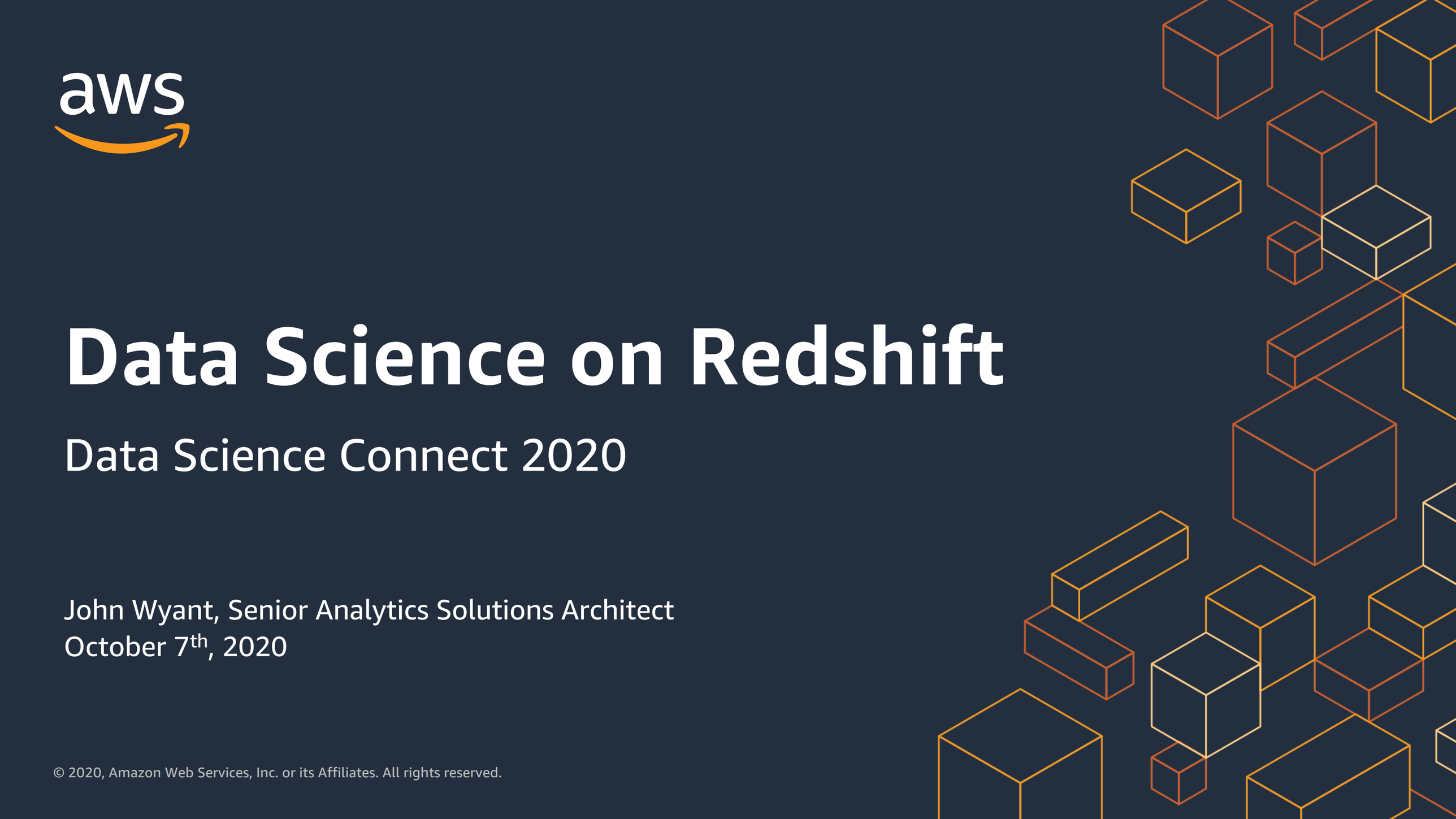


Data Science on Redshift

Data Science Connect 2020

John Wyant, Senior Analytics Solutions Architect
October 7th, 2020

Agenda

- Analytical Landscape Overview
- Redshift Overview
- Redshift Data Science Enabling Features
- Accessing Redshift
    - Amazon Console
    - JDBC
    - Notebook
- Sagemaker Python (scikit-learn) Demo – Sales Forecasting
- Sagemaker Training Demo – Smart Meter Prediction

