Lecture 8

Procedures

- Business processes
- Avoid cursors
- Use `insert` … `select` and complex `update`s

Lab 8

Store for REUSE

- Sequence of change operations
- Single business process
- Avoid `begin transaction` / `commit` inside

`commit` is a slow operation (it usually means writing to a file) and it may hurt if the procedure is called repeatedly.

May spent a lot of time in the network if running a business procedure in a remote server.

Advantages

- A single version to maintain
- Excute directly on the DBMS server
- Security, all changes follow the rules

`create procedure myproc`

`execute myproc`

Function that returns `void`

PostgreSQL is the only product for which, probably under the influence of languages such as C or Java, **procedures are just functions that return nothing**.

```
--
--  A procedure to register a film
--
create function movie_registraction
  ( p_title         varchar,
    p_country_name  varchar,
    p_year          varchar,
    p_director_fn   varchar,
    p_director_sn   varchar,
    p_actor1_fn     varchar,
    p_actor1_sn     varchar,
    p_actor2_fn     varchar,
    p_actor2_sn     varchar)
returns void
as $$
declare
  n_rowcount  int;
  n_movieid   int;
  n_people    int;
begin
  insert into movies(title, country, year_released)
  select p_title, country_code, p_year
  from countries
  where country_name = p_country_name;
  get diagnostics n_rowcount = row_count;
  if n_rowcount = 0
  then
    raise exception 'country not found in table COUNTRIES'
  end if
  n_movieid := lastval();

  --
  -- Count how many people were "provided" in the parameters
  -- (some of them could be NULL)
  --

  select count(surname)
  into n_people
  from (  select p_director_sn as surname
          union all
          select p_actor1_sn as surname
          union all
          select p_actor2_sn as surname) specified_people
  where surname is not null;

  --
  -- Get people identifiers and insert into table credits
  --
  insert into credits(movieid, peopleid, credited_as)
  select n_movieid, people.peopleid, provided.credited_as
  from (select coalesce(p_director_fn, '*') as first_name,
               p_director_sn as surname,
```

```
               'D' as credited_as
        union all
        select coalesce(p_actor1_fn, '*') as first_name,
               p_actor1_sn as surname,
               'A' as credited_as
        union all
        select coalesce(p_actor2_fn, '*') as first_name,
               p_actor2_sn as surname,
               'A' as credited_as) provided
       inner join people
         on people.surname = provided.surname
        and coalesce(people.first_name, '*') = provided.first_name
  where provided.surname is not null;
  get diagnostics n_rowcount = ROW_COUNT;
  if n_rowcount != n_people
  then
    -- My choice is to cancel everything ("raise" will
    -- generate a rollback of the whole procedure, the
    -- successful insert into movies will be cancelled)
    raise exception 'Some people couldn''t be found';
  end if;
end;
$$ language plpgsql;
```

```
select movie_registration('The Adventures of Robin Hood',
   'United States', 1938,
   'Michael', 'Curtiz',
   'Errol', 'Flynn',
   null, null);
```

Use `perform movie_registration(...)` inside another procedure.

Catch exceptions

```
begin -- same as'try'
...
exception -- same as as 'catch'
  when ... -- exception name here
end;
```

`unique_violation`

Using cursors

```
declare
  c cursor for select ...;
begin
  for row_var in c
  -- Inside the loop, you can refer to row_var.col_name
```

```
  loop
    ...
  end loop;
  ...
end;
```

DDL operations are usually unsupported by stored procedures.

A `CREATE TABLE` (or `ALTER TABLE`) in a procedure will fail.

BUT you can cheat.

```
begin
  ...
  cmd := 'create table T ...';
  execute cmd;
  ...
end;
```

Create a daily copy of tables

- `INFORMATION_SCHEMA` contains “System Views” that describe the database (tables, columns, constraints).
- `CREATE TABLE ... AS SELECT` let you copy structure and data. However, the copy is imperfect.
  - all columns are created nullable
  - constraints and other features we’ll see later are “forgotten”

```
--  An example where using a cursor is fully justified.
--  The procedure queries the catalogue to check the tables
--  in the current schema, and creates a copy (with the date in the
--  name) of every table for which no copy was created today and
--  that isn't itself a copy.
--  There is no way to do it without a cursor.
create or replace function save_tables()
returns void
as $$
declare
   v_suffix      varchar(50);
   v_create_cmd  varchar(100);
   c cursor for select replace(table_name, v_suffix, '') as table_name
                from information_schema.tables
                where table_schema = current_schema()
                group by replace(table_name, v_suffix, '')
                having count(*) = 1
                    and replace(table_name, v_suffix, '') not like '%_save_%';

begin
  select '_save_' || to_char(current_date, 'YYMMDD')
```

```
    into v_suffix;
    for fetched_row in c
    loop
      v_create_cmd := 'create table ' || fetched_row.table_name || v_suffix
                      || ' as select * from ' || fetched_row.table_name;
      execute v_create_cmd;
    end loop;
  end;
  $$ language plpgsql;
```

Triggers

For excuting stored procedures automatically.

