Mastering Amazon Relational Database Service for MySQL

Building and configuring MySQL instances

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Dedicated to

To the guiding light of my life, my mother, ***Subbulakshmi,*** *Your wisdom, strength, and unconditional love have been the pillars upon which my dreams stand. This book is a testament to the values you instilled in me and the endless support you continue to provide.*

To my loving wife, ***Chandra Jeyaram,*** *In the symphony of life, your love is the sweetest melody. Your encouragement and understanding have been the fuel for my creative endeavors. This book is as much yours as it is mine.*

To my beautiful daughters, ***Advika Jeyaram*** *and* ***Anvika Jeyaram,*** *In your innocence, I find inspiration. May your futures be filled with endless possibilities, and may this book serve as a reminder of the dreams and aspirations we share as a family.*

To my professional family at ***Doyensys,*** *Together, we have navigated challenges and celebrated victories. Your dedication and passion have shaped not just the work we do but also the person I am. This book is a collective achievement, and I am grateful for the support and camaraderie within our organization.*

This journey, both personal and professional, is enriched by the love and support of each one of you.

– Jeyaram Ayyalusamy

To my dearest wife, ***Leshma KK,*** *Your unwavering support and love have been my anchor through the highs and lows of this creative journey. Thank you for being my inspiration and my sanctuary.*

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– Arunjith Aravindan

To ***Mom*** *and* ***Dad,*** *Your unwavering love, guidance, and sacrifices have shaped me into the person I am today. This book is a tribute to the values you instilled in me and the endless support you have provided on my journey. Thank you for being my pillars of strength and for inspiring me to reach for the stars*

– Dr. P.V. Kumaraguru

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Preface

In the dynamic landscape of cloud-based database management, navigating the intricacies of Amazon Relational Database Service (RDS) for MySQL requires a comprehensive understanding and practical expertise. **Mastering Amazon Relational Database Service for MySQL** serves as an invaluable companion for professionals engaged in the administration of Amazon RDS instances.

This book is meticulously crafted to equip readers with the knowledge and skills necessary to excel in their roles, offering a deep dive into fundamental concepts, configuration best practices, and performance optimization strategies. Covering a wide spectrum, from essential components and regional considerations to advanced topics like managing multi-AZ clusters and upgrading MySQL versions, this guide provides a holistic approach to mastering the intricacies of Amazon RDS.

With an emphasis on security, storage management, backup strategies, and cost optimization, this book is a go-to resource for database administrators seeking expertise in the realm of Amazon RDS for MySQL. Each chapter is designed to address real-world challenges, offering best practices, troubleshooting insights, and practical tips to empower professionals in their journey to mastery.

Chapter 1: Amazon Relational Database Service – This chapter provides an overview of Amazon RDS for MySQL, including its definition, advantages, and supported features by region and engine. Additionally, it covers topics such as DB instances, DB instance classes, and DB instance storage.

Chapter 2: Configuring a DB Instance for Amazon RDS MySQL – This chapter covers the process of creating a DB instance for Amazon RDS MySQL, including creating resources with AWS CloudFormation, connecting to a DB instance, and working with option groups and parameter groups. The chapter also covers creating an ElastiCache cluster from Amazon RDS.

Chapter 3:Managing and Maintaining an Amazon RDS MySQL Instance – This chapter covers the process of managing a DB instance for Amazon RDS MySQL, including stopping and starting a DB instance, connecting an EC2 instance, modifying a DB instance, maintaining a DB instance, upgrading the engine version, renaming a DB instance, rebooting a DB instance, working with DB instance read replicas, tagging RDS resources, working with ARNs, working with storage, and deleting a DB instance.

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Chapter 4: Creating and Connecting to MySQL Database on Amazon RDS – This chapter covers creating and connecting to a MariaDB DB instance and a MySQL DB instance.

