Towards an inference detection system against multi-database attacks

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Inference detection in databases – Motivation

Name	Rank	Salary
John	Clerk	38,000
Mary	Secretary	28,000
Chris	Secretary	28,000
Joe	Manager	45,000
Sam	Clerk	38,000
Eve	Manager	45,000

Functional Dependency

Rank $\twoheadrightarrow$ **Salary**

Security rule

✖ **Name** and **Salary**

Q_1 `SELECT` **Rank**, **Salary**
`FROM` **Employee**

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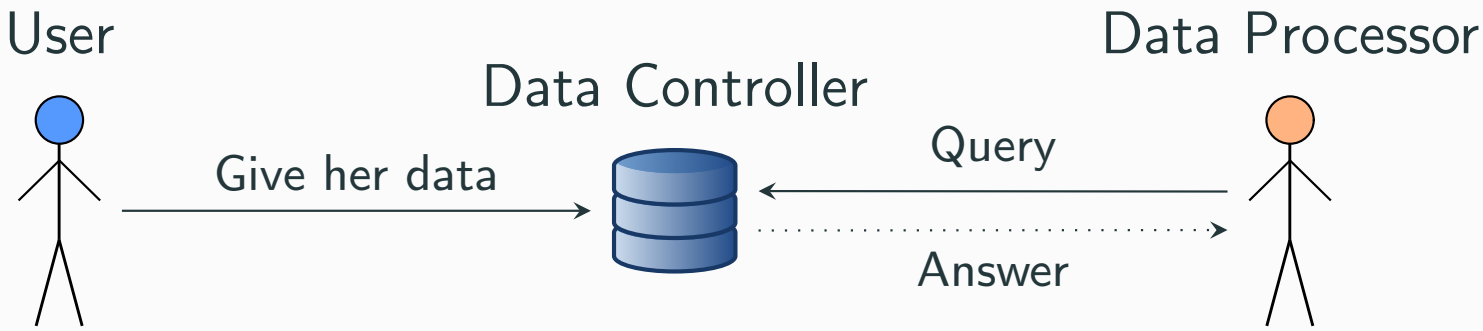

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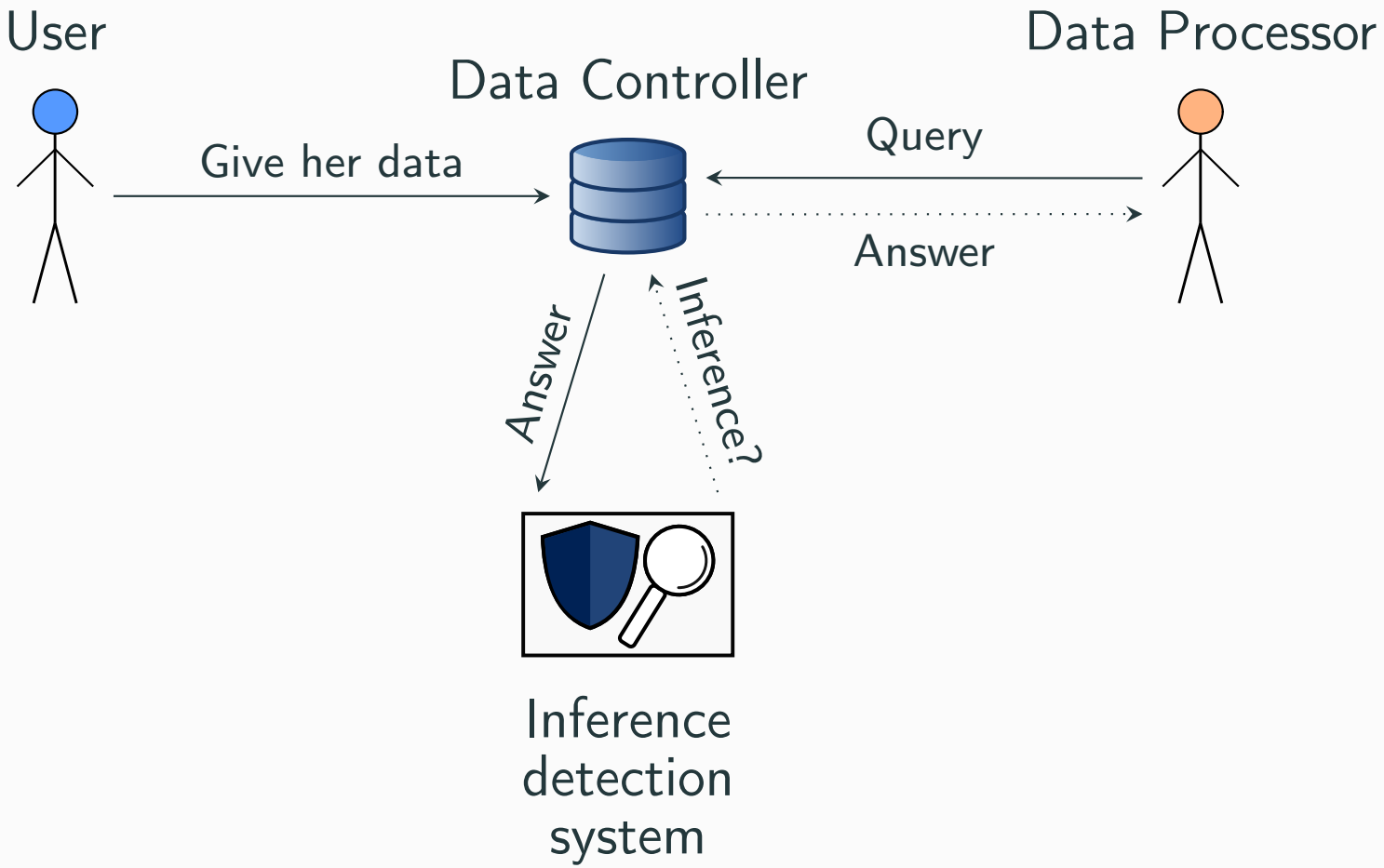
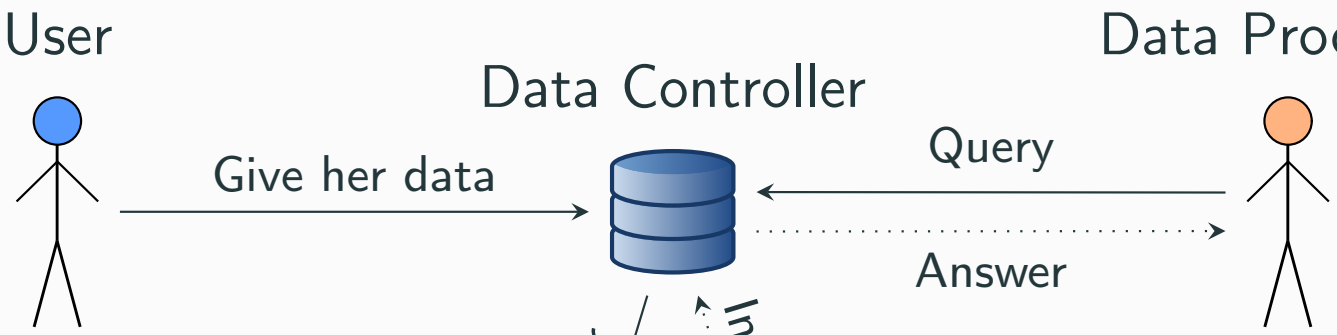


Inference detection system

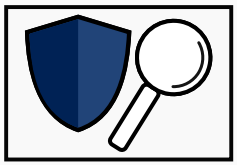
Protect a single database against inference attacks.



Logical framework

Example: *Horn Clauses*

Tyrone S Toland et al. (2010). "The inference problem: Maintaining maximal availability in the presence of database updates". In: *Computers & Security* 29.1, pp. 88–103



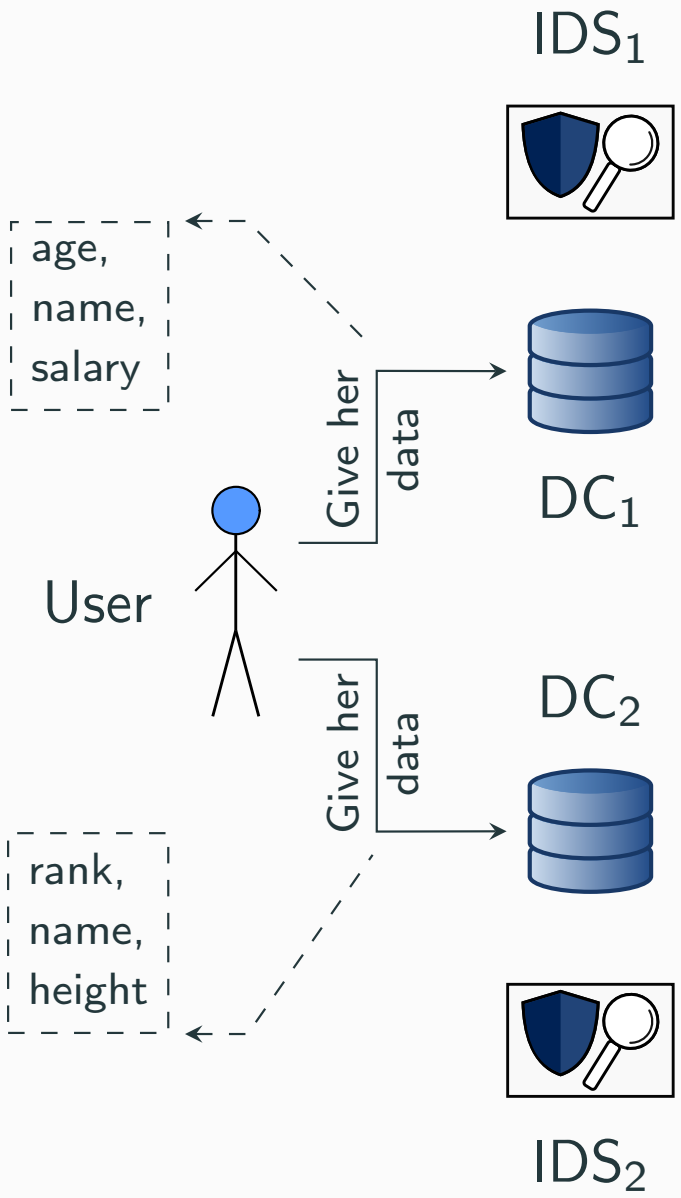
Inference detection system

Probabilistic framework

Example: *Bayesian Network*

Yu Chen et al. (2006). "Database Security Protection Via Inference Detection". In: *Intelligence and Security Informatics*. Berlin, Heidelberg, pp. 452–458

Limits of existing solutions



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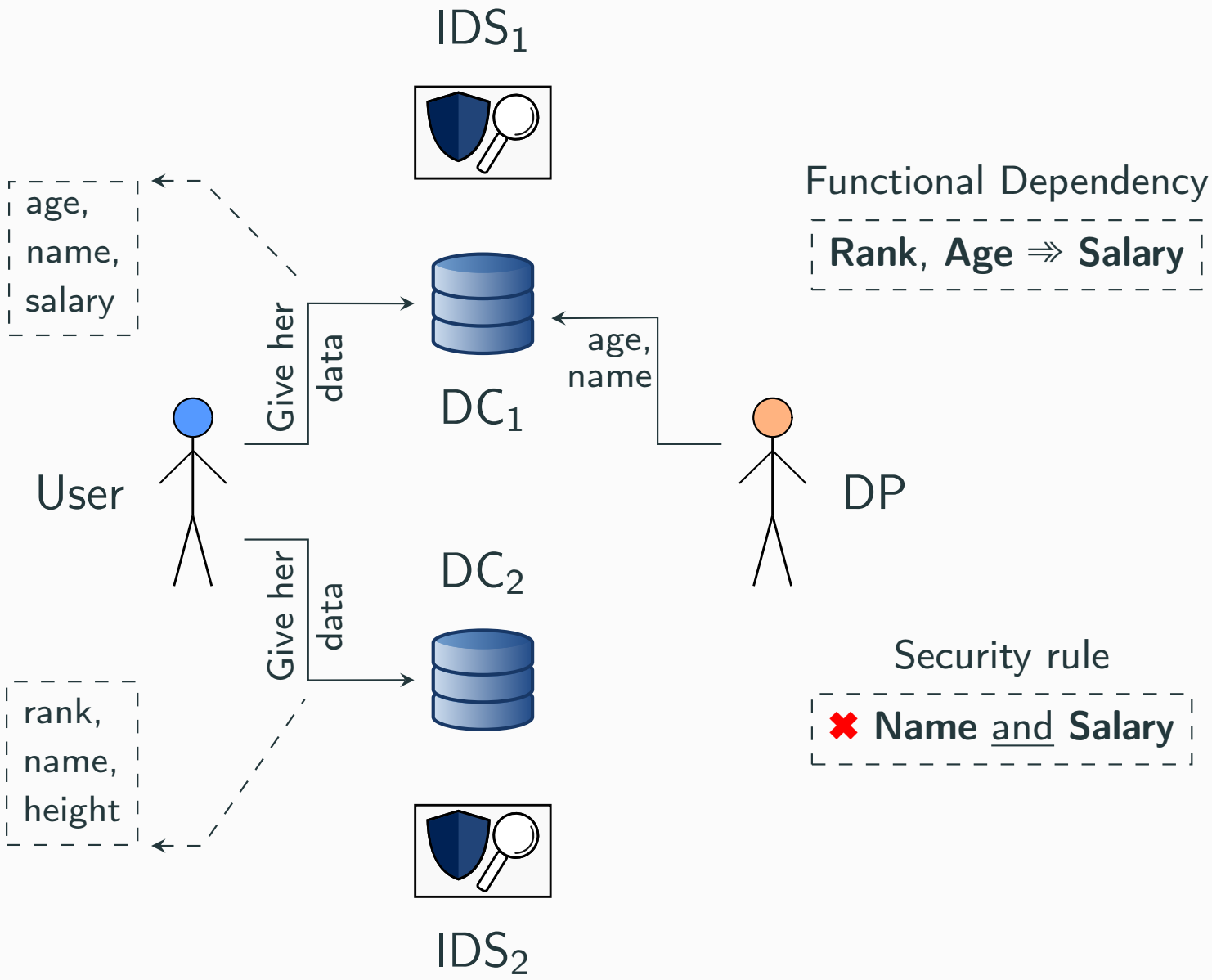

