Project 3

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Description

- Build a distributed application (3 or more components) that executes a business process or application
- This application must be entirely serverless
- You are not allowed to use a VM, a server-based database, or any component requiring a VM

Required Deliverables:

- [30 points] Demonstrates end-to-end working of the project
- [20 points] Built a distributed application with at least 3 serverless components (AWS Lambda or Azure/GCP functions)
- [10 points] CICD for deployment
- [10 points] Completeness of the report and detailed architecture
- [20 points] Source code included
- [10 points] Business process or application that resembles real-world problem

Original Problem Statement

The use-case I have created is one for recipes. Every-time a recipe is made, that recipe can be made exactly, or with modifications. When a recipe is made, that recipe begins in our system as a JSON file that is placed in some common location, in this case some shared file location. That file location is regularly polled by a file watcher for changes. When the poller notices that a file has been created, it creates an upload job. This job is then completed by a separate service that submits the job to our comparison server. This server then finds any changes between the original recipe and this make of the recipe, and stores those in a database to be analyzed later and eventually displayed on a dashboard.

Implementation description

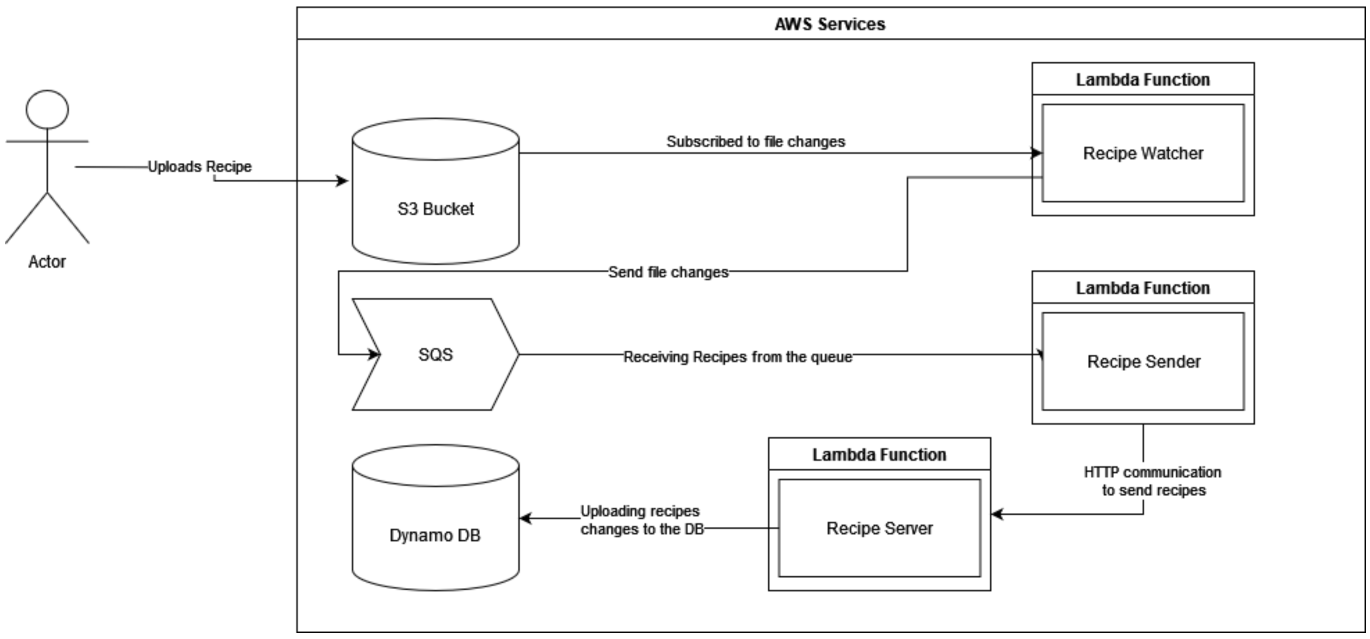
Component Description

1. `The File System` is just an S3 bucket
2. `The File Watcher` is a lambda function. The trigger for this function is uploads to the S3 bucket. The File Watcher publishes to the queue.
3. `Amazon SQS` stores jobs from the file watcher for the file sender. This allows the file watcher and file sender to communicate with one another.
4. `The File Sender` is also a lambda functions, the trigger for which is messages in the SQS. It sends the new recipe to the server and is responsible for the formatting.
5. `The Recipe Server` is an api gateway backed with, surprise, lambda functions.
6. `The Dynamo Database` where the recipe makes are stored.

