Shell.ai Hackathon 2025
Problem statement summary
Fuel Blend Properties Prediction Challenge

Introduction

Welcome to the sixth edition of the Shell.ai Hackathon for Sustainable and Affordable Energy. Shell.ai Hackathon brings together brilliant minds passionate about digital solutions and AI, to tackle real energy challenges and help build a lower-carbon world where everyone can access and afford energy. In the previous five editions, we addressed some of the digital challenges around the energy transition: windfarm layout optimisation (2020), irradiance forecasting for solar power generation (2021), optimal placement of electric vehicle (EV) charging stations (2022), supply chain optimisation for biorefineries (2023), and fleet decarbonisation (2024). This year, we focus on blend properties estimation for sustainable fuel.

Challenge

The global call for sustainability is reshaping every industry, including mobility, shipping and aviation. For example, use of fuels like Sustainable Aviation Fuels (SAFs), renewable diesel, and advanced bioethanol, among others has the potential to reduce the sector's environmental footprint. However, integrating these innovative fuels into the existing

ecosystem presents a challenge. Crafting the optimal fuel blend – mixing various sustainable fuel types sourced from diverse pathways with each other or with conventional fuels – is an intricate science. It demands a delicate balancing act: ensuring adherence to rigorous safety and performance specifications while maximizing environmental benefits and maintaining economic viability.

In this hackathon, you will immerse yourselves in the critical field of fuel blending. Your challenge is to develop models capable of predicting the final properties of complex fuel blends based on their constituent components and proportions. By exploring datasets rich with complex interactions, you will decipher the hidden relationships that dictate fuel performance, safety, regulatory and environmental characteristics. The endgame is to engineer powerful predictive tools that can guide the industry in formulating the next generation of sustainable fuels, potentially accelerating the transition to a net-zero future, without compromising on model excellence.

Data

To tackle this challenge, you will be equipped with a dataset reflecting the complexities of fuel blending. At a high level, this dataset will feature:

1. **Fuel Component Library:** An overview of the potential base components, including various sustainable and conventional fuel types.
2. **Blend Composition Data:** A significant number of diverse fuel blend examples, detailing the precise fractional makeup of each blend.
3. **Resultant Blend Properties:** The corresponding key characteristics/properties measured or calculated for each of these blends.

We will challenge you to develop models that can accurately predict these resultant properties when given new, unseen blend compositions.
Further, more granular details regarding the specific components, the full list of properties, the size of the dataset, and the exact format required for your submissions will be shared in the detailed problem statement, to be released closer to the hackathon date.
This is a challenge that will call for your expertise in mathematical modelling and machine learning. We do not expect you to have any prior knowledge in fuel blending. To create a level playing field, we will not provide the exact property names and scale the values to make it impossible to guess.

Please note that for the purposes of this challenge, the term "sustainable fuels" encompasses fuels derived from renewable or low-carbon sources; such as bio-based feedstocks, synthetic fuels generated using renewable electricity (e-fuels), and fuels produced from waste materials. These alternatives are intended to significantly reduce lifecycle greenhouse gas emissions when compared to conventional fossil fuels.

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