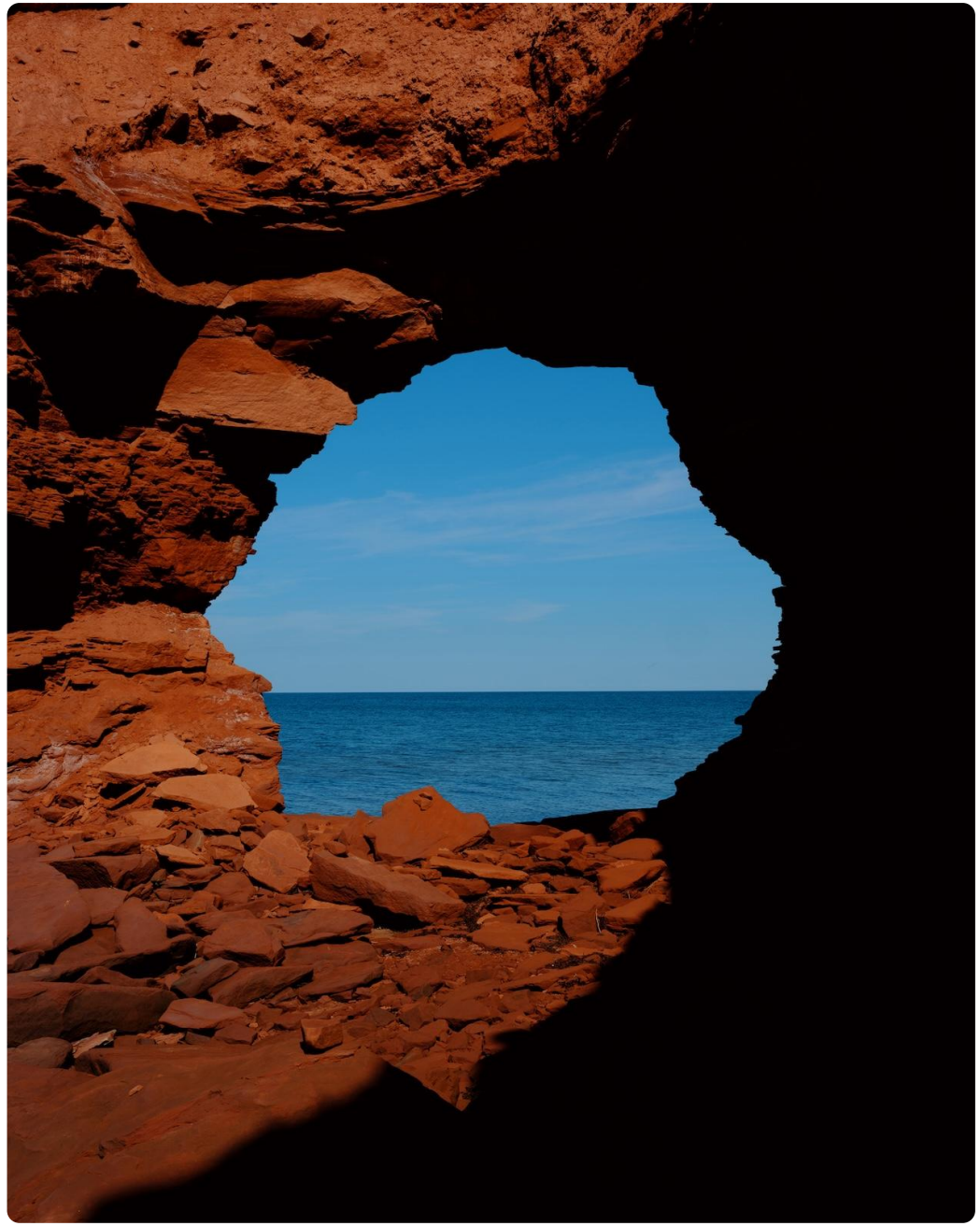
OpenAI

Harnessing LLMs for Scalable Data Minimization



Charles de Bourcy, PhD

Member of Technical Staff

What is Data Minimization?

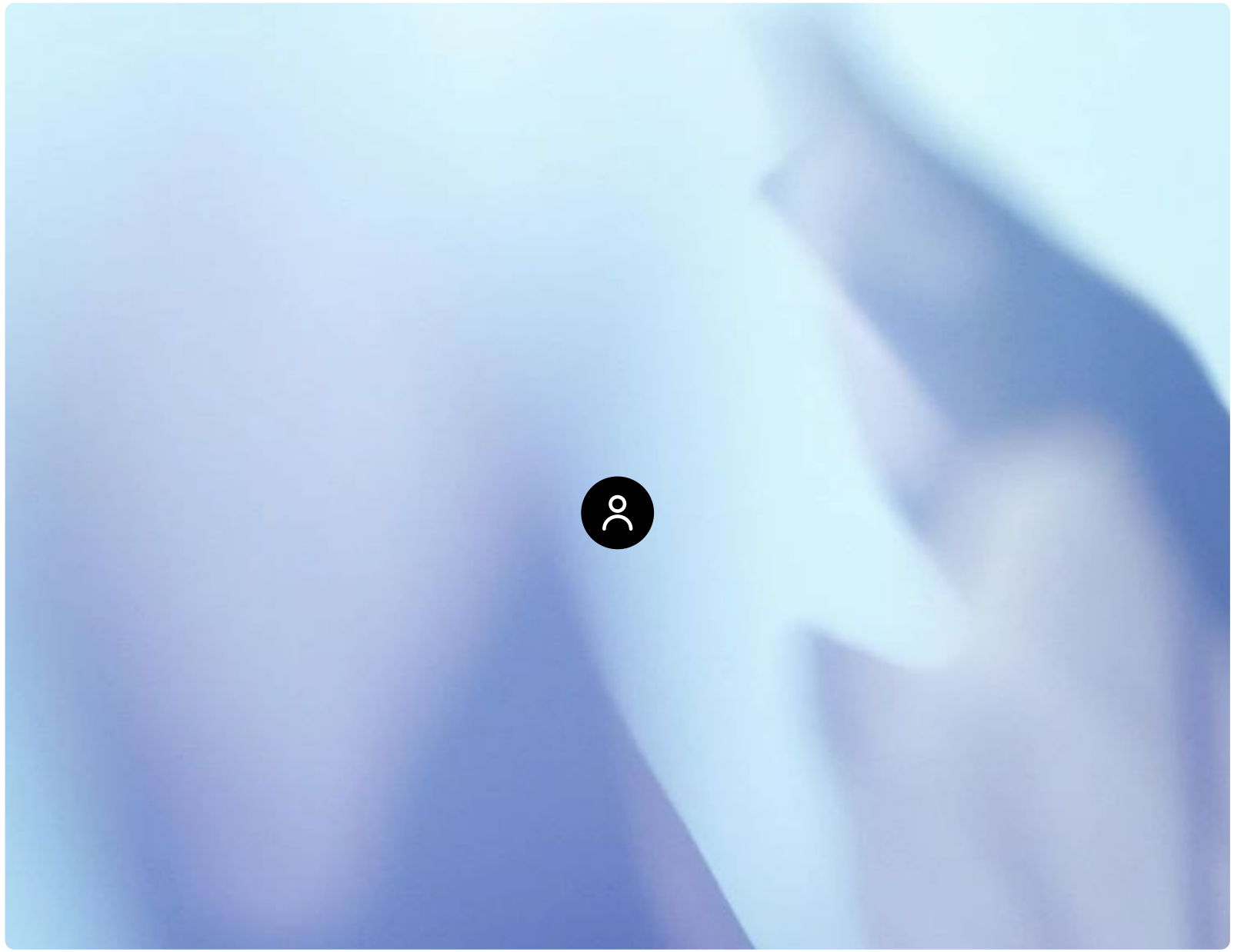
Only collect and retain PII as necessary for the specified purpose.

→ Don’t process irrelevant PII.

→ Expire PII when it is no longer needed.

What does it take to scale Data Minimization?

Understand and influence **large numbers** of code modules, data stores and employees across an organization.



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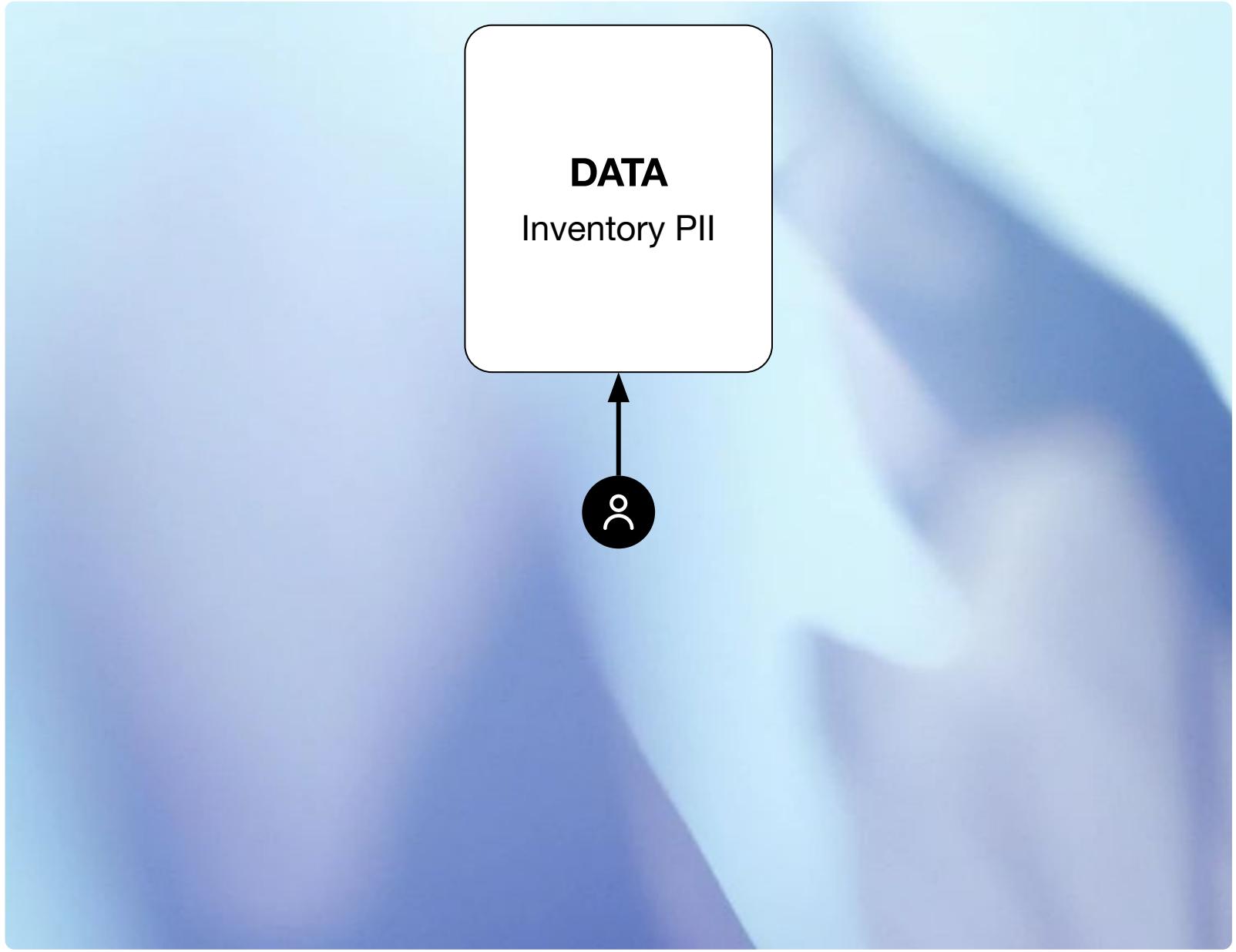

