

Cloud Spanner - Defining Schemas and Understanding Query Plans

GSP1050



- Cloud Spanner lab explores schema evolution and query optimization for Banking Operations database (`banking-ops-db`).
- Load data into Portfolio, Category, Product tables using provided Python client library code.
- **Schema Modifications**
 - Add `MarketingBudget` column to Category table via online DDL (no downtime).
 - Create secondary index on frequently queried columns to optimize performance.
- **Query Insights**
 - Examine execution plans via `EXPLAIN` to understand scan/index usage and optimize joins.
 - Key for financial workloads requiring sub-second latency at scale.

Create and Manage Cloud Spanner

https://partner.skills.google/course_templates/643/labs/612219

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Open Google Cloud console

Username: student-03-39e73dfc6385@qwiklabs.net

Password: 0jXN8ivIYoi1

Project ID: qwiklabs-gcp-01-c4c8572c

gcloud auth list

4. Click Authorize.

Output:

```
ACTIVE: *
ACCOUNT: student-03-39e73dfc6385@qwiklabs.net

To set the active account, run:
$ gcloud config set account `ACCOUNT`
```

5. (Optional) You can list the project ID with this command:

gcloud config list project

Output:

```
[core]
```

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Dashboard – qwiklabs-gcp-01-c4c8572d2603 x +

https://console.cloud.google.com/home/dashboard?project=qwiklabs-gcp-01-c4c8572d2603&pli=1&cloudshell=true

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CLOUD SHELL Terminal (qwiklabs-gcp-01-c4c8572d2603) x +

Welcome to Cloud Shell! Type "help" to get started, or type "gemini" to try prompting with Gemini CLI.
Your Cloud Platform project in this session is set to **qwiklabs-gcp-01-c4c8572d2603**.
Use `gcloud config set project [PROJECT_ID]` to change to a different project.
student_03_39e73dfc6385@cloudshell:~ (qwiklabs-gcp-01-c4c8572d2603)\$ gcloud auth list
Credentialled Accounts

ACTIVE: *
ACCOUNT: student-03-39e73dfc6385@qwiklabs.net

To set the active account, run:
\$ gcloud config set account `ACCOUNT`

student_03_39e73dfc6385@cloudshell:~ (qwiklabs-gcp-01-c4c8572d2603)\$ gcloud config list project
[core]
project = qwiklabs-gcp-01-c4c8572d2603

Your active configuration is: [cloudshell-19432]
student_03_39e73dfc6385@cloudshell:~ (qwiklabs-gcp-01-c4c8572d2603)\$

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Password

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Task 1. Load data into tables

The **banking-ops-db** was created with empty tables. Follow the steps below to load data into three of the tables (**Portfolio**, **Category**, and **Product**).

1. From the Cloud Console, open the navigation menu (≡) > **View All Products**, under **Databases** click **Spanner**.
2. The instance name is **banking-ops-instance**, click on the name to explore the databases.
3. The associated database is named **banking-ops-db**. Click on the name, scroll down to **Tables**, and you will see there are four tables already in place.
4. On the left pane of the Console, click **Spanner Studio**. Then click the **+ New SQL Editor Tab** button in the right frame.
5. This takes you to the **Query** page. Paste the insert statements below as a single block to load the **Portfolio** table. Spanner will execute each in succession. Click **Run**:

```
student@DESKTOP-1C9D9E8:~$ gcloud sql instances connect banking-ops-instance --username=student --password=qwiklabs-gcp-01-c4c8572c
```

[Next](#)



Caution: When you are in the console, do not deviate from the lab instructions. Doing so may cause your account to be blocked.

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Username

student-03-39e73dfc6385



Password

0jXN8ivIYoi1



Project ID

qwiklabs-gcp-01-c4c8572c



2. The instance name is **banking-ops-instance**, click on the name to explore the databases.

3. The associated database is named **banking-ops-db**. Click on the name, scroll down to **Tables**, and you will see there are four tables already in place.

4. On the left pane of the Console, click **Spanner Studio**. Then click the **+ New SQL Editor Tab** button in the right frame.

5. This takes you to the **Query** page. Paste the insert statements below as a single block to load the **Portfolio** table. Spanner will execute each in succession. Click **Run**:

```
insert into Portfolio (PortfolioId, Name, ShortName,
PortfolioInfo) values (1, "Banking", "Bnkg", "All Banking
Business");
insert into Portfolio (PortfolioId, Name, ShortName,
PortfolioInfo) values (2, "Asset Growth", "AsstGrwth", "All
Asset Focused Products");
insert into Portfolio (PortfolioId, Name, ShortName,
PortfolioInfo) values (3, "Insurance", "Ins", "All Insurance
Focused Products");
```

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Password

0jXN8ivIYoi1



Project ID

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```
insert into Portfolio (PortfolioId, Name, ShortName,
PortfolioInfo) values (3, "Insurance", "Ins", "All Insurance
Focused Products");
```

6. The lower page of the screen shows the results of inserting the data one row at a time. A green checkmark also appears on each row of inserted data. The **Portfolio** table now has three rows.

7. Click **Clear** in the top portion of the page.

8. Paste the insert statements below as a single block to load the **Category** table.

Click **Run**:

```
insert into Category (CategoryId,PortfolioId,CategoryName)
values (1,1,"Cash");
insert into Category (CategoryId,PortfolioId,CategoryName)
values (2,2,"Investments - Short Return");
insert into Category (CategoryId,PortfolioId,CategoryName)
values (3,2,"Annuities");
insert into Category (CategoryId,PortfolioId,CategoryName)
values (4,3,"Life Insurance");
```

9. The lower page of the screen shows the results of inserting the data one row at a

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Project ID

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```
insert into Category (CategoryId,PortfolioId,CategoryName)
values (4,3,"Life Insurance");
```

9. The lower page of the screen shows the results of inserting the data one row at a time. A green checkmark also appears on each row of inserted data. The **Category** table now has four rows.

