AWS Lambda Executor: The Speed of Local Execution with the Advantages of Remote 3.0

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Who Am I?

- Apache Airflow committer
- Sr. software engineer at Amazon
  - Amazon Managed Workflows for Apache Airflow (MWAA)
  - Founding member of the Amazon Apache Airflow Open Source Team

Executors in Airflow

- Executors facilitate the running of Airflow tasks (Task Instances)
- The Scheduler decides *when* a task runs; the executor decides *where* and *how*
- Executors run within the Scheduler process
- Pluggable and extensible, you can write your very own!

Executors in Airflow

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  - **Remote Containerized Executors**: Airflow tasks are executed ad hoc inside containers/pods. Each task is isolated in its own environment. E.g.: **KubernetesExecutor, AwsEcsExecutor**

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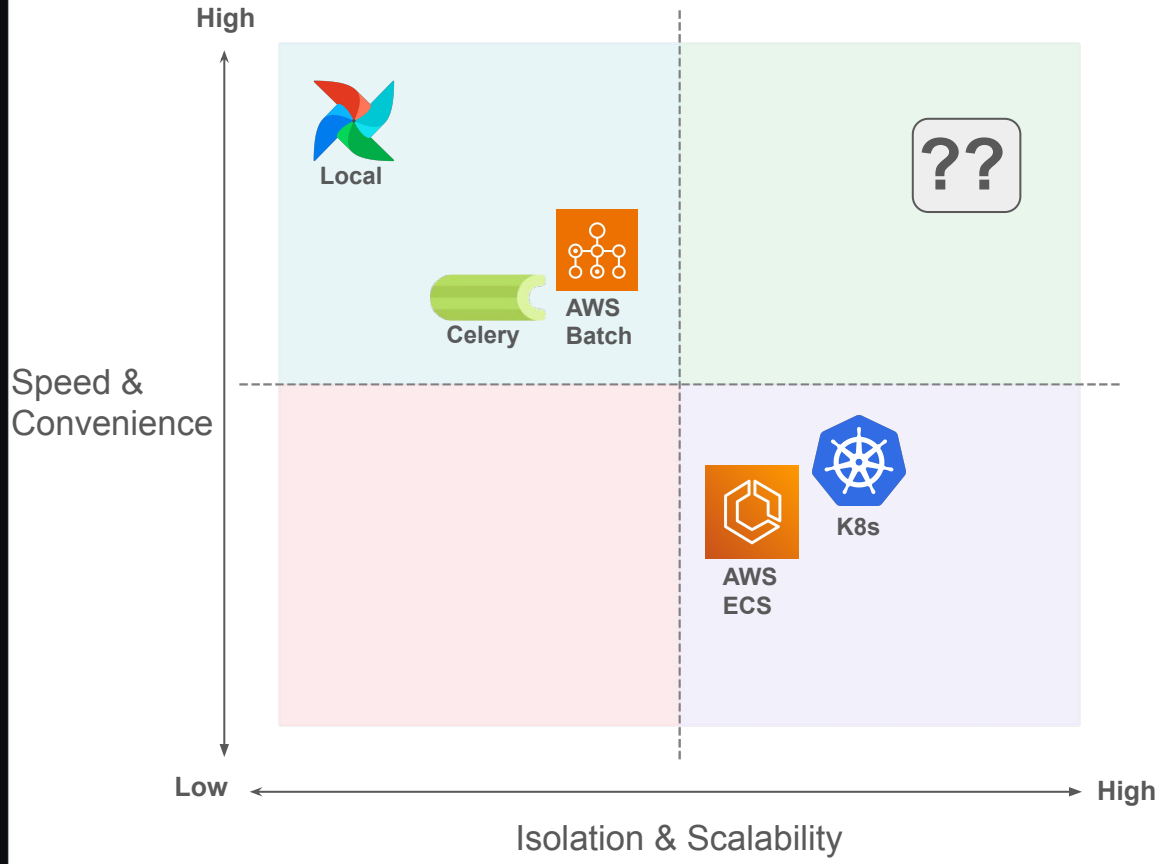
Speed vs Isolation

Speed & convenience vs isolation & scalability can you have it all?



