diffst - A tool for Data Integration Testing

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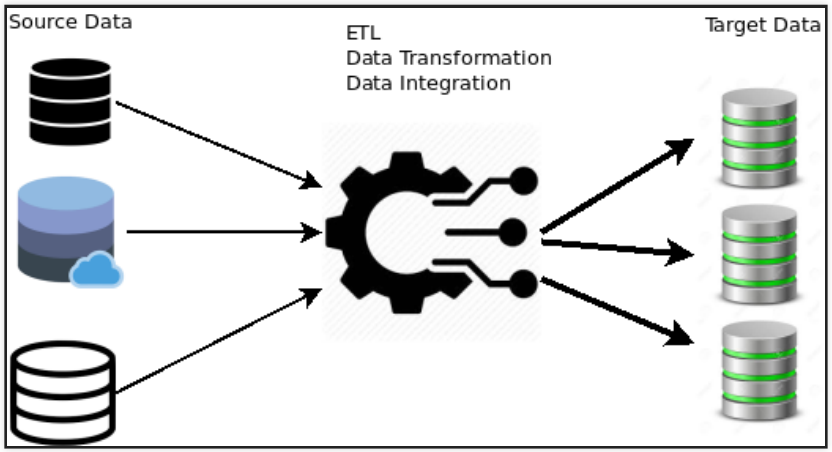
Outline

- Data Integration Applications
- Common risks and challenges
- Functional testing approaches
- diffst - Features and limitations
- Questions and Discussion

Data Integration/Migration Applications

- Once-off projects
  - Data Migration - hardware, software, database upgrade/relocation
  - Application Migration (CRM/ERP)
  - Take-on of new data sets (eg corporate mergers/acquisitions)
- Systems and Applications
  - Data Warehousing
  - Business Intelligence, Big Data,...
  - Loyalty Programme Engines



Data Integration Applications - Typical Risks

- Data not extracted from Source as expected
  - Wrong time period
  - Not all expected data extracted
  - Extracted at wrong time
- Expected business rules not applied
  - Fields truncated
  - Data Types misread
- Target data Incomplete/Duplicated/Inconsistent..
- Wrong grain

