AWS

MACHINE LEARNING

CERTIFICATION

DOMAIN #1: DATA ENGINEERING (20% EXAM)

AWS ML CERTIFICATION EXAM DOMAINS

Domain	% of Examination
Domain 1: Data Engineering	20%
Domain 2: Exploratory Data Analysis	24%
Domain 3: Modeling	36%
Domain 4: Machine Learning Implementation and Operations	20%
TOTAL	100%

Source: https://d1.awsstatic.com/training-and-certification/docs-ml/AWS%20Certified%20Machine%20Learning%20-%20Specialty_Exam%20Guide%20(1).pdf

DOMAIN #1: WHERE ARE WE NOW!!?

SECTION #1: INTRODUCTION, DATA/ML LINGO, AWS DATA STORAGE

- What is Machine Learning and Artificial Intelligence?
- What is Amazon Web Services (AWS)?
- Artificial Intelligence and Machine learning Lingo (data types, Labeled vs. unlabeled, sagemaker groundtruth)
- structured vs. unstructured and database vs. data lake vs. data storage
- AWS Data Storage (Redshift, RDS, S3, DynamoDB)

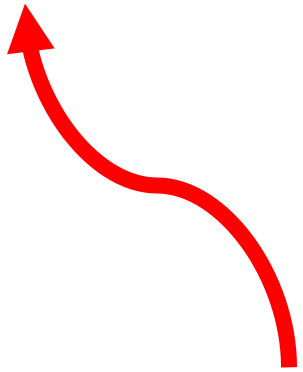
SECTION #2: AMAZON S3

- Amazon S3 in Depth (partitions, tags)
- Amazon S3 Storage Tiers and Lifecycles
- Amazon S3 Encryption and Security
- Amazon S3 Encryption and Security – Part #2 (ACL, CloudWatch, CloudTrail, VPC)
- Additional Notes (Elastisearch, ElastiCache, and Database vs. data warehouse)

DOMAIN #1: WHERE ARE WE NOW!!?

SECTION #3: AWS DATA MIGRATION, GLUE, PIPELINE, STEP AND BATCH

- AWS Glue (crawlers, features, built-in transformations etc)
- AWS Data pipeline
- AWS Data Migration Service (DMS)
- AWS Batch
- Step Function



WE ARE HERE!

SECTION #4: DATA STREAMING & KINESIS

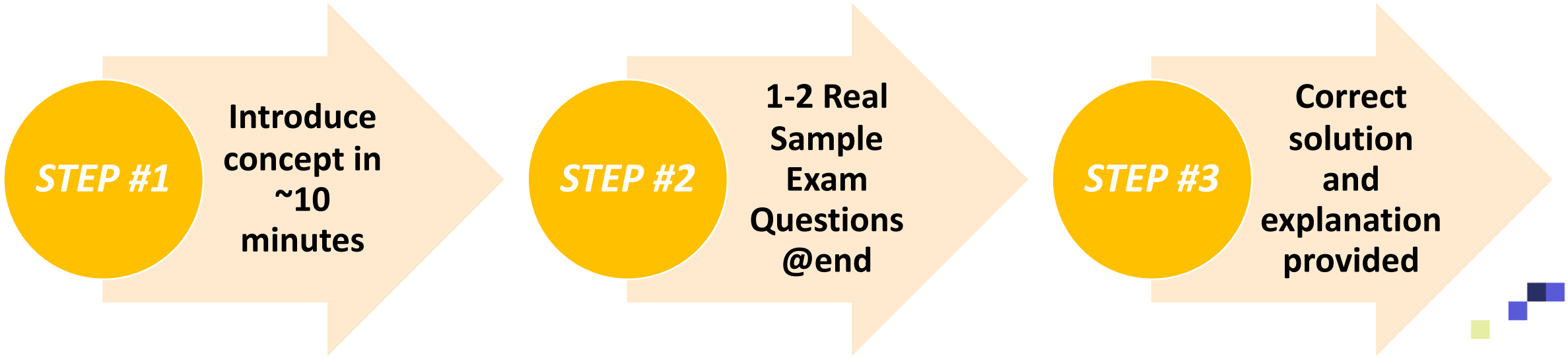
- Kinesis Overview
- Kinesis Video Streams
- Kinesis Data Streams
- Kinesis Firehose
- Kinesis Analytics and Random Cut Forest

LECTURE DESIGN

- We know how hard it is to study for an exam especially if you have a busy schedule.
- This course is designed to be extremely on point and optimized to pass the exam.

No boring content. Zero unnecessary information.

- Here's the lecture structure that we will follow:



RECALL OUR MINI CHALLENGE AND PRIZE!

- For those of you who will successfully complete the entire section and watch the videos till the end, they will receive a valuable prize!

https://pixabay.com/illustrations/trophy-win-prize-transparent-1414791/

AWS GLUE – Part #1

AWS GLUE: OVERVIEW

- AWS Glue is a fully managed service that enable users to extract, transform, and load (ETL) data.
- Data generated by AWS Glue could be fed into analytics tools such as Amazon QuickSight.
- AWS Glue steps:
    1. Setup AWS Glue and direct it to your stored data on AWS
    2. AWS Glue extracts metadata such as table definition and schema and put it in the AWS Glue Data Catalog.
    3. Once cataloged, you can query the data and perform ETL.

AWS GLUE: UNIQUE FEATURES

SEAMLESS INTEGRATION WITH AWS SERVICES

- AWS Glue works seamlessly with other AWS services which allow for easy integration.
- AWS Glue works well with stored data in Redshift, S3, and databases in Virtual Private Cloud (VPC) running on EC2.

MINIMUM CONFIGURATION HASSLE AND OPTIMIZED COST

- AWS Glue offers pay per use service so no upfront cost or servers to manage.
- AWS Glue will take care of scaling and configuration in running the ETL jobs.

EASY TO USE

- AWS Glue crawls data storages, extract data schemas and transformations.
- AWS Glue generates data transformation codes on its own.

AWS GLUE: HOW DOES IT WORK?

- AWS Glue is extremely easy to work with, users will have to first identify the data source/target.
- In python/Scala programming languages, AWS Glue generates ETL code to extract data from the source and transform it to match the target schema, and load it into the target.
- Users can then test the code in IDE/notebook.

STEP 1: CREATE DATA CATALOG

After identifying the source of data, AWS Glue will crawl the data sources (S3 bucket for example) and generates data catalogue. AWS Glue works with numerous data types such as JSON, CSV, and Parquet.

STEP 2: GENERATE AND EDIT TRANSFORMATIONS

In python/Scala programming languages, AWS Glue generates ETL code to extract data from the source and transform it to match the target schema, and load it into the target. Users can then test the code in IDE/notebook.

STEP 3: SCHEDULE AND RUN JOBS

AWS Glue facilitates running and scheduling multiple ETL jobs. AWS Glue efficiently and automatically scales based on demand.

