

# Sentiment Analysis for Product Reviews

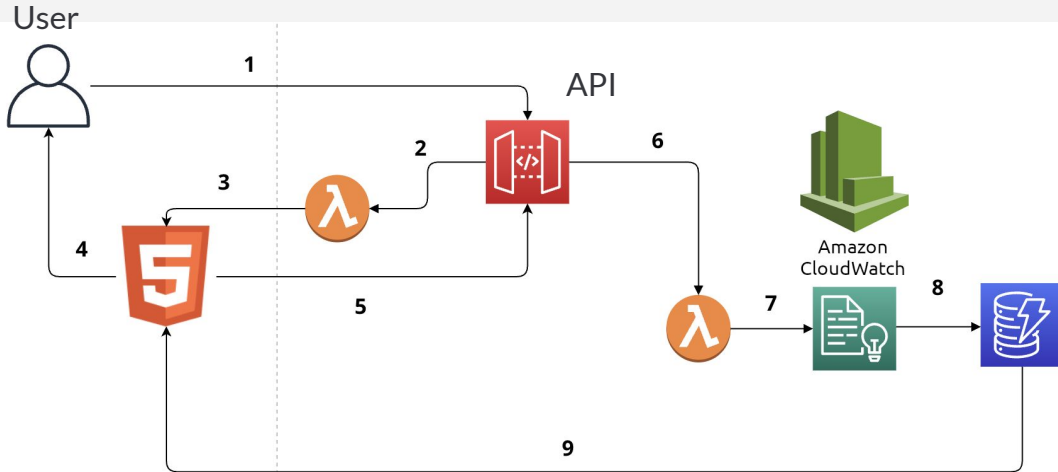
with AWS Services

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**(launch deployment)**

# Architecture Diagram



1. User calls the API gateway endpoint
2. Website Lambda is triggered
3. Website Lambda sends the HTML to the User
4. User sees the website
5. User submits review through the website
6. API Gateway receives a post request which triggers the review processor Lambda
7. The Lambda runs the review through AWS Comprehend
8. The review is passed through comprehend and output information is stored in DynamoDB
9. If successfully stored, the website lambda sends a get request through the API gateway to query DynamoDB
10. Website is updated with review and sentiment scores.



# Security

Our app's main point of contact is at the API gateway level, and the HTML that is given from the website Lambda:

- Website Level Security
  - We adhere to CORS (Cross Origin Resource Sharing) so the review processor endpoint can only be accessed through the form, or the same domain. This counters cross-site scripting.
  - We have input sanitization so our form won't accept raw input preventing things like SQL injection.
- API Gateway Security
  - Allows in-depth monitoring of the API endpoints
  - Can rate limit the endpoints depending on the traffic and activity
  - Can detect DDoS attacks by IP address or other parameters
- Lambda had a IAM policy that only allows it to do specific tasks
  - Lambda: InvokeFunction
  - DynamoDB: PutItem, GetItem, Scan
  - Comprehend: DetectSentiment
  - Logs: CreateLogGroup, CreateLogStream, PutLogEvents





# Scalability & Availability

- API gateway has load balancing and auto scaling that can scale to millions of users
- Lambdas can also infinitely scale depending on how many requests there are since they can spin up as many EC2 instances as they want
- DynamoDB can also auto scale in the case when there are many reads and writes happening to the database.
- Did not have time to add Route 53
  - This would have made a custom domain that we could use for our api gateway
  - This would provide availability since if the api gateway failed, it would spin up another api gateway and the user could use the same domain for that apigateway.



# Demo



1. Go to [https://github.com/YueKnowWho/Sentiment\\_Analysis](https://github.com/YueKnowWho/Sentiment_Analysis), and clone the repository:

```
anlu@ALMBP-2 Desktop % git clone https://github.com/YueKnowWho/Sentiment_Analysis.git && cd Sentiment_Analysis
```

```
Cloning into 'Sentiment_Analysis'...
remote: Enumerating objects: 46, done.
remote: Counting objects: 100% (46/46), done.
remote: Compressing objects: 100% (34/34), done.
remote: Total 46 (delta 15), reused 34 (delta 10), pack-reused 0 (from 0)
Unpacking objects: 100% (46/46), done.
anlu@ALMBP-2 Sentiment_Analysis %
```



