

Postgres Conference 2024

# Database operations in the AI era



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# Agenda

- 01** Introducing Gemini in Databases
- 02** Product overview and demos



# Industry trends have added new challenges to managing and operating databases at scale and velocity



## **Proliferation of databases are making it hard to manage**

Customers adopt multiple database engines with difference nomenclature, behaviors, and APIs making it hard to manage at scale resulting on governance risks



## **Reliable observability of databases with DevOps**

DevOps organizations have strong desire to empower more developers to develop and troubleshoot databases, but current database observability tools are hard to use for non experts



## **Migration off legacy databases**

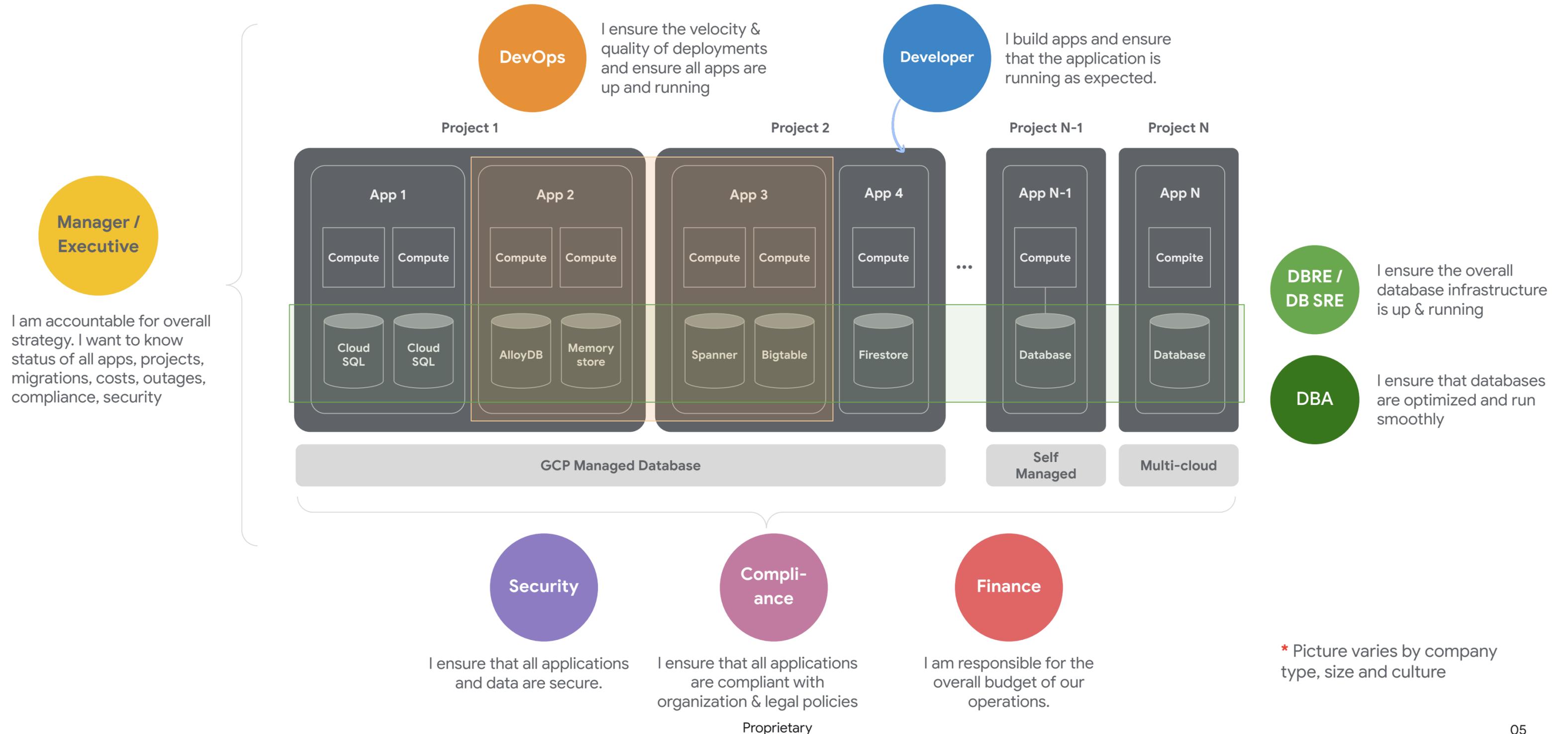
Customers have strong desire to move off legacy, proprietary databases, but they have complex data pipelines and application code slowing down migrations



