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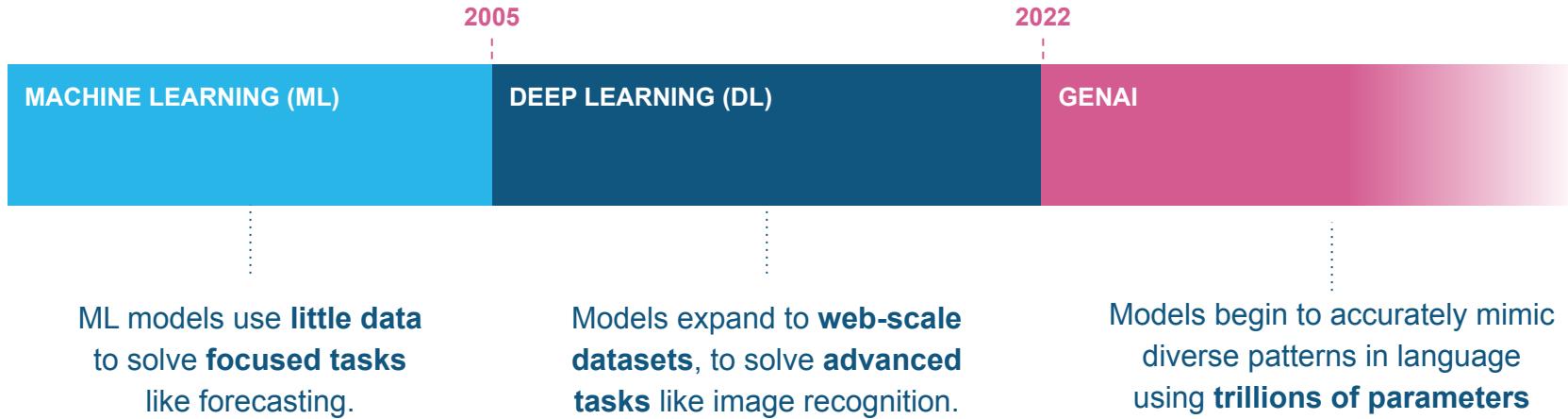


GENERATIVE AI & ML

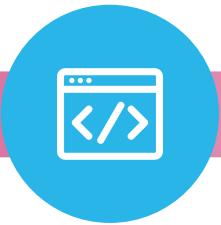
EFFICIENT. SECURE. TRUSTED

2024

Generative AI Is a New Era of Computing



GenAI Is Changing How We Interact



Generate Code

Driving engineering productivity is a board level issue for any software company



Understand information faster

Extract insights at scale from unstructured data (docs, reviews, images) using summarization, categorization & more.

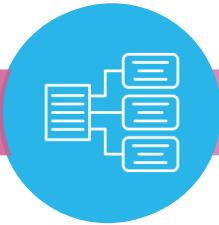


Chat with applications

Natural language and interactive chat as a new paradigm for interacting with analytical data from CRM, BI, etc



...And It's Changing What We Can **Create**



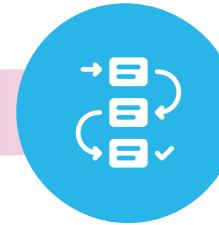
Write copy

Accurately generate domain-specific content for marketing, documentation, analysis



Generate images & video

Democratizing artistic and creative work for commercial and personal use



Agents that take action

Capable of complex workflows, able to decide what actions to take without intervention



Unified platform for end-to-end gen AI and ML

App Development
Studio | Notebooks | Streamlit | Copilot

Generative AI
Cortex AI

Machine Learning
Snowflake ML

Data & Model Governance
Snowflake Horizon | Model Registry

EFFICIENT

Streamline development-to-deployment lifecycle with cutting-edge AI models, frameworks and apps running next to the data

EASY

Fully managed and tightly integrated data and AI infrastructure accessible via no-code Studio, SQL, Python, and REST APIs interfaces

TRUSTED

Protect the value of your IP at scale with industry-leading security and unified governance for data and models trusted by thousands of organizations



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STUDIO

No-code interface to build ML models and chatbots using LLMs

NOTEBOOKS

Experiment and iterate quickly using Python or SQL in a single development environment

STREAMLIT IN SNOWFLAKE

Turn data and models into interactive applications such as chatbots using Python

COPILOT

Find answers and generate insights faster with SQL coding assistant inside Snowsight



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CORTEX AI

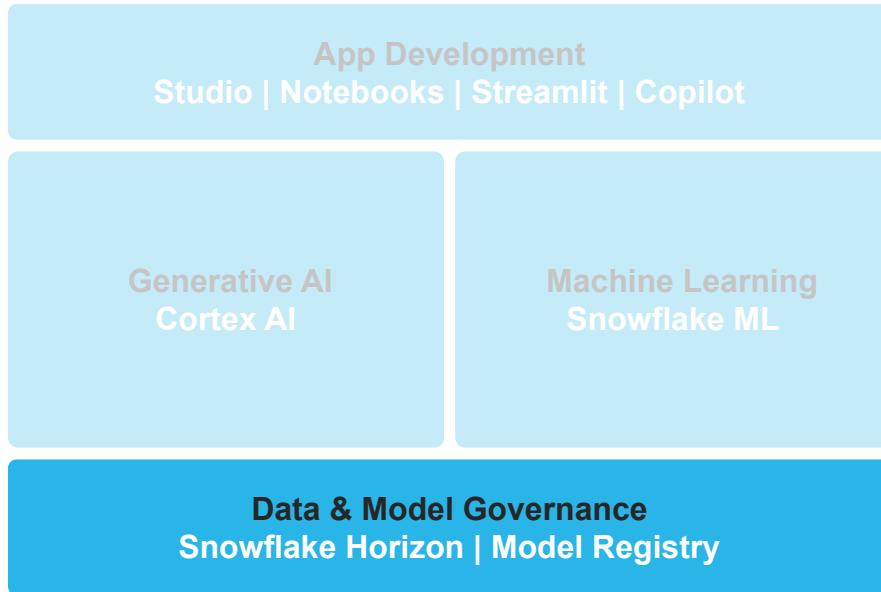
Serverless access to top-tier LLMs such as Snowflake Arctic, Mistral Large, and Llama 3 alongside cutting-edge services to build chatbots and other AI apps