AWS GLUE – Part #2

AWS GLUE: USE CASE

AMAZON S3

AWS GLUE CRAWLERS

AWS GLUE DATA CATALOGUE

AMAZON ATHENA

AMAZON QUICKSIGHT

AMAZON REDSHIFT

Setup a crawler to scan the S3 data periodically and generate Glue data catalogue

Once the AWS Glue data catalogue is available, Amazon Athena and Redshift can query the data and view in Quicksight

- *Athena and AWS Glue Data Catalog work seamlessly together, AWS Glue can be used to create databases and tables (schema) so that Athena can use it to query the data.*

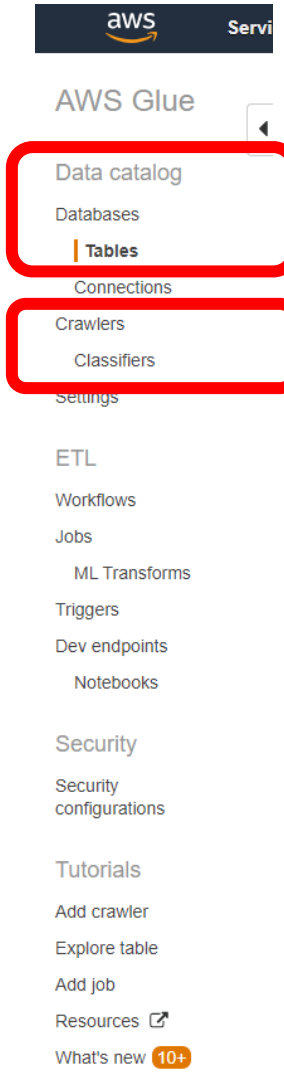
AWS GLUE: WHAT ARE CRAWLERS?

- Crawlers are used to scan the stored data and infer schemas and partitions.
- Once the crawler scans the data, it generates/updates the table in the Data Catalog.
- AWS Glue will rely on this data catalogue in performing Extract, transform, and load (ETL) jobs.
- You will require setting up an IAM role so that the crawler is able to access the data storage and infer schemas.
- AWS Glue works with several data formats such as JSON, Parquet, CSV.
- You can run the Crawler on demand or based on a schedule

AWS GLUE CRAWLERS

Photo Credit: https://pixabay.com/illustrations/insect-insects-insect-perfection-4470664/

AWS GLUE: CRAWLERS AND CLASSIFIERS



- A classifier reads the storage data and generates a schema if it finds one.
- AWS Glue provides built-in classifiers for several formats as shown below.

AWS GLUE CRAWLERS

Built-In Classifiers in AWS Glue

AWS Glue provides built-in classifiers for various formats, including JSON, CSV, web logs, and many database systems.

If AWS Glue doesn't find a custom classifier that fits the input data format with 100 percent certainty, it invokes the built-in classifiers in the order shown in the following table. The built-in classifiers return a result to indicate whether the format matches (`certainty=1.0`) or does not match (`certainty=0.0`). The first classifier that has `certainty=1.0` provides the classification string and schema for a metadata table in your Data Catalog.

Classifier type	Classification string	Notes
Apache Avro	`avro`	Reads the schema at the beginning of the file to determine format.
Apache ORC	`orc`	Reads the file metadata to determine format.
Apache Parquet	`parquet`	Reads the schema at the end of the file to determine format.
JSON	`json`	Reads the beginning of the file to determine format.
Binary JSON	`bson`	Reads the beginning of the file to determine format.
XML	`xml`	Reads the beginning of the file to determine format. AWS Glue determines the table schema based on XML tags in the document. For information about creating a custom XML classifier to specify rows in the document, see Writing XML Custom Classifiers.
Amazon Ion	`ion`	Reads the beginning of the file to determine format.
Combined Apache log	`combined_apache`	Determines log formats through a grok pattern.
Apache log	`apache`	Determines log formats through a grok pattern.
Linux kernel log	`linux_kernel`	Determines log formats through a grok pattern.
Microsoft log	`microsoft_log`	Determines log formats through a grok pattern.
Ruby log	`ruby_logger`	Reads the beginning of the file to determine format.
Squid 3.x log	`squid`	Reads the beginning of the file to determine format.

MANAGING PARTITIONS IN AWS GLUE

- Partitioning is critical for data organization.
- Proper portioning allow for an efficient query process.
- Once partitioned, AWS services such as Athena, Redshift, and Glue can utilize these partitions to filter through the data instead of scanning the entire bucket on S3.
- Partitioning allows for organizing data in a hierarchy directory structure as follows:

s3://my_bucket/logs/year=2018/month=01/day=23/

- AWS Glue Crawlers can rely on the partition structure to generate AWS Glue Data Catalog.
- The resulting partition columns can be queried using (1) AWS Glue ETL jobs and (2) Amazon Athena.

AWS GLUE BUILT-IN TRANSFORMATIONS

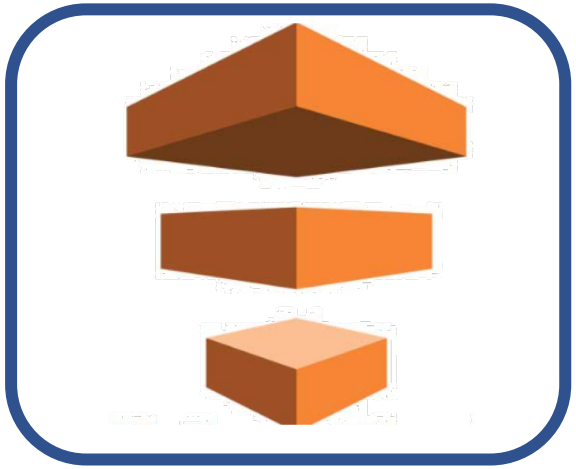
- AWS Glue offer several built-in transformations that could be called from an ETL script.
- Generally there are two types of transformations:
- **Bundled Transformations:**
  - DropFields Class
  - DropNullFields Class
  - Filter Class
  - Join Class
  - Map Class
  - MapToCollection Class
  - RenameField Class
  - ResolveChoice Class

- **Machine Learning Transformations:**
  - FindMatches ML: could be used to find matching data which enables you to find related products, customers, and places.
  - FindMatches ML could be used to find duplicate customers who have signed up more than once.

