



# STAT 8021: Big Data Analytics

Artificial Intelligence Video Interview Analyzer  
(AVIA)

Group 6.2

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# Agenda



**Project Background**



**Problem and Objectives**



**Literature Review**



**Research Methods**



**Findings & Demo**



**Interpretation & Recommendation**

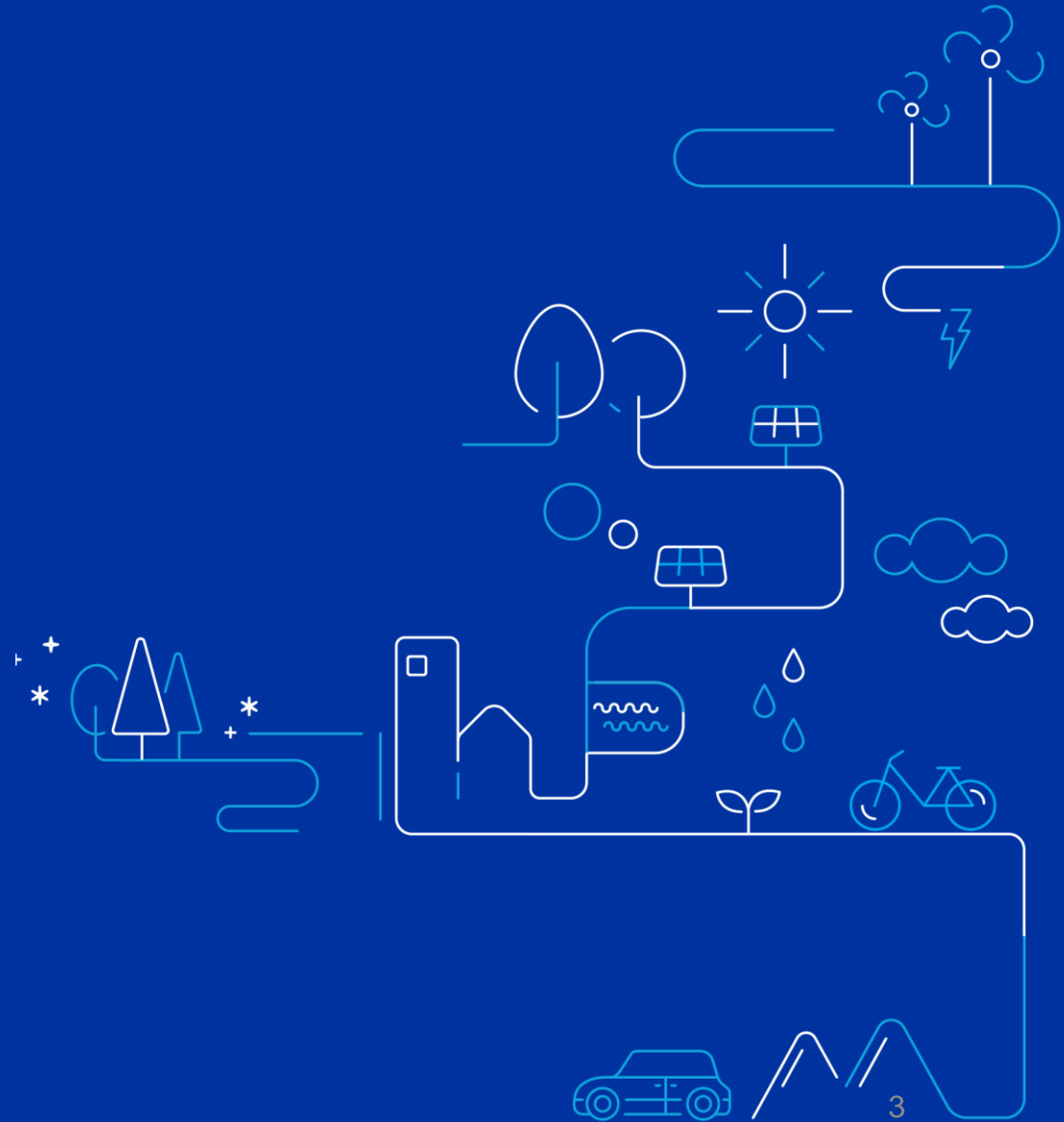


**Conclusion**



**Artificial Intelligence Video Interview Analyzer (AVIA)**

# PROJECT BACKGROUND





## How has COVID-19 changed our hiring process?

COVID-19 has changed the way we work and hire. Work from home and remote working is now a norm. Online video interviews and assessment have been very critical in hiring candidates during this pandemic.