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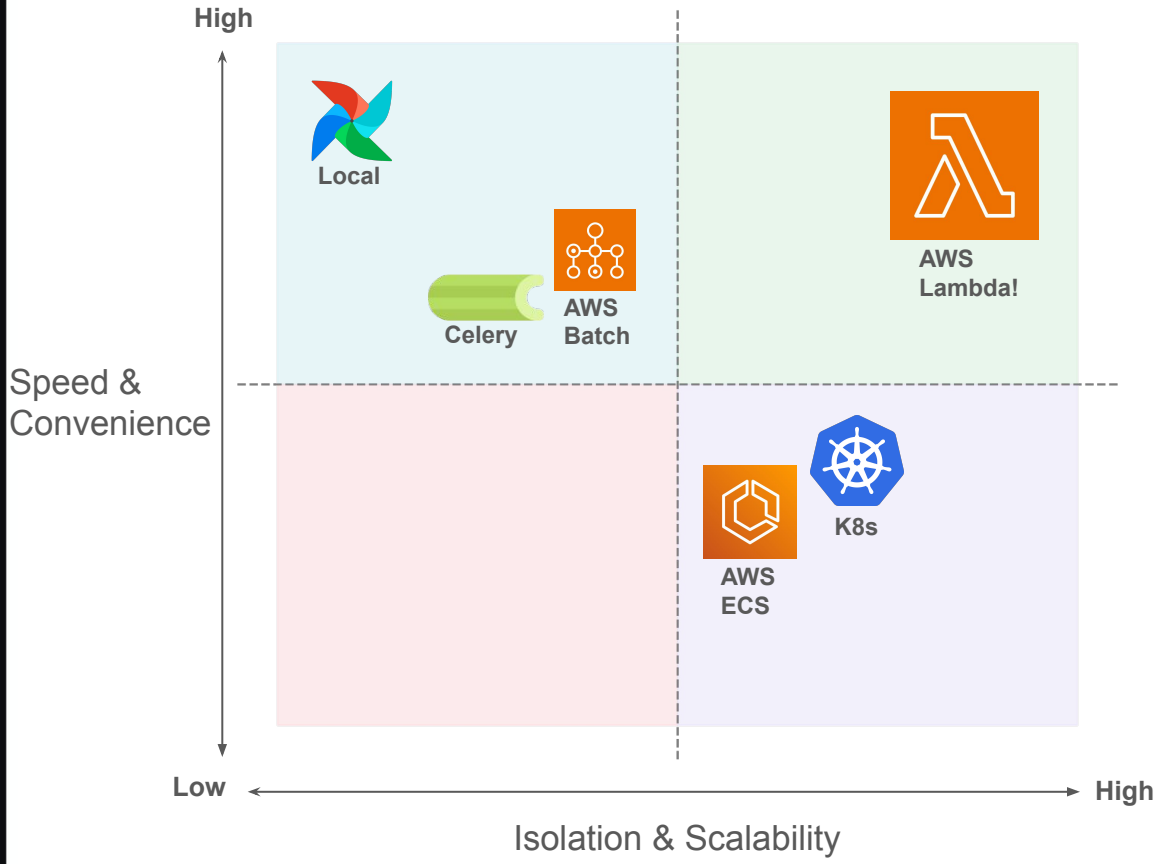
Speed vs Isolation

Yes, with the Lambda Executor!



Introducing: Lambda Executor

- Ephemeral containerized compute environment
- Massively scalable architecture
- Low latency (warm pools, Python runtime)
- Resilient: Highly available, retries, and dead letter queue
- Ideal for short to medium running tasks:
  - 15 min max execution time
  - Restrictive memory and storage (~10GB)

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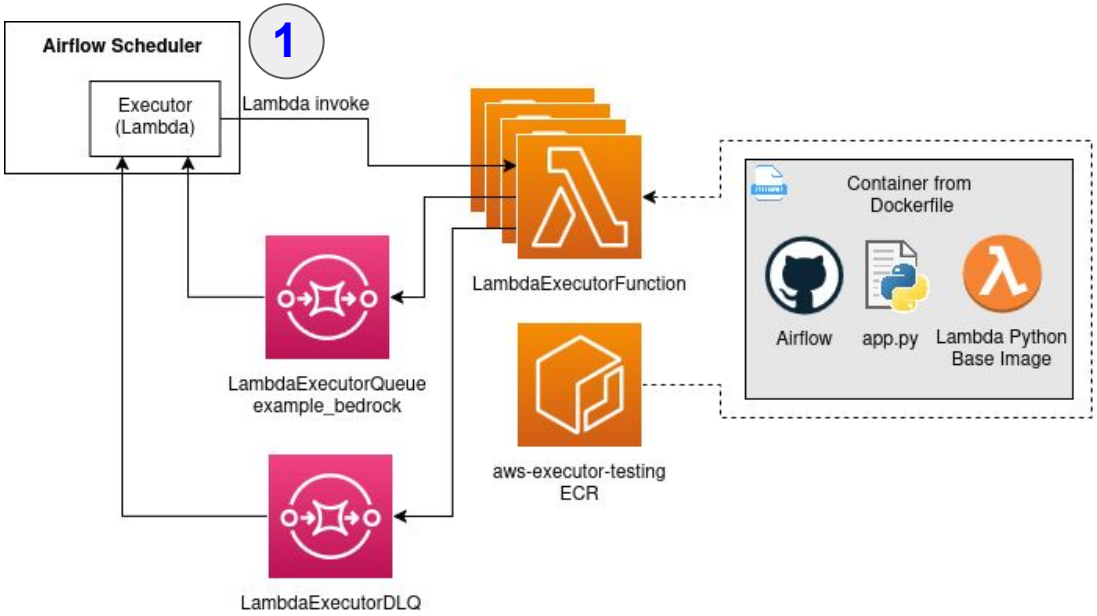
Lambda Executor Architecture

