Step 4: Cosmic AI Inference with Lambda FMI

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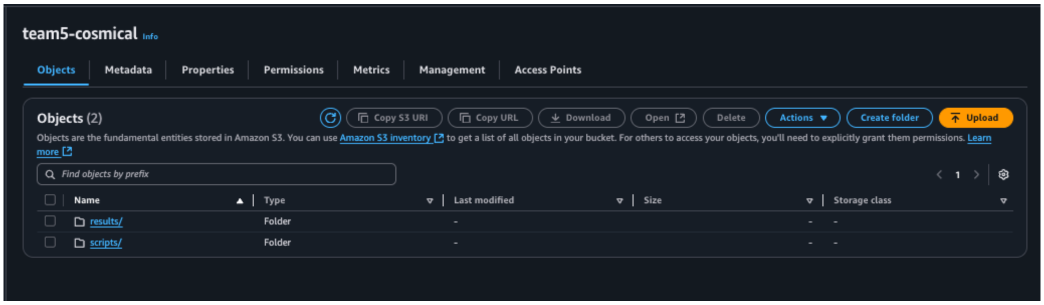
S3 Bucket with Scripts and Results Folders

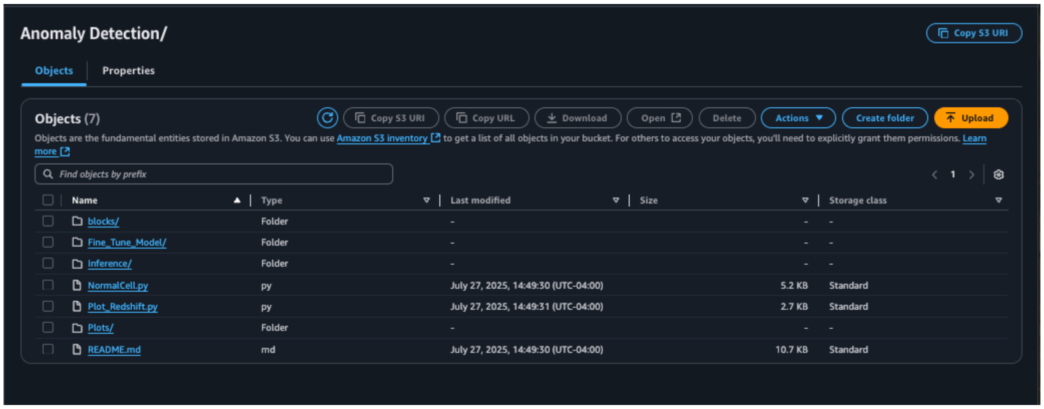


Objects (2)

Objects are the fundamental entities stored in Amazon S3. You can use Amazon S3 inventory to get a list of all objects in your bucket. For others to access your objects, you'll need to explicitly grant them permissions. Learn more

Name	Type	Last modified	Size	Storage class
results/	Folder	-	-	-
scripts/	Folder	-	-	-