Chapter 5: Managing Amazon RDS Multi-AZ MySQL DB Clusters – This chapter covers the process of creating and connecting to a Multi-AZ DB instance deployment for Amazon RDS MySQL, modifying a Multi-AZ DB cluster, renaming a Multi-AZ DB cluster, rebooting a Multi-AZ DB cluster, working with Multi-AZ DB cluster read replicas, and deleting a Multi-AZ DB cluster.

Chapter 6: Amazon RDS MySQL Backups: Best Practices for Data Integrity and Business Continuity – This chapter covers working with backups, including backing up and restoring a DB instance for Amazon RDS MySQL, cross-region automated backups, creating a DB snapshot, restoring from a DB snapshot, copying a DB snapshot, sharing a DB snapshot, exporting DB snapshot data to Amazon S3, restoring a DB instance to a specified time, and deleting a DB snapshot. Additionally, the chapter covers backing up and restoring a Multi-AZ DB cluster for Amazon RDS MySQL, creating a Multi-AZ DB cluster snapshot, restoring from a snapshot to a Multi-AZ DB cluster, and restoring from a Multi-AZ DB cluster snapshot to a DB instance.

Chapter 7: Upgrading AWS RDS MySQL – In this chapter, we embark on a journey through the complexities of upgrading AWS RDS MySQL, shedding light on the significance of upgrades and distinguishing between major and minor version transitions. We delve into the meticulous process of preparing for a major version upgrade, encompassing compatibility assessment, non-production testing, and the formulation of effective backup and rollback strategies. As we proceed, we uncover the steps involved in executing a major version upgrade, offering insights into the initiation, monitoring, and verification phases, along with specific considerations for upgrades from MySQL 5.7 to 8.0. Minor version upgrades also take center stage, as we explore both manual and automated execution, while outlining crucial monitoring practices. Furthermore, we dissect the art of upgrading Read Replicas and Multi-AZ deployments, minimizing downtime through strategic approaches. The chapter continues by addressing post-upgrade performance monitoring and tuning, culminating in a comprehensive exploration of minimizing disruption via Blue/Green deployments. Throughout this chapter, readers gain a deep understanding of orchestrating seamless and efficient MySQL upgrades within the Amazon RDS environment, empowering them with the knowledge to navigate intricate upgrade scenarios adeptly.

Chapter 8: Comprehensive Amazon RDS MySQL Monitoring: Metrics, Tools, and Insights – This chapter provides an overview of monitoring metrics, including viewing instance status and recommendations, viewing metrics in the Amazon RDS console,

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monitoring RDS with CloudWatch for Amazon RDS MySQL, monitoring DB load with Performance Insights for Amazon RDS MySQL, turning Performance Insights on and off for Amazon RDS MySQL, analyzing metrics with the Performance Insights dashboard for Amazon RDS MySQL, analyzing performance with DevOps Guru for Amazon RDS MySQL, monitoring the OS with Enhanced Monitoring for Amazon RDS MySQL, and a reference of RDS metrics for Amazon RDS MySQL.

Chapter 9: Comprehensive Monitoring Tools for Amazon RDS and AWS Solutions – This chapter covers viewing logs, events, and streams in the Amazon RDS console, monitoring for Amazon RDS MySQL events, working with Amazon RDS MySQL event notification, creating a rule that triggers on an Amazon for Amazon RDS MySQL event, Amazon for Amazon RDS MySQL event categories and event messages, monitoring for Amazon RDS MySQL logs, viewing and listing database log files, downloading a database log file, watching a database log file, publishing to CloudWatch Logs, and reading log file contents using REST. Additionally, the chapter covers MariaDB database log files, Microsoft SQL Server database log files, and MySQL database log files.

