Supporting UDFs in Peloton

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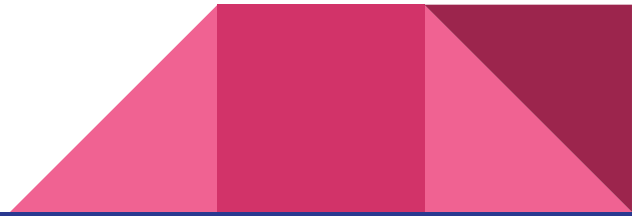
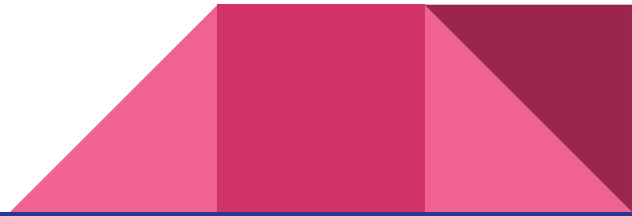
Proposed Goals

- 75% Goal: Registering a UDF
  - CREATE OR REPLACE FUNCTION increment (i int) RETURNS integer AS $$
  - BEGIN
  - RETURN i + 1;
  - END;
  - $$ LANGUAGE plpgsql;
- 100% Goal: Simple Add-One example
  - Ex: select increment(1);
  - Ex: select increment(a) from table;
- 125% Goal: Support complex constructs in UDF
  - Support if-else statement
  - Support Recursive

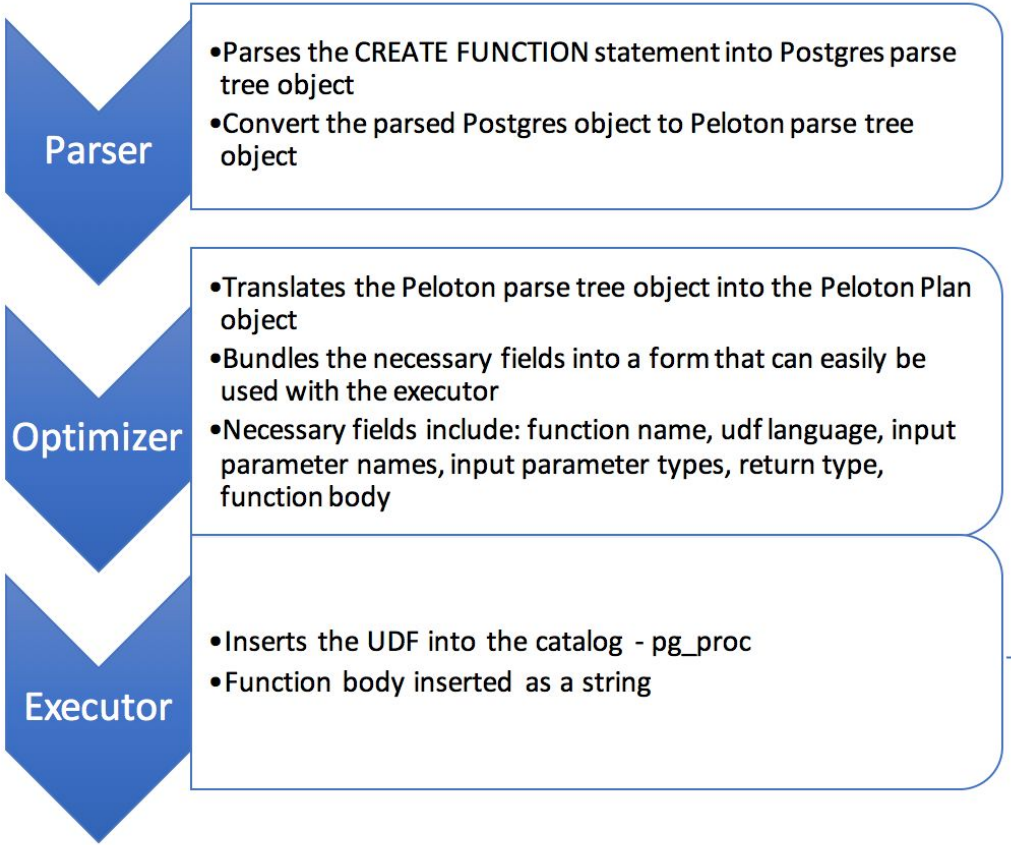


UDF Registration Example

```
CREATE OR REPLACE FUNCTION increment (i int)
RETURNS integer AS $$
BEGIN
    RETURN i + 1;
END;
$$ LANGUAGE plpgsql;
```