aws

Data warehousing trends

Migrations to the cloud

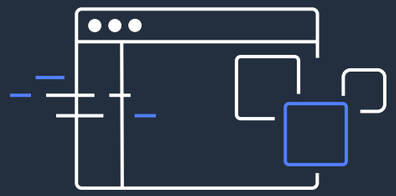
Exponential growth of event data

End-to-end insights from analyzing all your data

aws

Challenges of data analytics at scale

Data volume, variety, velocity



Performance, concurrency

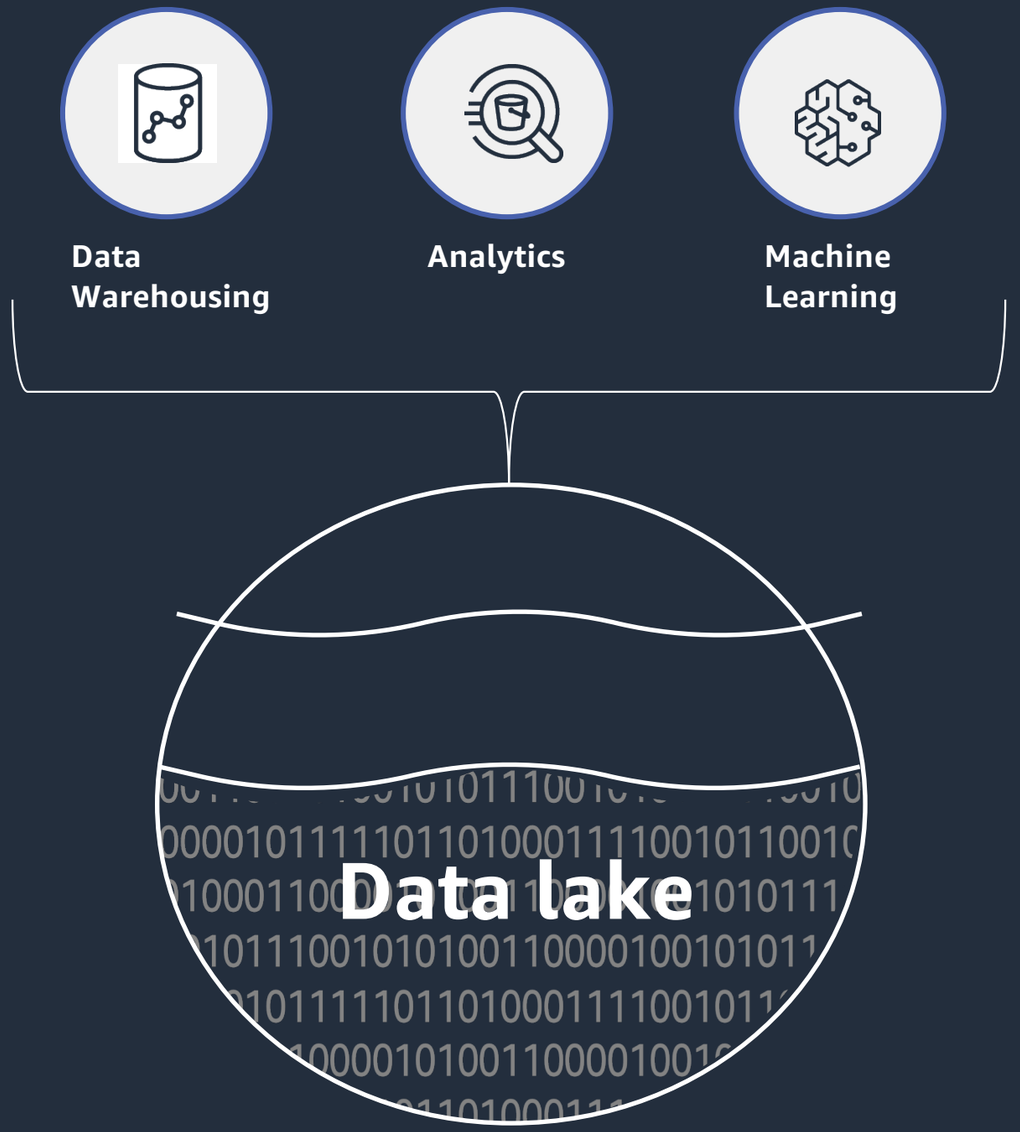
Multiple analytics needs

Security, governance

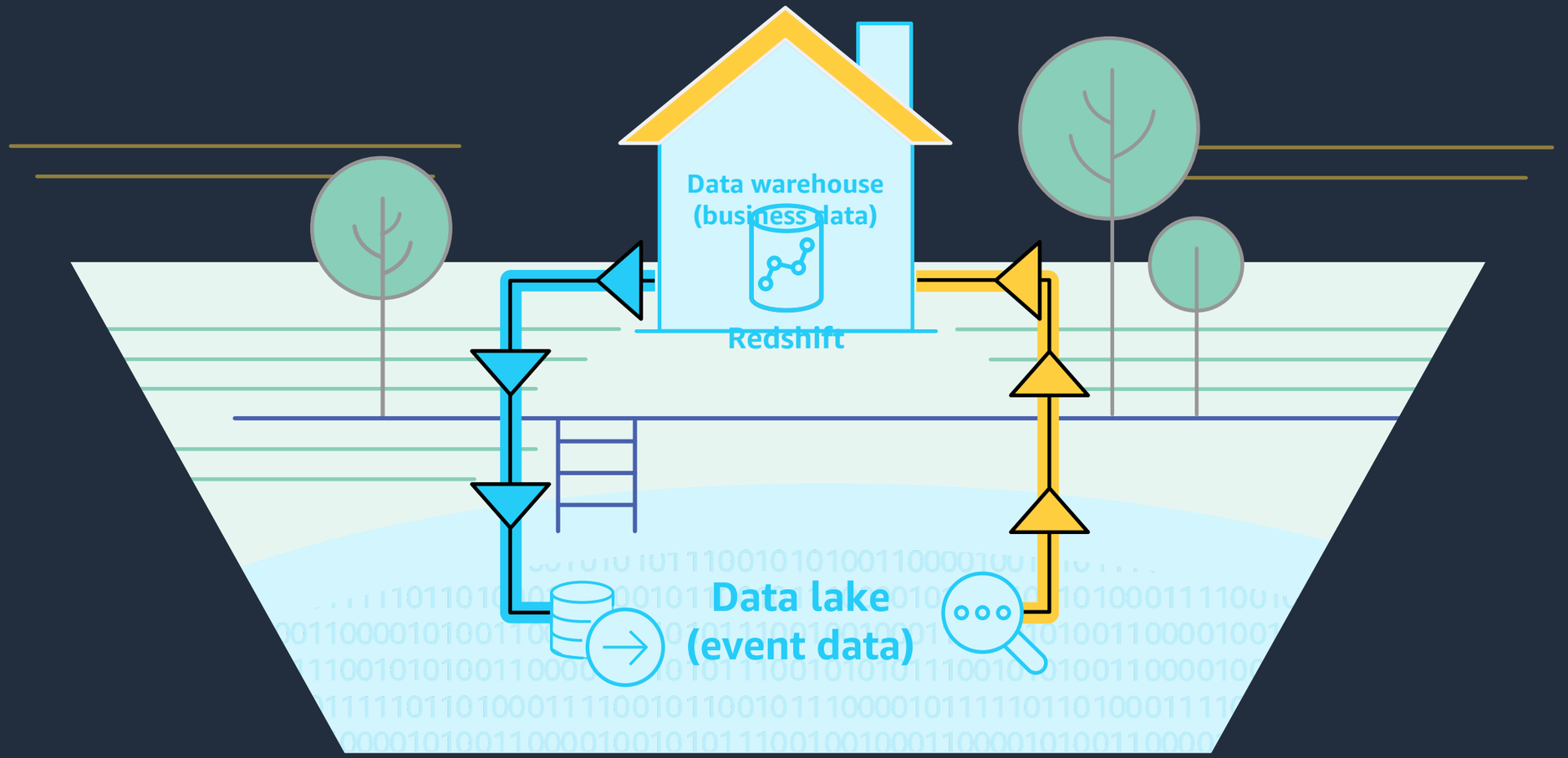
Increasingly costly, inflexible

Data lake architectures

Bringing together the best of both worlds



- Extends or evolves DW architectures
- Store any data in any format
- Durable, available, and exabyte scale
- Secure, compliant, auditable
- Run any type of analytics from DW to Predictive
- Cost-effectively scale compute and storage



Customers moving to data lake architectures

Redshift enables you to have a lake house approach

Amazon Redshift

is the most popular cloud data warehouse

21st Century Fox
23andMe
amazon
AMGEN
ancestry
AstraZeneca
CIVIS
coinbase
coursera
DOW JONES
edmunds
EA
EQUINOX
FT Financial Times
FOURSQUARE
HEARST
iflix
intuit
Jack in the box
Kimberly-Clark
Klarna
Liberty Mutual
London Stock Exchange
MANTHAN
MERCK
Nasdaq
The Ohio State University
OPTUM
PADDYPOWER betfair
Pfizer
Prezi
QANTAS
REDFIN
robinhood
SCHOLASTIC
Schumachergroup
SCOPELY SEIZE THE PLAY
SOUNDCLOUD
Sysco
tinder
yelp

3M Health Information Systems modernized their data warehouse with Redshift

Challenge

3M HIS needed to deliver customer value while scaling to support expected business growth. 3M HIS was already processing complex healthcare data for many customers, requiring a lot of complex transformations to get data into a format useful for analytics or machine learning.