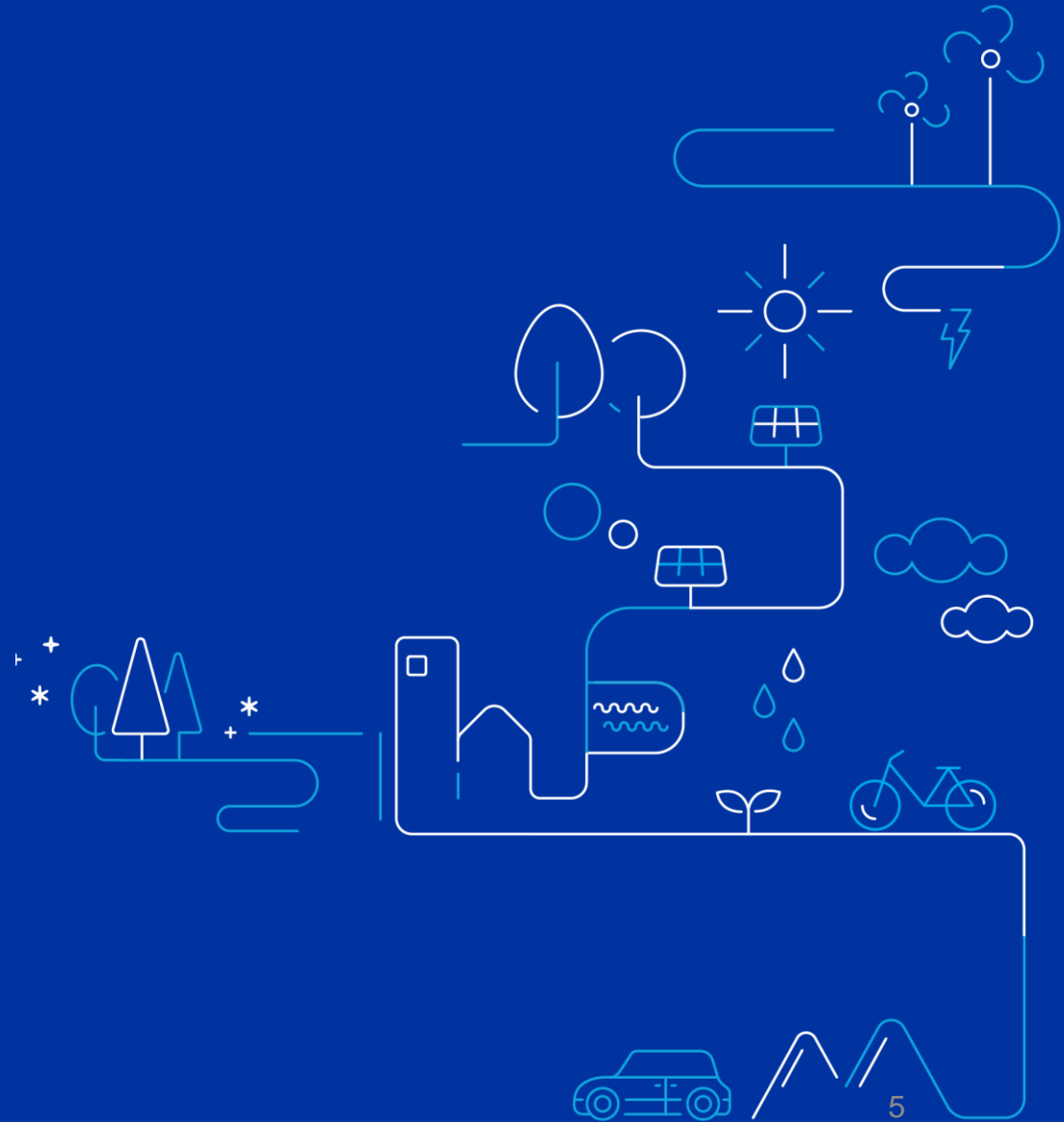


Face to face interviews  
& assessment



Online video interviews  
& assessment

# PROBLEM AND OBJECTIVES





## Problem

How can candidates better prepare and adapt to online video interviews and writing assessment?



### 1 Using AI to solve this problem

→ Build a comprehensive AI video interview analyzer **web application**



### 2 AI tool to assess candidate during online interview

→ **Facial expression recognition, eye contact detection** for video interview and **text analytics** on writing test



### 3 AI tool that lets candidates to review performance

→ Compute score of candidates and conduct data analysis for review



## Video Interview Assessment

Webcam Video Interview

Please introduce and give us a brief background of yourself

eye contact: center  
emotion: neutral 0.97

STOP SELECT DEVICE

Question Number  
1

1 5

**Facial Expression & Eye Contact Prediction Result**

face_id	datetime	question	name	prob	eye_contact
0	2021-06-24 22:54:27	1	neutral	0.9700	center

- Candidate answers questions with facial expression and eye contact being predicted real time.
- Data for each question being recorded for analysis.

## Writing Assessment

### Stage 2 - Writing Assessment

The writing interview is designed to test your English language abilities and also your writing skills. You will be asked various questions in terms of scenarios and business decision. Please kindly follow the instructions on the instructions panel on the sidebar.

Question 1: You are asked to finish a large number of tasks within a day. How would you manage that?

I will group them according to their level of priority. If the task is urgent and critical, I will finish it first. For the complicated task, I will break it down into several pieces and finish it step by step. If I know I cannot finish it within a day, I will communicate with my supervisor to see if the deadline can be extended or if some colleagues can give help.

Question 2: Everyone makes mistakes. How would you rectify the situation if you fail to meet the expectation?

Once I know I made a mistake, I will let my supervisor know as to see any bad influence on others. Then I will re-do or correct my mistakes as soon as possible. To prevent making the same type of mistake again, I will take down a note so that me and my colleagues will not make the same mistake too.

- Candidate writes answer to scenario-based questions.
- Text analytics conducted to extract **key noun and verbs** and match with suggested noun and verbs.

## Performance Review

### Performance Review

7.5 / 10

OVERALL SCORE

8.0

VIDEO INTERVIEW

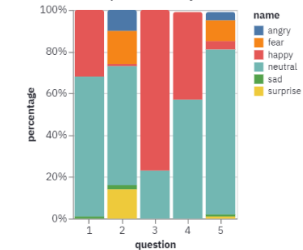
7.0

WRITING TEST

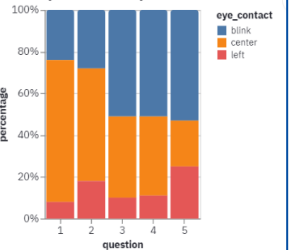
### Stage 1 - Video Interview

#### Percentage Breakdown

Facial Expression % by Question

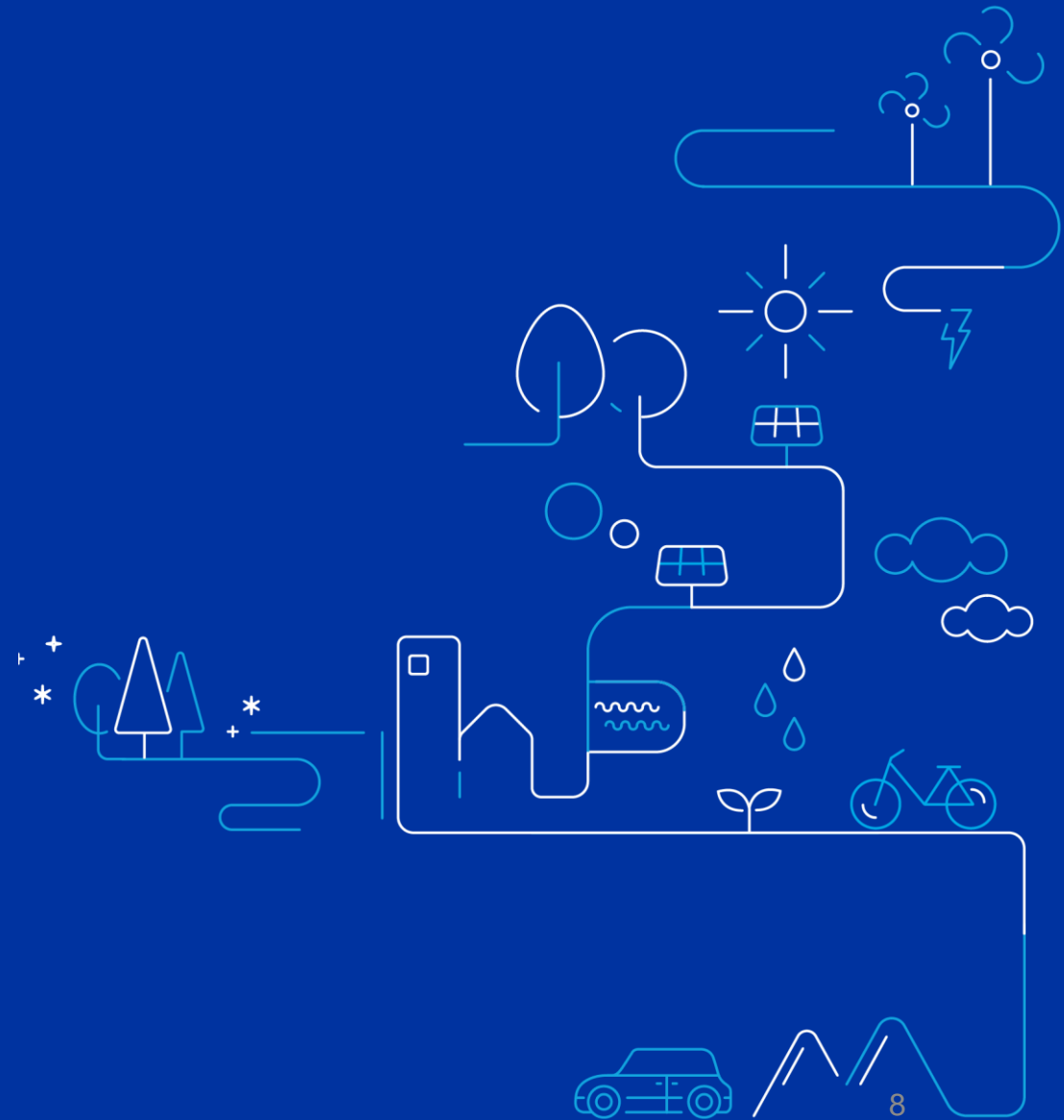


Eye Contact % by Question



- Review performance of video interview and writing assessment.
- Breakdown by question and computed score.

