SQL Lineage Made Easy with PL/Scope 12.2?

Philipp Salvisberg

@phsalvisberg

About Me

- Trivadian since April 2000
  - Senior Principal Consultant, Partner
  - Member of the Board of Directors
  - www.salvis.com/blog
  - @phsalvisberg
- Database centric development with Oracle database
- Fond of DSLs to build full stack solutions efficiently and keep them manageable
- Author of free SQL Developer Extensions PL/SQL Cop, PL/SQL Unwrapper, oddgen and Bitemp Remodeler

trivadis makes IT easier.

Agenda

1. Data Lineage
2. PL/Scope
3. Data Lineage with PL/Scope
4. Options
5. Core Messages

trivadis makes IT easier.

Data Lineage

trivadis
makes IT easier.

What Is Data Lineage?

Data lineage is generally defined as a kind of data life cycle that includes the data's origins and where it moves over time.

This term can also describe what happens to data as it goes through diverse processes.

Source: https://www.techopedia.com/definition/28040/data-lineage

trivadis makes IT easier.

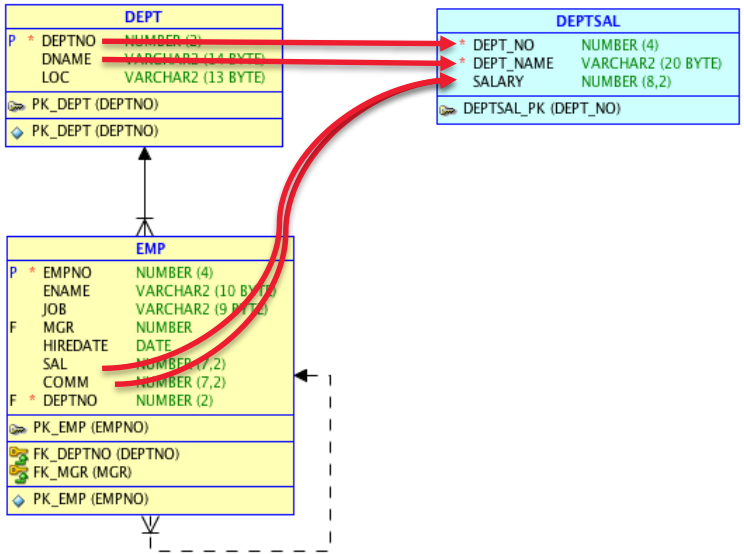
Example

```
INSERT INTO deptsal (dept_no, dept_name, salary)
SELECT d.deptno, d.dname, SUM(e.sal + NVL(e.comm, 0)) AS sal
  FROM dept d
  LEFT JOIN (SELECT *
               FROM emp
              WHERE hiredate > DATE '1980-01-01') e
    ON e.deptno = d.deptno
 GROUP BY d.deptno, d.dname;
```


trivadis makes IT easier.

Where Did the Output Come From?