10. Click **Clear** in the top portion of the page.

11. Paste the insert statements below as a single block to load the **Product** table.

Click **Run**:

```
insert into Product
(ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,Proc
values (1,1,1,"Checking Account","ChkAcct","Banking LOB");
insert into Product
(ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,Proc
values (2,2,2,"Mutual Fund Consumer Goods","MFundCG","Investment
LOB");
insert into Product
(ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,Proc
values (3,3,2,"Annuity Early Retirement","AnnuFixed","Investment
LOB");
```

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Open Google Cloud console

Username: student-03-39e73dfc6385

Password: 0jXN8ivIYoi1

Project ID: qwiklabs-gcp-01-c4c8572c

Click Run:

```
insert into Product
(ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,Proc
values (1,1,1,"Checking Account","ChkAcct","Banking LOB");
insert into Product
(ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,Proc
values (2,2,2,"Mutual Fund Consumer Goods","MFundCG","Investment
LOB");
insert into Product
(ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,Proc
values (3,3,2,"Annuity Early Retirement","AnnuFixed","Investment
LOB");
insert into Product
(ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,Proc
values (4,4,3,"Term Life Insurance","TermLife","Insurance LOB");
insert into Product
(ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,Proc
values (5,1,1,"Savings Account","SavAcct","Banking LOB");
insert into Product
(ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,Proc
values (6,1,1,"Personal Loan","PersLn","Banking LOB");
insert into Product
(ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,Proc
```

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Username

student-03-39e73dfc6385



Password

0jXN8ivIVoi1



Project ID

qwiklabs-gcp-01-c4c8572c



```
(ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,Proc  
values (4,4,3,"Term Life Insurance","TermLife","Insurance LOB");  
insert into Product  
(ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,Proc  
values (5,1,1,"Savings Account","SavAcct","Banking LOB");  
insert into Product  
(ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,Proc  
values (6,1,1,"Personal Loan","PersLn","Banking LOB");  
insert into Product  
(ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,Proc  
values (7,1,1,"Auto Loan","AutLn","Banking LOB");  
insert into Product  
(ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,Proc  
values (8,4,3,"Permanent Life Insurance","Permlife","Insurance  
LOB");  
insert into Product  
(ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,Proc  
values (9,2,2,"US Savings Bonds","USSavBond","Investment LOB");
```

12. The lower page of the screen shows the results of inserting the data one row at a time. A green checkmark also appears on each row of inserted data. The **Product** table now has nine rows.

13. Click **Check my progress** to verify the objective.

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https://console.cloud.google.com/spanner/instances?referrer=search&project=qwiklabs-gcp-01-c4c8572d2603 | 2

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Spanner All instances

Instances Create instance + Create free instance View fleet health

Spanner is an always-on, globally consistent database with virtually unlimited scale. Build intelligent applications with a single database that brings together relational, graph, key-value, and search functionalities. The elimination of maintenance windows ensures uninterrupted service for mission-critical applications. [Learn more](#)

Filter Enter property name or value

Name	ID	Edition	Configuration	Processing units	Nodes	Scaling mode	Storage utilization	Labels	Tags
banking-ops-instance	banking-ops-instance	Standard	us-east1 (South Carolina)	1,000	1	Manual allocation	0 B / 10 TB	–	–

https://console.cloud.google.com/spanner/instances/banking-ops-instance/details/database...

9+ 11°C Clear

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banking-ops-instance – Overview +

https://console.cloud.google.com/spanner/instances/banking-ops-instance/details/databases?project=qwiklabs-gcp-01-c4c8572d2603 | 2

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INSTANCE Overview Import/Export Backup/Restore Instance partitions ...

OBSERVABILITY System insights Query insights Lock insights Transaction insights Hotspot insights

Instance ID banking-ops-instance Configuration us-east1 (South Carolina) Show details Scaling mode Manual allocation Default backup schedule Enabled

banking-ops-db

Edit or delete roles below, or select "Add principal" to grant new access. Add principal

Show inherited roles in table Display roles inherited from the parent resources in the table below

Instance summary Statistics are updated every 3-5 minutes, which may cause some delay in actual data.

Compute capacity ② CPU utilization (high) Operations Throughput
1000 PUs (1 node) 1.08% Read: 0.03/s Read: 1 B/s
Write: -/s Write: -/s

Databases + Create database Import my own data Explore datasets Refresh

Filter databases

Name	Dialect	CPU utilization	Size	Backup schedules	Ver
banking-ops-db	Google Standard SQL	1.08%	0 B	1 h	

Release Notes

console.cloud.google.com/spanner/instances/banking-ops-instance/databases/.../tables?proje...

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banking-ops-db – Overview – qv x +

https://console.cloud.google.com/spanner/instances/banking-ops-instance/databases/banking-ops-db/details/tables?project=qwiklabs-gcp-01-c...

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OBSERVABILITY

- System insights
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Overview

Database Name: banking-ops-db
Database Dialect: Google Standard SQL
Encryption type: Google-managed
Scheduled backups: default_daily_full_backup_schedule
Schema updates: No recent updates

Summary

Statistics are updated every 3-5 minutes, which may cause some delay in actual data.

CPU utilization (mean)	Operations	Throughput	Total database storage
1.08%	Read: 0.03/s Write: -/s	Read: 1 B/s Write: -/s	0 B

Tables Views

Tables are structured with rows, columns, and values, and they contain primary keys and indexes. Parent-child relationship between tables can be defined through table interleaving or foreign keys. [Learn more](#)

+ Create table

banking-ops-db

Edit or delete roles below, or select "Add principal" to grant new access. Add principal

Show inherited roles in table

Display roles inherited from the parent resources in the table below

Filter Enter property name or value

Role / Principal	Inheritance
▶ Editor (2)	
▶ Owner (3)	
▶ Viewer (1)	

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banking-ops-db – Overview – qv X +

https://console.cloud.google.com/spanner/instances/banking-ops-instance/databases/banking-ops-db/details/tables?project=qwiklabs-gcp-01-c...

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OBSERVABILITY

- System insights
- Query insights
- Lock insights
- Transaction insights
- Hotspot insights
- Key Visualizer
- Release Notes

Summary

Statistics are updated every 3-5 minutes, which may cause some delay in actual data.

CPU utilization (mean) 1.08%	Operations Read: 0.03/s Write: -/s	Throughput Read: 1 B/s Write: -/s	Total database storage 0 B
---------------------------------	--	---	-------------------------------

Tables Views

Tables are structured with rows, columns, and values, and they contain primary keys and indexes. Parent-child relationship between tables can be defined through table interleaving or foreign keys. [Learn more](#)

+ Create table

Filter Filter tables

Name ↑	Schema	Indexes	Interleaved in	Watched by	Table Size
Campaigns	Default	—	—	—	—
Category	Default	—	Portfolio	—	—
Portfolio	Default	—	—	—	—
Product	Default	—	Category	—	—

Show equivalent ddl

banking-ops-db

Edit or delete roles below, or select "Add principal" to grant new access. [Add principal](#)

Show inherited roles in table
Display roles inherited from the parent resources in the table below

Filter Enter property name or value

Role / Principal ↑ Inheritance

- ▶ Editor (2)
- ▶ Owner (3)
- ▶ Viewer (1)

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banking-ops-db – Spanner Studio

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- Category
- Portfolio
- Product

Change streams 0

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Models 0

Graphs 0

INFORMATION_SCHEMA

SPANNER_SYS

Roles 3

Placements 1

Run Save Format Clear Documentation

Valid

1. insert into Portfolio (PortfolioId, Name, ShortName, PortfolioInfo) values (1, "Banking", "Bnkg", "All Banking Business");
2. insert into Portfolio (PortfolioId, Name, ShortName, PortfolioInfo) values (2, "Asset Growth", "AsstGrwth", "All Asset Focused Products");
3. insert into Portfolio (PortfolioId, Name, ShortName, PortfolioInfo) values (3, "Insurance", "Ins", "All Insurance Focused Products");

Results Explanation

1 row inserted

This statement inserted 1 row and did not return any rows.

