

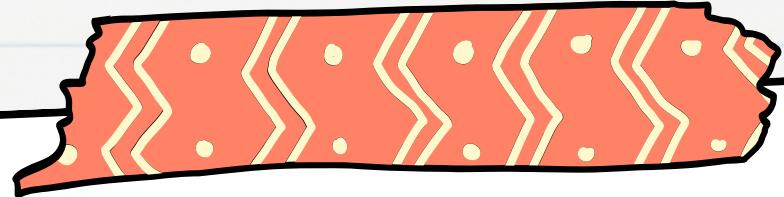
# Automatic MCQ Grader

By: GradeMates

# Overview

- Introduction
- Paper Overview
- Dataset Difference
- Our approach for new dataset
- extension propose
- Conclusions





# Introduction

To automate the grading of multiple-choice question (MCQ) exams.

- Manual grading is time-consuming and prone to human error, especially with large volumes of answer sheets.

## Goal

- Develop an MCQ grader system that automatically grades the answer sheets when the answer sheets folder path and the respective answer script path (A, B, or C)
- Efficiently count the correct answers by comparing the responses with the answer key.



# Paper Overview

**Image Preprocessing**

- Grayscale Conversion
- Filtering with Sobel Filter
- Binarization

**Line and Column Detection**

Using `FindRows()` `FindColumns()` and  
`FindTable()` functions with sobel filter

MATEMATICA				
Număr intrebare	Răspuns	A	B	C
1				
2	X			
3		X		
4	X			
5		X		
6		X		
7	X			
8		X		
9	X			
10	X			
11		X		
12	X			
13		X		
14	X			
15		X		

MATEMATICA				
Număr intrebare	Răspuns	A	B	C
1				
2	X			
3		X		
4	X			
5		X		
6		X		
7	X			
8		X		
9	X			
10	X			
11		X		
12	X			
13		X		
14	X			
15		X		

MATEMATICA				
Număr intrebare	Răspuns	A	B	C
1				
2	X			
3		X		
4	X			
5		X		
6		X		
7	X			
8		X		
9	X			
10	X			
11		X		
12	X			
13		X		
14	X			
15		X		

**Locating Answer Areas**

Număr intrebare	Răspuns
1	
2	X
3	
4	X
5	
6	X
7	
8	X
9	X
10	X
11	
12	X
13	
14	X
15	

Area of interest

**Handling Complex Scenarios**

- Scenario 2 (Rotated and Perspective Images)
- Scenario 3 (No Annotations)
- Scenario 4 (Handwritten Recognition)

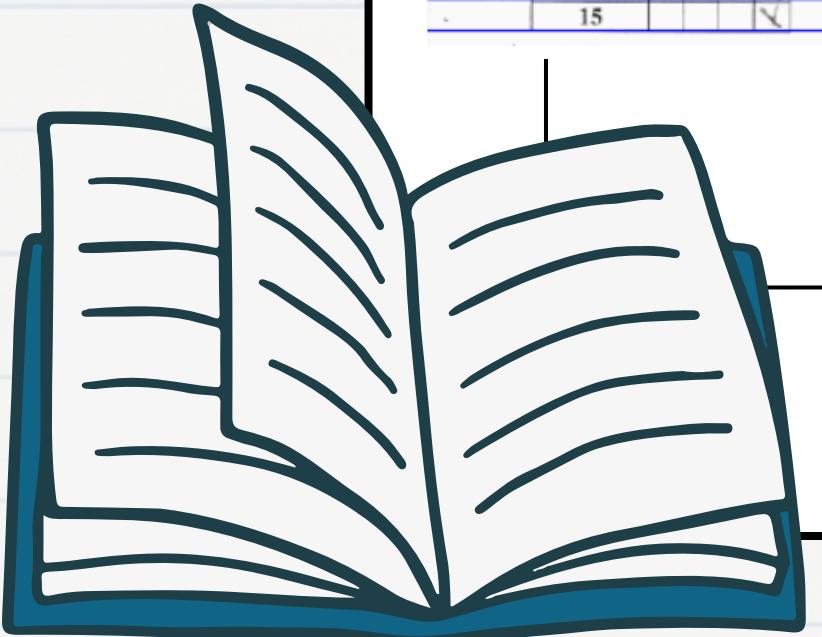
**Grading**

Predict Grade: Compare the identified answers with the correct ones, which are preloaded based on the test subject and question number. The grade is calculated by comparing the student's answers to the correct ones.