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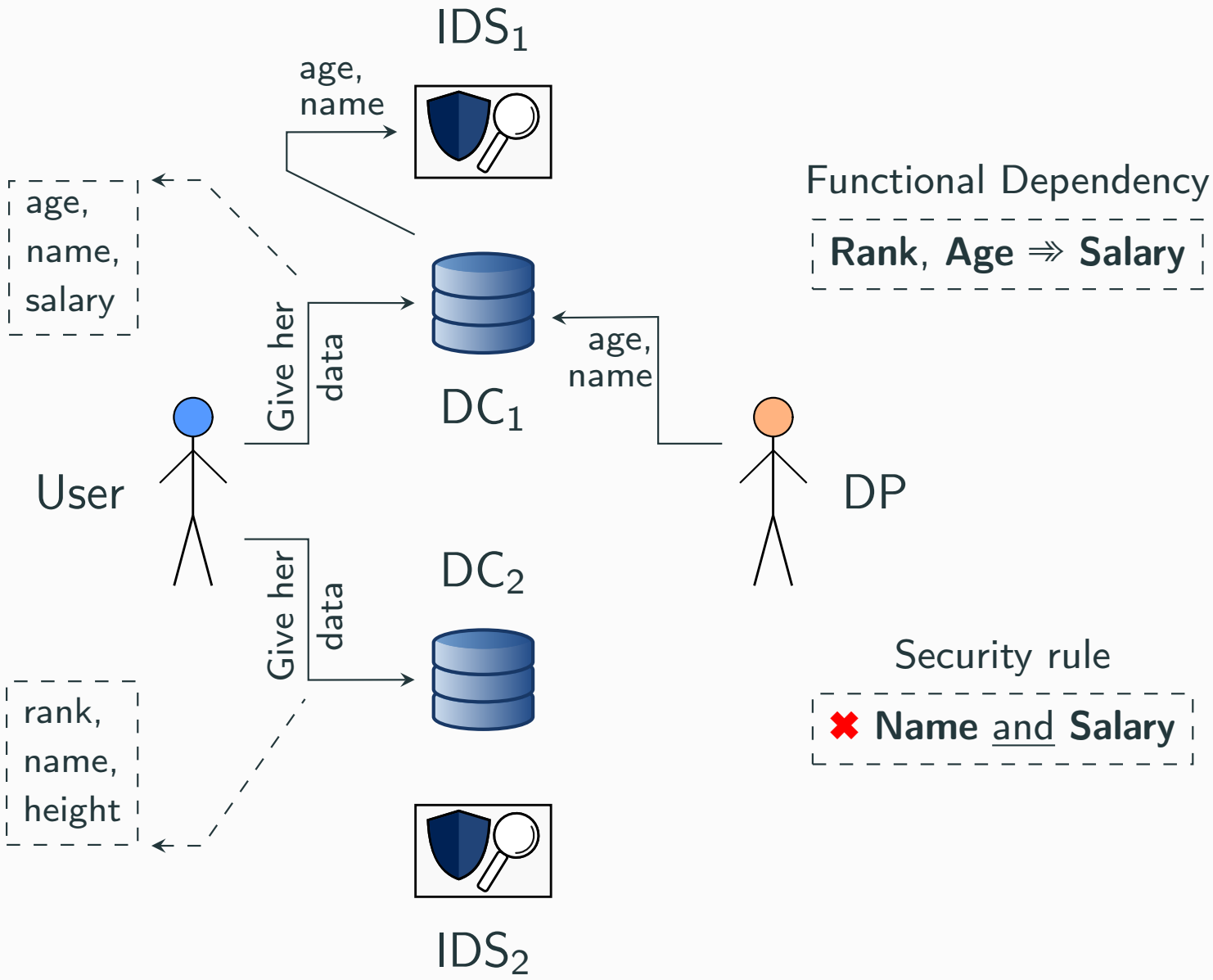

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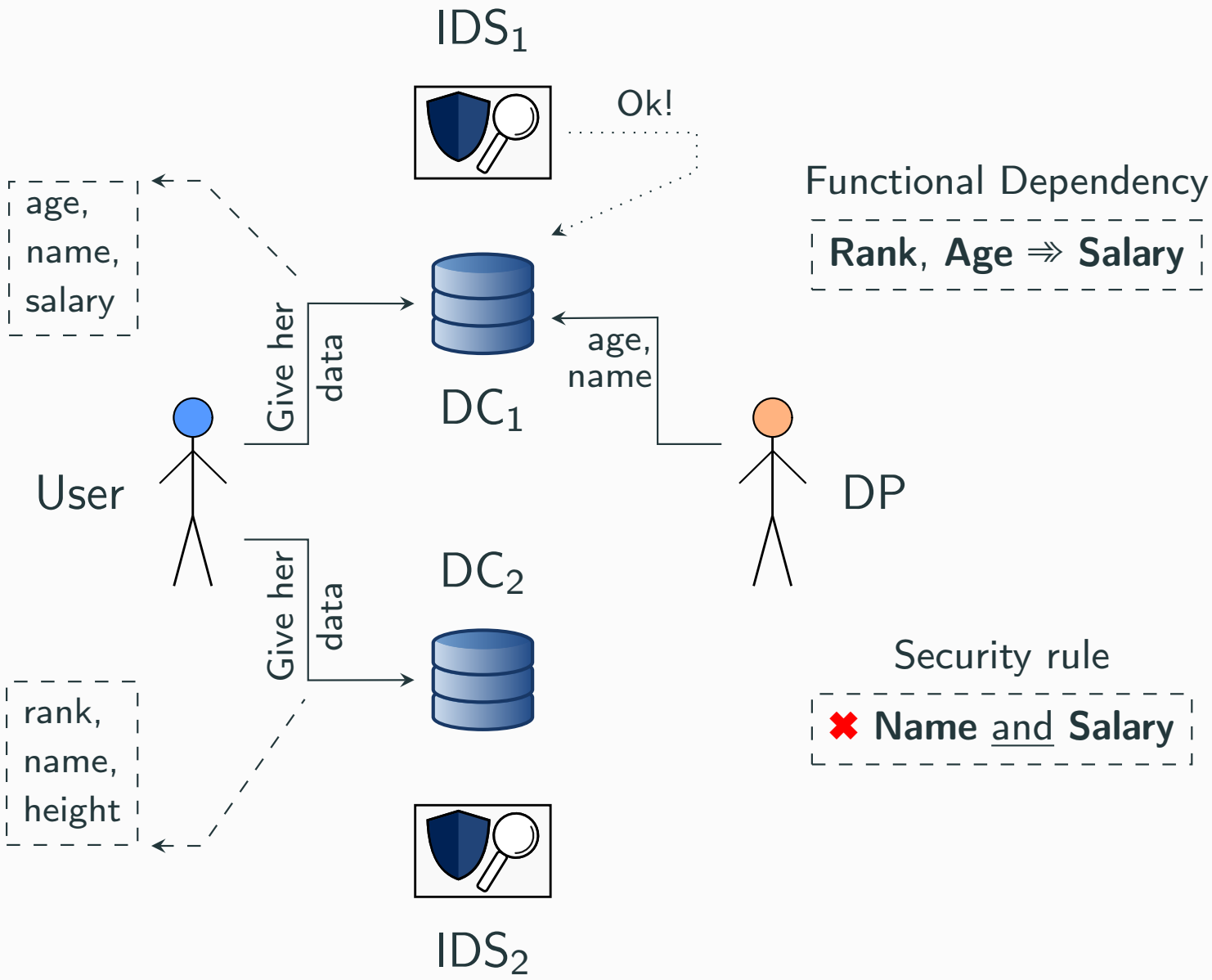

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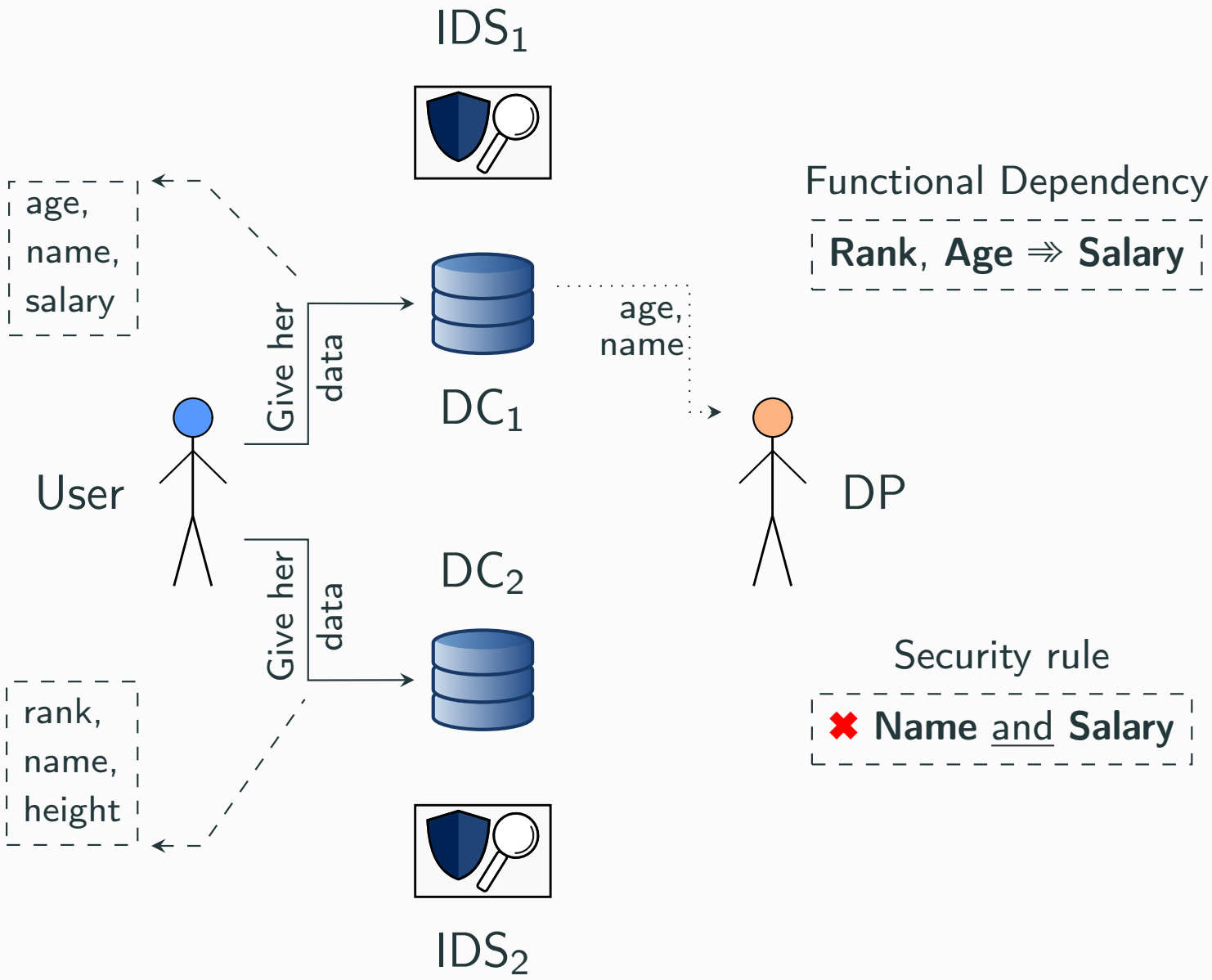