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banking-ops-db – Spanner Studio

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Search

Schemas 3 Default Tables 4 Campaigns Category Portfolio Product Change streams 0 Views 0 Models 0 Graphs 0 INFORMATION_SCHEMA SPANNER_SYS Roles 3 Placements 1

Run Save Format Clear Documentation

1. insert into Category (CategoryId,PortfolioId,CategoryName) values (1,1,"Cash");
2. insert into Category (CategoryId,PortfolioId,CategoryName) values (2,2,"Investments - Short Return");
3. insert into Category (CategoryId,PortfolioId,CategoryName) values (3,2,"Annuities");
4. insert into Category (CategoryId,PortfolioId,CategoryName) values (4,3,"Life Insurance");

Results Explanation

1. insert into Category (CategoryId,PortfolioId,CategoryName) values (1,1,"Cash")

1 row inserted

This statement inserted 1 row and did not return any rows.

1 row inserted by your query

9+ 11°C Clear

Search

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banking-ops-db – Spanner Studio

https://console.cloud.google.com/spanner/instances/banking-ops-instance/databases/banking-ops-db/details/query?project=qwiklabs-gcp-01-c...

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Graphs 0
INFORMATION_SCHEMA
SPANNER_SYS
Roles 3
Placements 1

Run Save Format Clear Documentation

Valid

```
✓ 1 insert into Product (ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,ProductClass) values (1,1,1,"Checking Account","ChkAcct","Banking LOB");
✓ 2 insert into Product (ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,ProductClass) values (2,2,2,"Mutual Fund Consumer Goods","MFundCG","Investment LOB");
✓ 3 insert into Product (ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,ProductClass) values (3,3,2,"Annuity Early Retirement","AnnuFixed","Investment LOB");
✓ 4 insert into Product (ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,ProductClass) values (4,4,3,"Term Life Insurance","TermLife","Insurance LOB");
✓ 5 insert into Product (ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,ProductClass) values (5,1,1,"Savings Account","SavAcct","Banking LOB");
✓ 6 insert into Product (ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,ProductClass) values (6,1,1,"Personal Loan","PersLn","Banking LOB");
✓ 7 insert into Product (ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,ProductClass) values (7,1,1,"Auto Loan","AutLn","Banking LOB");
✓ 8 insert into Product (ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,ProductClass) values (8,4,3,"Permanent Life Insurance","PermLife","Insurance LOB");
✓ 9 insert into Product (ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,ProductClass) values (9,2,2,"US Savings Bonds","USSavBond","Investment LOB");
```

Results Explanation

1. insert into Product (ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,Pr... ▾

1 row inserted

This statement inserted 1 row and did not return any rows.

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Search

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Password

0jXN8ivIYoi1



Project ID

qwiklabs-gcp-01-c4c8572c



Task 2. Use pre-built Python client library code to load data

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You will be using the client libraries written in Python for the next several steps.

1. Open the **Cloud Shell** and paste the commands below to create and change into a new directory to hold the required files.

```
mkdir python-helper  
cd python-helper
```

2. Next download two files. One is used to setup the environment. The other is the lab code.

```
wget https://storage.googleapis.com/cloud-training/OCBL373/requirements.txt  
wget https://storage.googleapis.com/cloud-training/OCBL373/snippets.py
```

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Create and Manage Cloud Spanner

https://partner.skills.google/course_templates/643/labs/612219

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Cloud Spanner - Defining Schemas and Understanding Query Plans

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End Lab 01:58:47 Time limit

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Username: student-03-39e73dfc6385c

Password: 0jXN8ivIYoi1

Project ID: qwiklabs-gcp-01-c4c8572c

mkdir python-helper
cd python-helper

2. Next download two files. One is used to setup the environment. The other is the lab code.

wget https://storage.googleapis.com/cloud-training/OCBL373/requirements.txt
wget https://storage.googleapis.com/cloud-training/OCBL373/snippets.py

3. Create an isolated Python environment and install dependencies for the Cloud Spanner client.

pip install -r requirements.txt
pip install setuptools

4. The **snippets.py** is a consolidated file with multiple Cloud Spanner DDL, DML, and DCL functions that you are going to use as a helper during this lab. Execute **snippets.py** using the **insert** argument to populate the **Campaigns** table.

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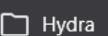
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Password

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Project ID

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2. Next download two files. One is used to setup the environment. The other is the lab code.

```
wget https://storage.googleapis.com/cloud-training/OCBL373/requirements.txt  
wget https://storage.googleapis.com/cloud-training/OCBL373/snippets.py
```

3. Create an isolated Python environment and install dependencies for the Cloud Spanner client.

```
pip install -r requirements.txt  
pip install setuptools
```

4. The **snippets.py** is a consolidated file with multiple Cloud Spanner DDL, DML, and DCL functions that you are going to use as a helper during this lab. Execute **snippets.py** using the **insert_data** argument to populate the **Campaigns** table.

```
python snippets.py banking-ops-instance --database-id banking-  
ops-db insert_data
```

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```
student_03_39e73dfc6385@cloudshell:~ (qwiklabs-gcp-01-c4c8572d2603)$ mkdir python-helper
cd python-helper
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$ wget https://storage.googleapis.com/cloud-training/OCBL373/requirements.txt
wget https://storage.googleapis.com/cloud-training/OCBL373/snippets.py
--2026-01-09 15:13:19-- https://storage.googleapis.com/cloud-training/OCBL373/requirements.txt
Resolving storage.googleapis.com (storage.googleapis.com)... 142.251.12.207, 64.233.170.207, 142.250.4.207, ...
Connecting to storage.googleapis.com (storage.googleapis.com)|142.251.12.207|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 66 [text/plain]
Saving to: 'requirements.txt'

requirements.txt          100% [=====] 66 --.-KB/s   in 0s

2026-01-09 15:13:19 (13.2 MB/s) - 'requirements.txt' saved [66/66]