**Identifying Student's Answers**

Iterate over the rows and calculate the average pixel value in each patch (which corresponds to answers A, B, C, D). The patch with the darkest pixels is considered the selected answer.

# Dataset Difference



MATEMATICĂ			
Număr întrebare	Răspuns		
A	B	C	D
1		X	
2	X		
3		X	
4	X		
5		X	
6		X	
7	X		
8		X	
9		X	
10	X		
11		X	
12	X		
13		X	
14		X	
15		X	

MATEMATICĂ			
Număr întrebare	Răspuns		
A	B	C	D
1		X	
2	X		
3		X	
4	X		
5		X	
6		X	
7	X		
8		X	
9		X	
10	X		
11		X	
12	X		
13		X	
14		X	
15		X	

MATEMATICĂ			
Număr întrebare	Răspuns		
A	B	C	D
1		X	
2	X		
3		X	
4	X		
5		X	
6		X	
7	X		
8		X	
9		X	
10	X		
11		X	
12	X		
13		X	
14		X	
15		X	



01 1 2 3 4 5	11 2 3 4 5	21 1 2 3 4 5	31 2 3 4 5	41 1 2 3 4 5
02 1 2 3 4 5	12 1 2 3 4 5	22 1 2 3 4 5	32 1 2 3 4 5	42 1 2 3 4 5
03 1 2 3 4 5	13 1 2 3 4 5	23 1 2 3 4 5	33 1 2 3 4 5	43 1 2 3 4 5
04 1 2 3 4 5	14 1 2 3 4 5	24 1 2 3 4 5	34 1 2 3 4 5	44 1 2 3 4 5
05 1 2 3 4 5	15 1 2 3 4 5	25 1 2 3 4 5	35 1 2 3 4 5	45 1 2 3 4 5
06 1 2 3 4 5	16 1 2 3 4 5	26 1 2 3 4 5	36 1 2 3 4 5	46 1 2 3 4 5
07 1 2 3 4 5	17 1 2 3 4 5	27 1 2 3 4 5	37 1 2 3 4 5	47 1 2 3 4 5
08 1 2 3 4 5	18 1 2 3 4 5	28 1 2 3 4 5	38 1 2 3 4 5	48 1 2 3 4 5
09 1 2 3 4 5	19 1 2 3 4 5	29 1 2 3 4 5	39 1 2 3 4 5	49 1 2 3 4 5
10 1 2 3 4 5	20 1 2 3 4 5	30 1 2 3 4 5	40 1 2 3 4 5	50 1 2 3 4 5



# Overview

Inner functionality>

## Input stage

- Load Followings
  - marking-scheme-path
  - answer-sheet-folder
  - output-folder