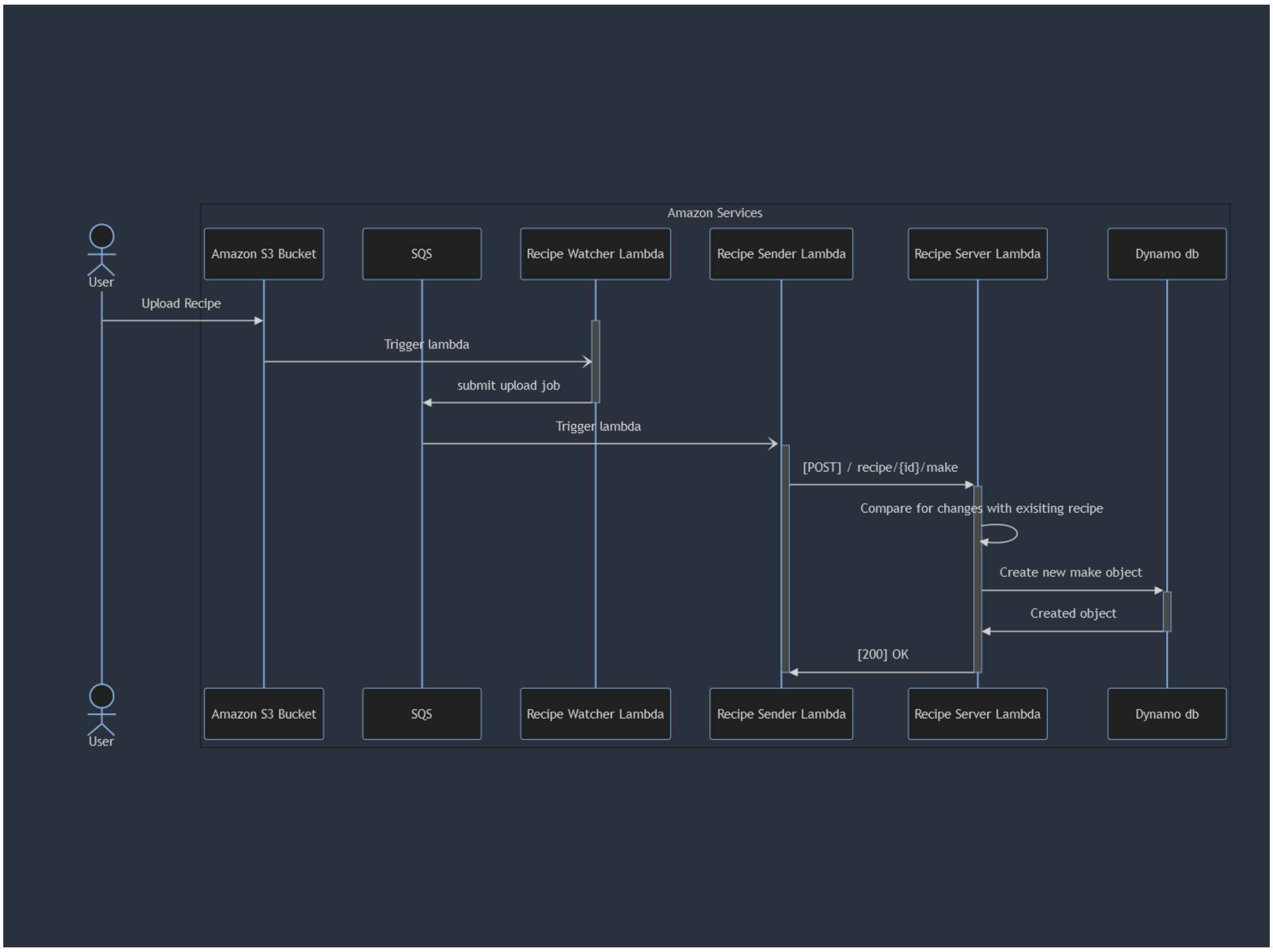
Summary of component changes between projects