--2026-01-09 15:13:19-- https://storage.googleapis.com/cloud-training/OCBL373/snippets.py
Resolving storage.googleapis.com (storage.googleapis.com)... 142.251.12.207, 64.233.170.207, 142.250.4.207, ...
Connecting to storage.googleapis.com (storage.googleapis.com)|142.251.12.207|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 81532 (80K) [text/x-python-script]
Saving to: 'snippets.py'

snippets.py          100% [=====] 79.62K 359KB/s   in 0.2s

2026-01-09 15:13:20 (359 KB/s) - 'snippets.py' saved [81532/81532]

student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$
```

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```
student_03_39e73dfc6385@cloudshell:~ (qwiklabs-gcp-01-c4c8572d2603)$ mkdir python-helper
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$ pip install -r requirements.txt
pip install setuptools
Defaulting to user installation because normal site-packages is not writeable
Ignoring futures: markers 'python_version < "3"' don't match your environment
Collecting google-cloud-spanner==3.14.0 (from -r requirements.txt (line 1))
  Downloading google_cloud_spanner-3.14.0-py2.py3-none-any.whl.metadata (9.1 kB)
Requirement already satisfied: google-api-core!=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5 in /usr/local/lib/python3.12/dist-packages (from google-api-core[grpc]!=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5->google-cloud-spanner==3.14.0->-r requirements.txt (line 1)) (2.25.1)
Requirement already satisfied: google-cloud-core<3.0dev,>=1.4.1 in /usr/local/lib/python3.12/dist-packages (from google-cloud-spanner==3.14.0->-r requirements.txt (line 1)) (2.4.3)
Requirement already satisfied: grpc-google-iam-v1<1.0.0dev,>=0.12.4 in /usr/local/lib/python3.12/dist-packages (from google-cloud-spanner==3.14.0->-r requirements.txt (line 1)) (0.14.2)
Requirement already satisfied: proto-plus!=1.19.6,>=1.15.0 in /usr/local/lib/python3.12/dist-packages (from google-cloud-spanner==3.14.0->-r requirements.txt (line 1)) (1.26.1)
Requirement already satisfied: sqlparse>=0.3.0 in /usr/local/lib/python3.12/dist-packages (from google-cloud-spanner==3.14.0->-r requirements.txt (line 1)) (0.5.3)
Requirement already satisfied: packaging>=14.3 in /usr/local/lib/python3.12/dist-packages (from google-cloud-spanner==3.14.0->-r requirements.txt (line 1)) (25.0)
Requirement already satisfied: googleapis-common-protos<2.0.0,>=1.56.2 in /usr/local/lib/python3.12/dist-packages (from google-api-core!=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5->google-api-core[grpc]!=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5->google-cloud-spanner==3.14.0->-r requirements.txt (line 1)) (1.70.0)
Requirement already satisfied: protobuf!=3.20.0,!3.20.1,!4.21.0,!4.21.1,!4.21.2,!4.21.3,!4.21.4,!4.21.5,<7.0.0,>=3.19.5 in /usr/local/lib/python3.12/dist-packages (from google-api-core!=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5->google-api-core[grpc]!=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5->google-cloud-spanner==3.14.0->-r requirements.txt (line 1)) (5.29.5)
Requirement already satisfied: google-auth<3.0.0,>=2.14.1 in /usr/local/lib/python3.12/dist-packages (from google-api-core!=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5->google-api-core[grpc]!=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5->google-cloud-spanner==3.14.0->-r requirements.txt (line 1)) (2.40.3)
Requirement already satisfied: requests<3.0.0,>=2.18.0 in /usr/local/lib/python3.12/dist-packages (from google-api-core!=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.
```

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```
2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5->google-api-core[grpc] !=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5->google-cloud-spanner==3.14.0->-r requirements.txt (line 1)) (0.4.2)
Requirement already satisfied: rsa<5,>=3.1.4 in /usr/local/lib/python3.12/dist-packages (from google-auth<3.0.0,>=2.14.1->google-api-core!=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5->google-api-core[grpc] !=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5->google-cloud-spanner==3.14.0->-r requirements.txt (line 1)) (4.9.1)
Requirement already satisfied: charset_normalizer<4,>=2 in /usr/local/lib/python3.12/dist-packages (from requests<3.0.0,>=2.18.0->google-api-core!=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5->google-api-core[grpc] !=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5->google-cloud-spanner==3.14.0->-r requirements.txt (line 1)) (3.4.2)
Requirement already satisfied: idna<4,>=2.5 in /usr/local/lib/python3.12/dist-packages (from requests<3.0.0,>=2.18.0->google-api-core!=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5->google-api-core[grpc] !=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5->google-cloud-spanner==3.14.0->-r requirements.txt (line 1)) (3.10)
Requirement already satisfied: urllib3<3,>=1.21.1 in /usr/local/lib/python3.12/dist-packages (from requests<3.0.0,>=2.18.0->google-api-core!=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5->google-api-core[grpc] !=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5->google-cloud-spanner==3.14.0->-r requirements.txt (line 1)) (2.5.0)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.12/dist-packages (from requests<3.0.0,>=2.18.0->google-api-core!=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5->google-api-core[grpc] !=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5->google-cloud-spanner==3.14.0->-r requirements.txt (line 1)) (2025.7.9)
Requirement already satisfied: pyasn1<0.7.0,>=0.6.1 in /usr/local/lib/python3.12/dist-packages (from pyasn1-modules>=0.2.1->google-auth<3.0.0,>=2.14.1->google-api-core!=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5->google-api-core[grpc] !=2.0.*,!=2.1.*,!=2.2.*,!=2.3.0,<3.0.0dev,>=1.31.5->google-cloud-spanner==3.14.0->-r requirements.txt (line 1)) (0.6.1)
Downloading google_cloud_spanner-3.14.0-py2.py3-none-any.whl (277 kB)
277.8/277.8 kB 7.3 MB/s eta 0:00:00
Installing collected packages: google-cloud-spanner
Successfully installed google-cloud-spanner-3.14.0
Defaulting to user installation because normal site-packages is not writeable
Requirement already satisfied: setuptools in /usr/local/lib/python3.12/dist-packages (80.9.0)
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$
```

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```
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$ python snippets.py banking-ops-instance --database-id banking-ops-db insert_data
/home/student_03_39e73dfc6385/.local/lib/python3.12/site-packages/google/cloud/spanner_v1/_init_.py:19: UserWarning: pkg_resources is deprecated as an API. See https://setuptools.pypa.io/en/latest/pkg_resources.html. The pkg_resources package is slated for removal as early as 2025-11-30. Refrain from using this package or pin to Setuptools<81.
    import pkg_resources
Inserted data.
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$
```

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Password

0jXN8ivIYoi1



Project ID

qwiklabs-gcp-01-c4c8572c



Task 3. Query data with client libraries

The `query_data()` function in `snippets.py` can be used to query your database. In this case you use it to confirm the data loaded into the `Campaigns` table. You will not change any code, the section is shown here for your reference.

```
def query_data(instance_id, database_id):
    """Queries sample data from the database using SQL."""
    spanner_client = spanner.Client()
    instance = spanner_client.instance(instance_id)
    database = instance.database(database_id)

    with database.snapshot() as snapshot:
        results = snapshot.execute_sql(
            "SELECT
                CampaignId, PortfolioId, CampaignStartDate, CampaignEndDate, CampaignName, CampaignBudget
            FROM Campaigns"
        )

        for row in results:
            print(u"CampaignId: {}, PortfolioId: {}, CampaignStartDate: {}, CampaignEndDate: {}, CampaignName: {}, CampaignBudget: {}")
```