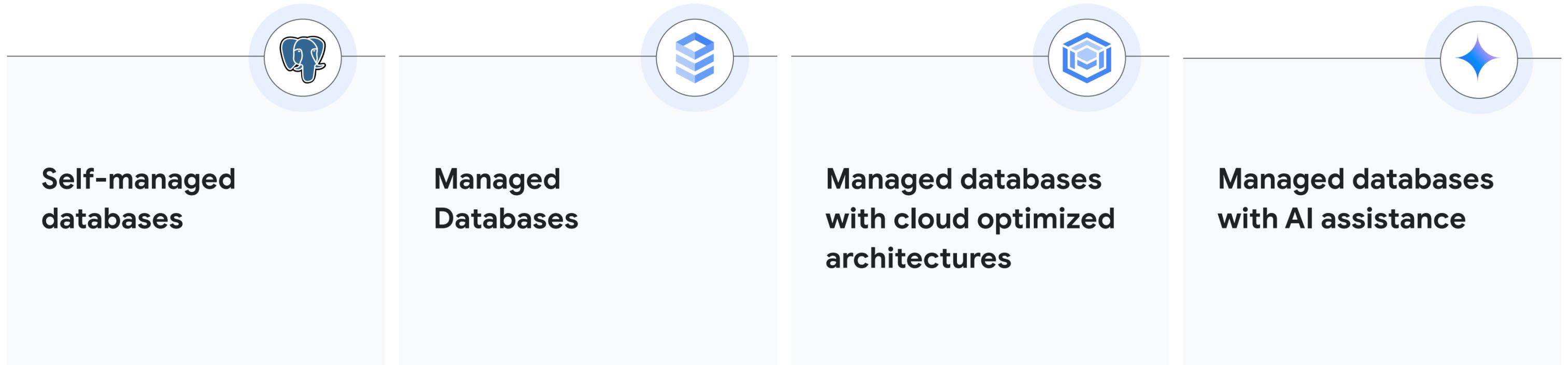
## **Rising security threats to databases**

Emerging technologies like AI, 5G, IoT, and quantum computing are making cybersecurity more critical than ever.

# Modern database management is getting complex



# Database management is evolving



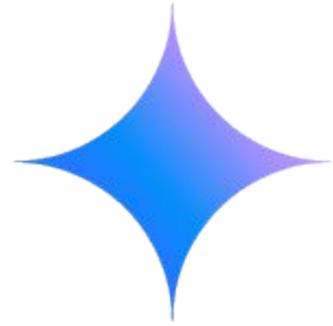
**Self-managed  
databases**

**Managed  
Databases**

**Managed databases  
with cloud optimized  
architectures**

**Managed databases  
with AI assistance**

**Better scale, productivity, resource optimization**



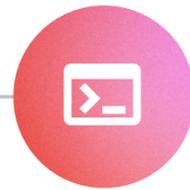
# Introducing Gemini in Databases

# Gemini in Databases – An AI powered database assistant



## Migration

Accelerate database migrations with automated code fixes, intuitive explanations, and actionable solutions.



## Development

Generate SQL code in natural language and gain insights into complex queries with clear explanations.



## Management

Manage your entire database fleet with a single dashboard and intuitive natural language queries.



## Troubleshoot & Optimize

Optimize database performance, prevent resource saturation, and troubleshoot issues with AI-powered insights.



## Governance

Proactively safeguard your system, achieve compliance, and optimize resources with intelligent insights.

# Gemini in Databases – An assistive AI at every step



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Database migrations are intricate processes – seemingly simple migrations can take six months, with complex projects demanding two years of focused work.

1

Complex code conversions  
esp. heterogeneous migrations

2

Time consuming requiring  
repeated tasks

# Introducing Gemini-assisted code & schema conversion in DMS

Now in Preview

Last mile code conversion automates repetitive fixes by learning from manual conversions, suggesting solutions for similar issues.

Conversion explainability clarifies conversion issues, offering natural language explanations, solutions, and sample code to streamline the resolution process.