Fired by data changes (never by a `SELECT`). [See below]

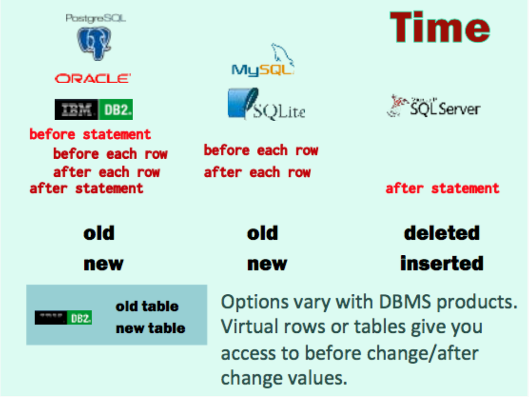
- Modify input on the fly
- Check complex rules
- Manage data redundancy

Trigger Activation

Depending on what the trigger is designed to achieve, it may be fired by various events and at various possible precise moments.

- before/after `insert` trigger
- before/after `insert` for each row trigger

Time



Time

before statement
before each row
after each row
after statement

before each row
after each row

after statement

old
new

old
new

deleted
inserted

old table
new table

Options vary with DBMS products. Virtual rows or tables give you access to before change/after change values.

Event

- `insert`
- `update`
- `delete`

Several possible triggers.

Several possible events can fire one trigger

PostgreSQL, Oracle, IBM DB2

Some products let you have several different events that fire the same trigger (timing must be identical).

```
create trigger trigger_name
before insert or update or delete
on table_name
for each row
as
begin
  ...
end
```

MySQL, SQLite

Other products allow only one trigger per event/timing, and one event per trigger.

```
create trigger trigger_name
before delete
on table_name
for each row
as begin
  ...
end
```

SQL Server

SQL Server is a bit special. Triggers are always after the statement, and syntax is different from other products. But several events can fire one trigger.

```
create trigger trigger_name
on table_name
after insert, update, delete as
begin
  ...
end
```

1. Modify input on the fly

For instance, you want to make sure that data is always in lowercase but the (bought) data entry program doesn't enforce it.

```
before insert / update
for each row
```

SQL Server: modify by joining on inserted

2. Check complex rules

```
before insert / update / delete
for each row
```

SQL Server: check by joining on inserted and deleted. Roll back if something wrong.

3. Manage data redundancy

```
after insert / update / delete
for each row
```

SQL Server: deleted/inserted

A third case is managing some data redundancy (which means some duplication of data). A trigger can write in your back to another table.

In the film database, this is done for titles: words are automatically isolated and added to MOVIE_TITLE_FT_INDEX2 whenever you add a row to MOVIES or ALT_TITLES.

```
create or replace function people_audit_fn() returns trigger
as
$$
begin
  if tg_op = 'UPDATE'
  then
    insert into people_audit(...)
    ...
  elsif tg_op = 'INSERT' then
    insert into people_audit(...)
    ...
  else
    insert into people_audit(...)
    ...
  end if;
return null;
end;
$$ language plpgsql;
```

Notice that the initial "returns trigger" is completely dummy. We can return anything, null is OK.

```
create trigger people_trg
after insert or update or delete on people
for each row
execute procedure people_audit_fn();
```

Beware of FOR EACH ROW triggers, you cannot do anything in them.

Unique Constraint

PostgreSQL

```
create table test
  (id int, label varchar(20),
    unique(id) deferrable initially deferred);
```

Consistency and constraints are checked AFTER the update, not DURING. During the update, the state is undefined.

DON'T look at other rows of the modified table in `for each row` triggers.

If you can, avoid triggers.

- Don't use triggers to fix design issues.
- Use stored procedures preferably to triggers.
- Use triggers if there are multiple access points (other than your programs).

Speeding Up

Index

Two columns often queried together can be indexed together; what is indexed is concatenated values (NOT separate values)

Whenever you declare a `PRIMARY KEY` or `UNIQUE` constraint, an index is created behind your back.

Additionally, indexes use a lot of storage, sometimes more than data! It has a huge impact on operations (regular activities such as backups).

You can also declare an index to be unique.

```
create unique index <index name>
on <table name>(<col1>, ... <coln>)
```

Use Unique constraint instead of Unique index.

…