GSP1050

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Project ID

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1. Execute `snippets.py` using the `query_data` argument to query the **Campaigns** table.

```
python snippets.py banking-ops-instance --database-id banking-  
ops-db query_data
```

The result should look like the following

```
CampaignId: 1, PortfolioId: 1, CampaignStartDate: 2022-06-07,  
CampaignEndDate: 2022-06-07, CampaignName: New Account Reward,  
CampaignBudget: 15000  
CampaignId: 2, PortfolioId: 2, CampaignStartDate: 2022-06-07,  
CampaignEndDate: 2022-06-07, CampaignName: Intro to Investments,  
CampaignBudget: 5000  
CampaignId: 3, PortfolioId: 2, CampaignStartDate: 2022-06-07,  
CampaignEndDate: 2022-06-07, CampaignName: Youth Checking Accounts,  
CampaignBudget: 25000  
CampaignId: 4, PortfolioId: 3, CampaignStartDate: 2022-06-07,  
CampaignEndDate: 2022-06-07, CampaignName: Protect Your Family,  
CampaignBudget: 10000
```

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```
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$ python snippets.py banking-ops-instance --database-id banking-ops-db query_data
/home/student_03_39e73dfc6385/.local/lib/python3.12/site-packages/google/cloud/spanner_v1/_init_.py:19: UserWarning: pkg_resources is deprecated as an API. See https://setuptools.pypa.io/en/latest/pkg_resources.html. The pkg_resources package is slated for removal as early as 2025-11-30. Refrain from using this package or pin to Setuptools<81.
    import pkg_resources
CampaignId: 1, PortfolioId: 1, CampaignStartDate: 2026-01-09, CampaignEndDate: 2026-01-09, CampaignName: New Account Reward, CampaignBudget: 15000
CampaignId: 2, PortfolioId: 2, CampaignStartDate: 2026-01-09, CampaignEndDate: 2026-01-09, CampaignName: Intro to Investments, CampaignBudget: 5000
CampaignId: 3, PortfolioId: 2, CampaignStartDate: 2026-01-09, CampaignEndDate: 2026-01-09, CampaignName: Youth Checking Accounts, CampaignBudget: 25000
CampaignId: 4, PortfolioId: 3, CampaignStartDate: 2026-01-09, CampaignEndDate: 2026-01-09, CampaignName: Protect Your Family, CampaignBudget: 10000
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$
```

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Explorer Untitled query Untitled query + Open CLI Gemini settings View in BigQuery Valid

Default Tables 4 Campaigns Columns 6 # CampaignId # PortfolioId CampaignStartDate CampaignEndDate CampaignName # CampaignBudget Keys 3 Indexes 0

Run Save Format Clear Documentation

1. insert into Product (ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,ProductClass) values (1,1,1,"Checking Account", "ChkAcct","Banking LOB");
2. insert into Product (ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,ProductClass) values (2,2,2,"Mutual Fund Consumer Goods", "MFundCG", "Investment LOB");
3. insert into Product (ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,ProductClass) values (3,3,2,"Annuity Early Retirement", "AnnuFixed", "Investment LOB");
4. insert into Product (ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,ProductClass) values (4,4,3,"Term Life Insurance", "TermLifeIns", "Investment LOB");

Results Explanation 1 row inserted This statement inserted 1 row and did not return any rows.

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```
import pkg_resources
Waiting for operation to complete...
Added the MarketingBudget column.
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$
```

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Username

student-03-39e73dfc6385



Password

0jXN8ivIYoi1



Project ID

qwiklabs-gcp-01-c4c8572c



Task 4. Updating the database schema

As part of your DBA responsibilities you are required to add a new column called **MarketingBudget** to the **Category** table. Adding a new column to an existing table requires an update to your database schema. Cloud Spanner supports schema updates to a database while the database continues to serve traffic. Schema updates do not require taking the database offline and they do not lock entire tables or columns; you can continue reading and writing data to the database during the schema update.

Adding a column using Python

The **update_ddl()** method of the **Database** class is used to modify the schema.

Use the **add_column()** function in **snippets.py** which implements that method. You will not change any code, the section is shown here for your reference.

```
def add_column(instance_id, database_id):
    """Adds a new column to the Albums table in the example database."""
    client = spanner.Client()  
    # ...
```

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can continue reading and writing data to the database during the schema update.

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Adding a column using Python

The `update_ddl()` method of the `Database` class is used to modify the schema.

Use the `add_column()` function in `snippets.py` which implements that method. You will not change any code, the section is shown here for your reference.

```
def add_column(instance_id, database_id):
    """Adds a new column to the Albums table in the example database."""
    spanner_client = spanner.Client()
    instance = spanner_client.instance(instance_id)
    database = instance.database(database_id)

    operation = database.update_ddl(
        ["ALTER TABLE Category ADD COLUMN MarketingBudget INT64"])
    )

    print("Waiting for operation to complete...")
    operation.result(OPERATION_TIMEOUT_SECONDS)
```

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```
def add_column(instance_id, database_id):
    """Adds a new column to the Albums table in the example database."""
    spanner_client = spanner.Client()
    instance = spanner_client.instance(instance_id)
    database = instance.database(database_id)

    operation = database.update_ddl(
        ["ALTER TABLE Category ADD COLUMN MarketingBudget INT64"]
    )

    print("Waiting for operation to complete...")
    operation.result(OPERATION_TIMEOUT_SECONDS)

    print("Added the MarketingBudget column.")
```

1. Execute `snippets.py` using the `add_column` argument.

```
python snippets.py banking-ops-instance --database-id banking-
ops-db add_column
```

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```
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$ python snippets.py banking-ops-instance --database-id banking-ops-db add_column
/home/student_03_39e73dfc6385/.local/lib/python3.12/site-packages/google/cloud/spanner_v1/_init_.py:19: UserWarning: pkg_resources is deprecated as an API. See https://setuptools.pypa.io/en/latest/pkg_resources.html. The pkg_resources package is slated for removal as early as 2025-11-30. Refrain from using this package or pin to Setuptools<81.
    import pkg_resources
Waiting for operation to complete...
Added the MarketingBudget column.
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$
```

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Default Tables 4 Campaigns Category Columns 4 # CategoryId # PortfolioId Tr CategoryName # MarketingBudget Keys 2 Indexes 0 Portfolio

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1. insert into Product (ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,ProductClass) values (1,1,1,"Checking Account", "ChkAcct","Banking LOB");
2. insert into Product (ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,ProductClass) values (2,2,2,"Mutual Fund Consumer Goods","MFundCG","Investment LOB");
3. insert into Product (ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,ProductClass) values (3,3,2,"Annuity Early Retirement","AnnuFixed","Investment LOB");
4. insert into Product (ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,ProductClass) values (4,4,3,"Term Life Insurance","TermLifeIns","Investment LOB");

Results Explanation 1 row inserted This statement inserted 1 row and did not return any rows.