1

Lambda Executor receives task from the Scheduler. Queueing them and ultimately calling an asynchronous invoke for each Airflow Task to be run.



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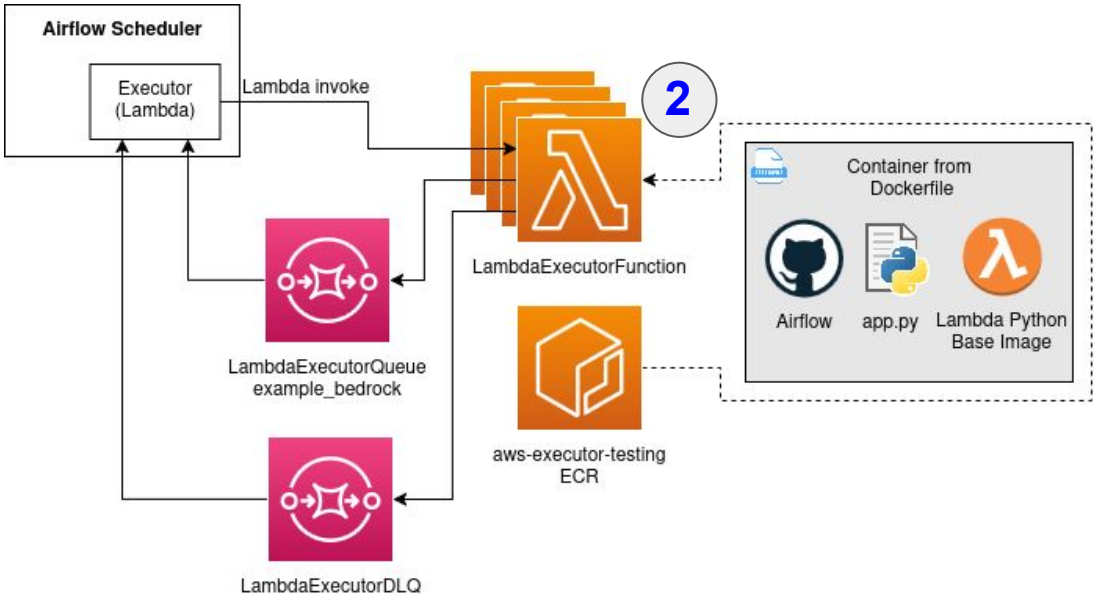
Lambda Executor Architecture

2

Lambda starts a Firecracker VM based off of the provided image.

Users must build the image to their specification and create the Lambda Function.

Example app/handler code and image building tips found here.



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Lambda Executor Architecture

