# OMR Script Guide

## 1. Overview

This script is designed to automatically detect filled bubbles in OMR (Optical Mark Recognition) sheets. It specifically extracts Serial Numbers and Total Marks from defined regions in scanned images and saves the results to a CSV file.

## 2. Required Libraries and Their Usage

- OpenCV (cv2): Used for loading images, cropping regions, applying filters, and detecting contours.  
- NumPy: Performs mathematical operations and handles pixel arrays efficiently.  
- Pandas: Used to store results and export them to CSV format.  
- OS: Fetches image files from the directory.

## 3. Step-by-Step Workflow

1. Load images from the input directory.  
2. Crop two regions: one for Serial Number and one for Marks.  
3. Enhance the cropped image using contrast, brightness, gamma correction, and blurring.  
4. Convert the enhanced image to black-and-white using thresholding.  
5. Detect bubble shapes through contour analysis.  
6. Identify the bubble positions and convert them into digits (0-9).  
7. Save results into a CSV file.

## 4. Flowchart

START  
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Load Images from Folder  
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Crop Serial & Marks Regions  
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Enhance Image (Brightness + Contrast + Gamma + Blur)  
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Threshold & Detect Bubbles  
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Convert Bubble Position to Digit  
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Save Results to CSV  
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END

## 5. Best Working Conditions (Image Quality Requirements)

This script works best when:  
- Images are clear and not blurred.  
- The bubbles are filled with dark ink (black or blue) on a light background.  
- The scanned sheet is aligned and not rotated or skewed.  
- There are no heavy shadows or glare on the sheet.  
- Resolution is at least 200 DPI for accurate detection.  
  
It may fail or misdetect when:  
- The sheet is wrinkled, tilted, or poorly scanned.  
- The bubbles are only lightly marked or have stray marks.  
- Multiple bubbles overlap or accidental markings exist.

## 6. Suggestions for Improving Accuracy

- Ensure uniform scanning of all sheets.  
- Add a preprocessing step to straighten rotated images.  
- Implement debug visualization to view detected bubbles.  
- Adjust threshold and bubble size parameters based on paper format.