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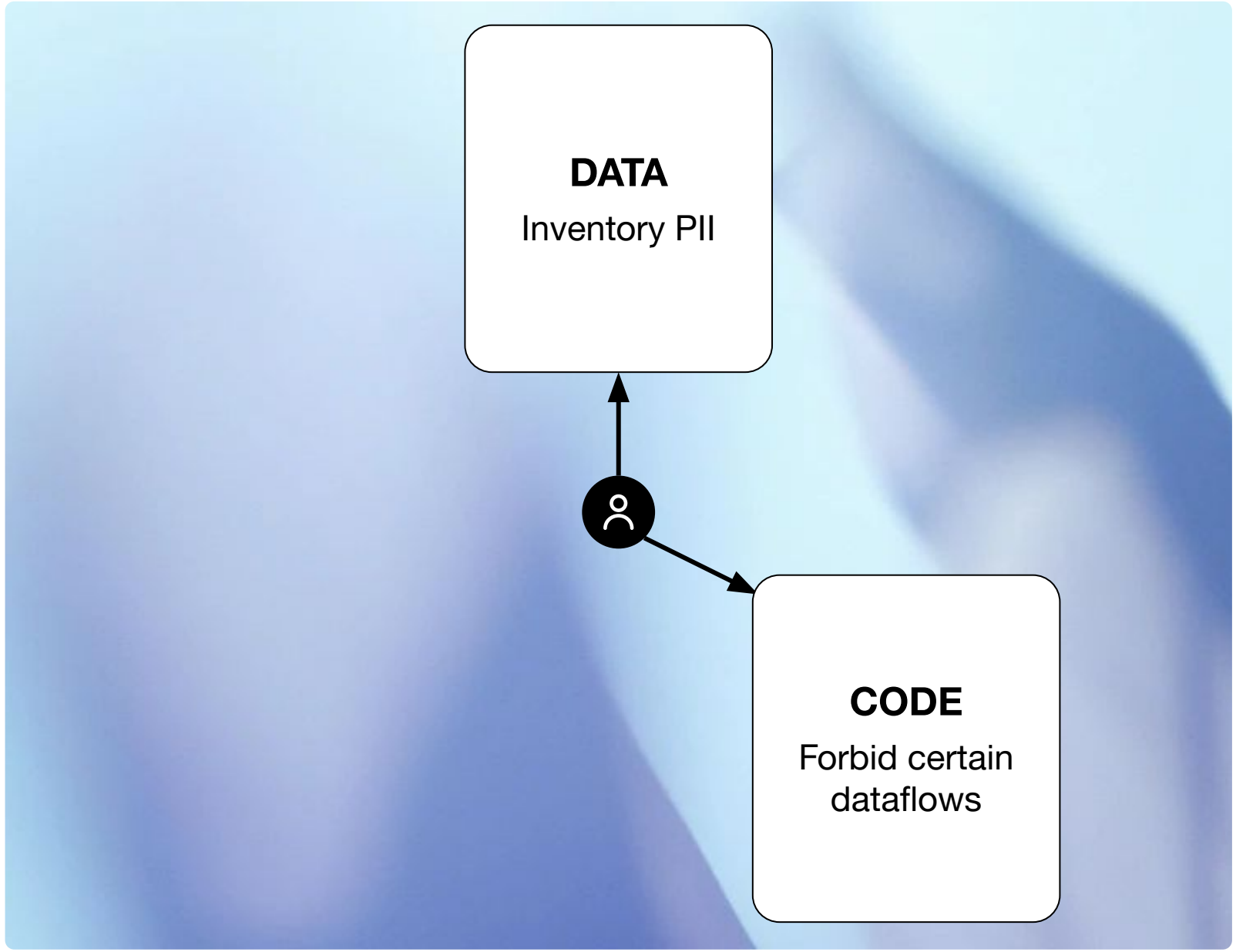

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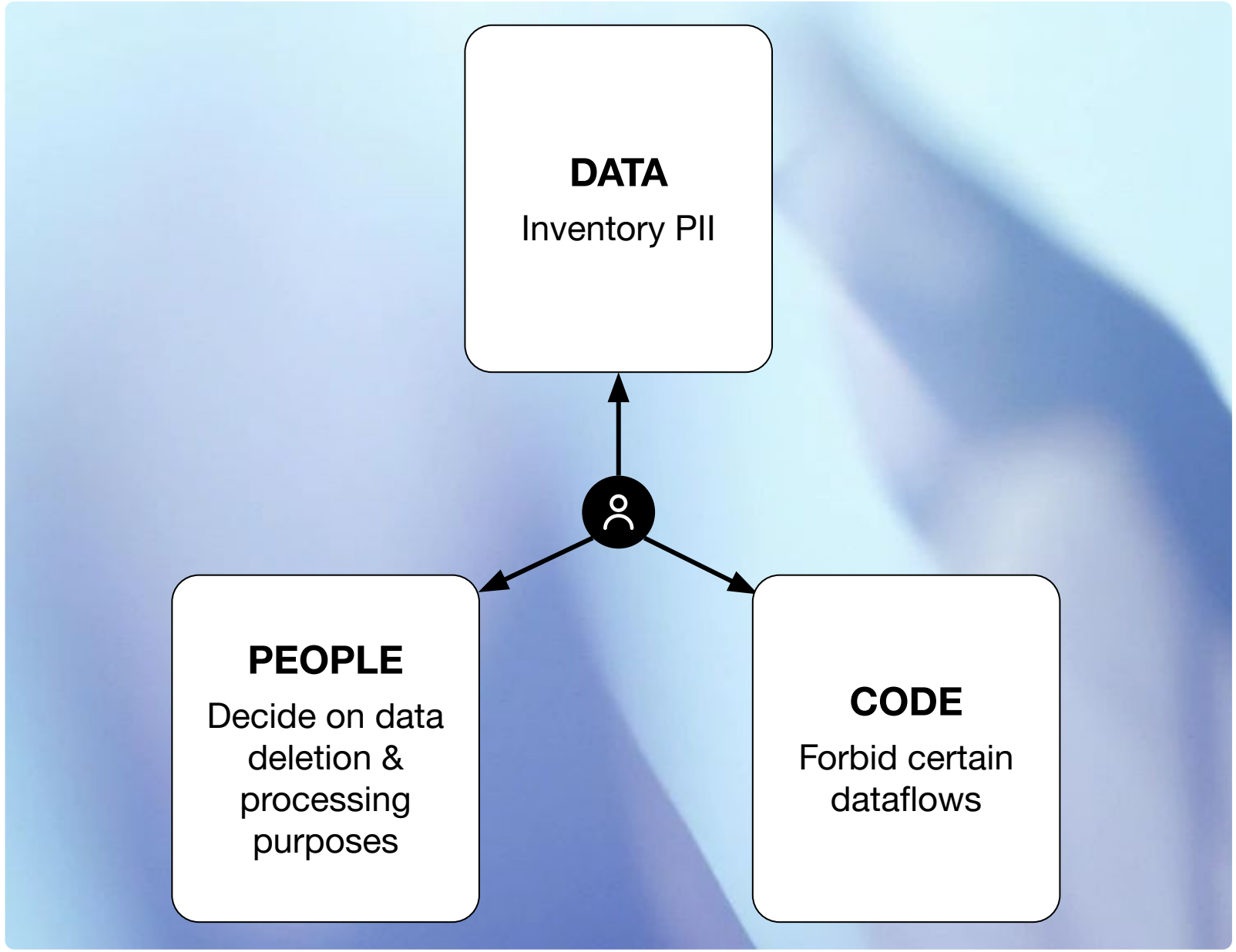
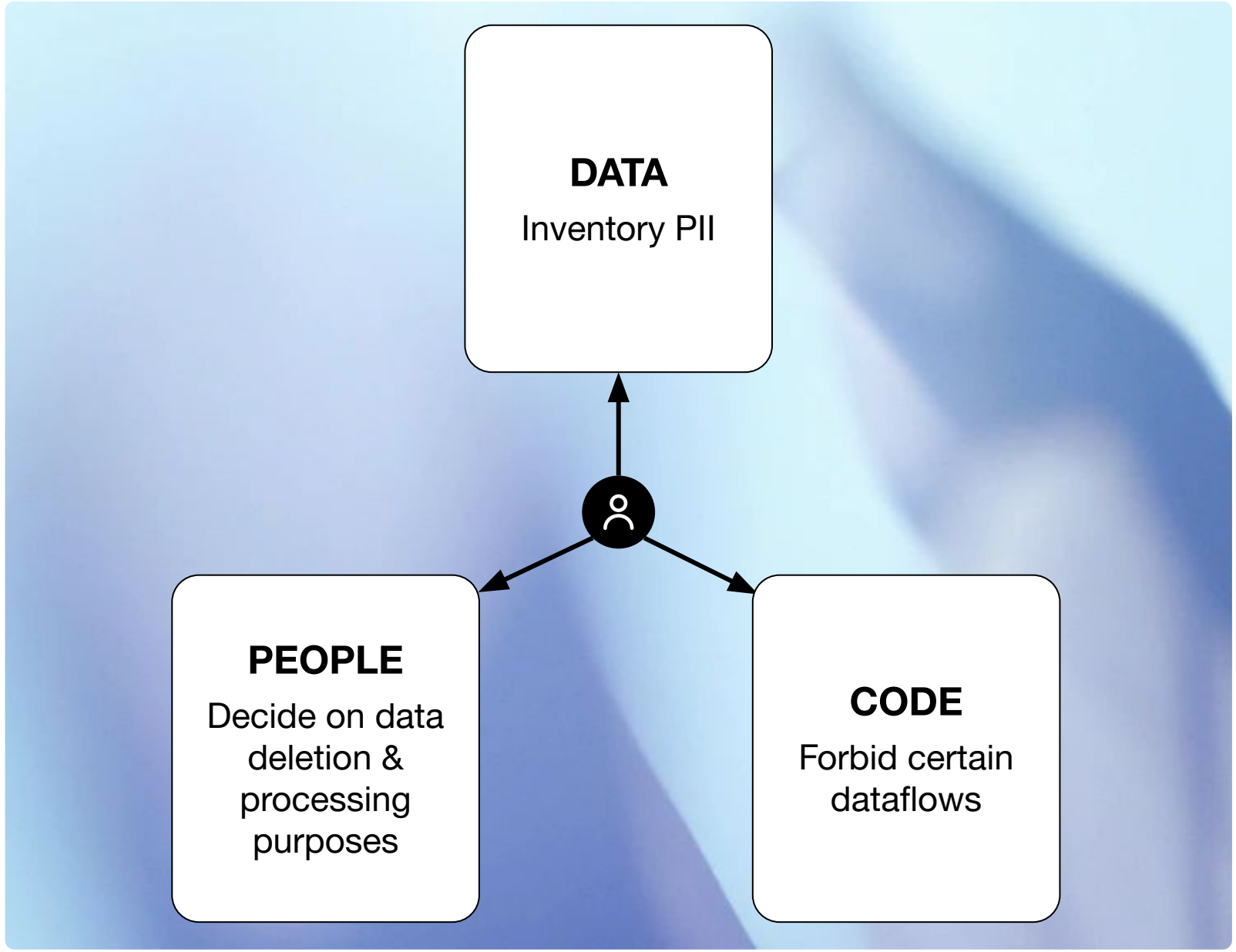


Can LLMs help improve accuracy & efficiency of Data Minimization processes?



Data

Task: Classify PII across diverse data stores

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Table: contact_methods

account_type	phone
A	+1 234 567 8910
A	+55 1 55 1234 567 89
B	+1 800 123 4567

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We can prompt, and later finetune, a foundation model to recognize PII categories in different forms and contexts.

Pick the correct label for this data object:

- *name*
- *phone_number*
- *email_address*
- *other*

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This approach can recognize a wider variety of PII with higher accuracy than traditional rules or regex-based approaches.

Table: contact_methods

account_type	phone
A	(234) 567-8910
A	+55 1 55 1234 567 89
B	001-800.123.4567

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Table: contact_methods

us_area_code	phone
408	1234567890
408	0987654321
800	1234567890

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Pick the correct label for this data object:

- *name*
- *phone_number*
- *email_address*
- ***other***

In case of ambiguity, the model can take context and domain knowledge into account.

Table: accounts

account_type	user_id
A	1234567890
A	0987654321
B	1234567890

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Since the foundation model has an understanding of the world, the categorization scheme can be adjusted flexibly.

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Pick the correct label for this data object:

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Since the foundation model has an understanding of the world, the categorization scheme can be adjusted flexibly.

Overhead is lower than creating new rules/regexes or targeted ML models for each new category.

