POZNAN UNIVERSITY OF TECHNOLOGY

DW Loading and Refreshing Techniques: ETL

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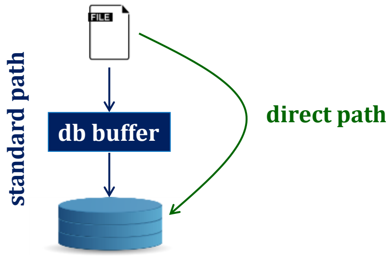
Outline

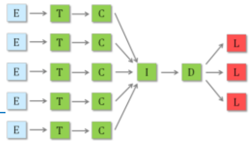
- ➲ **Loading data into DW**
- ➲ **Metadata**

Loading

- Parallel loading
- Direct path loading vs. standard path loading



- Collecting DW statistics after refreshing
- DW defragmentation



DW refreshing

- When?
  - synchronous (after a source transaction was committed) ⇨ (near) real-time DW
  - asynchronous ⇨ traditional DW
    - with a defined frequency
    - on demand
- How?
  - full (1st DW load)
  - incremental (all next loads)
- How data arrive?
  - batch ⇨ traditional DW
  - stream ⇨ (near) real-time DW

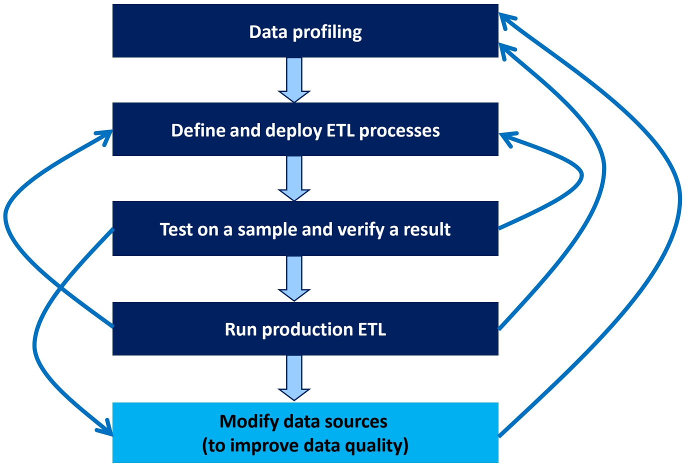
Ingesting data: tips

- Do not execute these operations in a data source
  - sorting
    - DISTINCT
    - set operators
    - GROUP BY
  - NOT and non-equijoins (typically require full scan)
  - functions in the WHERE clause

Ingesting data: tips

- Where to filter data?
  - at a data source (push down optimization), if
    - not overloaded with its proper processing
    - powerful query optimizer
    - low selectivity + good use of indexes
  - in an ETL layer, otherwise
    - sorting in a database
    - sorting in an OS (awk)
- Separate inserts from updates
  - updates → standard path
  - inserts → direct load path
- Decide how to maintain additional data structures
  - indexes
  - materialized views
- Integrity constraints in a DW?

Summary: ETL design process


Data profiling
Define and deploy ETL processes
Test on a sample and verify a result
Run production ETL
Modify data sources
(to improve data quality)

Jarke M., et. al.: Improving OLTP Data Quality Using Data Warehouse Mechanisms. SIGMOD Record, (28):2, 1999

Metadata

- On data sources
- On ETL processes
- On data warehouse

- **On data sources**
  - location (IP address)
  - hardware + operating system
  - type (RBD, OBD, XML, spreadsheet, ...)
  - schema
  - access methods (SQL, XQuery, dump file, ...)
  - connection credentials
  - results of data profiling
  - volume
  - performance characteristics

Metadata

- On ETL
  - data storage architecture of ODS and DW (e.g., disk capacities, row-store / column-store)
  - metadata on a dataset to be uploaded into DW (e.g., size, avg. record lengths)
  - definitions of ETL tasks/steps
  - available dictionaries (e.g., cities, zip codes, names)
  - workflow execution schedules
  - execution statistics (e.g., elapsed time, CPU time, #I/O, RAM usage, throughput, disc access conflicts, #records uploaded, #records rejected)
  - dependencies between workflows
  - dependencies between tasks for impact analysis
  - mappings between DS and DW structures
  - data lineage
  - execution logs

Requirements for ETL

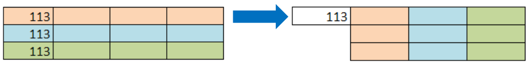
- Efficiency
  - finishing in a predefined time window
  - estimating execution termination
- Optimizable
- Fault-tolerance
  - restart after removing errors from a break point
  - restart from the beginning
  - recovery after crash
- Manageability
  - scheduling executions
    - time-based
    - token-based
  - stopping and restarting tasks
  - impact analysis
  - easy modifiable workflows

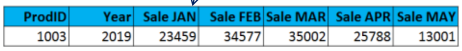
Requirements for ETL

- ➲ Producing data of high quality
- ➲ Security: access control
- ➲ Automatic code generation
- ➲ Support for user defined functions
- ➲ Automatic reporting on termination, errors, exceptions, and progress
- ➲ On line monitoring of work
- ➲ Parallel processing
- ➲ Direct path loading

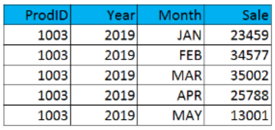
Requirements for ETL

- ➲ GUI for designing and managing processes
- ➲ A palette of predefined tasks
- ➲ Typical predefined tasks (ordered by usage frequency)
  1. Filter
  2. Aggregator
  3. Lookup
  4. Join
  5. Sort
  6. Combine record → combines records whose keys are identical into vectors of sub-records
  7. Modify → alters record structure
  8. Pivot





ProdID	Year	Sale JAN	Sale FEB	Sale MAR	Sale APR	Sale MAY
1003	2019	23459	34577	35002	25788	13001



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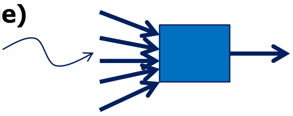
Requirements for ETL

- Typical predefined tasks (cont.)
  9. Merge → merging records (like SQL merge)
  10. Funnel → merging n input flows into one
  11. Transformer → transformation of data
  12. Remove duplicates
  13. Tail (usually in combination with sort)
  14. Head (usually in combination with sort)
  15. Compare → column-by-column comparison of records in two presorted input data sets
  16. Switch → dataflow split on a condition on column(s)
  17. Checksum → generates a checksum for a record
  18. Compress → dataset compression
  19. Expand → decompression



Off-the-shelf vs. in-house

- Off-the-shelf
  - faster design and deployment
  - integrated data repository
  - metadata management
  - workflow execution scheduling
  - built-in drivers to multiple DSs
  - impact analysis
  - incremental data loading
  - parallel processing
  - price
  - often require more advanced architectures → cost

- In-house-developed
  - longer design and development
  - thorough testing
  - dedicated to a given scenario
  - not customizable
  - may be tuned to a given scenario
  - may be less expensive