All about Data Engineering

AWS Lambda

by Sachin Chandrashekhar

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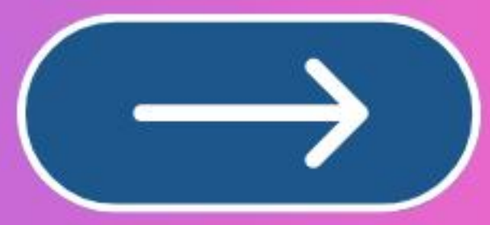
What is AWS Lambda?

AWS Lambda is a serverless compute service that automatically scales applications by running code in response to events. It eliminates the need to provision and manage servers.



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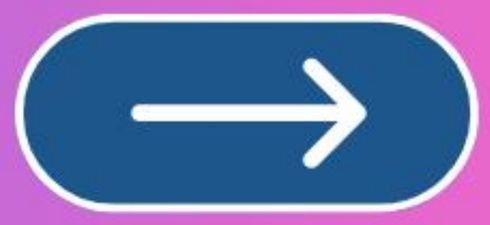
How AWS Lambda Works

You upload your code as Lambda functions, and Lambda executes it automatically based on triggers such as HTTP requests, file uploads, or database changes. Lambda handles scaling and resource provisioning.



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Benefits of AWS Lambda

Lambda offers automatic scaling, pay-per-use pricing, and no infrastructure management. Itâ€™s ideal for event-driven applications, microservices, and tasks like real-time file processing.

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Common Use Cases for AWS Lambda

AWS Lambda is used for real-time file processing, data transformation, API backends, chatbots, and automating tasks like backups, security checks, and system monitoring.

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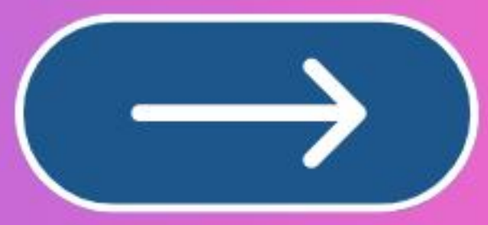
Event Sources for AWS Lambda

AWS Lambda can be triggered by various AWS services, such as S3, DynamoDB, SNS, SQS, and API Gateway, making it highly versatile for event-driven applications.



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AWS Lambda Pricing Model

Lambdaâ€™s pricing is based on the number of requests and the duration your code runs. You pay only for what you useâ€”no upfront costs or charges when your code is not running.

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Lambda Triggers

AWS Lambda can be triggered by events from services like Amazon S3, DynamoDB, Kinesis, and API Gateway. These triggers allow Lambda functions to execute in response to real-time events.

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Language Support in AWS Lambda

Lambda supports multiple programming languages, including Python, Node.js, Java, Go, Ruby, and .NET Core. You can also bring your own runtime to run other languages.

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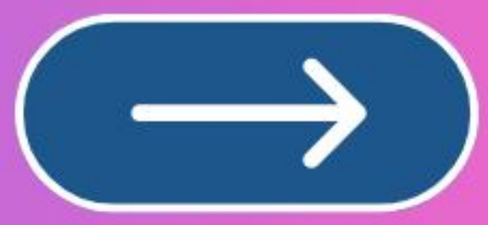
Stateless Nature of Lambda

Each Lambda function is stateless, meaning they do not retain data between executions. This ensures functions can scale horizontally but may require external storage solutions like DynamoDB or S3 for state persistence.



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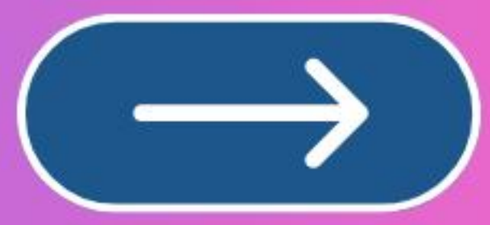
Timeout and Memory Configuration

AWS Lambda functions can be configured with a timeout (up to 15 minutes) and memory allocation (from 128 MB to 10 GB). Adjusting these parameters helps optimize performance and cost.