# LITERATURE REVIEW





# Facial Detection

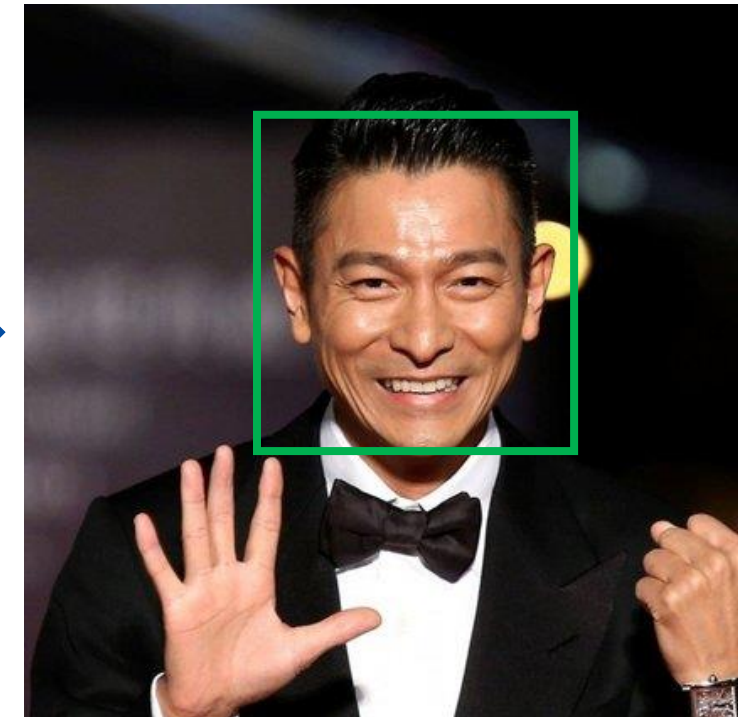


- Technology that detects human faces from a source (image or video)
- Important first steps to many key applications – facial expression recognition, facial recognition, etc
- High impact on sequential operations (Liu, 2015), highly reliant on good quality face detection

Input Image



Face Detection



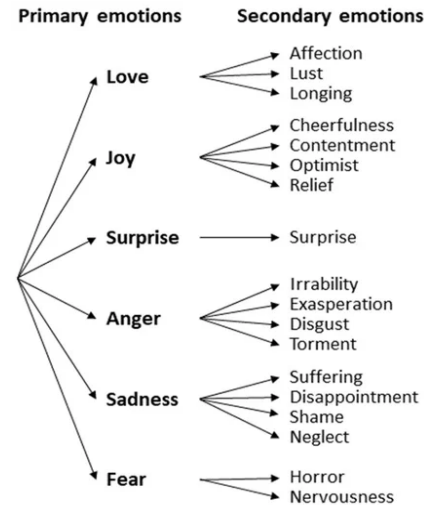
Liu, Haowei. 'Introduction to Computer Vision on Mobile Devices'. Facial Detection and Recognition on Mobile Devices, Elsevier, 2015, pp. 1–9. DOI.org (Crossref), doi:10.1016/B978-0-12-417045-2.00001-X.

# Facial Expression Recognition



- (Ekman, 1971) defined a set of six emotions that are accepted as universal: anger, disgust, fear, happiness, sadness, and surprise
- Positive facial expression can exuberate confidence during interviews
- Use trained model to predict emotion. Trained model on image database

## Primary & Secondary Emotions



Ekman, P., & Friesen, W. V. (1971). Constants across cultures in the face and emotion. *Journal of Personality and Social Psychology*, 17, 124–129

## Cropped & Grayscaled Image



## Emotion Prediction

### Predicted Emotion

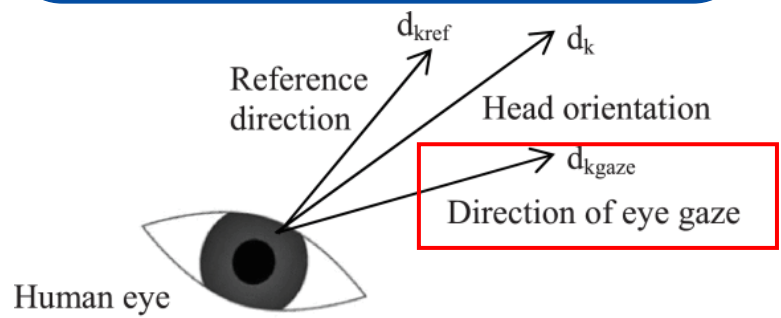
- **Happy: 0.99**
- Sad: 0.0
- Fear: 0.0
- Neutral: 0.0
- Surprise: 0.01
- Disgust: 0.0
- Angry: 0.0

# Eye Contact Detection (Eye Gaze Tracking)



- (Fayeem et al, 2014) Eye gaze tracking is the process of measuring the where the eyes is looking and can be used to understand a person's intentions, predict a person's actions, or analyze reactions to external stimuli
- Eye contact essential part of body language in interviews
- Detects coordinates of pupils and direction of eye gaze

## Direction of gaze



## Cropped & Grayscaled Image



## Gaze Estimation



**Estimation Gaze Direction:**

- Center

Bin Aziz, Fayeem & Mokhtar, Norrima & Arof, Hamzah & Mubin, Marizan & Ibrahim, Zuwairie. (2014). Review of Eye Gaze Tracking Application.



- Text mining extracts relevant words (N-grams) and relationships between them in order to categorize them. (Bach et al, 2019)
- Scenario based questions needs some important keywords i.e lead, take lead, step up. **Important nouns and verbs.**
- Sentiment analysis for sentiment of a document. Usually trained using some data. Predicts sentiment & polarity.