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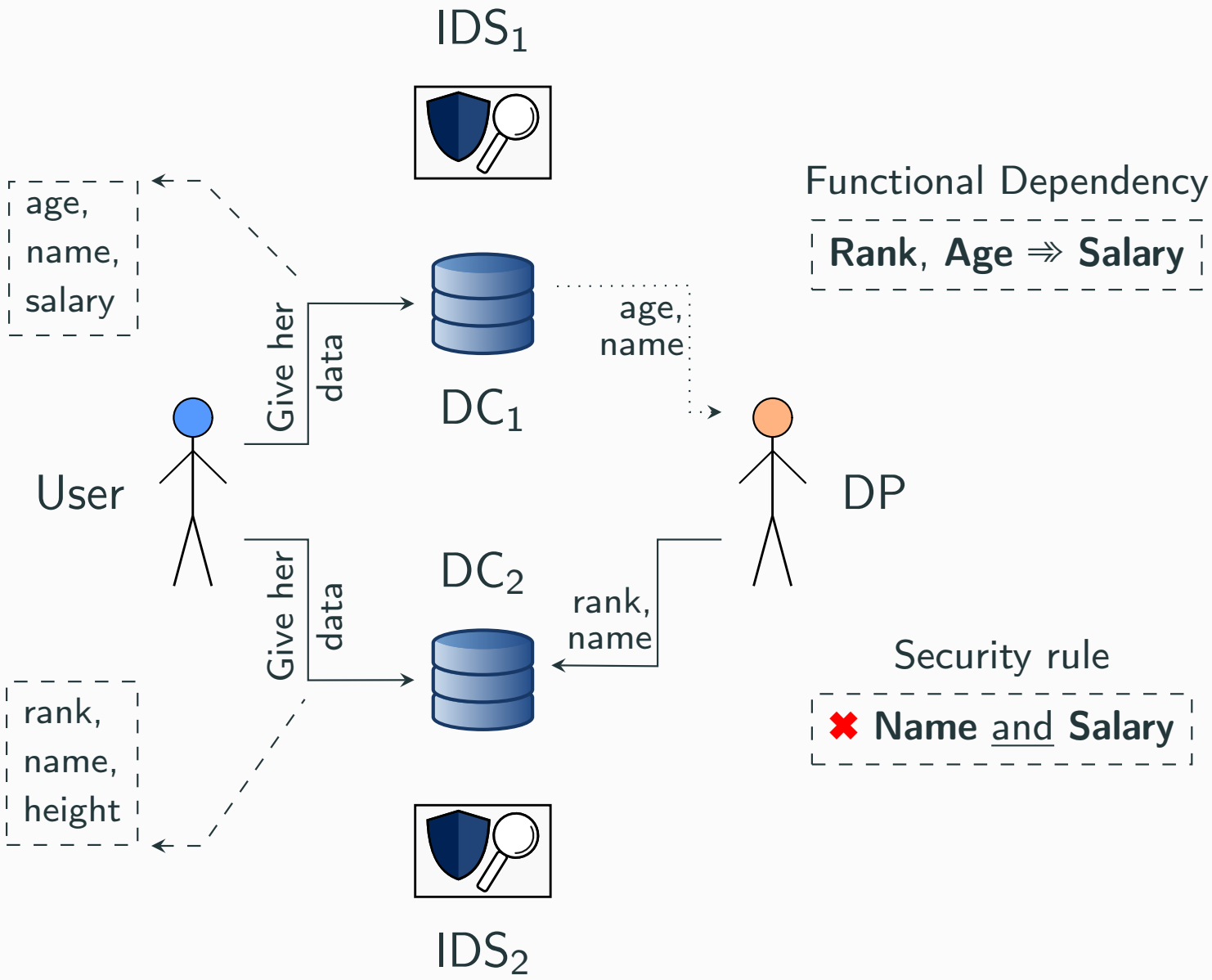

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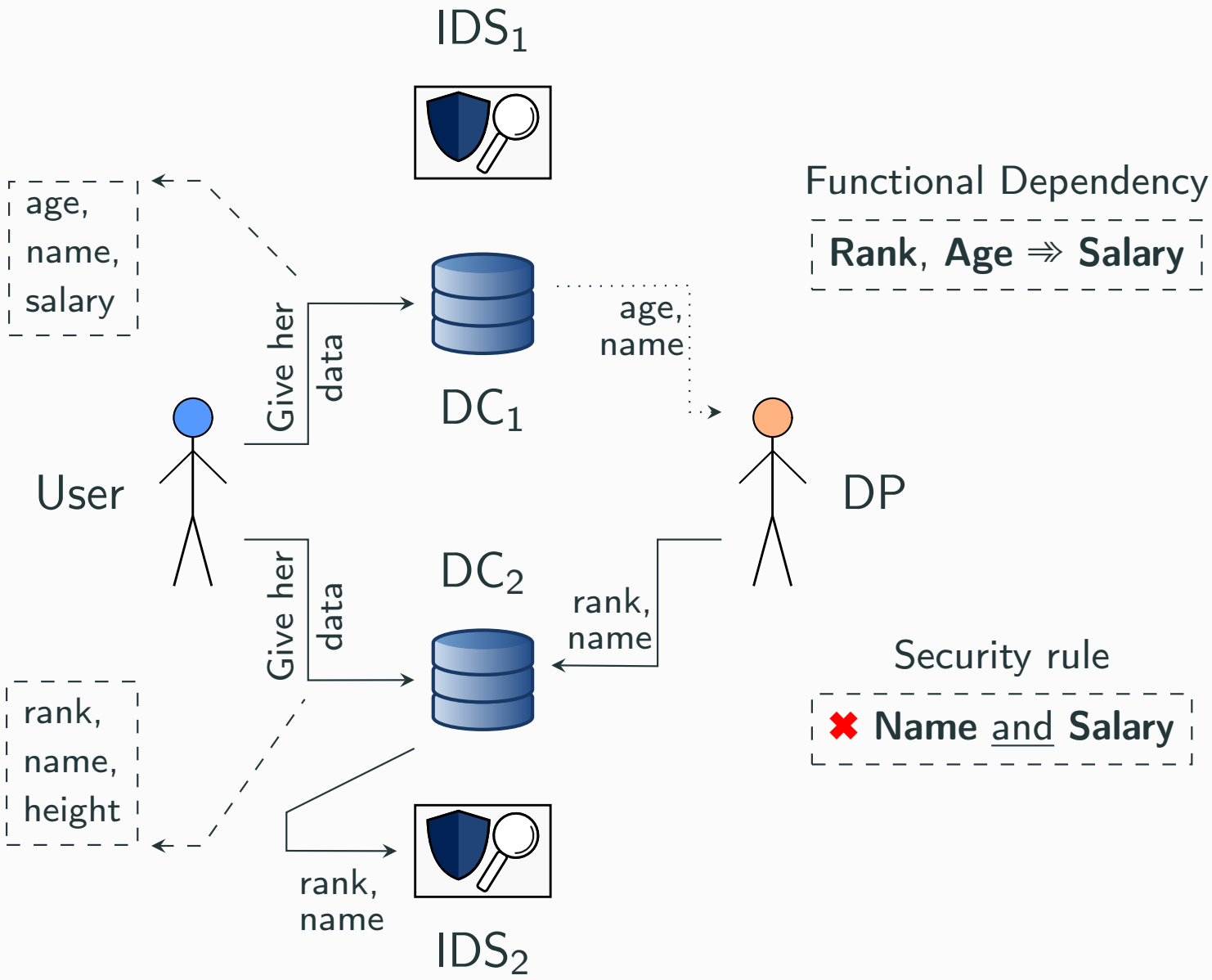

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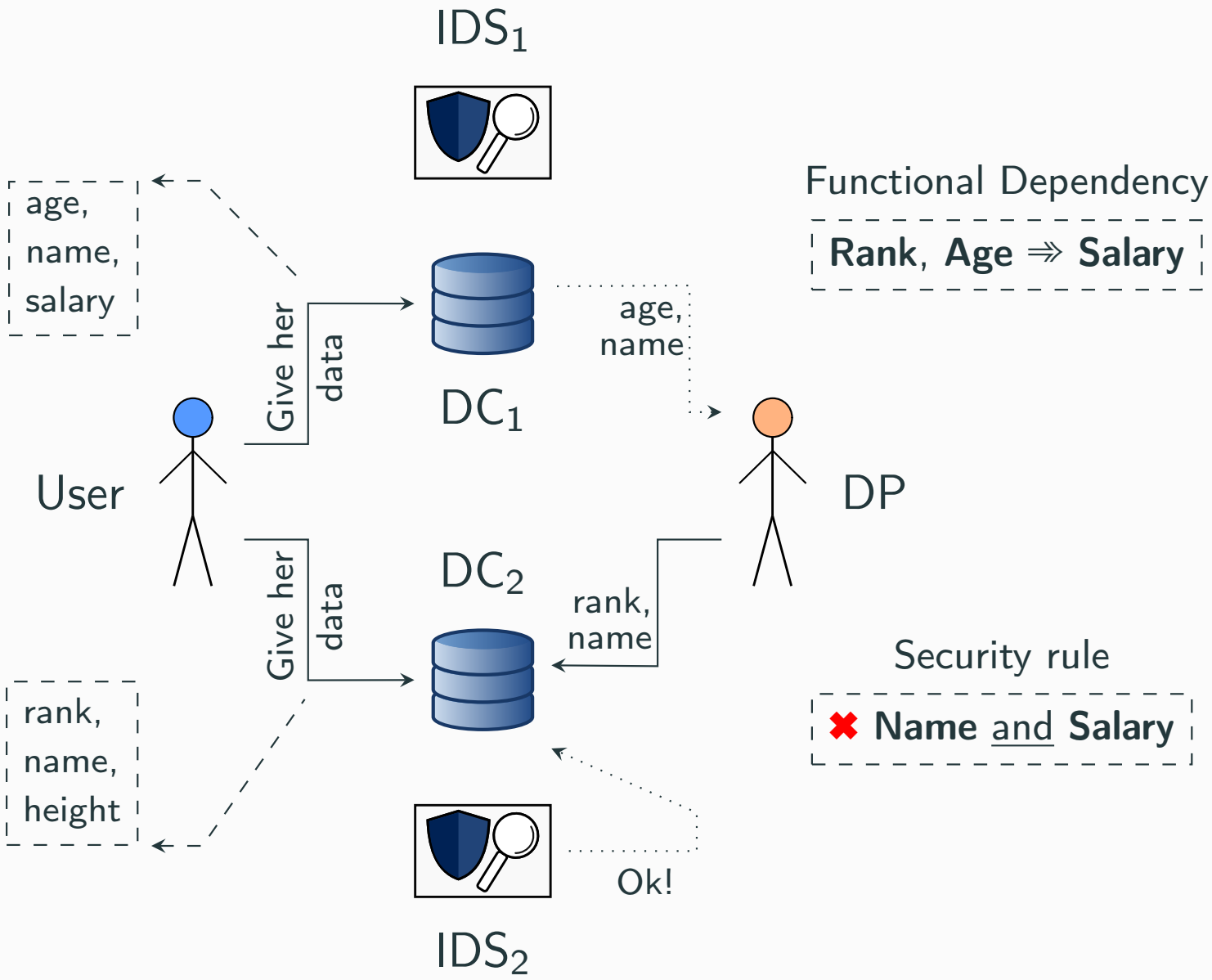

