

Human Emotions influences Heart Rate using Amazon Rekognition API and Fitbit API

Github Link: <https://github.com/shreyaabadri/Cloud-Computing-Project-Fall-2018>

Youtube Video Link: <https://youtu.be/DstXGGYwnkc>

Team Members :

Shreyaa Sridhar (16251190)

Fatema Hasta (16247903)

Team Members Role:

We both put in joint efforts into:

- Collection and Creation of facial image dataset and fitbit heart rate data
- Storage of dataset in AWS S3 buckets
- Using Amazon Athena to query data and generate useful insights
- Using Amazon QuickSight to visualize data.

Background and Motivation:

Facial emotions are important factors in human communication that help us understand the intentions of others. In general, people infer the emotional states of other people, such as joy, sadness, and anger, using facial expressions and vocal tone. Facial expressions are one of the main information channels in interpersonal communication. Therefore, it is natural that research of facial emotion has been gaining lot of attention over the past decades with applications not only in the perceptual and cognitive sciences, but also in affective computing and computer animations. Data Analytics has become very popular , where data is examined and meaningful insights are derived. People deal with different emotions each day and every minute of their life. These emotions could be a result of their responsibilities , relationships or any hardships they come across.

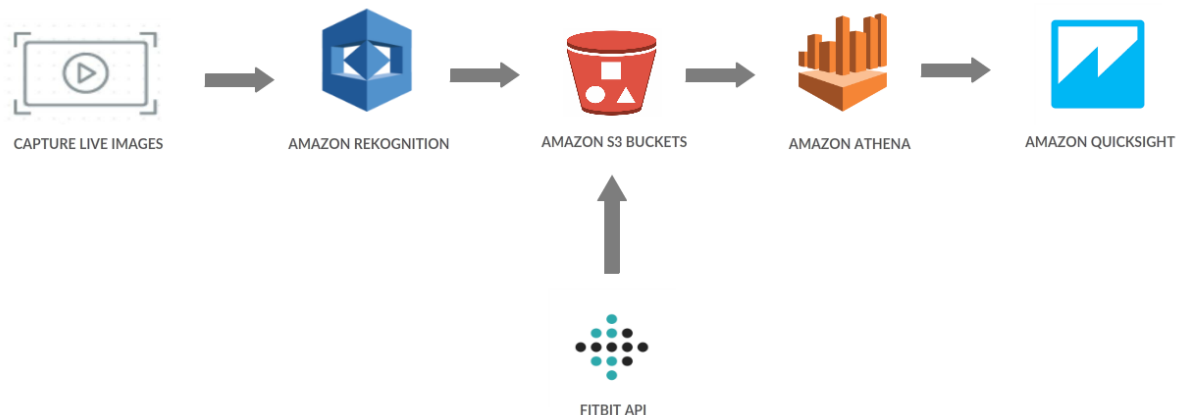
Emotions play a large role in heart rate response. Anger, fear, and anxiety cause a rapid heart rate, while depression usually results in lowering of heart rate. Feelings of love, compassion, happiness usually result in slow heart action. Emotional stress causes heart rate to stay elevated.

We would like to detect and study the emotions and heart rate based on those emotions we experience say per day, consolidating it for a month, by visualizing the rate at which it changes. We can find critical insights from our visualizations, hence taking corrective measures towards emotions we want to improve upon.

Objective:

The core idea of our project is to detect a person's emotion using their facial expression and heart rate using their wearable fitness device, to gain useful insights on how their emotion and heart rate varies when they experience a certain emotion.

Architecture Diagram



Tools and Languages, Platforms Used:

- API: Amazon Rekognition API , Fitbit API
- Languages: Python
- Cloud Platform: Amazon Web Services
- Software Platform: Pycharm
- Visualization Tool: Amazon Quicksight
- Querying Tool: Amazon Athena

Evaluation/Implementation/Development Plan

- Performance parameters: Confidence scores of emotions
- Type/Source of data: Capture images using webcam

Expected project outcome:

Successfully visualized the the emotions and heart rate and how emotions influence the heart rate response

Solution:

- **Emotion Rekognition and Fitbit Heart rate:**

Collection of dataset: We collected our real time facial images from October 14th 2018 to November 13th 2018, from 6pm to 10pm with 5 min burst time. We also collected our heart rate values from 6pm to 10pm from October 14th 2018 to November 13th 2018 using the Fitbit api.

