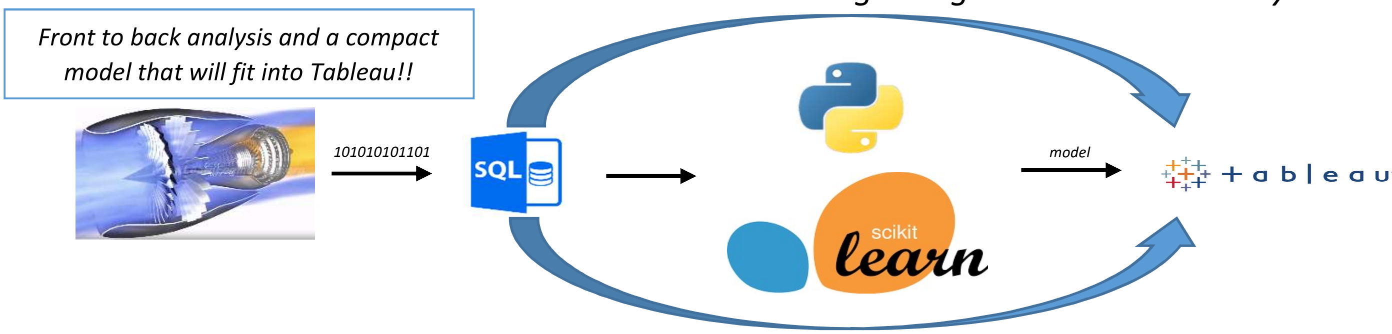
Your data is trying to tell you something…

…Flight Engineer will show it to you.



Over 10 years ago NASA realized that information regarding the performance and life cycle characteristics of aircraft engines was not publicly available[1]. This would, naturally, lead to a lack of exploration and analysis of a critical aircraft component. Aircraft manufacturers have methods of monitoring their equipment, but quite often these methods were not shared widely.

<u>Business Understanding:</u> “Save everything, we’ll figure out what to do with it later.” - your CTO

The amount of data about systems and their performance is increasing. Computer storage and processing can keep up, humans cannot; however, data can be filtered, analyzed, performance modeled and faults detected in a format that aids human understanding. Faster and accurate analysis leads to better scheduling of maintenance and operations while reducing the uncertainty of financial estimates.

<u>Data Understanding:</u> Sensor data from an aircraft engine.

The dataset is a multivariate “modified” time series with one fault condition: High-Pressure Compressor degradation. The dataset was divided into training and test data. Each time series is from a different engine i.e., the data can be considered to be from a fleet of engines of the same type.

<u>Analysis / Modeling:</u> Multivariate linear splines: include more features in a simpler model.

The data was preformatted and included engine number and 26 sensor measurements. After the initial data analysis, 13 features were found to be significant based on predictable patterns of behavior as they age. Several methods of analysis were conducted including basic linear regression, polynomial regression, and linear spline modeling to estimate the number of cycles remaining.

Testing included tree and gradient boosting as potential candidates for classifying engines as having longer or shorter than normal life expectancy during early portions of its life.

<u>Results:</u> A sleek model that will estimate cycles until failure.

The model estimates cycles until failure, contains 13 features, 78 knots, and can be integrated into a formula that is interpretable by Tableau.

<u>Production:</u> A model that is deployed now.

The linear spline coefficients, knot locations, and y-intercept terms were exported and converted into a small (< 6 kB) formula and entered into a Tableau Calculated Field. The formula computes the estimated number of cycles remaining directly from the thirteen relevant input parameters.

1. Reference: A. Saxena, K. Goebel, D. Simon, and N. Eklund, "Damage Propagation Modeling for Aircraft Engine Run-to-Failure Simulation", in the Proceedings of the Ist International Conference on Prognostics and Health Management (PHM08), Denver CO, Oct 2008.