Table: contact_methods

account_type	email
A	me@example.com
A	test@example.com
B	jane@doe.info

Task: Classify PII across diverse data stores

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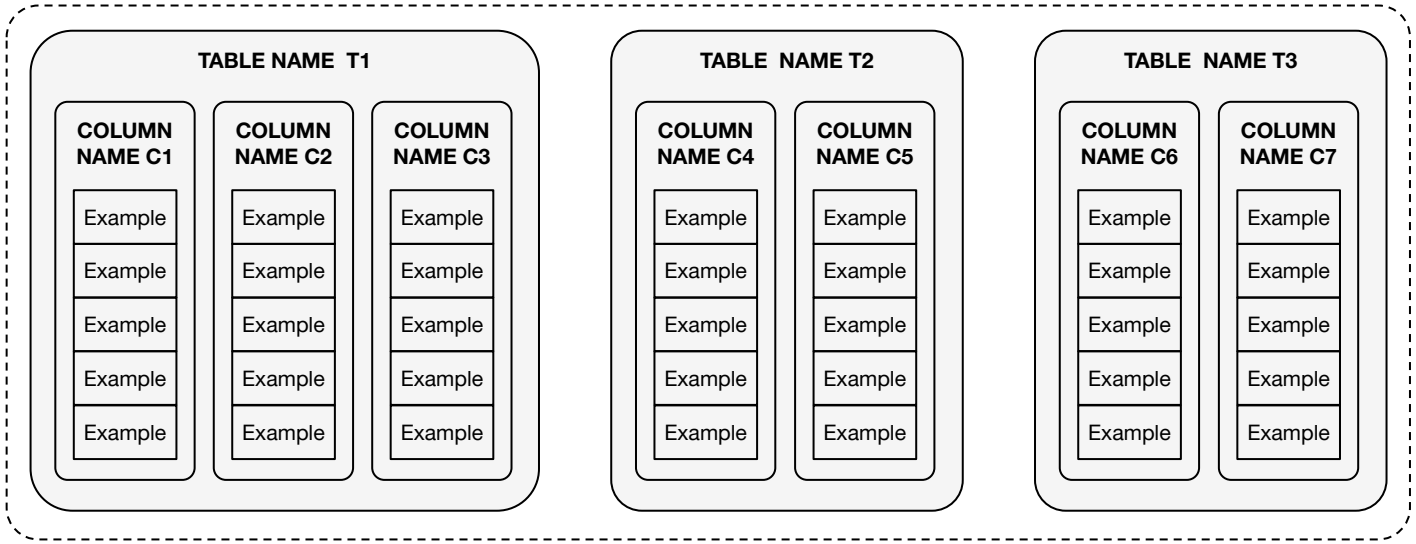

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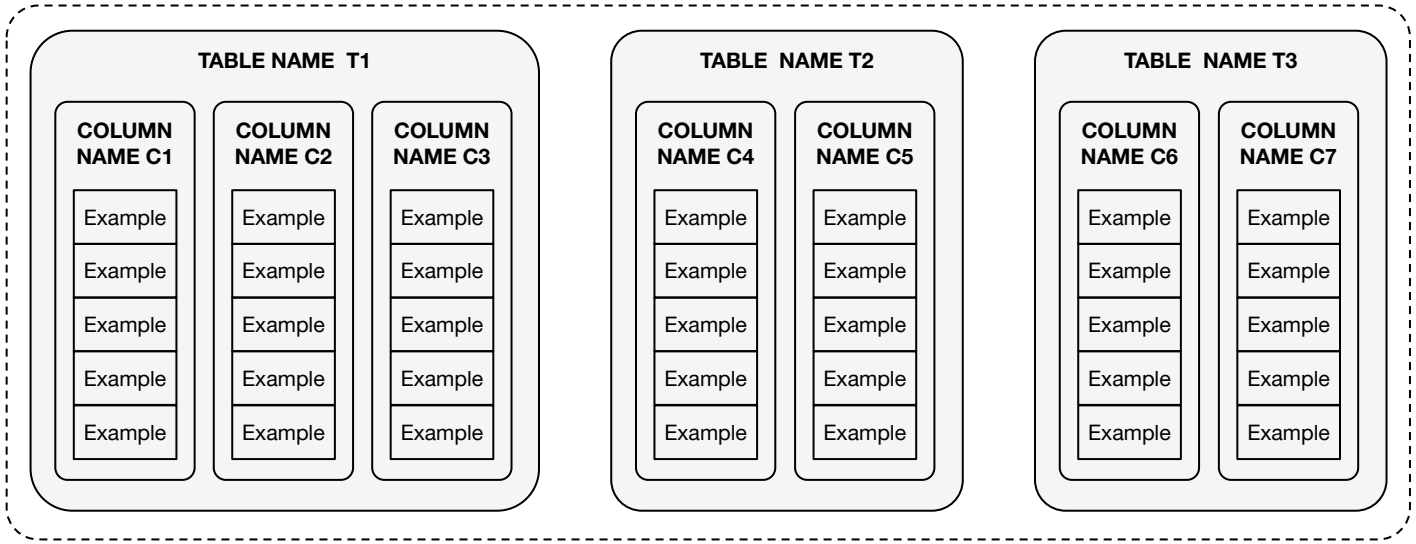


This flexible, automatable approach becomes especially useful if a large organization has

- many diverse data stores
- a complex, potentially evolving PII taxonomy.

PII TAXONOMY

Category A
Category B
Category C
Category D
...

Task: Classify PII across diverse data stores

Then the approach shortens turnaround time for a draft classification with good accuracy.

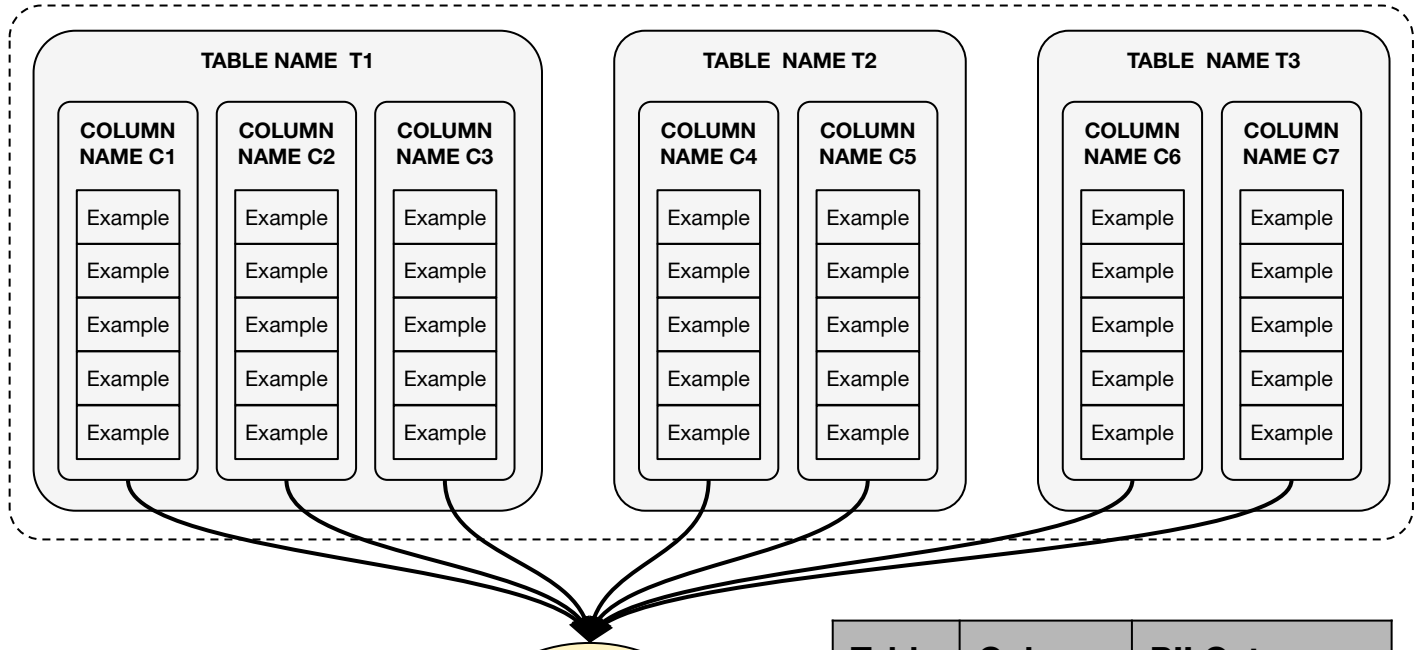
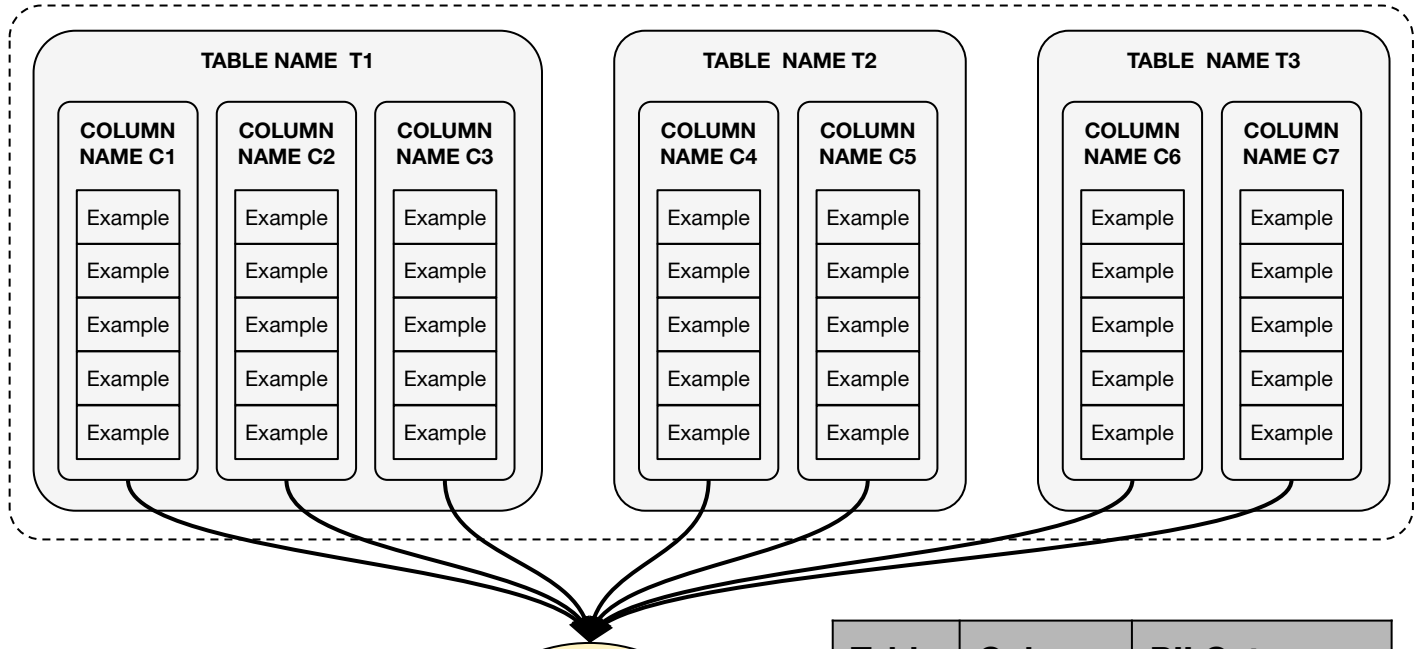


Table	Column	PII Category
T1	C1	A
T1	C2	B
T1	C3	None
T2	C4	None
T2	C5	C
T3	C6	None
T3	C7	A

Task: Classify PII across diverse data stores

Limitations include:

- Higher latency, more resource-intensive than lightweight rule engines or smaller models
- If not in-house, sending data to 3rd-party model provider could in itself conflict with Data Minimization (though mitigations like Zero Data Retention offerings exist).



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T2	C5	C
T3	C6	None
T3	C7	A

Code

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“What external data does this app store, and where?”

