Approach for the
OMR Sheet Bubble Detection Project

1. Introduction: The Limitation of Traditional CNN Approaches

Convolutional Neural Networks (CNNs) like fine-tuned ResNet-50 are often the go-to choice for tasks involving image-based object detection. However, for Optical Mark Recognition (OMR), relying solely on CNNs poses some challenges:

1. **Data Intensity**: Training CNNs requires large amounts of annotated data to achieve high accuracy.
2. **Computational Overhead**: These models are computationally expensive, making real-time processing on mobile devices, even with TensorFlow Lite, a significant hurdle.
3. **Fixed Bubble Positions**: OMR sheets have predefined and static layouts, reducing the need for complex spatial feature extraction—a strength of CNNs that becomes redundant in this context.

Given these limitations, combining traditional computer vision techniques with lightweight neural networks offers a more efficient and practical solution.

2. Proposed Methodology

The main objective of this would be to efficiently identify **Regions of Interest (ROIs)** corresponding to bubbles on OMR sheets. This can be done using **OpenCV's morphological** operations. This isolates the circular bubbles from the noise. Since the dataset provided has a consistent pattern, we can align the scanned sheets to a reference template for consistent bubble extraction. By training neural network models like **MobileNetV3** only for the ROIs, we can reduce the computational overhead.

3. Tools, Technologies, and AI Models

- **Programming**: Python for quick prototyping and deployment.
- **Image Processing**: OpenCV for preprocessing and feature extraction.
- **Machine Learning Frameworks**: TensorFlow Lite for lightweight neural network inference.
- **Visualization**: Streamlit and Matplotlib for result interpretation along with other metrics like accuracy and error rate.