AWS DATA PIPELINE

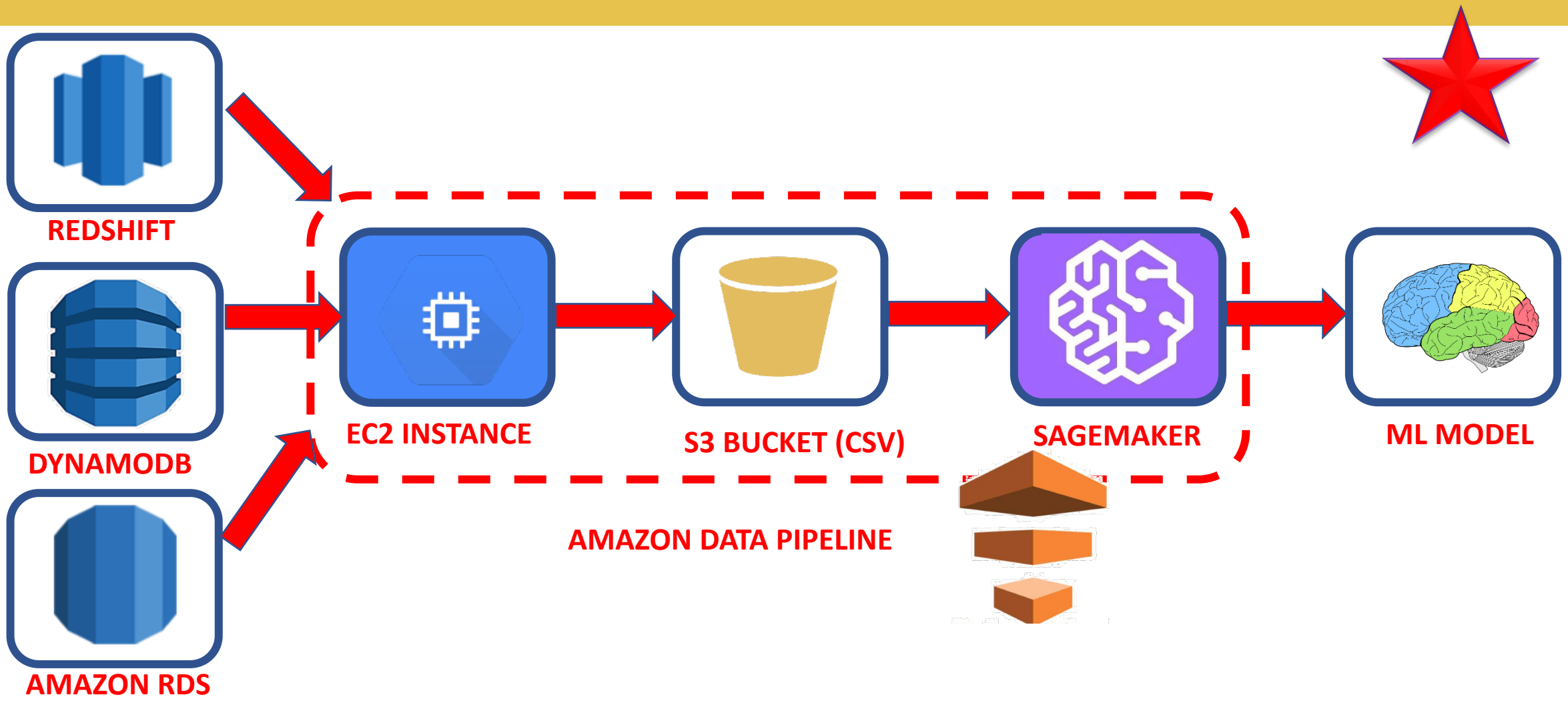
AWS DATA PIPELINE

- AWS Data Pipeline is an **orchestration service** that allows AWS users to transfer data reliably and securely between various AWS compute and storage services.
- You can transfer data to Amazon S3, Amazon RDS, Amazon DynamoDB, and Amazon EMR.
- AWS manages the workflow so minimum maintenance is required.
- AWS guarantees resource availability and handles failures.



AMAZON DATA PIPELINE

AWS DATA PIPELINE: EXAMPLE #1



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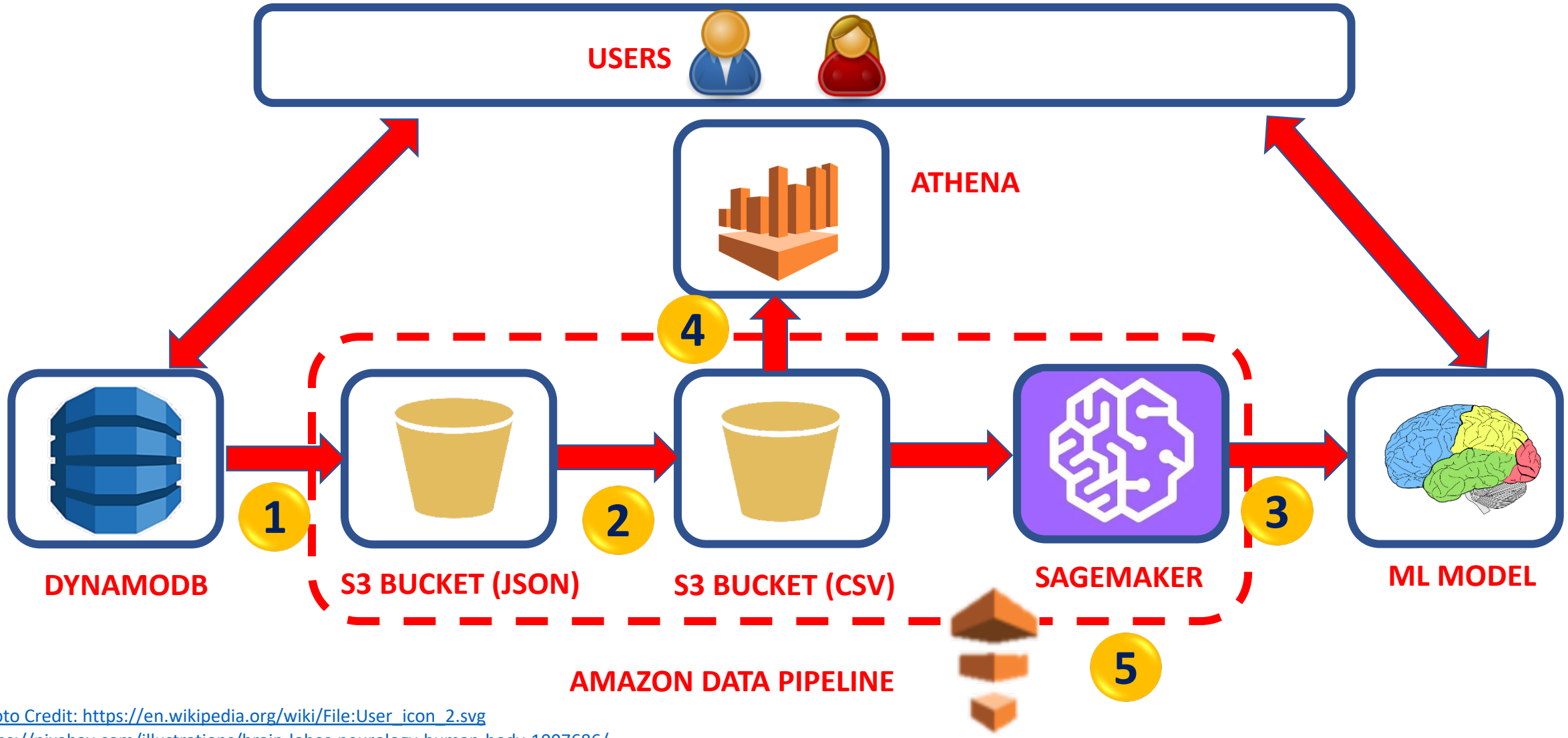
AWS DATA PIPELINE: EXAMPLE#2