app.py

```
app = App("Toy App")

@app.route("/submit_phone", methods=["POST"])
def submit():
    save_phone_number(**validate(request.json))
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if __name__ == "__main__":
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storage.py

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infra/main.tf

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resource "app_deployment" "toy_app" {
  env = {
    DB_URL    = module.db.connection_url
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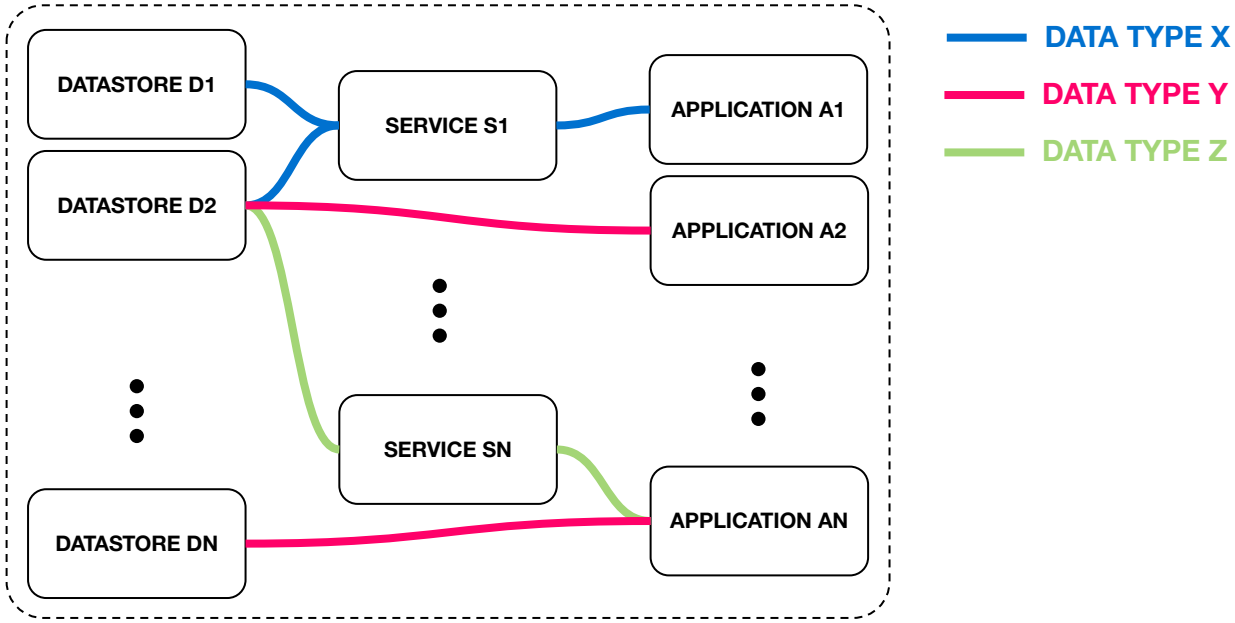
Application	Datastore	Data type	Infra Reference
Toy App	SQL Database	user_id, phone_number	DB_URL
Toy App	Cache	user_id, phone_number	CACHE_URL
Toy App	Application logs	user_id	LOG_SINK

Task: Review and forbid certain data flows to minimize sprawl

Particularly useful in large complex systems that are continually evolving.



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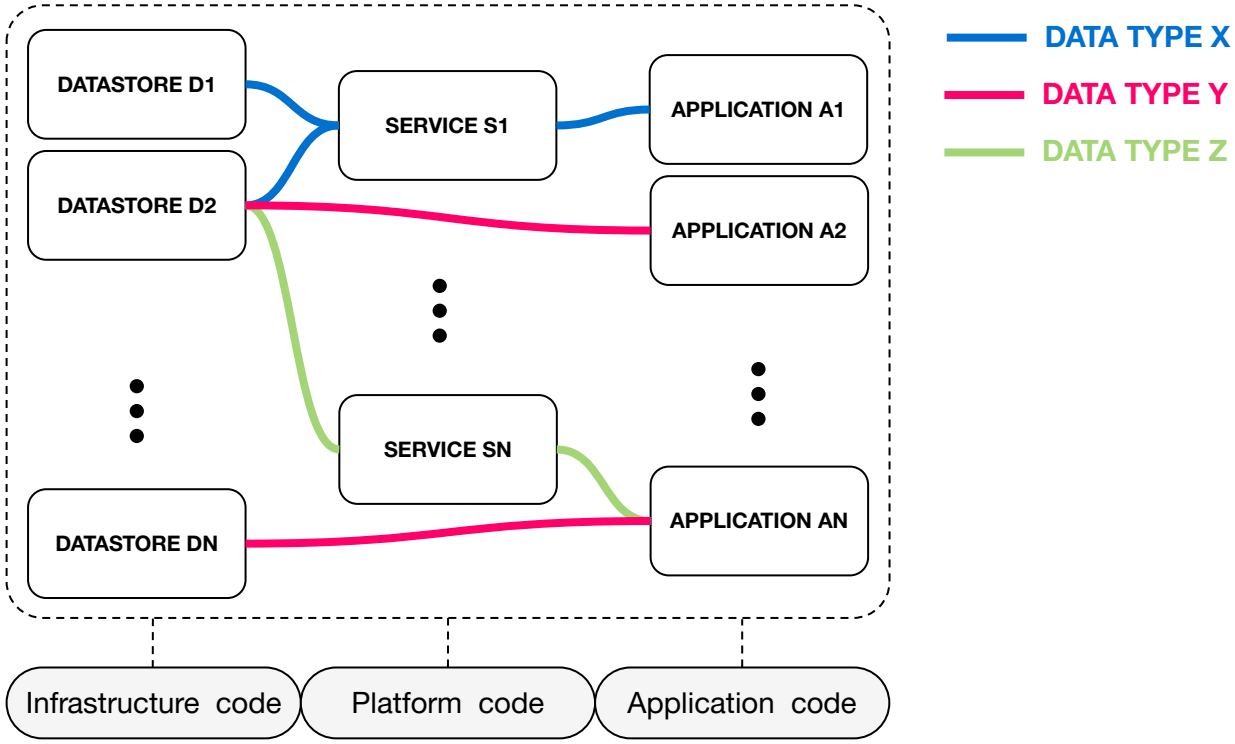