# Demo



1. cd into Sentiment\_Analysis, run the CloudFormation command using AWS CLI:  
aws cloudformation deploy --template-file template.yaml --stack-name Sentiment-Analysis --capabilities CAPABILITY\_NAMED\_IAM
2. Wait for creation completion

```
anlu@ALMBP-2 Sentiment_Analysis % aws cloudformation deploy --template-file template.yaml --stack-name Sentiment-Analysis --capabilities CAPABILITY_NAMED_IAM
```

```
Waiting for changeset to be created..  
Waiting for stack create/update to complete  
Successfully created/updated stack - Sentiment-Analysis  
anlu@ALMBP-2 Sentiment_Analysis %
```



# Demo



1. In the AWS console, go to CloudFormation:  
<https://console.aws.amazon.com/cloudformation/home>
2. search for the “Sentiment-Analysis” stack

The screenshot shows the AWS CloudFormation console interface. At the top is a dark navigation bar with the AWS logo, a grid icon, a search bar containing the text "Search", and a keyboard shortcut "[Option+S]". Below this is a breadcrumb trail: a hamburger menu icon, followed by "CloudFormation", "Stacks", and "Sentiment-Analysis". The main content area is split into two panels. The left panel, titled "CloudFormation", contains a sidebar with links for "Stacks", "Stack details" (highlighted in blue), "Drifts", "StackSets", "Exports", "Infrastructure Composer", and "IaC generator". The right panel, titled "Stacks (10)", features a search bar "Filter by stack name", a "Filter status" dropdown set to "Active", and a toggle switch for "View nested" which is currently turned on. Below these controls is a pagination indicator showing "&lt; 1 &gt;". A section header "Stacks" is followed by a list of stacks. The first stack, "Sentiment-Analysis", is highlighted with a light blue background and contains a blue circle icon, the timestamp "2024-12-04 10:56:27 UTC-0500", and a green checkmark icon followed by the text "CREATE\_COMPLETE".



# Demo



1. Click on "Outputs" tab
2. Click on the "WebsiteURL" link. This should take you to the HTML website.

**Sentiment-Analysis** ⚙️ >

< ⌂ Events - updated Resources **Outputs** Parameters Template Change sets Git sync >

Delete Update Stack actions ▼ Create stack ▼

---

**Outputs (2)** 🔄

< 1 > ⚙️

Key ▲	Value ▼	Description ▼	Export name ▼
ReviewApiEndpoint	<a href="https://8gg36zqxnk.execute-api.us-east-1.amazonaws.com/reviews">https://8gg36zqxnk.execute-api.us-east-1.amazonaws.com/reviews</a>	API Gateway endpoint to submit reviews	-
WebsiteURL	<a href="https://8gg36zqxnk.execute-api.us-east-1.amazonaws.com">https://8gg36zqxnk.execute-api.us-east-1.amazonaws.com</a>	URL of the Lambda website	-

# Demo



1. Here, this the Sentiment Analysis website
2. Enter the desired text in the textbox, and click “Analyze Sentiment”

## Sentiment Analysis

**Enter Text**

Analyze Sentiment

**Previous Review Sentiments**





# Example Reviews

Review	Expected Sentiments
Easily the <b>best</b> professor I've had at UML so far. Clear <b>passion</b> for what he's teaching, <b>engaging</b> lectures, and always <b>eager</b> to help students.	Positive
The current time is 10:19pm.	Neutral
The phone has a <b>stunning</b> screen, but the battery life is <b>awful</b> . Performance is <b>underwhelming</b> , though the camera is <b>decent</b> .	Mixed
<b>bad</b> quality. The rackets <b>broke</b> within the first 15 mins of usage.	Negative



# Demo



1. When done, you will notice a return statement, consisting of the submitted text, the Sentiment analysis, the Sentiment confidence score, and the 4 Sentiment sub-category scores:

## Sentiment Analysis

### Enter Text

Analyze Sentiment

### Previous Review Sentiments

Review: Easily the best professor I've had at UML so far. Clear passion for what he's teaching, engaging lectures, and always eager to help students.