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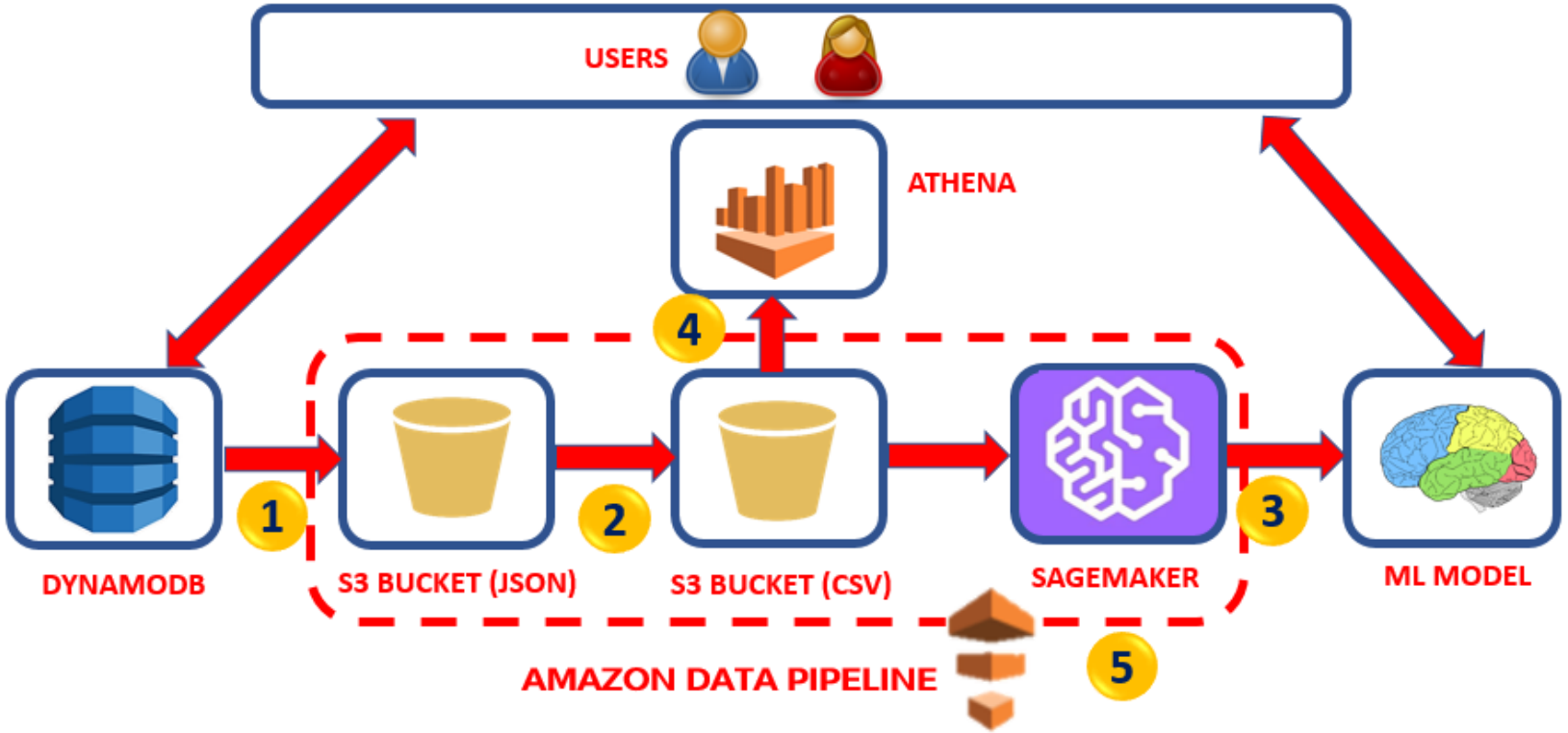
https://aws.amazon.com/blogs/big-data/analyze-data-in-amazon-dynamodb-using-amazon-sagemaker-for-real-time-prediction/

AWS DATA PIPELINE: EXAMPLE

The steps are as follows:

1. Data in DynamoDB is copied to Amazon S3 bucket (JSON) continuously as part of the Data Pipeline.
2. JSON files are then converted to CSV format to be used by Amazon SageMaker.
3. Amazon SageMaker consumes the data, trains the model, update endpoint for inference.
4. The data in CSV format is being queried (ad hoc) by Amazon Athena.
5. Data Pipeline manages the workflow as per the customer requirements.



WHEN SHOULD I USE AWS GLUE VS. DATA PIPELINE?

AWS GLUE:

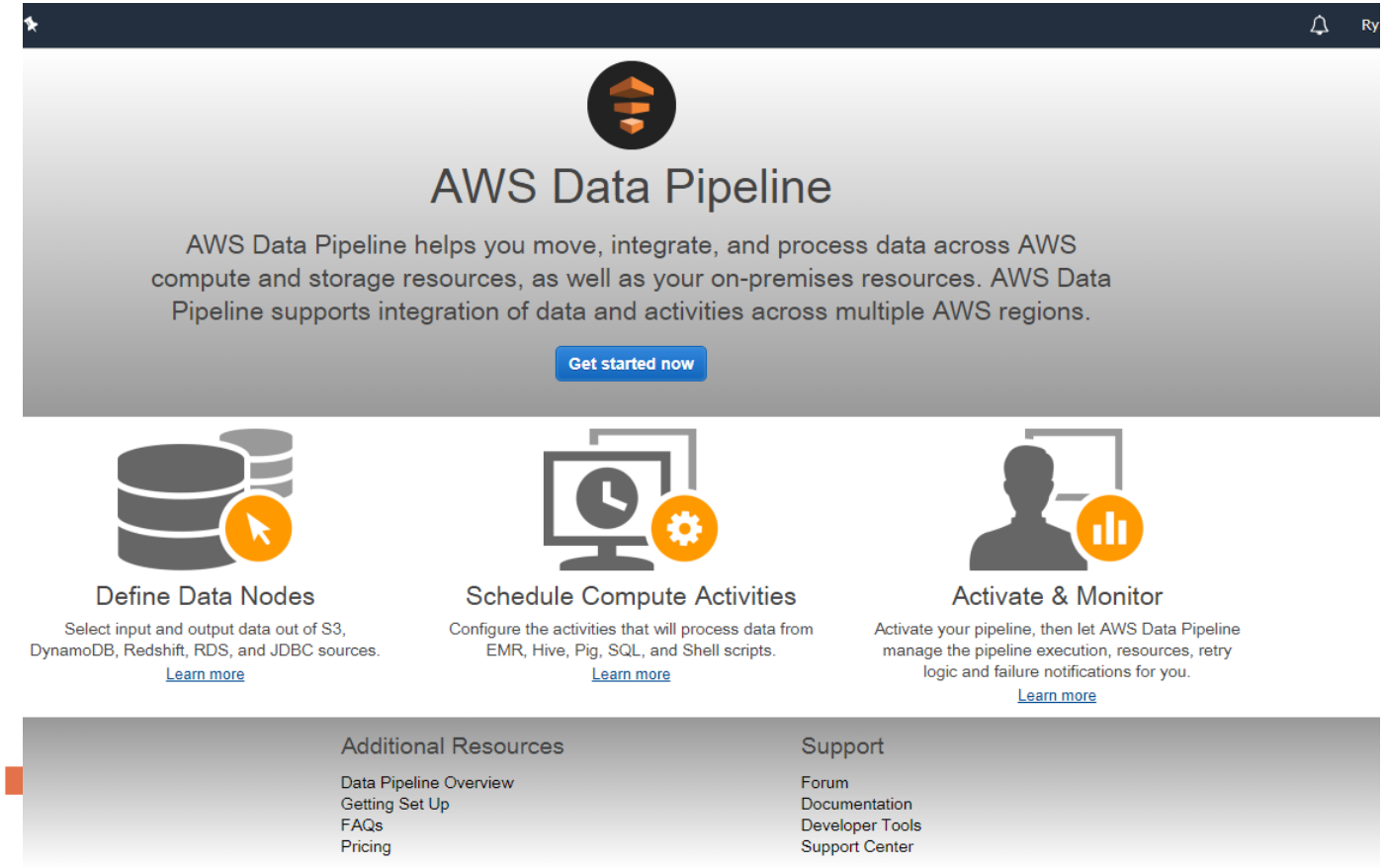
- Glue is an ETL service that runs on a serverless Apache Spark environment.
- As a user, you do not have to configure or manage resources.
- Glue contains a data catalogue for ETL that could be used with Athena and Redshift Spectrum.
- AWS Glue ETL jobs uses Scala or Python.