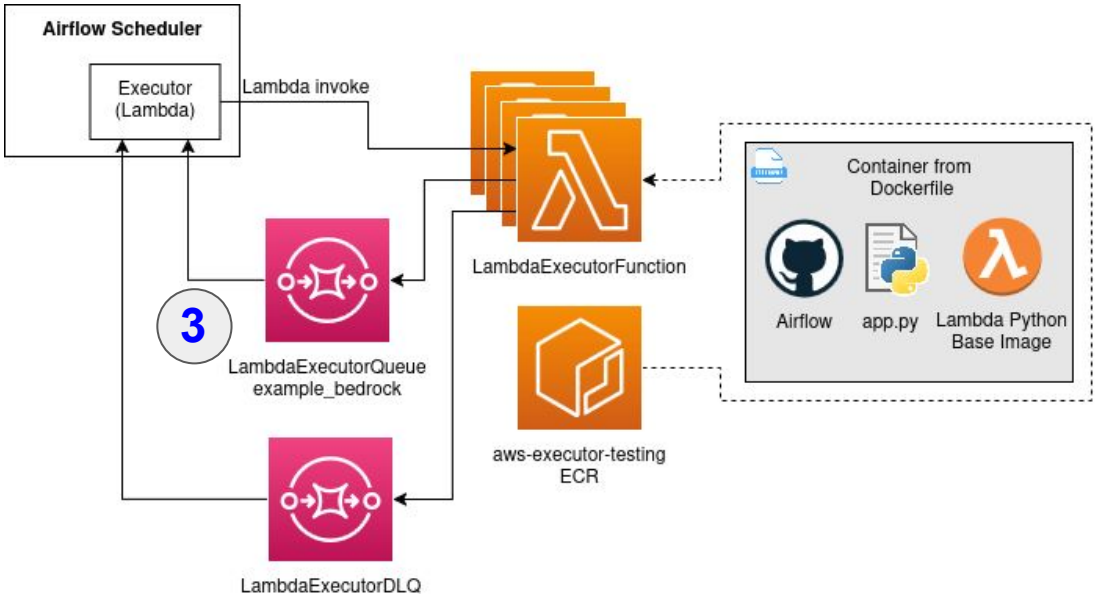
3

On Airflow Task completion, a message is sent to a results queue indicating pass/fail (SQS only as of now).

Async Lambdas cannot be described!

It is the responsibility of the Lambda app/handler code to send the results.

See provided example app.py in docs here.



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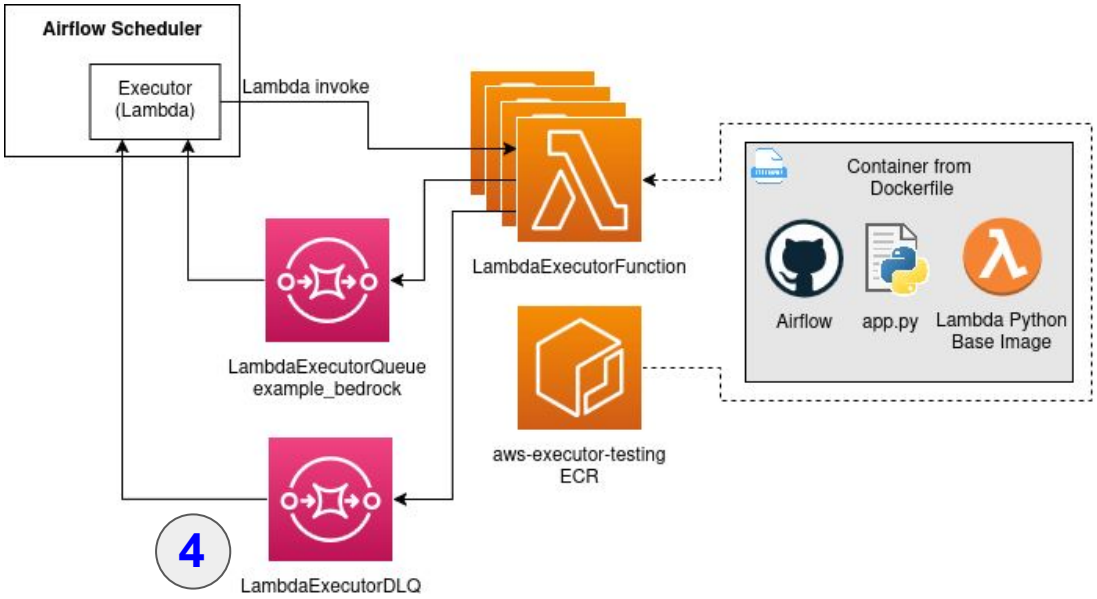
Lambda Executor Architecture

4

The Lambda function should be configured with a Dead Letter Queue (DLQ).

If an invocation fails catastrophically (OOM, uncaught exception, etc) the Lambda function will send a message to the DLQ.



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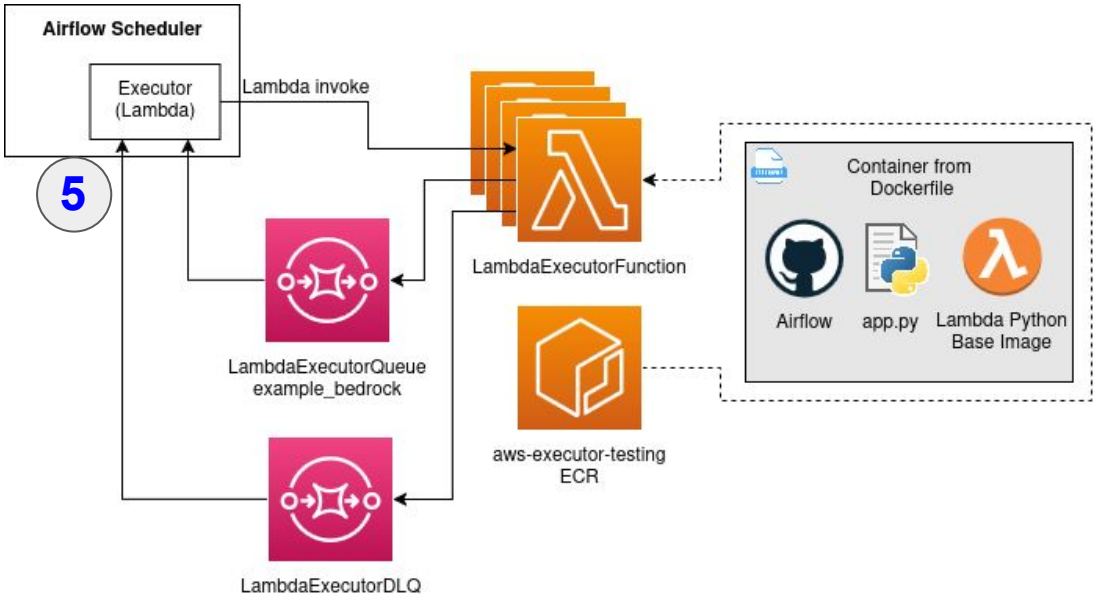
Lambda Executor Architecture

