Tutorial: Function in PostgreSQL

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>
> Reference some of queries from the teaching materials of Stephane Faroult.
>
> Other references:
>
> 1. Return a Result Set from a Stored Procedure
> 2. Set Returning Function

Experimental-Objective

1. Introduce more library functions in postgreSQL
2. Learn how to create your function
3. Have ability to complete complex questions about function

PART 1: PostgreSQL Defined Functions

1. Set Returning Function

Possibly return more than one row. Following description and examples are all referenced from official document

Function Description
`generate_series ( start integer, stop integer [, step integer ] ) → setof integer generate_series ( start bigint, stop bigint [, step bigint ] ) → setof bigint generate_series ( start numeric, stop numeric [, step numeric ] ) → setof numeric`
`generate_series ( start timestamp, stop timestamp, step interval ) → setof timestamp generate_series ( start timestamp with time zone, stop timestamp with time zone, step interval ) → setof timestamp with time zone`

Try following queries about generate numbers:

```
SELECT * FROM generate_series(1,30);
SELECT * FROM generate_series(5,1,-2);
SELECT * FROM generate_series(4,3);
SELECT * FROM generate_series(4,5);
```

Try following query about generate date:

```
SELECT current_date + date_table.interval AS dates
FROM generate_series(0, 28, 7) as date_table(interval);
```

result:

dates
2021-04-19
2021-04-26
2021-05-03
2021-05-10
2021-05-17

Try following query about generate time:

```
SELECT * FROM generate_series('2021-04-10 16:20'::timestamp,
                    '2021-04-10 18:10', '25 minutes');
```

Result:

generate_series
2021-04-10 18:00:00.000000
2021-04-10 17:35:00.000000
2021-04-10 17:10:00.000000
2021-04-10 16:45:00.000000
2021-04-10 16:20:00.000000

2. split_part()

splits a string on a specified delimiter and returns the nth substring.

```
splite_part(varchar <source text>, varchar <delimiter text>,int <field
serial number>)
```

If you need to split the title Feel relaxed studying database by a space into 4 different rows, what you plan to do?

Try following queries:

```
select split_part('Feel relaxed studying database',' ',1);
select split_part('Feel relaxed studying database',' ',2);
select split_part('Feel relaxed studying database',' ',3);
select split_part('Feel relaxed studying database',' ',4);
```

Results are only one row in each separate result set as follows：

```
Feel
relaxed
studying
database
```

Suppose select `split_part('Feel relaxed studying database',' ',n);` as a table named `t1`, and `generate_series(1, 4);` as a table named `t2`, what the result set of cross join of those two table?

```
select split_part(t1.words, ' ', t2.number)
from (select cast('Feel relaxed studying database' as text)) t1(words)
         cross join generate_series(1, 4) as t2(number);
```

We can replace 4 with `length(t1.words)-length(replace(t1.words,' ',''))+1`

```
select split_part(t1.words, ' ', t2.number)
from (select cast('Feel relaxed studying database' as text)) t1(words)
         cross join generate_series(1, length(t1.words) -
                                       length(replace(t1.words, ' ', '')) + 1)
as t2(number);
```

Results:

split_part
Feel
relaxed
studying
database

3. substr()

Get the substring according to the length from the begin position.

```
substr(varchar <source text>, int <begin position>, int <length>)
```

Try following queries

```
select substr('Feel relaxed studying database', 1, 1);
select substr('Feel relaxed studying database', 2, 1);
select substr('Feel relaxed studying database', 3, 1);
select substr('Feel relaxed studying database', 4, 1);
```

Results are only one character in one row in each separate result set as follows：

```
F
e
e
l
```

In the same way, if we want to get a table of all characters from a text, we can do as follows:

```
select distinct substr(character_table.cc,num.index,1)
from (select 'Feel relaxed studying database'::text ) as character_table(cc)
         cross join
    generate_series(1, length(character_table.cc)) as num(index);
```

4. ascii()

Convert a character to its corresponding ASCII code.

```
ascii(char <source char>)
```

Design a query to find all characters and their `ascii` code in Feel relaxed studying database in ascending order of `ascii` code.

```
select distinct ascii(substr(character_table.cc,num.index,1)) as ascii,
substr(character_table.cc,num.index,1)
from (select 'Feel relaxed studying database'::text ) as character_table(cc)
         cross join
    generate_series(1, length(character_table.cc)) as num(index)
order by ascii;
```