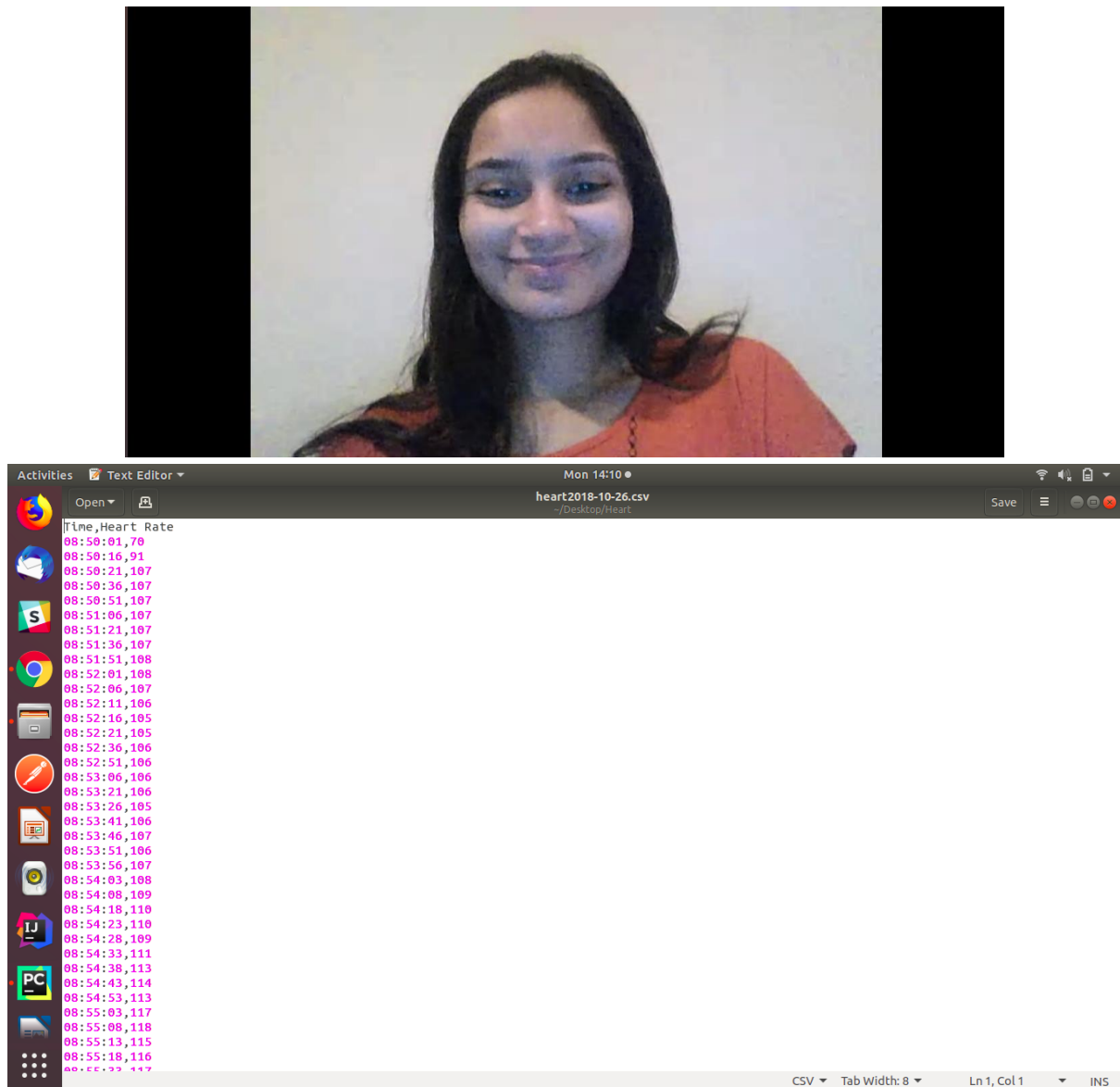
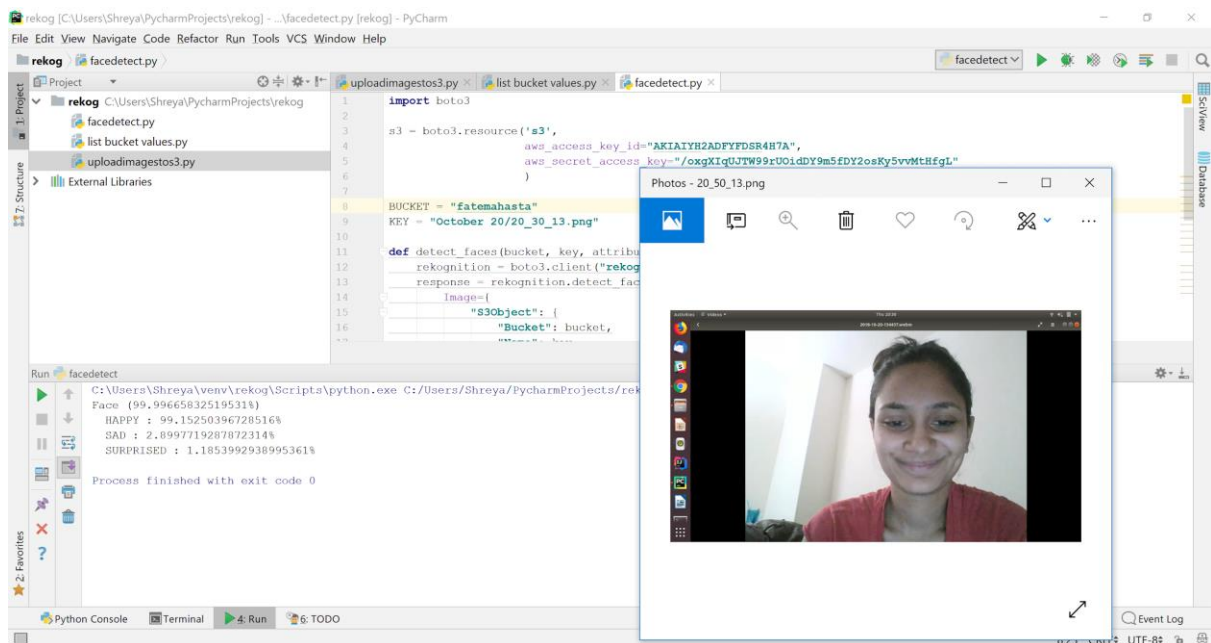
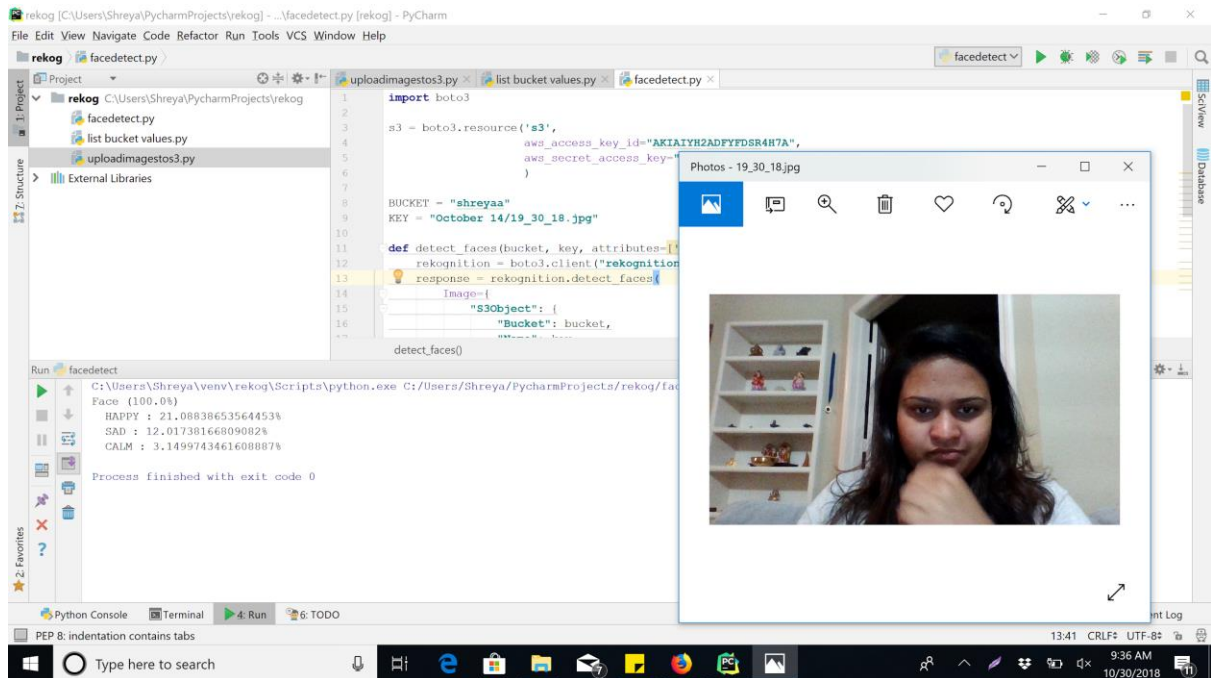