Solution

They migrated applications installed on-premises or on other cloud hosting providers to AWS and chose Amazon Redshift for their data warehouse.

Benefits

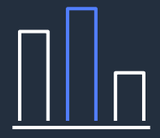
- Ability to load data in near real-time
- Scalability to store 10x the data of the existing solution
- Cost-effective, with the ability to integrate with other analytics solutions

Amazon Redshift benefits

10’s of thousands of customers use Redshift & process exabytes of data per day

Data lake & AWS integrated

Lake Formation catalog & security, Exabyte scale query (spectrum & federated), AWS integrated (DMS, CloudWatch)



Best performance

Up to 3x faster than other cloud data warehouses

Lowest cost

Up to 75% less than other cloud data warehouses & predictable costs

Most scalable

Virtually unlimited elastic linear scaling

Most secure & compliant

AWS-grade security, (e.g. VPC, encryption with KMS, Cloud Trail), Certifications such as SOC, PCI, DSS, ISO, FedRAMP, HIPAA

Easy to manage

Easy to provision & manage, automated backups, AWS support, 99.9% SLAs

Self-optimizing and easy to maintain

Easy to manage

Easy to provision & manage, automated backups, AWS support, 99.9% SLAs

Automatic Optimizations

Self-learning and self-optimizing to turbo charge performance based on usage patterns

Easy to customize

Get the best out of the cluster hardware and spend where it matters to the business

aws

Amazon Redshift architecture

Massively parallel, shared-nothing architecture

Leader node

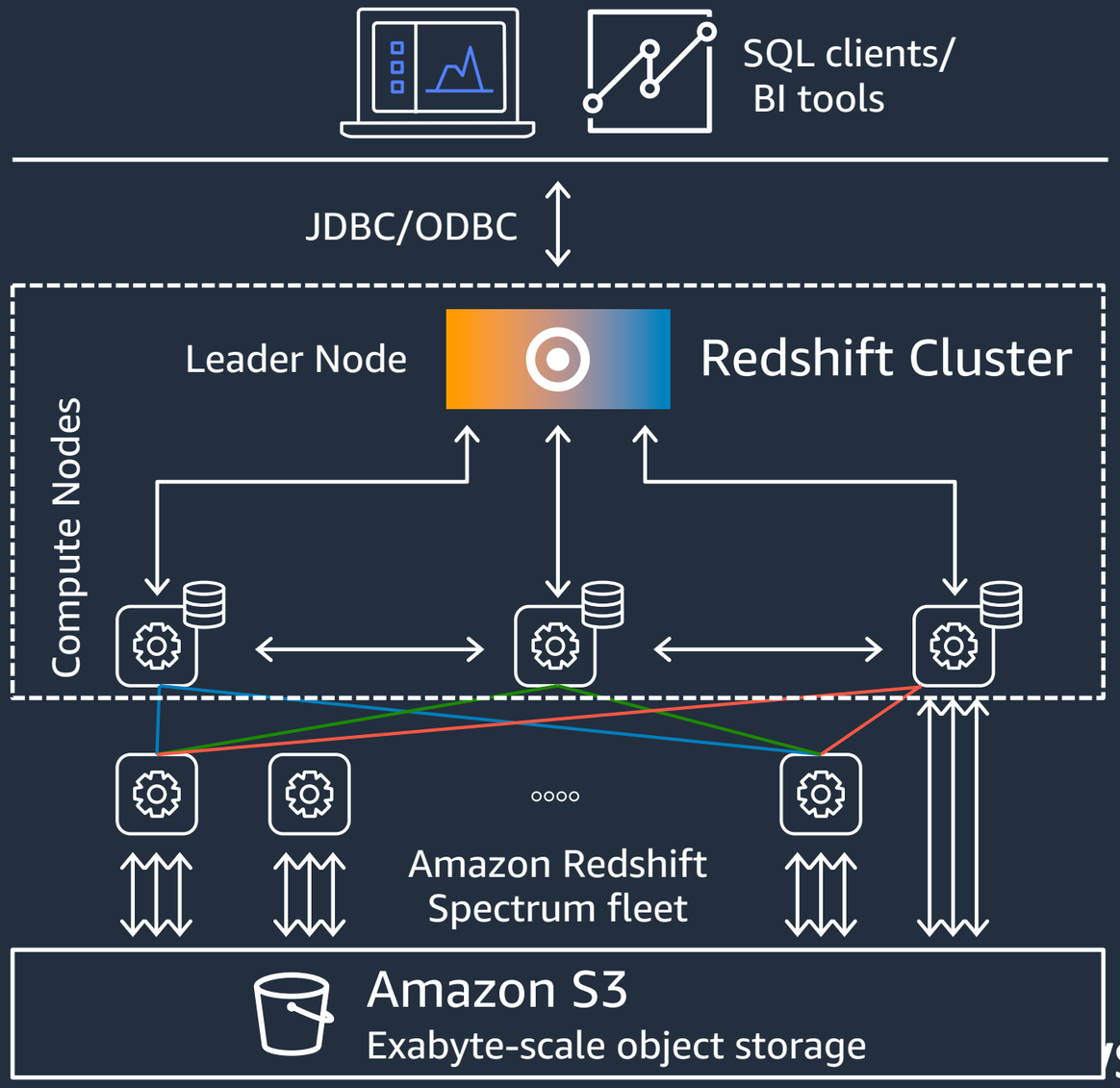
- SQL endpoint, stores metadata
- Coordinates parallel SQL processing
- Free for any cluster with two or more nodes

