LEVERAGING MACHINE LEARNING MODELS FOR OPTIMIZATION

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BACKGROUND

The oil industry has a great degree of familiarity with optimization, developed over decades of experience. Most of the optimization systems at work today in the oilfield consist of rules-based systems. An example of a rules-based system for consideration is a pump off controller that runs or stops based on pump fillage. Where these systems have left optimization windows open, those windows can now be closed by leveraging machine learning. For simple problems, traditional algorithmic approaches may still be the best choice. Machine Learning should be viewed as a new tool in the production optimization toolkit and applied where patterns are complex and traditional algorithmic approaches have been left wanting. The problems that are now soluble using Machine Learning may involve complex patterns, require prediction, involve vast amounts of data and require some degree of personalization.

ML PRE-REQUISITES

We cannot build ML models without good data. Generating good data requires that a company develop and adhere to sound data engineering practices. Relevant data must be stored in a form where it can be retrieved easily for analysis. Cybersecurity practices must be developed and followed. If executing personalized ML models at the edge is the goal, then edge computing must be deployed as and can be viewed as an enabling technology. The job of the production and operations team will be generating a well-considered problem framework, and meticulous categorization.

Enabling Technology

While there are ways to build embedded systems that execute machine learning models in isolation, the most practical approach is to construct your well pads so that there is a system in place that provides a place to deploy the developed model, and a system cloud based or otherwise to provide the team involved in creating the model with continuous feedback on the model's performance.

The Role of Cloud Computing

To store and process data for Machine Learning, cloud computing infrastructure is indispensable. More than simply a replacement for on-premises databases, cloud infrastructure should be leveraged if an oil company wishes to participate in the massive computing revolution that is taking shape across all industries. The ability to share relevant data easily across a wide geographic area, leverage computing resources to process the data, and build cloud-based classification tools quickly are some of the benefits. In the absence of a robust cloud computing infrastructure, it is unlikely that ML projects will gain traction as their implementation will be too clumsy.

The Role of Edge Computing

Once a ML model has been built, should the desire to be to have it live in the field and involve itself in the operation of an oil well, an Edge Computer with support for ML frameworks, containerization, a processor that can handle the computational load of both ML inference and rules-based algorithms, networking, version control, APIs for existing rules-based systems, cyber security to encrypt data at rest and in transit, and connectivity to the cloud to track the performance and health of the devices is necessary.

Problem Formulation – Detecting Tagging

As a simple example, an oil company wanted to detect tagging in their sucker rod pumped wells. A set of 10000 pump cards was gathered for this purpose. Traditional numerical methods were prone to error and false alarms. However, it was agreed that a skilled analyst could, by looking at a downhole card, detect tagging reliably.

Classification

The Analyst team classified a set of 2000 cards as either having a tag or not having a tag. Various ML frameworks were used in combination with the training data and raw data. The resulting algorithm detected pump tagging with 92% accuracy. The total effort involved was less than one week for one person.

Conclusion

Machine Learning should be a tool considered frequently when a production and operations team looks at providing solutions to new problems or better solutions to existing problems. The ability to incorporate the

qualitative analysis and tribal knowledge of a production team into the pattern recognition capabilities of Machine Learning should offer a step change in efficiency to teams who elect to exploit this new technology frontier. Good Data Engineering practices, enhancement of data acquisition systems, and the transition to edge and cloud-based infrastructure should be a priority for teams who want to participate in this exciting and rapidly developing opportunity.