The screenshot displays the Google Cloud Data Migration Service (DMS) interface. On the left, a sidebar shows a database schema for 'electronics-oracle-database-cor' with various objects like 'ELECTRONICS\_DEPARTMENT', 'Database Package (1)', 'Functions (6)', 'Object type (1)', 'Sequences (23)', and 'Stored Procedures (20)'. The main area shows a list of stored procedures with their status (e.g., 'ADD\_INVENTORY' has a warning icon). On the right, a panel titled 'How should I fix object conversion issues?' provides an 'Explanation of Changes' and 'Key Points' for a specific procedure. Below this, a 'Refactored Version' compares a 'PostgreSQL standard draft' with a 'PostgreSQL Gemini-enhanced' version. The standard draft includes a cursor loop with a complex SELECT statement and a view definition. The Gemini-enhanced version simplifies the cursor loop and view definition. At the bottom, there are buttons for 'INSERT SUGGESTION' and 'CLOSE'.

How should I fix object conversion issues?

### Explanation of Changes

- CURSOR FOR LOOP**: We replace the bulk operations with a `CURSOR FOR LOOP`. This iterates through the `items_staging` table row by row.
- Individual Variables**: Instead of array-like structures, we use individual variables (`item_id`, `item_name`, `addition_date`) to hold the values of each fetched row.
- EXIT WHEN NOT FOUND**: This part of the loop mimics the behavior of a bulk fetch, terminating the loop when there are no more rows.
- Data Transformations**: Your original logic for handling default dates is retained.
- INSERT Statements**: We insert the data into the items table one row at a time within the loop.
- Exception Handling**: I've added an `EXCEPTION` block. This is where you would place logic to:
  - Rollback the transaction if errors occur.
  - Log the specific errors encountered for debugging or analysis.

### Key Points

- Performance**: The cursor loop approach might be slightly less performant than `BULK COLLECT` for very large datasets. Consider performance implications if this is a critical factor in your application.
- Batching (Optional)**: If performance is absolutely critical, you could introduce a form of batching within the loop by accumulating a smaller number of rows before inserting, but this adds complexity.

### Refactored Version

```
PostgreSQL standard draft
1 DROP PROCEDURE IF EXISTS electronics_department.add_inventory;
2 CREATE OR REPLACE PROCEDURE
  electronics_department.add_inventory(p_limit DECIMAL)
3 LANGUAGE plpgsql
4 AS $$
5 DECLARE
6   add_inventory_c_stg_data CURSOR FOR SELECT
7     items_staging.item_id,
8     items_staging.item_name,
9     items_staging.addition_date
10  FROM
11    electronics_department.items_staging
12  WHERE items_staging.item_name <> 'X'
13 ;
14 v_stg_data ERROR_UNSUPPORTED(UserDefinedTypeRef(STG_DATA_TT))
15 := /* ERROR_UNSUPPORTED(PostgreSQL does not support
    associative tables. [AssocArrayConstructorOpcode]) */ NULL;
16 v_rows DECIMAL(38, 0) := 0;
```

```
PostgreSQL Gemini-enhanced
1 CREATE OR REPLACE PROCEDURE
  electronics_department.add_inventory(p_limit DECIMAL)
2 LANGUAGE plpgsql
3 AS $$
4 DECLARE
5+   add_inventory_c_stg_data CURSOR FOR
6+   SELECT items_staging.item_id, items_staging.item_name,
7+         items_staging.addition_date
8+   FROM electronics_department.items_staging
9+   WHERE items_staging.item_name <> 'X';
10+  item_id DECIMAL;
11+  item_name VARCHAR;
12+  addition_date DATE;
13 v_rows DECIMAL(38, 0) := 0;
```

INSERT SUGGESTION CLOSE



The 50-year-old big-box chain store has been interested in migrating the remainder of its on-prem databases to the Cloud, where much of Cymbal's newer applications and infrastructure already live.

Having used and tested Google Cloud for the past 2 years, Cymbal Shops wants to modernize all their legacy applications and move to Google Cloud.



The CIO asked Dina, Cymbal's DBA, to migrate their legacy databases starting with the electronics database.