Component	Project 1 Version	Project 2 Version	Project 3 Version
File System	S3 Bucket	S3 bucket	S3 Bucket
File Watcher	Executable python script `recipe_watcher.py` running directly on an EC2 instance	Containerized, and running on a cluster with the sender and server	Replaced with a lambda function. Trigger: S3 File Upload. Destination: SQS
Messaging Queue	Rabbit MQ deployed as a docker container running on an EC2 instance	Replaced with Amazon SQS	Amazon SQS
File Sender	Executable python script `recipe_sender.py` running directly on an EC2 instance	Containerized, and running on a cluster with the watcher and server	Replaced with a lambda function. Trigger: SQS message. Destination: REST API call.
Recipe Server	Running as an installed python package on the EC2 instance	Containerized, and running on a cluster with the watcher and sender	Replaced with API Gateway backed by lambda functions. Destination: Dynamo DB
Database	Dynamo DB	Dynamo DB	Dynamo DB

Architecture Diagram

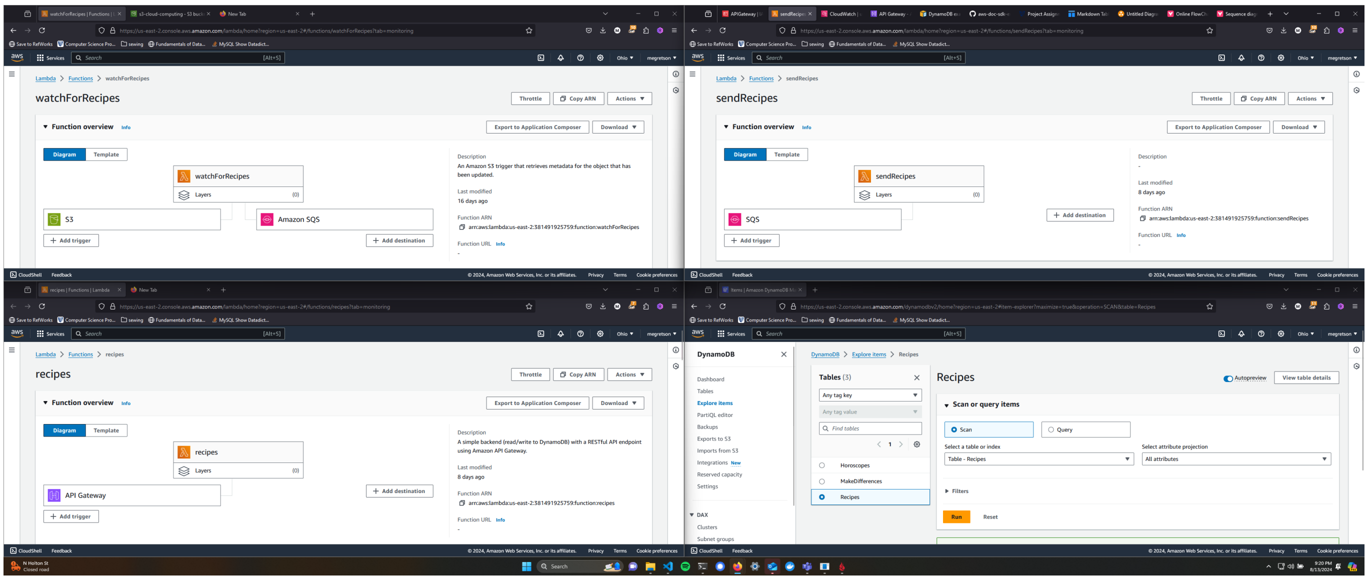


Sequence Diagram



Screenshots of working code

Code in use


https://us-east-2.console.aws.amazon.com/lambda/home?region=us-east-2#/functions/watchForRecipes?tab=monitoring

Lambda > Functions > watchForRecipes

watchForRecipes

Function overview

Description
An Amazon S3 trigger that retrieves metadata for the object that has been updated.