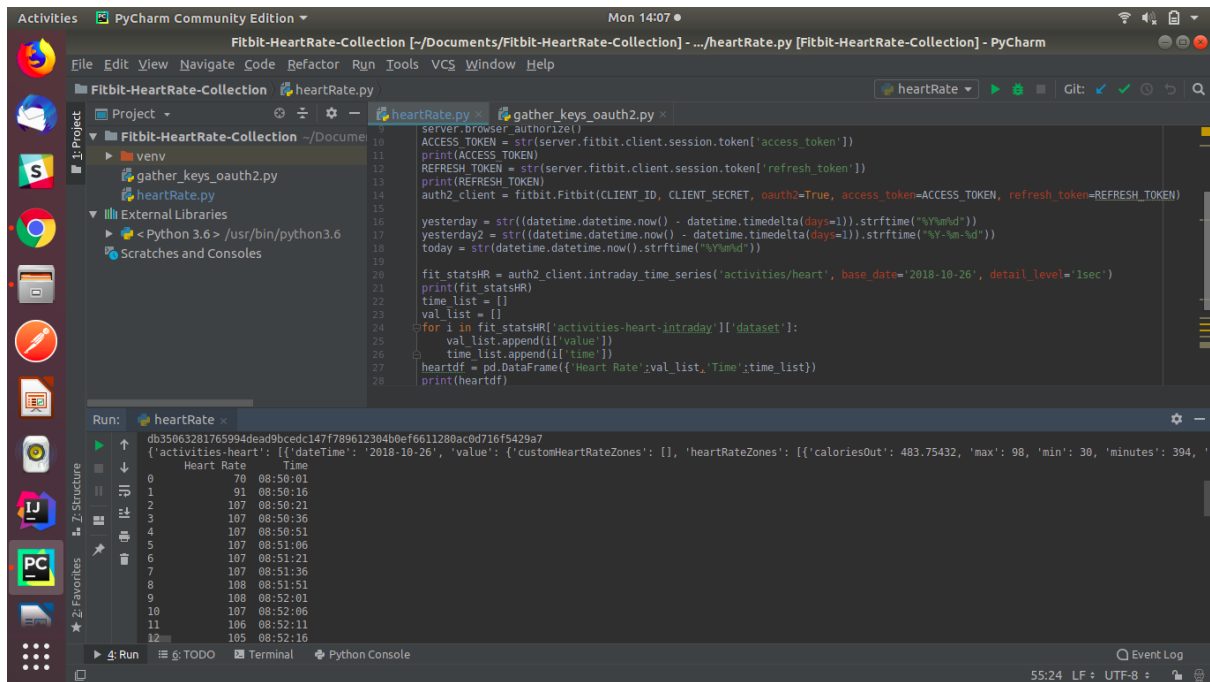
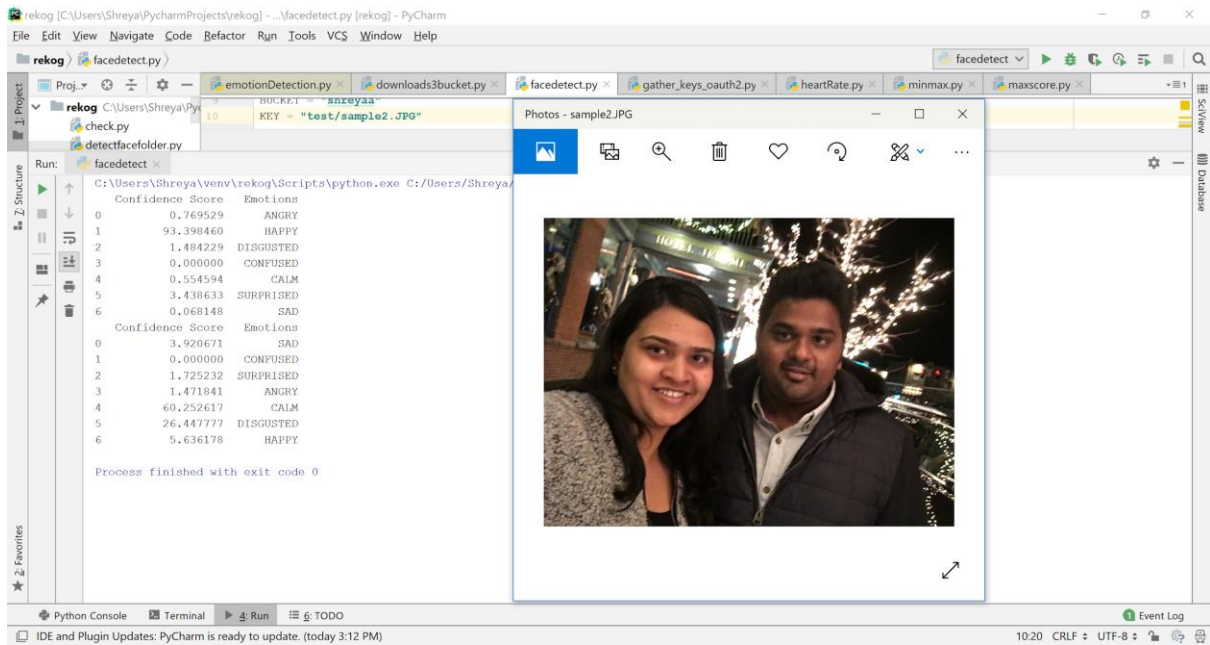