Sentiment: POSITIVE (Confidence: 1.00)

Scores - Positive: 1.00, Negative: 0.00, Neutral: 0.00, Mixed: 0.00



# Demo



To see the input being stored in DynamoDB:

1. Go to DynamoDB:  
<https://console.aws.amazon.com/dynamodbv2/home>
2. Click and click on “view all tables”

The screenshot shows the AWS Management Console for DynamoDB. The left sidebar contains navigation links for DynamoDB, Tables, Explore items, PartiQL editor, Backups, Exports to S3, Imports from S3, Integrations, Reserved capacity, and Settings. The main content area is titled 'Dashboard' and includes a 'Favorite tables' section with a search bar and a 'View all tables' button (highlighted with a red box). Below this is an 'Alarms' section with a search bar and a 'Manage in CloudWatch' button. The right sidebar contains a 'Create resources' section with a 'Create table' button and a 'Create DAX cluster' button, and a 'What's new' section with two news items.

**DynamoDB Dashboard**

**Favorite tables**

View all tables

Find favorite tables

Table name	Status	Created at (UTC)
No favorite tables		

To get started, click the star icon on the tables page or table details page to favorite a table.

**Alarms (0)**

Manage in CloudWatch

Find alarms

Alarm name	Status
No custom alarms	

**Create resources**

Create an Amazon DynamoDB table for fast and predictable database performance at any scale. [Learn more](#)

Create table

Amazon DynamoDB Accelerator (DAX) is a fully-managed, highly-available, in-memory caching service for DynamoDB. [Learn more](#)

Create DAX cluster

**What's new**

DEC 3 Amazon DynamoDB global tables previews multi-Region strong...

DEC 3 Amazon DynamoDB zero-ETL integration with Amazon SageMaker...

# Demo

1. Select the DynamoDB named “Group11Reviews”
2. Click on “explore table items”



The screenshot displays the AWS Management Console interface for the DynamoDB service. The breadcrumb navigation at the top indicates the path: **DynamoDB** > **Tables** > **Group11Reviews**. The left-hand navigation pane lists various DynamoDB features, with **Tables** currently selected. The main content area is titled **Group11Reviews** and includes a search bar for tags and a list of tables. The **Group11Reviews** table is highlighted. To the right of the table list, there are tabs for **Overview**, **Indexes**, **Monitor**, **Global tables**, **Backups**, and **Exports and stre**. A prominent orange button labeled **Explore table items** is visible. A blue warning banner at the top right states: **Protect your DynamoDB table from accidental writes and deletes**, explaining that PITR is active and backs up data for 35 days. Below this, the **General information** section provides details: Partition key is **reviewid (String)**, Sort key is **-**, Capacity mode is **On-demand**, and Table status is **Active**. The **Alarms** section shows **No active alarms**, and the **Point-in-time recovery (PITR)** section shows **Off**. The **Resource-based policy** section shows **Not active**. At the bottom, the **Items summary** section includes a **Get live item count** button and a note that **DynamoDB updates the following information approximately every six hours.**

# Demo



1. Scroll down to “Items returned”, and see the table items

**DynamoDB** > **Explore items** > **Group11Reviews**

**Scan or query items**  
Expand to query or scan items.

Completed. Read capacity units consumed: 2

**Items returned (8)**

Actions Create item

<input type="checkbox"/>	reviewId (String)	confidence	sentiment	sentimentScore	text
<input type="checkbox"/>	<a href="#">9575ced4-6884-4c12-...</a>	0.99985992...	NEGATIVE	{"Positive": 5.577...	bad quality. The rackets broke within the fir...
<input type="checkbox"/>	<a href="#">9d11fa22-f324-47f8-...</a>	0.99867188...	POSITIVE	{"Positive": 0.998...	Easily the best professor I've had at UML so...
<input type="checkbox"/>	<a href="#">abfaebe9-3364-4770-...</a>	0.98306941...	POSITIVE	{"Positive": 0.983...	I like chees and rice for real
<input type="checkbox"/>	<a href="#">89817dc6-372e-4312-...</a>	0.67849403...	MIXED	{"Positive": 0.320...	"The product works well and has some grea...
<input type="checkbox"/>	<a href="#">cbb80142-f4b8-4720-...</a>	0.34970211...	MIXED	{"Positive": 0.191...	Material confined likewise it humanity rail...
<input type="checkbox"/>	<a href="#">a0ef3e62-abd6-480a-...</a>	0.99859791...	NEUTRAL	{"Positive": 0.000...	The current time is 10:19pm.
<input type="checkbox"/>	<a href="#">a4e8db00-f9bc-4054-...</a>	0.99749195...	MIXED	{"Positive": 0.000...	The phone has a stunning screen, but the b...
<input type="checkbox"/>	<a href="#">fd6e3bec-296b-4f93-...</a>	0.99749195...	MIXED	{"Positive": 0.000...	The phone has a stunning screen, but the b...