**Dina Kaya**  
Database Administrator



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## Troubleshoot & Optimize

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**82% of developers  
spend 30 minutes  
each day searching  
for solutions**

Stack Overflow  
survey



**Lack of SQL expertise**



**Time consuming, high-toil.**



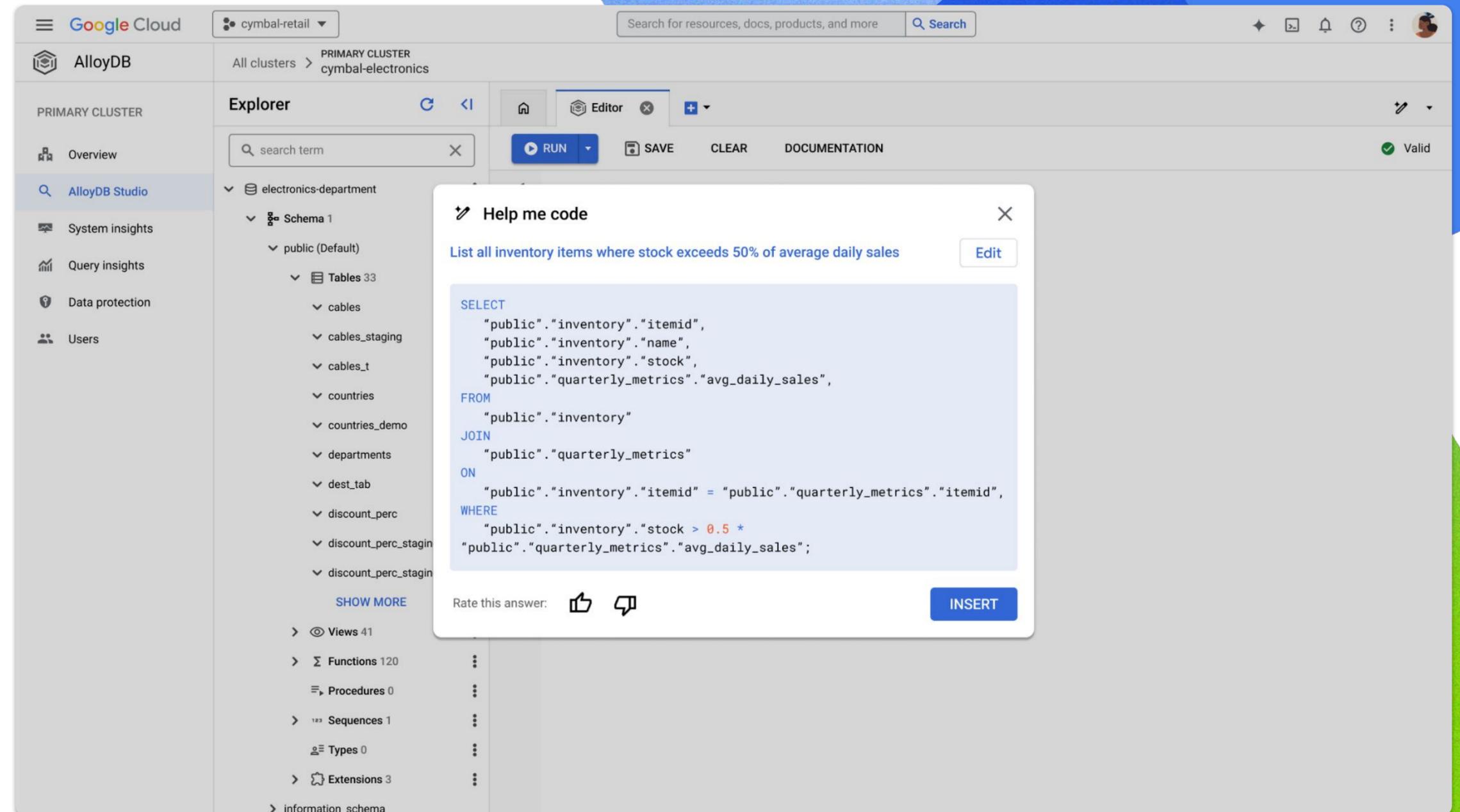
**Ensuring security and  
compliance.**

# Introducing Database Studios with code assistance

Now in Preview

**SQL code generation** accelerates query development by converting natural language descriptions directly into SQL, informed by your database schema.

**SQL code explainability** helps decipher existing or generated code by breaking it down into its components, clarifying the code's logic.





It's almost the end of the quarter and Cymbal shops wants to run a flash sale on their excess inventory.