## Detect stage

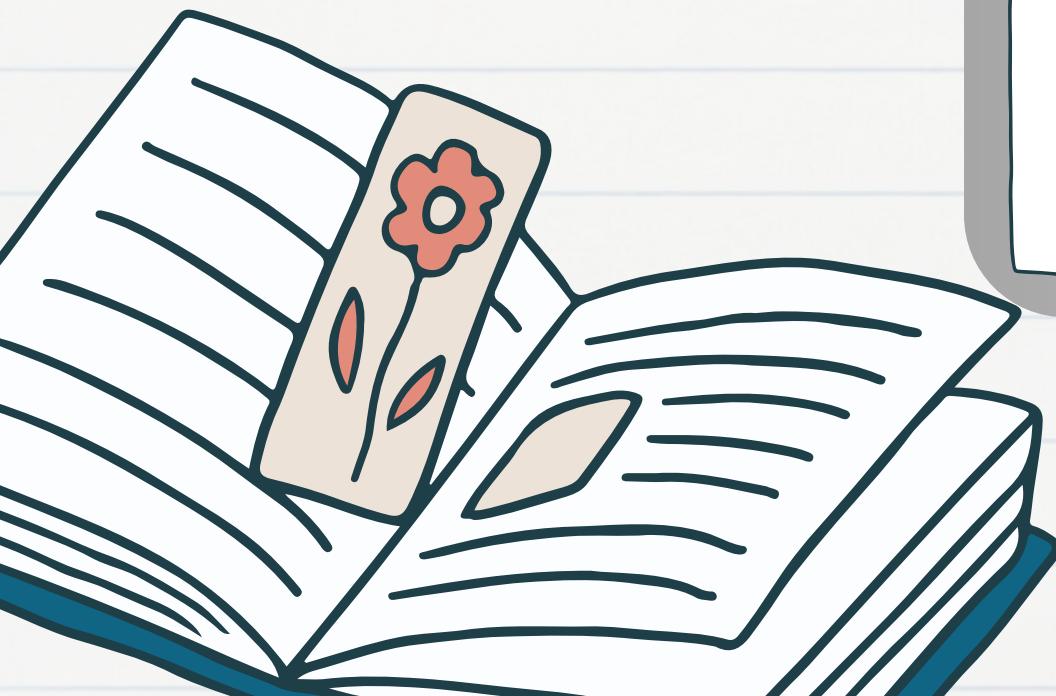
- find\_sheet\_corners
- warp\_perspective
- create\_grid
- extract\_question\_boxes
- detect\_colored\_bubble

## Grade stage

- process\_answer\_sheet
- load\_marking\_scheme
- grade
- save\_grading\_results