There, improved tools for understanding code can reduce manual effort of reviewing newly built systems.



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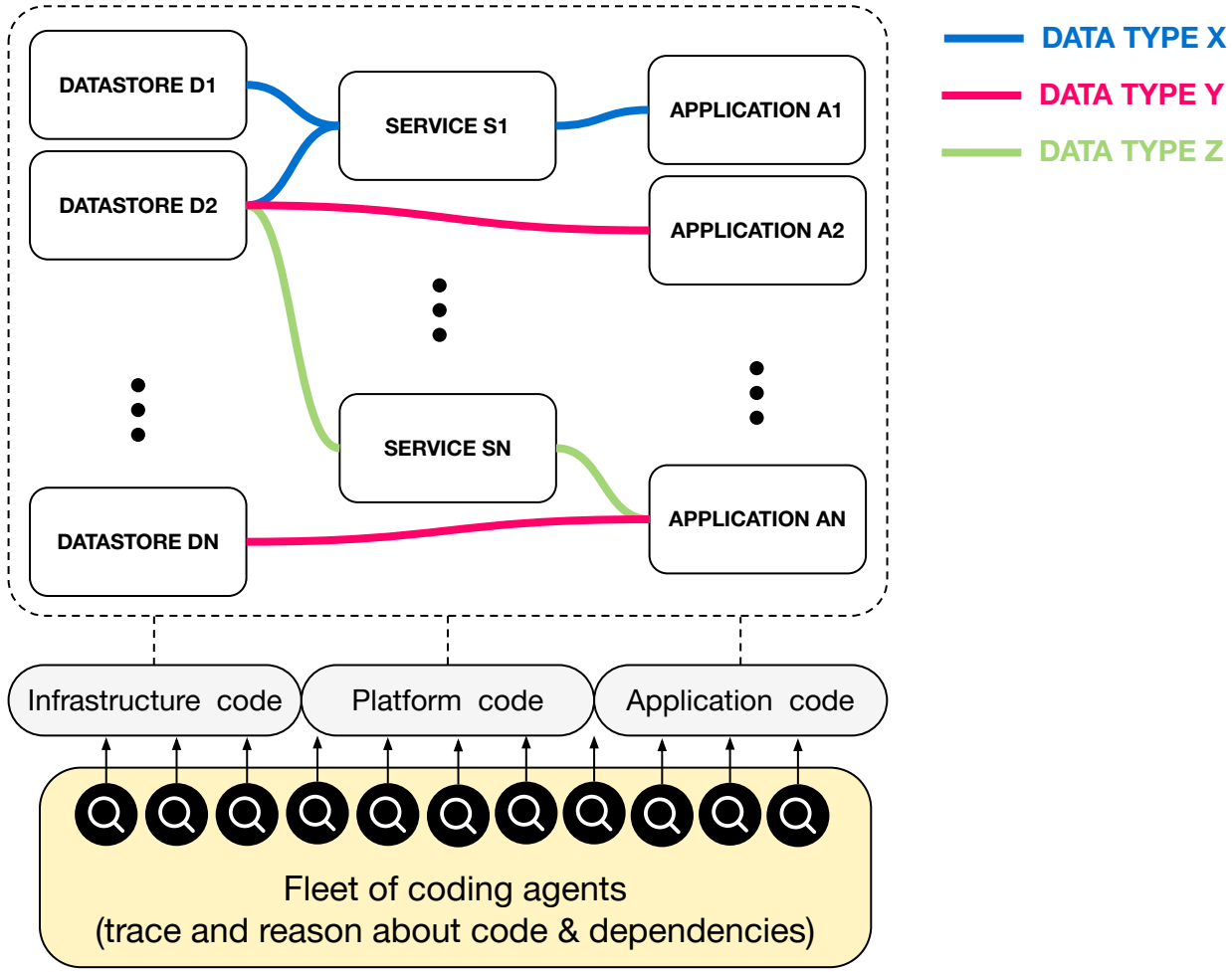
Parallelized LLM-based coding agents can regularly extract up-to-date insights from thousands of ever-changing modules for review.



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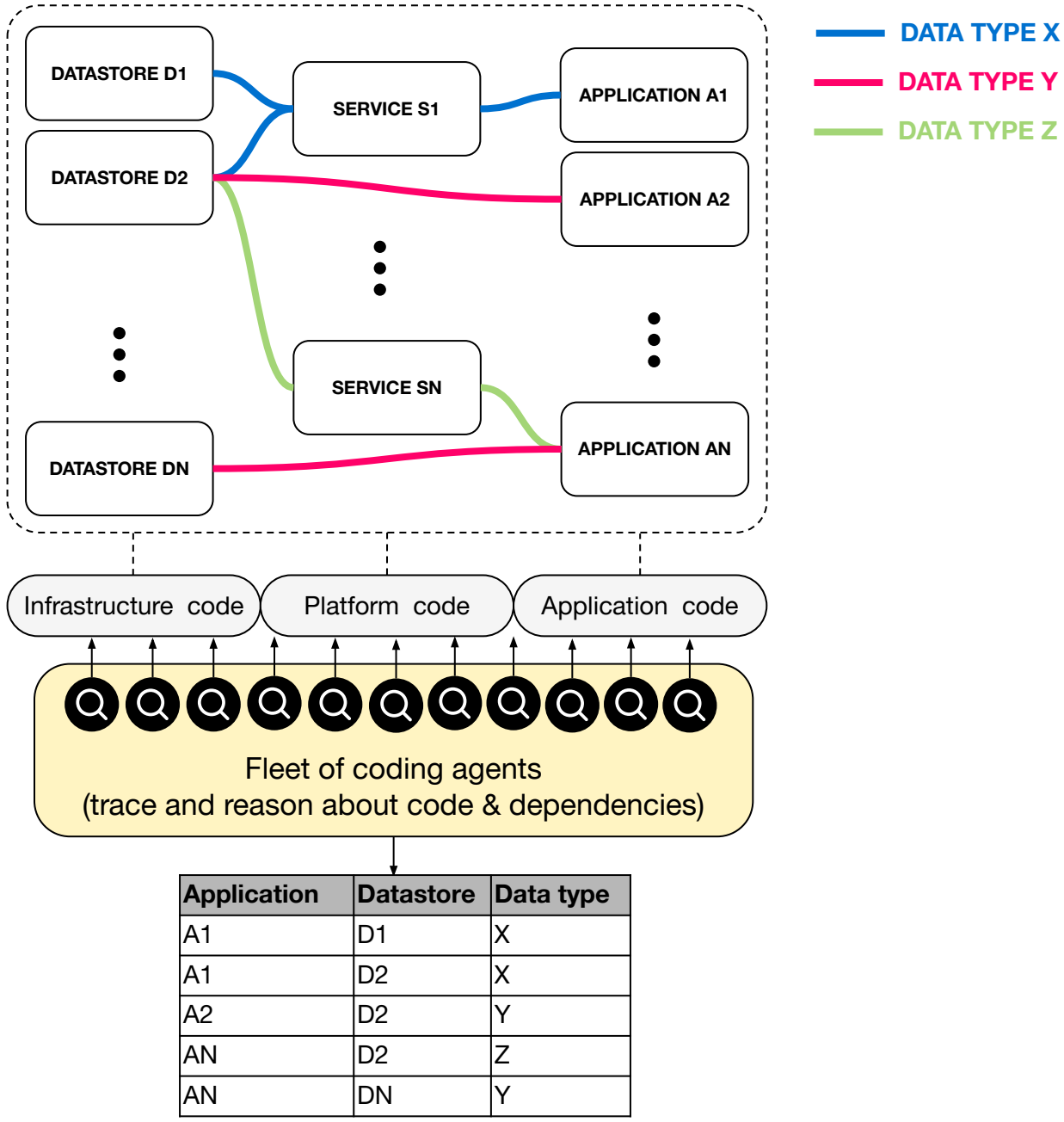

Application	Datastore	Data type
A1	D1	X
A1	D2	X
A2	D2	Y
AN	D2	Z
AN	DN	Y

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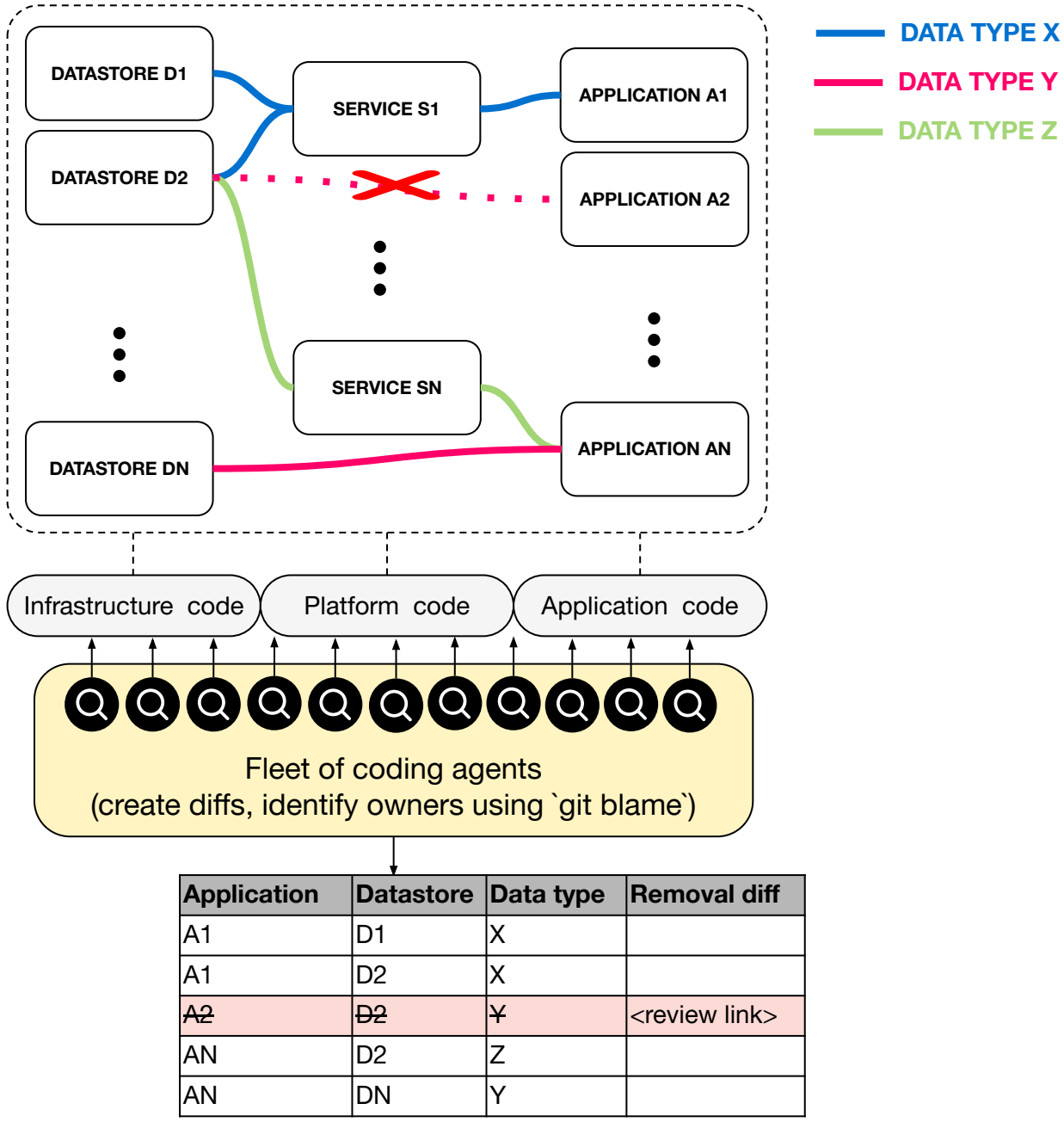
They can also accelerate removal of undesired data flows by drafting the required diffs.

Example: exclude certain data types from logs.



Application	Datastore	Data type	Removal diff
A1	D1	X	
A1	D2	X	
~~A2~~	~~D2~~	~~Y~~	<review link>
AN	D2	Z	
AN	DN	Y	

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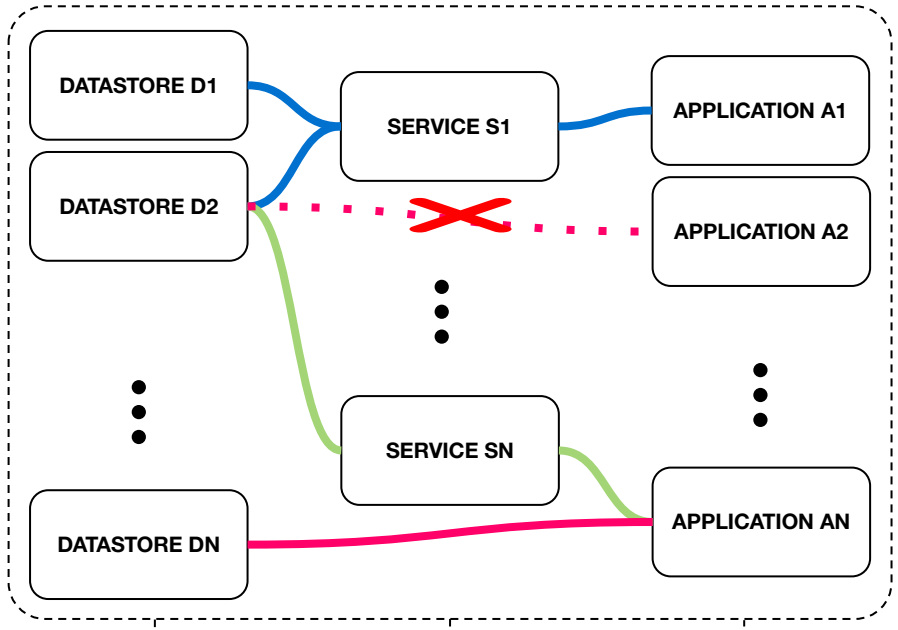
Advantages compared to traditional static analysis include:

- tracing across multiple layers of the stack without custom parsers
