MLE Capstone Proposal

Please fill out the following Capstone Proposal template to clarify your thinking!

Deliverables

At the conclusion of your cohort, you will be expected to deliver:

- Deployed Demo
- 10-minute Presentation
- GitHub Repo (description in README + code)

For more detailed information on student capstone projects, you can check out a detailed guide here.

Your Information

Name	Dinush De Alwis
Working Project Title	Booz-Hamilton: Predictive Maintenance
Datasets	• Turbofan Engine Degradation (2 data sets)

AI Product/Capstone Project Description

Problem

[Write a succinct statement of the problem that you're trying to solve (<50 words)]

The U.S. DoD's Joint Artificial Intelligence Center has designated Predictive Maintenance as one of its two founding National Mission Initiatives (NMIs). The

challenge we are trying to solve is accurately predicting the remaining useful life (RUL) of turbofan engines measured in operations cycles. RUL is equivalent of number of flights remaining for the engine.

Why

Write about why this is a problem worth solving. What is the business value hypothesis that connects to what success looks like and for whom? (~50-250 words)

Turbofans are widely used in aircraft propulsion, such aircrafts include military fighter jets. Accurate predictive maintenance of turbofan useful remaining life has huge potential to drastically reduce costs, increase mission readiness and even save lives of service members.

- Cost reductions can come in the form of to better inventory and cash-flow management
- Troop morale could be better knowing they are using aircrafts with reduced probability of failure
- With lower probability of potentially failing turbo engines in the field, critical missions could be executed with increased chances of success

Success

Write about what success looks like. What is the Key Performance Indicator (or couple of KPIs)? How might they connect to a relevant ML model accuracy metric? (<50 words)

Some KPIs I would consider as success indicators are:

- Reduced in-field turbofan engine failure occurrences
- Improved inventory management (e.g. cash flow)
- Improved military budgeting capability (e.g. spend needs)
- Enhanced manufacturer production lead times

We will explore a few model accuracy metrics such as mean square error (MSE), root mean square error (RMSE), mean absolute error (MAE) and mean absolute percent error (MAPE). These metrics not useful in isolation so we will leverage baseline models from which to compare our production model. The above KPIs should improve if our model can outperform exiting models used by the DoD on these accuracy metrics.

Audience

Specify exactly which users/customers this AI/ML product is being built for. What is the customer's pain or need that connects back to the problem? (<50 words)

Potential end-users of our product are:

- Military personnel such as engineers
- Military budgeting offices (inventory management, spending)
- Senior DoD officials for spend requests
- Turbofan engine manufacturers contracted by the DoD, for proper stock management, product quality inspection, etc.

What

Now describe what the ML looks like. This includes a discussion of data and sources, potential/likely models, a choice of an accuracy metric to optimize for and a defense of your choice. How does your accuracy metric connect back to the KPI(s) named above?

In terms of data sources, we will be using the NASA turbofan engine degradation datasets (2). These can be sourced directly from NASA's Intelligence Systems Division https://www.nasa.gov/intelligent-systems-division#turbofan.

Our approach will be a supervised regression problem with time dependency to predict the number of useful operational cycles remaining on a turbofan engine. Before exploring machine learning frameworks we will establish a few simpler baseline models (e.g. classical auto-regressive time series, multiple regression, etc.).

Our machine learning approach will explore the more powerful ML models including but not limited to support vector regression (SVR), XGBoost regression, Random Forest Regressor as well as a neural network time-series approaches such as convolution neural networks (CNN) and long short-term neural networks (LSTM).

For accuracy metrics we will use a few metrics to report including mean square error (MSE), root mean square error (RMSE), mean absolute error (MAE) and mean absolute percent error (MAPE). Our approach will be to calculate these metrics on our baseline models before doing so on our machine learning models. If these metrics are better on our production model than on the existing DoD models, we should see the KPIs we stated above improve over time.

You may also find it helpful to fill out an MLOps Stack Canvas or MLOps Stack Template to help clarify the technical requirements that you envision.

Anything Else?

Please provide any additional information on key activities, technologies, datasets,, or anything else not listed above!

- For all our data pipelines we will use AirFlow
- We will deploy our model to production in a cloud environment and monitor its performance (based on the metrics we stated above) using a front-end PowerBI dashboard.
- For performance monitoring and model tuning we will consider something like MLFlow.

About FourthBrain

FourthBrain trains aspiring Machine Learning engineers in the technical and practical skills necessary to contribute immediately to an AI team. Our remote, online program is designed to be flexible and accessible for anyone with software experience. We infuse values of collaboration, communication, empathy, and equity throughout the program.

We are part of the AI Fund, founded by Andrew Ng.