They've asked Anita, an application developer, to ensure the "Flash Sale" tag seamlessly displays on the app to attract shoppers.



**Anita Osei**  
App Developer



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**Majority (79%)  
of IT teams are now  
using more than one  
database platform,  
with 29% of using  
more than five.**

Redgate survey



**Proliferation of databases**



**Fragmented tools**

# Introducing Database Center

Now in Preview

**Single pane of glass** for monitoring health of all the databases across your entire organization.

**Proactive recommendations** to optimize cost, identify performance issues and find security and compliance problems.

**Natural language interface** to easily ask questions of your fleet from the Console Gemini Chat.

Google Cloud cymbal-retail Search for resources, docs, products, and more Search Gemini Updated at 1:57 PM PST

Database Center

Projects Products & versions Regions Labels

### Fleet inventory

62 resource groups

Group by Engine/version Group by Region

Database version	Groups	Resources
MySQL 8.0	37	76
MySQL 5.7	12	26
PostgreSQL 15	7	7
AlloyDB	4	21
PostgreSQL 14	2	5
<b>Total</b>	<b>62</b>	<b>135</b>

### Fleet issues

**Availability** 95% passing 59/62 resource groups  
3 issues detected  
Resource not failover protected  
[SHOW AFFECTED RESOURCES](#)

**Data protection** 91% passing 57/62 resource groups  
5 issues detected  
No automated backup policy  
Last backup failed  
Short backup retention  
[SHOW AFFECTED RESOURCES](#)

**Security** 79% passing 49/62 resource groups  
15 issues detected  
Broad public IP access  
No root password  
Exposed to external scripts  
[SHOW AFFECTED RESOURCES](#)

**Industry compliance** 75% passing 47/62 resource groups  
40 issues detected  
ISO-27001  
CIS GCP Foundation 2.0  
NIST 800-53  
[SHOW AFFECTED RESOURCES](#)

**Performance and capacity** 36% passing 22/62 resource groups  
46 issues detected  
Underprovisioned resource  
Nearing cluster quota limit  
[SHOW AFFECTED RESOURCES](#)

**Cost** 68% passing 49/62 resource groups  
13 issues detected  
Idle resource  
[SHOW AFFECTED RESOURCES](#)

### Fleet resources

Availability 3 Data protection 5 Security 15 Industry compliance 40 Performance and capacity 46 Cost 13

Resource not failover protected Filter table

Gemini

Are all my production databases highly available?

3 of your production databases are not highly available.

Issues	Resource #
Resource not failover protected	3

Results obtained with the following query:

- Filtering by: labels.key:'track' AND labels.value:'production'
- Finding Signals: Availability configuration

To see more details of these issues and affected resources, [go to Database Center](#).

Rate this answer:

Enter a prompt here

For best results use a detailed prompt. [Prompt guide](#)



All teams are mobilized to prepare for the sale. Pat at the Database platform team has a checklist of things he wants to ensure — Are the instances right-sized for the heavy load? Are there any security issues? Are their databases backing up regularly? Are they set up for failover?



**Pat Miller**  
Platform Admin

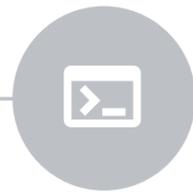


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Nearly a third (30%) of development teams are now deploying database changes to production in a day or less, up by 50% from just two years ago.

Redgate Survey

1

Frequent releases

2

Lack of expertise

3

Existing tools are complex

# Introducing Enhanced insights

Now in Preview

**System tuning recommenders** helps you to optimize your resources by setting the right database flags and preventing from running out of resources.

**Query tuning recommenders** monitors your workload patterns and provides recommendations to improve query performance.

**Assistive troubleshooting** streamlines root cause analysis by offering relevant explanations and troubleshooting guidance within your workflow.