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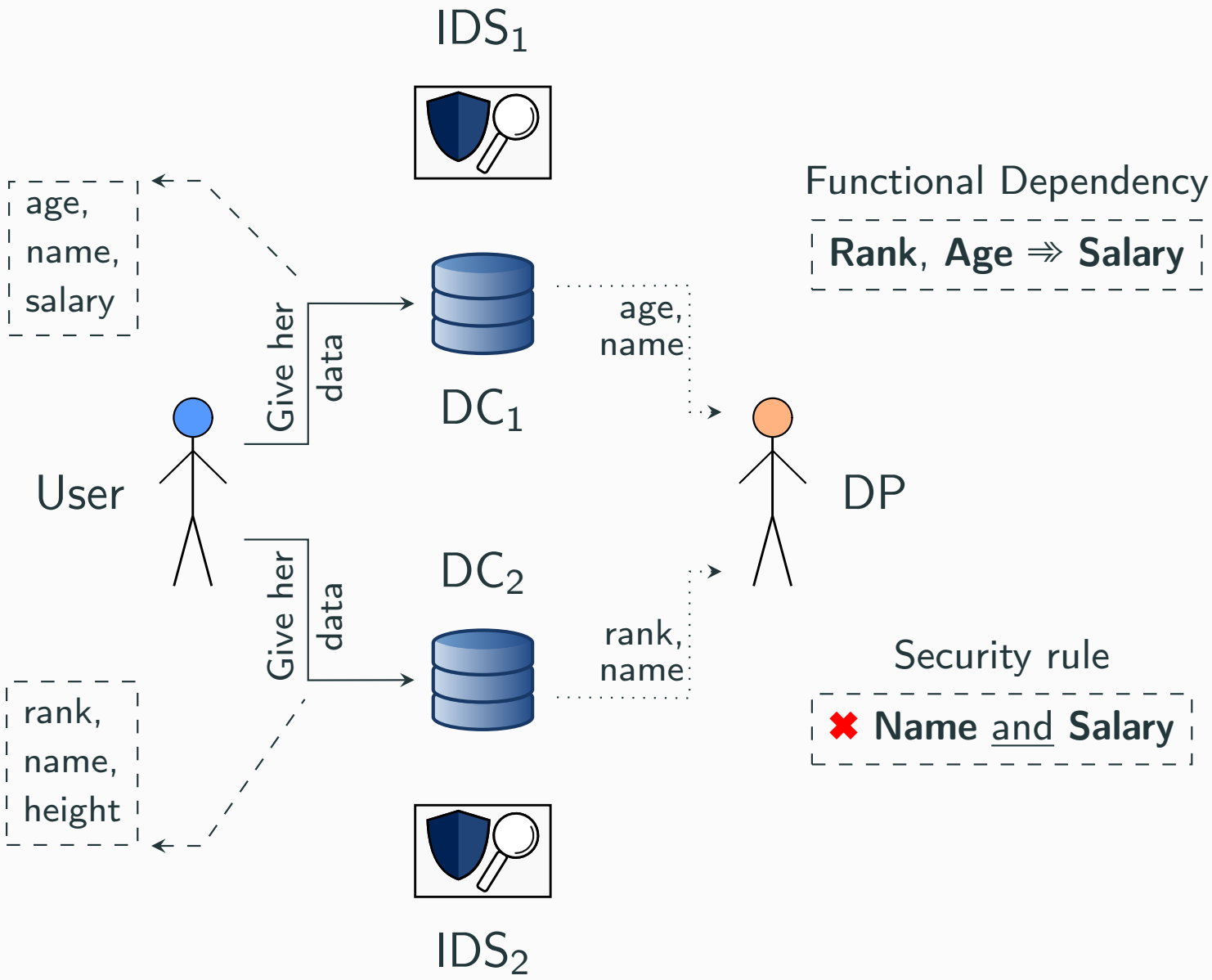
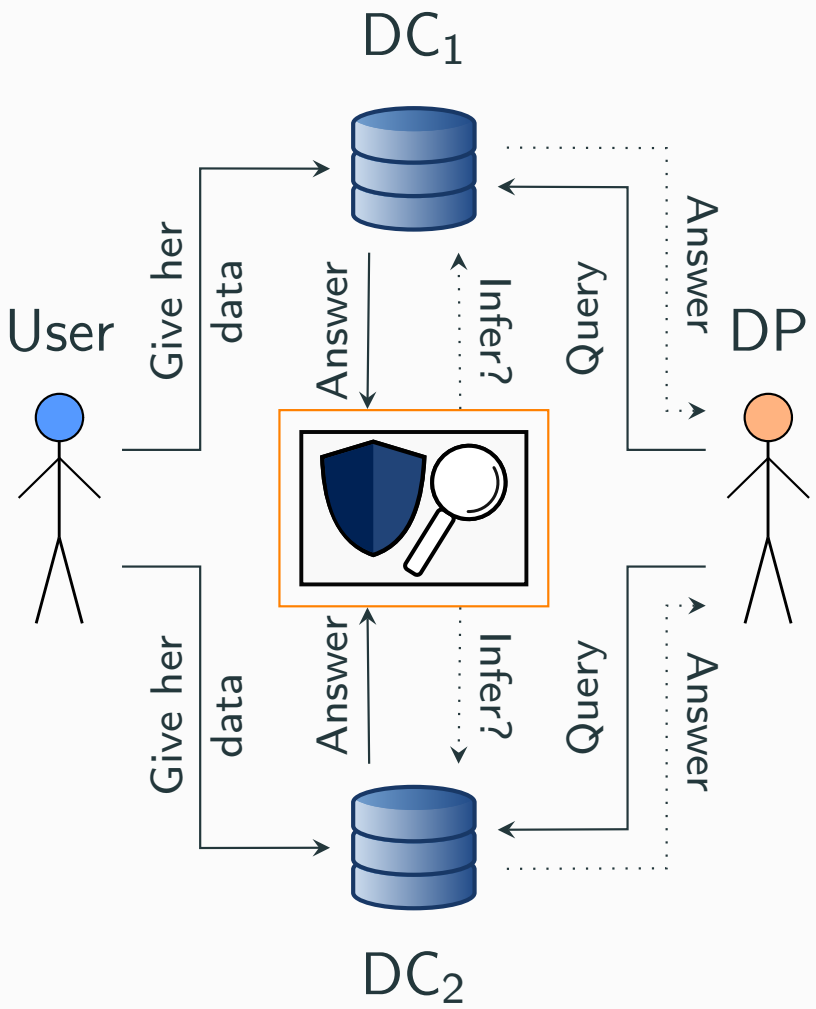


Our proposition



Challenges

- Identify similar instances.
- The system can have an honest-but-curious behavior.

Hypothesis

- Data controllers collaborate with our system.
- The system is centralised to extend the solution of Chen et al. 2006.

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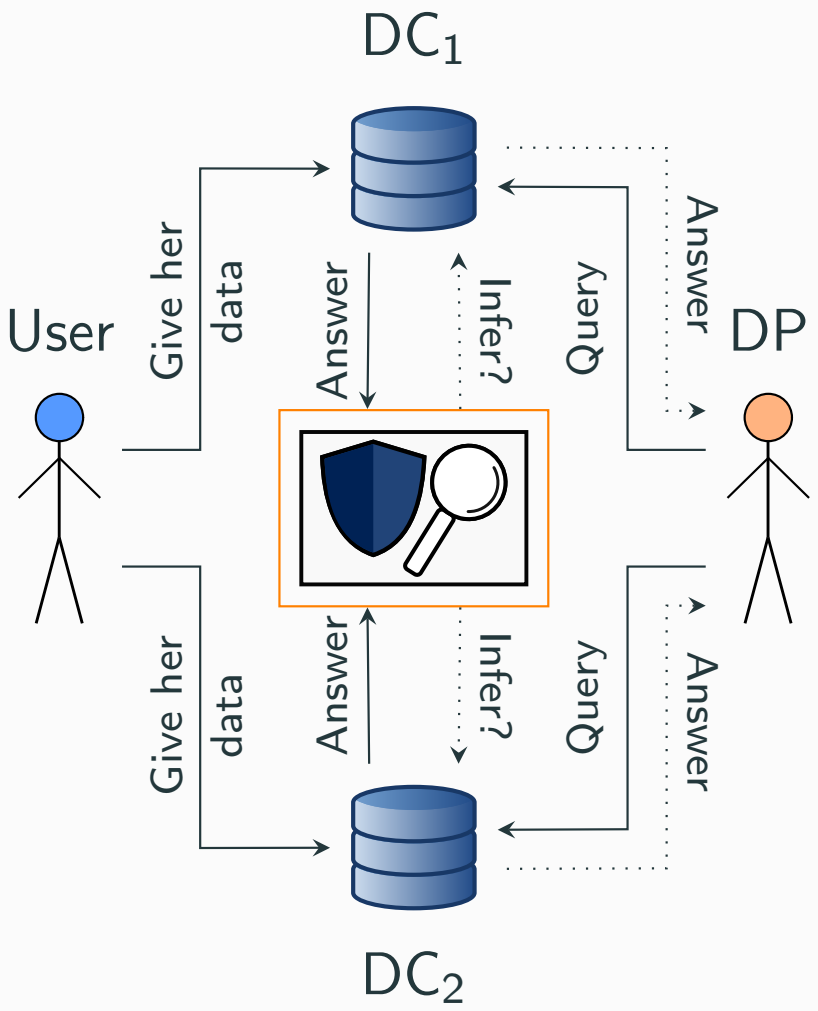

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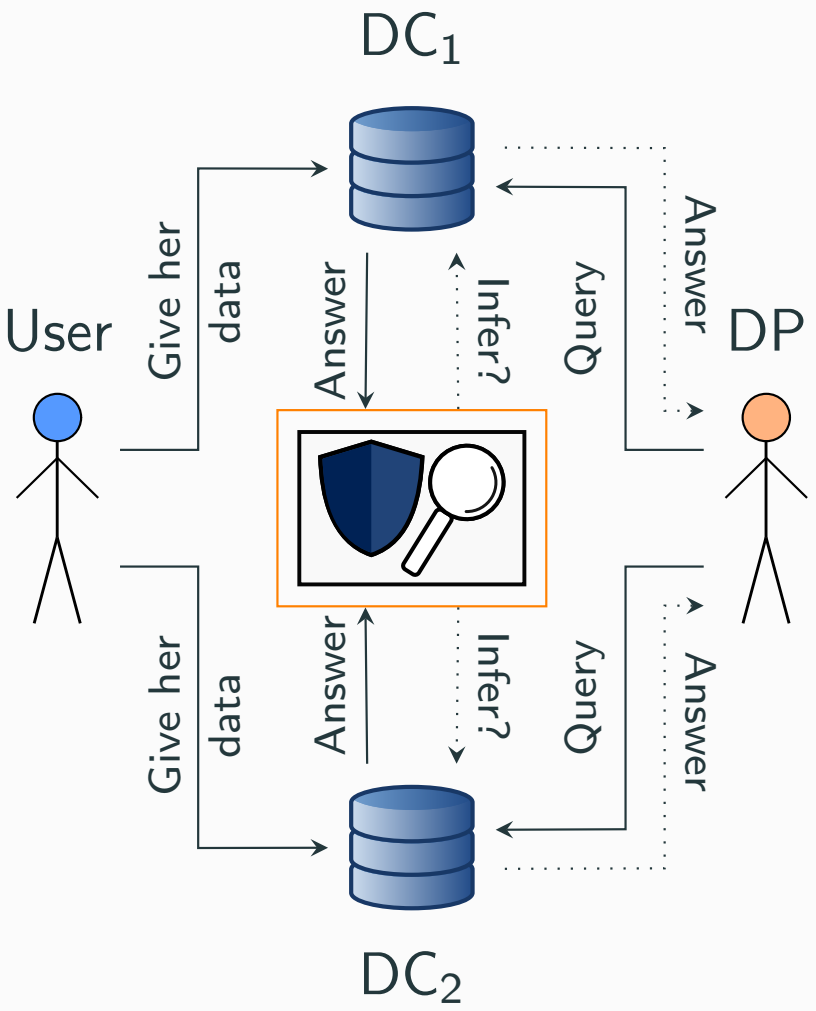