## Output stage

- Separate csv files for each answer sheet
- Graded results
- Overall Summary

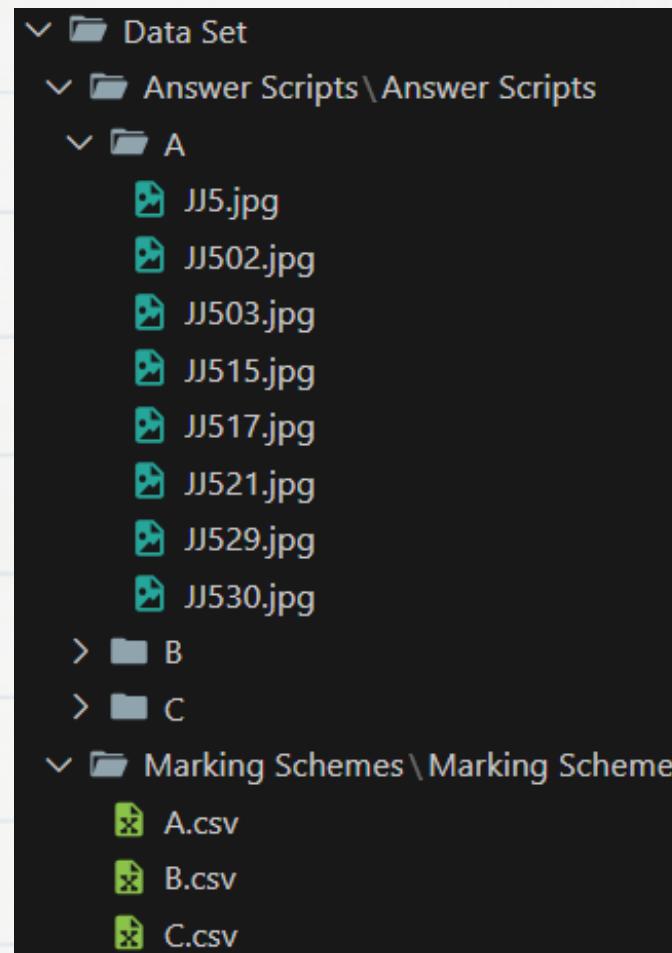


# Input Stage



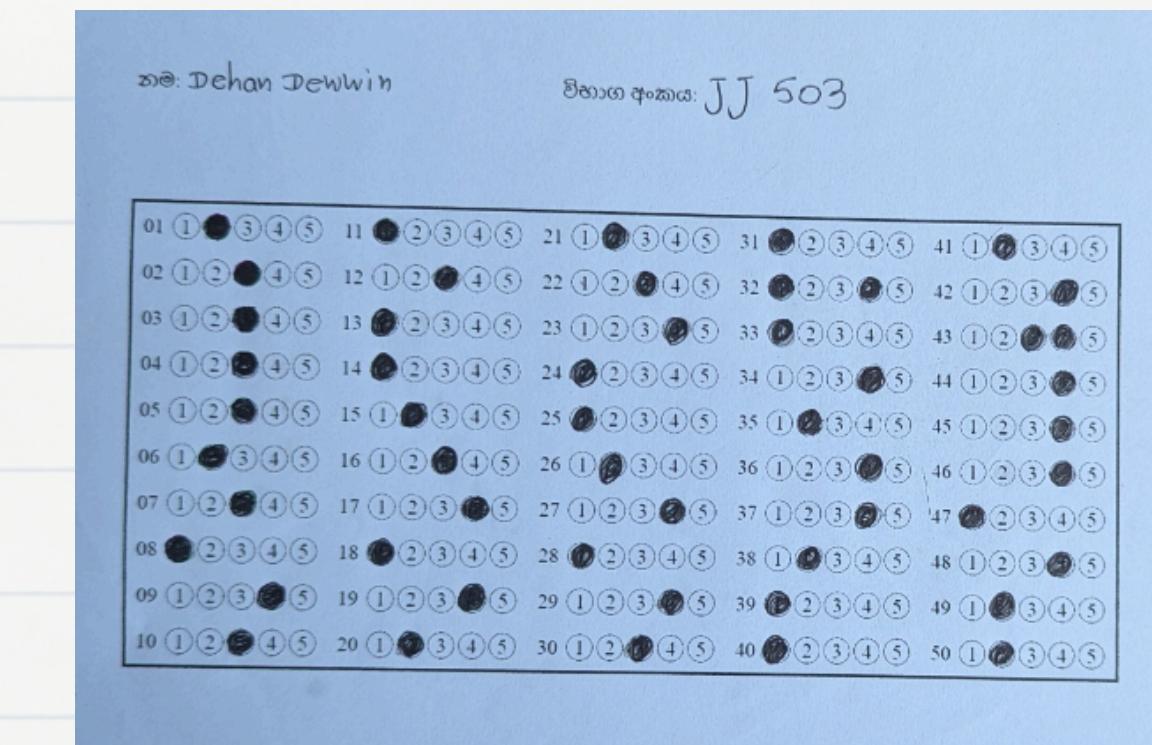
## Input Stage

- Marking Scheme Input: The answer key is loaded (from a CSV file).
- Image Directory Input: A directory of scanned or photographed answer scripts is provided.
- Output Directory Input: Path to where the CSV and overall summary will be saved.



```
PS D:\Academics\Modules\Mora\Fifth sem\Automatic-MCQ-Grader-main\Automatic-MCQ-Grader-main>
python grade_mcq.py --marking-scheme-path "Data Set\Marking Schemes\Marking Schemes\A.csv" -
--answer-sheet-folder "Data Set\Answer Scripts\Answer Scripts\A" --output-folder "Graded\A"
```

	A.csv
1	Question ID,Answer ID,Condition
2	1,2,-
3	2,3,-
4	3,3,-
5	4,3,-
6	5,3,-
7	6,3,-
8	7,4,-
9	8,3,-
10	9,4,-



# Detect Stage

## Image Preprocessing

- Load Image: Read each image from the provided directory.
- Grayscale Conversion: Convert the color images to grayscale.
- Find sheet corners using Canny Edge Detector
- Find the largest contour
- Warp image into a known aspect ratio using perspective transform matrix and warp perspective
- Orientation fixing - flipping and rotation

## Making Grid

- Creating question grid to identify question numbers separately
- 5 columns and 10 question numbers per column
- defining top-left and bottom-right corners for each cell
- Using rectangle function showing grid on warped image
- Extract each question box for finding student answers

## Detect Colored bubbles

- Take each question box
- Convert to grayscale
- Thresholding and detecting the colored bubble
- Divide each question box into 6 sub boxes
  - first one for question number
  - other 5 for answer boxes
- Calculate filled area percentages and take the maximum from them.
- Take each question number and detected student's answer for the respective question.