SNOWFLAKE ML

Develop, manage, and productionize features for ML workflows. Train models with CPUs or GPUs using any Python framework. Use ML Functions to shorten development time or democratize ML across your organization



Unified platform for end-to-end gen AI and ML



SNOWFLAKE HORIZON

Protect your IP with a built-in, unified set of capabilities including Role-Based Access Controls and granular governance policies for data, apps and models

MODEL REGISTRY

Advanced model management for fine-tuned LLMs as well as internally and externally-built ML models and their metadata



Snowflake AI Is Easy

Snowflake Copilot GA Soon

Document AI GA Soon

Cortex AI

Studio PR

Chat

Structured Data

Cortex Analyst PU Soon

Documents

Cortex Search PU Soon

Models



Task-Specific &
Embed Models

Foundation Models

Fine-Tuned
Models PU



A New Customer Experience in Financial Services



Banking

- Chatbots & Virtual Assistants
- Robo-advisory
- Personalization
- Tailored Recommendations



Asset Management

- Investor Reporting
- Portfolio Optimization
- Quantitative Research
- Portfolio Risk Management



Insurance

- Claims Management
- Regulatory Reporting
- Fraud Detection
- Credit Scoring

AI Security and Governance



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Snowflake's commitment to trust and Safety extends to GenAI, upholding high standards for security and governance

Data governance

-  **Fully secure** – AI features adhere to the standard security program for the Snowflake Service, designed to protect the confidentiality and integrity of your data
-  **No training on your data** – Snowflake never uses Customer Data to train AI models made available to our customer base
-  **No requests to third-party services** – your data never leaves Snowflake when you use an AI feature; all data is kept within the Snowflake security perimeter
-  **No commingling of data** – AI services isolate customer data at the software level, so no data is ever mixed with that of another Snowflake customer



Cortex AI serverless inference architecture – designed with security at the forefront

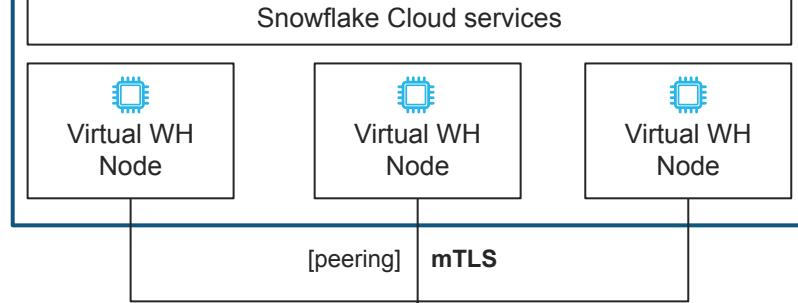
AI Services are fully contained within the Snowflake Secure deployment boundary

- Multi-tenant, serverless inference services run in an Applications Cluster VPC that is peered to the customer warehouse
- Data across customer accounts is isolated at the software level during inference
- Stateless GPU inference with no persistence of any data to disk

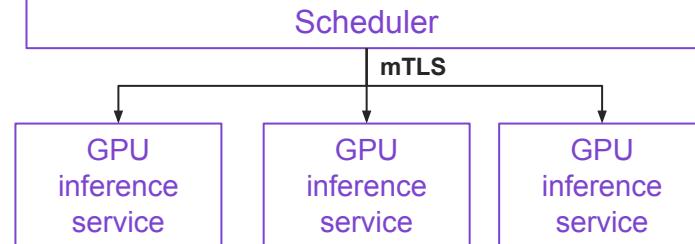
CSP region

Snowflake deployment

CSP Private Network (SF VPC/VNET)



Applications Cluster VPC



[GPU nodes preloaded with AI models]