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import pkg_resources
Waiting for operation to complete...
Added the MarketingBudget column.
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)\$

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Task 5. Add a Secondary Index

Suppose you wanted to fetch all rows of Categories that have CategoryNames values in a certain range. You could read all values from the **CategoryName** column using a SQL statement or a read call, and then discard the rows that don't meet the criteria, but doing this full table scan is expensive, especially for tables with a lot of rows. Instead you can speed up the retrieval of rows when searching by non-primary key columns by creating a secondary index on the table.

Adding a secondary index to an existing table requires a schema update. Like other schema updates, Cloud Spanner supports adding an index while the database continues to serve traffic. Cloud Spanner populates the index with data (also known as a "backfill") under the hood. Backfills might take several minutes to complete, but you don't have to take the database offline or avoid writing to certain tables or columns during this process.

Add a secondary index using the Python client library

Use the `add_index()` method to create a secondary index. You will not change any code, the section is shown here for your reference.

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Add a secondary index using the Python client library

Use the `add_index()` method to create a secondary index. You will not change any code, the section is shown here for your reference.

```
def add_index(instance_id, database_id):
    """Adds a simple index to the example database."""
    spanner_client = spanner.Client()
    instance = spanner_client.instance(instance_id)
    database = instance.database(database_id)

    operation = database.update_ddl(
        [ "CREATE INDEX CategoryByCategoryName ON
Category(CategoryName)"]
    )

    print("Waiting for operation to complete...")
    operation.result(OPERATION_TIMEOUT_SECONDS)

    print("Added the CategoryByCategoryName index.")
```

1. Execute `snippets.py` using the `add_index` argument.

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```
def add_index(instance_id, database_id):
    """Adds a simple index to the example database."""
    spanner_client = spanner.Client()
    instance = spanner_client.instance(instance_id)
    database = instance.database(database_id)

    operation = database.update_ddl(
        ["CREATE INDEX CategoryByCategoryName ON
        Category(CategoryName)"]
    )

    print("Waiting for operation to complete...")
    operation.result(OPERATION_TIMEOUT_SECONDS)

    print("Added the CategoryByCategoryName index.")
```

1. Execute `snippets.py` using the `add_index` argument.

```
python snippets.py banking-ops-instance --database-id banking-
ops-db add_index
```

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Columns 4

- # CategoryId
- # PortfolioId
- Tr CategoryName
- # MarketingBudget

Keys 2

Indexes 1

- CategoryByCategoryName

Portfolio

Run Save Format Clear Documentation

Results Explanation ?

1. insert into Product (ProductId,CategoryId,PortfolioId,ProductName,ProductAssetCode,Pr... ▾

Index on Category(CategoryName) X

This statement inserted 1 row and did not return any rows.

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```
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$ python snippets.py banking-ops-instance --database-id banking-ops-db ad_index
/home/student_03_39e73dfc6385/.local/lib/python3.12/site-packages/google/cloud/spanner_v1/_init_.py:19: UserWarning: pkg_resources is deprecated as an API. See https://setuptools.pypa.io/en/latest/pkg_resources.html. The pkg_resources package is slated for removal as early as 2025-11-30. Refrain from using this package or pin to Setuptools<81.
    import pkg_resources
Waiting for operation to complete...
Added the CategoryByCategoryName index.
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$
```

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Read using the index

To read using the index, invoke a variation of the `read()` method with an index included. You will not change any code, the section is shown here for your reference.

```
def read_data_with_index(instance_id, database_id):
    """Reads sample data from the database using an index.

    """
    spanner_client = spanner.Client()
    instance = spanner_client.instance(instance_id)
    database = instance.database(database_id)

    with database.snapshot() as snapshot:
        keyset = spanner.KeySet(all_=True)
        results = snapshot.read(
            table="Category",
            columns=("CategoryId", "CategoryName"),
            keyset=keyset,
            index="CategoryByCategoryName",
        )
```

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```
columns=[category_id, category_name],  
keyset=keyset,  
index="CategoryByCategoryName",  
)  
  
for row in results:  
    print("CategoryId: {}, CategoryName: {}".format(*row))
```

1. Execute `snippets.py` using the `read_data_with_index` argument.

```
python snippets.py banking-ops-instance --database-id banking-  
ops-db read_data_with_index
```

The result should look like this:

```
CategoryId: 3, CategoryName: Annuities  
CategoryId: 1, CategoryName: Cash  
CategoryId: 2, CategoryName: Investments - Short Return  
CategoryId: 4, CategoryName: Life Insurance
```

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```
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$ python snippets.py banking-ops-instance --database-id banking-ops-db read_data_with_index
/home/student_03_39e73dfc6385/.local/lib/python3.12/site-packages/google/cloud/spanner_v1/_init__.py:19: UserWarning: pkg_resources is deprecated as an API. See https://setuptools.pypa.io/en/latest/pkg_resources.html. The pkg_resources package is slated for removal as early as 2025-11-30. Refrain from using this package or pin to Setuptools<81.
    import pkg_resources
CategoryId: 3, CategoryName: Annuities
CategoryId: 1, CategoryName: Cash
CategoryId: 2, CategoryName: Investments - Short Return
CategoryId: 4, CategoryName: Life Insurance
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$
```

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Add an index with a STORING clause

You might have noticed that the read example above did not include reading the **MarketingBudget** column. This is because Cloud Spanner's read interface does not support the ability to join an index with a data table to look up values that are not stored in the index.

To bypass this restriction, create an alternate definition of the **CategoryByCategoryName** index that stores a copy of **MarketingBudget** in the index.

Use the **update_ddl()** method of the Database class to add an index with a **STORING** clause. You will not change any code, the section is shown here for your reference.

```
def add_storing_index(instance_id, database_id):
    """Adds an storing index to the example database."""
    spanner_client = spanner.Client()
    instance = spanner_client.instance(instance_id)
    database = instance.database(database_id)

    operation = database.update_ddl(
        [
            "CREATE INDEX CategoryByCategoryName2 ON
                Category(CategoryName)"
```

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```
print("Added the CategoryByCategoryName2 index.")
```

1. Execute `snippets.py` using the `add_storing_index` argument.

```
python snippets.py banking-ops-instance --database-id banking-  
ops-db add_storing_index
```

Now you can execute a read that fetches the `CategoryId`, `CategoryName`, and `MarketingBudget` columns while using the `CategoryByCategoryName2` index. You will not change any code, the section is shown here for your reference.

```
def read_data_with_storing_index(instance_id, database_id):  
    """Reads sample data from the database using an index with a storing  
    clause.  
  