## Keyword Extraction

["I would step up and take lead of the project and give encouragement to my team mates to ensure that we are on track to hit our KPI"]



["lead", "encourage", "track"]

Pejić Bach, M., Krstić, Ž., Seljan, S. & Turulja, L. (2019). Text Mining for Big Data Analysis in Financial Sector: A Literature Review. *Sustainability*, 11. (5). doi: 10.3390/su11051277

## Sentiment Analysis

["I would step up and take lead of the project and give encouragement to my team mates to ensure that we are on track to hit our KPI"]



**Predicted Sentiment : Positive**  
**Predicted Polarity: 0.3**

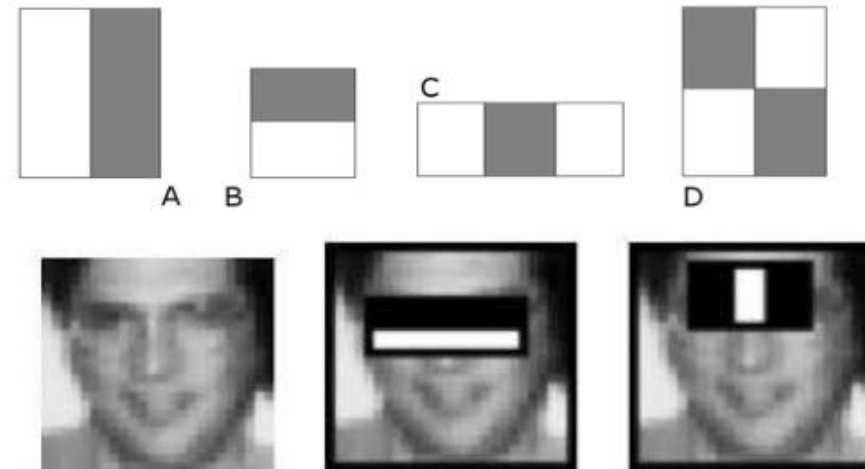
# RESEARCH METHODS





- Two methods – HaarCascade method and CNN method
- HaarCascade method faster but less accurate. CNN method is more accurate but needs more resources. Team proceeded with **HaarCascade**
- Tuned parameters of HaarCascade that is suitable for webcam frontal pose

## Haar Cascade Method



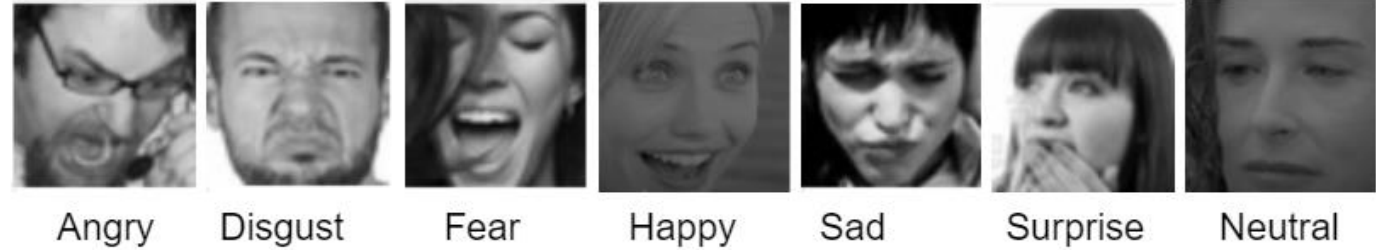
So what is **Haar Cascade**? It is an Object Detection Algorithm used to identify faces in an image or a real time video. The algorithm uses **edge or line detection features** proposed by Viola and Jones in their research paper “Rapid Object Detection using a Boosted **Cascade** of Simple Features” published in 2001.

# Facial Expression Recognition

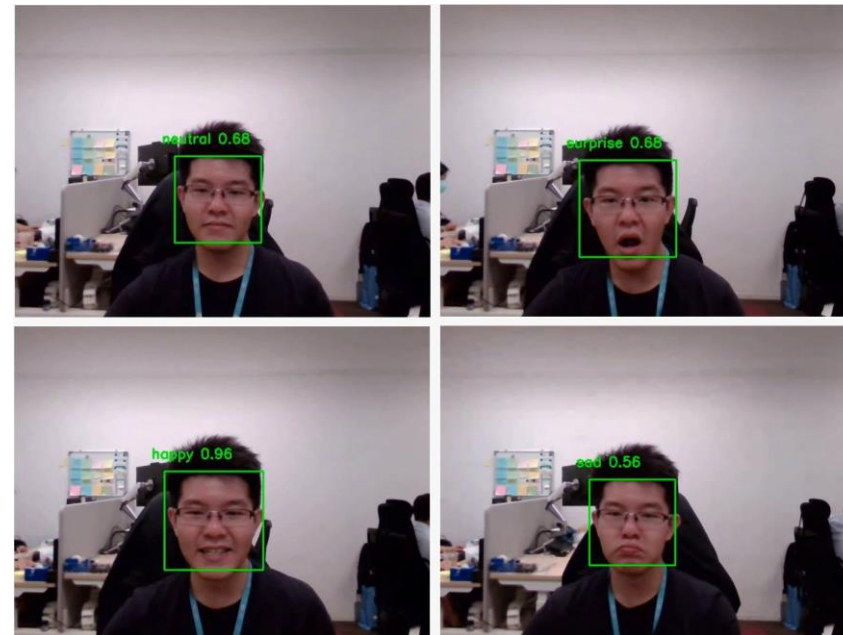


- **FER2013 dataset** from Kaggle. Grayscale images of faces with 32,298 samples and 7 emotions
- Webcam face image after face detection is cropped and converted to grayscale
- Use pre-trained Keras CNN model to predict the emotion real time. 4 Blocks of 2D Conv and BatchNormalization.