Repository Cloning

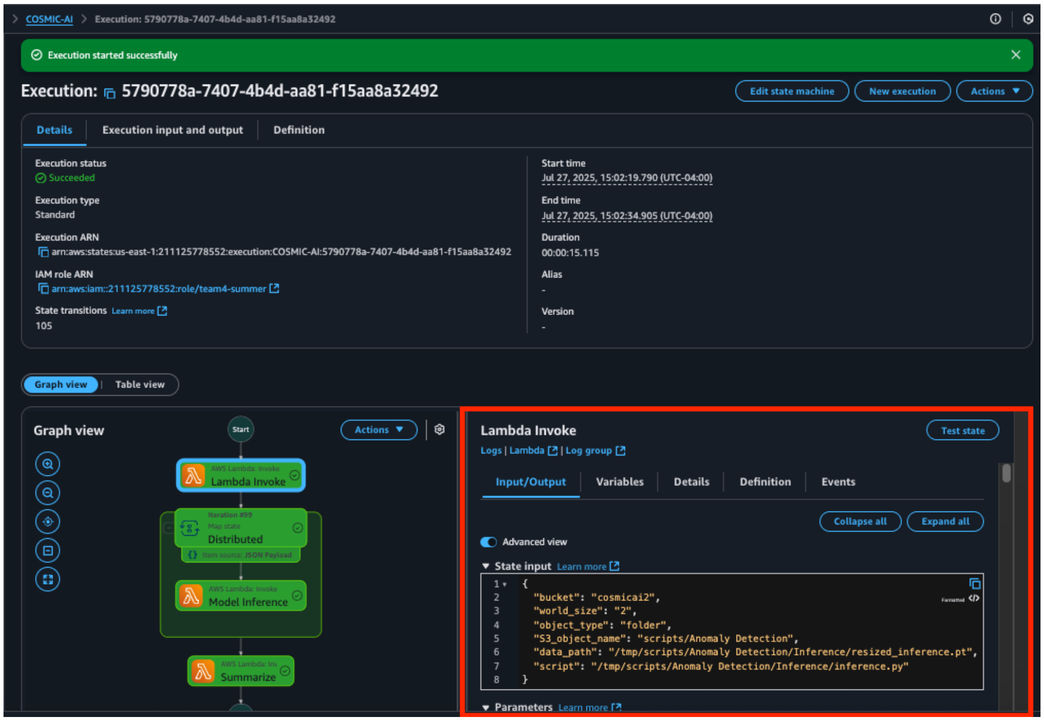


Objects (7)

Objects are the fundamental entities stored in Amazon S3. You can use Amazon S3 inventory to get a list of all objects in your bucket. For others to access your objects, you'll need to explicitly grant them permissions. Learn more

Name	Type	Last modified	Size	Storage class
blocks/	Folder	-	-	-
Fine_Tune_Model/	Folder	-	-	-
Inference/	Folder	-	-	-
NormalCell.py	py	July 27, 2025, 14:49:30 (UTC-04:00)	5.2 KB	Standard
Plot_Redshift.py	py	July 27, 2025, 14:49:31 (UTC-04:00)	2.7 KB	Standard
Plots/	Folder	-	-	-
README.md	md	July 27, 2025, 14:49:30 (UTC-04:00)	10.7 KB	Standard

Step Function Configuration



Execution started successfully

Execution: 5790778a-7407-4b4d-aa81-f15aa8a32492

Execution status
Succeeded

Execution type
Standard

Execution ARN
arn:aws:states:us-east-1:211125778552:execution:COSMIC-AI:5790778a-7407-4b4d-aa81-f15aa8a32492

IAM role ARN
arn:aws:iam::211125778552:role/team4-summer

State transitions Learn more
105

Start time
Jul 27, 2025, 15:02:19.790 (UTC-04:00)

End time
Jul 27, 2025, 15:02:34.905 (UTC-04:00)