Corrected Warped Image				
01 1 2 3 4 5	11 1 2 3 4 5	21 1 2 3 4 5	31 1 2 3 4 5	41 1 2 3 4 5
02 1 2 3 4 5	12 1 2 3 4 5	22 1 2 3 4 5	32 1 2 3 4 5	42 1 2 3 4 5
03 1 2 3 4 5	13 1 2 3 4 5	23 1 2 3 4 5	33 1 2 3 4 5	43 1 2 3 4 5
04 1 2 3 4 5	14 1 2 3 4 5	24 1 2 3 4 5	34 1 2 3 4 5	44 1 2 3 4 5
05 1 2 3 4 5	15 1 2 3 4 5	25 1 2 3 4 5	35 1 2 3 4 5	45 1 2 3 4 5
06 1 2 3 4 5	16 1 2 3 4 5	26 1 2 3 4 5	36 1 2 3 4 5	46 1 2 3 4 5
07 1 2 3 4 5	17 1 2 3 4 5	27 1 2 3 4 5	37 1 2 3 4 5	47 1 2 3 4 5
08 1 2 3 4 5	18 1 2 3 4 5	28 1 2 3 4 5	38 1 2 3 4 5	48 1 2 3 4 5
09 1 2 3 4 5	19 1 2 3 4 5	29 1 2 3 4 5	39 1 2 3 4 5	49 1 2 3 4 5
10 1 2 3 4 5	20 1 2 3 4 5	30 1 2 3 4 5	40 1 2 3 4 5	50 1 2 3 4 5

Gridded Answer Sheet				
01 1 2 3 4 5	11 1 2 3 4 5	21 1 2 3 4 5	31 1 2 3 4 5	41 1 2 3 4 5
02 1 2 3 4 5	12 1 2 3 4 5	22 1 2 3 4 5	32 1 2 3 4 5	42 1 2 3 4 5
03 1 2 3 4 5	13 1 2 3 4 5	23 1 2 3 4 5	33 1 2 3 4 5	43 1 2 3 4 5
04 1 2 3 4 5	14 1 2 3 4 5	24 1 2 3 4 5	34 1 2 3 4 5	44 1 2 3 4 5
05 1 2 3 4 5	15 1 2 3 4 5	25 1 2 3 4 5	35 1 2 3 4 5	45 1 2 3 4 5
06 1 2 3 4 5	16 1 2 3 4 5	26 1 2 3 4 5	36 1 2 3 4 5	46 1 2 3 4 5
07 1 2 3 4 5	17 1 2 3 4 5	27 1 2 3 4 5	37 1 2 3 4 5	47 1 2 3 4 5
08 1 2 3 4 5	18 1 2 3 4 5	28 1 2 3 4 5	38 1 2 3 4 5	48 1 2 3 4 5
09 1 2 3 4 5	19 1 2 3 4 5	29 1 2 3 4 5	39 1 2 3 4 5	49 1 2 3 4 5
10 1 2 3 4 5	20 1 2 3 4 5	30 1 2 3 4 5	40 1 2 3 4 5	50 1 2 3 4 5

Question 1: Option 1  
Question 2: Option 3  
Question 3: Option 1  
Question 4: Option 3  
Question 5: Option 4  
Question 6: Option 3  
Question 7: Option 4  
Question 8: Option 4  
Question 9: Option 2  
Question 10: Option 3

# Grading and Output

## Previous data for grading

- Take detected student answer sheets and load marking schemes
- Take correct answers wrt question number from marking script
- store conditions given to answers