    """  
    spanner_client = spanner.Client()  
    instance = spanner_client.instance(instance_id)  
    database = instance.database(database_id)  
  
    with database.snapshot() as snapshot:
```

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```
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$ python snippets.py banking-ops-instance --database-id banking-ops-db read_data_with_index
/home/student_03_39e73dfc6385/.local/lib/python3.12/site-packages/google/cloud/spanner_v1/_init__.py:19: UserWarning: pkg_resources is deprecated as an API. See https://setuptools.pypa.io/en/latest/pkg_resources.html. The pkg_resources package is slated for removal as early as 2025-11-30. Refrain from using this package or pin to Setuptools<81.
    import pkg_resources
CategoryId: 3, CategoryName: Annuities
CategoryId: 1, CategoryName: Cash
CategoryId: 2, CategoryName: Investments - Short Return
CategoryId: 4, CategoryName: Life Insurance
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$ python snippets.py banking-ops-instance --database-id banking-ops-db add_storing_index
/home/student_03_39e73dfc6385/.local/lib/python3.12/site-packages/google/cloud/spanner_v1/_init__.py:19: UserWarning: pkg_resources is deprecated as an API. See https://setuptools.pypa.io/en/latest/pkg_resources.html. The pkg_resources package is slated for removal as early as 2025-11-30. Refrain from using this package or pin to Setuptools<81.
    import pkg_resources
Waiting for operation to complete...
Added the CategoryByCategoryName2 index.
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$
```

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Project ID

qwiklabs-gcp-01-c4c8572c



```
results = snapshot.read(
    table="Category",
    columns=("CategoryId", "CategoryName", "MarketingBudget"),
    keyset=keyset,
    index="CategoryByCategoryName2",
)

for row in results:
    print(u"CategoryNameId: {}, CategoryName: {}, "
"MarketingBudget: {}".format(*row))
```

2. Execute `snippets.py` using the `read_data_with_storing_index` argument.

```
python snippets.py banking-ops-instance --database-id banking-
ops-db read_data_with_storing_index
```

The result should be

```
CategoryNameId: 3, CategoryName: Annuities, MarketingBudget: 500000
CategoryNameId: 1, CategoryName: Cash, MarketingBudget: 100000
CategoryNameId: 2, CategoryName: Investments - Short Return,
MarketingBudget: None
```

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```
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$ python snippets.py banking-ops-instance --database-id banking-ops-db read_data_with_storing_index
/home/student_03_39e73dfc6385/.local/lib/python3.12/site-packages/google/cloud/spanner_v1/_init__.py:19: UserWarning: pkg_resources is deprecated as an API. See https://setuptools.pypa.io/en/latest/pkg_resources.html. The pkg_resources package is slated for removal as early as 2025-11-30. Refrain from using this package or pin to Setuptools<81.
    import pkg_resources
CategoryNameId: 3, CategoryName: Annuities, MarketingBudget: None
CategoryNameId: 1, CategoryName: Cash, MarketingBudget: None
CategoryNameId: 2, CategoryName: Investments - Short Return, MarketingBudget: None
CategoryNameId: 4, CategoryName: Life Insurance, MarketingBudget: None
student_03_39e73dfc6385@cloudshell:~/python-helper (qwiklabs-gcp-01-c4c8572d2603)$
```

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Create and Manage Cloud Spanner

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Username: student-03-39e73dfc6385

Password: 0jXN8ivIYoi1

Project ID: qwiklabs-gcp-01-c4c8572c

Task 6. Examine Query plans

In this section, you will explore Cloud Spanner **Query Plans**.

1. Return to the **Cloud Console**, it should still be on the **Query** tab of **Spanner Studio**. Clear any existing query, paste, and **Run** the following query:

```
SELECT Name, ShortName, CategoryName  
FROM Portfolio  
INNER JOIN Category  
ON Portfolio.PortfolioId = Category.PortfolioId;
```

2. The result should look like this:

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Explorer C K 🔒 Query 1 +
Default Tables 4
Campaigns Category Portfolio Products
RUN CLEAR QUERY FORMAT QUERY SHORTCUTS SQL query help
1 SELECT Name, ShortName, CategoryName
2 FROM Portfolio
3 INNER JOIN Category
4 ON Portfolio.PortfolioId = Category.PortfolioId;

9+ 10°C Clear

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100/100

Setup and requirements

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Congratulations!

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 - Change streams 0
 - Views 0
 - Models 0
 - Graphs 0
- INFORMATION_SCHEMA
- SPANNER_SYS
- Roles 3
- Placements 1

Run Save Format Clear Documentation

Valid

```
1 SELECT Name, ShortName, CategoryName
2 FROM Portfolio
3 INNER JOIN Category
4 ON Portfolio.PortfolioId = Category.PortfolioId;
```

Results Explanation ? Export

Name	ShortName	CategoryName
"Banking"	"Bnkg"	"Cash"
"Asset Growth"	"AsstGrwth"	"Investments - Short Return"
"Asset Growth"	"AsstGrwth"	"Annuities"
"Insurance"	"Ins"	"Life Insurance"

Rows per page: 30 ▾ 1 – 4 of 4 < >

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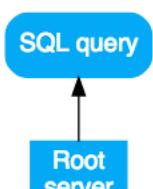


Life of a query

A SQL query in Cloud Spanner is first compiled into an execution plan, then it is sent to an initial root server for execution. The root server is chosen so as to minimize the number of hops to reach the data being queried. The root server then:

- Initiates remote execution of subplans (if necessary)
- Waits for results from the remote executions
- Handles any remaining local execution steps such as aggregating results
- Returns results for the query

Remote servers that receive a subplan act as the "root" server for their subplan, following the same model as the top-most root server. The result is a tree of remote executions. Conceptually, query execution flows from top to bottom, and query results are returned from bottom to top. The following diagram shows this pattern:



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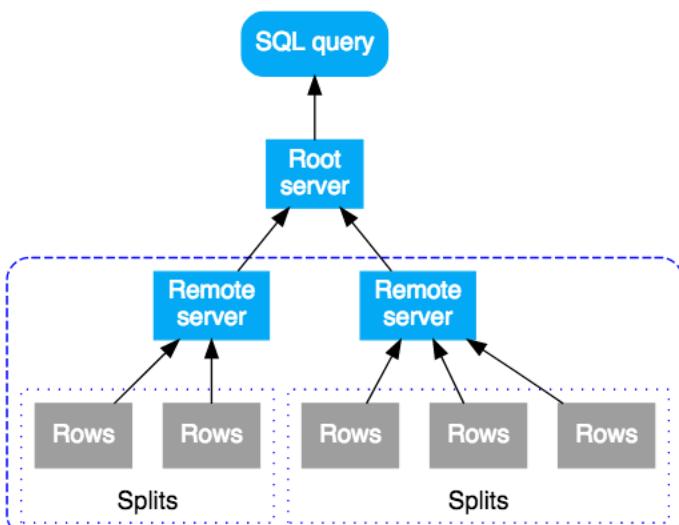


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- Handles any remaining local execution steps such as aggregating results
- Returns results for the query

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Project ID

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Aggregate Query

Now take look at the query plan for an aggregated query.

1. On the **Query** tab of **Spanner Studio**, clear the existing query, paste, and **Run** the following query.