Schema Level



Instance Level

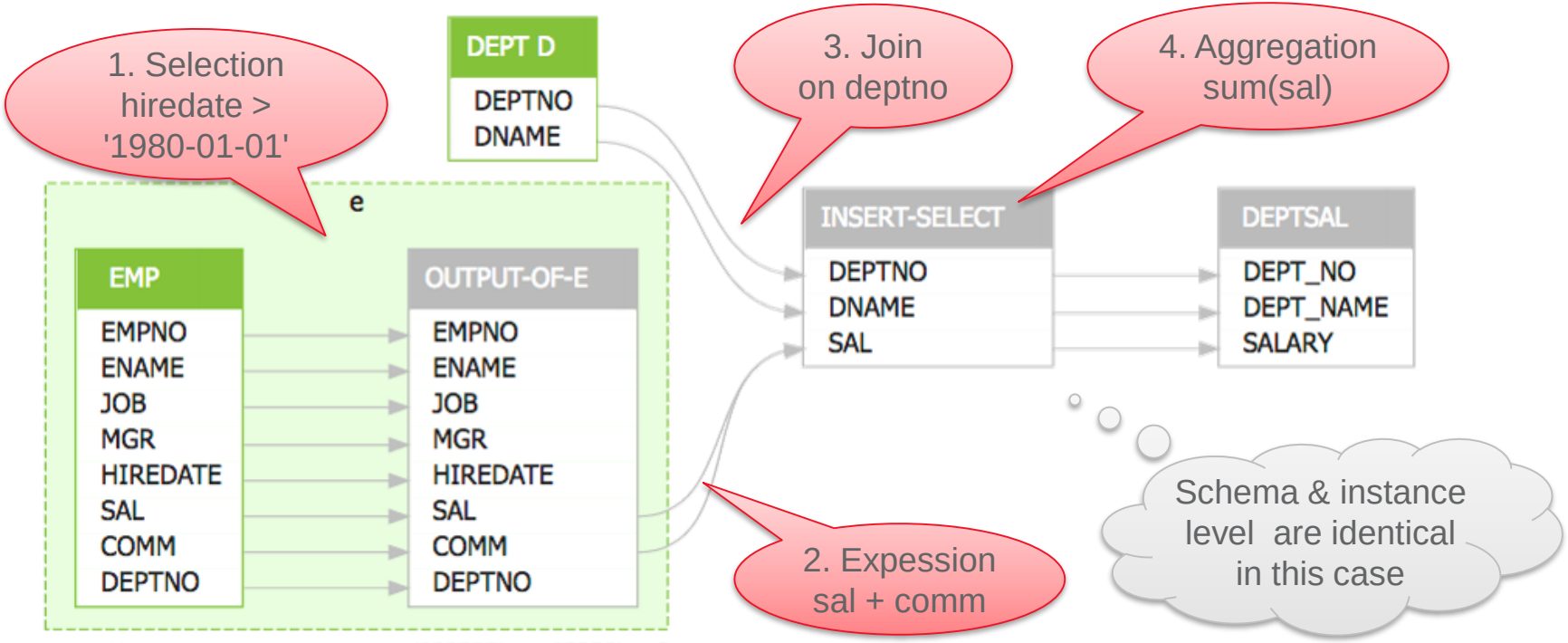
DEPTNO	DNAME
10	ACCOUNTING
20	RESEARCH
30	SALES
40	OPERATIONS

DEPT...	DEPT_NAME	SALARY
10	ACCOUNTING	8750
20	RESEARCH	10875
30	SALES	11600
40	OPERATIONS	(null)

DEPTNO	ENAME	SAL	COMM
10	CLARK	2450	(null)
10	KING	5000	(null)
10	MILLER	1300	(null)
20	ADAMS	1100	(null)
20	FORD	3000	(null)
20	JONES	2975	(null)
20	SCOTT	3000	(null)

trivadis makes IT easier.

How Were the Inputs Manipulated to Produce the Output?



trivadis
makes IT easier.

PL/Scope

trivadis
makes IT easier.

What Is PL/Scope

PL/Scope is a compiler-driven tool that
collects PL/SQL and SQL identifiers as well as
SQL statements usage in PL/SQL source code.

PL/Scope lets you develop powerful and effective
PL/Scope source code tools that
increase PL/SQL developer productivity by
minimizing time spent browsing and
understanding source code.

Source: Oracle Database Developer's Guide 12c Release 2 (12.2) E49632-15, January 2017

trivadis makes IT easier.

Using PL/Scope

1. Enable (on session or system level, disabled by default, check IDE settings as well)

```
ALTER SESSION SET plscope_settings='identifiers:all, statements:all';
```

2. Compile schemas of interest (package, procedure, function, type, trigger, synonym)
3. Query views (uncompiled, referenced objects are suppressed)

```
SELECT * FROM all_identifiers;
SELECT * FROM all_statements;
```

4. Build your code analysis utilities (views and packages)
   see also https://github.com/PhilippSalvisberg/plscope-utils

trivadis makes IT easier.