The screenshot displays the Google Cloud AlloyDB console interface. At the top, the navigation bar shows 'Google Cloud' and the project 'cymbal-retail'. The main content area is titled 'PRIMARY CLUSTER cart-checkout' and features a 'Query insights' section for 'PRIMARY: CART-CHECKOUT'. This section includes filters for 'Database: All', 'User: All', and 'Client address: All', along with a time range selector set to '1 hour'. Below the filters is a line chart titled 'Database load - all queries' showing various metrics over time. A legend at the bottom of the chart lists metrics such as Client, CPU, Internal wait event, IO, IPC, Lock, and LWLock. Below the chart, there is a 'Top queries and tags' section with a table of queries. A circular callout highlights a 'wait event types' bar chart and a 'Recommendations' section that suggests 'Create indexes' for the highlighted queries. On the right side of the console, a Gemini AI chat window is open, displaying a prompt and a response about Duet AI and LW locks.

Duet AI is an AI-powered collaborator to help you get more done faster. Get answers to your questions about how to get started with a Cloud solution, strategies for optimizing resources, or using the gcloud CLI to manage Google Cloud.

In addition to general knowledge about Google Cloud, it also has some awareness of your context, like your project and console page.

What are LW locks and what are some reasons they might have high wait times?

**LW locks** (Lightweight Locks) are used to protect shared resources, such as buffer pool pages and shared memory segments. They are lightweight, meaning that they have a low overhead and do not significantly impact the performance of the database. LW locks are also non-blocking, meaning that they do not cause transactions to wait for each other to complete.

**Reasons for high lock waits** can include:

- High contention on shared resources, such as when multiple transactions are trying to access the same data at the same time.
- Long-running transactions that hold locks for extended periods of time.
- Deadlocks, which occur when multiple transactions are waiting for each other to release locks.
- Poorly designed indexes that can lead to lock contention and deadlocks.

To reduce lock waits, it is important to identify and address the underlying causes, such as reducing contention on shared resources, optimizing transaction duration, and improving index design.

Enter a prompt here

Best results use a detailed prompt. [Prompt guide](#)



The Cymbal DevOps team runs a test of their retail applications to ensure quality performance the day of the sale. They notice slow behavior and an inability to add items to their checkout carts.

Dave from the DevOps receives a page to look into the issue.



**Dave Wong**  
DevOps

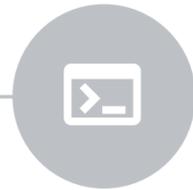


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**Weekly cyber-attacks  
have increased  
worldwide by 7% in Q1  
2023 compared to the  
same period last year,  
with each firm facing  
an average of 1248  
attacks per week**

Check Point survey

1

Lack of expertise

2

Existing tools are complex

# Introducing proactive governance in Database Center

Now in Preview

## Security agents

proactively safeguards your system by detecting risky configurations and missing critical settings.

## Compliance agents

checks for compliance violations with integrated experience of Security Command Center

## Cost recommenders

help you optimize spending by identifying wasted and underutilized resources.

The screenshot displays the Google Cloud Database Center interface for 'Cymbal Shops'. It features a 'Fleet summary' section with a 'Fleet inventory' donut chart showing 138 resource groups. Below this is a table with columns for 'Product & version', 'Groups', and 'Resources'. The table lists various database instances such as AlloyDB PostgreSQL 14, Cloud SQL PostgreSQL 14, and Cloud SQL MySQL 8.0. To the right, the 'Fleet issues' section shows 'Availability configuration' at 99% passing (136/137 resource groups) and 'Industry compliance' at 97% passing (134/138 resource groups). A list of issues is shown, including 'Resource not failover protected' and 'Violates ISO-27001'. A sidebar on the right provides a detailed view of selected issues, with categories like 'Security' (16/16 selected), 'Industry compliance' (3/8 selected), 'Performance & capacity' (6/6 selected), and 'Cost' (2/2 selected). The sidebar lists specific compliance violations such as 'Violates NIST 800-53' and 'Violates ISO-27001' with their applicability to different database products.



Cymbal Shops' successful flash sale fueled rapid growth, leading to new contracts and a broader customer base. The catch is, they now face the challenge of meeting a new compliance standard across the entire organization.

Ian is tasked with implementing the necessary changes to achieve compliance.