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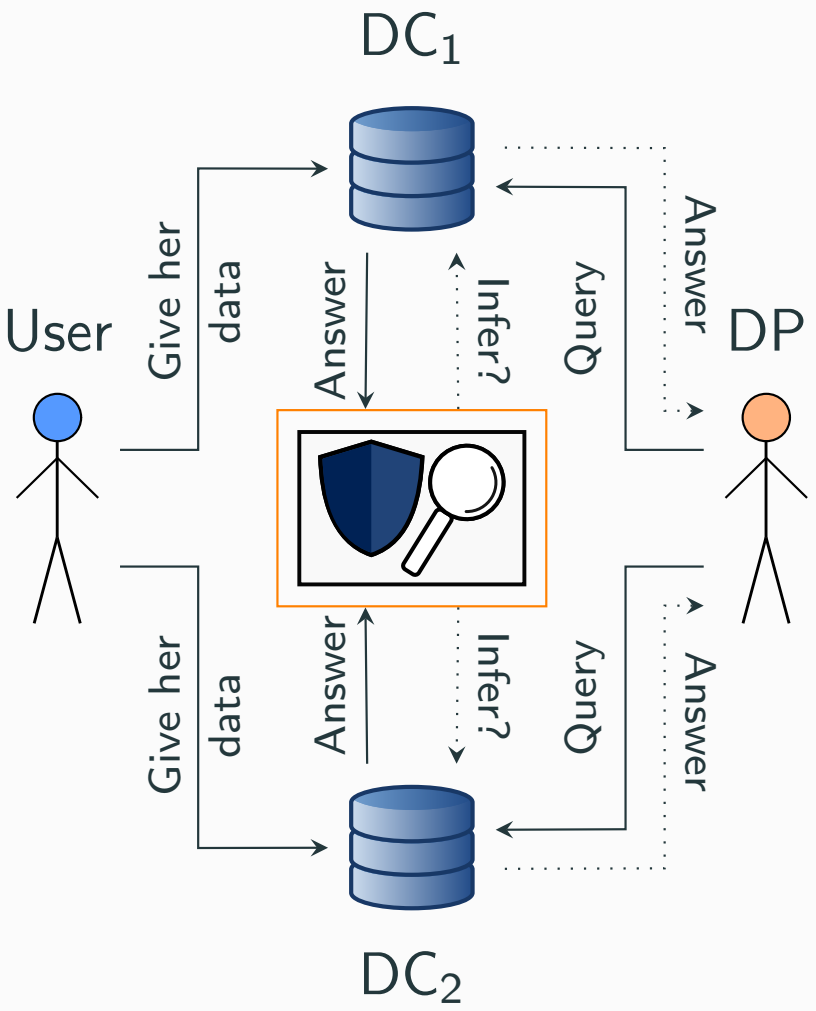

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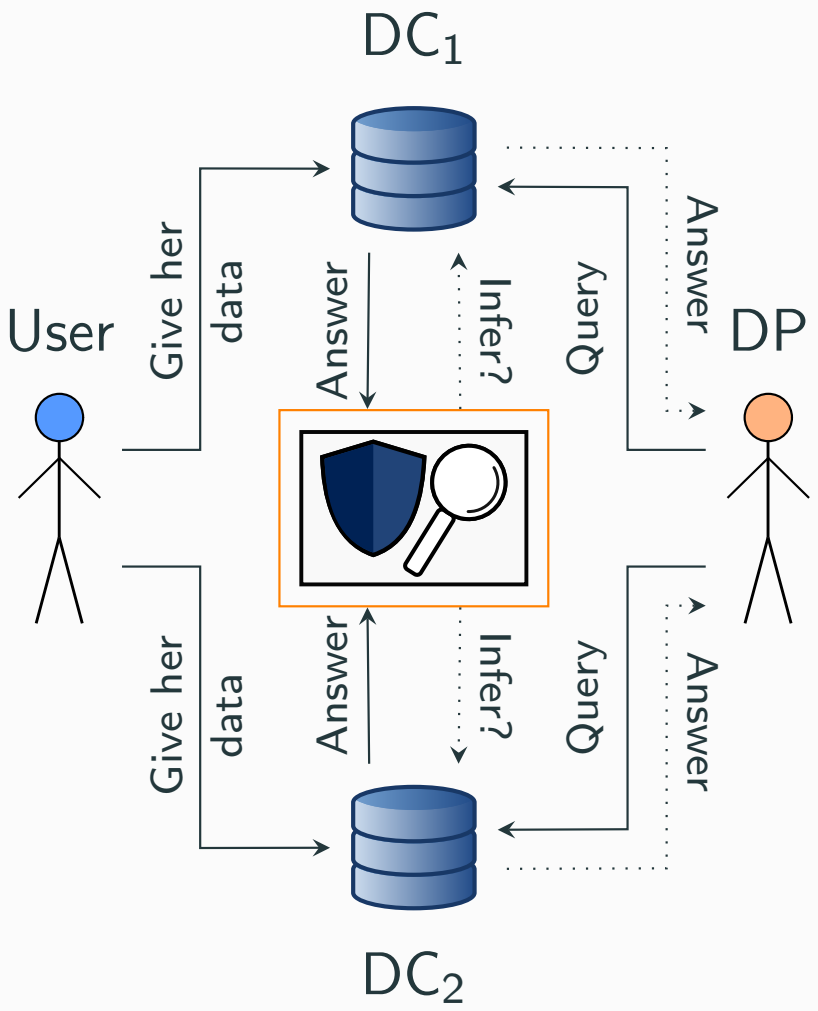

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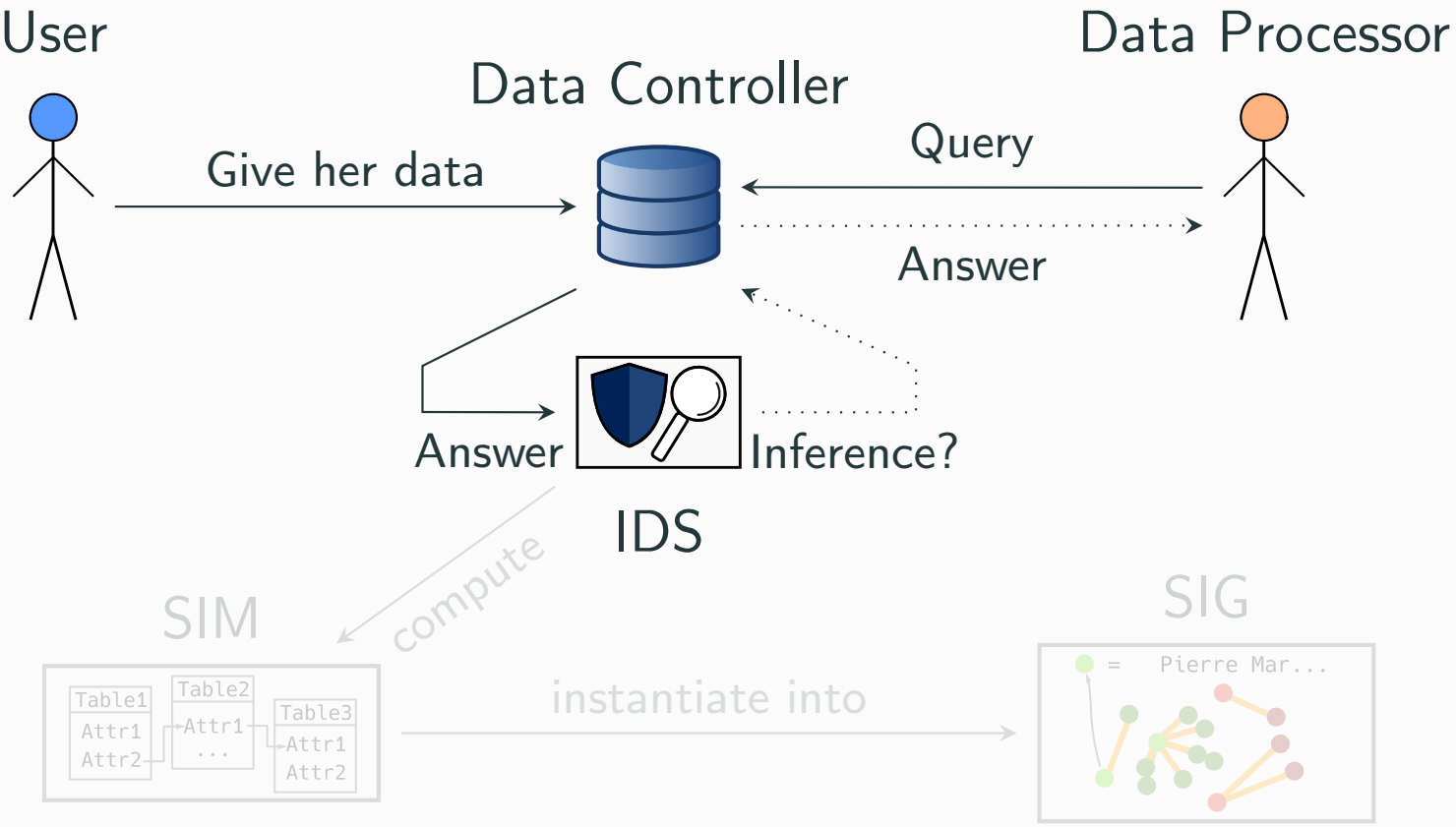

Semantic Inference Model (SIM)

Dependencies at schema level.

Semantic Instance Graph (SIG)

Dependencies at instances level.

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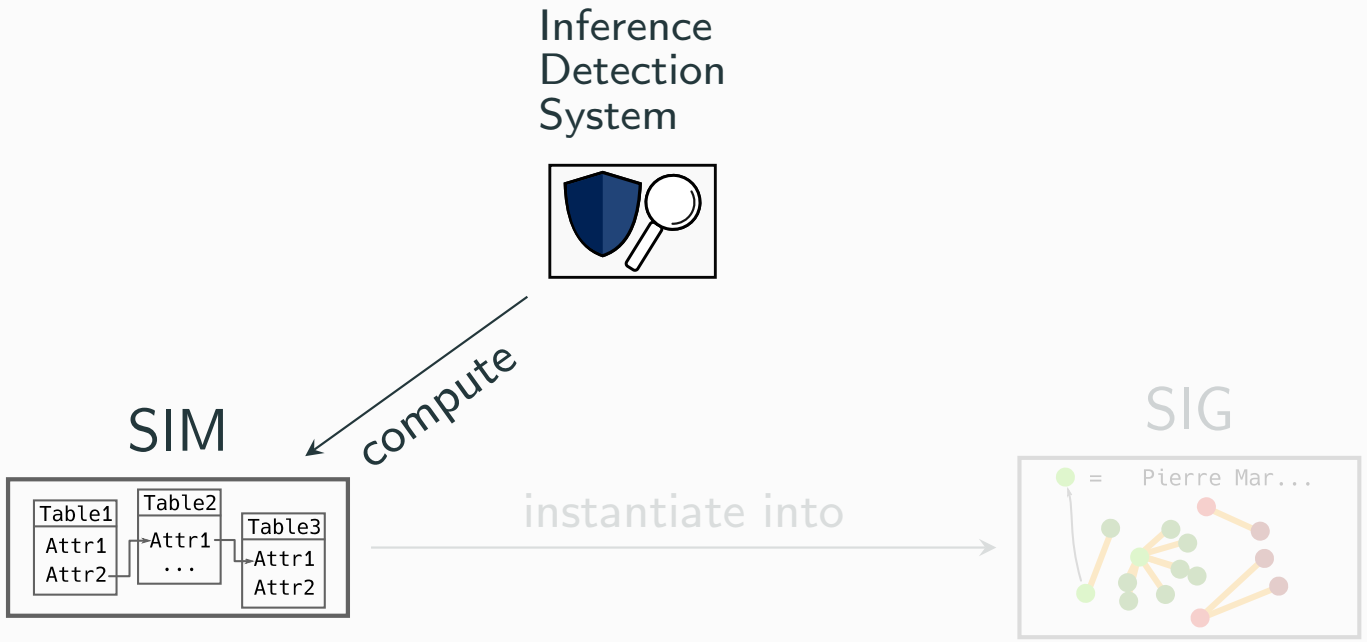