# Demo



1. To view CloudWatch logs, head to the following link:  
<https://console.aws.amazon.com/cloudwatch/home>
2. Click on “View logs”


The screenshot shows the AWS CloudWatch console interface. On the left is a navigation sidebar with links to Dashboards, Alarms, Logs, Metrics, X-Ray traces, Events, Application Signals, Network Monitoring, and Insights. The main content area is titled 'Overview' and includes a 'Get started with CloudWatch' section. This section contains four cards: 'Set alarms', 'Create and name any CloudWatch dashboard', 'Monitor using your existing system, application and custom log files' (which is highlighted with a red box and contains a 'View logs' link), and 'Write rules to indicate which events are of interest to your application'. Below this is a 'Get started with Observability solutions' section, and at the bottom is a 'Get started with Application Insights' section.



# Demo



1. search for "/aws/lambda/Group11ReviewProcessor"




 [CloudWatch](#) > Log groups

CloudWatch <

Favorites and recents ▶


Dashboards [New](#)

▶ AI Operations [Preview](#)

▶ Alarms  0  0  0

▼ Logs

[Log groups](#) [New](#)


Log groups (1184)  [Actions](#) ▼

[View in Logs Insights](#)

[Start tailing](#)

[Create log group](#)

By default, we only load up to 10000 log groups.

1 match ☒ Exact match < 1 > 

<input type="checkbox"/>	Log group	Log class ▼	Anomaly d... ▼	D... ▼	S... ▼
<input type="checkbox"/>	<a href="#">/aws/lambda/Group11ReviewProcessor</a>	Standard	<a href="#">Configure</a>	-	-

# Demo



1. Open this Log group
2. Open the most recent Log stream

The screenshot shows the AWS CloudWatch console interface. The breadcrumb navigation at the top indicates the path: CloudWatch > Log groups > /aws/lambda/Group11ReviewProcessor. The left-hand navigation pane lists various CloudWatch features, with 'Logs' and 'Log groups' being relevant to the task. The main content area displays the details for the log group '/aws/lambda/Group11ReviewProcessor'. Below the details, there are tabs for 'Log streams', 'Tags', 'Anomaly detection', 'Metric filters', 'Subscription filters', and 'Contributor Insights'. The 'Log streams' tab is active, showing a list of log streams. The most recent log stream, '2024/12/04/[\$LATEST]b38bbe90a1194a75ac9c3100170db', is highlighted with a red box. The console also includes buttons for 'Actions', 'View in Logs Insights', 'Start tailing', and 'Search log group' at the top of the log group details section.

CloudWatch > Log groups > /aws/lambda/Group11ReviewProcessor

**/aws/lambda/Group11ReviewProcessor**

Actions View in Logs Insights Start tailing Search log group

**Log group details**

Log class [Info](#)  
Standard

ARN  
[arn:aws:logs:us-east-1:620339869704:log-group:/aws/lambda/Group11ReviewProcessor:](#)

Creation time  
6 minutes ago

Retention  
Never expire

Stored bytes  
-

Metric filters  
0

Subscription filters  
0

Contributor Insights rules  
-

KMS key ID  
-

Anomaly detection  
[Configure](#)

Data protection  
-

Sensitive data count  
-

Field indexes  
[Configure](#)

Transformer  
[Configure](#)

**Log streams (1)**

Filter log streams or try prefix search

☐ Log stream ☐ Exact match ☐ Show expired [Info](#) < 1 > [Settings](#)

☐ **2024/12/04/[\$LATEST]b38bbe90a1194a75ac9c3100170db** 2024-12-04 16:03:48 (UTC)

# Demo



1. Find the “User input received” input text recorded
2. Find the “Sentiment analysis result” return response recorded

CloudWatch > Log groups > /aws/lambda/Group11ReviewProcessor > 2024/12/04/[\$LATEST]b38bbe90a1194a75ac9c3100170db3fa