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AWS Lambda Layers

Lambda Layers allow you to package and share libraries and dependencies across multiple Lambda functions. This reduces redundancy and simplifies management for shared code.

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Lambda Environment Variables

Lambda allows you to set environment variables to pass configuration information to your function. This simplifies parameter management without hardcoding values.

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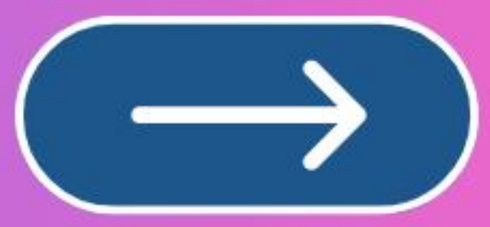
Monitoring AWS Lambda with CloudWatch

AWS Lambda integrates with CloudWatch to automatically log function execution details. You can monitor invocation metrics, execution duration, and error rates to maintain optimal performance.



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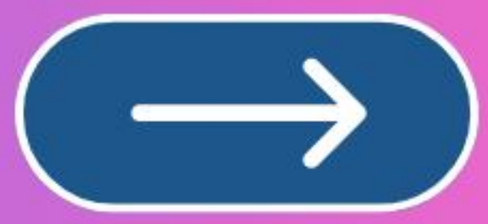
Lambda Function Concurrency

Lambda functions can scale to handle thousands of concurrent requests. By default, Lambda limits concurrency to 1,000 per region but can be adjusted based on requirements.



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Lambda Reserved Concurrency

Reserved concurrency ensures that a specific number of concurrent executions are reserved for a particular function, preventing overuse and ensuring availability during peak loads.

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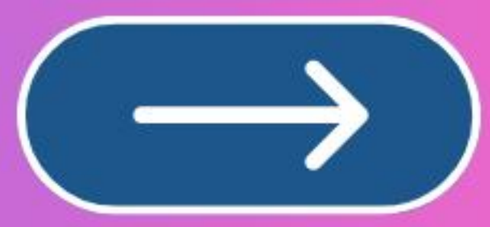
Lambda Provisioned Concurrency

Provisioned Concurrency keeps functions initialized and ready to respond, reducing latency for workloads with predictable traffic patterns, such as APIs or web apps.



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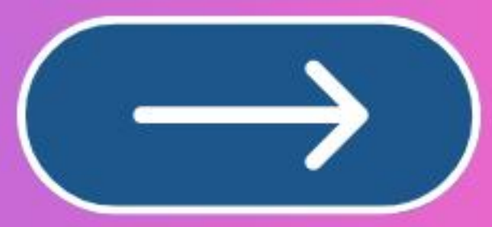
Error Handling in Lambda

Lambda provides automatic retries for asynchronous invocations. You can configure Dead Letter Queues (DLQs) and use Amazon SQS or SNS to handle function errors and failures gracefully.



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Asynchronous and Synchronous Invocations

Lambda supports both synchronous (real-time) and asynchronous (event-driven) invocations. You choose the invocation model based on whether you need an immediate response or background processing.

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Lambda Destinations

Lambda Destinations allow you to route the success or failure of function invocations to other AWS services, like SQS, SNS, or EventBridge, for post-processing or alerts.

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Lambda and API Gateway

When integrated with API Gateway, Lambda can serve as the backend for RESTful APIs. API Gateway handles routing, security, and scaling, while Lambda processes the requests.

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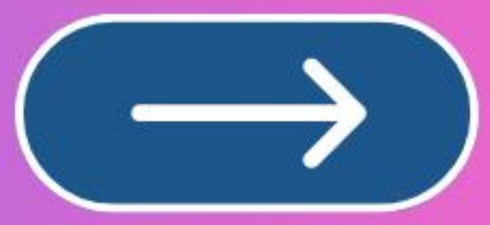
Lambda Edge for Low Latency

Lambda@Edge enables you to run Lambda functions closer to your users, providing lower latency by executing code at AWS edge locations in response to CloudFront events.