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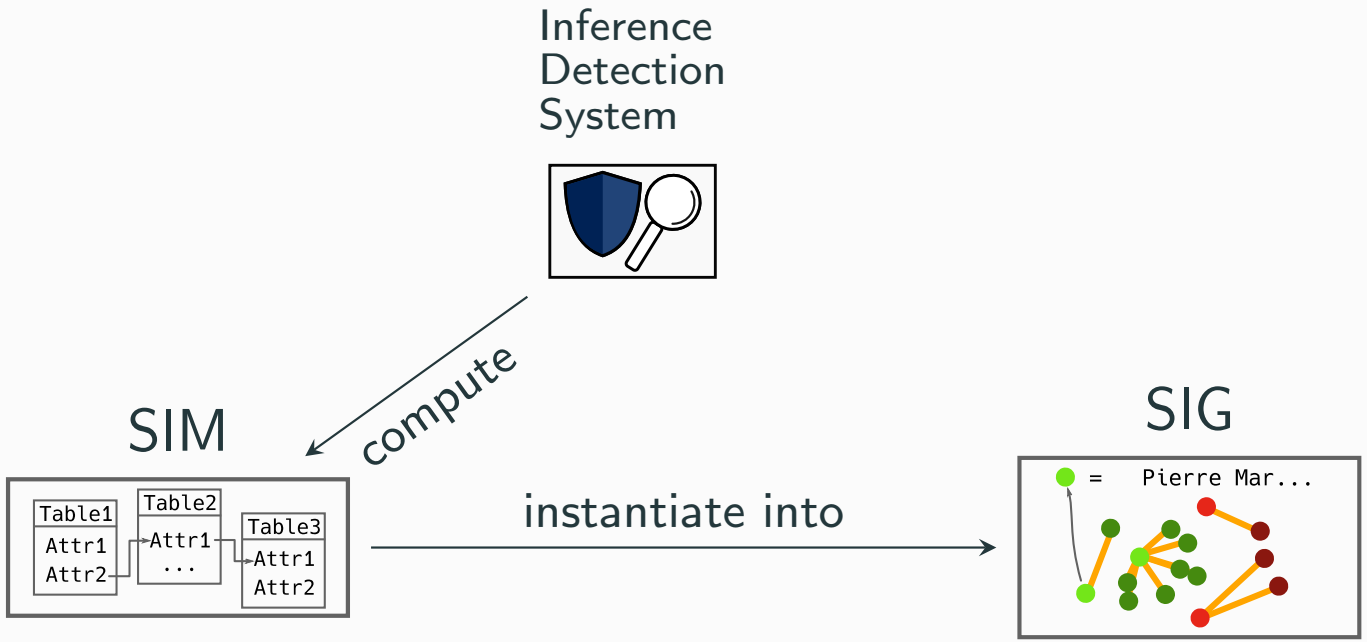

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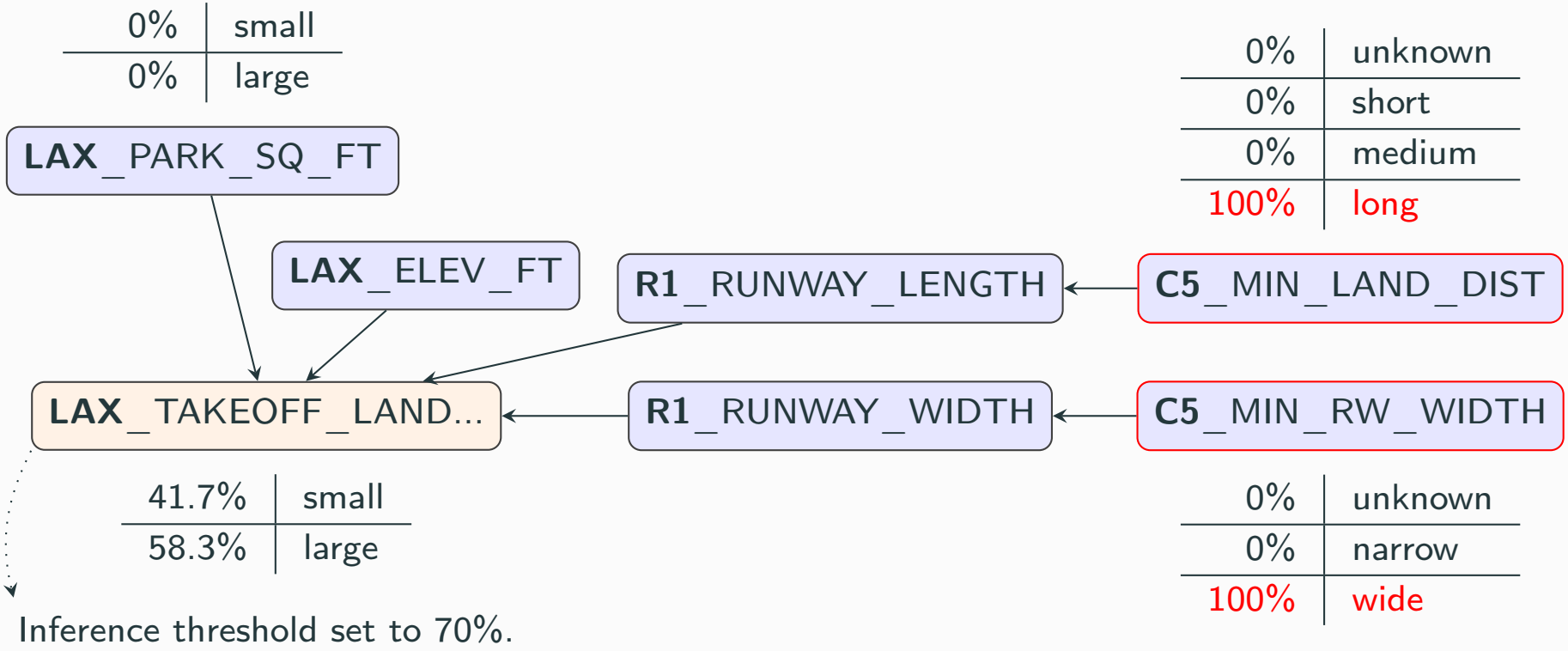
Chen et al. 2006 – Illustration

Inference channels within a database: Example of a SIG



Dependencies between **instances** of the Los Angeles airport database.

LAX is an airport, **R1** a runway, and **C5** an aircraft.

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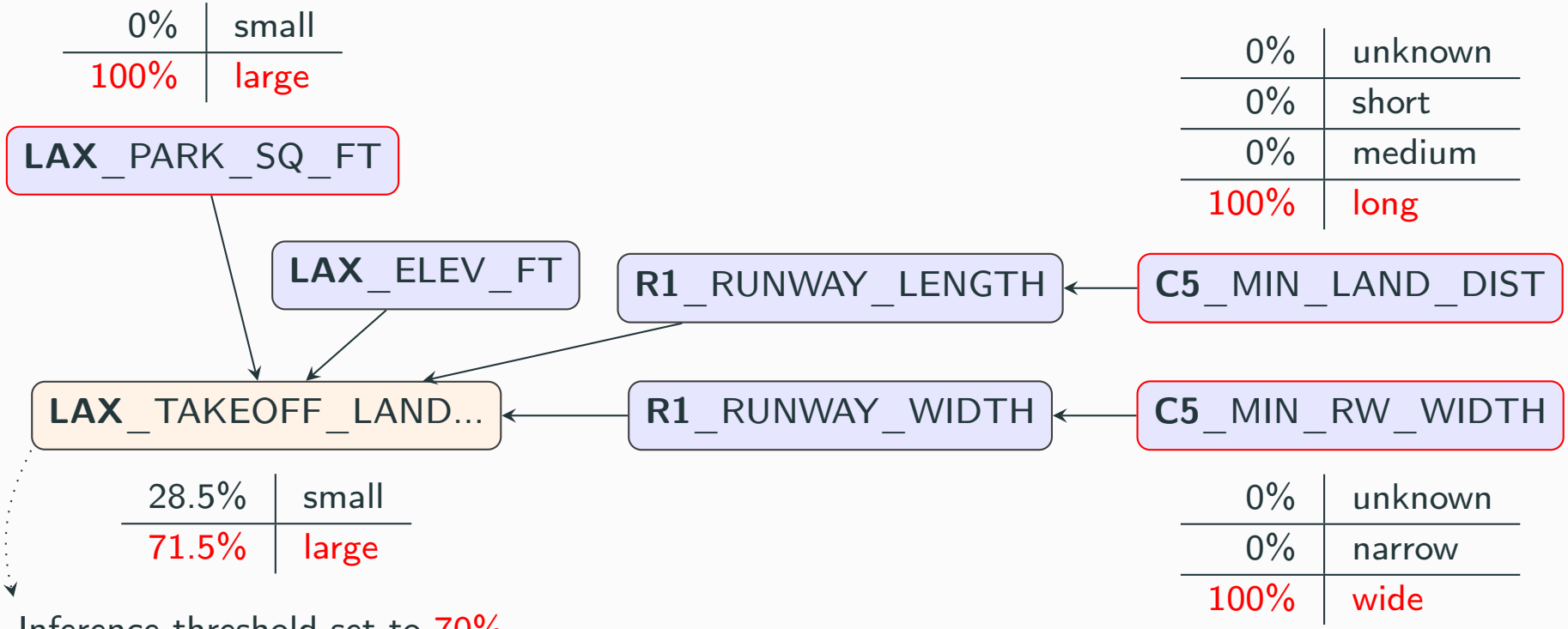

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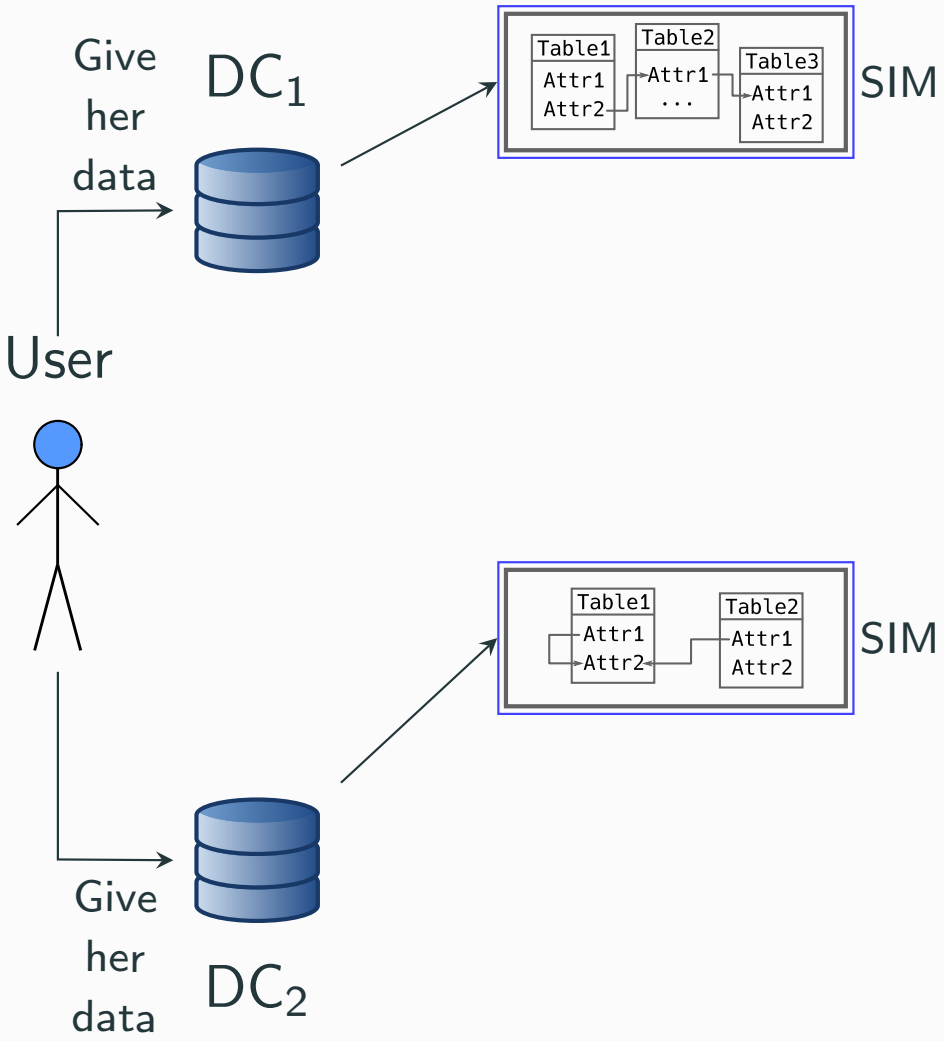