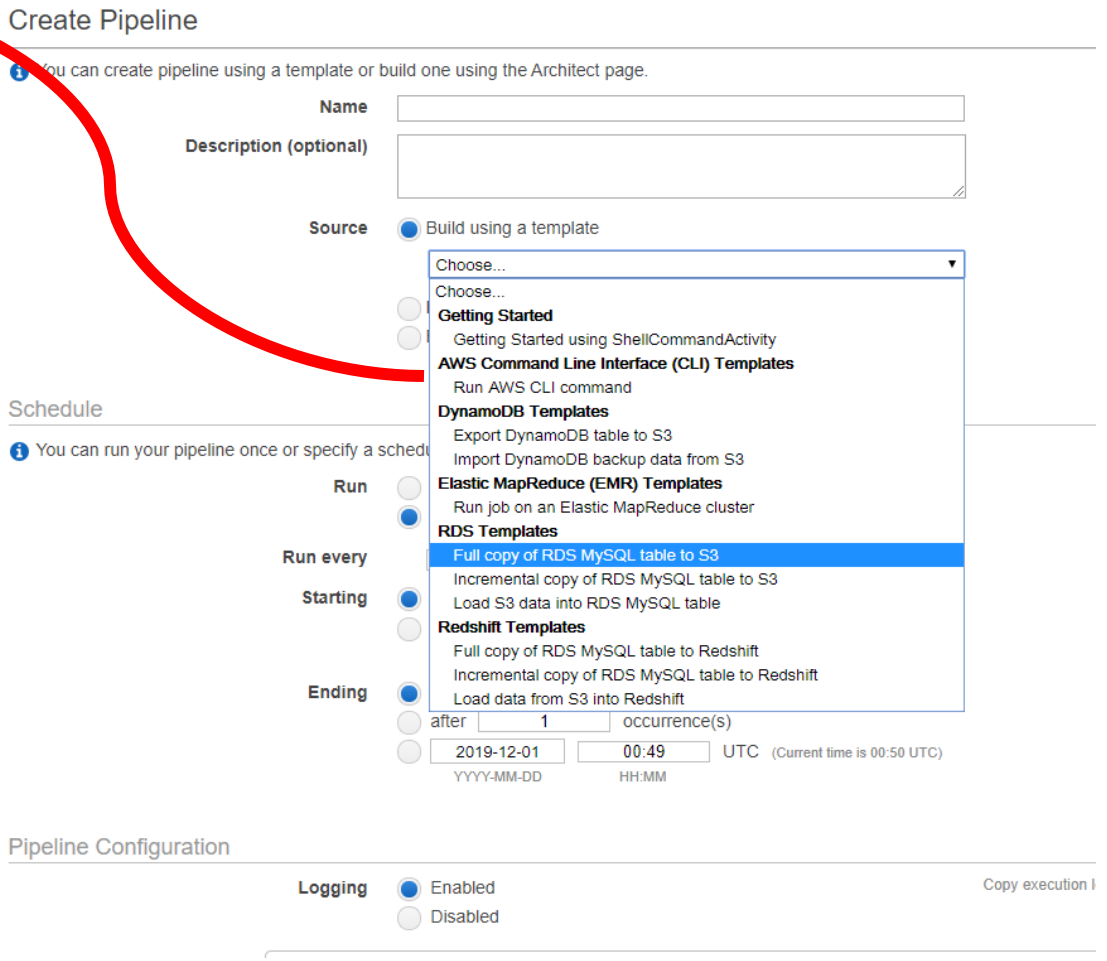
AWS DATA PIPELINE:

- AWS Data Pipeline is a managed orchestration service.
- AWS Data pipeline offers more flexibility over EC2 instances that runs your code.
- If you are not using Apache Spark, its recommended to use AWS data pipeline.

