Overview
Penn State Applied Research Laboratory (ARL) finds, in their design process, the ideas of design engineers are not always connected with manufacturing engineers. This capstone project is aimed to create an AI/ML algorithm to facilitate the process of development of manufacturing plans with different manufacturing processes, and provide some insights into bridging the gap between design and manufacturing.

Objectives
Our objective was to develop an AI/ML algorithm that predicts the manufacturing process for a given CAD model and estimate the cost and lead time to manufacture that part. This was done by creating manufacturing plans that describe casting, machining, welding, and 3D printing processes, making parameterized CAD models, and building a data set to train an AI/ML algorithm.

Approach
- Review previous teams work to understand project idea
- Participate in weekly sponsor or advisor meetings to receive feedback/give updates on project
- Create new manufacturing plan template for each process (4 total)
- Use SolidWorks API Macro feature to produce STEP files for each process plan
- Exploratory data analysis on previous teams dataset and code
- Research new ideas for algorithms and create 3 (random forest, gradient boosting, and xgboost)
- Use feature importance and other analysis test (ex. accuracy) to find best model
- Select xgboost model based on results and prediction object type
- Use sponsor’s previous code to help create a dataset for each process by reading through the STEP files using python
- Use data manipulation and cleaning to create one large dataset with process type
- Run xgboost model with new datasets test and train values
- Implement respective time and cost formulas based off model predicted results
- Manufacturing plans variable cells read in respective information in needed cell location
- Organize step file name input into each respective manufacturing plan based on predicted process

Outcomes
- The AI/ML algorithm will reduce time between part model generation and the start of the manufacturing process
- Cost and lead times can be quickly estimated after a part model is generated