Duration
00:00:15.115

Alias
-

Version
-

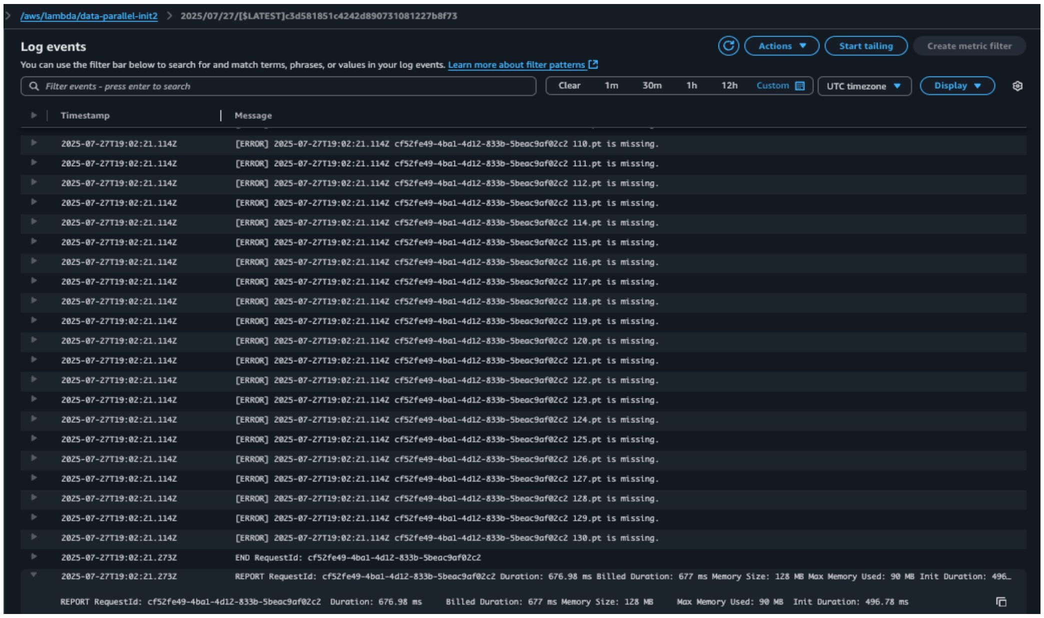
Advanced view

State input Learn more

```
{
  "bucket": "cosmicai2",
  "world_size": "2",
  "object_type": "folder",
  "S3_object_name": "scripts/Anomaly Detection",
  "data_path": "/tmp/scripts/Anomaly Detection/Inference/resized_inference.pt",
  "script": "/tmp/scripts/Anomaly Detection/Inference/inference.py"
}
```

Parameters Learn more

CloudWatch Logs



/aws/lambda/data-parallel-init2 > 2025/07/27/[$LATEST]c3d581851c4242d890731081227b8f73

Log events

You can use the filter bar below to search for and match terms, phrases, or values in your log events. Learn more about filter patterns

```
Timestamp                  Message
2025-07-27T19:02:21.114Z   [ERROR] 2025-07-27T19:02:21.114Z cf52fe49-4ba1-4d12-833b-5beac9af02c2 110.pt is missing.
2025-07-27T19:02:21.114Z   [ERROR] 2025-07-27T19:02:21.114Z cf52fe49-4ba1-4d12-833b-5beac9af02c2 111.pt is missing.
2025-07-27T19:02:21.114Z   [ERROR] 2025-07-27T19:02:21.114Z cf52fe49-4ba1-4d12-833b-5beac9af02c2 112.pt is missing.
2025-07-27T19:02:21.114Z   [ERROR] 2025-07-27T19:02:21.114Z cf52fe49-4ba1-4d12-833b-5beac9af02c2 113.pt is missing.
2025-07-27T19:02:21.114Z   [ERROR] 2025-07-27T19:02:21.114Z cf52fe49-4ba1-4d12-833b-5beac9af02c2 114.pt is missing.
2025-07-27T19:02:21.114Z   [ERROR] 2025-07-27T19:02:21.114Z cf52fe49-4ba1-4d12-833b-5beac9af02c2 115.pt is missing.
2025-07-27T19:02:21.114Z   [ERROR] 2025-07-27T19:02:21.114Z cf52fe49-4ba1-4d12-833b-5beac9af02c2 116.pt is missing.
2025-07-27T19:02:21.114Z   [ERROR] 2025-07-27T19:02:21.114Z cf52fe49-4ba1-4d12-833b-5beac9af02c2 117.pt is missing.
2025-07-27T19:02:21.114Z   [ERROR] 2025-07-27T19:02:21.114Z cf52fe49-4ba1-4d12-833b-5beac9af02c2 118.pt is missing.
2025-07-27T19:02:21.114Z   [ERROR] 2025-07-27T19:02:21.114Z cf52fe49-4ba1-4d12-833b-5beac9af02c2 119.pt is missing.
2025-07-27T19:02:21.114Z   [ERROR] 2025-07-27T19:02:21.114Z cf52fe49-4ba1-4d12-833b-5beac9af02c2 120.pt is missing.
2025-07-27T19:02:21.114Z   [ERROR] 2025-07-27T19:02:21.114Z cf52fe49-4ba1-4d12-833b-5beac9af02c2 121.pt is missing.
2025-07-27T19:02:21.114Z   [ERROR] 2025-07-27T19:02:21.114Z cf52fe49-4ba1-4d12-833b-5beac9af02c2 122.pt is missing.
2025-07-27T19:02:21.114Z   [ERROR] 2025-07-27T19:02:21.114Z cf52fe49-4ba1-4d12-833b-5beac9af02c2 123.pt is missing.
2025-07-27T19:02:21.114Z   [ERROR] 2025-07-27T19:02:21.114Z cf52fe49-4ba1-4d12-833b-5beac9af02c2 124.pt is missing.
2025-07-27T19:02:21.114Z   [ERROR] 2025-07-27T19:02:21.114Z cf52fe49-4ba1-4d12-833b-5beac9af02c2 125.pt is missing.
2025-07-27T19:02:21.114Z   [ERROR] 2025-07-27T19:02:21.114Z cf52fe49-4ba1-4d12-833b-5beac9af02c2 126.pt is missing.
2025-07-27T19:02:21.114Z   [ERROR] 2025-07-27T19:02:21.114Z cf52fe49-4ba1-4d12-833b-5beac9af02c2 127.pt is missing.
2025-07-27T19:02:21.114Z   [ERROR] 2025-07-27T19:02:21.114Z cf52fe49-4ba1-4d12-833b-5beac9af02c2 128.pt is missing.
2025-07-27T19:02:21.114Z   [ERROR] 2025-07-27T19:02:21.114Z cf52fe49-4ba1-4d12-833b-5beac9af02c2 129.pt is missing.
2025-07-27T19:02:21.114Z   [ERROR] 2025-07-27T19:02:21.114Z cf52fe49-4ba1-4d12-833b-5beac9af02c2 130.pt is missing.
2025-07-27T19:02:21.273Z   END RequestId: cf52fe49-4ba1-4d12-833b-5beac9af02c2
2025-07-27T19:02:21.273Z   REPORT RequestId: cf52fe49-4ba1-4d12-833b-5beac9af02c2 Duration: 676.98 ms Billed Duration: 677 ms Memory Size: 128 MB Max Memory Used: 90 MB Init Duration: 496…

    REPORT RequestId: cf52fe49-4ba1-4d12-833b-5beac9af02c2  Duration: 676.98 ms    Billed Duration: 677 ms Memory Size: 128 MB    Max Memory Used: 90 MB  Init Duration: 496.78 ms
```

