Handgriffe ROT
      - 4 x Schaukelschelle mit Karabiner 90x90mm Vierkant
      - 1 x Schrauben MultiFlyer
      - 1 x Sticker - W - Oracal 751c, 010 weiß
      - 1 x Teleskop Kunststoff GELB-blau 0,3 KG 300 mm, Befestigung in der Mitte mit 4 Schrauben

```
with flat as
(select pdt.id as pdt_id
      ,pdt.productname
      ,ppg.id as ppg_id
      ,ppg.packagename
      ,prt.id as prt_id
      ,prt.partname
  from orderscontainarticle oce
  join products pdt
    on oce.pdt_id = pdt.id
  join (select ppg.id
             ,ppg.pdt_id
             ,ppg.packagename
         from product_packagings ppg
        start with ppg.ppg_id is null
        connect by ppg.ppg_id = prior ppg.id) ppg
    on pdt.id = ppg.pdt_id
  join packaged_parts ppt
    on ppg.id = ppt.ppg_id
  join parts prt
    on prt.id = ppt.prt_id
 where oce.odr_id = v ('P5_ODR_ID')
)
, tree as (
select distinct
       pdt_id
      ,null pdt_pdt_id
      ,productname
  from flat
 union
select distinct
       ppg_id
      ,pdt_id
      ,packagename
  from flat
 union
select prt_id
      ,ppg_id
      ,partname
  from flat
)
select pdt_id as value
      ,pdt_pdt_id
      ,productname
      ,level
      ,case when connect_by_isleaf = 1 then 0 when level = 1 then 1 else -1 end as status
      ,null as icon
      ,null as tooltip
      ,null as link
  from tree
  start with pdt_pdt_id is null
  connect by pdt_pdt_id = prior pdt_id
```

```
with flat as
(select pdt.id as pdt_id
      ,pdt.productname
      ,ppg.id as ppg_id
      ,ppg.packagename
      ,prt.id as prt_id
      ,prt.partname
  from orderscontainarticle oce
  join products pdt
    on oce.pdt_id = pdt.id
  join (select ppg.id
             ,ppg.pdt_id
             ,ppg.packagename
         from product_packagings ppg
        start with ppg.ppg_id is null
        connect by ppg.ppg_id = prior ppg.id) ppg
    on pdt.id = ppg.pdt_id
  join packaged_parts ppt
    on ppg.id = ppt.ppg_id
  join parts prt
    on prt.id = ppt.prt_id
 where oce.odr_id = v ('P5_ODR_ID')
)
, tree as (
select distinct
       pdt_id
      ,null pdt_pdt_id
      ,productname
  from flat
 union
select distinct
       ppg_id
      ,pdt_id
      ,packagename
  from flat
 union
select prt_id
      ,ppg_id
      ,partname
  from flat
)
select pdt_id as value
      ,pdt_pdt_id
      ,productname
      ,level
      ,case when connect_by_isleaf = 1 then 0 when level = 1 then 1 else -1 end as status
      ,null as icon
      ,null as tooltip
      ,null as link
  from tree
  start with pdt_pdt_id is null
  connect by pdt_pdt_id = prior pdt_id
```

```
create or replace function billofmaterial (p_odr_id in number)
return varchar2 sql_macro
as
begin
  return '
with flat as
(select pdt.id as pdt_id
    ........
 where oce.odr_id = billofmaterial.p_odr_id
)
    .........';
end billofmaterial;
```

```
create or replace function billofmaterial (p_odr_id in number)
return varchar2 sql_macro
as
begin
  return '
with flat as
(select pdt.id as pdt_id
    ........
 where oce.odr_id = billofmaterial.p_odr_id
)
    .........';
end billofmaterial;
```

```
select *
  from billofmaterial (p_odr_id => 180945);
```