Example – Identifiers & Statements


```
CREATE OR REPLACE PROCEDURE load_from_tab IS
BEGIN
   INSERT INTO deptsal (dept_no, dept_name, salary)
   SELECT /*+ordered */
          d.deptno, d.dname, SUM(e.sal + NVL(e.comm, 0)) AS sal
     FROM dept d
     LEFT JOIN (SELECT *
                  FROM emp
                 WHERE hiredate > DATE '1980-01-01') e
           ON e.deptno = d.deptno
    GROUP BY d.deptno, d.dname;
   COMMIT;
END load_from_tab;
```


trivadis makes IT easier.

```
1  SELECT line, col, name, name_path, type, usage, ref_owner, ref_object_type, ref_object_name
2    FROM plscope_identifiers
3   WHERE object_name = 'LOAD_FROM_TAB'
4     AND owner = USER
5   ORDER BY line, col;
```

Script Output | Query Result

SQL | All Rows Fetched: 19 in 0.063 seconds

	LINE	COL	NAME	NAME_PATH	TYPE	USAGE	REF_OWNER	REF_OBJECT_TYPE	REF_OBJECT_NAME
1	1	11	LOAD_FROM_TAB	/LOAD_FROM_TAB	PROCEDURE	DECLARATION	PLSCOPE	PROCEDURE	LOAD_FROM_TAB
2	1	11	LOAD_FROM_TAB	/LOAD_FROM_TAB/LOAD_FROM_TAB	PROCEDURE	DEFINITION	PLSCOPE	PROCEDURE	LOAD_FROM_TAB
3	3	4	3nyyhcpmwxcgz	/LOAD_FROM_TAB/LOAD_FROM_TAB/3nyyhcpmwxcgz	INSERT	EXECUTE	(null)	(null)	(null)
4	3	16	DEPTSAL	/LOAD_FROM_TAB/LOAD_FROM_TAB/3nyyhcpmwxcgz/DEPTSAL	TABLE	REFERENCE	PLSCOPE	TABLE	DEPTSAL
5	3	25	DEPT_NO	/LOAD_FROM_TAB/LOAD_FROM_TAB/3nyyhcpmwxcgz/DEPT_NO	COLUMN	REFERENCE	PLSCOPE	TABLE	DEPTSAL
6	3	34	DEPT_NAME	/LOAD_FROM_TAB/LOAD_FROM_TAB/3nyyhcpmwxcgz/DEPT_NAME	COLUMN	REFERENCE	PLSCOPE	TABLE	DEPTSAL
7	3	45	SALARY	/LOAD_FROM_TAB/LOAD_FROM_TAB/3nyyhcpmwxcgz/SALARY	COLUMN	REFERENCE	PLSCOPE	TABLE	DEPTSAL
8	5	13	DEPTNO	/LOAD_FROM_TAB/LOAD_FROM_TAB/3nyyhcpmwxcgz/DEPTNO	COLUMN	REFERENCE	PLSCOPE	TABLE	DEPT
9	5	23	DNAME	/LOAD_FROM_TAB/LOAD_FROM_TAB/3nyyhcpmwxcgz/DNAME	COLUMN	REFERENCE	PLSCOPE	TABLE	DEPT
10	5	36	SAL	/LOAD_FROM_TAB/LOAD_FROM_TAB/3nyyhcpmwxcgz/SAL	COLUMN	REFERENCE	PLSCOPE	TABLE	EMP
11	5	48	COMM	/LOAD_FROM_TAB/LOAD_FROM_TAB/3nyyhcpmwxcgz/COMM	COLUMN	REFERENCE	PLSCOPE	TABLE	EMP
12	6	11	DEPT	/LOAD_FROM_TAB/LOAD_FROM_TAB/3nyyhcpmwxcgz/DEPT	TABLE	REFERENCE	PLSCOPE	TABLE	DEPT
13	8	24	EMP	/LOAD_FROM_TAB/LOAD_FROM_TAB/3nyyhcpmwxcgz/EMP	TABLE	REFERENCE	PLSCOPE	TABLE	EMP
14	9	24	HIREDATE	/LOAD_FROM_TAB/LOAD_FROM_TAB/3nyyhcpmwxcgz/HIREDATE	COLUMN	REFERENCE	PLSCOPE	TABLE	EMP
15	10	10	DEPTNO	/LOAD_FROM_TAB/LOAD_FROM_TAB/3nyyhcpmwxcgz/DEPTNO	COLUMN	REFERENCE	PLSCOPE	TABLE	EMP
16	10	21	DEPTNO	/LOAD_FROM_TAB/LOAD_FROM_TAB/3nyyhcpmwxcgz/DEPTNO	COLUMN	REFERENCE	PLSCOPE	TABLE	DEPT
17	11	16	DEPTNO	/LOAD_FROM_TAB/LOAD_FROM_TAB/3nyyhcpmwxcgz/DEPTNO	COLUMN	REFERENCE	PLSCOPE	TABLE	DEPT
18	11	26	DNAME	/LOAD_FROM_TAB/LOAD_FROM_TAB/3nyyhcpmwxcgz/DNAME	COLUMN	REFERENCE	PLSCOPE	TABLE	DEPT
19	12	4	COMMIT	/LOAD_FROM_TAB/LOAD_FROM_TAB/COMMIT	COMMIT	EXECUTE	(null)	(null)	(null)