AWS PIPELINE TEMPLATES

READILY AVAILABLE TEMPLATES FOR REDSHIFT, RDS, AND DYNAMODB





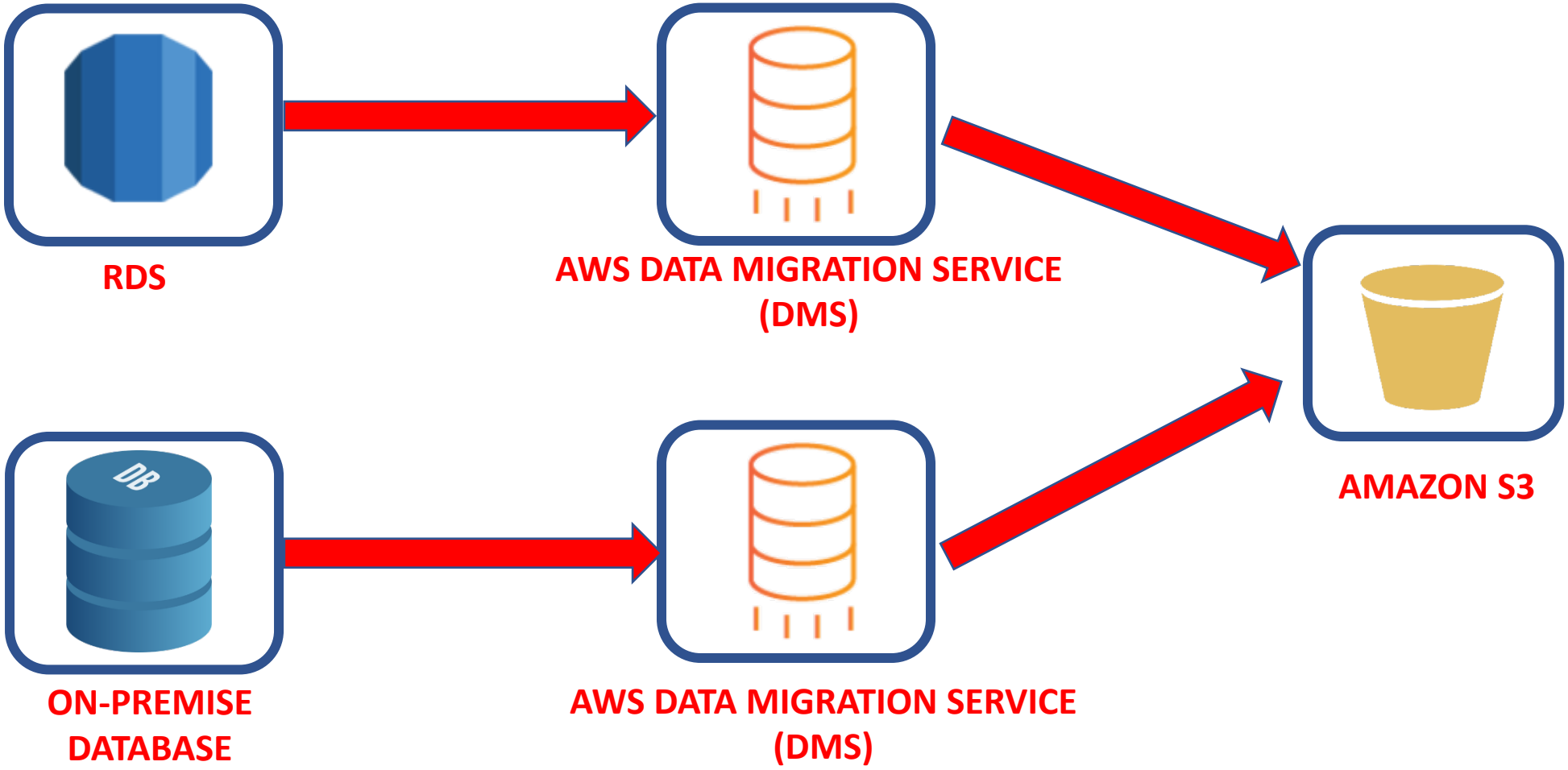
AWS DATA MIGRATION SERVICE (DMS)

AWS DATA MIGRATION SERVICE (DMS)

- As the name stated, AWS Database Migration Service allows for database migration to AWS quickly.
- Source database remains functional during migration.
- Oracle to oracle migration or oracle to Aurora (RDS).
- Allows for database consolidation.
- Allows for data replication in a Data warehouse such as Amazon Redshift and S3.
- Watch Video: https://aws.amazon.com/dms/

AWS DATA MIGRATION SERVICE (DMS)

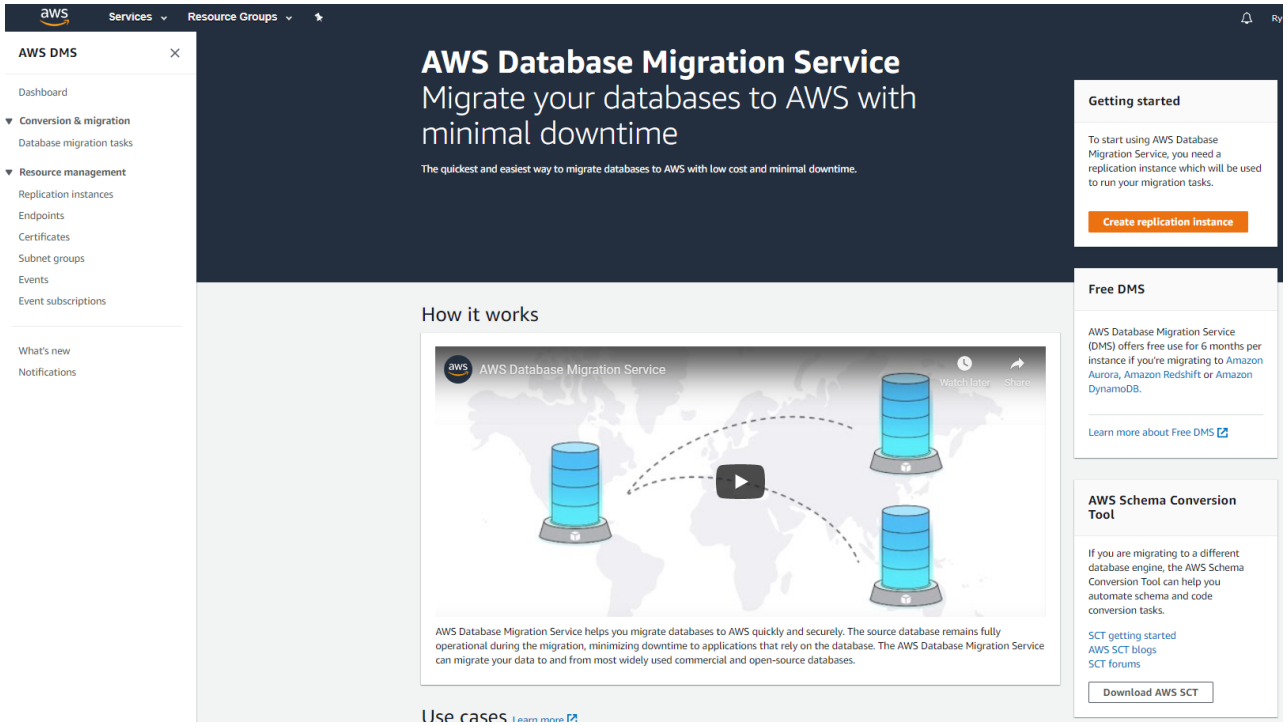
AWS DATA MIGRATION SERVICE (DMS)