CREATE FUNCTION statement



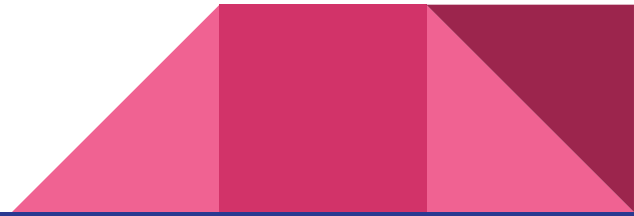
Pg_proc Catalog

- Stores all the registered UDFs
- Created during Bootstrapping
- Supports querying by oid and function name

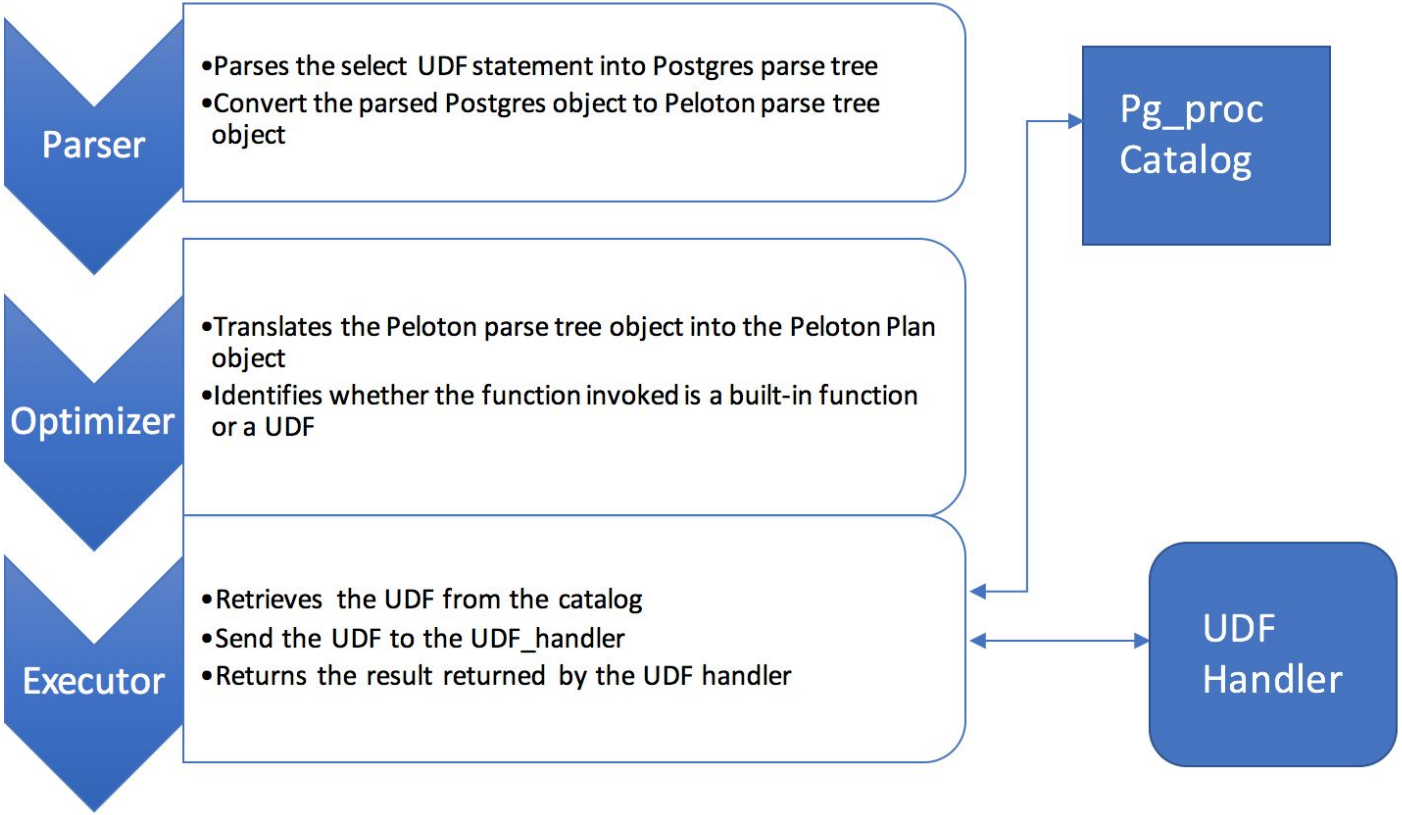
UDF Invocation Example

```
select increment(2);
```

