(Big) Data Engineering In Depth

From Beginner to Professional

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The Definitive Guide to Big Data Engineering Tasks

Videos classification

Watching Method / Audience	Computer	Mobile/Tablet	Just listening
Developer	🔴		
DevOps	🔴		
Business	🔴		

Table: Video classification
The green circle 🟢 means short video.
The blue circle 🔵 means medium video.
The red circle 🔴 means long video

Sub-Section: Fact Table

Fact Table Recap

What is the fact table?

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- It contains measurements/facts and foreign keys to *dimensions table*.
- It located at the center of the schema and surrounded by dimension tables.

Fact Table Recap

> *“There is no point in hoisting fact tables up the flagpole unless they have been chosen to reflect urgent business priorities“*
>
> Ralph Kimball, *kimballgroup.com*

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- Grain controls the dimensions which are available in fact.
- Grain represents the level of information we need to represent. It is not always time; it could be the physical business measurement level.
- Design from the lowest possible grain.

Sub-Section: Fact Table Types

Fact Types

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- For each transaction, we add a new single record.
- The transaction fact table is known to grow very fast as the number of transactions increases.

Fact Types:Transaction Example

customer_id	trns_date	trns_time	call_type	duration
1234	2020-01-01	12:22:45.9	Incoming	29
1234	2020-01-01	12:22:45.9	Incoming	3134
1234	2020-01-02	15:22:45.0	Outgoing	890
1234	2020-01-02	15:22:45.0	International	119
1234	2020-01-03	23:22:45.0	Incoming	145
1234	2020-01-03	23:22:45.0	Outgoing	124
1234	2020-01-03	23:22:45.0	Outgoing	1200

Table: Transaction fact example of telecom calls data.

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- It must be from lower granularity to higher granularity hourly, daily, monthly, and quertrly, then yearly.

Fact Types: Periodic Fact Table Example

cust_id	month_id	incoming	outgoing	international
1234	20200131	3308	2124	119

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- These fact tables are updated as the business process unfolds, and each milestone is completed.

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    - Hiring process.

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- This fact update after each stage finished.

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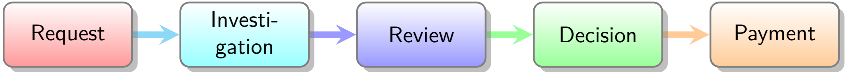

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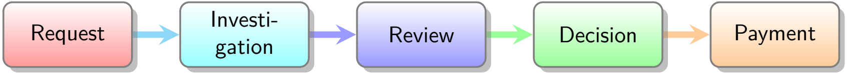

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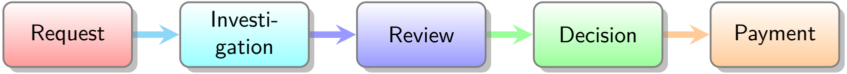

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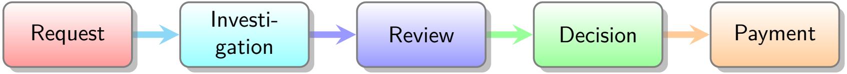

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Example of Accumlated Snapshot: An insurance company

- It fact table named: fact_claim_processing.
- This fact represents the claim life-cycle inside the company.
- It contains detail related to claim.
- This fact update after each stage finished.
- The requirement it to report the number of days (lag) between stages (milestone) and the claim data (starting).

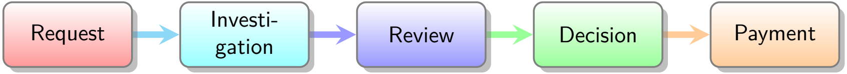

Figure: Claim Life-Cycle

Fact Types:Accumulated Snapshot Example

- One solution to implement the requirement is to use SCD.

FACT_CLAIM_PROCESSING
CLAIM_KEY
CUSTOMER_KEY
POLICY_KEY
CLAIM_DATE
INVESTIGATION_DATE
REVIEW_DATE
DECISION_DATE
PAYMENT_DATE

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- In this case, we will have stages and dates, and we will calculate the difference between stages and dates using complex sub-query.

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Fact Types:Accumulated Snapshot Example

- One solution to implement the requirement is to use SCD.
- In this case, we will have stages and dates, and we will calculate the difference between stages and dates using complex sub-query.
- Another solution is to implement an accumulated snapshot fact.

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REVIEW_DATE
DECISION_DATE
PAYMENT_DATE

FACT_CLAIM_PROCESSING_ACCUM
CLAIM_KEY
CUSTOMER_KEY
POLICY_KEY
CLAIM_DATE
INVESTIGATION_DATE
DAY_TO_INVESTIGATE
REVIEW_DATE
DAY_TO_REVIEW
DECISION_DATE
DAY_TO_DECISION
PAYMENT_DATE
DAY_TO_PAYMENT

Fact Types: Accumulated Snapshot Table Example

column_name	column_value
claim_key	123
customer_key	5235326
policy_key	23632623
claim_date	2020-01-01
investigation_date	2020-01-03
day_to_investigate	2
review_date	2020-01-07
day_to_review	6
decision_date	2020-01-08
day_to_decision	7
payment_date	2020-01-11
day_to_payment	10
process_completed_flag	10

Table: Accumulated Snapshot Fact Example on Claim Process Data.

Fact Table Types: Comparison

Feature	Transaction	Periodic	Accumulating
Grain	1 row/transaction	1 row/time-period	1 row/entire event stages
Date Dimension	Lowest granularity	End-of-period granularity	Multiple date
Facts	Transaction activities	Periodic activities	Defined lifetime activities
Size	Largest	Medium	Smallest
Update	No	No	Yes, after stage finished

Table: Fact tables types comparison.

Fact types

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- Additive facts.
- Semi-additive facts.
- Non-additive facts.
- Derived facts.
- Textual facts.
- Factless fact.

Additive facts

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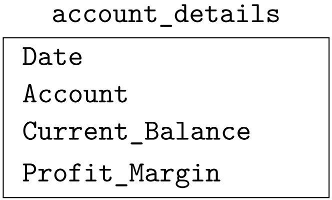
Sales
Date
Store
Product
Sales_Amount

Semi-additive facts

- It can be added across some dimensions but not all also known as (partially-additive).



account_details

Date
Account
Current_Balance
Profit_Margin

- what's the total current balance for all accounts in the bank?
- What's the current balances for a given account for each day of the month does not give us any useful information?

Non-additive facts

- It can't be added for any of the dimensions.
- Non-additive facts are usually the result of ratios (percentage) or other mathematical calculations.
- **Profit_Margin** is an example non-additive.

account_details
Date
Account
Current_Balance
Profit_Margin

Derived facts

- Derived facts are created by performing a mathematical calculation on a number of other facts, and are sometimes referred to as calculated facts. Derived facts may or may not be stored inside the fact table.
- Total_sales = Qty_Sold * (Unit_price - Discount)

Order_Details
Order_id
Item_id
Order_date
Qty_Sold
Unit_price
Discount
Total_sales

Textual facts

- A textual fact consists of one or more characters such as flags and indicators.
- It should be avoided in the fact table.

Factless fact

- A fact table with only foreign keys and no facts is called a factless fact table.

References

- https://www.nuwavesolutions.com/accumulating-snapshot-fact-tables/
- https://www.kimballgroup.com/2008/11/fact-tables/
- https://www.1keydata.com/datawarehousing/fact-table-types.html