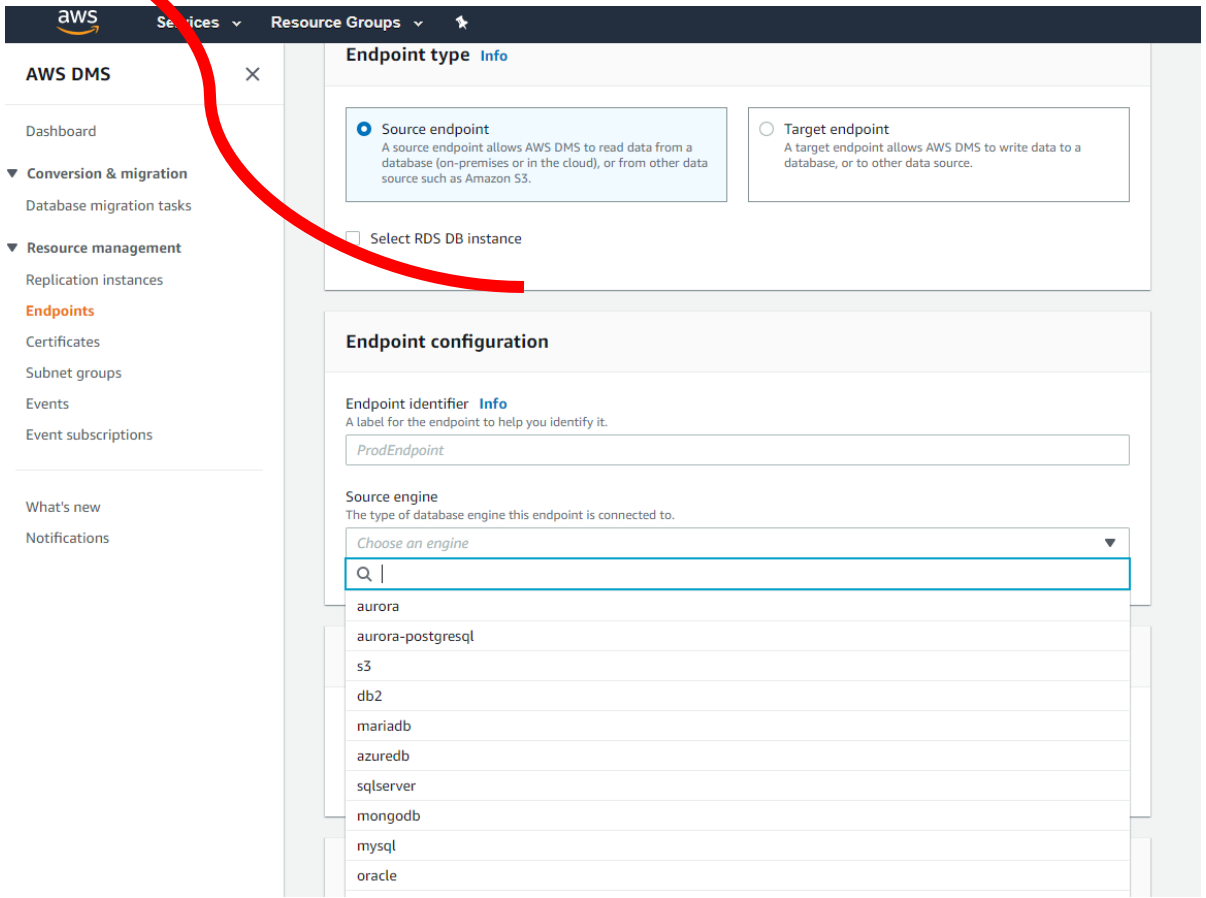


https://freesvg.org/vector-drawing-of-blue-database-symbol

AWS DATA MIGRATION SERVICE (DMS)

SELECT THE SOURCE AND ENDPOINT





WHEN SHOULD I USE AWS GLUE VS. AWS MIGRATION SERVICE?

AWS GLUE:

- Glue is an ETL service that runs on a serverless Apache Spark environment.
- As a user, you do not have to configure or manage resources.
- Glue contains a data catalogue for ETL that could be used with Athena and Redshift Spectrum.
- AWS Glue ETL jobs uses Scala or Python.

AWS MIGRATION (DMS):

- AWS DMS allows for data migration to AWS safely and cheaply.
- AWS DMS is recommended when database migration is needed to AWS.
- Once data is available in AWS, AWS Glue could be used to transform/move data source to data warehouse such as Amazon Redshift.

AWS BATCH

AWS BATCH

- AWS Batch allows for running of batch computing jobs on AWS.
- AWS batch optimizes the type and number of compute resources based on volume.
- No management or hassle (serverless), AWS takes care of the batch computing software and resources.
- AWS Batch performs all the scheduling and execution of the batch using Amazon EC2 and Spot Instances.
- Users pay for the EC2 resources that the batch run on.
- AWS Batch jobs could be scheduled using CloudWatch Events
- AWS batch jobs could be orchestrates using AWS Step Functions

AWS BATCH

WHEN SHOULD I USE AWS GLUE VS. BATCH?

AWS GLUE:

- Glue is an ETL service that runs on a serverless Apache Spark environment.
- As a user, you do not have to configure or manage resources.
- Glue contains a data catalogue for ETL that could be used with Athena and Redshift Spectrum.
- AWS Glue ETL jobs uses Scala or Python.

AWS BATCH:

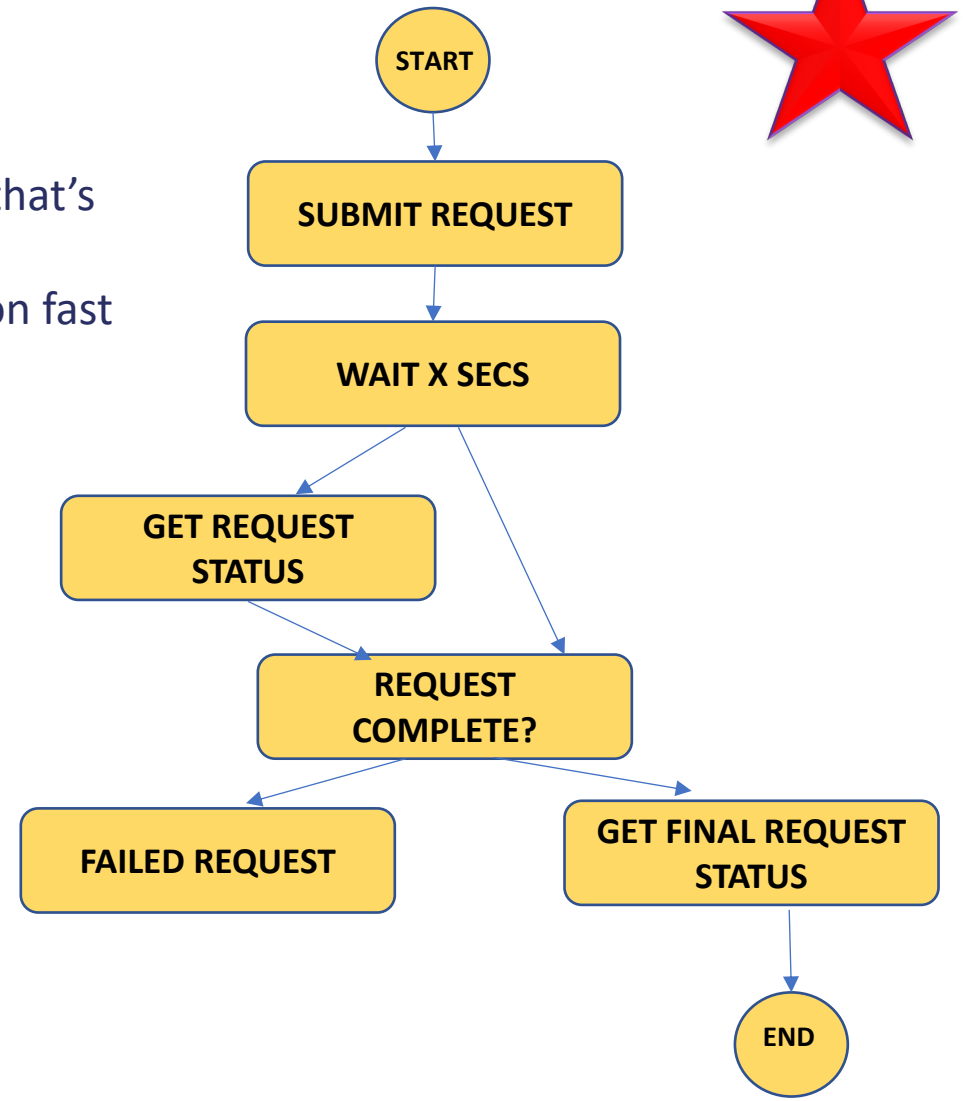
- Regardless of the type of the job, AWS Batch enables running of batch computing jobs on AWS.
- AWS Batch creates and manages the compute resources in the AWS account.
- AWS batch gives users full visibility and control over resources (EC2 instances).