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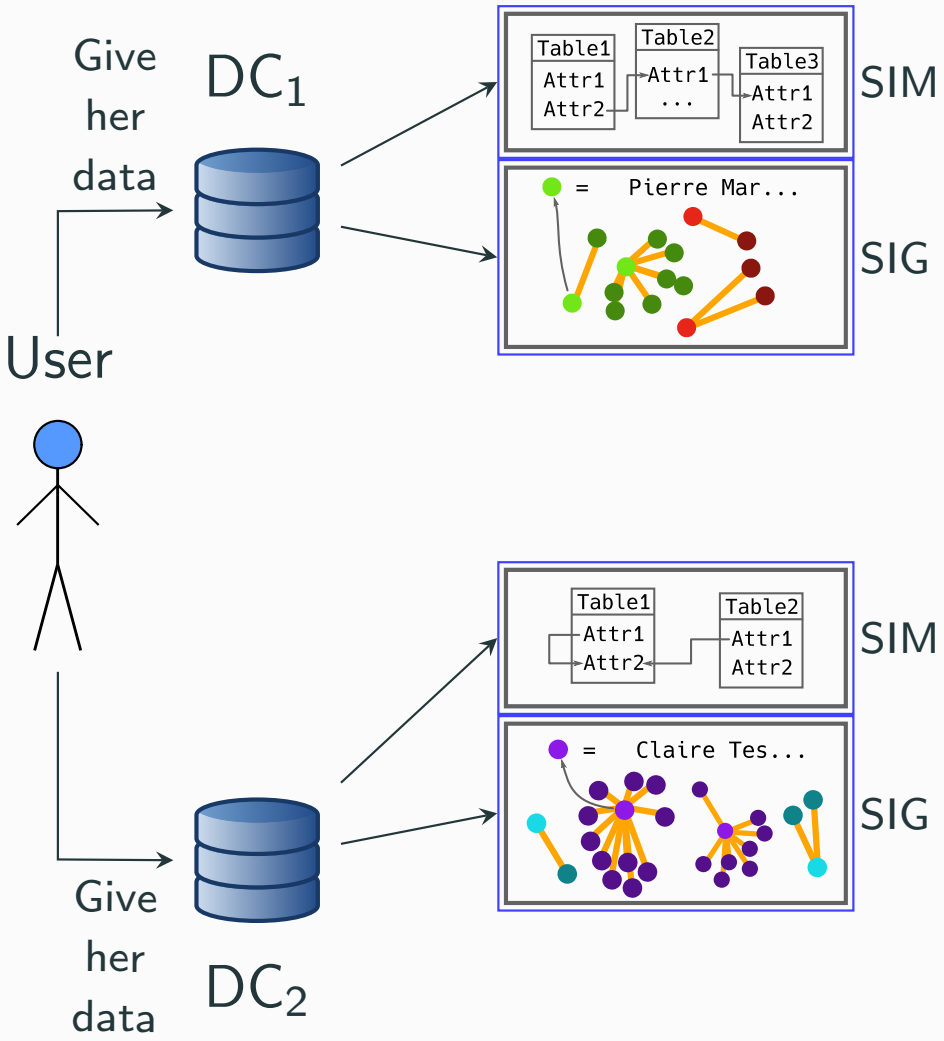

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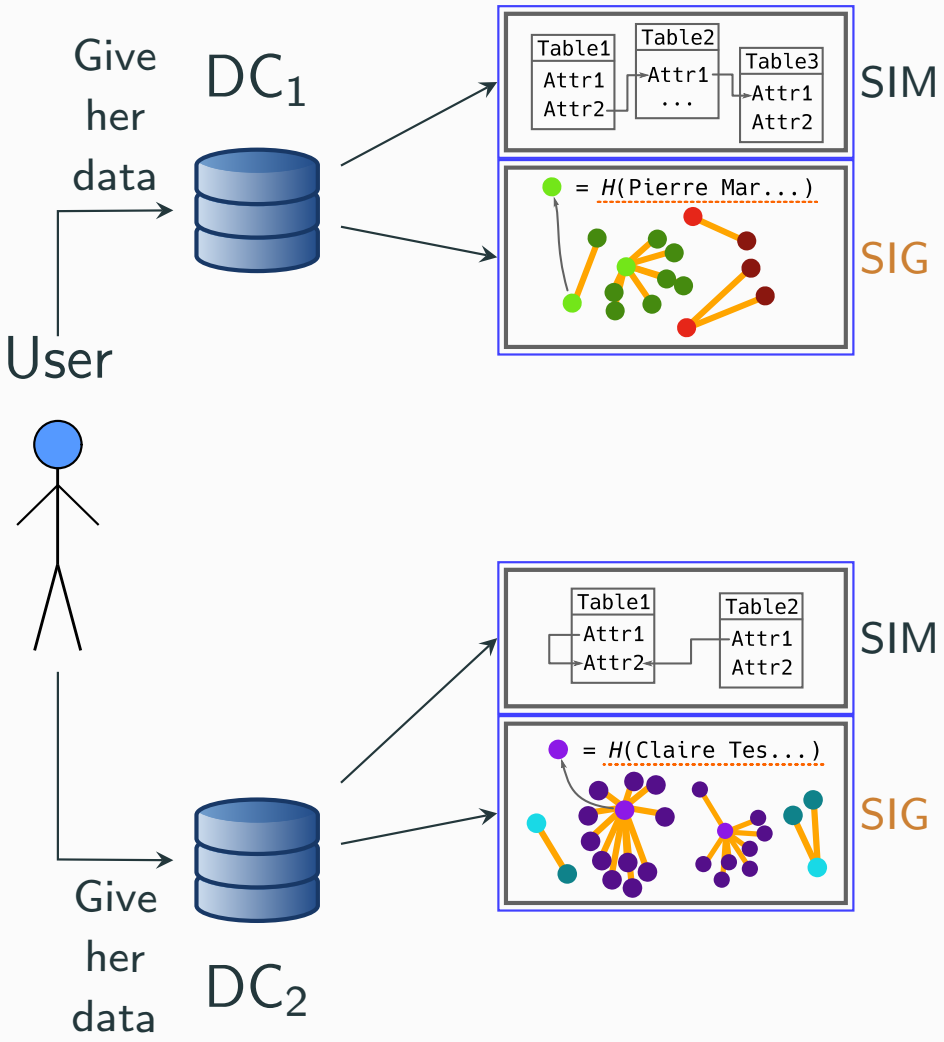

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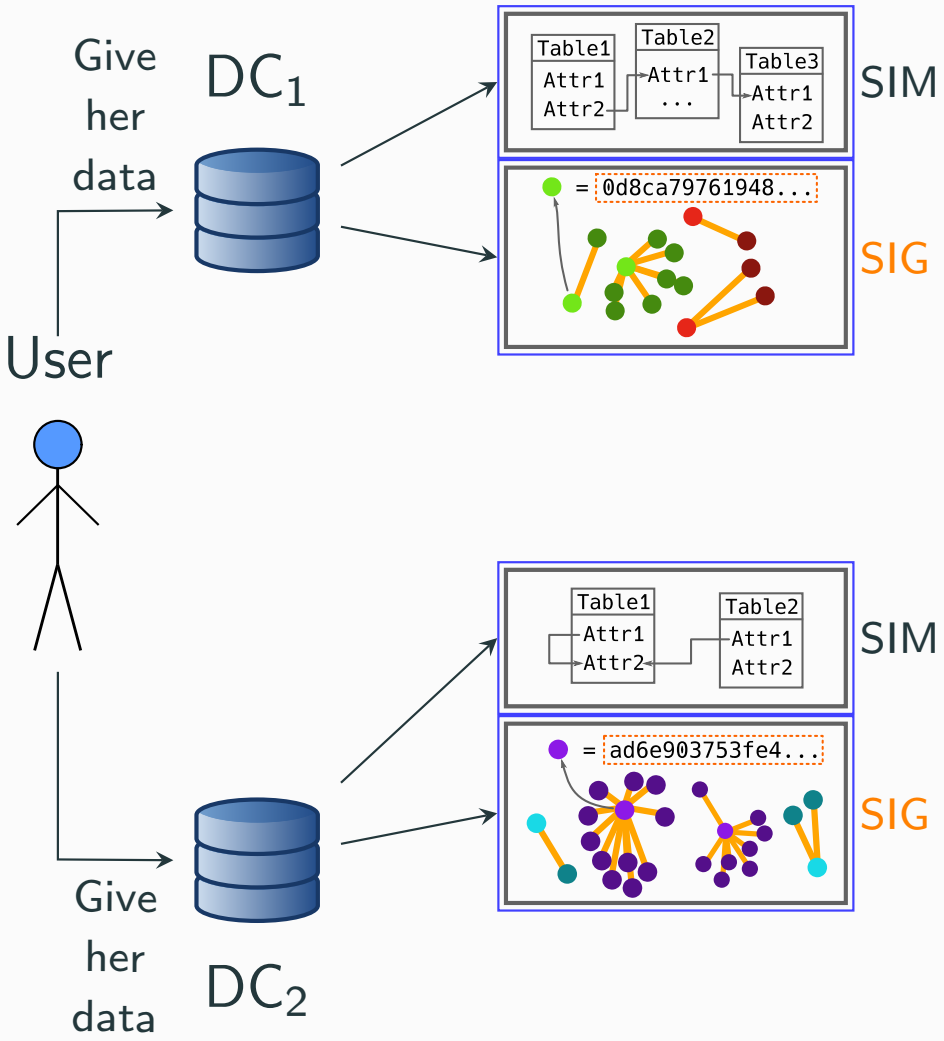

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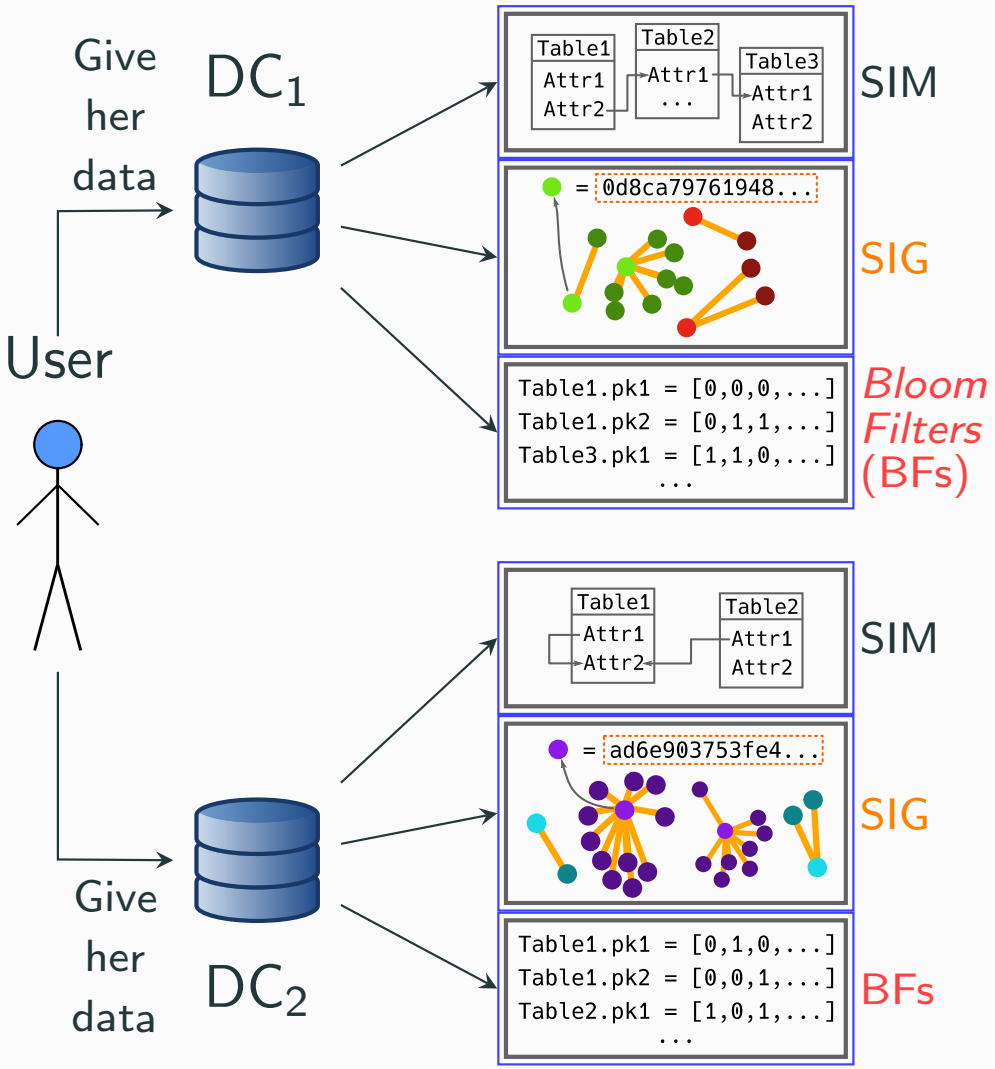