DEFAULT GRADE -----> FALSE

## Check for conditions

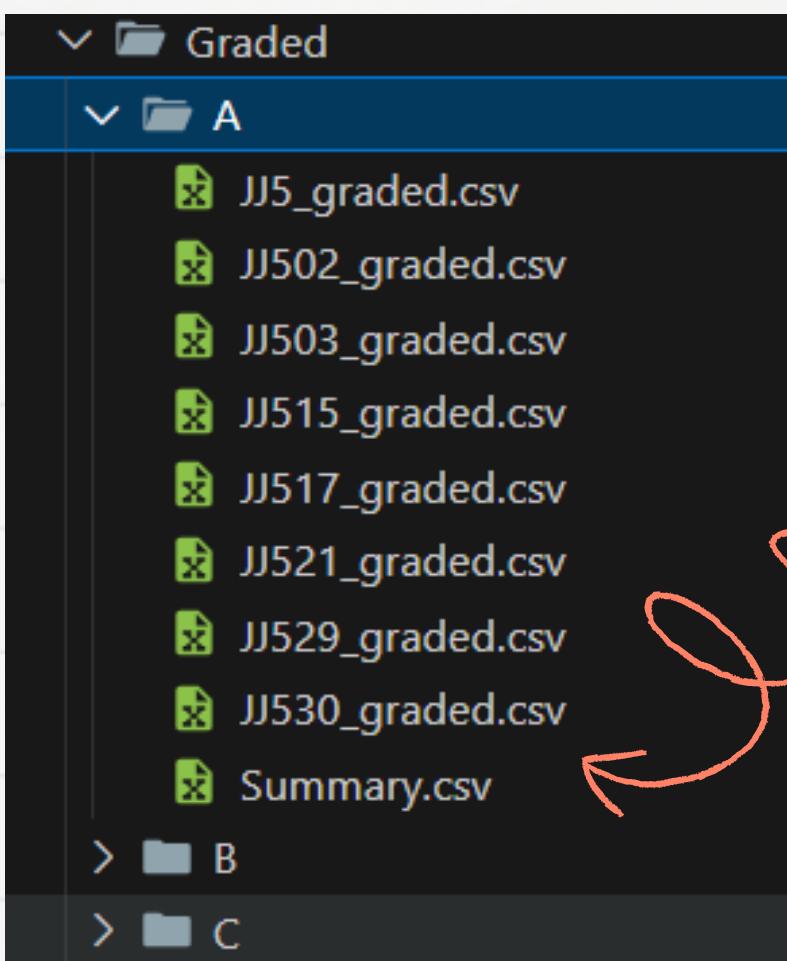
- if '-'
  - Only one answer
- if 'Any'
  - Any of the given answers is accepted
- if 'All'
  - All options must be selected.

- Compare with Marking Scheme: Compare the detected answers with the marking scheme (answer key) to determine if each response is correct or incorrect with checking for the conditions.

IF STUDENT'S ANSWER IS TRUE,  
GRADE -----> TRUE

- Assign Grades: Calculate the total score based on correct answers and grading rules.
- Take final Grade and store in a csv file
- Output the grade as well
- And append to a summary file which enhances user experience.

```
Total Marks: 31/50  
Processed JJ5.jpg and saved results to Graded\A\JJ5_graded.csv  
Total Marks: 16/50  
Processed JJ502.jpg and saved results to Graded\A\JJ502_graded.csv  
Total Marks: 27/50  
Processed JJ503.jpg and saved results to Graded\A\JJ503_graded.csv  
Total Marks: 25/50  
Processed JJ515.jpg and saved results to Graded\A\JJ515_graded.csv  
Total Marks: 12/50  
Processed JJ517.jpg and saved results to Graded\A\JJ517_graded.csv  
Total Marks: 14/50  
Processed JJ521.jpg and saved results to Graded\A\JJ521_graded.csv  
Total Marks: 22/50  
Processed JJ529.jpg and saved results to Graded\A\JJ529_graded.csv  
Total Marks: 24/50  
Processed JJ530.jpg and saved results to Graded\A\JJ530_graded.csv  
Overall summary saved to Graded\A\Summary.csv
```