Chapter 10: Understanding Amazon RDS Read Replicas: Scaling and High Availability – In this pivotal chapter, we delve into the realm of MySQL replication within Amazon RDS, unraveling its intricacies and diverse applications. We begin by introducing the concept of Read Replicas for AWS RDS MySQL and explore compelling use cases, from scaling to disaster recovery. Unveiling the mechanics of Read Replicas' operation, we venture into the realm of multi-AZ deployments and cross-region configurations, while also examining constraints and considerations in replica creation and deletion. Guiding readers through the creation process, we demonstrate the use of AWS Management Console and the process of promoting a Read Replica to a standalone DB instance. The chapter continues with a thorough exploration of monitoring techniques, encompassing Read Replica status options and addressing the impact of replication disruptions. We conclude by delving into advanced concepts like using Global Transaction Identifiers (GTIDs), replicating between RDS and external instances, and choosing replication methods, all complemented by practical configuration examples. This chapter empowers readers with comprehensive knowledge to harness the potential of MySQL replication within Amazon RDS and effectively manage their database instances.

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The code bundle for the book is also hosted on GitHub at
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Chapter 1
Amazon Relational Database Service

Introduction

An AWS **Relational Database Service** (**RDS**) MySQL instance is a powerful database solution within the Amazon Web Services ecosystem. It leverages the robust and popular MySQL database engine while providing the convenience of AWS's cloud infrastructure. This service offers a seamless way to set up, manage, and scale MySQL databases, making it an ideal choice for businesses and developers who require a reliable and fully managed relational database.

With AWS RDS MySQL, you benefit from automated backups, security features, and high availability options, all handled by AWS, allowing you to focus your efforts on developing applications rather than database maintenance. Whether you are launching a new project or migrating an existing MySQL database to the cloud, AWS RDS MySQL instances offer the scalability and reliability needed to support your data-driven applications while simplifying the management of your database infrastructure.

Structure

In this chapter, we will cover the following topics:

- Definition of Amazon RDS
- Advantages of using Amazon RDS for MySQL

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- Essential components of Amazon RDS
- Understanding supported Amazon RDS MySQL features
- Choosing the right storage engine for Amazon RDS for MySQL
- MySQL on Amazon RDS versions
- Amazon RDS MySQL major version lifecycle and support dates

Objectives

This chapter provides an overview of Amazon RDS for MySQL, including its definition, advantages, and supported features by region and engine. Additionally, it covers topics such as DB instances, DB instance classes, and DB instance storage.

Definition of Amazon RDS

Amazon RDS is a managed database service offered by **Amazon Web Services** (**AWS**) that simplifies the process of setting up, operating, and scaling a relational database in the cloud. With Amazon RDS, you can easily create, operate, and scale a highly available and secure MySQL database in the cloud.

Advantages of using Amazon RDS for MySQL

Following are the advantages of using Amazon RDS for MYSQL:

- **Easy setup and management**: Amazon RDS automates many of the time-consuming database administration tasks, such as backups, software patching, and monitoring.
- **Scalability**: Amazon RDS allows you to scale your database resources up or down with a few clicks or API calls, without any downtime.
- **High availability**: Amazon RDS provides multi-AZ deployment options that automatically replicate your database across multiple Availability Zones for high availability and data durability.
- **Security**: Amazon RDS provides a range of security features, such as encryption at rest and in transit, network isolation, and IAM integration.
- **Cost-effective:** With Amazon RDS, you only pay for the resources you use, and you can choose from a range of pricing options based on your needs.

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- **Performance**: Amazon RDS supports a range of instance types optimized for different workloads, and you can also use features like read replicas and automated backups to improve performance.
- **Compatibility**: Amazon RDS supports popular MySQL features like InnoDB, replication, and Amazon Aurora MySQL-compatible features like Aurora read replicas.
- **Integration:** Amazon RDS integrates with other AWS services like Amazon EC2, Amazon VPC, and AWS **Identity and Access Management** (**IAM**) for seamless management and security.
- **Monitoring and metrics:** Amazon RDS provides comprehensive monitoring and metrics through Amazon CloudWatch, allowing you to monitor database performance Insights and set alarms for critical events.
- **Flexibility**: Amazon RDS allows you to easily migrate your existing MySQL databases to the cloud, and you can also use it to build new applications with ease.