Image Recognition: We then used the **Amazon Rekognition API** to detect the emotions of the images into HAPPY, CALM, DISGUSTED, SURPRISED, ANGRY, SAD and CONFUSED. We then created csv files for all, storing the confidence scores of each emotion from 6pm to 10pm. We also calculated the maximum scores of the emotion experienced for a particular day, for a month and stored them in a csv. Also detects multiple faces in an image.





```
1 import pandas as pd
2 import os
3
4 basePath = 'C:\\Users\\Shreya\\Desktop\\Cloud Computing\\Project\\shreya\\'
5 folder = 'heart_rate'
6 fullPath = basePath+folder+'/'
7
8 maxRows = []
9 fileNames = []
10
11 columns = ['Date', 'Max Heart Rate', 'Min Heart Rate']
12 final_df = pd.DataFrame(columns=columns)
13
14 for filename in os.listdir(fullPath):
```

Run: minmax x

C:\Users\Shreya\venv\rekoq\Scripts\python.exe C:/Users/Shreya/PycharmProjects/rekoq/minmax.py

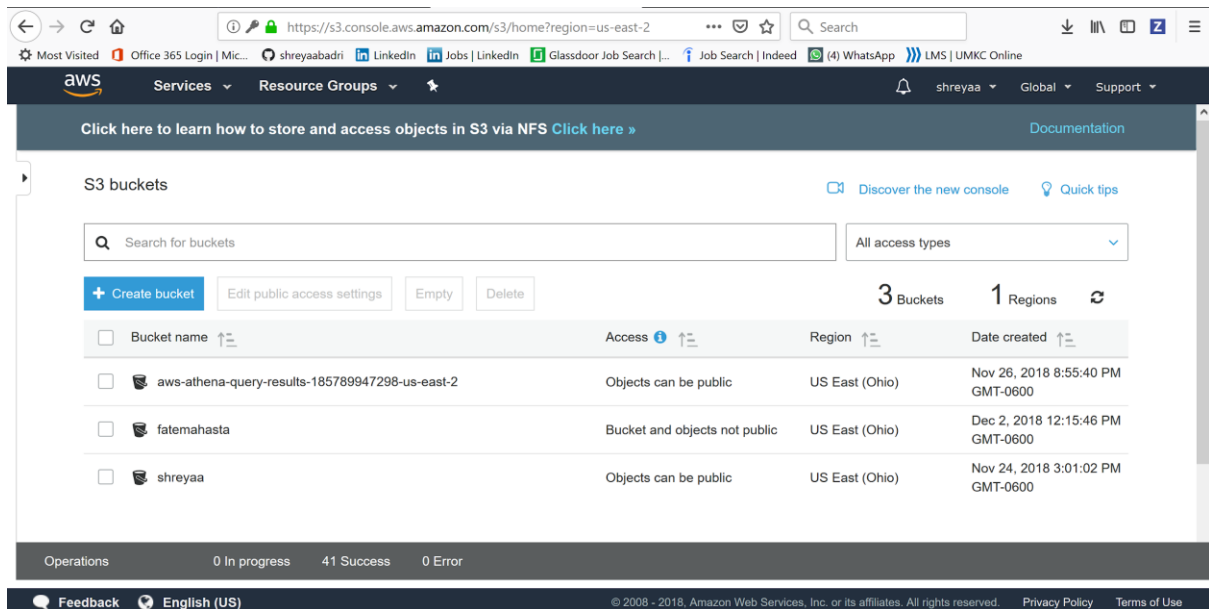
	Date	Max Heart Rate	Min Heart Rate
0	2018-10-14	128	70
1	2018-10-15	140	68
2	2018-10-16	147	70
3	2018-10-17	134	70
4	2018-10-18	140	70
5	2018-10-19	124	63
6	2018-10-20	133	70
7	2018-10-21	123	65
8	2018-10-22	132	70
9	2018-10-23	127	66
10	2018-10-24	137	68
11	2018-10-25	123	70
12	2018-10-26	137	71

Python Console Terminal Run TODO

IDE and Plugin Updates: PyCharm is ready to update. (46 minutes ago)

29:105 CRLF UTF-8

Storage of data: We then stored all the data into Amazon S3 buckets.



Activities Google Chrome Sat 20:25

Secure https://s3.console.aws.amazon.com/s3/buckets/fitbit-heartrate/?region=us-east-1&tab=overview

Services Resource Groups

Amazon S3 > fitbit-heartrate

Overview Properties Permissions Management

Search Type a prefix and press Enter to search. Press ESC to clear.

Upload Create folder Download Actions

US East (Ohio)

Viewing 1 to 31

<input type="checkbox"/>	Name	Last modified	Size	Storage class
<input type="checkbox"/>	2018-10-14.csv	Nov 27, 2018 1:06:48 PM GMT-0600	6.0 KB	Standard
<input type="checkbox"/>	2018-10-15.csv	Nov 27, 2018 1:06:47 PM GMT-0600	4.7 KB	Standard
<input type="checkbox"/>	2018-10-16.csv	Nov 27, 2018 1:06:47 PM GMT-0600	6.0 KB	Standard
<input type="checkbox"/>	2018-10-17.csv	Nov 27, 2018 1:06:46 PM GMT-0600	4.7 KB	Standard
<input type="checkbox"/>	2018-10-18.csv	Nov 27, 2018 1:06:46 PM GMT-0600	37.2 KB	Standard

Nov 27, 2018 1:06:46 PM GMT-

Feedback English (US)

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https://s3.console.aws.amazon.com/s3/buckets/shreyaa/ 90% Search

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Services Resource Groups

Amazon S3 > shreyaa / Consolidated_data / EmotionHR_consolidated

Overview

Search Type a prefix and press Enter to search. Press ESC to clear.