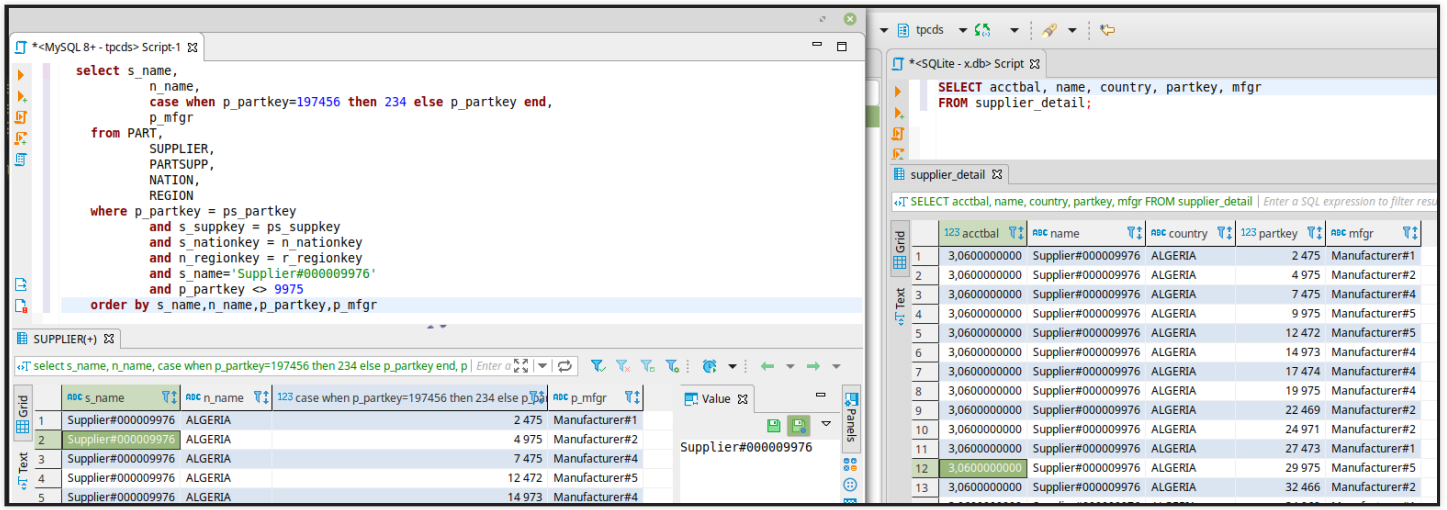
Coverage Challenges

- Large actual data volumes and
- Business logic complexity - per column
- Implies many actual data points available for testing
- ... and they need to be tested - more important than synthetic test data

Common functional testing checks

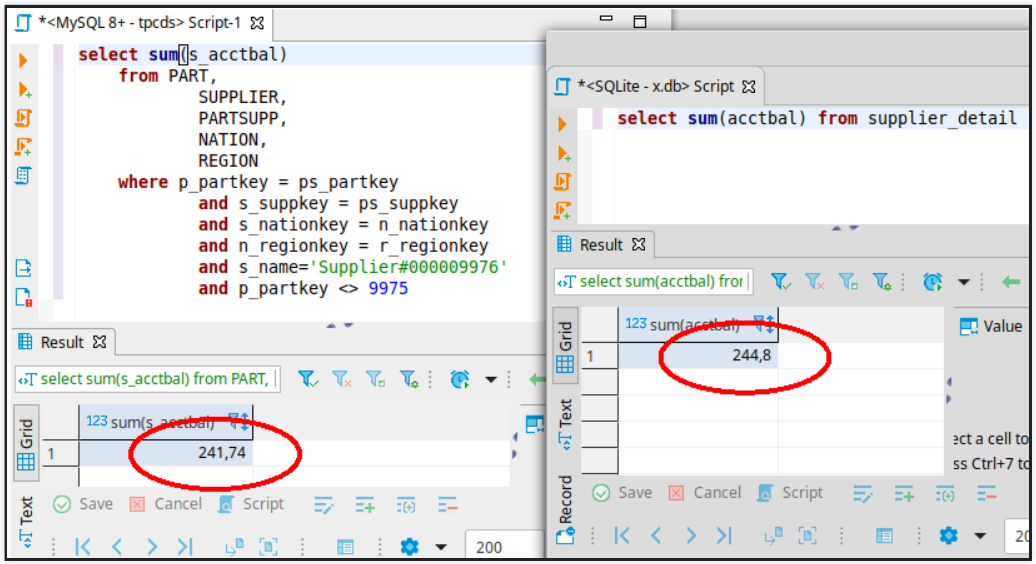
- SELECT data from Source
- Apply business rules
- SELECT expected data from Target
- Compare and evaluate
- ⇒ Automation opportunity

Sampling: Comparing individual data items



- Useful for testing specific data items - Exploratory value
- But not effective in testing large data volumes
- How to build into regression, test suites?

Aggregated SQL



- Can only test few columns at a time
- Slow to investigate source-target discrepancies

MINUS Queries

- Source and Target need to be accessed in same statement
- Slow - have to run a query on each side separately - then compare

Source

	Col1	Col2	Col3
Row1	xxxxx	xxxxx	xxxxx
Row2	xxxxx	xxxxx	xxxxx
Row3	xxxxx	xxxxx	xxxxx
Row4	xxxxx	xxxxx	xxxxx
Row5	xxxxx	xxxxx	xxxxx
Row6	xxxxx	xxxxx	xxxxx
Row7	xxxxx	xxxxx	xxxxx
Row8	xxxxx	xxxxx	xxxxx
Row9	xxxxx	xxxxx	xxxxx
Row10	xxxxx	xxxxx	xxxxx
Row11	xxxxx	xxxxx	xxxxx
Row12	xxxxx	xxxxx	xxxxx
Row13	xxxxx	xxxxx	xxxxx
....	xxxxx	xxxxx	xxxxx