Compute nodes

- Local, columnar storage
- Executes queries in parallel
- Load, backup, restore

Amazon Redshift Spectrum nodes

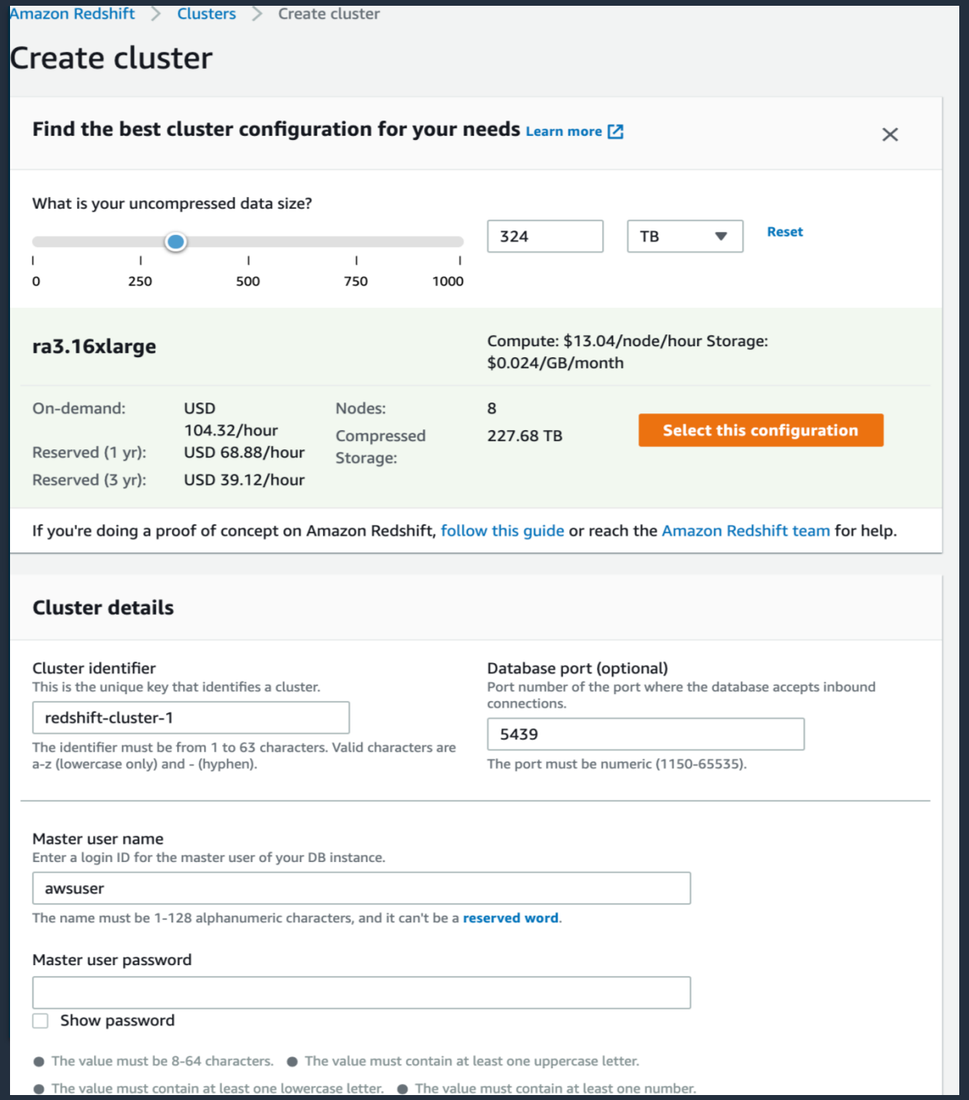
- Serverless, not managed by customer, bring power proportional to cluster slices
- Execute queries directly against data lake



Very Simple to Create and Manage Redshift Warehouse

Okay, you have your VPC and IAM roles already defined from other AWS services you've been using, and now you want to launch a Redshift cluster? Easy-peasy!

1. Select Redshift from the AWS Service Console
2. Use the Create Cluster wizard to select the size of your dataset and enter basic information such as instance type, number of nodes, IAM role to use, etc.
3. Click the "Create cluster" button



Amazon Redshift has been innovating quickly

Robust result set caching

Large # of tables support ~20000

Copy command support for ORC, Parquet

IAM role chaining

Elastic resize

Groups

Redshift Spectrum: date formats, scalar json and ION file formats support, region expansion, predicate filtering

Auto analyze

Health and performance monitoring w/Amazon Cloud watch

Automatic table distribution style

Cloud watch support for WLM queues

Performance enhancements—hash join, vacuum, window functions, resize ops, aggregations, console, union all, efficient compile code cache

Auto WLM

~25 Query Monitoring Rules (QMR) support

AQUA

Concurrency Scaling

200+

new features & enhancement in the past 18 months

DC1 migration to DC2

Resiliency of ROLLBACK processing

Manage multi-part query in AWS console

Auto analyze for incremental changes on table

Spectrum Request Accelerator

Apply new distribution key

Redshift Spectrum: Row group filtering in Parquet and ORC, Nested data support, Enhanced VPC Routing, Multiple partitions

Faster Classic resize with optimized data transfer protocol

Performance: Bloom filters in joins, complex queries that create internal table, communication layer

Redshift Spectrum: Concurrency scaling

Amazon Lake Formation integration

Auto-Vacuum sort, Auto-Analyze and Auto Table Sort

Auto WLM with query priorities

Snapshot scheduler

Performance: join pushdowns to subquery, mixed workloads temporary tables, rank functions, null handling in join, single row insert