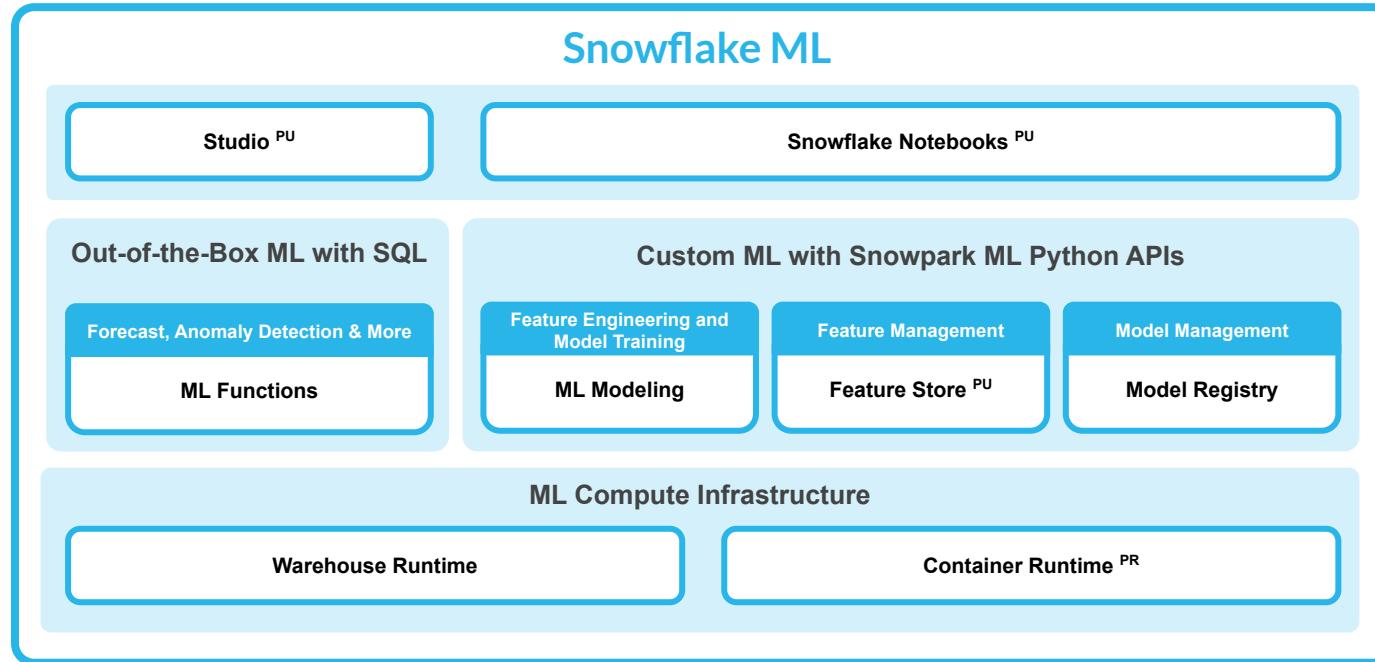
Snowflake ML



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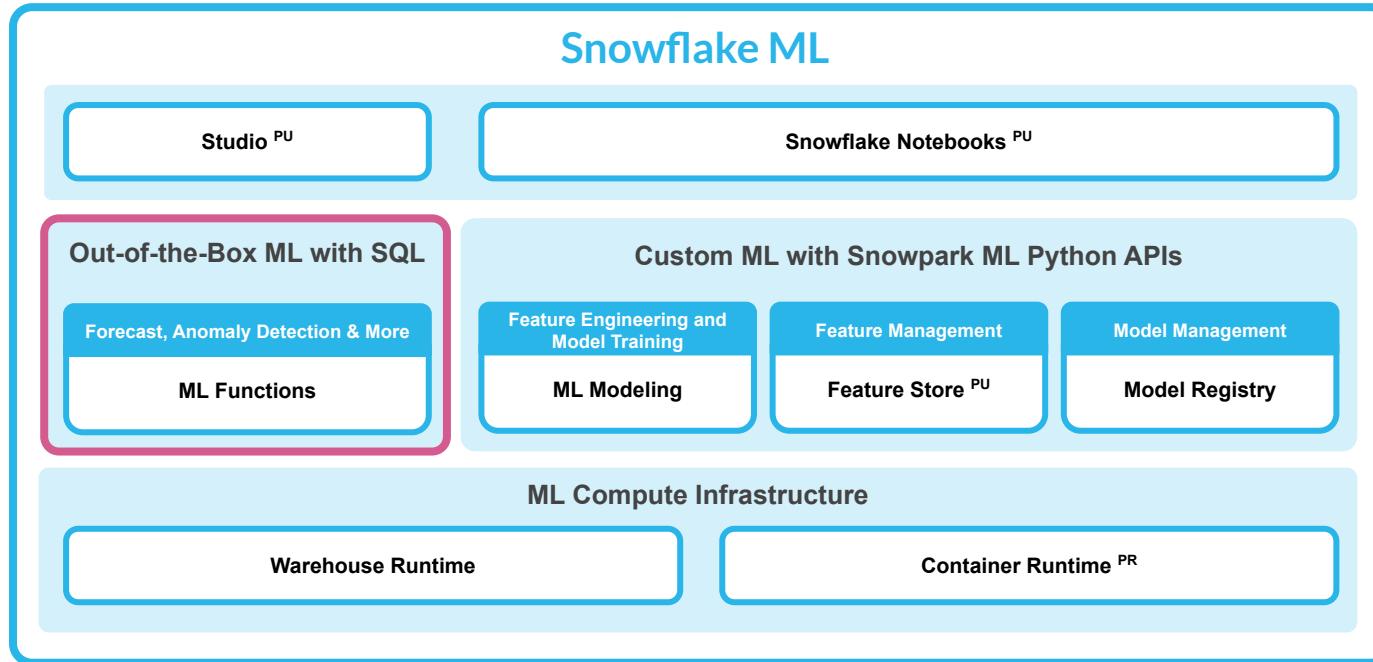
Snowflake ML

Integrated set of capabilities for end-to-end ML workflows in Snowflake



Snowflake ML

Integrated set of capabilities for end-to-end ML workflows in Snowflake



Snowflake ML Functions

What Is It

SQL functions that perform predictive analytics using machine learning under the hood

Why Use It

Generate predictions and insights on your structured data with the power of ML—but without its complexity

How To Use It

Use SQL function in Snowsight or expose as a custom app via Streamlit

ML Functions

FORECAST()

ANOMALY_DETECTION()

TOP_INSIGHTS()

PuPr

CLASSIFICATION()

PuPr



Structured Data



ML Functions in Snowflake



Forecasting

Build more reliable time series forecasts with automated handling of seasonality, missing values and more



Anomaly Detection

Identify outliers and trigger alerts or help find unlikely-to-happen-again situations that should be excluded from analysis



Contribution Explorer

Quickly identify drivers contributing to the change of a given metric across user defined time intervals



Classification

Sort data into different classes (e.g., loyal customer vs. likely to churn) using supervised learning techniques