## FER2013 Dataset



## AVIA Real Time Webcam Prediction

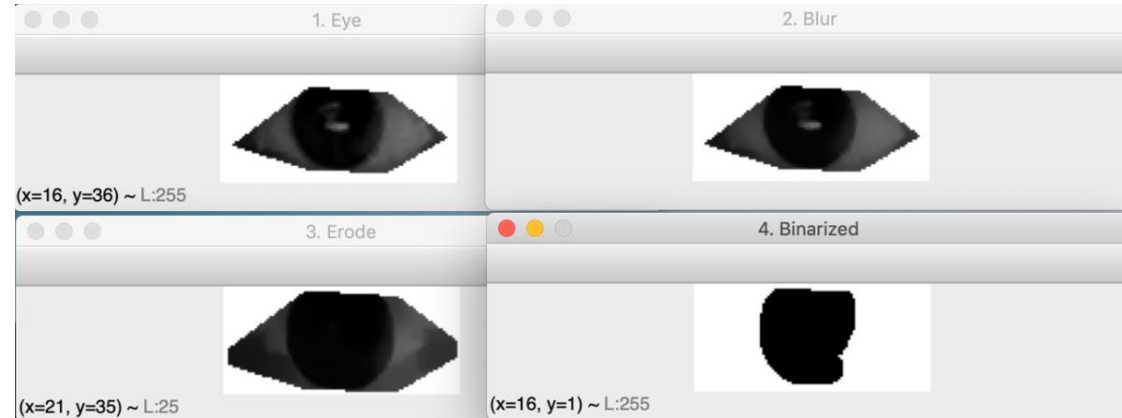


# Eye Contact Detection (Eye Gaze Tracking)

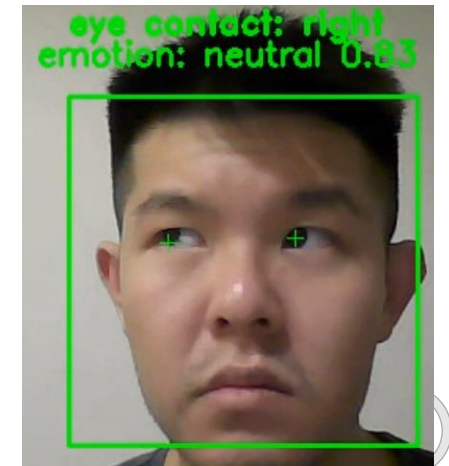
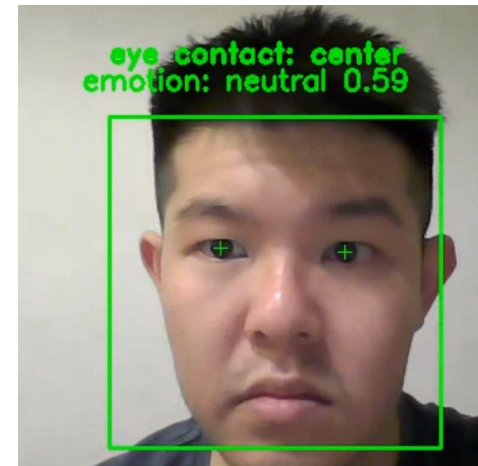
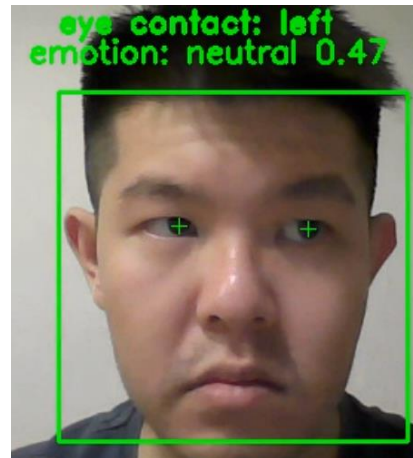


- Using algorithm-based method of pupil detection and gaze direction
- Python library GazeTracking, efficient and fast eye gaze tracking
- 4 steps, pupil detection, blurring, eroding, and binarize to estimate gaze direction
- Center gaze is having direct eye contact with camera

## Gaze Tracking Steps



## AVIA Real Time Webcam Prediction







- Use tokenizing and, lemmatization to normalize keywords. Use spaCy to determine if it is noun or verb.
- Sentiment analysis data using TextBlob models that has been trained over more diverse data instead of just twitter data
- Hard to get scenario-based interview questions data to train on

## Text Mining

'I will group them according to their level of priority and prioritize sh it first. For the complicated task, I will break down the task into I cannot finish it within a day, I will communicate with my supervisor leagues can give help.'

### Nouns

```
['level', 'priority', 'task', 'task', 'task', 'piece', 'step', 'day', 'supervisor', 'deadline', 'colleague', 'help'], dtype='<U10'>
```

### Verbs

```
['group', 'accord', 'prioritize', 'be', 'finish', 'break', 'finish', 'step', 'know', 'finish', 'communicate', 'see', 'extend', 'give'],
```

## Sentiment Analysis

'I will group them according to their level of priority and prioritize sh it first. For the complicated task, I will break down the task into I cannot finish it within a day, I will communicate with my supervisor leagues can give help.'

TextBlob Model

### Polarity

0.2

# DEMO



# INTERPRETATION & RECOMMENDATION

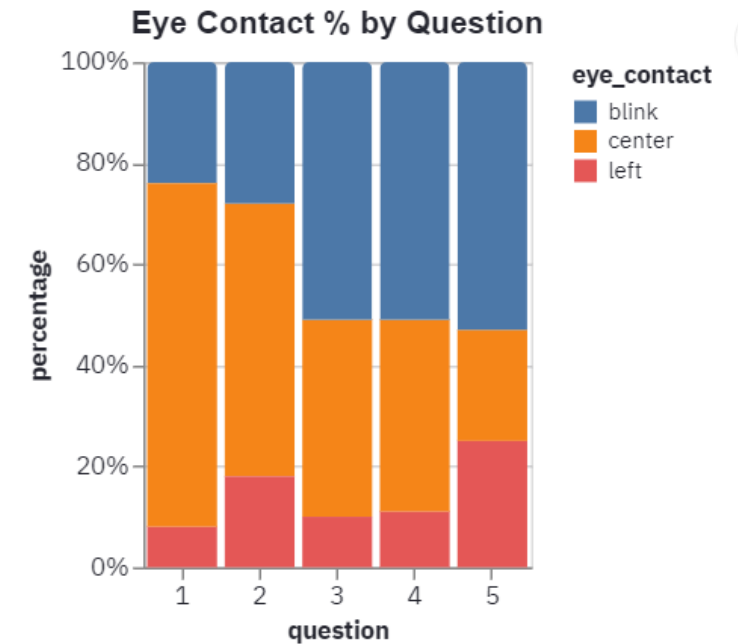
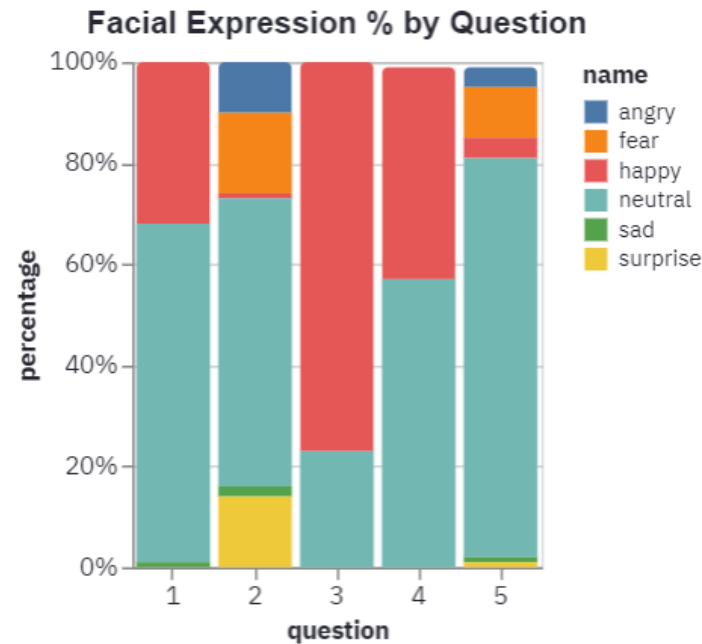




- After analyzing some data, realized that confidence is a combination of happy and neutral with eye contact
- Ordinal encoding to emotions and eye contact:
  - Happy = 10, ... Angry = 0
  - Center = 10, ..., left = 0
- Create a formula to compute confidence score

## Stage 1 - Video Interview

### Percentage Breakdown



$$\text{Video Interview Score} = \frac{\sum_1^n (p(\text{emotion}) \times \text{score})}{n} + \frac{\sum_1^n (p(\text{eye contact}) \times \text{score})}{n}$$