5

The LambdaExecutor periodically reads from both SQS queues for results.

Updating Task state and communicating events back to the Scheduler.



Local vs Lambda

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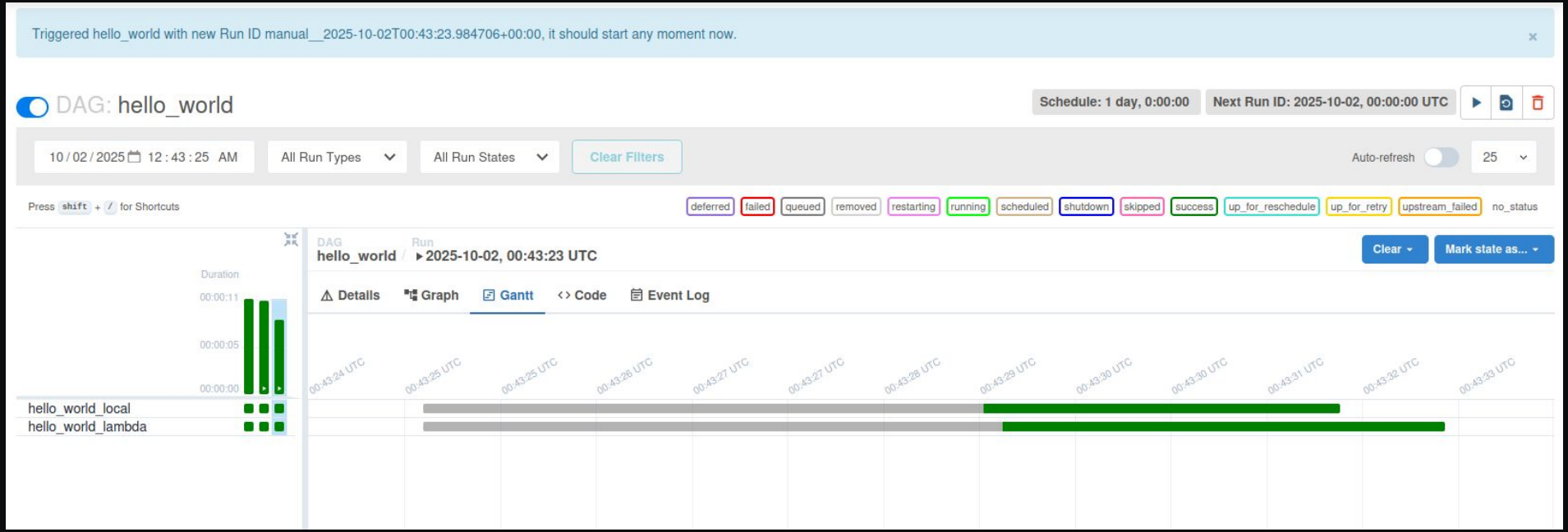

