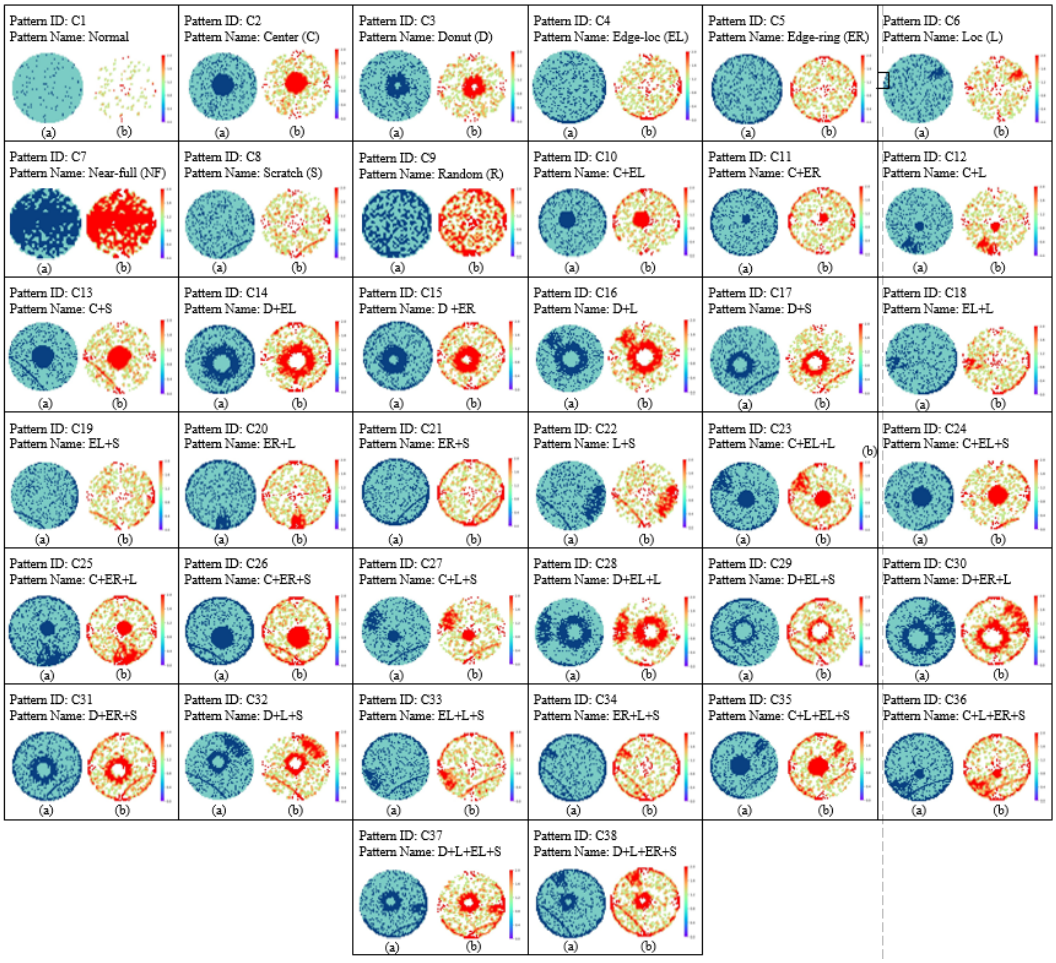
AI 2024, Assignment 3A:

Generative Adversarial Networks (GAN)

In this assignment, you will explore how Generative Adversarial Networks (GAN) can be used to process the MixedWM38 dataset, which contains wafer map defect patterns critical for semiconductor defect analysis.

MixedWM38

https://github.com/Junliangwangdhu/WaferMap



Dataset Overview:

The MixedWM38 dataset consists of over 38,000 wafer maps categorized into 1 normal pattern, 8 single-defect patterns, and 29 mixed-defect patterns. It is designed for defect pattern recognition in semiconductor manufacturing, and addresses the imbalances in defect pattern occurrences by generating additional samples using GANs. The goal is to aid the research on detecting mixed-type wafer defects and assist in identifying the root causes of these defects.

Task Requirements:

1. Model Design: Implement a GAN architecture using TensorFlow or PyTorch to generate synthetic wafer maps based on the MixedWM38 dataset.
2. Data Augmentation: Use the GAN to generate new wafer maps to balance the distribution of defect patterns within the dataset.
3. Training: Train the GAN model on the MixedWM38 dataset, adjusting hyperparameters such as learning rate, batch size, and number of epochs.
4. Evaluation: Evaluate the quality of the generated wafer maps using Mean Squared Error (MSE) as the primary metric. Compare the performance of the GAN in generating realistic mixed-type defect patterns.
5. Visualization: Visualize generated wafer maps, comparing them to real samples, and plot training curves showing loss over time.

Deliverables:

1. Code Implementation: Submit your GAN implementation with appropriate comments.
2. Report: Include a detailed report discussing the GAN's performance, evaluation using MSE, and challenges in generating wafer maps.
3. Visualizations: Provide relevant charts such as loss curves and generated wafer maps.