trivadis makes IT easier.

Data Lineage With PL/Scope

trivadis
makes IT easier.

Where-Lineage On Schema-Level of …

```
CREATE OR REPLACE PROCEDURE load_from_tab IS
BEGIN
   INSERT INTO deptsal (dept_no, dept_name, salary)
   SELECT /*+ordered */
          d.deptno, d.dname, SUM(e.sal + NVL(e.comm, 0)) AS sal
     FROM dept d
     LEFT JOIN (SELECT *
                  FROM emp
                 WHERE hiredate > DATE '1980-01-01') e
           ON e.deptno = d.deptno
    GROUP BY d.deptno, d.dname;
   COMMIT;
END load_from_tab;
```


trivadis makes IT easier.

… Needs a Parser to Produce this Result

Line	Col	From Owner	From Object Type	From Object Name	From Column Name	To Owner	To Object Type	To Object Name	To Column Name
3	4	PLSCOPE	TABLE	DEPT	DEPTNO	PLSCOPE	TABLE	DEPTSAL	DEPT_NO
3	4	PLSCOPE	TABLE	DEPT	DNAME	PLSCOPE	TABLE	DEPTSAL	DEPT_NAME
3	4	PLSCOPE	TABLE	EMP	SAL	PLSCOPE	TABLE	DEPTSAL	SALARY
3	4	PLSCOPE	TABLE	EMP	COMM	PLSCOPE	TABLE	DEPTSAL	SALARY

trivadis makes IT easier.

SYS.UTL_XML.ParseQuery to the Rescue

```
SELECT /*+ordered */
       d.deptno, d.dname,
       SUM(e.sal + NVL(e.comm, 0)) AS sal
  FROM dept d
  LEFT JOIN (SELECT *
               FROM emp
              WHERE hiredate >
                    DATE '1980-01-01') e
    ON e.deptno = d.deptno
 GROUP BY d.deptno, d.dname;
```


```
<QUERY> (…)
      <SELECT_LIST_ITEM>
        <SUM>
          <ADD>
            <COLUMN_REF>
              <TABLE_ALIAS>E</TABLE_ALIAS>
              <COLUMN>SAL</COLUMN>
            </COLUMN_REF>
            <NVL>
              <COLUMN_REF>
                <TABLE_ALIAS>E</TABLE_ALIAS>
                <COLUMN>COMM</COLUMN>
              </COLUMN_REF>
              <LITERAL>0</LITERAL>
            </NVL>
          </ADD>
        </SUM>
        <COLUMN_ALIAS>SAL</COLUMN_ALIAS>
      </SELECT_LIST_ITEM> (…)
</QUERY>
```


trivadis makes IT easier.