GA

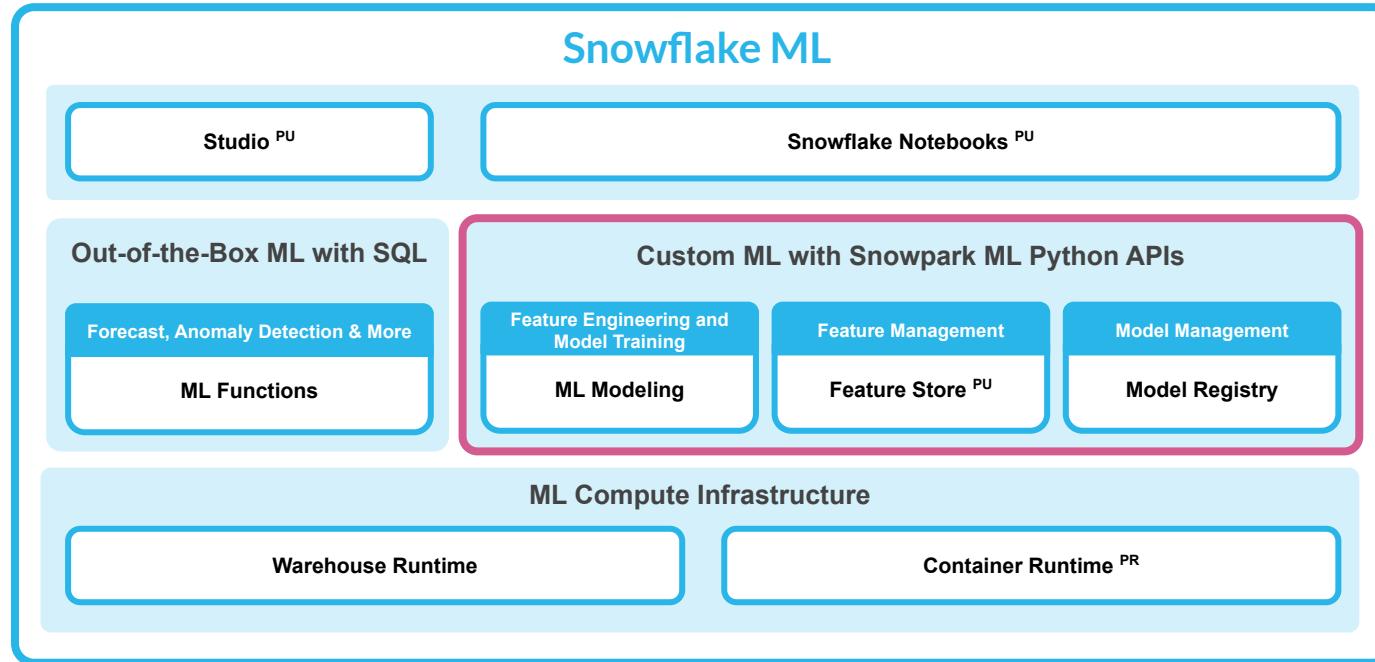
GA

Public Preview

Public Preview

Snowflake ML

Integrated set of capabilities for end-to-end ML workflows in Snowflake



Snowflake Notebooks

WHAT IS IT

Familiar, easy-to-use notebook interface for your data work that blends Python, SQL, and Markdown. Available on warehouse runtime (PuPr) and container runtime (PrPr)

WHY USE IT

Simplify the process of connecting to your data and to amplify your data engineering, analytics, and machine learning workflows

HOW TO USE IT

- Create a notebook directly in Snowsight or from an existing project
- Sync with remote Git repo for version control and collaboration
- Schedule notebooks to run automated pipelines

The screenshot shows a Snowflake Notebook interface with three code cells:

- Python v as cell3**: Contains Python code for importing Streamlit, Altair, Pandas, NumPy, and Matplotlib.
- Markdown v as cell4**: Contains a heading "SQL Querying at your fingertips" with a lightbulb icon, followed by a note about switching between Python and SQL, and a prompt to write SQL.
- SQL v as cells**: Contains SQL code for generating a synthetic dataset of snowboard products. The resulting table has 5 rows of sample data:

	PRODUCT_ID	RATING	PRICE
0	SNOW-9681	2.2102	879.2882
1	SNOW-9657	3.3833	835.3502
2	SNOW-3551	3.511	864.5094
3	SNOW-8226	0.9605	673.7927
4	SNOW-R473	3.1038	496.0473

Snowpark ML Modeling

WHAT IS IT

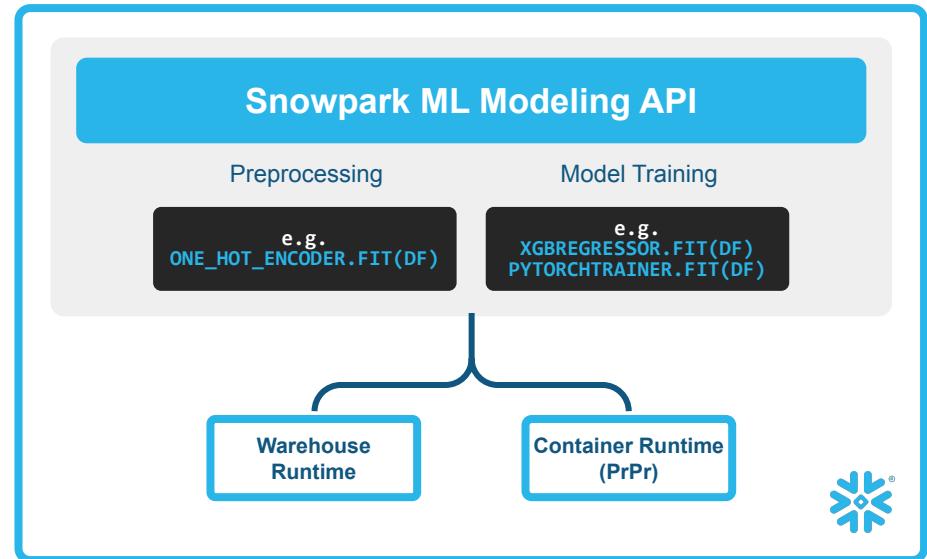
Popular frameworks for feature engineering and ML training in Snowflake directly with warehouse or container runtimes

WHY USE IT

- **Preprocessing:** Improve performance and scalability with distributed execution for common scikit-learn preprocessing functions
- **Model Training:** Streamline model training for popular ML and deep learning frameworks (e.g. pytorch, scikit-learn, xgboost, lightgbm)

HOW TO USE IT

Use pre-installed from Snowflake Notebooks or your tool of choice by downloading the Snowpark ML library



Snowpark for Python

Python in virtual warehouses



Snowflake Copilot



Document AI



Universal Search



Snowflake Notebooks



Feature Store



Streamlit in Snowflake



Snowpark for Python



Model Registry



Snowpark Container Services



Snowflake Cortex



Snowflake Data



Security & Governance



Snowpark Overview

What is Snowpark?

Set of libraries and runtimes that securely deploy and process Python and other programming languages in Snowflake to develop data pipelines, machine learning models, apps, and more.