Essential components of Amazon RDS

We will understand DB instances, instance classes, storage, and Amazon VPC in the following:

- **DB instances** are the building blocks of Amazon RDS, and they represent a running database environment.
- **DB instance classes** define the CPU, memory, and network capacity of a DB instance, and they determine the price of the instance.
- **DB instance storage** refers to the amount of storage allocated to a DB instance. It can be scaled up or down as needed, and it is charged separately from the instance itself.
- **Amazon Virtual Private Cloud (Amazon VPC)** empowers you to run your DB instance within a customized virtual networking environment, offering control over IP address range, subnets, routing, and access control lists.

Understanding supported Amazon RDS MySQL Features: Variations by region and engine

Amazon RDS supports a range of MySQL features, including InnoDB, MyISAM, replication, and Amazon Aurora MySQL-compatible features. The specific features supported may vary by region and engine.

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For example, the following are some of the supported features for Amazon RDS for MySQL in the US East (*N. Virginia*) region:

- InnoDB storage engine
- Read replicas
- Multi-AZ deployments
- Automated backups
- Point-in-time recovery
- Encryption at rest
- Enhanced monitoring
- Amazon RDS Performance Insights
- Slow query log access
- Cross-region replication
- Amazon RDS blue/green deployments

It is important to check the AWS documentation for the specific region and engine you are using to ensure that you can take advantage of the desired features.

Choosing the right storage engine for Amazon RDS for MySQL

When selecting a storage engine for Amazon RDS for MySQL, it is important to understand that while MySQL supports multiple storage engines, not all are optimized for recovery and data durability.

- **InnoDB:** Amazon RDS provides fully support for the InnoDB storage engine in MySQL DB instances. This engine is strongly recommended due to its ability to facilitate features like Point-In-Time restore and snapshot restore, essential for ensuring recoverable storage.
- **FEDERATED storage engine:** It is important to note that Amazon RDS for MySQL does not currently offer support for the FEDERATED storage engine.
- **MyISAM:** This storage engine lacks reliable recovery support, which may lead to data loss or corruption when MySQL is restarted after a recovery process. Additionally, it hinders the proper functioning of features like point-in-time restore and snapshot restore. Nevertheless, MyISAM is employed in system tables within the MySQL schema. If you opt to continue using MyISAM with Amazon RDS, snapshots can prove beneficial under specific circumstances.

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To convert existing MyISAM tables to InnoDB tables, you can use the **`ALTER TABLE`** command, like so:

```
ALTER TABLE TABLE_NAME ENGINE=InnoDB;
```

Keep in mind that MyISAM and InnoDB possess distinct advantages and disadvantages. Therefore, it is important to assess how this transition may affect your applications before proceeding.

AWS Regions

AWS Regions represent distinct geographical zones. Within these AWS Regions, you will find multiple Availability Zones, each physically separated and self-contained. These Availability Zones are interconnected by a network with minimal latency, high throughput, and robust redundancy. Let us learn about them briefly in the following:

- **Isolation and fault tolerance:** Each AWS Region is an independent geographic area with its own infrastructure. AWS designs Regions to be isolated from each other, ensuring fault tolerance and stability. A failure in one Region does not affect other Regions.
- **Resource replication across AWS Regions:** Resources, including AWS RDS MySQL DB instances, are not automatically replicated across AWS Regions. To achieve cross-Region redundancy, you must set up replication mechanisms like Amazon RDS Read Replicas.

Availability Zones

Availability Zones comprise one or more individual data centers, each equipped with backup power, networking, and connectivity. These data centers are situated in distinct facilities for added resilience.

- **Choosing an availability zone for DB Instances:** When creating an AWS RDS MySQL DB instance, you have the option to select a specific Availability Zone or let Amazon RDS choose one randomly. Availability Zones are distinct locations within an AWS Region, identified by a unique code.
- **Multi-AZ DB Deployment:** In a Multi-AZ deployment, Amazon RDS automatically provisions and maintains a standby replica in a different Availability Zone for enhanced availability and automatic failover.

Local zones

AWS Local Zones represent a specific form of AWS infrastructure deployment. They strategically position computing, storage, databases, and specific services in proximity to major population centers, industrial hubs, and IT focal points. This proximity facilitates

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