**Ian Pereira**  
Infrastructure Admin

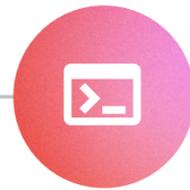


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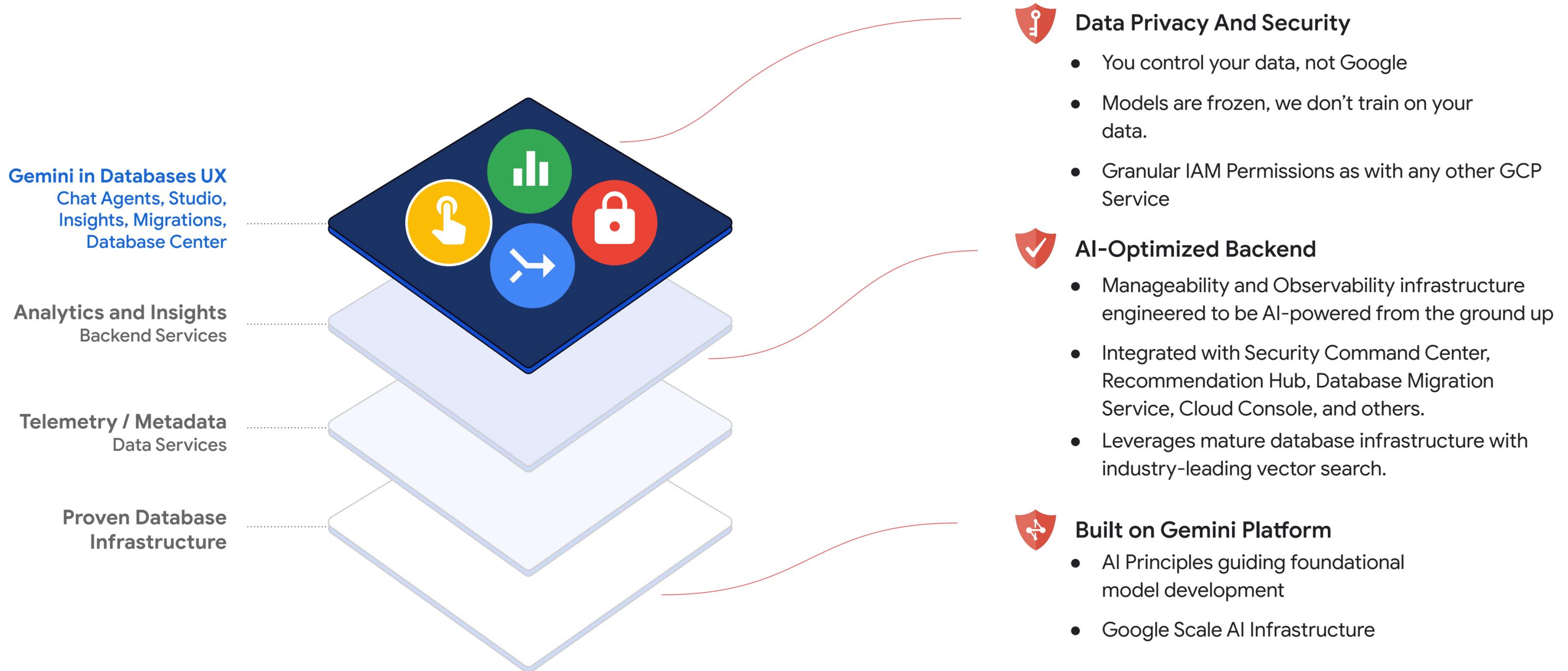
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# ◆ Gemini in Databases is **enterprise ready** from day one



Learn more at:

<https://cloud.google.com/products/gemini/databases>



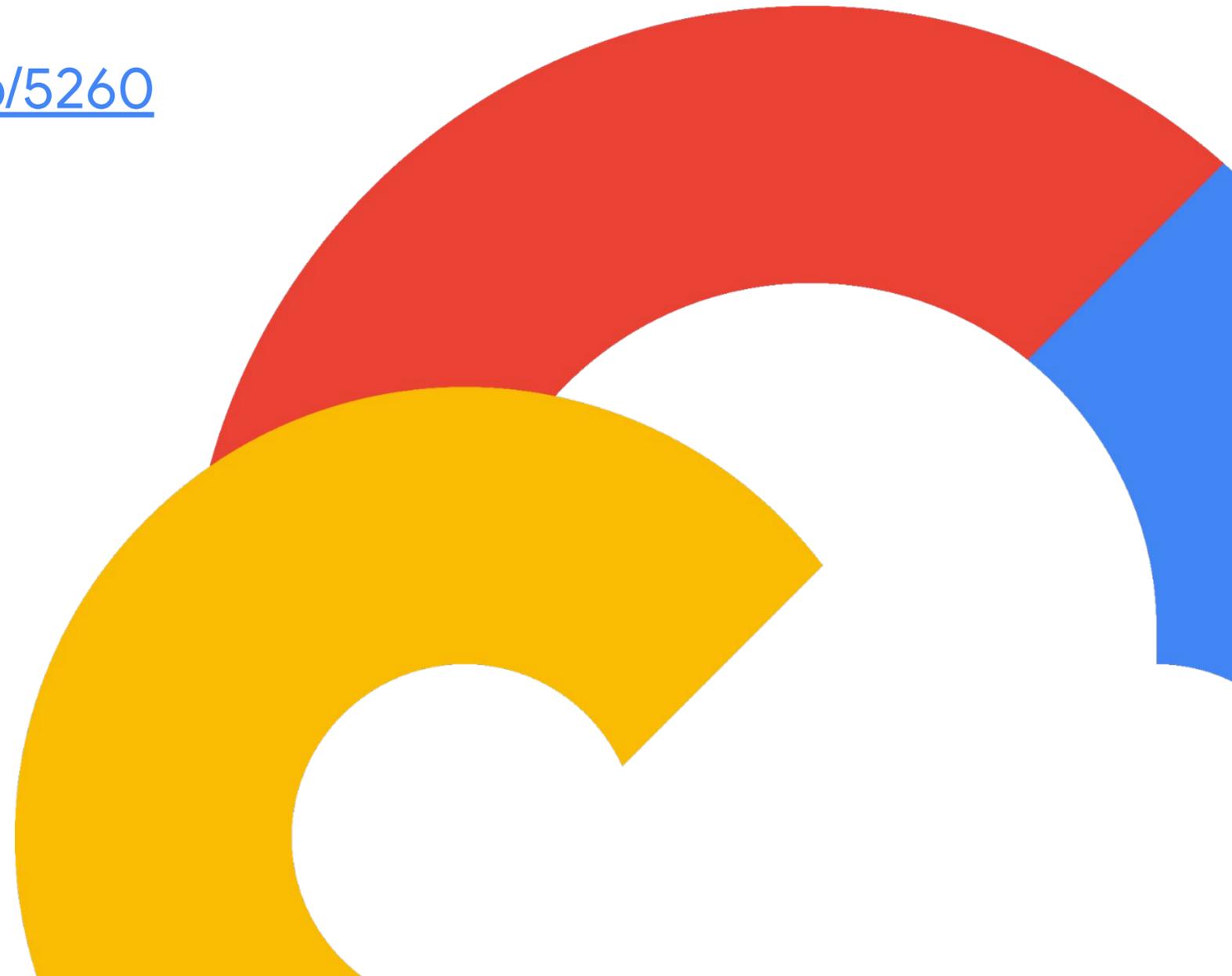
# Google Cloud Skills boost Lab

Administering an AlloyDB Database

[https://www.cloudskillsboost.google/catalog\\_lab/5260](https://www.cloudskillsboost.google/catalog_lab/5260)



Google Cloud



# The Lab

Starting with the lab - following link:

- [https://www.cloudskillsboost.google/catalog\\_lab/5260](https://www.cloudskillsboost.google/catalog_lab/5260)

A screenshot of the Google Cloud sign-in interface. At the top, the 'Google Cloud' logo is displayed. Below it, the text 'Sign in' is centered. A button labeled 'Sign in with Google' is prominent. Underneath, the word 'or' is centered. There are two input fields: one for 'Email' containing 'johnsmith@hotmail.com' and one for 'Password'. A 'Forgot password?' link is located to the right of the password field. A 'Remember me' checkbox is checked. At the bottom of the form, there are two buttons: 'Create account' and 'Sign in'.

This site is protected by reCAPTCHA and the Google [Privacy Policy](#) and [Terms of Service](#) apply.



[Help](#) [Privacy](#) [Terms](#)

# The Lab

Create an account (if you don't have one):

- [https://www.cloudskillsboost.google/catalog\\_lab/5260](https://www.cloudskillsboost.google/catalog_lab/5260)



Google Cloud

Create account

[Sign in with Google](#)

or

\* First name  \* Last name

\* Email

\* Company

\* Password  \* Password confirmation

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