Last modified
16 days ago

Function ARN
arn:aws:lambda:us-east-2:381491925759:function:watchForRecipes

Function URL
-

https://us-east-2.console.aws.amazon.com/lambda/home?region=us-east-2#/functions/sendRecipes?tab=monitoring

Lambda > Functions > sendRecipes

sendRecipes

Function overview

Description
-

Last modified
8 days ago

Function ARN
arn:aws:lambda:us-east-2:381491925759:function:sendRecipes

Function URL
-

https://us-east-2.console.aws.amazon.com/lambda/home?region=us-east-2#/functions/recipes?tab=monitoring

Lambda > Functions > recipes

recipes

Function overview

Description
A simple backend (read/write to DynamoDB) with a RESTful API endpoint using Amazon API Gateway.

Last modified
8 days ago

Function ARN
arn:aws:lambda:us-east-2:381491925759:function:recipes

Function URL
-

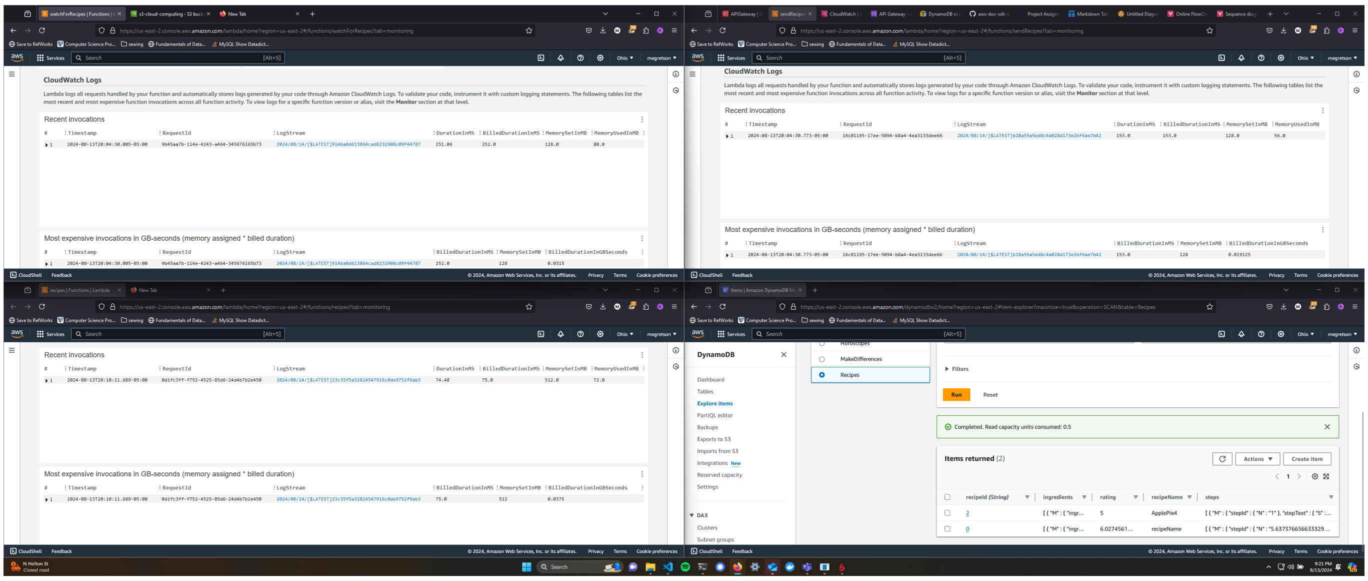
https://us-east-2.console.aws.amazon.com/dynamodbv2/home?region=us-east-2#item-explorer?maximize=true&operation=SCAN&table=Recipes

DynamoDB > Explore items > Recipes

Tables (3)
Horoscopes
MakeDifferences
Recipes

Recipes

Scan or query items
[✓ Scan] Query
Select a table or index: Table - Recipes
Select attribute projection: All attributes



CloudWatch Logs

Lambda logs all requests handled by your function and automatically stores logs generated by your code through Amazon CloudWatch Logs. To validate your code, instrument it with custom logging statements. The following tables list the most recent and most expensive function invocations across all function activity. To view logs for a specific function version or alias, visit the **Monitor** section at that level.