Where n = number of questions

p = percentage of that emotion

# Interpretation – Writing Assessment



- Extract key verbs and nouns from the answer.
- Construct score formula with a base score and add score with hit rate and sentiment
- Higher score means candidates hit closer to expected answer.
- Additional score for positive sentiment for the question

## Expected Keywords (Lemmatized)

admit VERB   rectify VERB   prevent NOUN   source NOUN   reflect VERB  
 acknowledge VERB   assist VERB   discussion NOUN   learn VERB

### Candidate's Answer

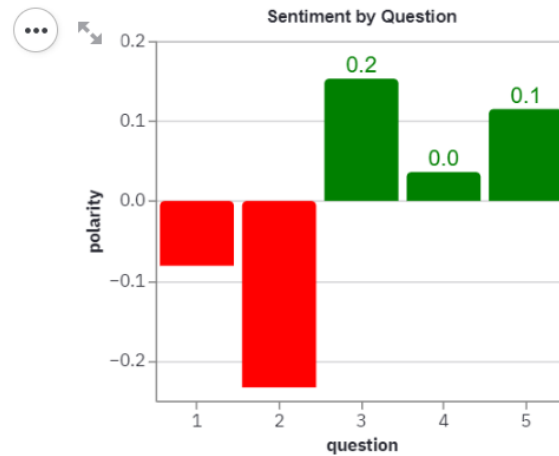
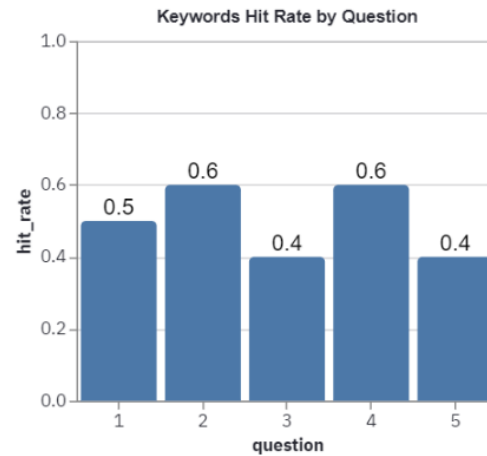
Once I know I made a mistake, I will admit MATCH my mistake to my supervisor and see if there are any bad influence on others. Then I rectify MATCH my mistakes as soon as possible. To prevent MATCH making the same type of mistake again, I will self reflect MATCH on what caused the mistake and find the source MATCH of the mistake and learn MATCH from it and grow.



Hit Rate: 60.0%

Polarity: -0.233

## Keywords Hit Rate and Sentiment Breakdown



$$Writing\ Score = 5 + 4 \frac{\sum_1^n (p(hit\_rate))}{n} + \frac{\sum_1^n (p(polarity))}{n}$$

5 serves as a base score

# Recommendation For Future Work

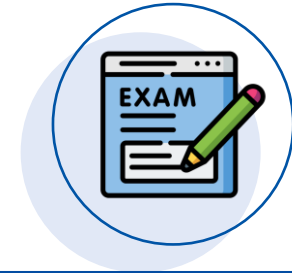


## Video Interview

**Speech analysis** – apply voice to text on speech during video interview and do further analysis

**Stutter & filler words detection**– Detect stuttering and filler words, e.g uh, like, um, yeah, etc

**Advanced Pose Detection**– shrugging, hand on chin, etc



## Writing Assessment

**Spelling & grammar mistakes** – Detect spelling and grammar mistakes of candidates. Suggest proper spelling and grammar to help improve candidate's writing abilities

**Better Sentiment Prediction** – Model trained on interview scripts can help improve the accuracy of the polarity

**Key ideas of future improvements**  
Making AVIA more realistic





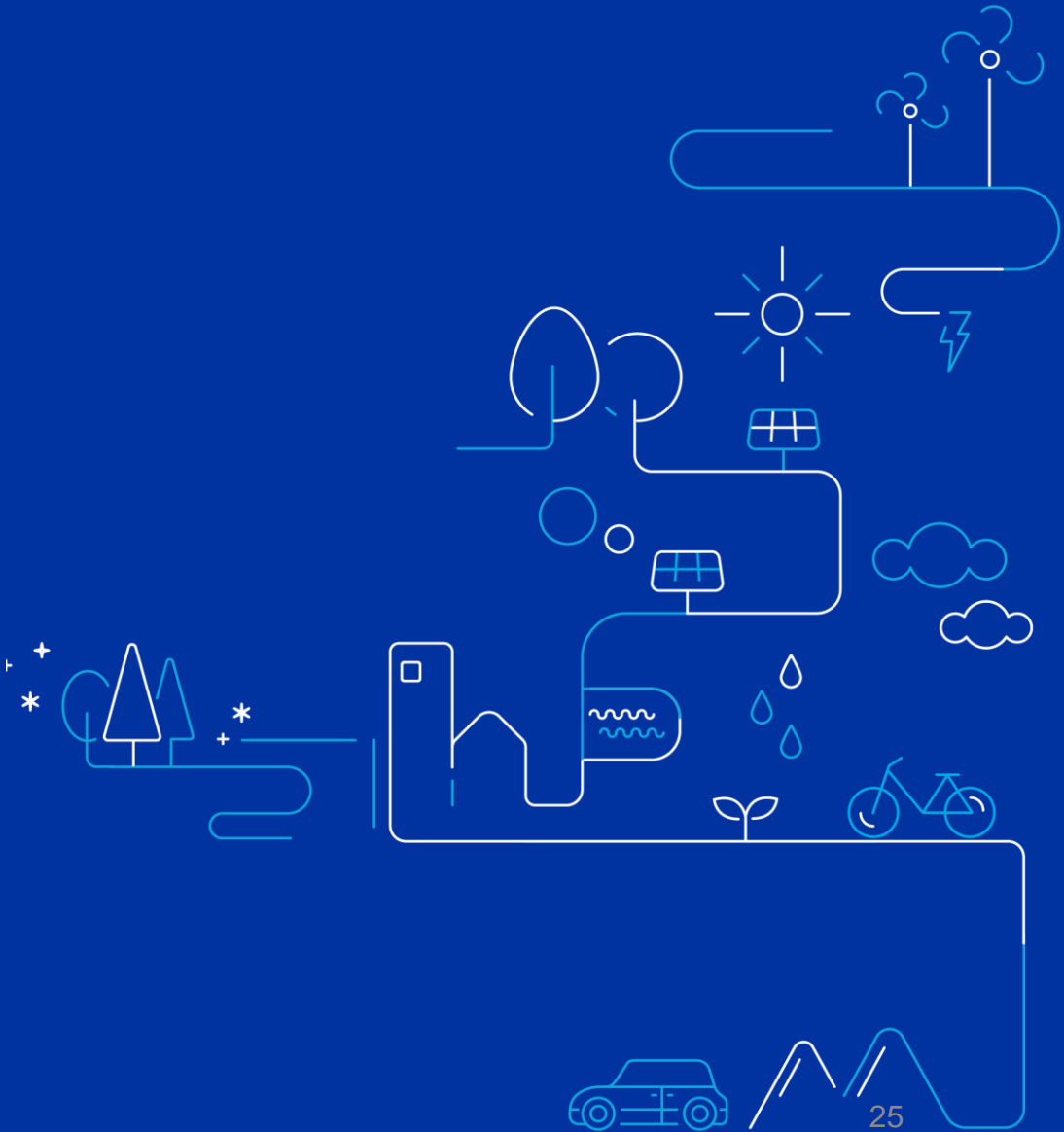
- Built AVIA, an AI web application that helps prepare candidates for online interview and assessments
- AVIA uses face detection, facial expression recognition, eye gaze tracking for video interview and text mining and sentiment analysis for writing assessment
- Demonstrated usage of AVIA web application real time with working functionalities and feature
- Proposed recommendations for future work: implementing speech analysis, stutter analysis, filler words analysis, and advanced posture detection such as shrug or hand on face/chin

An aerial night view of a city, likely San Francisco, with a prominent 'THANK YOU' text overlay in the top left. The city lights are visible against a dark sky with some clouds. The foreground shows a grassy hillside.