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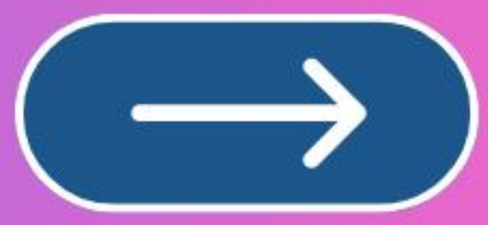
Lambda Function Versioning

AWS Lambda allows versioning, enabling you to manage and deploy different versions of your functions. Each version is immutable and can be used for rollback or testing.



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Lambda Aliases

Lambda aliases are pointers to specific function versions, allowing you to switch between versions without updating client applications. This supports blue/green deployments and gradual rollouts.

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VPC Integration with AWS Lambda

Lambda functions can connect to resources within a Virtual Private Cloud (VPC), such as RDS databases. This enables secure access to private resources during function execution.

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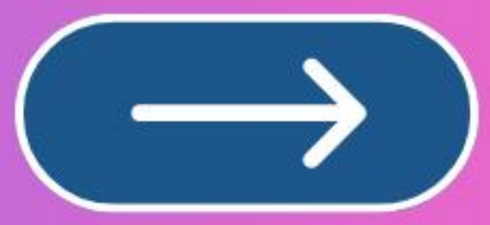
Lambda with DynamoDB Streams

AWS Lambda integrates with DynamoDB Streams, allowing you to trigger functions in response to data changes in a DynamoDB table. This is useful for building real-time processing workflows.



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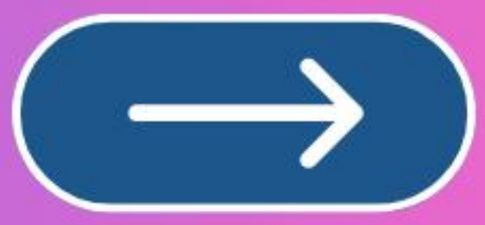
Serverless Application Model (SAM)

The AWS Serverless Application Model (SAM) simplifies the deployment and management of serverless applications, including Lambda functions. SAM helps automate packaging, testing, and deployment workflows.



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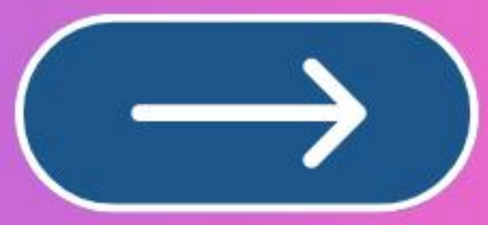
Lambda with AWS AppConfig

AWS Lambda integrates with AppConfig to allow dynamic configuration changes without redeploying code. This helps in managing feature flags, operational parameters, and system behavior across multiple environments.



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Lambda and Application Load Balancer (ALB)

You can integrate Lambda with an Application Load Balancer to serve web traffic without traditional web servers. ALB routes HTTP(S) requests directly to Lambda functions, providing flexibility in scaling web applications.

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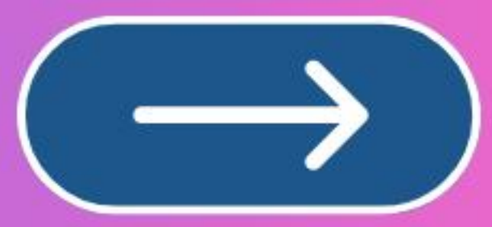
Lambda and Real-Time Analytics

Lambda can be used in real-time analytics pipelines, processing streams from sources like Kinesis and DynamoDB Streams. This allows you to analyze data in real time, making it ideal for monitoring, alerting, and dashboard updates.



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Lambda Throttling

AWS Lambda enforces throttling on function invocations when concurrency limits are reached. Throttled invocations are automatically retried, ensuring that requests are eventually processed without overwhelming resources.

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Lambda with Amazon Kinesis

Lambda integrates with Kinesis to process real-time data streams. It is commonly used to build serverless analytics pipelines, allowing you to process data as itâ€™s ingested into the stream.