- reduced maintenance overhead, rapid iteration
- semantic understanding of data and its flows, which can improve precision for privacy use cases.



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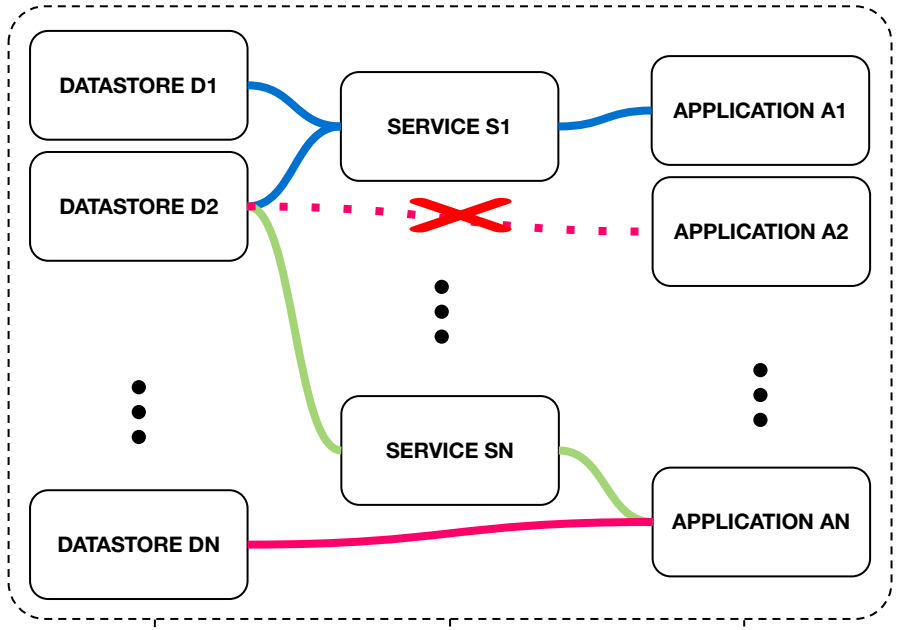
Limitations include:

- Context length caps the amount of code that can be considered in 1 analysis, so judicious division into separate agent tasks is essential.
- False positives can occur. Specifying detailed analysis recipes and cross-referencing results against production logs helps.



Fleet of coding agents
(create diffs, identify owners using `git blame`)

Application	Datastore	Data type	Removal diff
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People

Task: Facilitate organizational decisions around data deletion

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[MM/DD/YYYY] "Please join me in welcoming person B who will be leading team A moving forward"

Is table X still needed?
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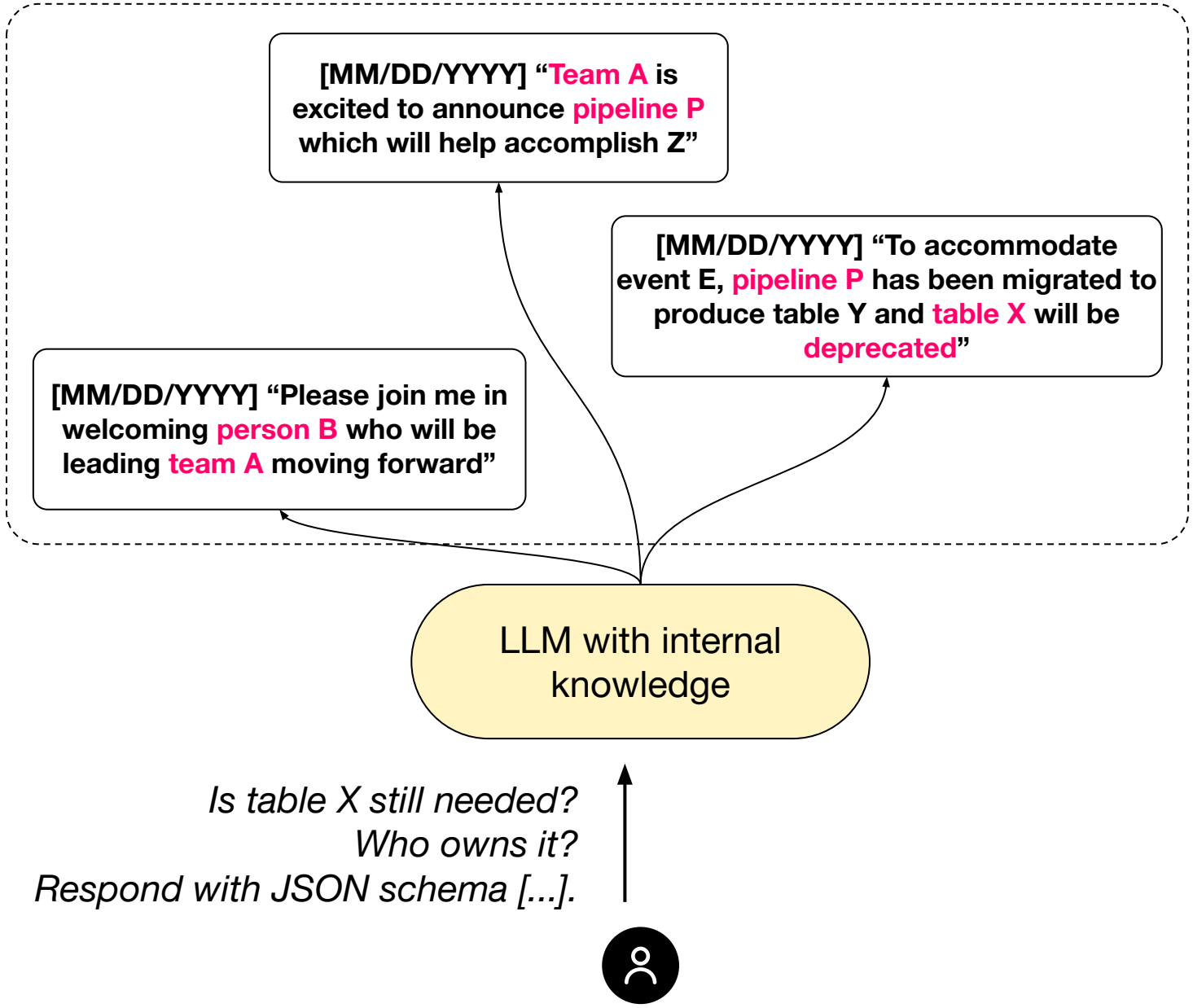