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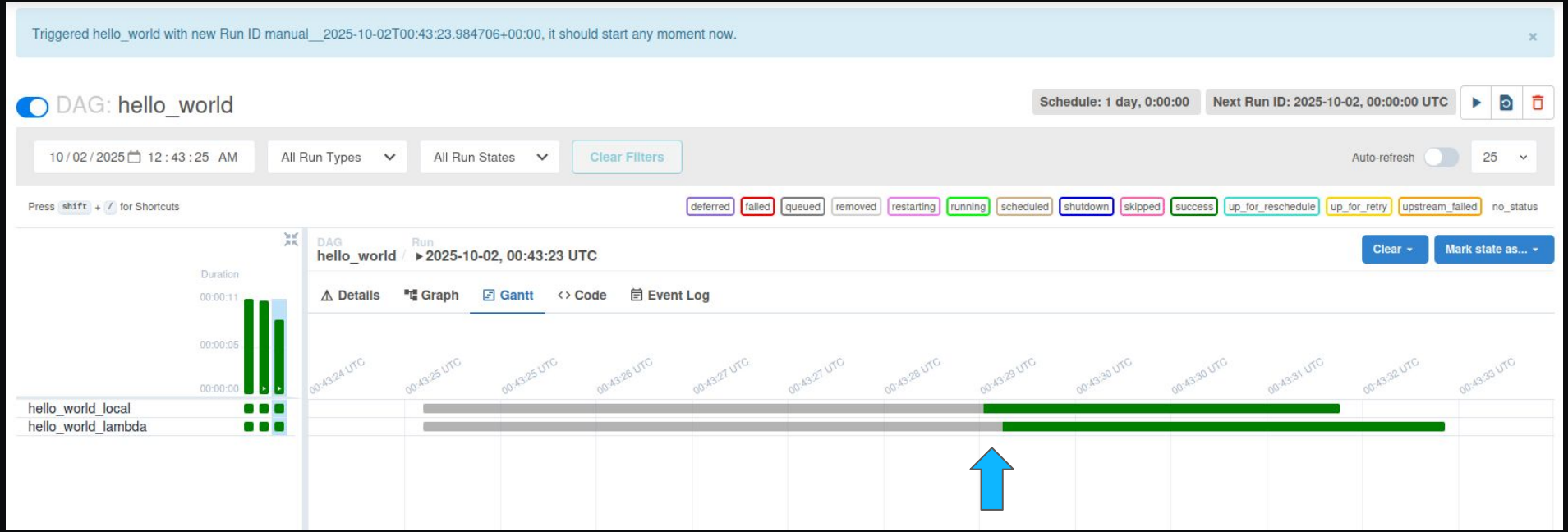

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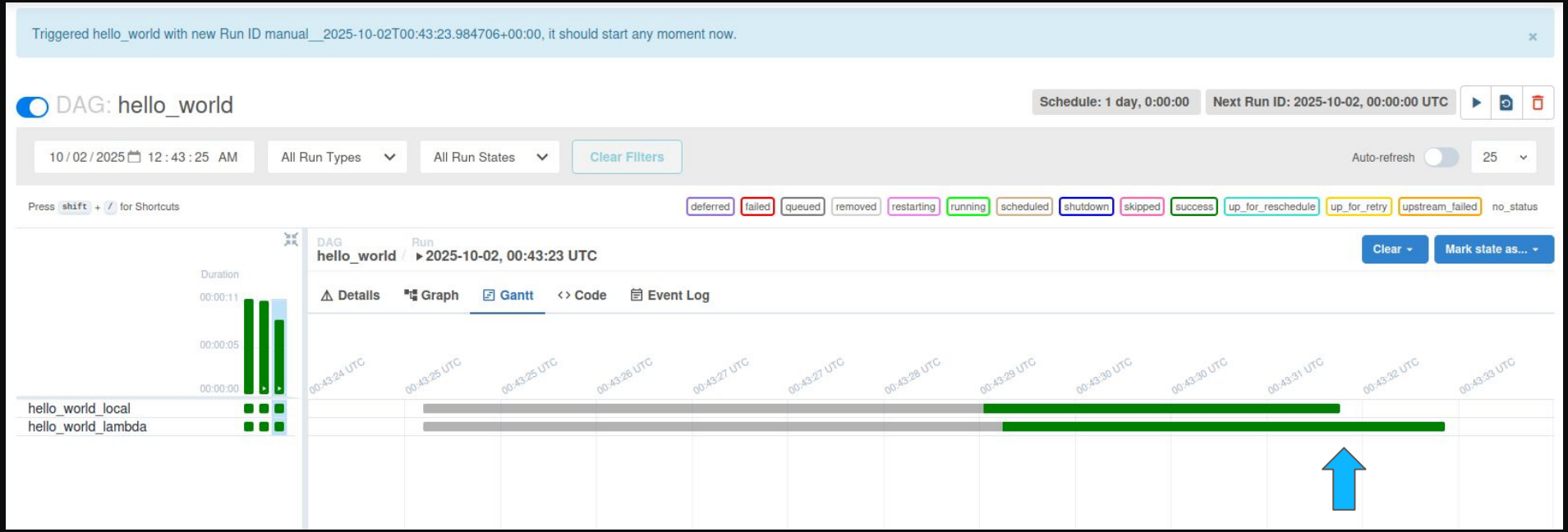

System tests: ECS vs Lambda

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ECS Executor

Apache Airflow - Amazon Provider Package Health

View the health of AWS service integrations for Apache Airflow

This live dashboard displays the current health of AWS service integrations available in the Amazon Provider package of Apache Airflow.
The following table shows data for all runs from the past 7 days of the AWS System Tests using the latest Apache Airflow codebase.
The data currently being displayed reflects the tests run using the ecs executor.