Target

	Col1	Col2	Col3
Row1	xxxxx	xxxxx	xxxxx
Row2	xxxxx	xxxxx	xxxxx
Row3	xxxxx	xxxxx	xxxxx
Row4	xxxxx	xxxxx	xxxxx
Row5	xxxxx	xxxxx	xxxxx
Row6	xxxxx	xxxxx	xxxxx
Row7	xxxxx	xxxxx	xxxxx
Row8	xxxxx	xxxxx	xxxxx
Row9	xxxxx	xxxxx	xxxxx
Row10	xxxxx	xxxxx	xxxxx
Row11	xxxxx	xxxxx	xxxxx
Row12	xxxxx	xxxxx	xxxxx
Row13	xxxxx	xxxxx	xxxxx
....	xxxxx	xxxxx	xxxxx

Manual Detailed Comparison

Source

	Col1	Col2	Col3
Row1	xxxxx	xxxxx	xxxxx
Row2	xxxxx	xxxxx	xxxxx
Row3	xxxxx	xxxxx	xxxxx
Row4	xxxxx	xxxxx	xxxxx
Row5	xxxxx	xxxxx	xxxxx
Row6	xxxxx	xxxxx	xxxxx
Row7	xxxxx	xxxxx	xxxxx
Row8	xxxxx	xxxxx	xxxxx
Row9	xxxxx	xxxxx	xxxxx
Row10	xxxxx	xxxxx	xxxxx
Row11	xxxxx	xxxxx	xxxxx
Row12	xxxxx	xxxxx	xxxxx
Row13	xxxxx	xxxxx	xxxxx
....	xxxxx	xxxxx	xxxxx

Target

	Col1	Col2	Col3
Row1	xxxxx	xxxxx	xxxxx
Row2	xxxxx	xxxxx	xxxxx
Row3	xxxxx	xxxxx	xxxxx
Row4	xxxxx	xxxxx	xxxxx
Row5	xxxxx	xxxxx	xxxxx
Row6	xxxxx	xxxxx	xxxxx
Row7	xxxxx	xxxxx	xxxxx
Row8	xxxxx	xxxxx	xxxxx
Row9	xxxxx	xxxxx	xxxxx
Row10	xxxxx	xxxxx	xxxxx
Row11	xxxxx	xxxxx	xxxxx
Row12	xxxxx	xxxxx	xxxxx
Row13	xxxxx	xxxxx	xxxxx
....	xxxxx	xxxxx	xxxxx

Group By Query Comparison

Source

	Col1	Col2	Col3
Row1	xxxxx	xxxxx	xxxxx
Row2	xxxxx	xxxxx	xxxxx
Row3	xxxxx	xxxxx	xxxxx
Row4	xxxxx	xxxxx	xxxxx
Row5	xxxxx	xxxxx	xxxxx
Row6	xxxxx	xxxxx	xxxxx
Row7	xxxxx	xxxxx	xxxxx
Row8	xxxxx	xxxxx	xxxxx
Row9	xxxxx	xxxxx	xxxxx
Row10	xxxxx	xxxxx	xxxxx
Row11	xxxxx	xxxxx	xxxxx
Row12	xxxxx	xxxxx	xxxxx
Row13	xxxxx	xxxxx	xxxxx
....	xxxxx	xxxxx	xxxxx

Target

	Col1	Col2	Col3
Row1	xxxxx	xxxxx	xxxxx
Row2	xxxxx	xxxxx	xxxxx
Row3	xxxxx	xxxxx	xxxxx
Row4	xxxxx	xxxxx	xxxxx
Row5	xxxxx	xxxxx	xxxxx
Row6	xxxxx	xxxxx	xxxxx
Row7	xxxxx	xxxxx	xxxxx
Row8	xxxxx	xxxxx	xxxxx
Row9	xxxxx	xxxxx	xxxxx
Row10	xxxxx	xxxxx	xxxxx
Row11	xxxxx	xxxxx	xxxxx
Row12	xxxxx	xxxxx	xxxxx
Row13	xxxxx	xxxxx	xxxxx
....	xxxxx	xxxxx	xxxxx