PL/Scope Provides an INSERT Statement

```
INSERT INTO deptsal
       (dept_no, dept_name, salary)
SELECT /*+ordered */
       d.deptno, d.dname,
       SUM(e.sal + NVL(e.comm, 0)) AS sal
  FROM dept d
  LEFT JOIN (SELECT *
               FROM emp
              WHERE hiredate >
                    DATE '1980-01-01') e
    ON e.deptno = d.deptno
 GROUP BY d.deptno, d.dname;
```


```
<QUERY>
    <SELECT>
        <SELECT_LIST/>
    </SELECT>
    <FROM>
        <FROM_ITEM>
            <TABLE>DEPTSAL</TABLE>
        </FROM_ITEM>
    </FROM>
</QUERY>
```


trivadis makes IT easier.

That's All We Need

Don't talk. Just act.
Don't say. Just show.
Don't promise. Just prove.

trivadis
makes IT easier.

Where-Lineage in SQL Developer

Worksheet | Query Builder

```
1  SELECT line, col,
2         from_owner, from_object_type, from_object_name, from_column_name,
3         to_owner, to_object_type, to_object_name, to_column_name
4    FROM plscope_ins_lineage
5   WHERE object_name = 'LOAD_FROM_TAB'
6   ORDER BY to_column_name;
```

Query Result

SQL | All Rows Fetched: 4 in 0.842 seconds

	LINE	COL	FROM_OWNER	FROM_OBJEC...	FROM_OBJE...	FROM_CO...	TO_OWNER	TO_OBJECT_TYPE	TO_OBJECT_NAME	TO_COLUMN_NAME
1	3	4	PLSCOPE	TABLE	DEPT	DNAME	PLSCOPE	TABLE	DEPTSAL	DEPT_NAME
2	3	4	PLSCOPE	TABLE	DEPT	DEPTNO	PLSCOPE	TABLE	DEPTSAL	DEPT_NO
3	3	4	PLSCOPE	TABLE	EMP	COMM	PLSCOPE	TABLE	DEPTSAL	SALARY
4	3	4	PLSCOPE	TABLE	EMP	SAL	PLSCOPE	TABLE	DEPTSAL	SALARY

trivadis makes IT easier.

Today's Where-Lineage by plscope-utils

In scope

- INSERT … SELECT statements
  - single_table_insert
  - multi_table_insert
  - with_clause
  - error_logging_clause
  - Views as source or target
  - Synonyms as source or target
  - Insert without column-list
  - Qualified all-column wildcard

Out of scope

- UPDATE
- MERGE
- INSERT
  - values_clause
  - Explict or implicit cursors
  - PL/SQL transformations (functions, procedures, triggers)
  - Database links
- Dynamic SQL
- Specialities (pivot, unpivot, XML, …)

trivadis makes IT easier.

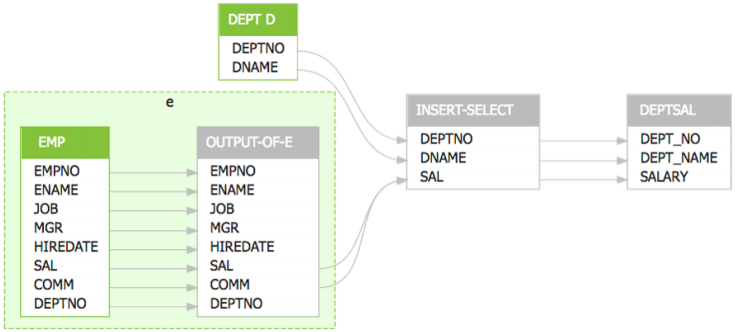
Options

trivadis
makes IT easier.