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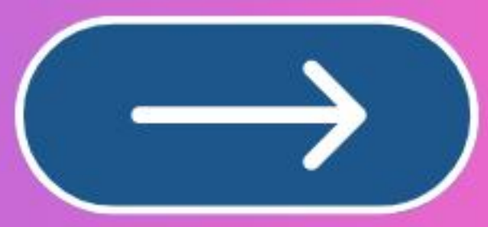
AWS Lambda Blue/Green Deployments

By using aliases and traffic shifting, Lambda supports blue/green deployments, enabling you to roll out new versions of functions gradually and minimize the impact of potential issues.



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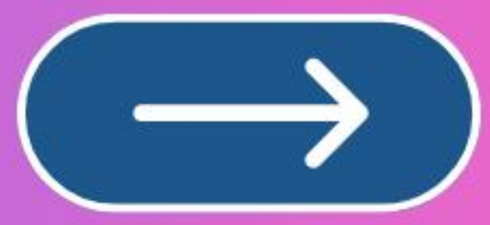
Lambda Runtime Performance Optimization

Optimize Lambda performance by reducing cold start times. Choose runtimes with faster initialization or use Provisioned Concurrency to keep functions warm and ready to serve requests quickly.



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Lambda and Cross-Account Access

AWS Lambda allows cross-account access via IAM roles. This enables functions to securely interact with resources in other AWS accounts, making multi-account architectures easier to manage.

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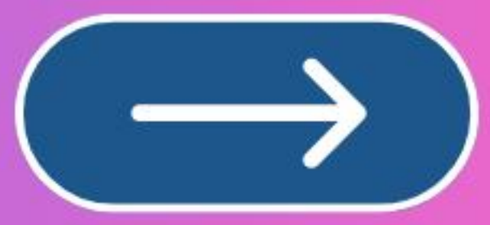
Lambda with Amazon EventBridge

Lambda integrates seamlessly with Amazon EventBridge to react to system events from AWS services or SaaS applications. This event-driven architecture enables flexible automation and custom workflows.



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AWS Lambda Cold Starts

Cold starts occur when Lambda initializes a new execution environment for a function. Cold start times vary based on factors such as runtime, VPC integration, and the size of the code package. Optimize code and leverage Provisioned Concurrency to mitigate delays.

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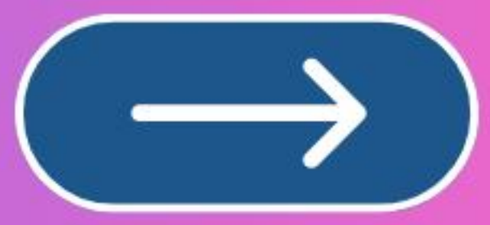
Lambda with Amazon MQ

AWS Lambda can be triggered by messages in Amazon MQ. This integration allows you to connect serverless applications to traditional message brokers like RabbitMQ or ActiveMQ, making it easier to modernize legacy systems.



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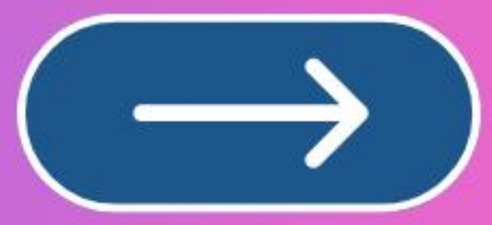
Lambda Error Monitoring with AWS X-Ray

AWS Lambda integrates with AWS X-Ray, allowing you to trace requests as they pass through your functions. This provides visibility into execution time, error rates, and bottlenecks, helping you troubleshoot performance issues.



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Lambda and Custom Runtimes

AWS Lambda supports custom runtimes, allowing you to run functions in languages not natively supported by Lambda, such as Rust or PHP. This flexibility extends Lambdaâ€™s use cases beyond the provided runtimes.

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Lambda with Rekognition for Image Processing

Lambda integrates with Amazon Rekognition for serverless image and video analysis. You can trigger Lambda functions to process media files as they are uploaded to S3, enabling automated tagging, object detection, or facial recognition.

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Blue/Green Deployment with Lambda and CloudFormation

CloudFormation supports blue/green deployment strategies for Lambda using versioning and aliases. This allows you to route a portion of traffic to new Lambda versions, enabling safe rollouts with minimal disruption.

