PLpgSQL (i)

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❖ PLpgSQL

PLpgSQL = **P**rocedural **L**anguage extensions to **P**ost**g**re**SQL**

A PostgreSQL-specific language integrating features of:

- procedural programming and SQL programming

Provides a means for extending DBMS functionality, e.g.

- implementing constraint checking (triggered functions)
- complex query evaluation (e.g. recursive)
- complex computation of column values
- detailed control of displayed results

Details: PostgreSQL Documentation, Chapter 42

❖ Defining PLpgSQL Functions

PLpgSQL functions are created (and inserted into db) via:

```
CREATE OR REPLACE
    funcName(param1, param2, ....)
    RETURNS rettype
AS $$
DECLARE
    variable declarations
BEGIN
    code for function
END;
$$ LANGUAGE plpgsql;
```

Note: the entire function body is a single SQL string (**$$...$$**)

❖ PLpgSQL Examples

Example: function to compute *x / y* "safely"

```
create or replace function
   div(x integer, y integer) returns integer
as $$
declare
   result integer;      -- variable
begin
   if (y <> 0) then     -- conditional
      result := x/y;    -- assignment
   else
      result := 0;      -- assignment
   end if;
   return result;
end;
$$ language plpgsql;
```

❖ PLpgSQL Examples (cont)

Example: function to compute n!

```
create or replace function
   factorial(n integer) returns integer
as $$
declare
   i integer;
   fac integer := 1;
begin
   for i in 1..n loop
      fac := fac * i;
   end loop;
   return fac;
end;
$$ language plpgsql;
```

❖ PLpgSQL Examples (cont)

Example: function to compute n! recursively

```
create function
   factorial(n integer) returns integer
as $$
begin
   if n < 2 then
      return 1;
   else
      return n * factorial(n-1);
   end if;
end;
$$ language plpgsql;
```

Usage: **`select factorial(5);`**

❖ PLpgSQL Examples (cont)

Example: handle withdrawl from account and return status message

```
create function
    withdraw(acctNum text, amount integer) returns text
as $$
declare bal integer;
begin
    select balance into bal
    from   Accounts
    where  acctNo = acctNum;
    if bal < amount then
        return 'Insufficient Funds';
    else
        update Accounts
        set    balance = balance - amount
        where  acctNo = acctNum;
        select balance into bal
        from   Accounts
        where  acctNo = acctNum;
        return 'New Balance: ' || bal;
    end if;
end;
$$ language plpgsql;
```

❖ PLpgSQL Gotchas

Some things to beware of:

- doesn't provide any i/o facilities (except **`RAISE NOTICE`**)
  - the aim is to build computations on tables that SQL alone can't do
- functions are not syntax-checked when loaded into DB
  - you don't find out about the syntax error until "run-time"
- error messages are sometimes not particularly helpful
- functions are defined as strings
  - change of "lexical scope" can sometimes be confusing
- giving params/variables the same names as attributes
  - can avoid by starting all param/var names with underscore

Summary: debugging PLpgSQL can sometimes be tricky.

❖ Data Types

PLpgSQL constants and variables can be defined using:

- standard SQL data types (**`CHAR, DATE, NUMBER, ...`**)
- user-defined PostgreSQL data types (e.g. **`Point`**)
- a special structured record type (**`RECORD`**)
- table-row types (e.g. **`Branches%ROWTYPE`** or simply **`Branches`**)
- types of existing variables (e.g. **`Branches.location%TYPE`**)

There is also a **`CURSOR`** type for interacting with SQL.

❖ Data Types (cont)

Variables can also be defined in terms of:

- the type of an existing variable or table column
- the type of an existing table row (implict **RECORD** type)

Examples:

```
quantity     INTEGER;
start_qty    quantity%TYPE;

employee     Employees%ROWTYPE;
-- or
employee     Employees;

name         Employees.name%TYPE;
```

❖ Syntax/Control Structures

Typical set of control structures, with extensions:

Assignment

var **:=** *expr*

SELECT *expr* **INTO** *var*

Selection

```
IF Cond1 THEN S1
ELSIF Cond2 THEN S2 ...
ELSE S END IF
```

Iteration

```
LOOP S END LOOP
WHILE Cond LOOP S END LOOP
FOR rec_var IN Query LOOP ...
FOR int_var IN lo..hi LOOP ...
```

S_i = list of PLpgSQL statements, each terminated by semi-colon

❖ SELECT...INTO

Can capture query results via:

```
SELECT Exp1,Exp2,...,Expn
INTO   Var1,Var2,...,Varn
FROM   TableList
WHERE  Condition ...
```

The semantics:

- execute the query as usual
- return "projection list" (Exp_1,Exp_2,...) as usual
- assign each Exp_i to corresponding Var_i

❖ SELECT...INTO (cont)

Assigning a simple value via **`SELECT...INTO`**:

```
-- cost is local var, price is attr
select price into cost
from   StockList
where  item = 'Cricket Bat';
cost := cost * (1+tax_rate);
total := total + cost;
```

The current PostgreSQL parser also allows this syntax:

```
select into cost price
from   StockList
where  item = 'Cricket Bat';
```

❖ SELECT...INTO (cont)

Assigning whole rows via **`SELECT...INTO`**:

```
declare
    emp     Employees%ROWTYPE;
    -- alternatively,  emp  RECORD;
    eName   text;
    pay     real;
begin
    select * into emp
    from Employees where id = 966543;
    eName := emp.name;
    ...
    select name,salary into eName,pay
    from Employees where id = 966543;
end;
```

❖ SELECT...INTO (cont)

In the case of a PLpgSQL statement like

```
select a into b from R where ...
```

If the selection returns no tuples

- the variable **b** gets the value **NULL**

If the selection returns multiple tuples

- the variable **b** gets the value from the first tuple

❖ SELECT...INTO (cont)

An alternative to check for "no data found"

Use the special variable **FOUND** ...

- local to each function, set false at start of function
- set true if a **SELECT** finds at least one tuple
- set true if **INSERT/DELETE/UPDATE** affects at least one tuple
- otherwise, remains as **FALSE**

Example of use:

```
select a into b from R where ...
if (not found) then
    -- handle case where no matching tuples b
```

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