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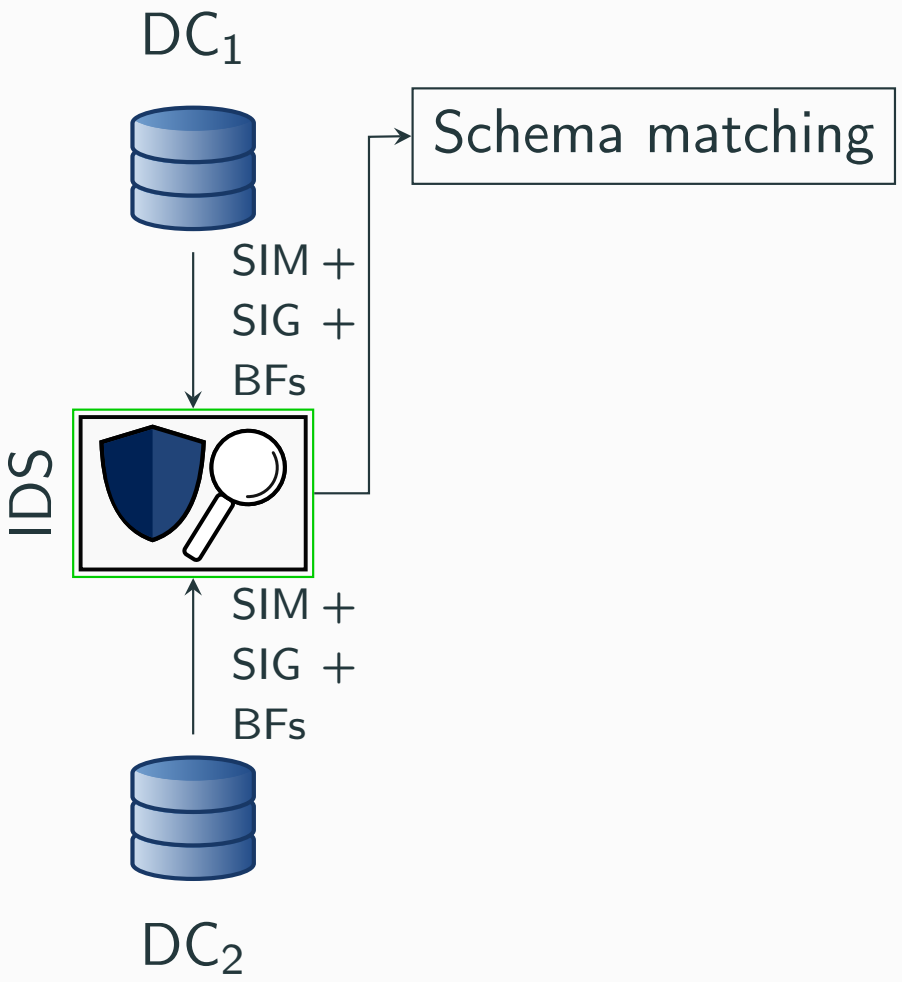

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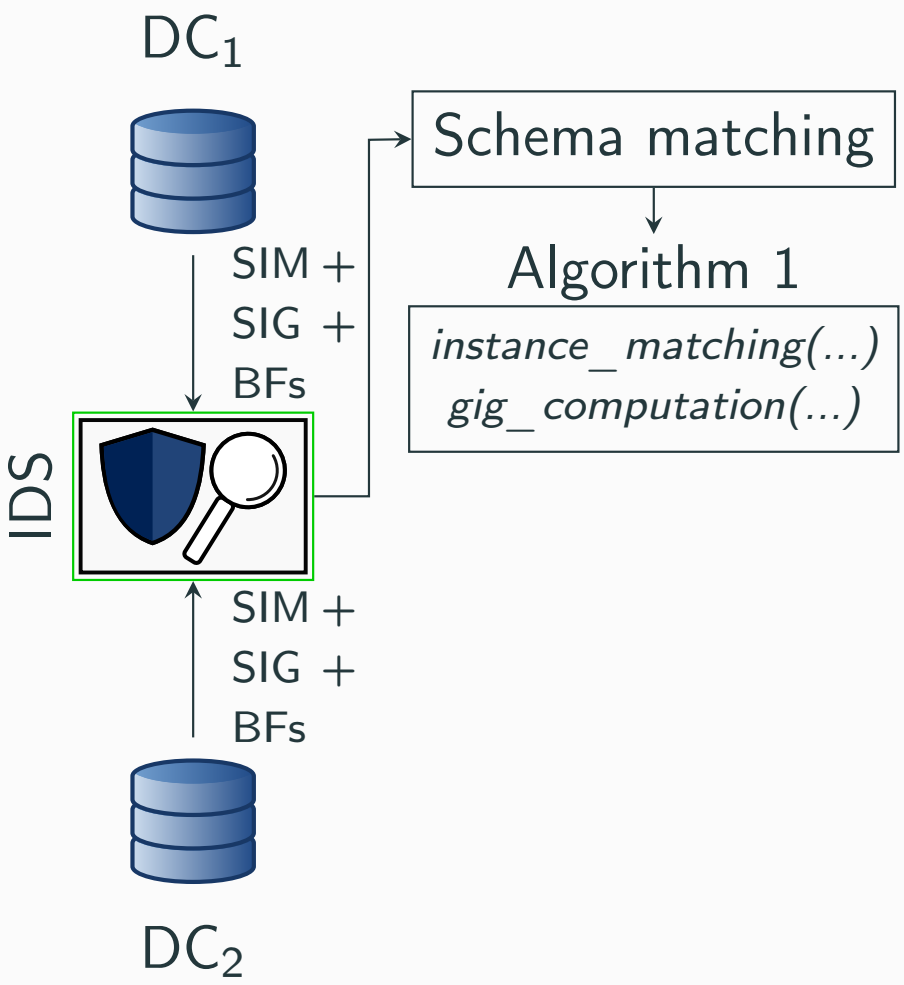

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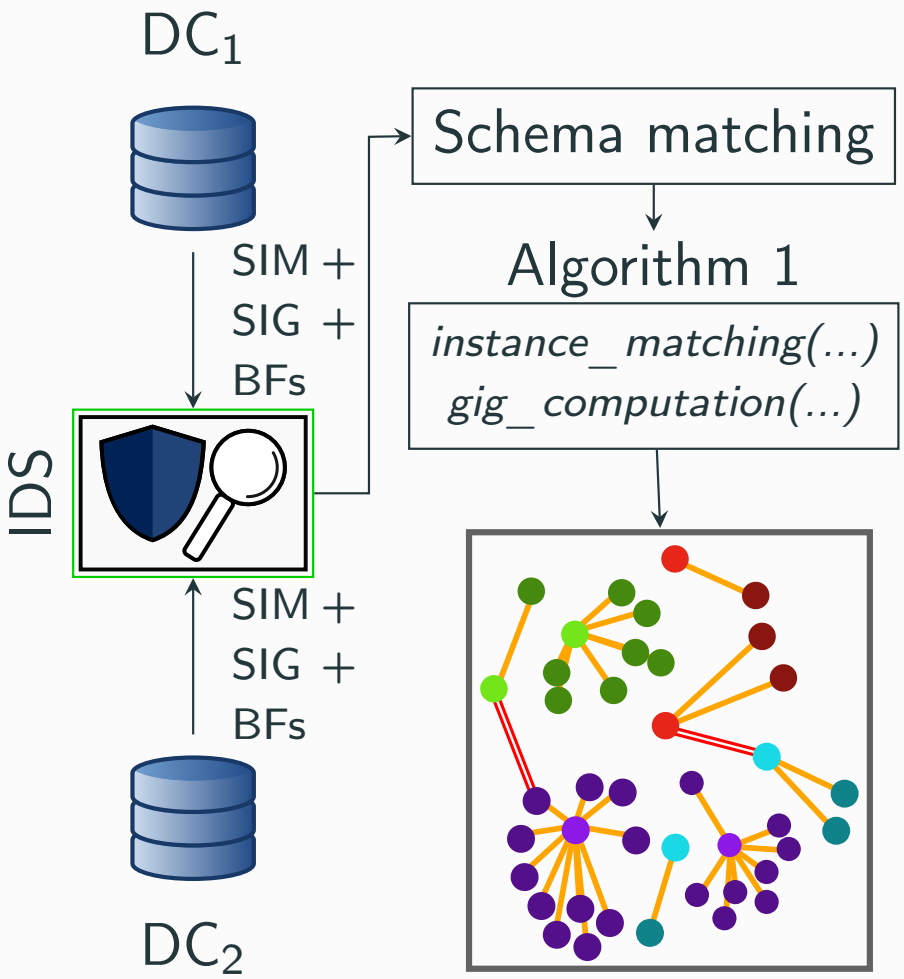

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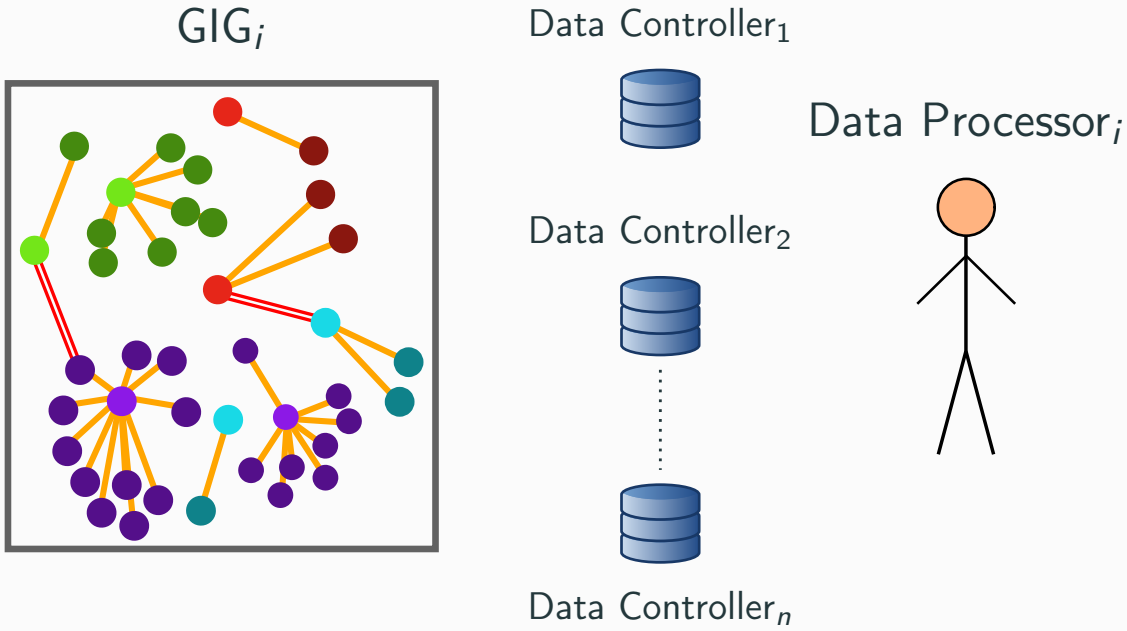
Conclusion & Future work



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Next steps

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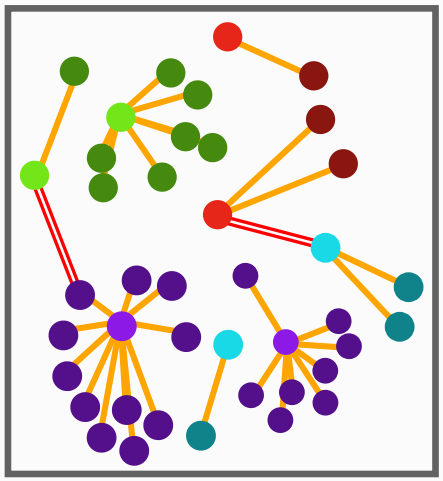

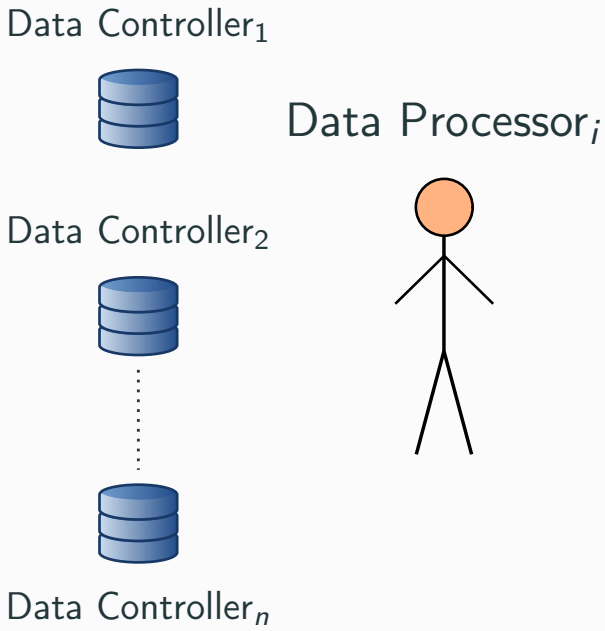

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