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Lambda Function Testing and Debugging

Use AWS SAM CLI and local testing tools to simulate Lambda function executions in your local environment. This ensures better testing coverage and faster debugging before deployment to production.

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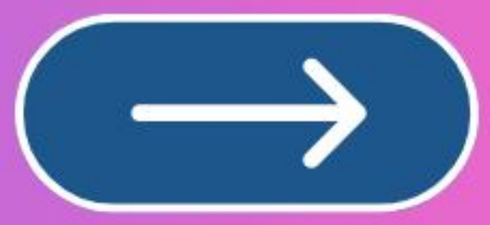
Continuous Deployment for Lambda with CDK Pipelines

AWS CDK Pipelines allow you to automate Lambda deployments in a CI/CD pipeline. By integrating with CodePipeline, CDK Pipelines ensure your Lambda code is automatically tested and deployed to production in a repeatable manner.



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Lambda with AWS CodeDeploy

AWS CodeDeploy integrates with Lambda to manage deployments, offering features like automatic rollbacks, traffic shifting, and canary deployments. This reduces risk when updating functions in production.

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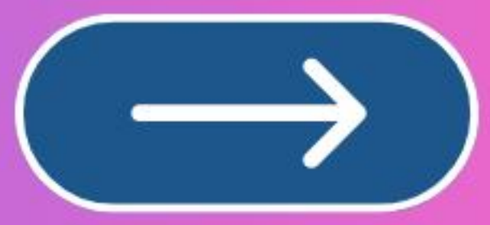
Lambda Cost Optimization Tips

Optimize Lambda costs by minimizing execution duration, using appropriate memory settings, and consolidating small functions. Monitor usage with AWS Cost Explorer to identify cost-saving opportunities.



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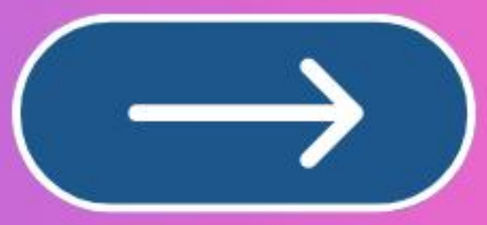
Deploying Lambda with AWS CloudFormation

AWS CloudFormation allows you to deploy Lambda functions as part of an infrastructure-as-code (IaC) template. You define your Lambda function, triggers, and permissions in a CloudFormation template, automating deployment and management.



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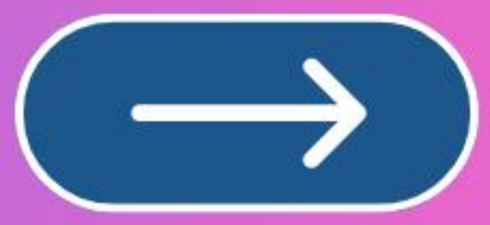
Lambda Deployment with AWS CDK

The AWS Cloud Development Kit (CDK) enables you to deploy Lambda functions using familiar programming languages like Python and TypeScript. CDK simplifies the creation and deployment of Lambda functions by abstracting away low-level infrastructure code.



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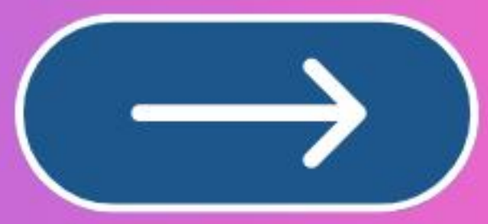
Lambda Retry Behavior

AWS Lambda automatically retries failed invocations for asynchronous functions. Configure retries and backoff strategies to control the timing and frequency of retries to avoid cascading failures.



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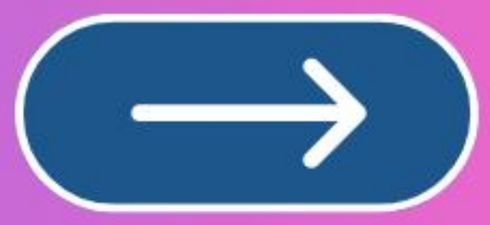

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