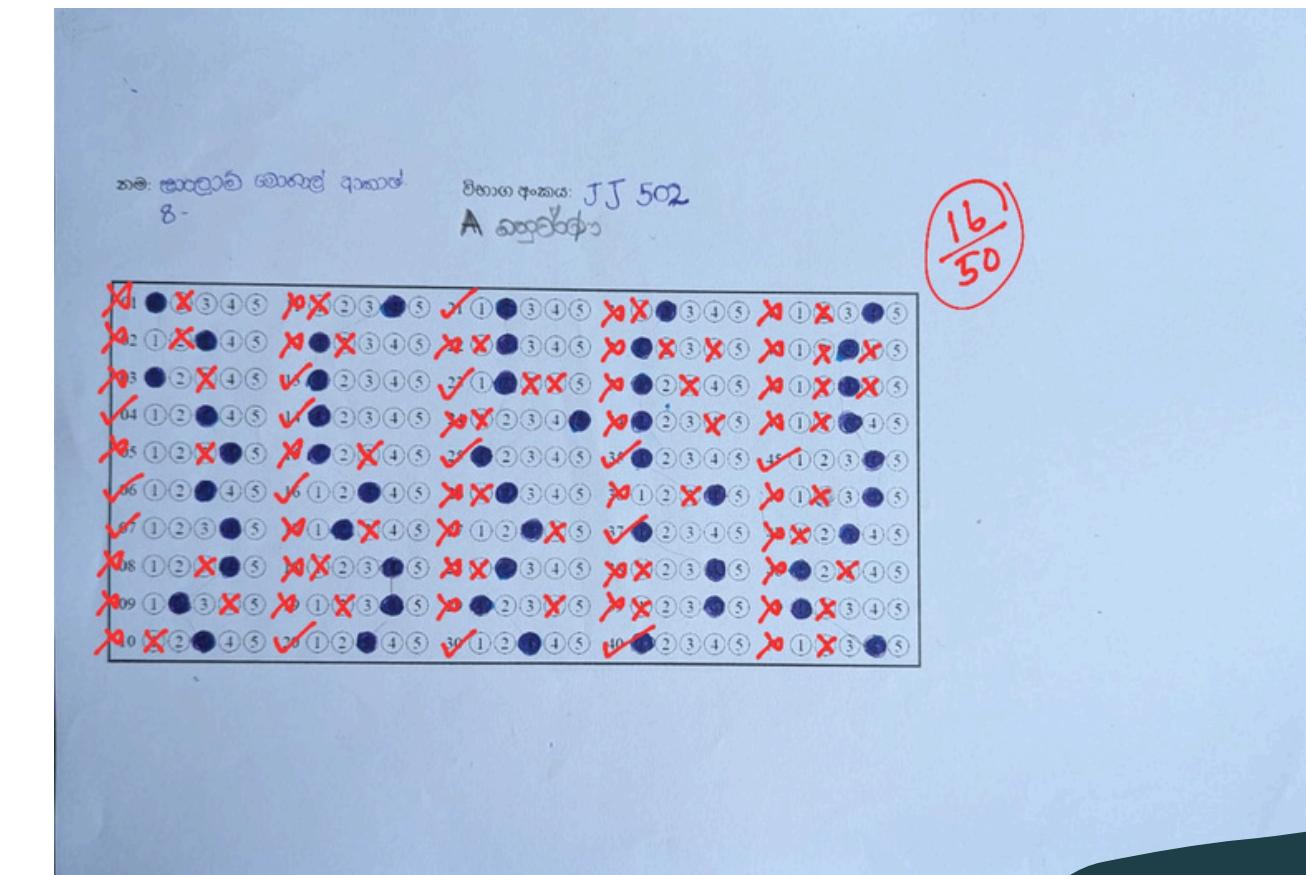
Save Files: Save the final CSV and marked csv files for each answer sheet in the output directory.

- CSV Report: Generate a CSV file with images names and their final grades

# Proposing an extension

- Grading PDF and annotated answer sheet for Feedback:

Generate a student-friendly PDF with "correct" and "incorrect" annotations using specific symbols (e.g., tick for correct and cross for incorrect).



# Thank You

## We are Team-GradeMates



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