Two-phase Parallel Learning to Identify Similar Strutures among Relational Databases

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Motivation

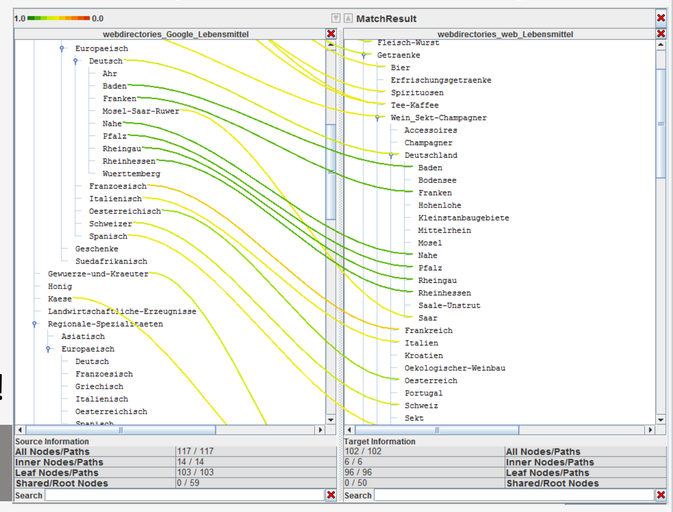
The Ministry of Social Development of Brazil maintains hundreds of **large databases.** Some of them are similar, which leads to:

- Wrong analysis
- The complexity of management
- The high cost of services
- The high cost of hardware

Identify similarities between large datasets are time-consuming and error-prone process.

We need more efficient techniques!

Example of Manual Matche's System



Previous Work

- Manual matches;
- Required all data dictionary to perform the matches;
- Depend on frequent human classification to continue perform the matches;
- Do not analyze large datasets.

Purpose

Apply **data mining** techniques to **classify similar schemas** based on its structure. **Parallel** and **Sequential** of:

- Generalized Linear Model (GLM)
- Random Forest (RF)
- Gradient Boost Machines (GBM)

Metrics:

- Precision
- Recall
- F-measure

Goals

- Automatic schema matches
- Less dependency on data dictionary
- Reduce overload of human work
- Analyze large datasets

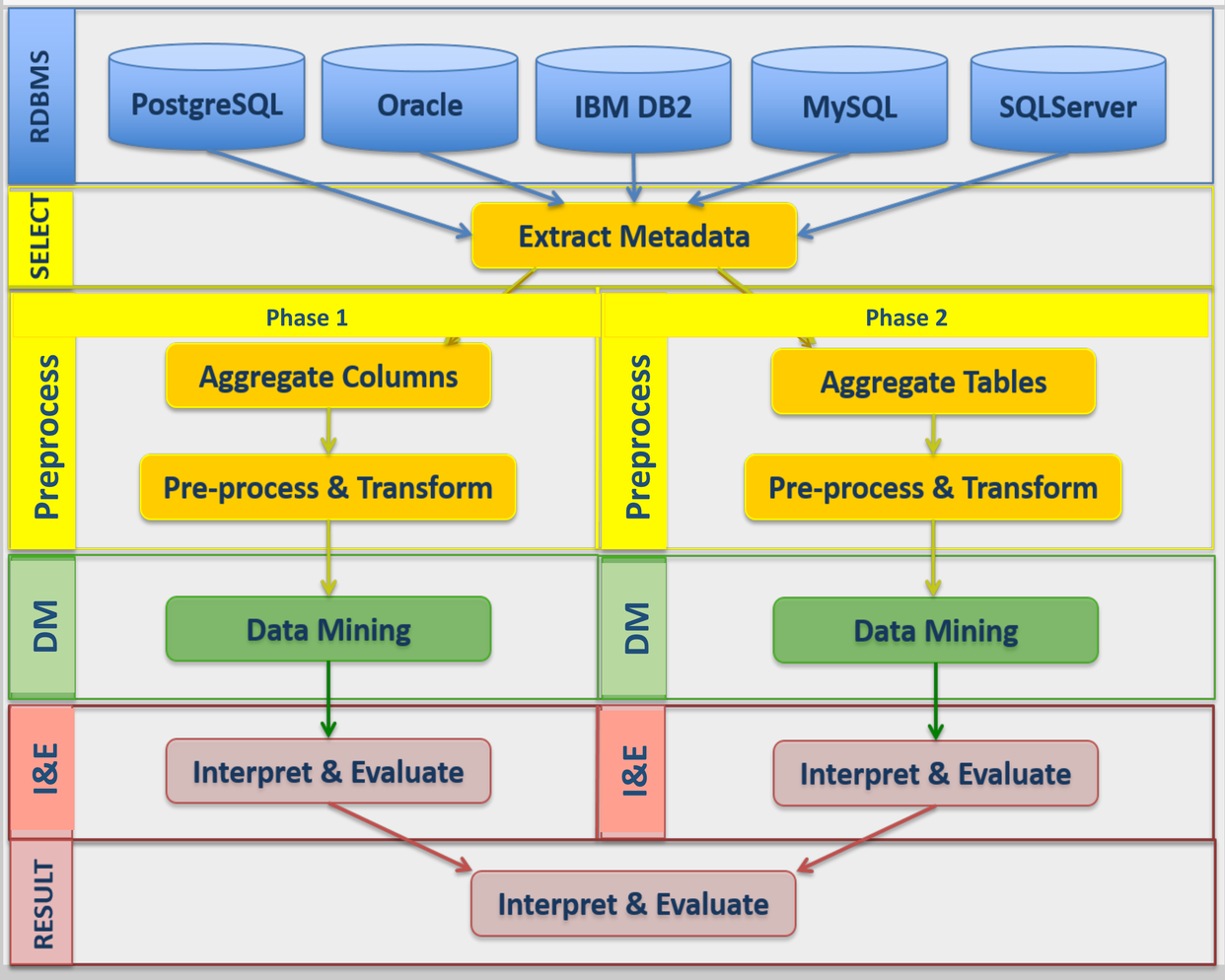
Which relational database have a similar structure?