**THANK  
YOU**



# APPENDIX





## Welcome to AVIA - AI Video Interview Analyzer



Greetings! AVIA is a video interview tool that helps you prepare for an online interview. By doing this, you can enhance your online interview skills. AVIA consists of **two stages**, the video interview stage and the writing interview stage. The processes of these two stages are further explained below.

### Stage 1 - Video Interview

The video interview tests you on your facial expressions, eye contact, and posture while answering the questions. This is essential as you might not be conscious of your body language during an online interview. Try to be yourself during this process as it will make the performance review more genuine.

### Stage 2 - Writing Interview

The writing interview is designed to test your English language abilities and also your writing skills. You will be asked various questions in terms of scenarios and business decision.

### Performance Review

After completing the video and writing interview, you will be able to see your performance on both these stages. You may review the analytics of your performance for each question and the interview as a whole. There will be a final single computed score that will decide your overall performance.

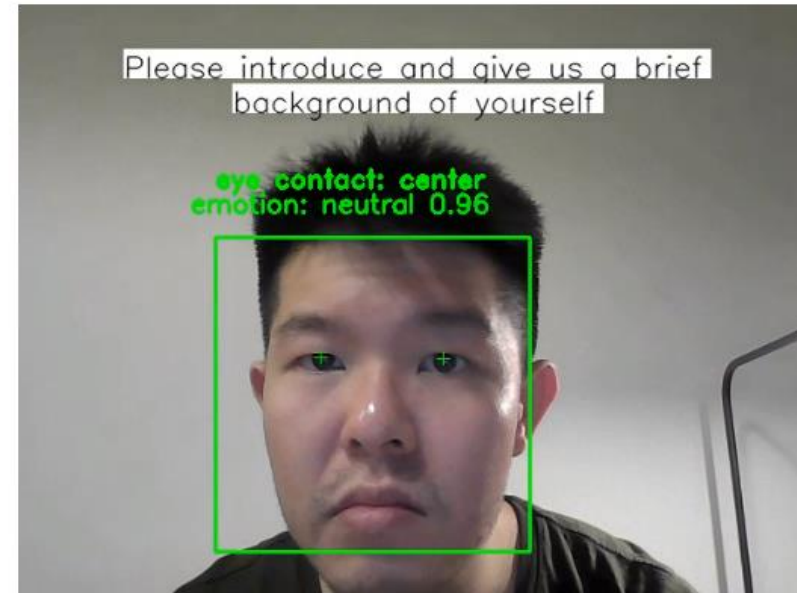
Scroll to Top and Click Next Page. Happy Practising! 😊



## Stage 1 - Video Interview

The video interview tests you on your facial expressions, eye contact, and posture while answering the questions. This is essential as you might not be conscious of your body language during an online interview. Try to be yourself during this process as it will make the performance review more genuine. Please kindly follow the instructions on the instructions panel on the sidebar.

### Webcam Video Interview



STOP

SELECT DEVICE

Question Number

1

1

5

### Facial Expression & Eye Contact Prediction Result

face_id	datetime	question	name	prob	eye_contact
0	2021-07-04 18:30:05	1	neutral	0.9600	center



## Stage 2 - Writing Assessment

The writing interview is designed to test your English language abilities and also your writing skills. You will be asked various questions in terms of scenarios and business decision. Please kindly follow the instructions on the instructions panel on the sidebar.

Question 1: You are asked to finish a large number of tasks within a day. How would you manage that?

I will group them according to their level of priority and prioritize them. If the task is urgent and critical, I will finish it first. For the complicated task, I will break down the task into several pieces and finish it step by step. If I know I cannot finish it within a day, I will communicate with my supervisor to see if the deadline can be extended or if some colleagues can give help.

Question 2: Everyone makes mistakes. How would you rectify the situation if you fail to meet the expectation?

Once I know I made a mistake, I will admit my mistake to my supervisor and see if there are any bad influence on others. Then I rectify my mistakes as soon as possible. To prevent making the same type of mistake again, I will self reflect on what caused the mistake and find the source of the mistake and learn from it and grow.

Question 3: When there is an expansion of your team and many new teammates join in. How would you adjust for this?

I will be friendly to them and give a helpful hand whenever they need it. Then, I will see if my supervisor has any training plan for the new teammates in which I can contribute my experience and knowledge. Clear division of labor and communication is needed since the team is getting larger.

Question 4: If you are 100% sure that your boss's idea is wrong, what would you do?

I will step up, voice out, and justify to my boss that this is not a good idea. In a calm manner I shall explain the wrong things in his idea at the same time with facts and justifications. I will suggest that he gather more ideas and opinions from other teammates. It is important to be direct but in a manner such that he does not get offended and understands my point.