Code development & deployment
client-side libraries

Code execution
elastic compute runtimes

Any notebook / IDE



Snowpark API

For data pipelines, apps, and more

Snowpark ML API

For ML features & models

Virtual Warehouse

Python | Java | Scala
CPU

Snowpark Container Services

Any language
CPU & GPU



Language of Choice on a Single Platform



Scalability Without Operational Complexity



No Governance and Security Trade-offs

Over 35% of Snowflake customers use Snowpark on a weekly basis, including:



*As of October 2023



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Snowpark Features in Virtual Warehouses

SNOWPARK API

DATAFRAME API

Use DataFrames to transform structured and unstructured data into modeled formats

SNOWPARK ML API

ML MODELING

Popular frameworks for feature engineering and ML training without data movement

ML OPERATIONS

(PuPr)

Integrated solution to manage models and their metadata natively in Snowflake

USER-DEFINED FUNCTIONS (UDFs)

Execute custom Python and other programming languages in Snowflake's distributed engine

VECTORIZED UDFs

Pandas DataFrame batch processing of vectorized functions (e.g., model inference)

UDTFs: USER-DEFINED TABLE FUNCTIONS

Non 1:1 transformations with custom partitioning guaranteeing contiguous batches

VECTORIZED UDTFs

Define Python table functions that receive a partition as a Pandas DataFrame and return results as Pandas DataFrame or arrays/ series

UDAFs: USER-DEFINED AGGREGATE FUNCTIONS

(PrPr)
Act on values across multiple rows to return a single aggregated value as a result

STORED PROCEDURES

Host and operationalize Python and other languages and/or Snowpark API calls. Single node bounded

TABLE STORED PROCEDURES

Write a procedure that returns data in tabular form

ANONYMOUS STORED PROCEDURES

Create and call temporary stored procedures anonymously



Snowpark for Python



Familiar Programming Constructs

Use familiar syntax
with DataFrame
abstraction



Rich Ecosystem

Easy access to thousands of
open source packages with
automated dependency
management

