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Agenda

- Analyst Perspectives
- Basic Functionality
- Performance Features (Hands-On)
- Usability Features (Demo)
- Discussion
  - Pricing
  - Takeaways

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Basic Functionality

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AWS Redshift Console

- Serverless and Provisioned Clusters
- Snapshots
- Query editor
- Query history
- Workload Management
- Advisor

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Provisioned Clusters vs. Serverless

	Provisioned	Serverless
Managed	Self managed	Fully managed
Compute	Choose node type and cluster size	Workgroup
Storage	Provisioned disk capacity	Namespace
WLM	User configured	Not applicable
Concurrent scaling	User enabled	Not applicable
Scale out/up/down	User-initiated cluster resize	Not applicable
Pause/resume	Manual	Automatic
Compute billing	Per second when not paused $/hour rate	Per second when workloads run RPU-hour rate
Storage billing	$ per managed storage amount	$ per GB-month used

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More detailed comparison: https://docs.aws.amazon.com/redshift/latest/mgmt/serverless-console-comparison.html

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Cluster Sizes

Type	CPU/RAM	Node Range	Price Per Node
dc2.large	2 / 15 GB	1 – 32	$0.25
dc2.8xlarge	32 / 244 GB	2 – 128	$4.80
ra3.xlplus	4 / 32 GB	1 – 32	$1.09
ra3.4xlarge	12 / 96 GB	2 – 32	$3.26
ra3.16xlarge	48 / 384 GB	2 – 128	$13.04
Serverless (Base & Max RPUs)	?	32 – 512 RPUs*	$0.36

*Redshift Processing Units are available in units of 8 (32, 40, 48, and so on, up to 512)

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Redshift and PostgreSQL differences

Redshift is based on PostgreSQL, except:

- Redshift does not support tablespaces, table partitioning, inheritance, and certain constraints
  - Unique, primary key, and foreign key constraints are permitted, but they are informational only
- No indexes in Redshift
- COPY command is highly specialized to enable the loading of data from Amazon S3 buckets
- Parameters for VACUUM are entirely different
- Trailing spaces in VARCHAR values are ignored when string values are compared
- Unsupported data types:
  - https://docs.aws.amazon.com/redshift/latest/dg/c_unsupported-postgresql-datatypes.html

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Other DDL Features

- <database_name>.<schema_name>.<object_name>
- Case insensitive identifiers
- Deep copy (CREATE TABLE LIKE + INSERT INTO (SELECT *))
  - Forces a re-sorting of data
  - Faster than VACUUM
- To get DDL, run this script:
  - https://github.com/awslabs/amazon-redshift-utils/blob/master/src/AdminViews/v_generate_tbl_ddl.sql

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Loading Data

1.	2.	3.	4.
COPY from AWS sources (S3, EMR, Dynamo)	**Continuous file ingestion** from S3 (preview)	With **Amazon Kinesis** (streaming Kafka-like)	Via third-party ETL (Informatica)

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Query History and Results Cache

- Use SYS_QUERY_HISTORY instead of STL_QUERY
  - STL_QUERY not supported by Serverless
- Turn off query results cache:
  - SET enable_result_cache_for_session TO OFF;

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Performance Features

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Table Design

Sort Keys

Choose the best sort keys:

- If recent data is queried most frequently, specify the timestamp column as the leading column
- If you do frequent range filtering or equality filtering on one column, specify that column
- If you frequently join a table, specify the join column as both the sort key and the distribution key

Distribution Style

Choose the best distribution style (EVEN, KEY, ALL):

- Distribute the fact table and one dimension table on their common columns
- Only the rows that are used in the join need to be distributed, so consider the size of the dataset after filtering, not the size of the table
- Choose a column with high cardinality in the filtered result set
- If a dimension table cannot be collocated with the fact table or other important joining tables, distributing the entire table to ALL of the nodes

OR use Automatic Table Optimizations

- ALTER TABLE table_name ALTER SORTKEY AUTO;
- ALTER TABLE table_name ALTER DISTSTYLE AUTO;

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Redshift Advisor

Advisor makes the following suggestion:

- Compress Amazon S3 file objects loaded by COPY
- Isolate multiple active databases
- Reallocate workload management (WLM) memory
- Skip compression analysis during COPY
- Split Amazon S3 objects loaded by COPY
- Update table statistics
- Enable short query acceleration
- Alter distribution keys on tables
- Alter sort keys on tables
- Alter compression encodings on columns
- Data type recommendations

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Workload Management

Automatic WLM

Redshift will:

- Use up to 8 queues
- Auto sets Memory
- Auto sets concurrency on Main cluster*
- Default priority set to Normal

*You still must manually enable Concurrency Scaling

Manual WLM

You decide:

- Concurrency scaling mode
- Concurrency level
- User groups
- Query groups
- WLM memory percent to use
- WLM timeout
- WLM query queue hopping

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Concurrency Scaling

Does

- Automatically adds additional clusters as concurrency increases
- Charge you for concurrency-scaling clusters only for the time they're actively running queries
- Supports COPY, INSERT, DELETE, and UPDATE statements
- Automatically in Serverless

Does NOT

- Support temporary tables
- Support Interleaved sort keys
- Support DDL statements, including CTAS
- Work on write statements where a target table where DISTSTYLE is set to ALL
- Support non-RA3 models
- Support auto refresh for materialized views

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Transparent Materialized Views

Automatic query rewriting does NOT support:

- Subqueries
- Left, right, or full outer joins
- Set operations
- Any aggregate functions, except SUM, COUNT, MIN, MAX, and AVG
- Any aggregate functions with DISTINCT
- Any window functions
- SELECT DISTINCT or HAVING clauses
- External tables
- Other materialized views
- CREATE TABLE AS statements
- SELECT INTO statements
- Queries on catalogs or system tables
- Queries with outer joins or a SELECT DISTINCT clause

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Short Query Acceleration

- Prioritizes selected short-running queries ahead of longer-running queries
- Runs in a dedicated space
- Work only for SELECT and CTAS statements
- Automatically assigns a maximum qualifying estimated runtime
  - Can be manually set from 1 – 20 seconds
- Best practice recommends using a WLM query slot count of 15 or fewer to achieve best results

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Usability Features

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Redshift Spectrum (External Tables)

- Spectrum resides on dedicated Redshift servers that are independent of your cluster
- Scales automatically
- Uses an external data catalog
  - AWS Glue, Athena data catalog, or your own Apache Hive metastore
- Can't perform UPDATE or DELETE operations
  - But can INSERT

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Automated Materialized Views (AutoMV)

- Generally available July 2022
- Continually monitors the workload using ML and creates new materialized views when they are beneficial
- Automatically drops them when they are no longer beneficial
- AutoMV behavior and capabilities are the same as user-created materialized views
  - e.g., used in Automatic Query Rewriting
- View the EXPLAIN plan and look for `%_auto_mv_%` in the output
  - Example TPC-H Q19

Does not support:

- Left, right, or full outer joins
- Aggregate functions other than SUM, COUNT, MIN, MAX, and AVG
- Any aggregate function that includes DISTINCT
- Any window functions
- SELECT DISTINCT or HAVING clauses
- External tables, such as datashares and federated tables
- Other materialized views

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Dynamic Data Masking

- Brand new, in preview since Nov 29
- You can apply multiple masking policies with varying levels of obfuscation to the same column in a table and assign them to different roles and use priority number to resolve conflicts
- Supports UDF in SQL, Python, or AWS Lambda functions

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Federated Queries

- You can query data in other operational databases, data warehouses, and data lakes
- Incorporate live data into BI and reporting
- Apply transformations
- Load data into the target Redshift tables without ETL

Currently supports only:

- Amazon RDS for PostgreSQL
- Amazon Aurora PostgreSQL-Compatible Edition
- Amazon RDS for MySQL
- Amazon Aurora MySQL-Compatible Edition

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Semi-Structured and SUPER Type

- SUPER data type supports up to 16 MB of data
  - Data larger than 1 MB still in Preview
- Uses PartiQL (brackets, dots, and asterisks)
- Supports UNPIVOT for object iteration
- Doesn't require explicit type casting of extracted data
- Lax semantics (returns NULL instead of an error when navigation is invalid)
- Supports inspection functions (IS_INTEGER, IS_VARCHAR, etc.)
- Supports JSON but not XML

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Streaming Ingest with Kinesis

- New feature since Feb 2022
- Eliminates Kinesis Data Firehose to S3 stage and batch loading into Redshift
- Supports both Provisioned Clusters and Serverless
- Uses a materialized view as the target and refreshes to get its SEQUENCE_NUMBER in parity with the Kafka Offset
- Kinesis-created MVs do not support JOINs
- Source data comes in as VARBYTE data type
- 1 MB record size limit

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Python UDF

- Scalar SQL and Lambda UDFs also supported
- Requirements:
  - The function converts the input arguments to Python data types.
  - The function runs a valid Python program, passing the converted input arguments.
  - The Python code returns a single value.
  - The data type of the return value must correspond to the RETURNS data type specified by the function definition.
  - The function converts the Python return value to the specified Amazon Redshift data type, then returns that value to the query.

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Redshift ML

Backdoor integration with SageMaker Autopilot with this workflow:

- Redshift exports the training data to S3
- SageMaker performs data preprocessing
- SageMaker finds algorithm and algorithm hyperparameters
- Redshift registers the model as a SQL UDF (CREATE MODEL)

- Pre-configured models for:
  - Churn
  - Remote inference
  - K-means clustering
  - Multi-class classifiers
  - XGBoost
  - Regressions
- Pay separate S3 and SageMaker costs

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Discussion

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Pricing

- Price-per-performance
- Gotchas:
  - Concurrency Scaling
  - Serverless RPU Usage
  - SageMaker costs for Redshift ML
- Discounts

	vCPU	Memory	Addressable storage capacity	I/O	Price
Dense Compute DC2					
dc2.large	2	15 GiB	0.16TB SSD	0.60 GB/s	$0.25 per Hour
dc2.8xlarge	32	244 GiB	2.56TB SSD	7.50 GB/s	$4.80 per Hour
RA3 with Redshift Managed Storage*					
ra3.xlplus	4	32 GiB	32TB RMS	0.65 GB/s	$1.086 per Hour
ra3.4xlarge	12	96 GiB	128TB RMS	2.00 GB/s	$3.26 per Hour
ra3.16xlarge	48	384 GiB	128TB RMS	8.00 GB/s	$13.04 per Hour

Instance name	RI upfront fee	RI monthly fees*	RI effective hourly rate**	Effective price per TB per year***	Savings over On-Demand	On-Demand rate
dc2.8xlarge	$0	$2,774.00	$3.800	$13,003.13	21%	$4.8000
dc2.large	$0	$146.00	$0.200	$10,950.00	20%	$0.2500
ra3.16xlarge	$0	$6,663.44	$9.128	$1,249.40	30%	$13.0400
ra3.4xlarge	$0	$1,665.86	$2.282	$312.35	30%	$3.2600
ra3.xlplus	$0	$554.95	$0.760	$208.10	30%	$1.0860

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