## Performance Review

7.5 / 10

OVERALL SCORE

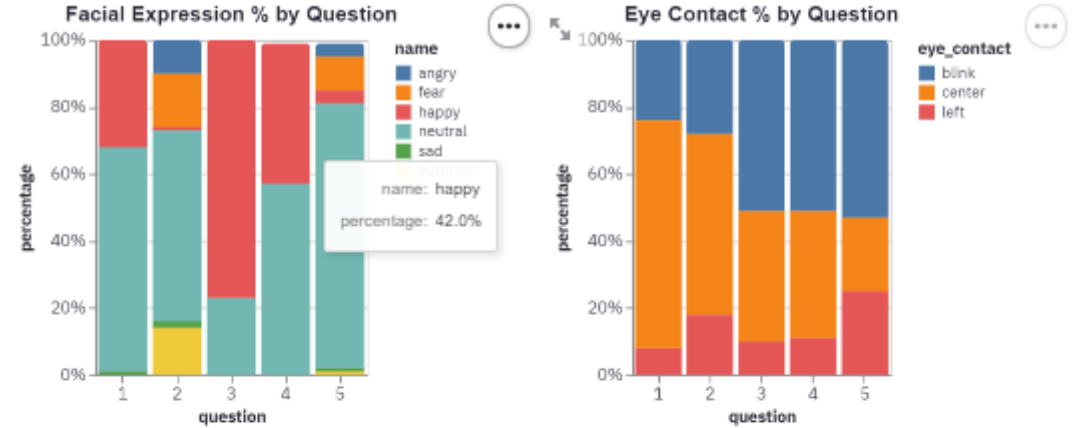
8.0

VIDEO INTERVIEW

7.0

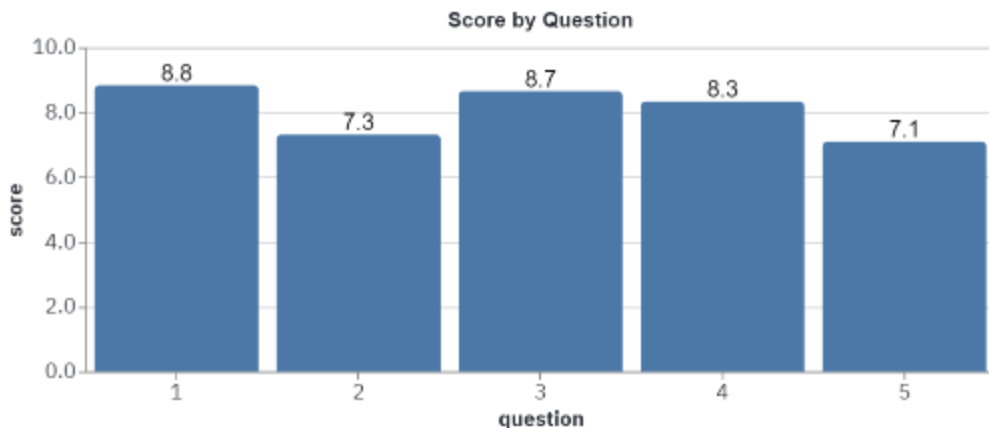
WRITING TEST

## Percentage Breakdown



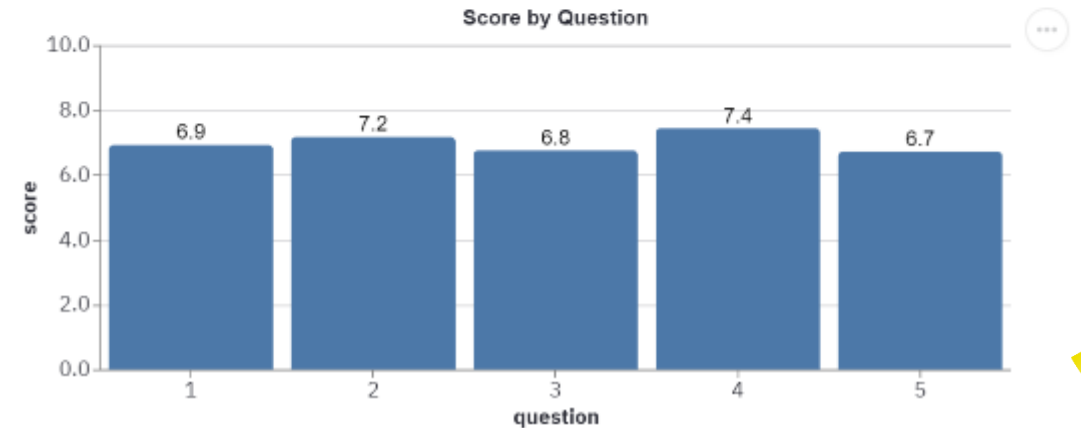
## Stage 1 - Video Interview

### Score Breakdown



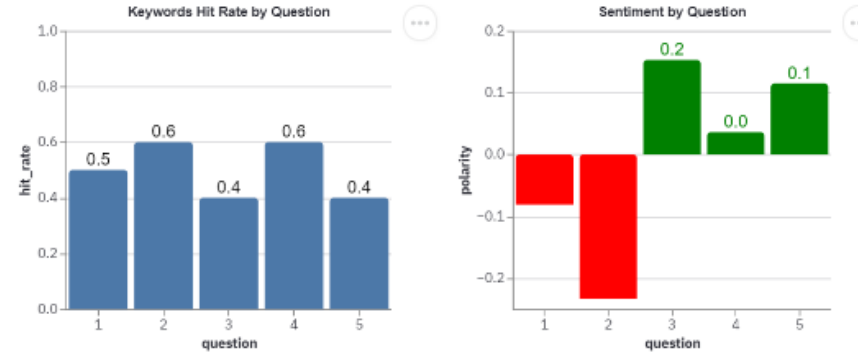
## Stage 2 - Writing Test Assessment

### Score Breakdown





## Keywords Hit Rate and Sentiment Breakdown



### Question 1

#### Expected Keywords (Lemmatized)



#### Candidate's Answer

I will group them according to their level of **priority MATCH** and **prioritize MATCH** them. If the task is urgent and critical, I will finish it first. For the complicated task, I will break down the task into several pieces and finish it step by step. If I know I cannot finish it within a day, I will communicate with my **supervisor MATCH** to see if the **deadline MATCH** can be **extended MATCH** or if some colleagues can give **help MATCH**.

Hit Rate: 50.0%

Sentiment Polarity: -0.081



## Video Interview Assessment

Webcam Video Interview

Please introduce and give us a brief background of yourself

eye contact: center  
emotion: neutral 0.97

STOP SELECT DEVICE

Question Number  
1

1 5

**Facial Expression & Eye Contact Prediction Result**

face_id	datetime	question	name	prob	eye_contact
0	2021-06-24 22:54:27	1	neutral	0.9700	center

- **Facial Detection** – Haar Cascade
- **Facial Expression Recognition** – CNN model
- **Eye Contact Detection** – Eye gaze estimation

## Writing Assessment

### Stage 2 - Writing Assessment

The writing interview is designed to test your English language abilities and also your writing skills. You will be asked various questions in terms of scenarios and business decision. Please kindly follow the instructions on the instructions panel on the sidebar.

Question 1: You are asked to finish a large number of tasks within a day. How would you manage that?

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Question 2: Everyone makes mistakes. How would you rectify the situation if you fail to meet the expectation?

Once I know I made a mistake, I will let my supervisor know as to see any bad influence on others. Then I will re-do or correct my mistakes as soon as possible. To prevent making the same type of mistake again, I will take down a note so that me and my colleagues will not make the same mistake too.

- **Text Mining** – tokenizer, stemmer, lemmatizer, stopwords removal
- **Sentiment Analysis** – BERT model for classification

## Performance Review

### Performance Review

7.5 / 10  
OVERALL SCORE

8.0 VIDEO INTERVIEW

7.0 WRITING TEST

### Stage 1 - Video Interview

**Percentage Breakdown**

**Facial Expression % by Question**

question	neutral	surprise	happy	fear	angry
1	70%	0%	10%	10%	10%
2	70%	15%	10%	5%	0%
3	20%	0%	70%	10%	0%
4	55%	0%	30%	10%	5%
5	80%	0%	0%	0%	20%

**Eye Contact % by Question**

question	center	left	blink
1	70%	10%	20%
2	70%	10%	20%
3	50%	10%	40%
4	55%	10%	35%
5	80%	10%	10%

- **Web Application** – Streamlit Python framework
- **Display** – altair charts