Purpose of Project:

This project aims to develop machine learning models for a manufacturing company to predict the lifespan of metal parts and identify defects. By leveraging supervised learning techniques and image classification algorithms, the project seeks to enhance quality control processes, reduce waste, and improve production efficiency.

Conclusions:

Regression Model: The Random Forest Regressor emerges as the recommended choice for predicting metal part lifespans, boasting a high R-squared value of 0.9798 and lower error rates (MAE and RMSE). Cross-validation confirms its robust performance and generalization, making it a valuable tool for quality control and process optimization.

Binary Classification Model: The Random Forest Classifier exhibits promising results in defect classification, achieving an accuracy rate of 87% on the test set and a balanced accuracy of 0.6208. While the model surpasses the trivial baseline accuracy, further refinements are suggested to improve detection of less common defects, potentially through oversampling or class-weighted training.

Convolutional Neural Network (CNN): The CNN demonstrates strong capabilities in defect classification, outperforming the trivial baseline with an accuracy of 87%. While the model shows promise for practical deployment, enhancements are recommended to bolster detection of less prevalent defects, ensuring consistent performance across all defect types in real-world scenarios.

Overall, the machine learning solutions presented in this project offer valuable insights and tools for the manufacturing industry, enabling more accurate lifespan predictions and efficient defect identification, ultimately contributing to improved product quality and cost reduction. Further refinements and enhancements, particularly in defect detection, can be explored to continually advance manufacturing processes and quality assurance standards.