Advisor recommendations for distribution keys

AZ64 compression encoding

Console redesign

Stored procedures

Spatial Processing

Column level access control with AWS lake formation

RA3

Performance of Inter-Region Snapshot Transfers

Federated Query

Materialized Views

Manual Pause and Resume

Amazon Redshift: Key 2019 innovations

Performance & scalability

NEW! RA3 with Redshift managed storage

PREVIEW! AQUA

NEW! AZ64

PREVIEW! Materialized views

NEW! Spatial data support

NEW! Concurrency Scaling

Data lake & AWS integration

PREVIEW! Federated query across Redshift & RDS/Aurora

NEW! Data lake export in Parquet

NEW! Spectrum Request Accelerator

NEW! Amazon Lake Formation integration

Fully managed

NEW! New management console

NEW! Auto WLM: Query priorities

NEW! Elastic resize scheduler

NEW! Auto-Vacuum, Auto-Analyze & Auto Table Sort

NEW! Stored procedures

NEW! Distribution and sort key advisor

NEW! Cross-instance restore

NEW! Faster cross regional copy and change

NEW! Auto Data Distribution

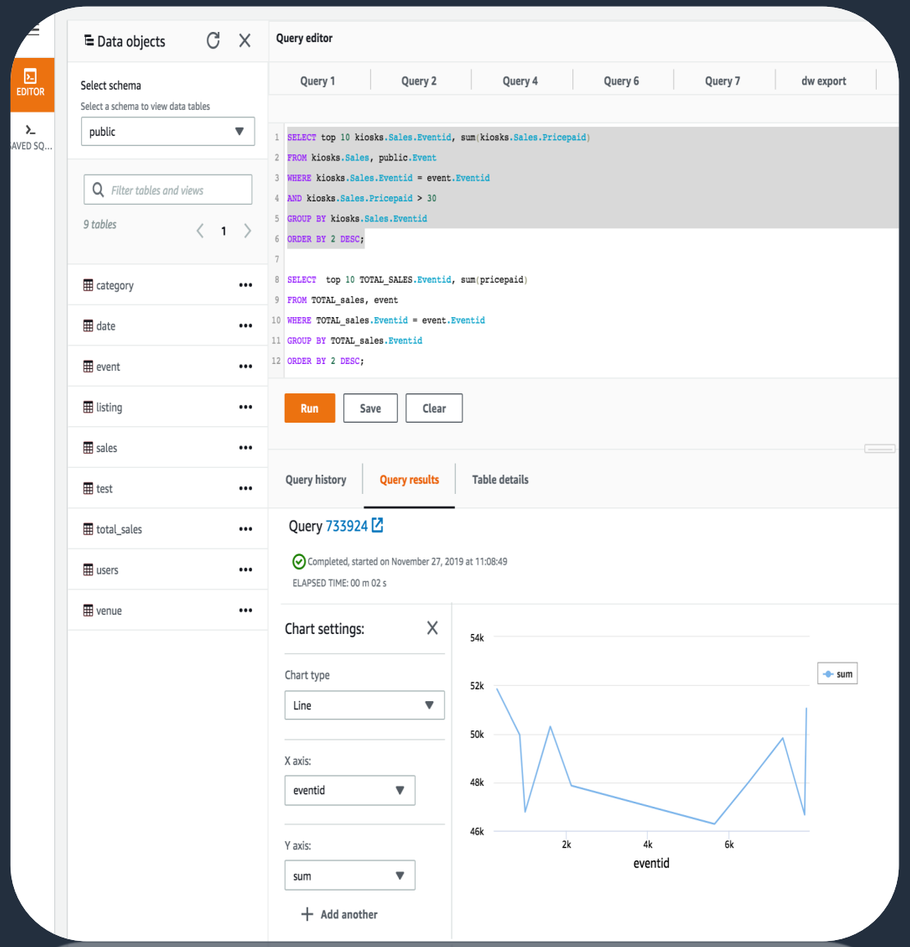
NEW! Deferred Maintenance

NEW! Elastic resize

aws

Query Editor

- Author & Execute
- Visually analyze your query results
- Results viewable & downloadable to CSV file
- Queries can be Saved for repeat execution
- In-Place analysis of Query Plan
- Considerations
  - Max 50 Query Editor users
  - Result paginated (100 rows/page)
  - Not intended for transactions (begin/commit)
  - Enhanced VPC Routing is not supported
  - Access requires IAM permissions

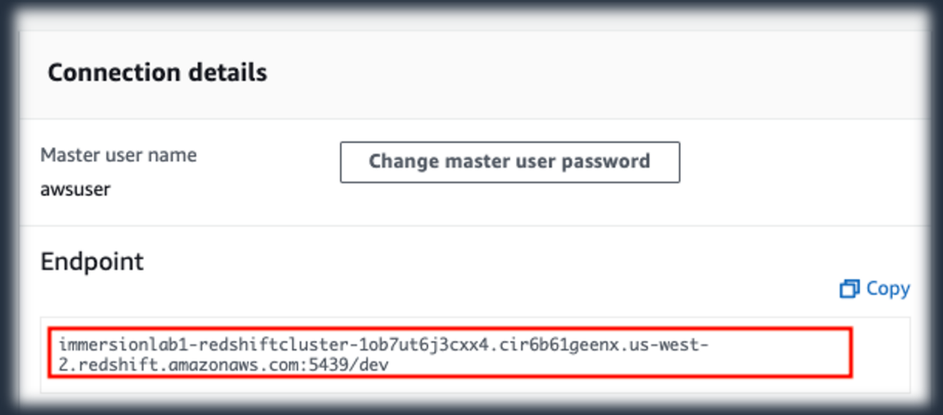


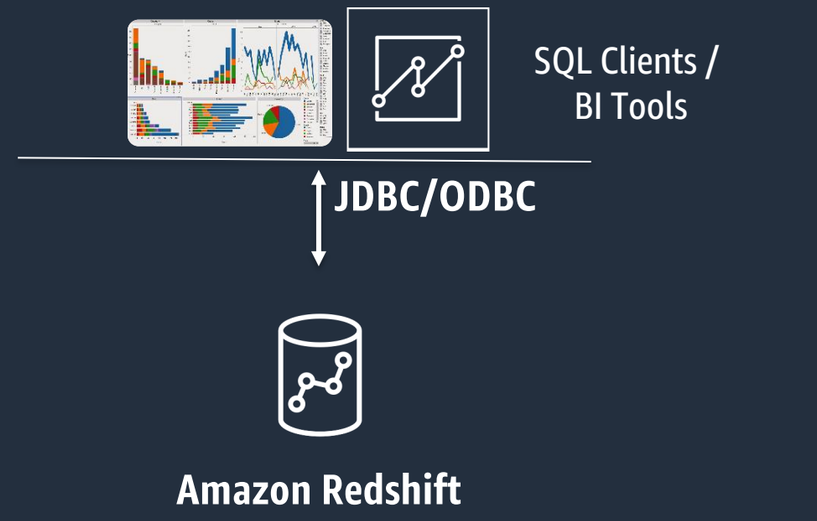
JDBC Client

- Two driver options for connecting to Redshift
  - Redshift driver (recommended)
    - 35% faster than Postgres Driver
    - Support for IAM SSO / Active Directory
    - Download from console
  - JDBC/ODBC Postgres driver (Not recommended)
- JDBC URL (Copy from Redshift console)