- REPORT RequestId: cf52fe49-4ba1-4d12-833b-5beac9af02c2
- Duration: 676.98 ms
- Billed Duration: 677 ms
- Memory Size: 128 MB
- Max Memory Used: 90 MB
- Init Duration: 496.78 ms

Local vs Distributed Inference Comparison

Execution Mode	Batch Size	Duration (s)	Memory (GB)	Throughput (bps)
Local (CPU)	512	9.56	31.5	21.5M
AWS Lambda	512	6.2–24.3	2.5-7.0	19–22M

Performance Metrics from Distributed Lambda Execution

Partition Size (MB)	Data Size (GB)	Batch Size	World Size	Duration (s)	Memory (GB)	Cost ($)	Throughput (bps)
25	1.25	512	52	6.2	2.5	0.15	~19M
50	2.5	512	52	11.5	3.8	0.19	~20M
75	3.75	512	50	17.0	5.7	0.29	~21M
100	5.0	512	50	24.3	7.0	0.36	~22M

Summary Analysis

We executed a scalable AI inference workflow using AWS Lambda and Step Functions, leveraging FMI-based communication across distributed functions. By reusing the architecture and components developed in Steps 1-3, we streamlined deployment and execution while minimizing configuration changes.

The results demonstrate strong throughput and cost-effective scaling. Compared to local CPU-based inference, our Lambda-based solution achieved similar or better performance, with the added benefit of parallelization. Key bottlenecks like I/O and cold start delays were mitigated by properly tuning partition sizes and using even world sizes. This serverless approach provides a reproducible and efficient solution for processing large astronomy datasets at scale.