Upload Create folder Download Actions

US East (Ohio)

Viewing 1 to 8

<input type="checkbox"/>	Name	Last modified	Size	Storage class
<input type="checkbox"/>	2018-10-14_consolidated.csv	Dec 2, 2018 1:06:32 PM GMT-0600	1.4 KB	Standard
<input type="checkbox"/>	2018-10-15_consolidated.csv	Dec 2, 2018 1:06:32 PM GMT-0600	1.4 KB	Standard
<input type="checkbox"/>	2018-10-16_consolidated.csv	Dec 2, 2018 1:06:32 PM GMT-0600	1.4 KB	Standard
<input type="checkbox"/>	2018-10-17_consolidated.csv	Dec 2, 2018 1:06:33 PM GMT-0600	1.2 KB	Standard
<input type="checkbox"/>	2018-10-18_consolidated.csv	Dec 2, 2018 1:06:33 PM GMT-0600	855.0 B	Standard

Operations 0 In progress 48 Success 0 Error

https://s3.console.aws.amazon.com/s3/#

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Activities Google Chrome Sat 20:25

Secure | https://s3.console.aws.amazon.com/s3/buckets/emotion-classify-csv/?region=us-east-1&tab=overview

aws Services Resource Groups

Amazon S3 > emotion-classify-csv

Overview Properties Permissions Management

Search Type a prefix and press Enter to search. Press ESC to clear.

Upload Create folder Download Actions

US East (Ohio)

Viewing 1 to 31

<input type="checkbox"/>	Name	Last modified	Size	Storage class
<input type="checkbox"/>	2018-10-14	--	--	--
<input type="checkbox"/>	2018-10-15	--	--	--
<input type="checkbox"/>	2018-10-16	--	--	--
<input type="checkbox"/>	2018-10-17	--	--	--
<input type="checkbox"/>	2018-10-18	--	--	--
<input type="checkbox"/>	2018-10-19	--	--	--
<input type="checkbox"/>	2018-10-20	--	--	--

Feedback English (US)

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aws Services Resource Groups

Amazon S3 > shreyaa / Consolidated_data / averageHR

Overview

Search Type a prefix and press Enter to search. Press ESC to clear.

Upload Create folder Download Actions

US East (Ohio)

Viewing 1 to 5

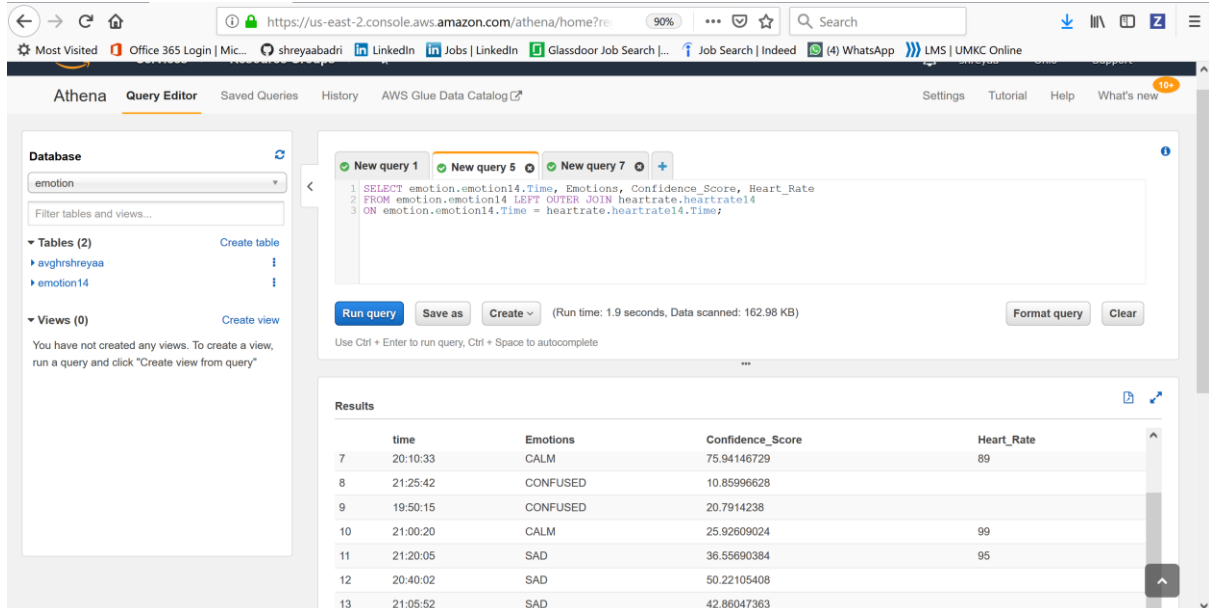
<input type="checkbox"/>	Name	Last modified	Size	Storage class
<input type="checkbox"/>	2018-10-14_averageHR.csv	Dec 2, 2018 1:02:45 PM GMT-0600	119.0 B	Standard
<input type="checkbox"/>	2018-10-15_averageHR.csv	Dec 2, 2018 1:02:45 PM GMT-0600	90.0 B	Standard
<input type="checkbox"/>	2018-10-16_averageHR.csv	Dec 2, 2018 1:02:46 PM GMT-0600	81.0 B	Standard
<input type="checkbox"/>	2018-10-17_averageHR.csv	Dec 2, 2018 1:02:46 PM GMT-0600	101.0 B	Standard
<input type="checkbox"/>	2018-10-18_averageHR.csv	Dec 2, 2018 1:02:46 PM GMT-0600	56.0 B	Standard

Operations 0 In progress 46 Success 0 Error

Feedback English (US)

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Data Querying: We combine the Emotion results and Heart Rate with respect to date and time using LEFT OUTER JOIN command. After joining we use the AVERAGE command to find the average Heart Rate for each emotion.