Local | ECS executor | Batch executor | Lambda executor

System name	Successes	Failures	Duration
example_appflow_run	28	0	24 minutes
example_athena	27	1	33 minutes
example_batch	28	0	an hour
example_bedrock	28	0	17 minutes
example_bedrock_batch_inference	28	0	28 minutes
example_cloudformation	27	1	17 minutes
example_comprehend	28	0	24 minutes
example_comprehend_document_classifier	28	0	33 minutes
example_datasync	27	1	39 minutes
example_dynamodb	28	0	17 minutes

Lambda Executor

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System name	Successes	Failures	Duration
example_appflow_run	20	7	5 minutes
example_athena	20	7	6 minutes
example_batch	20	7	8 minutes
example_bedrock	20	7	4 minutes
example_bedrock_batch_inference	20	7	10 minutes
example_cloudformation	20	7	4 minutes
example_comprehend	20	7	9 minutes
example_comprehend_document_classifier	20	7	11 minutes
example_datasync	20	7	6 minutes
example_dynamodb	20	7	4 minutes

System tests: ECS vs Lambda

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System tests: Batch vs Lambda

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Batch Executor

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The data currently being displayed reflects the tests run using the batch executor.

Local | ECS executor | Batch executor | Lambda executor

System name	Successes	Failures	Duration
example_appflow_run	28	0	14 minutes
example_athena	28	0	20 minutes
example_batch	28	0	33 minutes
example_bedrock	28	0	10 minutes
example_bedrock_batch_inference	28	0	21 minutes
example_cloudformation	28	0	10 minutes
example_comprehend	28	0	18 minutes
example_comprehend_document_classifier	28	0	25 minutes
example_datasync	28	0	25 minutes
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Lambda Executor

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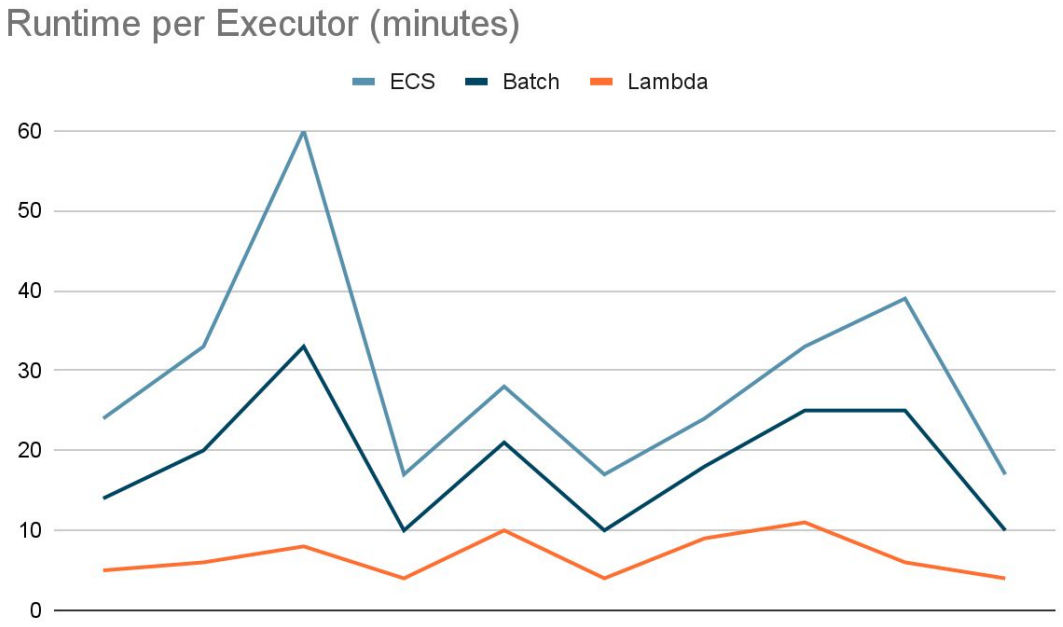
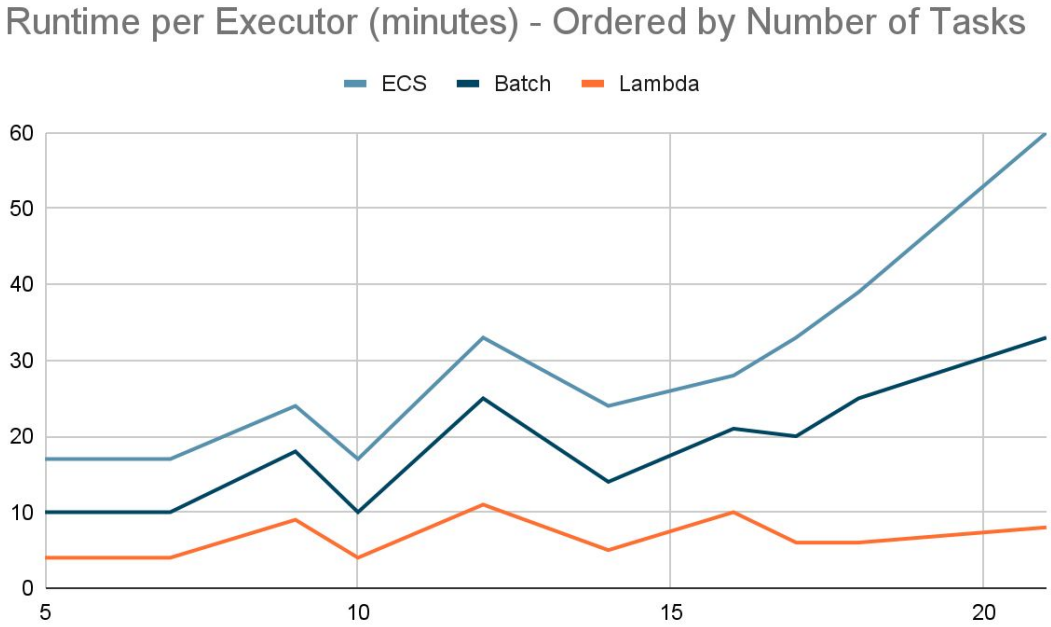
ECS vs Batch vs Lambda