Two-phase Parallel Learning

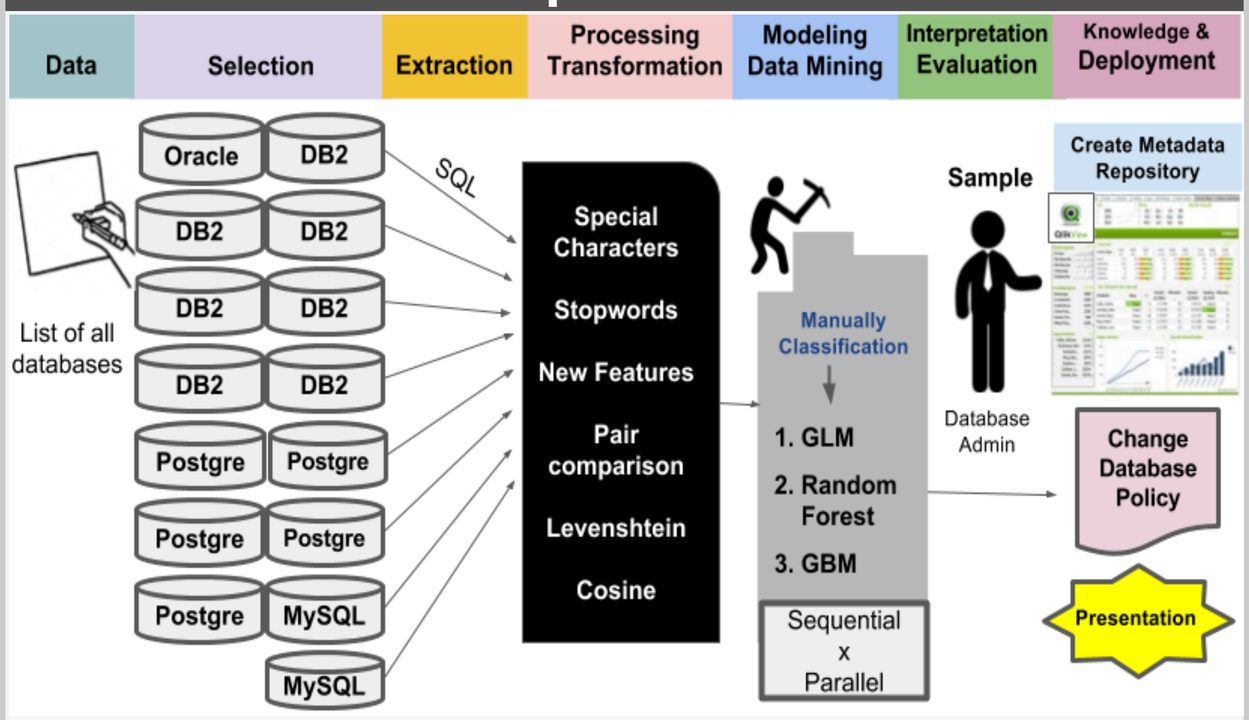
A new approach to identify similar structures of relational databases fast. The extraction of metadata is the same for any RDBMSs, which brings **flexibility**. Each phase performs the steps of **KDD** as methodology, where:

- **Phase 1:** identify similar columns
- **Phase 2:** identify similar tables

The Data Mining (DM) steps brings **parallelism.**



Experiment



Example of metadata extraction:

servidor	schema	banco	tabelas	tamanho_GB	qtd_linhas	qtd_colunas
supghm01	adesan	adesan	rltipoperfilmenu, adesaomunicipal, anexoadesaomunic...	0.0005874634	6228	115
supghm02	adesan	adesan	rltipoperfilmenu, adesaomunicipal, anexoadesaomunic...	0.0005111694	6069	115

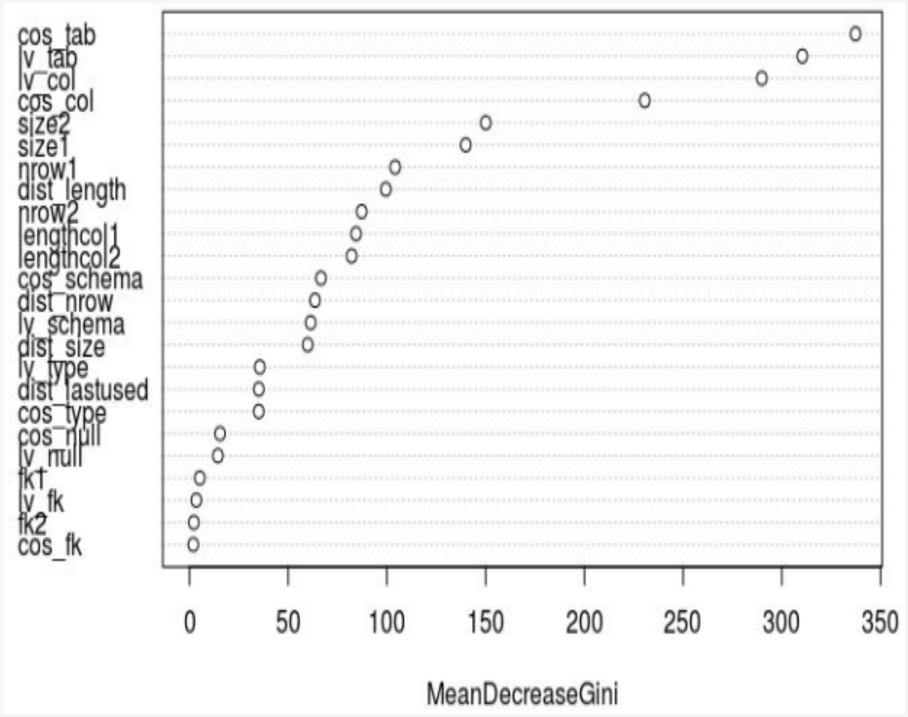
Paired comparison from 13 large schemas:
Sums the total of 78 schemas comparisons *(calculate by 13*13-13/2 = 78)*

Groups:

- 60% training
- 20% validation
- 20% test

Hardware & Software

64-bit, 8 cores
32GB RAM
Ubuntu Server
R 3.3.1, Rstudio
1.0.143 H2O
3.10.4.6



Importance of Variables

Classes are unbalanced.

- Undersampling with 10-folds cross-validation repeating 3 times.
- Balanced classes, validated using test dataset.

Results:

- Parallel processing had 1.0 of Precision, Recall, and F-measure.
- Duration was a decisive factor in choosing the best algorithm.
- The parallel execution of GBM took 3 mins and was at least 10 times faster than the sequential processing, which took 40 mins.

Conclusion

- ✓ Created the two-phase parallel learning approach to schema matching.
- ✓ Validate it by an experiment that classified similar datasets structures, using GLM, RF, and GBM in parallel and sequential processing mode.
- ✓ The GBM in parallel mode was the faster and better than others.
- ✓ The final result shows **35% of similar structures.**

Future Work

- Apply these techniques to all Ministry's datasets
- Compare the results with first-order approach

More Info