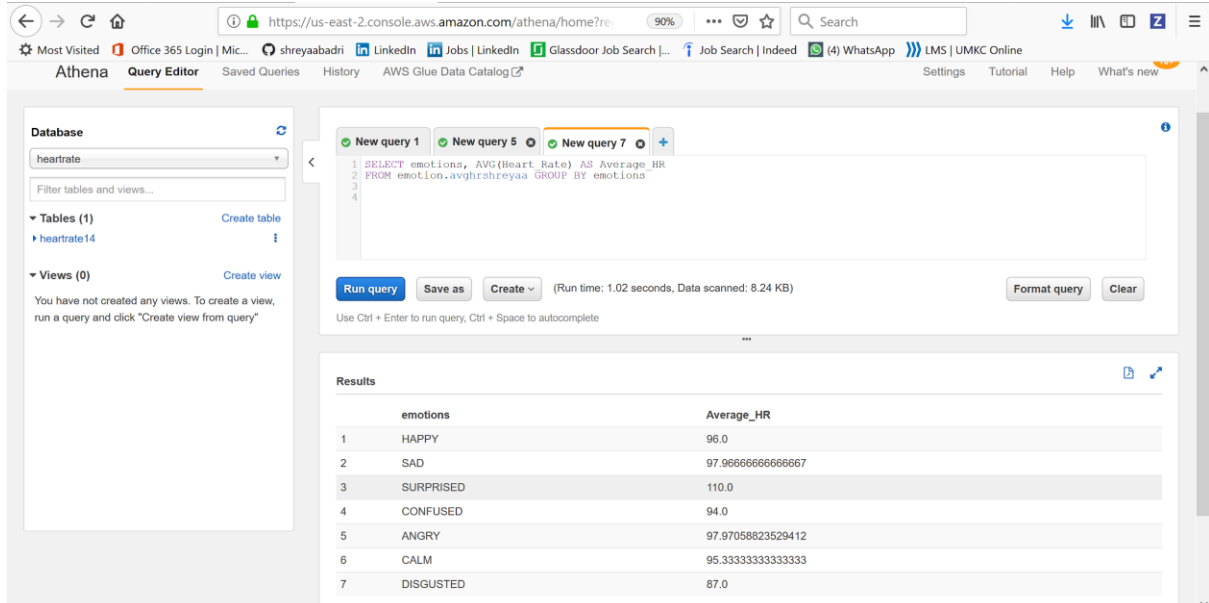


The screenshot shows the AWS Athena Query Editor interface. On the left, the 'Database' dropdown is set to 'emotion'. The 'Tables (2)' section lists 'avghrshreyaa' and 'emotion14'. The 'Views (0)' section is empty. The main query editor contains the following SQL code:

```
1 SELECT emotion.emotion14.Time, Emotions, Confidence_Score, Heart_Rate
2 FROM emotion.emotion14 LEFT OUTER JOIN heartrate.heartrate14
3 ON emotion.emotion14.Time = heartrate.heartrate14.Time;
```

The 'Run query' button is highlighted. Below the query editor, the 'Results' section displays a table with 5 columns: 'time', 'Emotions', 'Confidence_Score', and 'Heart_Rate'. The table contains 7 rows of data.

	time	Emotions	Confidence_Score	Heart_Rate
7	20:10:33	CALM	75.94146729	89
8	21:25:42	CONFUSED	10.85996628	
9	19:50:15	CONFUSED	20.7914238	
10	21:00:20	CALM	25.92609024	99
11	21:20:05	SAD	36.55690384	95
12	20:40:02	SAD	50.22105408	
13	21:05:52	SAD	42.86047363	



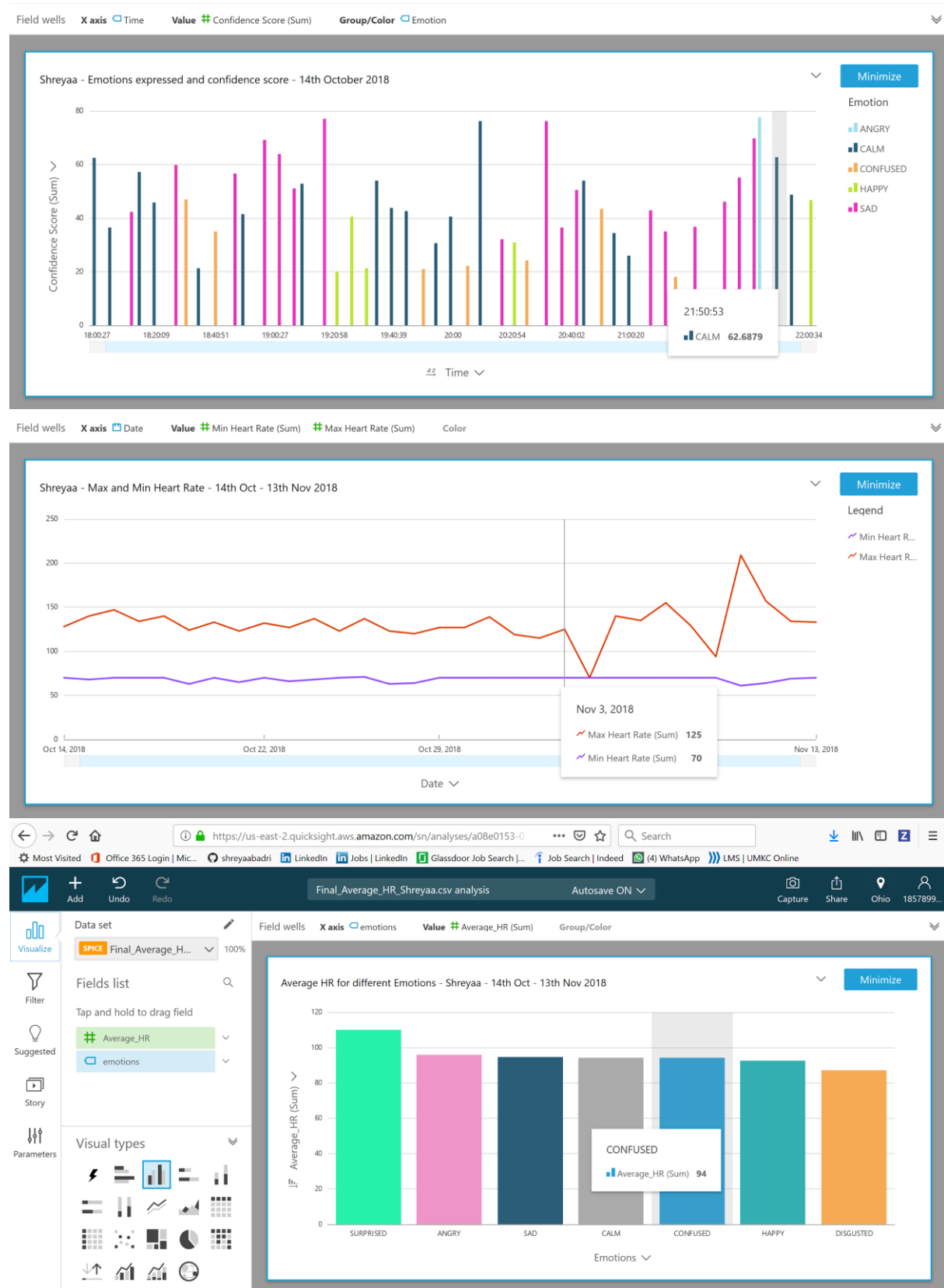
The screenshot shows the AWS Athena Query Editor interface. On the left, the 'Database' dropdown is set to 'heartrate'. The 'Tables (1)' section lists 'heartrate14'. The 'Views (0)' section is empty. The main query editor contains the following SQL code:

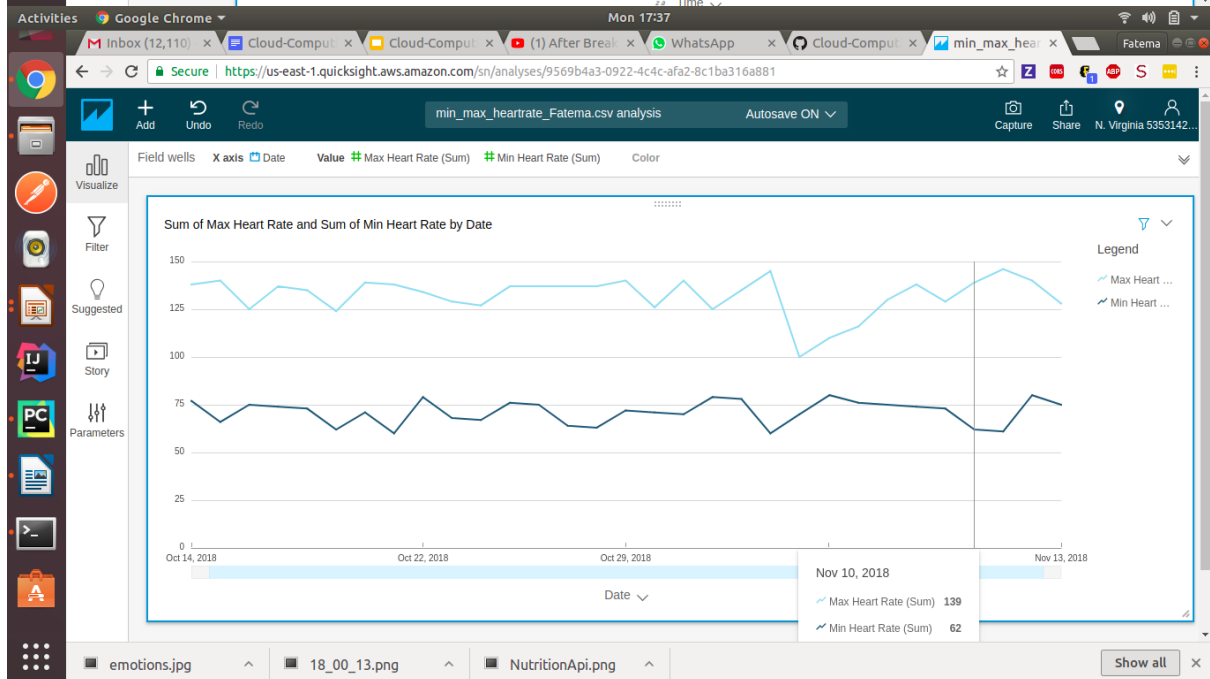
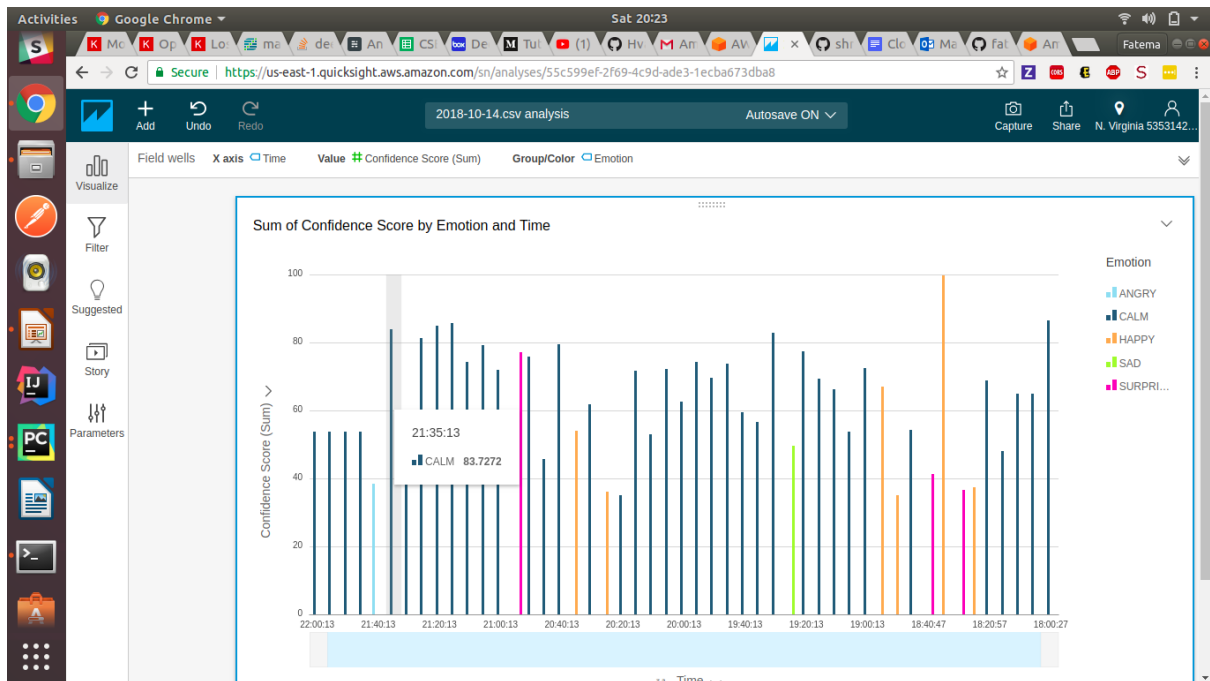
```
1 SELECT emotions, AVG(Heart_Rate) AS Average_HR
2 FROM emotion.avghrshreyaa GROUP BY emotions
3
4
```