For ETL use cases, use AWS Glue
For any other batch services (that might include ETL), use AWS Batch

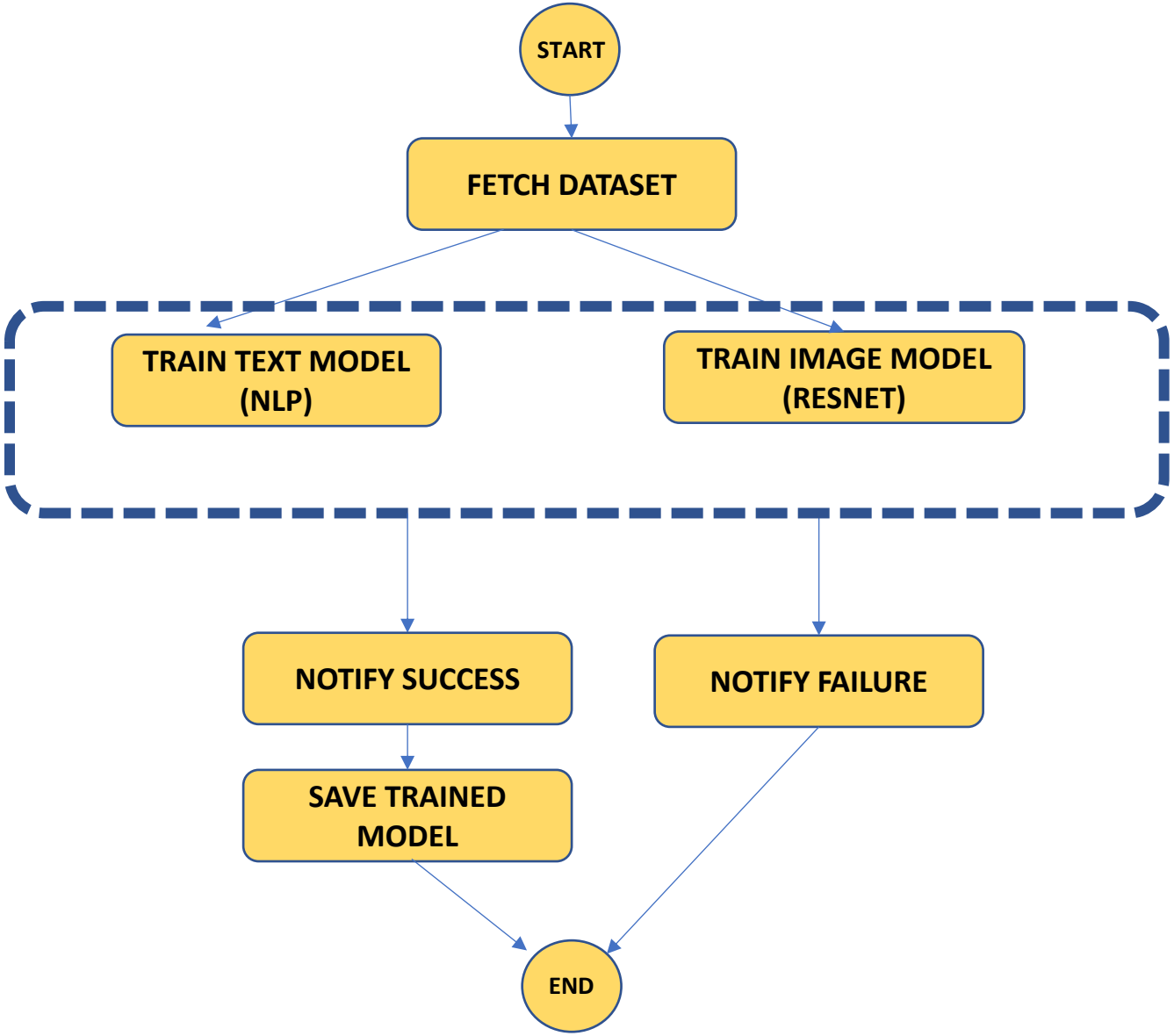
AWS STEP FUNCTION

AMAZON AWS STEP FUNCTIONS

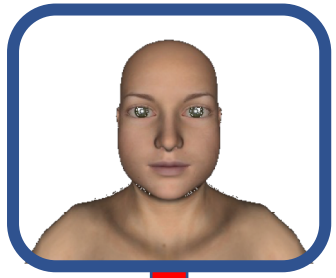
- AWS Step Functions allows for creating serverless workflows.
- Output from a step is fed as an input to the next step.
- AWS Step functions converts a workflow into a state machine diagram that's easy to debug and understand.
- AWS Step Functions allows for performing resilient workflow automation fast without writing code.
- It allows for advanced error handling and retrying mechanisms.
- Watch Video: https://aws.amazon.com/step-functions/getting-started/



AMAZON AWS STEP FUNCTIONS: MACHINE LEARNING EXAMPLE



AWS STEP FUNCTION: EXAMPLE #1



User took photo and upload it

S3 BUCKET

Photo is uploaded and stored in Amazon S3 Bucket

AWS STEP FUNCTION

AWS step functions performs task orchestration to perform image analysis

AWS Lambda invokes Amazon Rekognition API

AWS LAMBDA

AWS LAMBDA

AWS Lambda consumes photo metadata such as size, resolution

Amazon ReKognition performs object (face) detection

AMAZON REKOGNITION

AMAZON DYNAMODB

Amazon DynamoDB stores generated data related to object recognition

Photo Credit: https://www.publicdomainpictures.net/en/view-image.php?image=245536&picture=face-model

AWS STEP FUNCTION: EXAMPLE #2