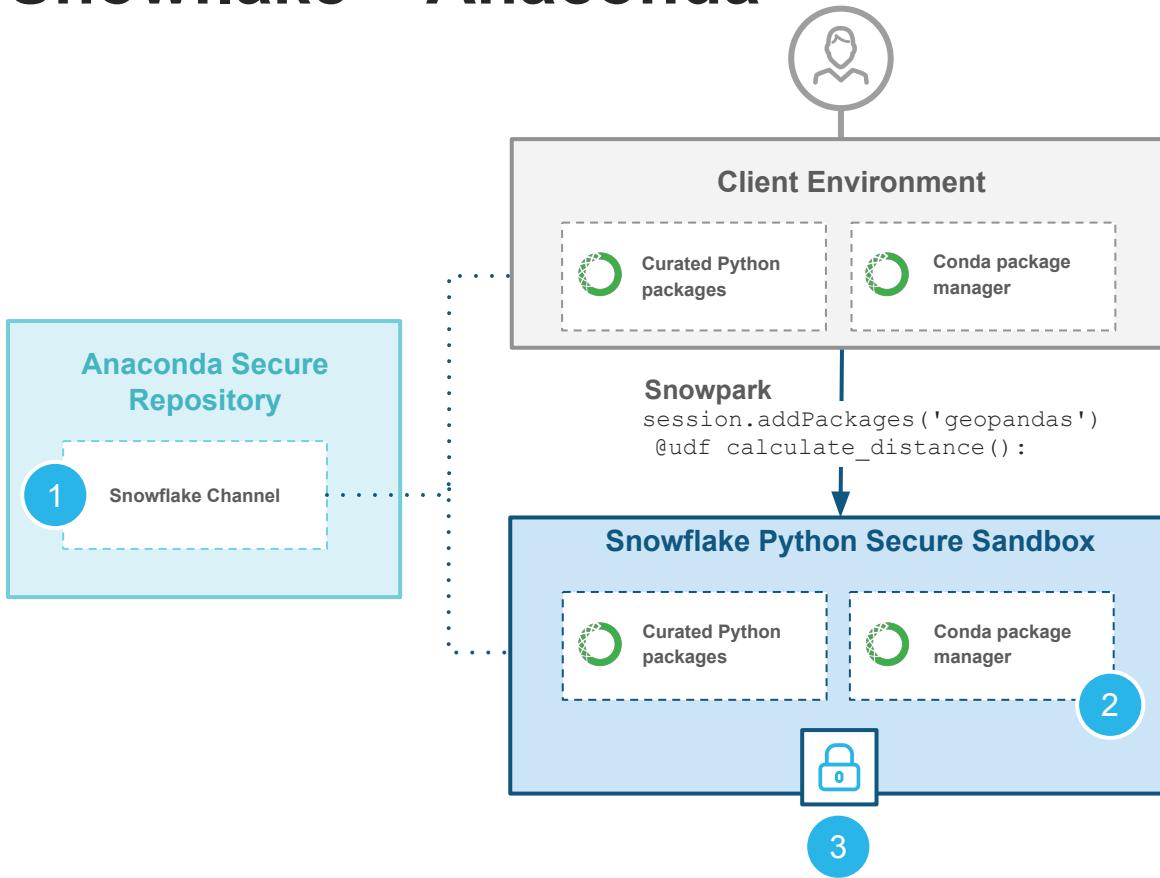


Secure Processing

Build with confidence
in a highly secure,
sandboxed environment



Snowflake + Anaconda



1 Easy Access

Curated packages pre-installed in Snowflake also available for local development

2 No Dependency Hell

Conda package manager integrated in Snowflake secure sandbox

3 Scalable and Secure

Process with secure sandbox integrated into Snowflake processing engine

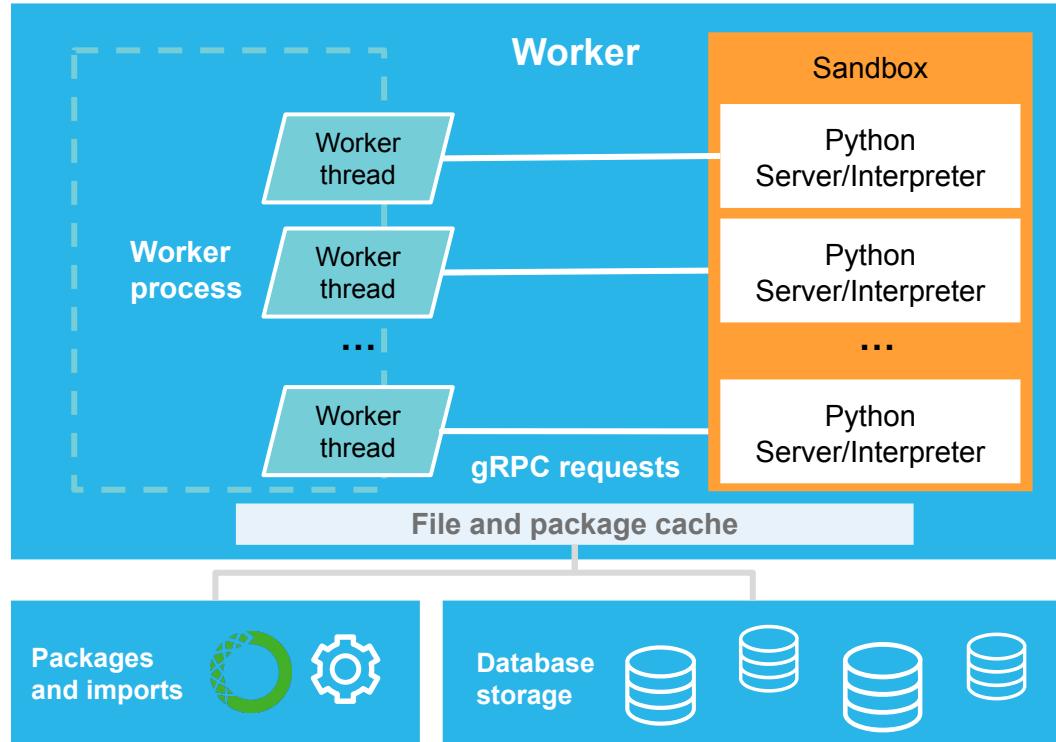
All of this with no additional charges beyond warehouse usage



PYTHON FUNCTION EXECUTION

2

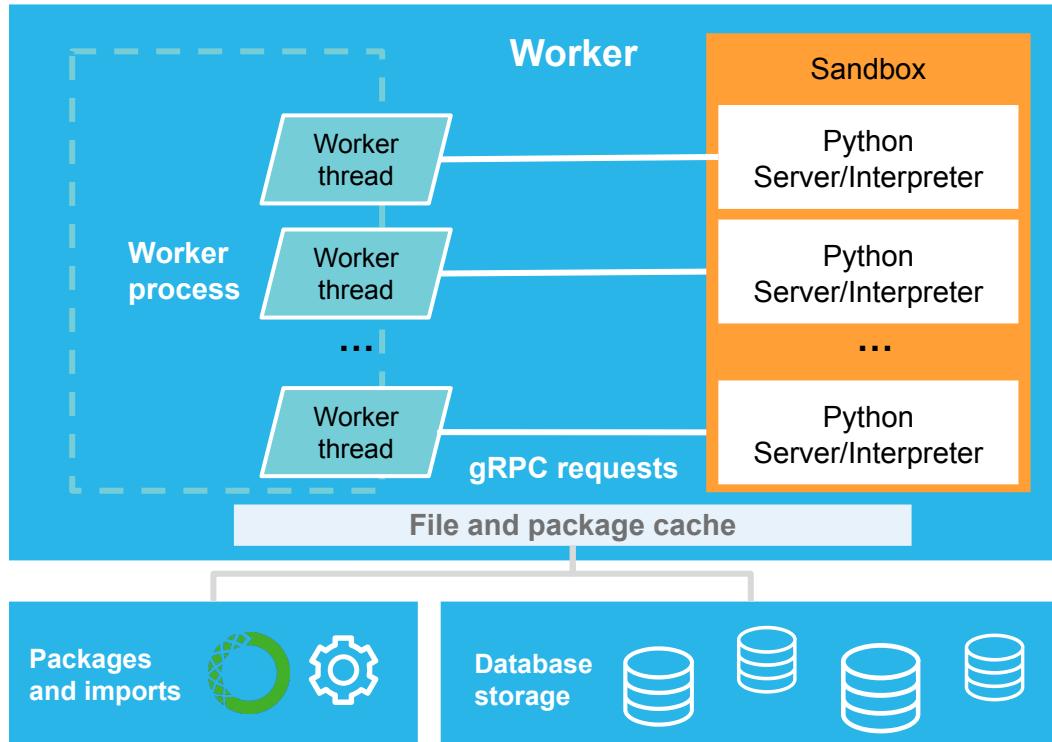
- Since Python has a global interpreter lock, Snowflake creates many Python interpreter processes for each function in the query.
- Snowflake initializes the Python interpreter before forking additional processes to reduce initialization time.