-> Returns 3



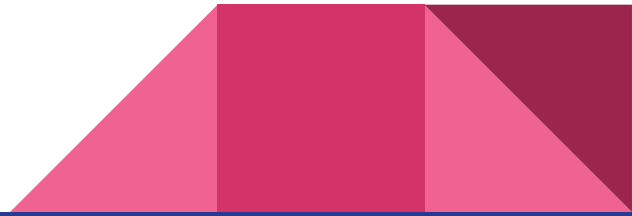
Select increment (2);



Output: 3

How to implement UDF?

- Link the library of Postgres
  - Clean Interface?
  - Transformation!
- Include all files under Postgres UDF directories
  - Global variables & Dependencies
  - Transformation Again
- Build it from scratch
  - Start by small steps



How to implement UDF?

- ~~Link the library of Postgres~~
  - Clear Interface?
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- ~~Include all files under its plpgsql directories~~
  - Global variables & Dependencies
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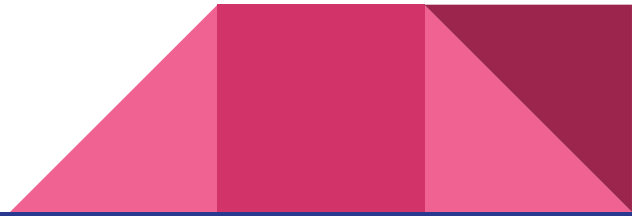
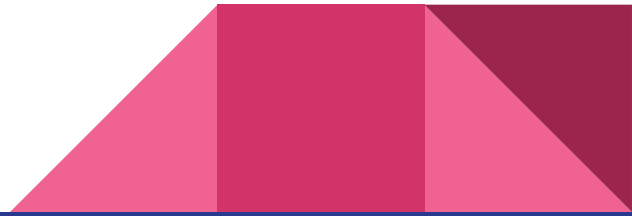


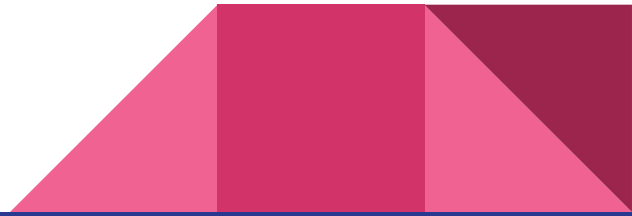
UDF Implementation & Interface

- Build the Yacc and Lex for UDF
  - If-else & return_stmt are supported
- UDF Handler is an interpreter
  - climb the parse-tree, execute and return the final value
  - UDF_Handle::Execute(vector<Value> values)
- UDF_Stmt is the base class with virtual method Evaluate()
  - UDF_Return_Stmt & UDF_IFELSE_Stmt are the children class



If-else Example

```
CREATE OR REPLACE FUNCTION OddEven (i int)
RETURNS integer AS $$
BEGIN
        IF  i % 2 = 0 THEN
                RETURN i;
        ELSE
                RETURN - i;
        END IF
END;
$$ LANGUAGE plpgsql;
```



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Execution of SQL Expression

- Take “Select i + 1;” as the example
- The Token “i” is replaced by its value, say 5
  - “Select i + 1;” ------> “Select 5 + 1;”
- The replaced string is executed as normal SQL statement by
  - traffic_cop.ExecuteStatement(sql_expr)
    - Which does parse(), plan() and execute()
- This means, an identical plan is generated every time
- [TODO] Value injection happens after the plan is generated
  - So that “Select i + 1;” is parsed and node “i” is replaced by its value in every invocation

DEMO

Future Work

1. Supporting more functionalities within the UDF - requires more work on yacc and lex side
2. Supporting transactions in expressions
3. Function syntax and argument validations
4. Storing function pointer (UDFhandle) in the catalog
5. Performance overhead