The same data from the previous slides plotted alongside each other



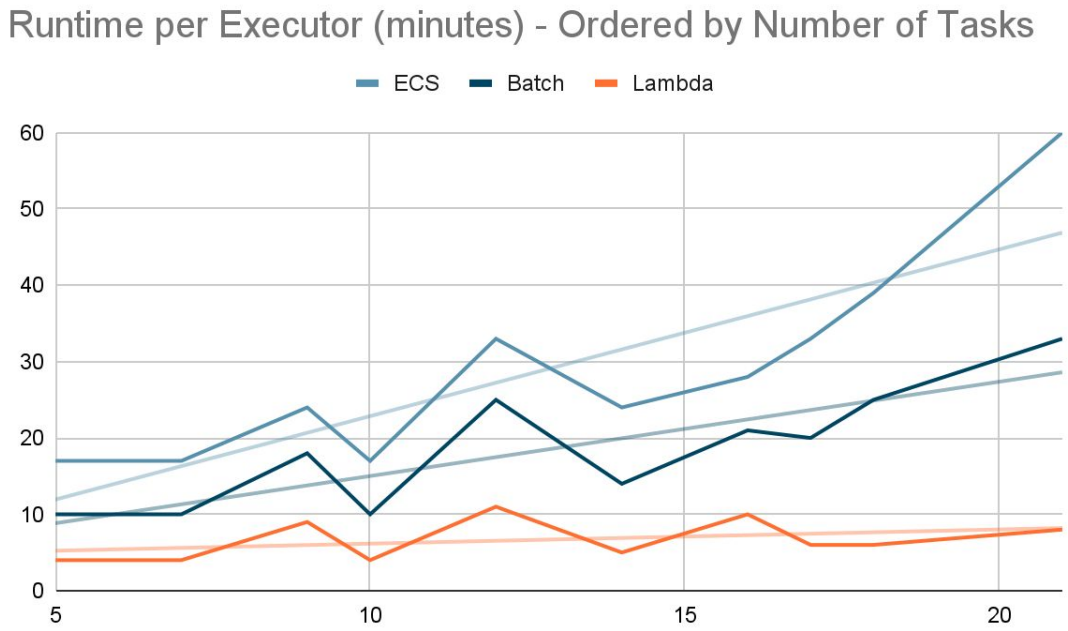
ECS vs Batch vs Lambda

If you order the data by the number of tasks you start to see the defining factor. Startup latency!



ECS vs Batch vs Lambda

Plotting a trend, you can see Lambda runtime as tasks are added grows at a slower rate.



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What about the 15min Limit?

Of all the AWS Operators we test regularly. Only 1 was not usable with the Lambda Executor, in its basic use case.

Other Operators or usage patterns may differ.

Deferrable operators are your friend!

Not just Lambda: FaaS(t) Executors

- A new type of executor: Function as a Service (FaaS) --> FaaSt
- Distinctly different:
  - Queued/async execution pattern
  - FAST/resilient/scalable
  - Restrictive memory/storage
  - Execution time limits

Questions?

Try it out now! Supports Airflow 2 and 3:

Currently Experimental

Link to the docs

github.com/o-nikolas

linkedin.com/in/niko-oliveira-aws