  Examples

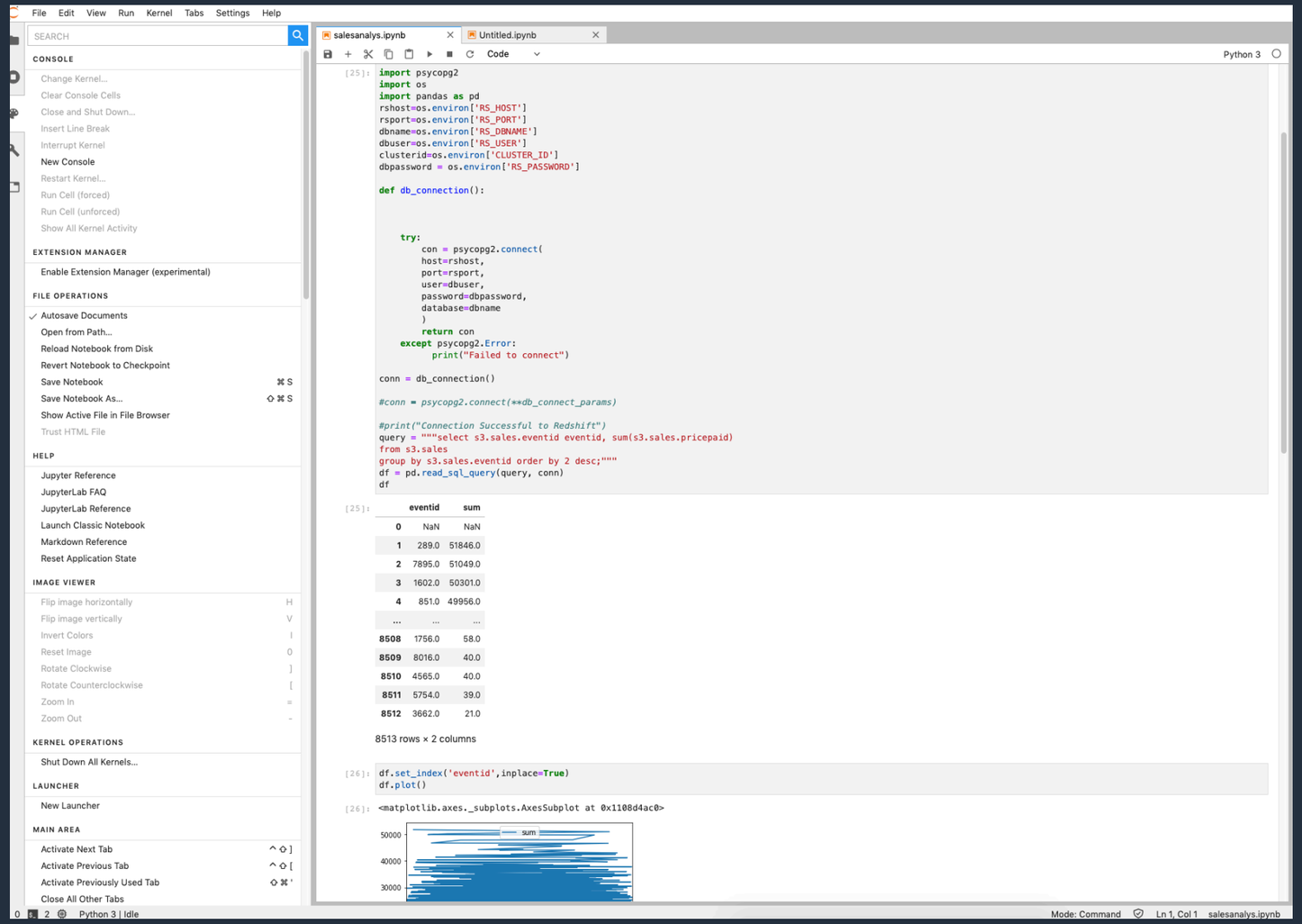
  `jdbc:[redshift|postgresql]://endpoint:port/databaseName`
  - `jdbc:redshift://demo.dsi9zn4ccku4.us-east-1.redshift.amazonaws.com:8192/pocdb`





Connecting from Jupyter Notebook

- You can use *pyscopg2* or *pygresql* driver with *sqlalchemy*
- You can use *boto3* package and *Secrets Manager* with *SageMaker* notebook to retrieve credentials



Amazon Redshift Data API

Simplifies data access from web services based applications

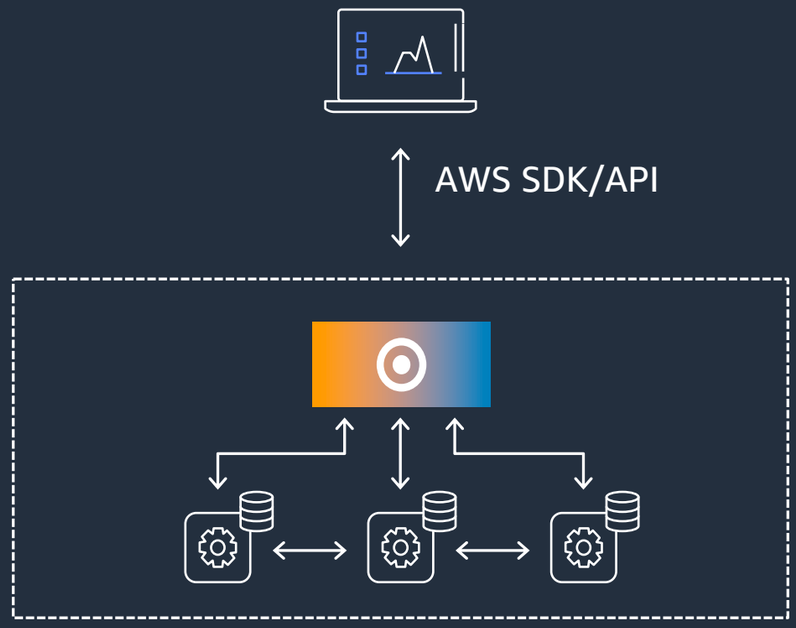
Simplifies data access from languages such as Python, Go, Java, Node.js and other languages

Query, Load and Unload data from CLI/SDK

Do not have to worry about configuring drivers, connection pools

Leverages IAM credentials or Secrets manager

```
aws redshift-data execute-statement
--database [DATABASE]
--query [QUERY]
--secret-arn [CREDENTIALS_ARN]
```




```
response = redshift.execute_statement(
      ClusterIdentifier = ‘data_science’,
      Database = ‘churn_model’,
      …
      Statement = ‘select * from customer_profile’
)
```