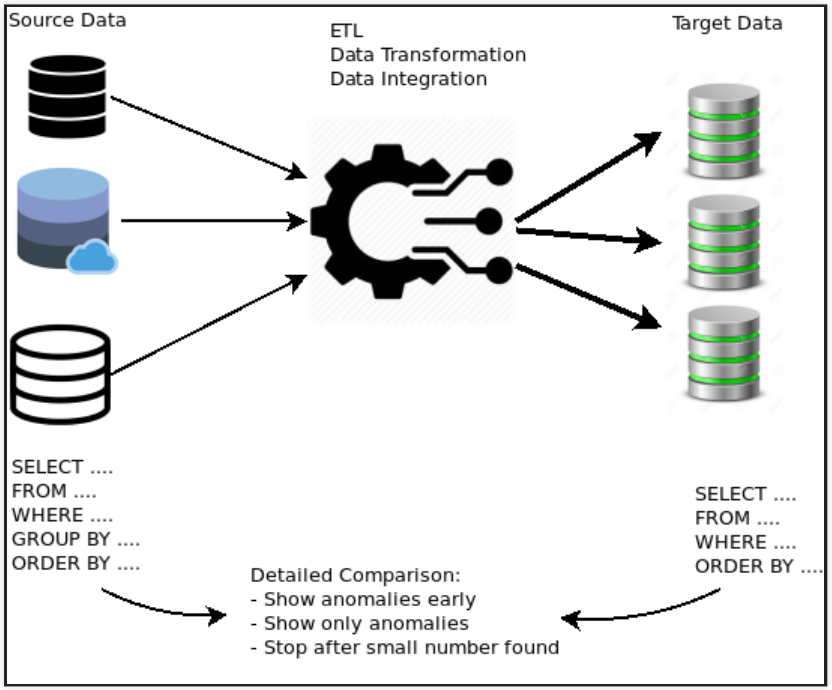
Test Tool – Detailed Comparison of entire data sets

Source

	Col1	Col2	Col3
Row1	xxxxx	xxxxx	xxxxx
Row2	xxxxx	xxxxx	xxxxx
Row3	xxxxx	xxxxx	xxxxx
Row4	xxxxx	xxxxx	xxxxx
Row5	xxxxx	xxxxx	xxxxx
Row6	xxxxx	xxxxx	xxxxx
Row7	xxxxx	xxxxx	xxxxx
Row8	xxxxx	xxxxx	xxxxx
Row9	xxxxx	xxxxx	xxxxx
Row10	xxxxx	xxxxx	xxxxx
Row11	xxxxx	xxxxx	xxxxx
Row12	xxxxx	xxxxx	xxxxx
Row13	xxxxx	xxxxx	xxxxx
....	xxxxx	xxxxx	xxxxx

Target

	Col1	Col2	Col3
Row1	xxxxx	xxxxx	xxxxx
Row2	xxxxx	xxxxx	xxxxx
Row3	xxxxx	xxxxx	xxxxx
Row4	xxxxx	xxxxx	xxxxx
Row5	xxxxx	xxxxx	xxxxx
Row6	xxxxx	xxxxx	xxxxx
Row7	xxxxx	xxxxx	xxxxx
Row8	xxxxx	xxxxx	xxxxx
Row9	xxxxx	xxxxx	xxxxx
Row10	xxxxx	xxxxx	xxxxx
Row11	xxxxx	xxxxx	xxxxx
Row12	xxxxx	xxxxx	xxxxx
Row13	xxxxx	xxxxx	xxxxx
....	xxxxx	xxxxx	xxxxx



Requirement for Test Tool

An In-House Solution - Based on Unix Philosophy

- Write programs that do one thing and do it well.
- Write programs to work together.
- Write programs to handle text streams, because that is a universal interface.

Peter H. Salus, A Quarter-Century of Unix (1994)

diffst - Test Case

```
Source:
  DB: SUPPDB
  SQL: |
    select s_name,
           n_name,
           p_partkey,
           max(p_mfgr) mfgr
    from PART,
           SUPPLIER,
           PARTSUPP,
           NATION,
           REGION
    where p_partkey = ps_partkey
           and s_suppkey = ps_suppkey
           and s_nationkey = n_nationkey
           and n_regionkey = r_regionkey
           and s_name='Supplier#000009976'
           -- and p_partkey=[< SINGLE >]
    group by s_name,n_name,p_partkey
    order by s_name,n_name,p_partkey
Target:
  DB: DW
  SQL: |
    select name, country,
        partkey,mfgr
    from supplier_detail
    -- where partkey =[< SINGLE >]
    order by name, country, partkey,mfgr
Description: Supplier details by manufacturer and country
```