PART 2. User Designed Function in PostgreSQL

1. general format of postgreSQL function

```
create or replace function function_name(parameter_name
parameter_type)
returns return_type
language plpgsql
as $$
declare
variable_name variable_type: = initial value
.....
begin
end;
$$
language plpgsql;
```

Exercise 1:

Create a function to calculate the sum of two integer numbers. After your design, you can execute the following query.

```
create or replace function sum_func(a int, b int)
  returns int
language plpgsql
as $function$
begin
  return a + b;
end;
$function$;
```

Test:

```
select fun(3,4);
```

Exercise 2:

Create a function named `fullname`, which has two variables called `firstname` and `secondname` and return the combination of two variables. After your design, you can execute following queries.

```
create or replace function fullname(firstname varchar, secondname varchar)
  returns varchar
language plpgsql
as $function$
declare
  name varchar :=null;
begin
  name := firstname || ' ' || secondname;
  return name;
end;
$function$;
```

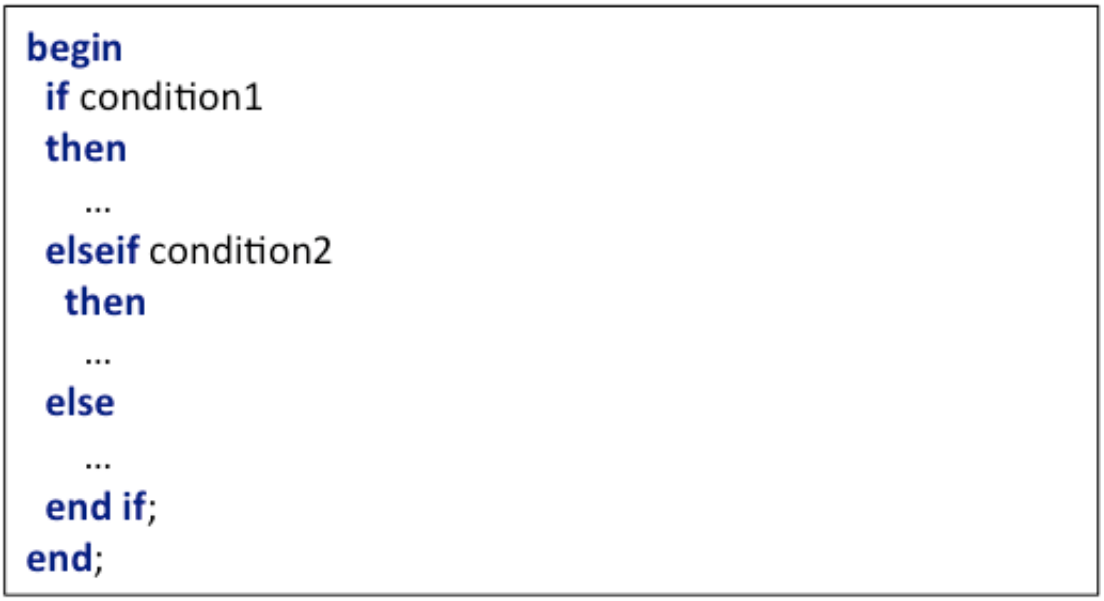
Test:

```
select fullname('ZHU','Yueming');
```

Result:

	fullname
1	ZHU Yueming

2. Conditions in procedure



Exercise 3:

Create a function to combine firstname and surname of people according to the people coming from eastern country or western country.

```
create function full_name(p_fn varchar, p_sn varchar, style char)
  returns varchar
as $$
begin
```

```
  if upper(style) = 'W'
  then
    return trim(coalesce(p_fn, '') || ' ' || p_sn);
  elseif upper(style) = 'E'
    then
      return trim(p_sn || ' ' || coalesce(p_fn, ''));
  else
    raise exception 'Style must be W or E';
  end if;
end;
$$
language plpgsql;
```

Test:

```
select full_name(p.first_name, p.surname, 'E')
from people p
  join credits c on p.peopleid = c.peopleid and c.credited_as = 'D'
  join movies m on m.movieid = c.movieid
where m.country = 'cn';
```

Result:

196 rows

	full_name
1	Wan Laiming
2	Mashimo Kōichi
3	Qian Yunda
4	Yan Shanchun
5	Zhang Yimou
6	Lee Ang
7	Diao Yinan
8	Diao Yi'nan
9	Yu Zhong

3. Loop in procedure

```
for variable_value in start_value .. end_value loop
 statements;
end loop;

while condition loop
 statements;
end loop;
```

Exercise 4:

Find the factorial of number

```
create or replace function factorial(number int)
  returns int
language plpgsql
as $function$
declare result int;
begin
  result = 1;
  for i in 1 .. number loop
    result = result * i;
  end loop;
  return result;
end;
$function$;
```

or

```
create or replace function factorial2(number int)
  returns int
language plpgsql
as $function$
declare
  result int;
  i      int;
begin
  result = 1;
  i = 1;
  while i <= number loop
    result = result * i;
    i = i + 1;
  end loop;
  return result;
end;
$function$;
```

Test:

```
select factorial2(5);
```

Result:

	factorial2
1	120

4. Return a table from function

The structure:

```
create function fun_name(arg1 type1, ...)
   returns
      table(
         col_name1 col_type,
         col_name2 col_type.
         ......
      )
   as
   $$
   begin
      return query select col1,col2 from ...;
   end;
   $$
   language plpgsql;
```

The column type of result set should be same as the type of return table exactly, more specifically, the type of col1 should be same as the first col_type, and the type of col2 should be same as the second col_type.

Exercise 5:

Design a function to return a table that contains all characters and their `ascii` code from a pattern string in ascending order of `ascii` code.

```
create function character_table(pattern varchar)
    returns table
            (
                chr   char,
                ascii int
            )
as
$body$
begin
    return query
        select distinct (substr(t1.title, t2.index, 1)::char)   chr,
                        ascii(substring(t1.title, t2.index, 1)) ascii
        from (select pattern) t1(title)
                 cross join generate_series(1, length(pattern)) t2(index)
        order by ascii;
end;
$body$
language plpgsql;
```

Then you can test the function as

```
select * from character_table('I love database!');
```

5. Return cursor for large result set

If the result set of your sql function is too large that it may have a memory overflow error, you can returns a reference of your result set to cursor so that it is an effective way to solve the problem.

Materials in this part mainly referenced from [How to Return a Result Set]

The structure of return single result set:

```
create function fun_name(arg1 type1, ...)
   returns
      refcursor
   as
   $$
   declare
    ref refcursor; -- Declare a cursor variable
   begin
      open ref for select col1,col2 from table.....;-- Open a cursor
      return ref; --  Return the cursor to the caller
   end;
   $$
   language plpgsql;
```

Structure of return multiple result sets:

To return multiple result sets, specify `SETOF refcursor` return type and use `RETURN NEXT` to return each cursor:

```
create function fun_name(arg1 type1, ...)
   returns
      SETOF refcursor
   as
   $$
   declare
    ref1 refcursor; -- Declare a cursor variable1
    ref2 refcursor; -- Declare a cursor variable1
   begin
      open ref1 for select col1,col2 from table.....;-- Open a cursor1
      return next ref1; --  Return the cursor to the caller

      open ref2 for select col1,col2 from table.....;-- Open a cursor2
      return next ref2; --  Return the cursor to the caller
   end;
   $$
   language plpgsql;
```

Features:

- Return multiple result sets
- Cursor Lifetime: Until the end of transaction
- Auto-commit: Must be **off**

Exercise 6:

Example: rewrite the function in exercise 5, and returns a cursor replaced.

```
create function character_cursor(pattern varchar)
    returns refcursor
as
$body$
declare
    ref refcursor;
begin
    open ref for
        select distinct (substr(t1.title, t2.index, 1)::char)   chr,
                        ascii(substring(t1.title, t2.index, 1)) ascii
        from (select pattern) t1(title)
                 cross join generate_series(1, length(pattern)) t2(index)
        order by ascii;
    return ref;
end;
$body$
    language plpgsql;
```

The process of using cursor:

1. Start a transaction:

   ```
   begin;
   ```

2. Get cursor of the function

   ```
   select character_cursor('I love database!');
   ```

   The return result is:

   ```
   <unnamed portal 2>
   ```

3. Fetch all result set from `<unnamed portal 2>`

   ```
   fetch all in "<unnamed portal 2>";
   ```

4. Commit transaction:

```
commit;
```