Recent invocations

#	Timestamp	RequestId	LogStream	DurationInMS	BilledDurationInMS	MemorySetInMB	MemoryUsedInMB
1	2024-08-13T20:04:30.005-05:00	9b45aa7b-114e-4243-a464-345676165b73	2024/08/14/[$LATEST]914ba0d613864cad8232908c09f44787	251.06	252.0	128.0	80.0

Most expensive invocations in GB-seconds (memory assigned * billed duration)

#	Timestamp	RequestId	LogStream	BilledDurationInMS	MemorySetInMB	BilledDurationInGBSeconds
1	2024-08-13T20:04:30.005-05:00	9b45aa7b-114e-4243-a464-345676165b73	2024/08/14/[$LATEST]914ba0d613864cad8232908c09f44787	252.0	128	0.0315

CloudWatch Logs

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Recent invocations

#	Timestamp	RequestId	LogStream	DurationInMS	BilledDurationInMS	MemorySetInMB	MemoryUsedInMB
1	2024-08-13T20:04:30.773-05:00	16c01195-17ee-5094-b8a4-4ea3133dee66	2024/08/14/[$LATEST]b28a55a5ed8c4a028d173e2bf6ae7b42	153.0	153.0	128.0	56.0

Most expensive invocations in GB-seconds (memory assigned * billed duration)

#	Timestamp	RequestId	LogStream	BilledDurationInMS	MemorySetInMB	BilledDurationInGBSeconds
1	2024-08-13T20:04:30.773-05:00	16c01195-17ee-5094-b8a4-4ea3133dee66	2024/08/14/[$LATEST]b28a55a5ed8c4a028d173e2bf6ae7b42	153.0	128	0.019125

Recent invocations

#	Timestamp	RequestId	LogStream	DurationInMS	BilledDurationInMS	MemorySetInMB	MemoryUsedInMB
1	2024-08-13T20:10:11.689-05:00	0d1fc3ff-f752-4525-85d6-24d4b7b2e450	2024/08/14/[$LATEST]23c35f5a32824547916c0de9752f6ab3	74.48	75.0	512.0	72.0

Most expensive invocations in GB-seconds (memory assigned * billed duration)

#	Timestamp	RequestId	LogStream	BilledDurationInMS	MemorySetInMB	BilledDurationInGBSeconds
1	2024-08-13T20:10:11.689-05:00	0d1fc3ff-f752-4525-85d6-24d4b7b2e450	2024/08/14/[$LATEST]23c35f5a32824547916c0de9752f6ab3	75.0	512	0.0375

Completed. Read capacity units consumed: 0.5

Items returned (2)

recipeId (String)	ingredients	rating	recipeName	steps
2	[{ "M" : { "ingr...	5	ApplePie4	[{ "M" : { "stepId" : { "N" : "1" }, "stepText" : { "S" :...
0	[{ "M" : { "ingr...	6.0274561...	recipeName	[{ "M" : { "stepId" : { "N" : "5.637376656633329...

The top image shows what each component is.

The upper left corner is the file watcher.

The upper right corner is the file sender.

The bottom left corner is the recipe server lambda which is invoked.

The bottom right is the dynamo db, showing that a recipe has been uploaded.

Current code shortcomings and next steps

I did not set up an automated deployment for my lambda functions due to time constraints, and, as is the case with most of my grad school projects, it has poor / insufficient automated testing. All testing was done manually.

Additionally, as discussed in class, my project was not built with security in mind. My recipe server is currently running open to the internet, so anyone could create objects within my dynamo db until I shut it down. If I were to iterate on this project with security in mind, I would have a particular eye towards authenticating clients of my recipe server. This should be relatively straightforward with some sort of auth token.

For my job, security is oftentimes a tricky problem. We have strong security on the borders of our system, but within the system all microservices operate as trusted / safe. Our software currently runs almost exclusively on device, meaning this has been sufficient for us in the past. This project was meant to operate as a basic prototype for a use-case at work. In the "real-life" version of this problem, protected health information would be sent rather than recipes, which would require a far tighter approach to security than I have taken here. After this class, I intend to do a ghost "project 4" where I implement a secure version of this same project.

Thank you for your time over the semester Dr. Sedighi. It's been incredibly useful to have your guidance over the semester to help me shift my thinking towards cloud deployments, and I've been grateful to have the impetuous to experiment with tools I don't have a chance to use at work.

Source code

All source code is on my github: https://github.com/megretson/CloudNativeArchitecture