Config in the Environment

```
# The Data Warehouse DB Connection
export DIFFST_DB_DW_DRIVER=sqlite3
export DIFFST_DB_DW_URL=/home/fm/x.db

export DIFFST_DB_ACS_URL=/home/fm/x.db
export DIFFST_DB_ACS_DRIVER=sqlite3
export DIFFST_DB_MYSQLEG_DRIVER=mysql
export DIFFST_DB_MYSQLEG_URL=fm:lkj@/mysql

# Supplier Details Database
export DIFFST_DB_SUPPDB_DRIVER=mysql
export DIFFST_DB_SUPPDB_URL='tpcds:tpcds@tcp(127.0.0.1:3306)/tpcds'

# Test Case Directory
export DIFFST_TC_DIR=/home/fm/t
```

diffst - Output

```
fm@fm-VirtualBox:~$ diffst -t supplier_details
Setting up SUPPDB DB connection:...
Running SUPPDB SQL...
Setting up DW DB connection:...
Running DW SQL...
Fetching results...
+-------------------------------------------------+-------------------------------------------------+
|                                                 >Supplier#000009976|ALGERIA|9975|Manufacturer#5    |
|Supplier#000009976|ALGERIA|62457|Manufacturer#5   <                                                 |
|Supplier#000009976|ALGERIA|184939|Manufacturer#5  *Supplier#000009976|ALGERIA|184939|Manufactur      |
|Supplier#000009976|ALGERIA|197456|Manufacturer#9  *Supplier#000009976|ALGERIA|197456|Manufacturer#4  |
+-------------------------------------------------+-------------------------------------------------+
2019/08/14 23:38:54 Not OK - diffs found
```

diffst - Output

```
fm@fm-VirtualBox:~$ diffst -t supplier_details -c
Setting up SUPPDB DB connection:...
Running SUPPDB SQL...
Setting up DW DB connection:...
Running DW SQL...
Fetching results...
+-----------------------------+-----------------------------+-----------------------------+
|name                         |                             >Supplier#000009976           |
|country                      |                             >ALGERIA                      |
|partkey                      |                             >9975                         |
|mfgr                         |                             >Manufacturer#5               |
+-----------------------------+-----------------------------+-----------------------------+
|name                         |Supplier#000009976           <                             |
|country                      |ALGERIA                      <                             |
|partkey                      |62457                        <                             |
|mfgr                         |Manufacturer#5               <                             |
+-----------------------------+-----------------------------+-----------------------------+
|name                         |Supplier#000009976           |Supplier#000009976           |
|country                      |ALGERIA                      |ALGERIA                      |
|partkey                      |184939                       |184939                       |
|mfgr                         |Manufacturer#5               *Manufactur                   |
+-----------------------------+-----------------------------+-----------------------------+
|name                         |Supplier#000009976           |Supplier#000009976           |
|country                      |ALGERIA                      |ALGERIA                      |
|partkey                      |197456                       |197456                       |
|mfgr                         |Manufacturer#9               *Manufacturer#4               |
+-----------------------------+-----------------------------+-----------------------------+
2019/08/14 23:39:46 Not OK - diffs found
```

```
Usage:
  diffst [flags]
  diffst [command]

Available Commands:
  cmdl        Test case specified on the command line
  help        Help about any command
  sql         Run ad-hoc SQL

Flags:
  -c, --columns            Columnar output
      --config string      config file (default is $HOME/.diffst.yaml)
  -h, --help               help for diffst
  -a, --show-all           Show all results
  -i, --singl-arg string   Run test for single value only
  -s, --source-db string   Source DB - overrides Test Case and Environment
  -b, --source-sql-only    Source SQL Only
  -x, --target-db string   Target DB - overrides Test Case and Environment
  -d, --target-sql-only    Target SQL Only
  -t, --testcase string    Test Case
  -v, --verbose            Run Verbosely producing lots of diagnostic output

Use "diffst [command] --help" for more information about a command.
```