PYTHON FUNCTION EXECUTION

3

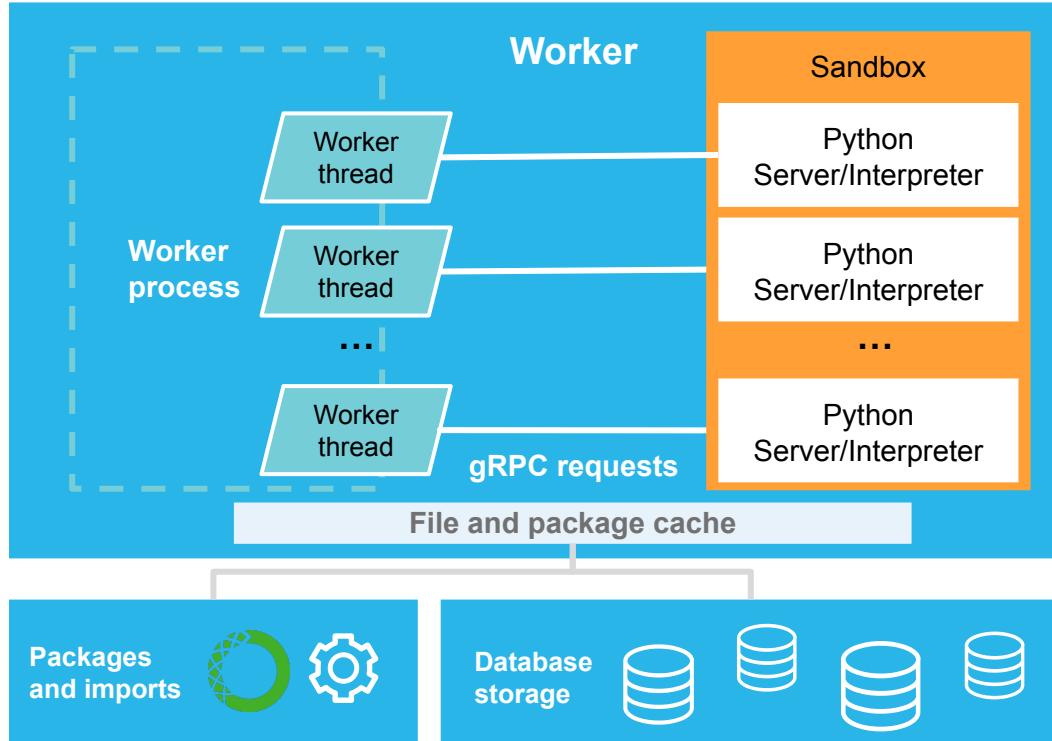
- When the query is done, packages and imports remain in a local cache, but the sandbox and Python interpreters are cleaned up.
- Re-running the same query, or another query that uses some of the same packages or imports, will be faster due to caching.



PYTHON FUNCTION SANDBOXING

4

- As with Java functions, the Python function sandbox prevents network and local file system access.
- Anaconda shares common vulnerabilities and exposures (CVEs) through their website.
- The sandbox mitigates CVEs that could lead to data exfiltration or attacks on the host system.



Streamlit in Snowflake Deep Dive



Snowflake Copilot



Document AI



Universal Search



Snowflake Notebooks



Feature Store



Streamlit in Snowflake



Snowpark ML



Model Registry



Snowpark Container Services



Snowflake Cortex



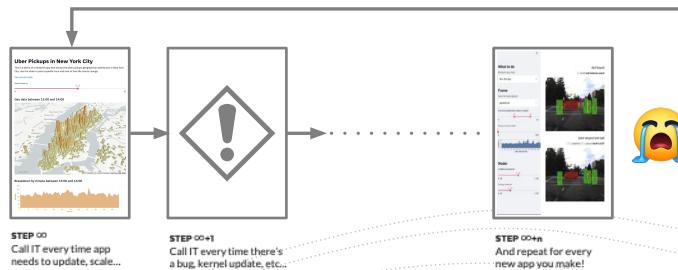
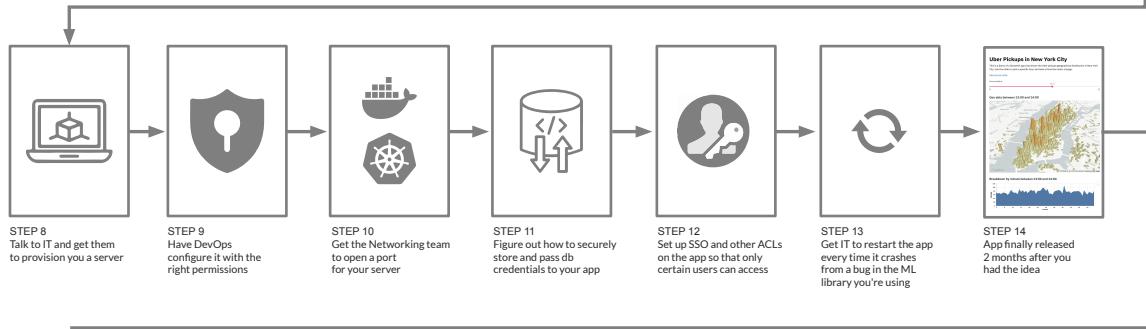
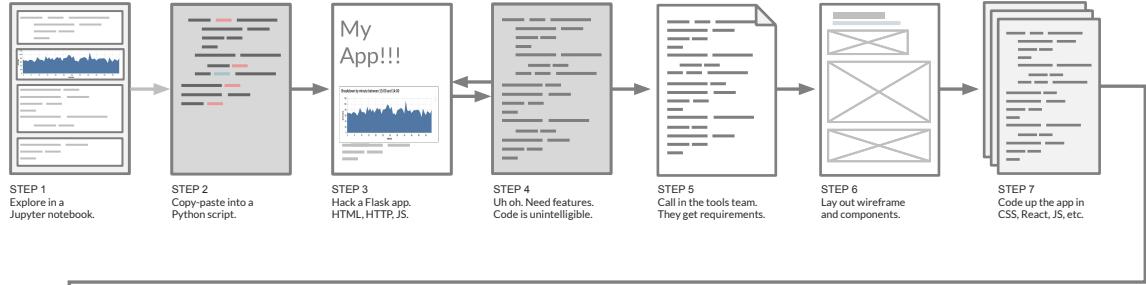
Snowflake Data