### CloudWatch

Favorites and recents

Dashboards [New](#)

▶ **AI Operations** [Preview](#)

▶ **Alarms**

▼ **Logs**

[Log groups](#) [New](#)

Log Anomalies

Live Tail

Logs Insights [New](#)

Contributor Insights

▶ **Metrics**

▶ **X-Ray traces** [New](#)

### 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](#)

1m 30m 1h 12h  UTC timezone

Timestamp	Message
	No older events at this moment. <a href="#">Retry</a>
2024-12-04T16:03:47.523Z	INIT_START Runtime Version: python:3.9.v64 Runtime Version ARN: arn:aws:lambda:us-east-1::runtime:57e9dce4a928fd5b7bc1015238a5bc8a9146f096d69571fa4219ed8a2e76...
2024-12-04T16:03:47.849Z	[INFO] 2024-12-04T16:03:47.848Z Found credentials in environment variables.
2024-12-04T16:03:47.992Z	START RequestId: f351b68b-8076-4718-a963-621eaf570a8a Version: \$LATEST
2024-12-04T16:03:47.993Z	[INFO] 2024-12-04T16:03:47.993Z f351b68b-8076-4718-a963-621eaf570a8a User input received: Easily the best professor I've had at UML so far. Clear passion for ...
2024-12-04T16:03:48.274Z	[INFO] 2024-12-04T16:03:48.274Z f351b68b-8076-4718-a963-621eaf570a8a Sentiment analysis result: {'Sentiment': 'POSITIVE', 'SentimentScore': {'Positive': 0.998...
2024-12-04T16:03:48.449Z	END RequestId: f351b68b-8076-4718-a963-621eaf570a8a
2024-12-04T16:03:48.449Z	REPORT RequestId: f351b68b-8076-4718-a963-621eaf570a8a Duration: 456.46 ms Billed Duration: 457 ms Memory Size: 128 MB Max Memory Used: 79 MB Init Duration: 4...
	No newer events at this moment. <a href="#">Auto retry paused</a> . <a href="#">Resume</a>

# Demo



aws

Search

[Option+S]

N. Virginia

anson\_lu@student.um.edu @ 6203-3986-9704

CloudWatch

Log groups

/aws/lambda/Group11ReviewPro...

2024/12/04/[LATEST]b38bbe90a1194a75ac9c310...

CloudWatch

Favorites and recents

Dashboards

AI Operations

Alarms

Logs

Log groups

Log Anomalies

Live Tail

Logs Insights

Contributor Insights

Metrics

X-Ray traces

Events

Application Signals

Network Monitoring

Insights

Settings

Telemetry config

Getting Started

Log events

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

Filter events - press enter to search

1m 1h Clear

UTC timezone

Display

Create metric filter

Learn more about filter patterns

Timestamp	Message
No older events at this moment. <a href="#">Retry</a>	
2024-12-04T16:03:47.523Z	INIT_START Runtime Version: python:3.9.v64 Runtime Version ARN: arn:aws:lam...
2024-12-04T16:03:47.849Z	[INFO] 2024-12-04T16:03:47.848Z Found credentials in environment variables.
2024-12-04T16:03:47.992Z	START RequestId: f351b68b-8076-4718-a963-621eaf570a8a Version: \$LATEST
2024-12-04T16:03:47.993Z	[INFO] 2024-12-04T16:03:47.993Z f351b68b-8076-4718-a963-621eaf570a8a User i...
2024-12-04T16:03:47.993Z	[INFO] 2024-12-04T16:03:47.993Z f351b68b-8076-4718-a963-621eaf570a8a User input received: Easily the best professor I've had at UML so far. Clear passion for what he's teaching, engaging lectures, and always eager to help students.
2024-12-04T16:03:48.274Z	[INFO] 2024-12-04T16:03:48.274Z f351b68b-8076-4718-a963-621eaf570a8a Sentim...
2024-12-04T16:03:48.274Z	[INFO] 2024-12-04T16:03:48.274Z f351b68b-8076-4718-a963-621eaf570a8a Sentiment analysis result: {'Sentiment': 'POSITIVE', 'SentimentScore': {'Positive': 0.9986718893051147, 'Negative': 2.7687268811860122e-05, 'Neutral': 0.0012897314736619592, 'Mixed': 1.0688389011193067e-05}, 'ResponseMetadata': {'RequestId': '47113e54-25d0-4706-8bdf-1682cfbc5ea5', 'HTTPStatusCode': 200, 'HTTPHeaders': {'x-amzn-requestid': '47113e54-25d0-4706-8bdf-1682cfbc5ea5', 'content-type': 'application/x-amz-json-1.1', 'content-length': '168', 'date': 'Wed, 04 Dec 2024 16:03:47 GMT'}, 'RetryAttempts': 0}}
2024-12-04T16:03:48.449Z	END RequestId: f351b68b-8076-4718-a963-621eaf570a8a
2024-12-04T16:03:48.449Z	REPORT RequestId: f351b68b-8076-4718-a963-621eaf570a8a Duration: 456.46 ms ...
No newer events at this moment. <a href="#">Auto retry paused. Resume</a>	