SQL Lineage Tools

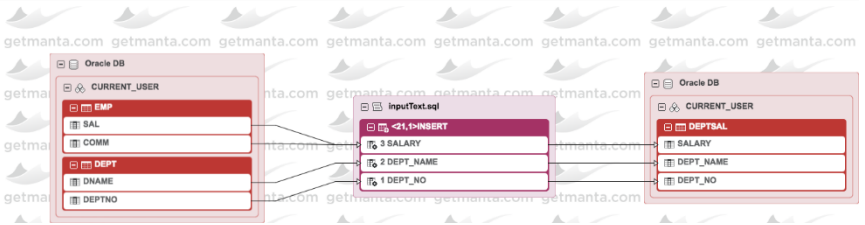
SQLDep

- https://sqldep.com/



MANTA FLOW

- https://getmanta.com/



trivadis makes IT easier.

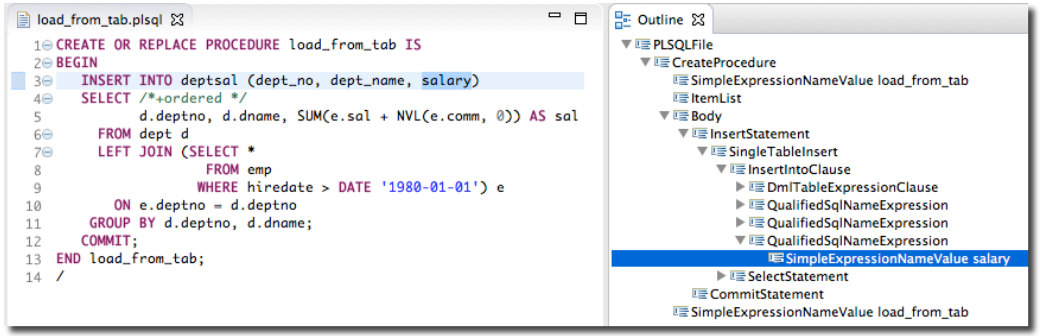
Third Party SQL & PL/SQL Parsers

General SQL Parser

- http://www.sqlparser.com/
- http://www.sqlparser.com/determining-impact-data-lineage.php

PL/SQL Cop or PL/SQL Analyzer

- https://www.trivadis.com/en/plsql-cop
- https://www.salvis.com/blog/plsql-cop/
- https://www.salvis.com/blog/tvdca-trivadis-plsql-sql-codeanalyzer/



trivadis makes IT easier.

Semantic Analysis by 3rd Party Products

```
INSERT INTO deptsal
       (dept_no, dept_name, salary)
SELECT /*+ordered */
       d.deptno, dname,
       SUM(sal + NVL(comm, 0)) AS sal
  FROM dept d
  LEFT JOIN (SELECT *
               FROM emp
              WHERE hiredate >
                    DATE '1980-01-01') e
    ON e.deptno = d.deptno
 GROUP BY d.deptno, dname;
```

- Source of unqualified columns? (dname, sal, comm)
- Details about data model required
- Challenges
  - Multi-schema applications
  - Parsing user
  - Definer/invoker rights
  - Synonyms (private, public)
  - Session settings (container, schema)

trivadis makes IT easier.

Core Messages

trivadis
makes IT easier.

Data Lineage with Oracle DB 12.2 – Possible

- SQL statements collected by PL/Scope 12.2 are the key for various analysis
- You need a parser for data lineage
- Parse-tree produced by SYS.UTL_XML.ParseQuery is helpful, but incomplete
  - Perfect for SELECT
  - 12.2 grammar support
  - Subset for INSERT, UPDATE, DELETE and MERGE
  - No PL/SQL (nowhere)
- Requires 3rd party tools

trivadis makes IT easier.

Questions and Answers

Philipp Salvisberg
Senior Principal Consultant

Tel. +41 58 459 52 31
philipp.salvisberg@trivadis.com

trivadis
makes IT easier.