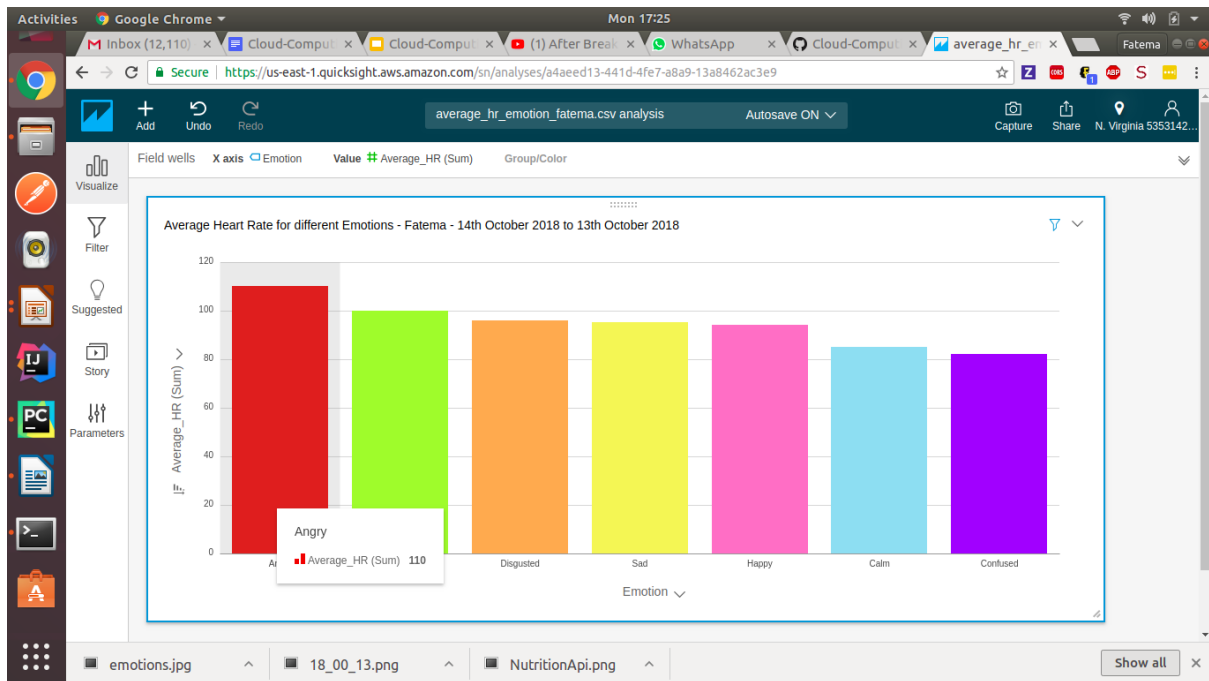
The 'Run query' button is highlighted. Below the query editor, the 'Results' section displays a table with 2 columns: 'emotions' and 'Average_HR'. The table contains 7 rows of data.

	emotions	Average_HR
1	HAPPY	96.0
2	SAD	97.96666666666667
3	SURPRISED	110.0
4	CONFUSED	94.0
5	ANGRY	97.97058823529412
6	CALM	95.33333333333333
7	DISGUSTED	87.0

Visualization: We then import data from S3 buckets and Athena to visualize our data and results.







Advantages and Disadvantages:

- **Advantages:**
 - The visualization graphs between heart rate and emotion really tell you how the emotions influence heart rates.
 - Our visualization can help a person understand his/her emotions in-depth and take corrective measure in order to manipulate a certain emotion, depending on whether that emotion dominates his/her life.
- **Disadvantages:**
 - Image data set consists of images taken when we spent time working on our laptop.

Challenges:

- The initial challenge that we faced was the collection of dataset which really was time consuming and took lots of effort.

Individual learning outcome (what would you get to learn out of this project):

- We really are fascinated to look at how a particular emotion really dominates us and how our heart rate fluctuates when we experience a particular emotion.
- Learn to use Amazon Rekognition API for facial analysis.
- Learn to use Amazon s3 and Amazon Athena.
- Learn to gain insights on our data and visualize using Amazon Quicksight.

Inferences:

- After analyzing the graph between emotion and average heart rate, we can conclude that emotions totally play a role in fluctuating heart rates.
- Fatema's Emotion-Heart-Rate Analysis:
 - Fatema's heart rate is the maximum (110) when she is very angry, whereas her heart rate is low at a value of 82 when she is confused.
 - Also there is not much fluctuations in heart rate when she is Happy/Sad/Disgusted. They are quite aligned to heart rate value of 87.
- Shreyaa's Emotion-Heart-Rate Analysis:
 - Shreyaa's heart rate is the maximum (110) when she is surprised, whereas her heart rate is low at a value of 84 when she is disgusted.
 - Also there is not much fluctuations in heart rate when she is Sad/Calm/Confused. They are quite aligned to heart rate value of 88.

Conclusion:

After analyzing the graph between emotion and average heart rate, we can conclude that emotions totally play a role in fluctuating heart rates.

Future Work:

In the future, we plan to extend our project by creating a web application, which will except a real time face image as an input, and will detect the emotion of the person in the image using the Amazon Rekognition API. We will also detect the heart rate from the wearable device and display it on our webpage. It will then create a visualization in the form of a graph for that particular emotion and heart rate.

References:

- <https://console.aws.amazon.com/rekognition/home?region=us-east-1#/face-detection>
- <https://docs.aws.amazon.com/AmazonS3/latest/dev/Welcome.html>
- https://docs.aws.amazon.com/quicksight/index.html#lang/en_us
- <https://dev.fitbit.com/build/reference/web-api/heart-rate/>
- <https://docs.aws.amazon.com/athena/latest/ug/understanding-tables-databases-and-the-data-catalog.html>