# Demo



1. To delete all AWS resources created, run the following command:  
`aws cloudformation delete-stack --stack-name Sentiment-Analysis`

```
[anlu@ALMBP-2 Sentiment_Analysis % aws cloudformation delete-stack --stack-name Sentiment-Analysis  
anlu@ALMBP-2 Sentiment_Analysis %
```

Sentiment-Analysis



2024-12-04 10:56:27 UTC-0500



DELETE\_IN\_PROGRESS



# Demo



1. To delete the CloudWatch logs:  
`aws logs delete-log-group --log-group-name  
"/aws/lambda/Group11ReviewProcessor"`  
  
`aws logs delete-log-group --log-group-name  
"/aws/lambda/Group11WebsiteLambdaFunction"`

```
anlu@ALMBP-2 Sentiment_Analysis % aws logs delete-log-group --log-group-name "/aws/lambda/Group11ReviewProcessor"
```

```
[anlu@ALMBP-2 Sentiment_Analysis % aws logs delete-log-group --log-group-name "/aws/lambda/Group11WebsiteLambdaFunction"  
anlu@ALMBP-2 Sentiment_Analysis % ]
```

## Log groups (1186)

[Actions](#)[View in Logs Insights](#)[Start tailing](#)[Create log group](#)

By default, we only load up to 10000 log groups.



0 matches

☒ Exact match

<

1

>



Log group



Log class



Anomaly d...



D...



S...



No log groups matched your filter.

# Applications

## Customer Feedback Analysis

- Service
- Product
- Game patch notes

## Social Media Monitoring

- Content

## Personal Feedback

- Performance reviews
- Hospitality

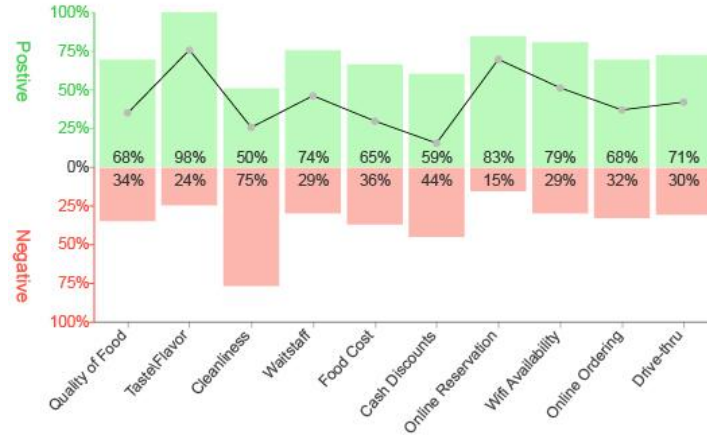
## Education Feedback

- Universities/Schools
- Teaching methods/material

## Market Research

- Startup/Kickstarters

Restaurant Customers Sentiment Analysis



## Employee performance review

Dear Ms. Owens,

I hope this email finds you well. As we approach the end of the [quarter/year], it's time to take stock of your performance over the past [period]. First and foremost, I want to express my appreciation for your hard work and dedication to [company/project/team].

Here is brief feedback from your manager:

**Employee rating:** Often exceeds expectations

**Strengths:** Alice excelled in team collaboration by helping team members brainstorm solutions in order to meet deadlines and onboarding new hires remotely.

**Opportunity:** I believe Alice could improve her hard skills to become an even more seasoned specialist. She can learn new skills by attending workshops and industry events.

RATE MY PROFESSORS

**End**