Reasoning over internal documents can help



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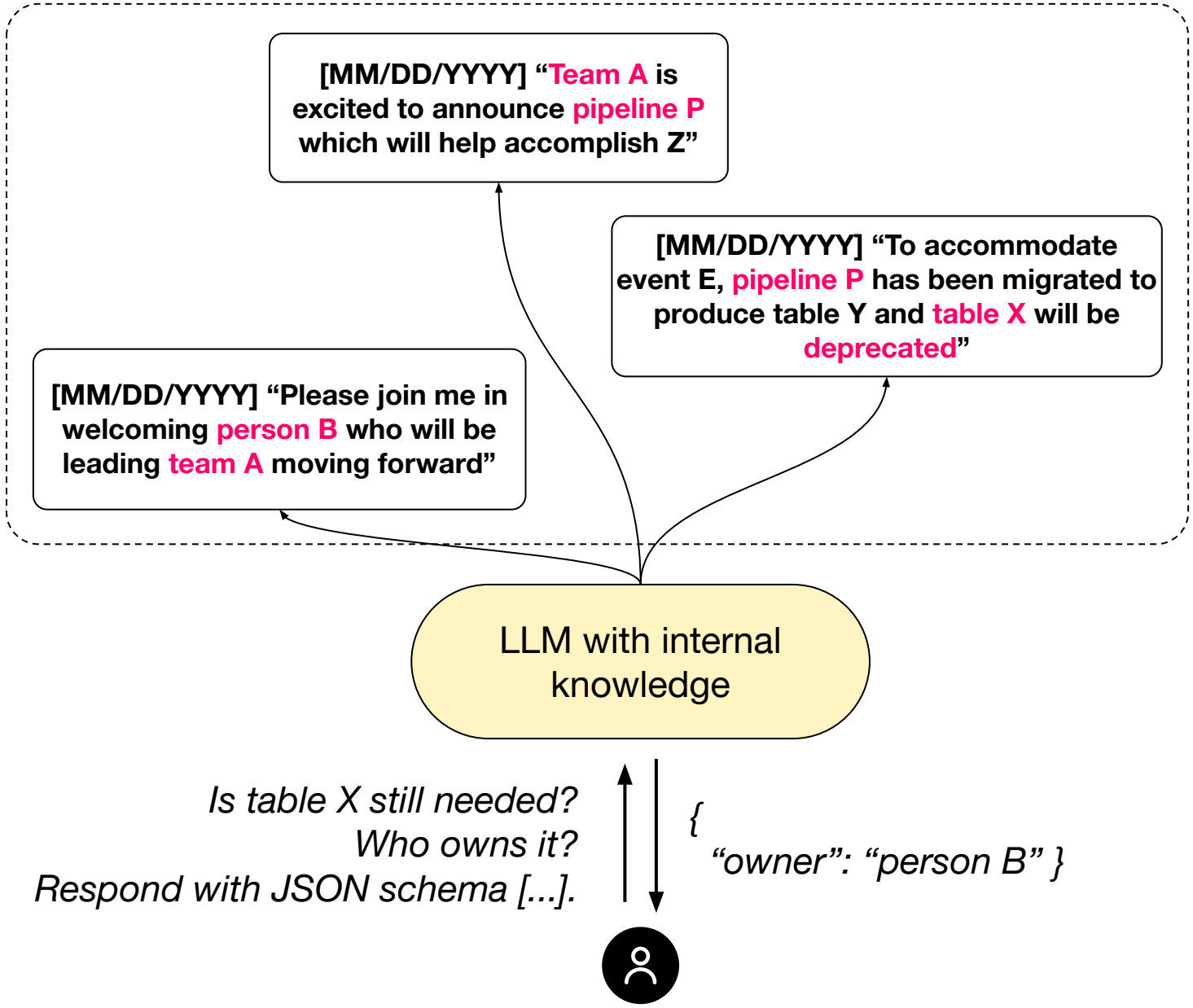
Reasoning over internal documents can help

- automatically close gaps in ownership frameworks (e.g. departing employees)



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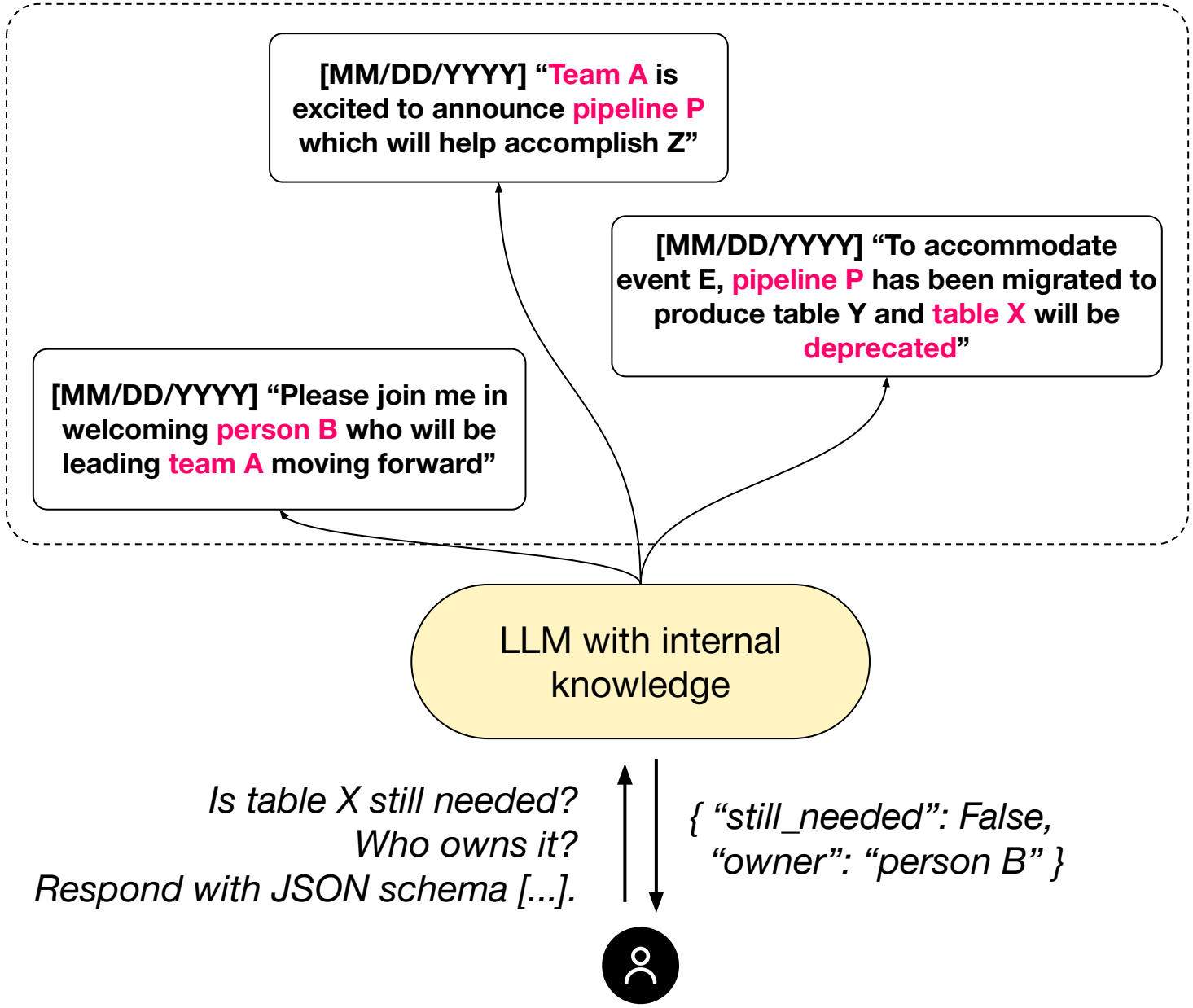

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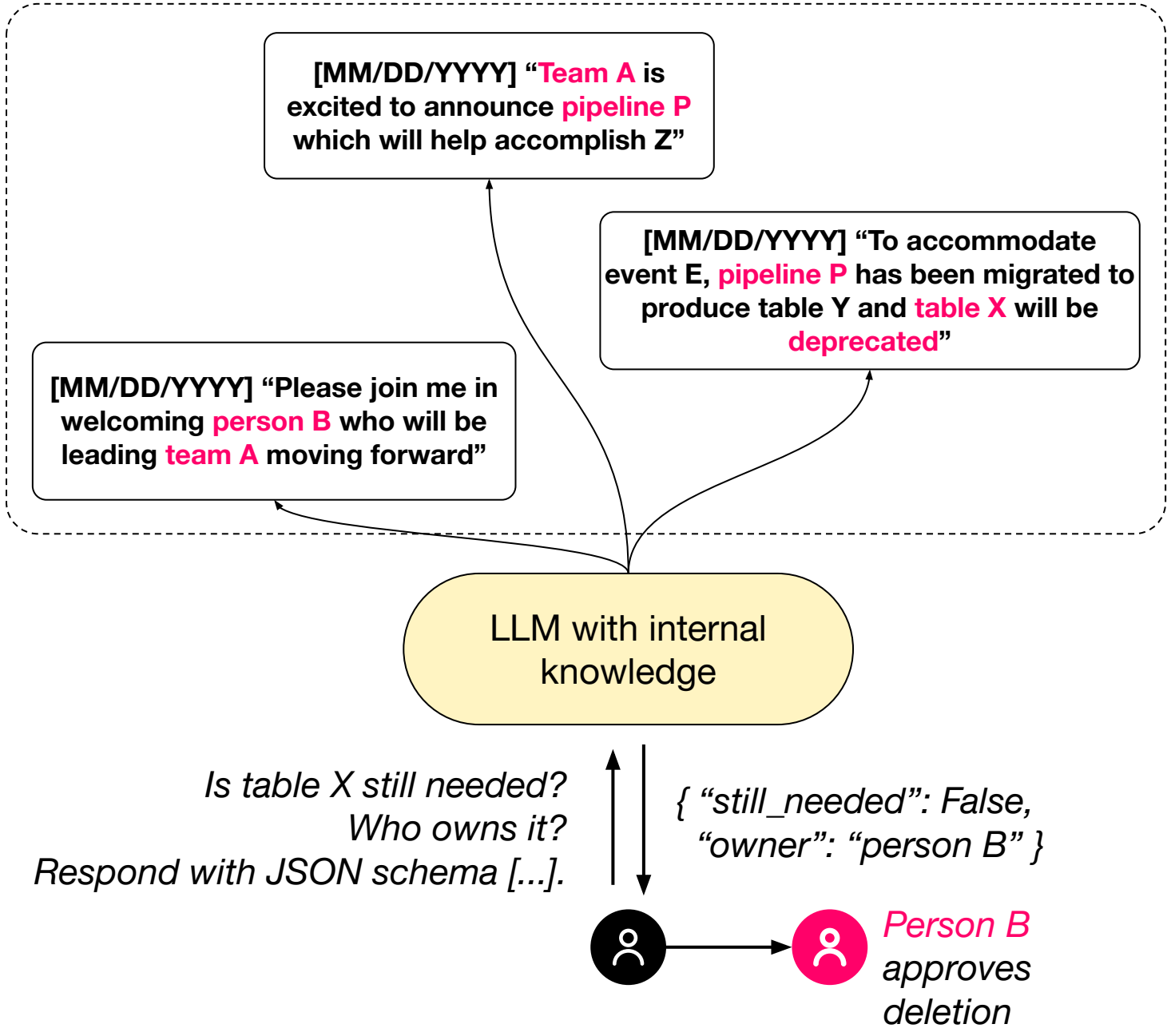
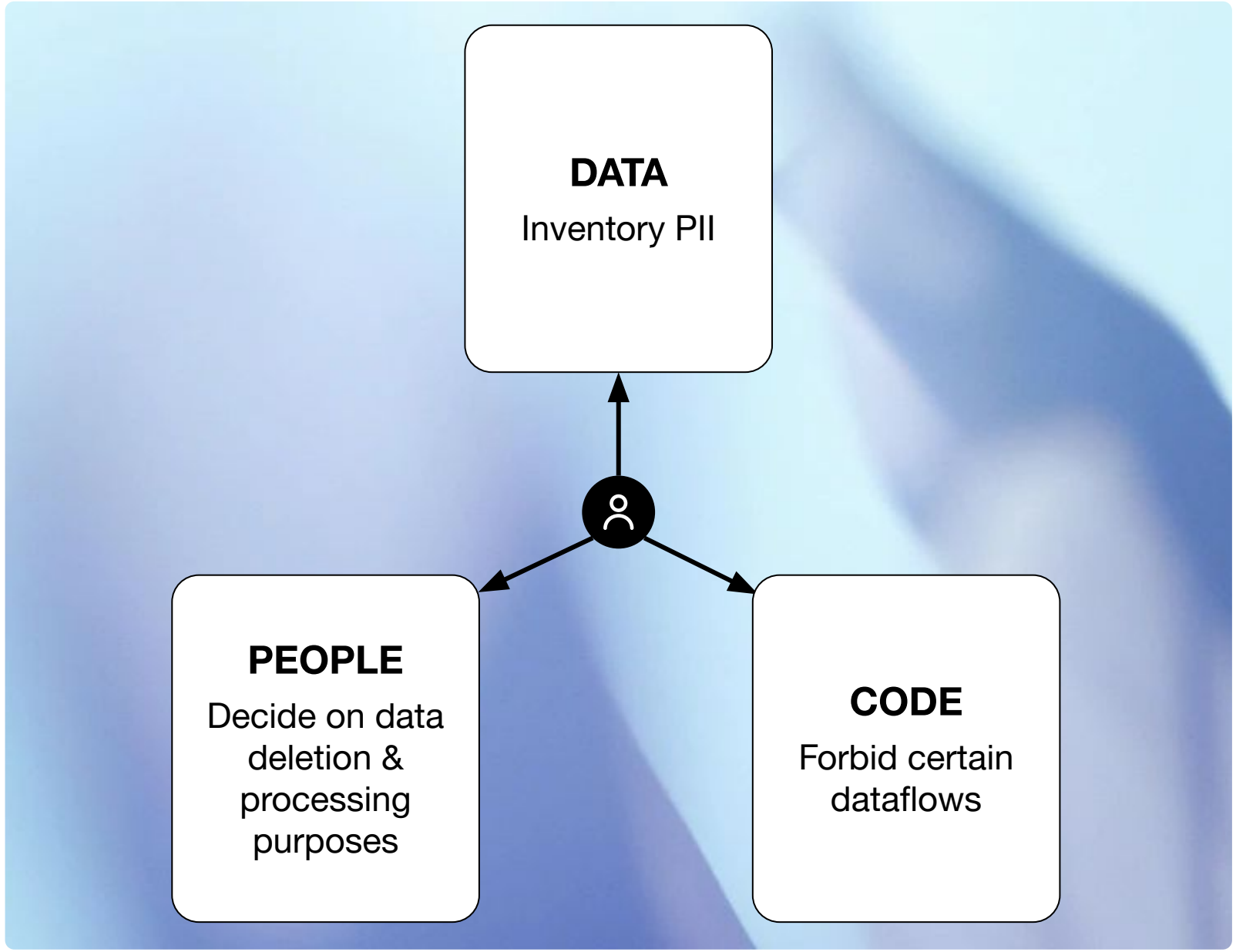
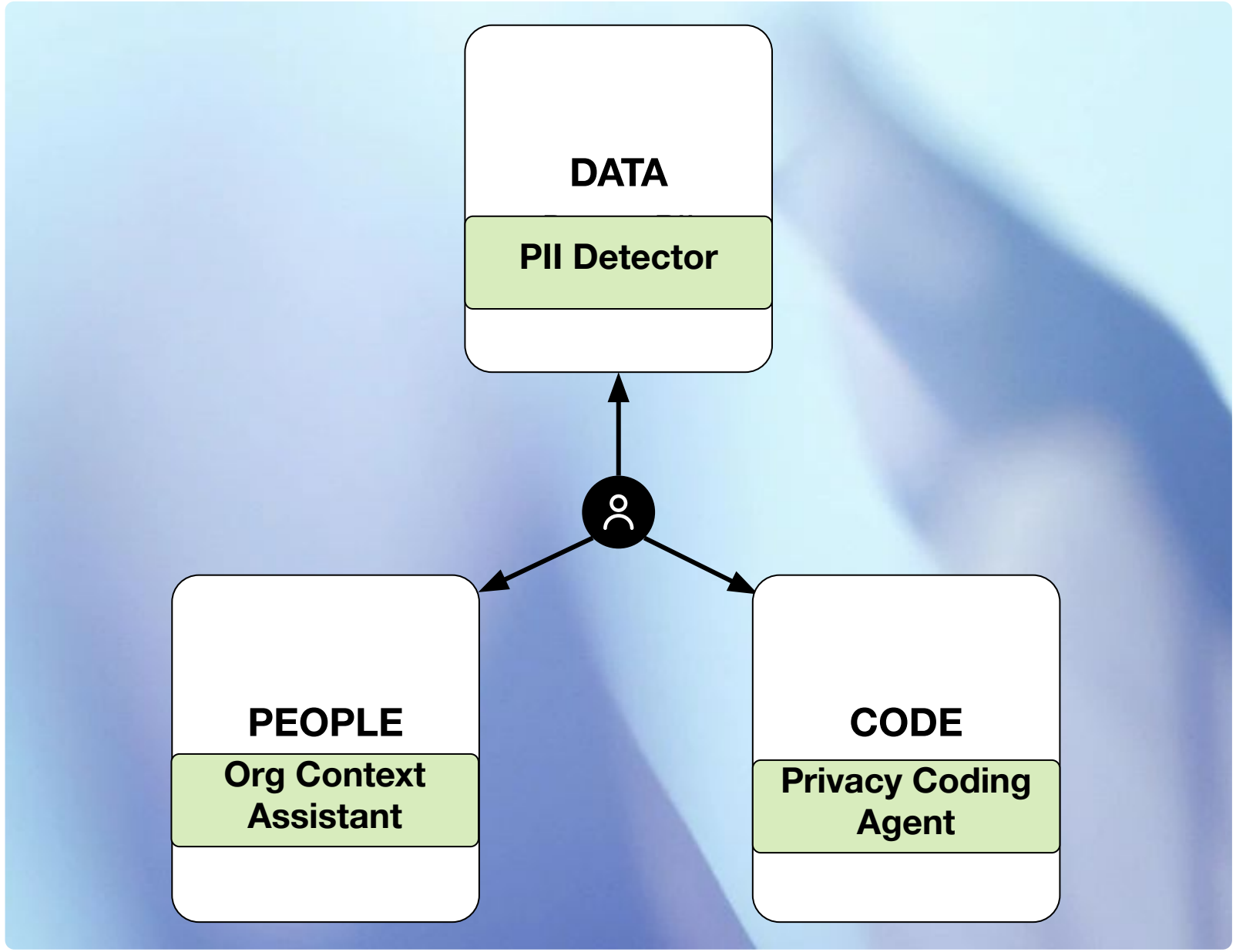


Can LLMs help improve accuracy & efficiency of Data Minimization processes?



Yes, LLMs provide new architectural components for proactive Data Minimization



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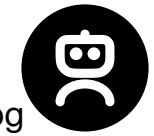
Putting it all together…

Automated systems can e.g. nudge an organization towards retention adjustments.

Retention watchdog 

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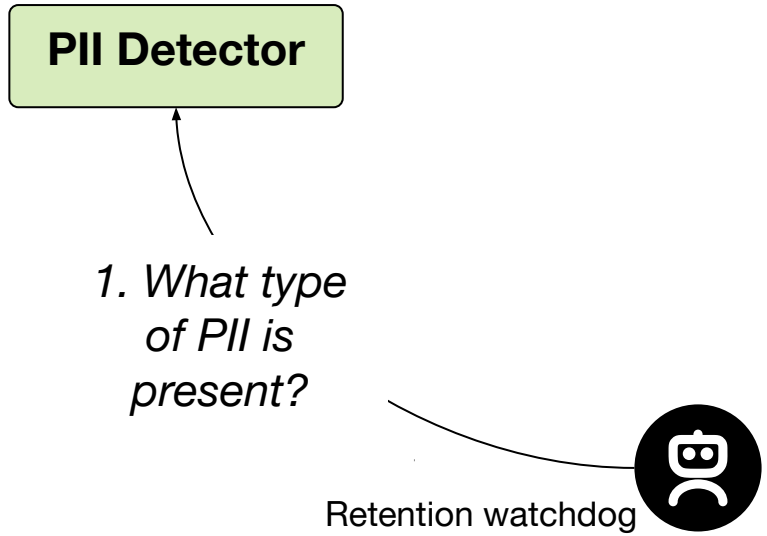