```
SELECT pr.ProductId, COUNT(*) AS ProductCount
FROM Product AS pr
WHERE pr.ProductId < 100
GROUP BY pr.ProductId;
```

2. Once the query completes click on the **Explanation** tab below the query body to examine the query plan.

Cloud Spanner sends the execution plan to a root server that coordinates the query execution and performs the remote distribution of subplans.

This execution plan starts with a serialization which orders all values returned. Then the plan completes an initial hash aggregate operator to preliminarily calculate results. Then a distributed union is executed which distributes subplans to remote servers whose

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Views 0

Models 0

Graphs 0

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Valid

SELECT pr.ProductId, COUNT(*) AS ProductCount
FROM Product AS pr
WHERE pr.ProductId < 100
GROUP BY pr.ProductId;

Results Explanation

ProductId	ProductCount
7	1
4	1
5	1
1	1
2	1
3	1
6	1
8	1
9	1

Export

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Results Explanation

SELECT pr.ProductId, COUNT(*) AS ProductCount FROM Product AS pr WHERE pr.ProductId < 100 GROUP BY pr.ProductId Statement completed (5.97 ms elapsed)

Schemas 3 Default Tables 4 Campaigns Category Portfolio Product Change streams 0 Views 0 Models 0 Graphs 0 INFORMATION_SCHEMA SPANNER_SYS Roles 3 Placements 1

Expanded Compact + - ↻

Serialize result Highest row count Rows returned: 9 Latency: <1 ms CPU time: <1 ms

Hash aggregate Highest row count Rows returned: 9

Distributed union Highest row count Rows returned: 9 Latency: <1 ms CPU time: <1 ms

Table scan on Product as pr Highest row count Latency: <1 ms CPU time: <1 ms

Hash aggregate Highest row count Rows returned: 9 Latency: <1 ms CPU time: <1 ms

Filter scan Highest row count Rows returned: 9

Index recommendation Preview This query has a missing index and could benefit by adding an index to speed up this query by reading less data from disk.

Performance Est. improvement% : 77.17% View details

Query summary Total elapsed time 5.97 ms CPU time 5.49 ms

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Latency: <1 ms CPU time: <1 ms Expanded Compact + - ↻

Hash aggregate Highest row count Rows returned: 9 Latency: <1 ms CPU time: <1 ms

Filter scan Highest row count Rows returned: 9

Table scan on Product Full scan Highest latency Highest CPU time Highest row count

Statement completed (5.97 ms elapsed)

Download JSON

Index recommendation Preview This query has a missing index and could benefit by adding an index to speed up this query by reading less data from disk.

Performance Est. improvement% : 77.17% View details

Query summary Total elapsed time 5.97 ms CPU time 5.49 ms

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Search Schemas 3 Default Tables 4 Campaigns Category Portfolio Product Change streams 0 Views 0 Models 0 Graphs 0 INFORMATION_SCHEMA SPANNER_SYS Roles 3 Placements 1

Results Explanation

```
SELECT pr.ProductId, COUNT(*) AS ProductCount FROM Product AS pr WHERE pr.ProductId < 100 GROUP BY pr.ProductId
```

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Download JSON

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Password

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Project ID

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Co-located join queries

Interleaved tables are physically stored with their rows of related tables co-located. A join between interleaved tables is known as a co-located join. Co-located joins can offer performance benefits over joins that require indexes or back joins.

1. On the **Query** tab of **Spanner Studio**, clear the existing query, paste, and **Run** the following query.

```
SELECT c.CategoryName, pr.ProductName
FROM Category AS c, Product AS pr
WHERE c.PortfolioId = pr.PortfolioId AND c.CategoryId =
pr.CategoryId;
```

2. Once the query completes click on the **Explanation** tab below the query body to examine the query plan.

This execution plan starts with a distributed union, which distributes subplans to remote servers that have splits of the table **Category**. Because **Product** is an interleaved table of **Category**, each remote server is able to execute the entire subplan on each remote server without requiring a join to a different server.

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Views 0

Models 0

Graphs 0

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Run

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Format

Clear

Documentation

Results Explanation

Export

CategoryName ProductName

CategoryName	ProductName
"Cash"	"Checking Account"
"Cash"	"Savings Account"
"Cash"	"Personal Loan"
"Cash"	"Auto Loan"
"Investments - Short Return"	"Mutual Fund Consumer Goods"
"Investments - Short Return"	"US Savings Bonds"
"Annuities"	"Annuity Early Retirement"
"Life Insurance"	"Term Life Insurance"
"Life Insurance"	"Permanent Life Insurance"

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Search Results Explanation ? Statement completed (7.88 ms elapsed)

SELECT c.CategoryName, pr.ProductName FROM Category AS c, Product AS pr WHERE c.Portfoliod = pr.Portfoliod AND c.Cate...

Distributed union
Highest row count
Rows returned: 9
Latency: <1 ms CPU time: <1 ms

Serialize result
Highest row count
Rows returned: 9
Latency: <1 ms CPU time: <1 ms

Download JSON

Query summary

Total elapsed time	7.88 ms
CPU time	7.81 ms
Plan creation time	7.25 ms
Server Queue Delay	<1 ms
Rows returned	9
Rows scanned	18
Query optimizer version	8
Statistics package	auto_202601
	09_14_34_42
	UTC

Prominent operators

Highest latency	<1 ms
Highest CPU time	<1 ms

9+ 10°C Clear

Search

9 10°C Clear

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Results Explanation ? Statement completed (7.88 ms elapsed)

SELECT c.CategoryName, pr.ProductName FROM Category AS c, Product AS pr WHERE c.Portfoliod = pr.Portfoliod AND c.Cat...

Cross apply
Highest row count
Rows returned: 9
Latency: <1 ms CPU time: <1 ms

Table scan
on Product
Full scan
Highest latency
Highest CPU time
Highest row count
Rows returned: 9
Latency: <1 ms CPU time: <1 ms

Filter scan
Highest row count
Rows returned: 9

Distributed union
Highest row count
Rows returned: 9
Latency: <1 ms CPU time: <1 ms

Serialize result
Highest row count
Rows returned: 9
Latency: <1 ms CPU time: <1 ms

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Search Results Explanation Statement completed (7.88 ms elapsed)

SELECT c.CategoryName, pr.ProductName FROM Category AS c, Product AS pr WHERE c.Portfoliod = pr.Portfoliod AND c.Cat...

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Full scan
Highest latency
Highest CPU time
Highest row count
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Filter scan
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Highest row count Rows returned: 9 Latency: <1 ms CPU time: <1 ms

Table scan
on Category
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Prominent operators

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Highest CPU time	<1 ms

9+ 10°C Clear

Search

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