Seamless Integration with AWS Services

Migration | ETL | Machine Learning | Data Visualization

AWS Database Migration Service (DMS)
Fully-managed migration service

AWS Glue
Fully managed extract, transform, and load (ETL) service

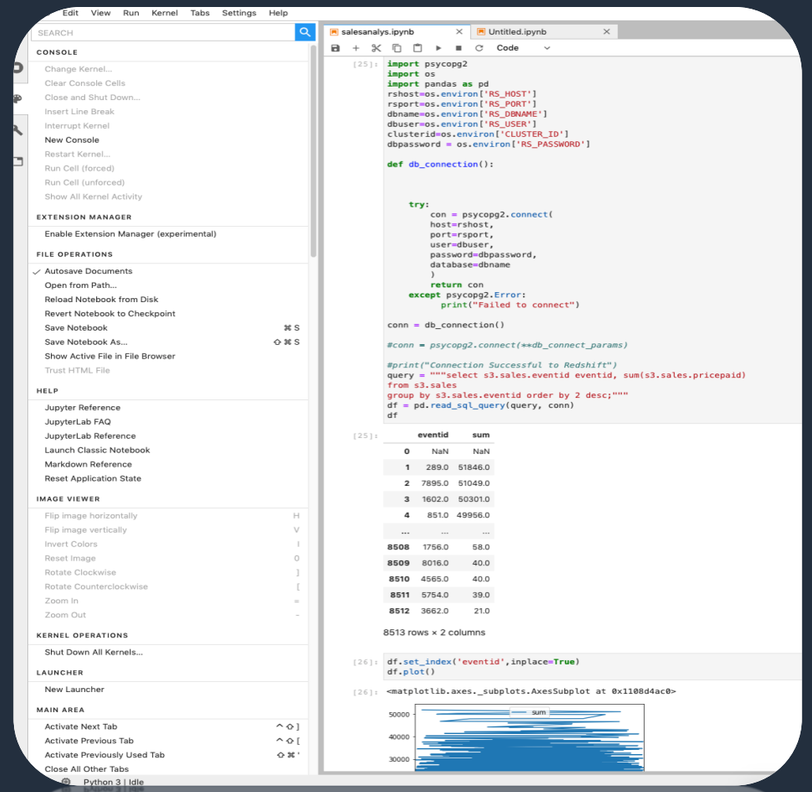
Amazon EMR
Cloud-native big data platform

Amazon Sagemaker
Fully managed service to build, train, and deploy machine learning (ML) models

Amazon Quicksight
Fast, cloud-powered business intelligence service

and more…

Sagemaker / Jupyter Notebook



Unloading Data: UNLOAD Command

UNLOAD command is the reverse of COPY, in that it outputs data from Amazon Redshift to S3

- Runs from a SELECT statement. Order By clause respected by UNLOAD if PARALLEL=OFF
- Encryption & compression handled automatically
- Runs in parallel on all compute nodes

UNLOAD output

- CSV or Parquet (**Data Lake Export**) file formats
- Generates > 1 file per slice for all compute nodes
- Max file size written on S3 can be controlled (max internal limit 6.2GB)
- Generates a manifest for all unloaded files (useful for COPY into another cluster)
- Control if files can overwrite existing locations or not

```
UNLOAD ('select-statement')
TO 's3://object-path/name-prefix'
iam_role “arn” [ option [ ... ] ]
```

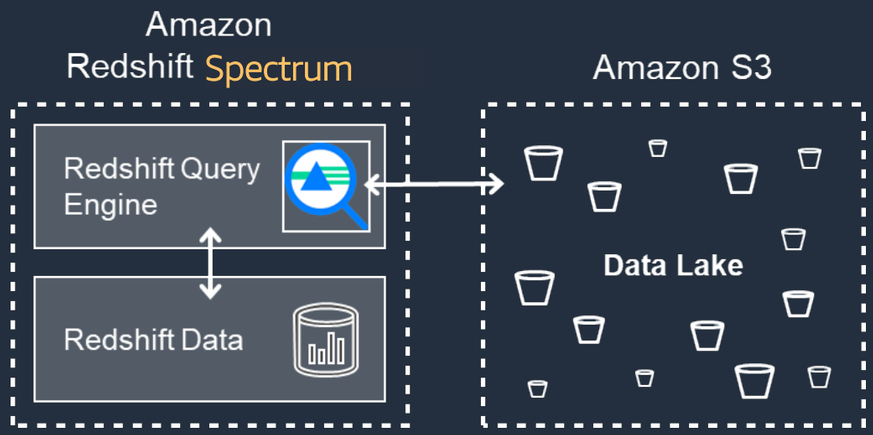
Redshift Spectrum Overview

Redshift *Spectrum* is a feature of Redshift that allows Redshift SQL queries to reference external data on Amazon S3 as they would any other table in Amazon Redshift

Benefits

- Enables the *Lake House* pattern out-of-the-box
- Allows for querying of potentially exabytes of data in an S3 data lake from within Amazon Redshift
- Data is queried in-place so no loading of data into your Redshift cluster is required
- Keeps your data warehouse lean by ingesting warm data locally while keeping other data in the data lake within reach
- Powered by a separate fleet of powerful Amazon Redshift Spectrum nodes

Run SQL queries directly against data in S3 using thousands of nodes

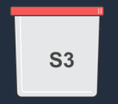



Fast @ Exabyte scale


Elastic & highly available


On-demand, pay-per-query


High concurrency: Multiple clusters access same data



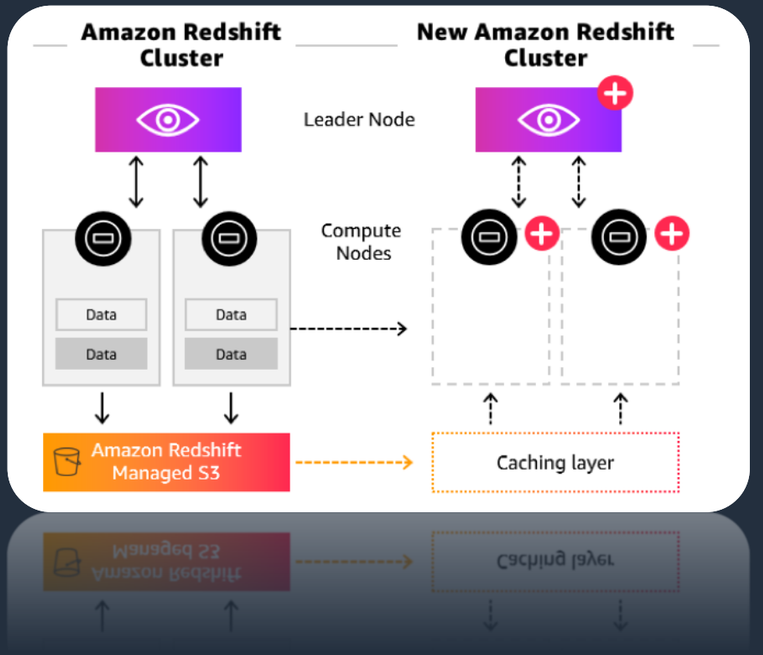
No ETL: Query data in-place using open file formats