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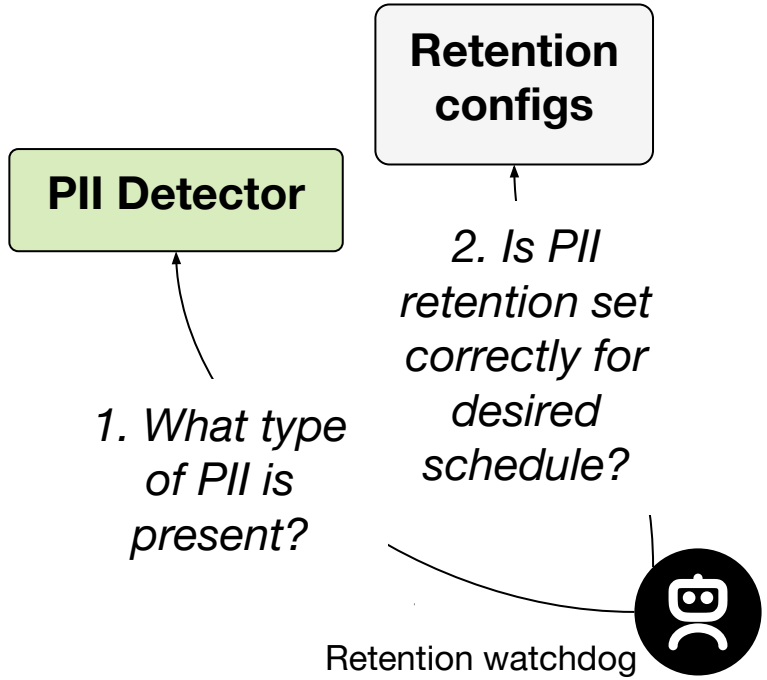

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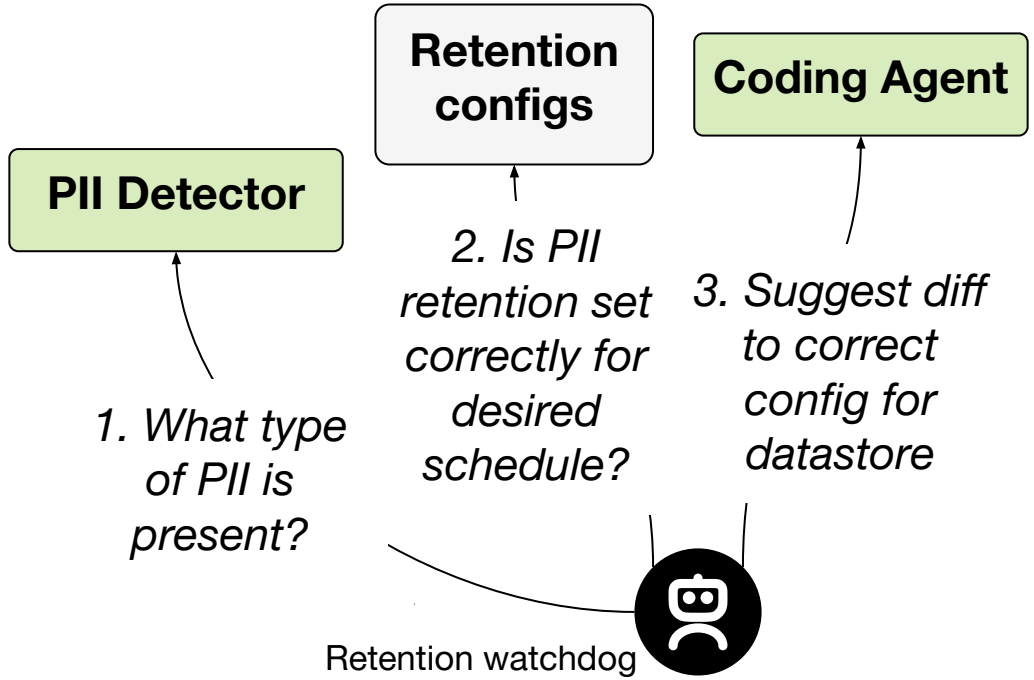

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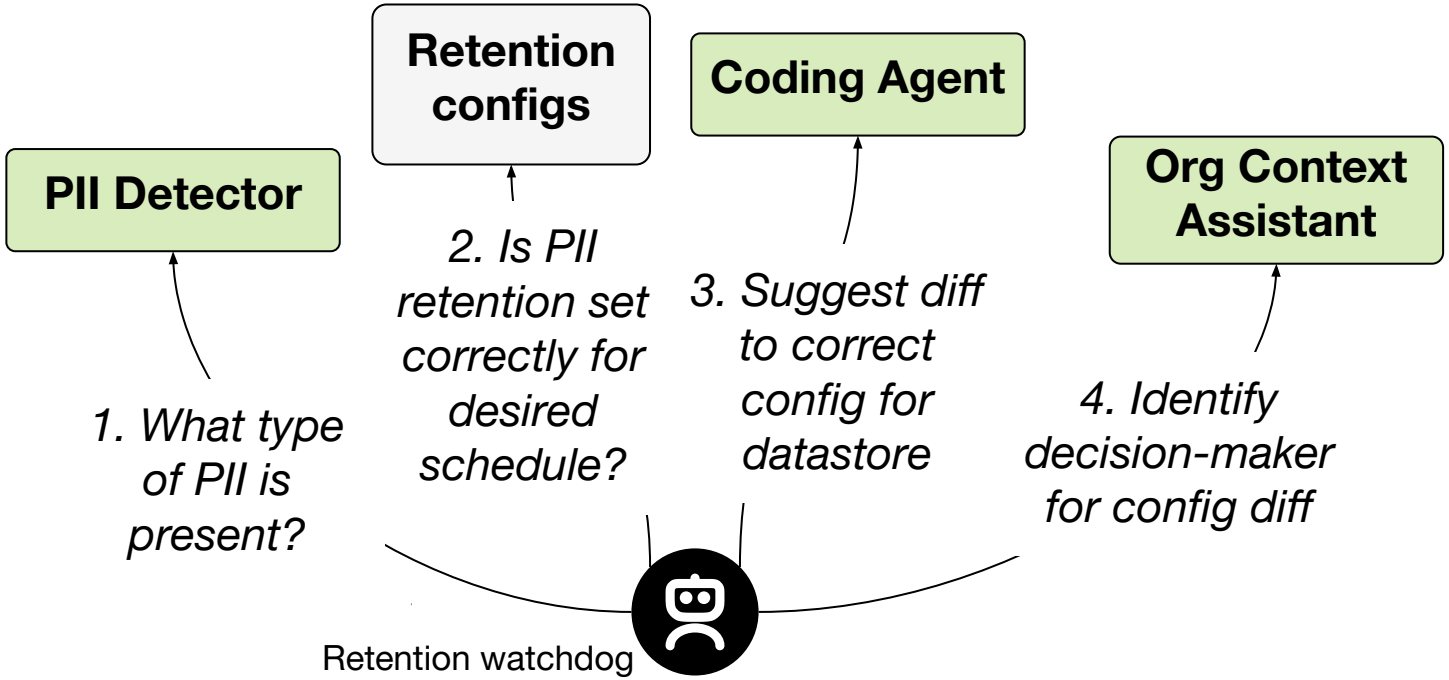

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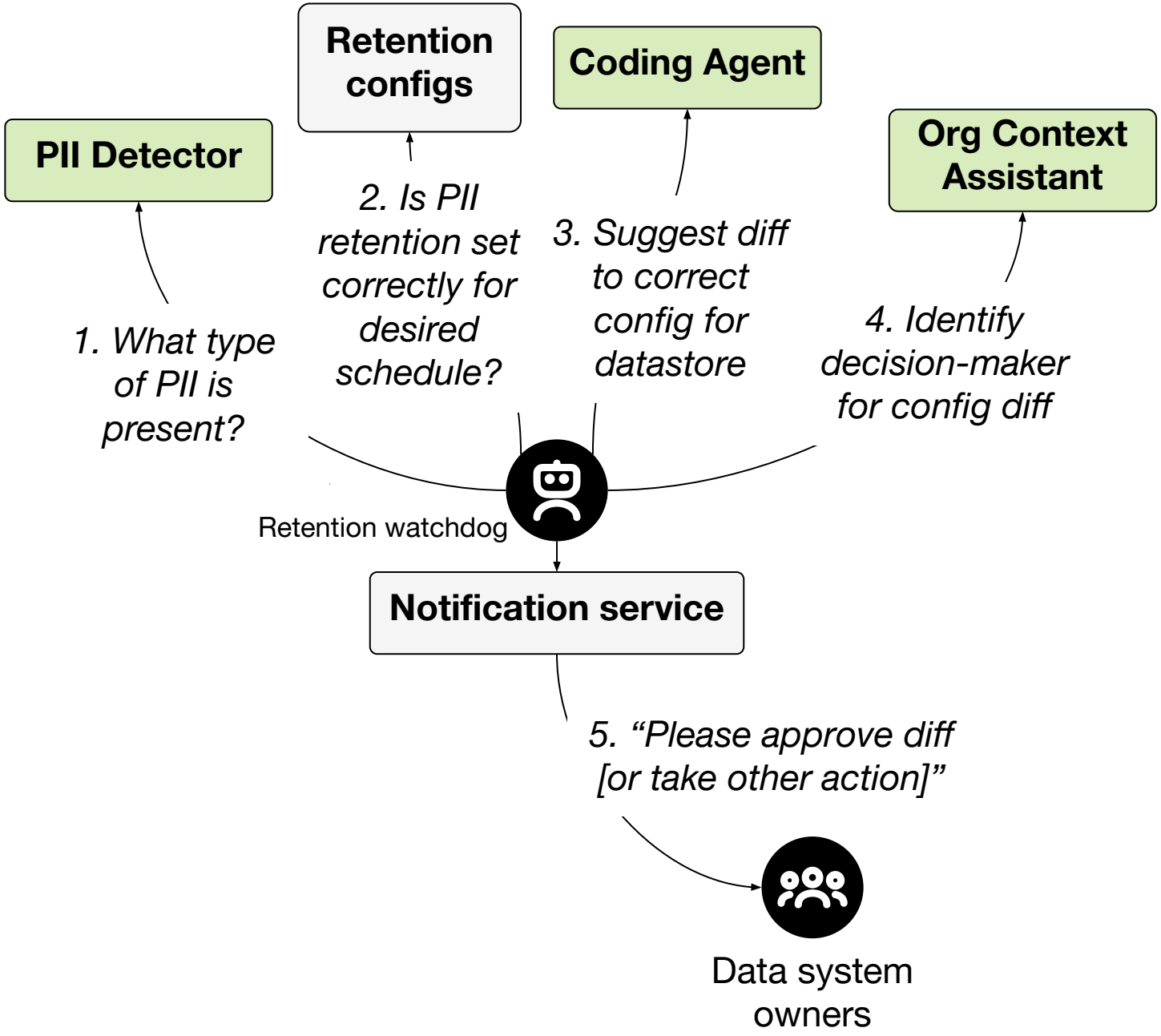

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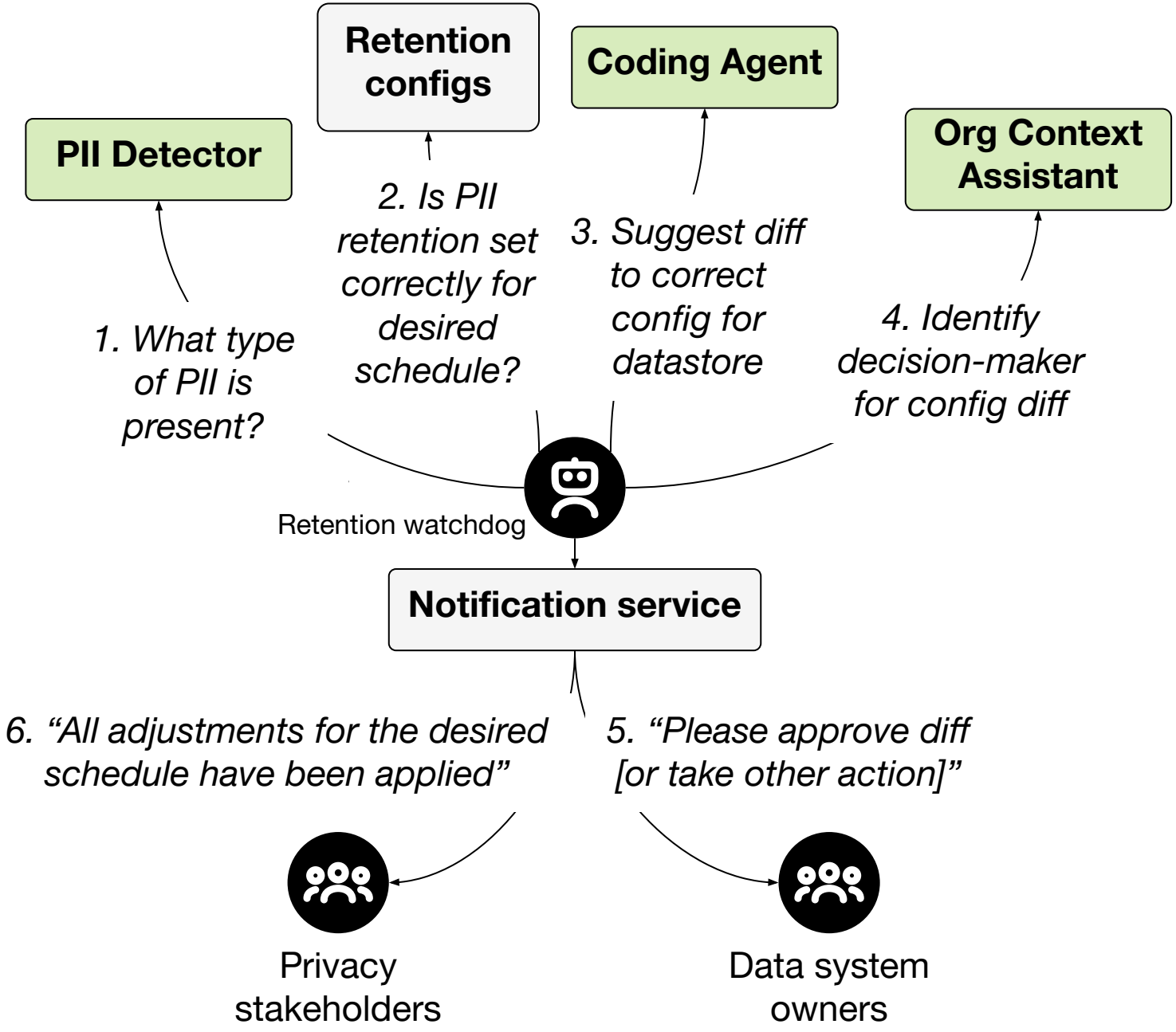

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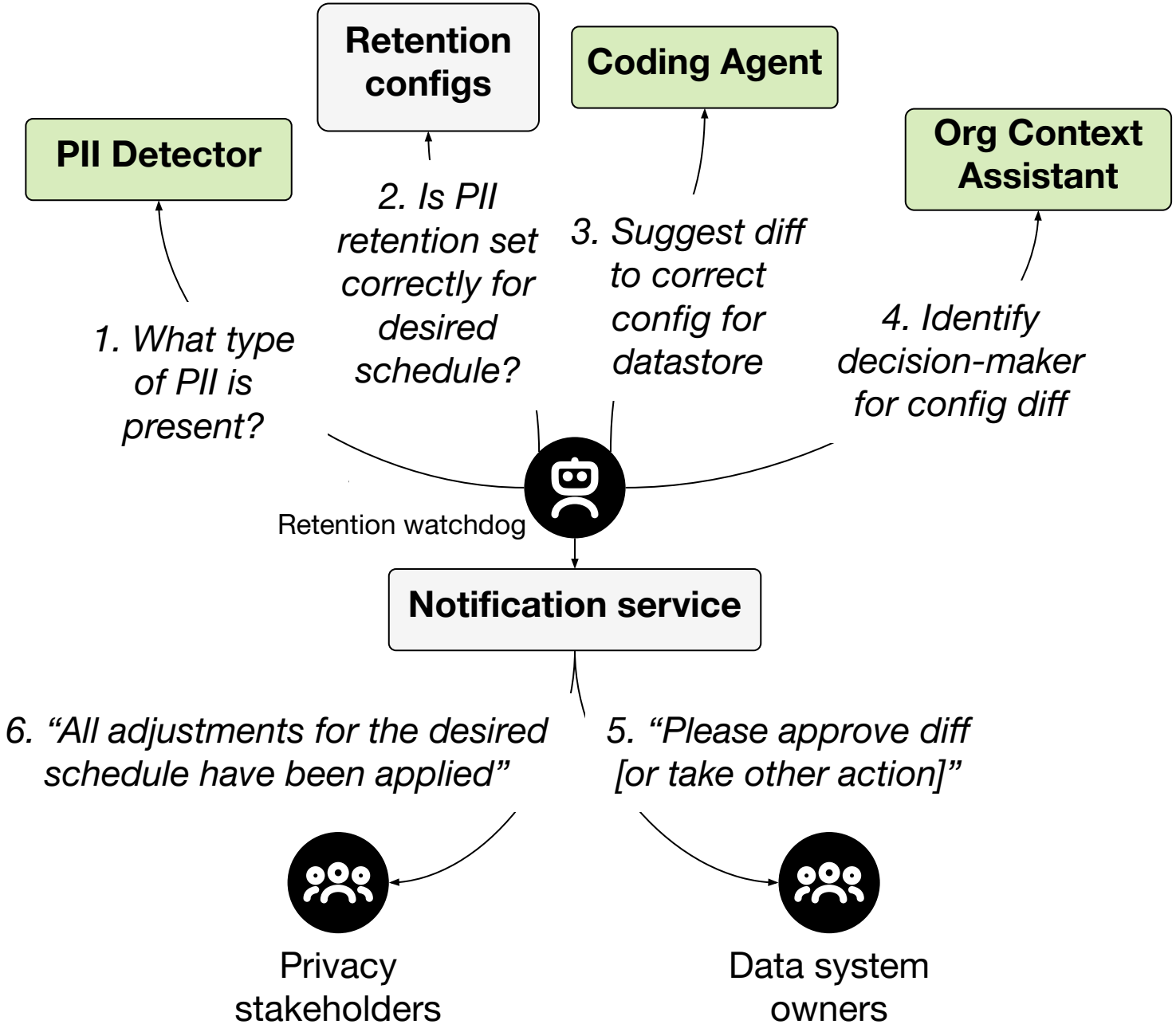
This can optimize the signal from nuanced human judgments while reducing effort and errors.



LLM-based tools can improve accuracy of Data Minimization and give focus time back to product developers.

In experiments, tools were good at: PII detection in context, converting code & docs into structured insights for governance.

We’re interested in collaborating with and learning from this community to advance privacy *for* and *with* AI.

Thank you