Limitations

- SQL-accessibility
- Limited by DB Drivers

- **Apache Ignite/GridGain**: https://github.com/amsokol/ignite-go-client
- **Apache Impala**: https://github.com/bippio/go-impala
- **Apache Avatica/Phoenix**: https://github.com/apache/calcite-avatica-go
- **AWS Athena**: https://github.com/segmentio/go-athena
- **ClickHouse** (uses native TCP interface): https://github.com/kshvakov/clickhouse
- **ClickHouse** (uses HTTP API): https://github.com/mailru/go-clickhouse
- **CockroachDB**: Use any PostgreSQL driver
- **Couchbase N1QL**: https://github.com/couchbase/go_n1ql
- **DB2 LUW** and **DB2/Z with DB2-Connect**: https://bitbucket.org/phiggins/db2cli (Last updated 2015-08)
- **DB2 LUW** (uses cgo): https://github.com/asifjalil/cli
- **DB2 LUW, z/OS, iSeries and Informix**: https://github.com/ibmdb/go_ibm_db
- **Firebird SQL**: https://github.com/nakagami/firebirdsql
- **MS ADODB**: https://github.com/mattn/go-adodb
- **MS SQL Server** (pure go): https://github.com/denisenkom/go-mssqldb
- **MS SQL Server** (uses cgo): https://github.com/minus5/gofreetds
- **MySQL**: https://github.com/ziutek/mymysql `[*]`
- **MySQL**: https://github.com/go-sql-driver/mysql/ `[*]`
- **ODBC**: https://bitbucket.org/miquella/mgodbc (Last updated 2016-02)
- **ODBC**: https://github.com/alexbrainman/odbc
- **Oracle**: https://github.com/mattn/go-oci8
- **Oracle**: https://gopkg.in/rana/ora.v4
- **Oracle**: https://gopkg.in/goracle.v2

Source and Target database options - 1

- **QL**: http://godoc.org/github.com/cznic/ql/driver
- **Postgres** (pure Go): https://github.com/lib/pq `[*]`
- **Postgres** (uses cgo): https://github.com/jbarham/gopgsqldriver
- **Postgres** (pure Go): https://github.com/jackc/pgx `[**]`
- **Presto**: https://github.com/prestodb/presto-go-client
- **SAP HANA** (uses cgo): https://help.sap.com/viewer/0eec0d68141541d1b07893a39944924e/2.0.03/en-US/0ffbe86c9d9f44338441829c6bee15e6.html
- **SAP HANA** (pure go): https://github.com/SAP/go-hdb
- **SAP ASE** (uses cgo): https://github.com/SAP/go-ase - package cgo (pure go package planned)
- **Snowflake** (pure Go): https://github.com/snowflakedb/gosnowflake
- **SQLite** (uses cgo): https://github.com/mattn/go-sqlite3 `[*]`
- **SQLite** (uses cgo): https://github.com/gwenn/gosqlite - Supports SQLite dynamic data typing
- **SQLite** (uses cgo): https://github.com/mxk/go-sqlite
- **SQLite**: (uses cgo): https://github.com/rsc/sqlite
- **SQL over REST**: https://github.com/adaptant-labs/go-sql-rest-driver
- **Sybase SQL Anywhere**: https://github.com/a-palchikov/sqlago
- **Sybase ASE** (pure go): https://github.com/thda/tds
- **Vitess**: https://godoc.org/vitess.io/vitess/go/vt/vitessdriver
- **YQL (Yahoo! Query Language)**: https://github.com/mattn/go-yql
- **Apache Hive**: https://github.com/sql-machine-learning/gohive
- **MaxCompute**: https://github.com/sql-machine-learning/gomaxcompute

Source and Target database options - 2

diffst - About

- Developed in Go (golang)
- Go programs compile into statically linked executables for Windows/Linux/Mac/...
- ⇒ No VM required

Advantages of bespoke tool

- Coverage - extends the reach of manual testing
- Bug lifecycle is simpler, faster, better
- CLI, numeric exit status, text input and output supports:
  - Job scheduling
  - Interface with test management tool via API
  - Customizable test suites with scripting
  - Deployability - tester laptop or server

Questions/Comments?