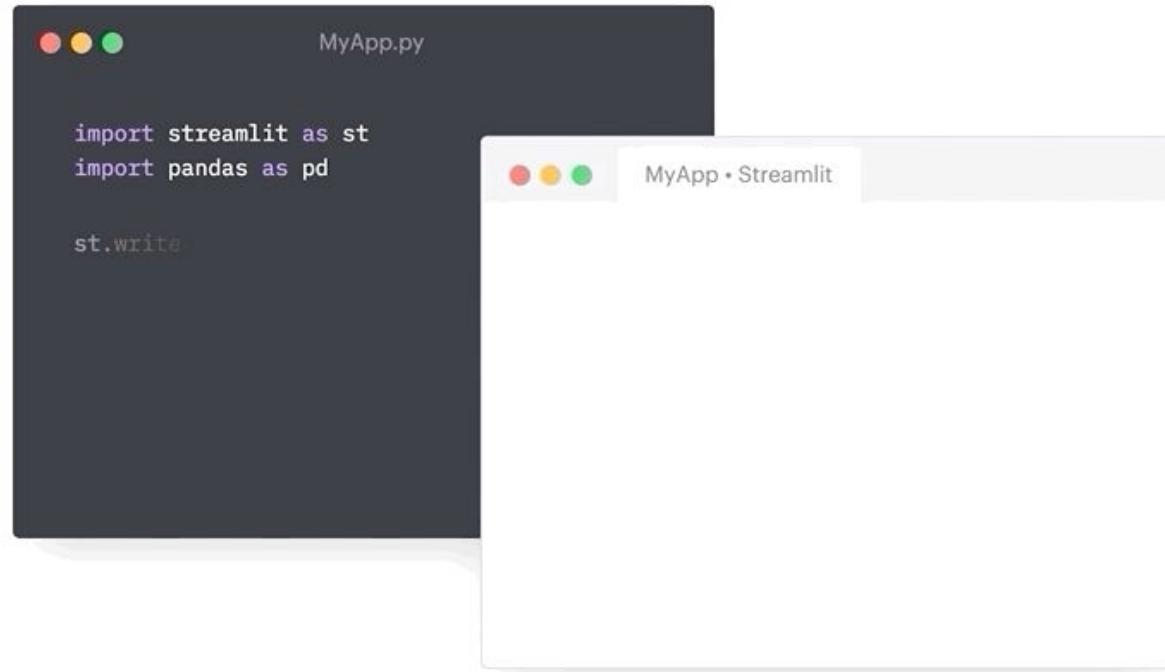
Security & Governance



Getting from data to action is hard

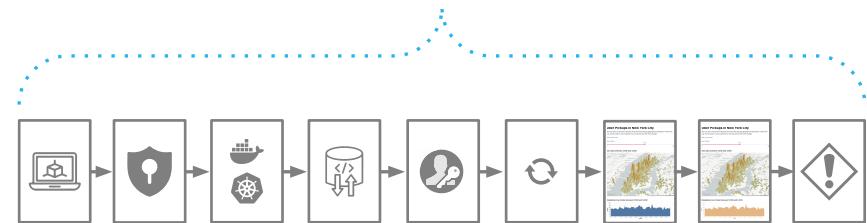
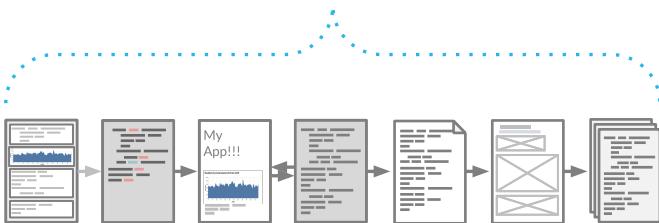


Streamlit is an open-source UI library for Python



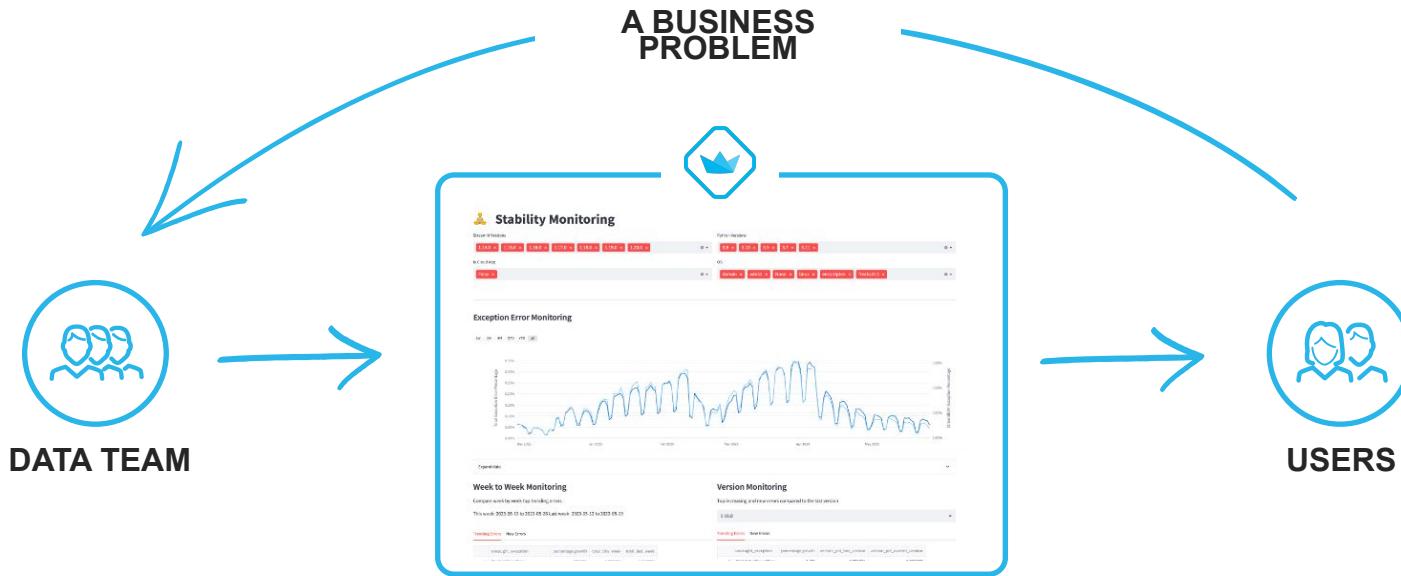


Streamlit in Snowflake



Streamlit Changes How Your Teams Interact with Data

by rapidly bringing data apps and insights to market



Today, Streamlit in Snowflake are great when:



APP COMPONENTS LIVE IN SNOWFLAKE

Maintain consistent governance of data, ML models and app in Snowflake



APP IS FOR INTERNAL USE ONLY

Apps users are coworkers that can access Snowflake account where app is created



CAN LIVE WITHOUT JS/REACT/CSS

Develop app using Python only because speed is more important than fancy gradients



Package Streamlits into a **Snowflake Native App** for external distribution