PLS-306: wrong number or types of arguments in call to 'BILLOFMATERIAL'

```
create or replace
function macro (p_arg in varchar2)
return varchar2 sql_macro
as
begin
   return 'with test as
   (select * from dual where dummy = macro.p_arg)
   select * from test';
end macro;
/
```

```
create or replace
function macro (p_arg in varchar2)
return varchar2 sql_macro
as
begin
   return 'with test as
   (select * from dual where dummy = macro.p_arg)
   select * from test';
end macro;
/
```

```
create or replace
function macro (p_arg in varchar2)
return varchar2 sql_macro
as
begin
   return 'with test as
   (select * from dual where dummy = macro.p_arg)
   select * from test';
end macro;
/
```

```
SQL> select *
  2    from macro ('X')
  3  /
```

```
SQL> select *
  2    from macro ('X')
  3  /

Error starting at line : 1 in command -
select *
  from macro ('X')

Error at Command Line : 1 Column : 28
Error report -
SQL Error: ORA-06553: PLS-306: wrong number or types of arguments in call to 'MACRO'
06553. 00000 -  "PLS-%s: %s"
*Cause:
*Action:
```

```
set serveroutput on
declare
  l_clob clob;
begin
  dbms_utility.expand_sql_text (
    input_sql_text  => q'[select * from macro ('x')]',
    output_sql_text => l_clob
  );
  dbms_output.put_line(l_clob);
end;
/
```

```
select
   "A1"."DUMMY" "DUMMY"
from
   (
      select
         "A3"."DUMMY" "DUMMY"
      from
         (
            select
               "A4"."DUMMY" "DUMMY"
            from
               (
                  select
                     "A2"."DUMMY" "DUMMY"
                  from
                     "SYS"."DUAL" "A2"
                  where
                     "A2"."DUMMY" = "WKY"."MACRO"()
               ) "A4"
         ) "A3"
   ) "A1"
```

Bug 32212976

USING SCALAR ARGUMENTS IN WITH CLAUSE
IN SQL TABLE MACRO RAISES ORA-06553 PLS-306

```
create or replace
function not_scalar_arg (p_tab in dbms_tf.table_t)
   return varchar2 sql_macro
is
begin
   return
   'with local as
      (select * from not_scalar_arg.p_tab)
    select * from local';
end not_scalar_arg;
```

```
SQL> select *
  2    from not_scalar_arg (dept)
  3* /

    DEPTNO DNAME          LOC
---------- -------------- -------------
        10 ACCOUNTING     NEW YORK
        20 RESEARCH       DALLAS
        30 SALES          CHICAGO
        40 OPERATIONS     BOSTON
```

ATP

```
SQL> select banner_full
  2    from v$version
  3  /

BANNER_FULL
--------------------------------------------------------------------------------
Oracle Database 19c Enterprise Edition Release 19.0.0.0.0 - Production
Version 19.12.0.1.0
```

```
create or replace function getpromodiscount (p_amount in number)
   return varchar2 sql_macro (type => scalar)
is
begin
   return q'[p_amount * .10]';
end getpromodiscount;
```

```
SQL> select empno, getpromodiscount (empno)
  2    from emp
  3  /

     EMPNO    GETPROMODISCOUNT(EMPNO)
---------- -------------------------
      7369                     736.9
      7499                     749.9
      7521                     752.1
      7566                     756.6
      7654                     765.4
      7698                     769.8
      7782                     778.2
      7788                     778.8
      7839                     783.9
      7844                     784.4
      7876                     787.6
      7900                       790
      7902                     790.2
      7934                     793.4

14 rows selected.
```

```
create or replace function getpromodiscount (p_amount in number)
   return varchar2 sql_macro (type => scalar)
is
begin
   return q'[getpromodiscount.p_amount * .10]';
end getpromodiscount;
```

```
SQL> select empno, getpromodiscount (empno)
  2    from emp
  3* /

Error starting at line : 1 in command -
select empno, getpromodiscount (empno)
  from emp

Error at Command Line : 1 Column : 9
Error report -
SQL Error: ORA-06553: PLS-306: wrong number or types of arguments in call to 'GETPROMODISCOUNT'
06553. 00000 -  "PLS-%s: %s"
*Cause:
*Action:
```

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What Questions do You Have?
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