Full Amazon Redshift SQL support

aws

Redshift Concurrency Scaling Overview

- *Concurrency Scaling* is a Redshift feature that automatically adds transient clusters to your cluster within seconds to handle concurrent requests with consistently fast performance
- Free for over 97% of Redshift customers
- For every 24 hours that your main cluster is in use, you accrue a one-hour credit for Concurrency Scaling. Beyond that, customers are billed on a per-second basis per transient cluster
- Applies to Redshift local & spectrum queries
- Email notifications are issued when concurrency scaling occurs



Machine learning based automatic optimizations

To simplify maintenance and turbo charge performance

Automates table maintenance

Optimizes for peak performance as data and workloads scale

Leverages machine learning

Offers prescriptive recommendations with ability to apply changes dynamically

Automatic Analyze

Automatic Table Distribution Style

Distribution/Sort Key Advisors

Automatic Vacuum Delete

Automatic Table Sort

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The Amazon ML Stack

AI Services

VISION			SPEECH		LANGUAGE		CHATBOTS	FORECASTING	RECOMMENDATIONS
REKOGNITION IMAGE	REKOGNITION VIDEO	TEXTRACT	POLLY	TRANSCRIBE	TRANSLATE	COMPREHEND	LEX	FORECAST	PERSONALIZE

ML Services

Amazon SageMaker

Ground Truth	Notebooks	Algorithms + Marketplace	Reinforcement Learning	Training	Optimization	Deployment	Hosting

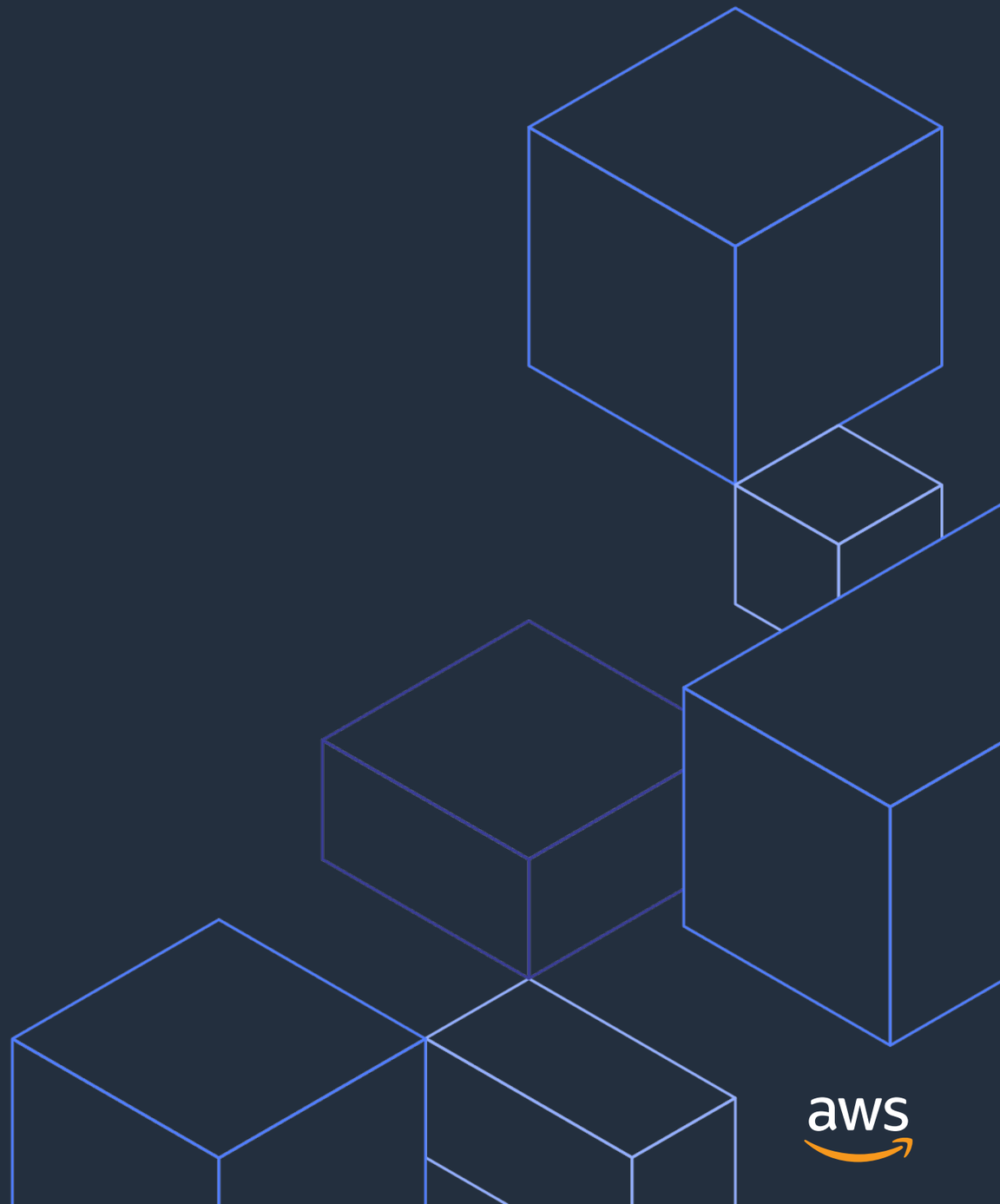
ML Frameworks + Infrastructure

FRAMEWORKS	INTERFACES
TensorFlow, mxnet, PYTORCH	GLUON, Keras

INFRASTRUCTURE						
EC2 P3 & P3DN	EC2 G4	EC2 C5	FPGAS	GREENGRASS	ELASTIC INFERENCE	INFERENTIA

aws

Demo Time!



Thank You!

jwyant@amazon.com

https://aws.amazon.com/big-data/datalakes-and-analytics/

Try it on your own: https://github.com/aws/amazon-sagemaker-examples/blob/master/advanced_functionality/working_with_redshift_data/working_with_redshift_data.ipynb