1. Scope
A major part of Schlumberger’s revenue has to do with the imaging and processing of data for its client to evaluate oil wells. For that reason, a wide variety of measurements are collected encompassing a number of modalities such as electromagnetic and acoustic often with tools lowered into wells in the ground and scanning thousands of meters of rock formations. This diverse data provides answers that are important to understanding the subsurface geology. Currently, there is still a great amount of manual intervention in data processing, which limits the value that can be extracted from the measurements as well as the quality of the subsequent workflows. Therefore, in this project Deep Reinforcement Learning (DRL) was leveraged in to order automate acoustic data processing and decrease its turnaround time by 30%.

2. Data
The raw waveform of the acoustic data and the dimensionally reduced features extracted from this data using a variational autoencoder algorithm served as inputs to the DRL scheme.

3. DRL Cycle
The agent picks up an input from the environment (VAE output or waveform), takes an action (choice of echo tracking method and additional parameter), receives a reward (using the actual echoes or the output of a data derived quality control (QC) function), and starts over again.

4. Exploration vs. Exploitation
Initially, it took about 10 hours to run the algorithm. Since we were not working in a very complex environment, we did not need to spend a considerable amount of time in exploration mode in the beginning of training. We thus decided to decrease the initial value of epsilon and were able to decrease the processing time to about 25 min.

5. DRL Performance
Reward converged to 6,000 in only 3 episodes when epsilon was set to 0.2 while training using synthetic dataset 1. Moreover, the performance of the DRL algorithm was consistent when training using one environment and testing on a different environment (using real echoes). Finally, the algorithm was able to track the correct echoes when trained using the QC function.

6. DRL Flexibility
Two approaches were explored in order to increase the flexibility of the DRL algorithm.

7. Business Impact
The cost of acoustic data processing is close to $30M per year. The DRL algorithm we created will result in 30% cost saving, which is equivalent to $9M saved every year.