Development of water flood model for oil production enhancement

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PROJECT

AREA : OIL AND GAS

- Water injection involves drilling injection wells into a reservoir and introducing water into that reservoir to encourage oil production.

RESEARCH PROBLEM

- Determine oil production for a given water injection rate.
- Setting proper water injection rates for the injection wells is a key factor to successfully operate an oil field under water flooding.

TASKS

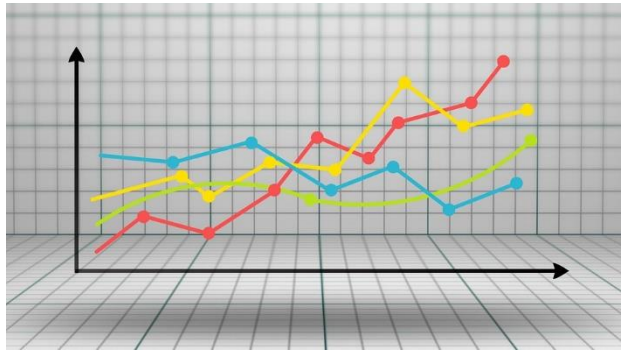
- Development of water flood model for oil production using artificial neural networks
- Forecast oil production
- To measure correlation between water injection and oil production

OBJECTIVES

1. Preprocessing - this involves elimination of unnecessary columns(variable selection), conversion of categorical data, treatment of outliers, dealing with missing values and formatting data into required data types. Eliminate unnecessary columns from the dataset
2. Generate possible features on the dataset based on a hypothesis that is proved mathematically (conditioned on the basis of necessity)
3. Treatment of missing values on the dataset (conditioned on the basis of reasons why there are missing values, criterion will be established after data understanding)
4. Convert all categorical data in the dataset to numerical representation
5. Formulate an accurate algorithm to make a prediction of oil for a given water injection rate
6. Measure the correlation between water injection rates and oil production rates

PROPOSED MODELS

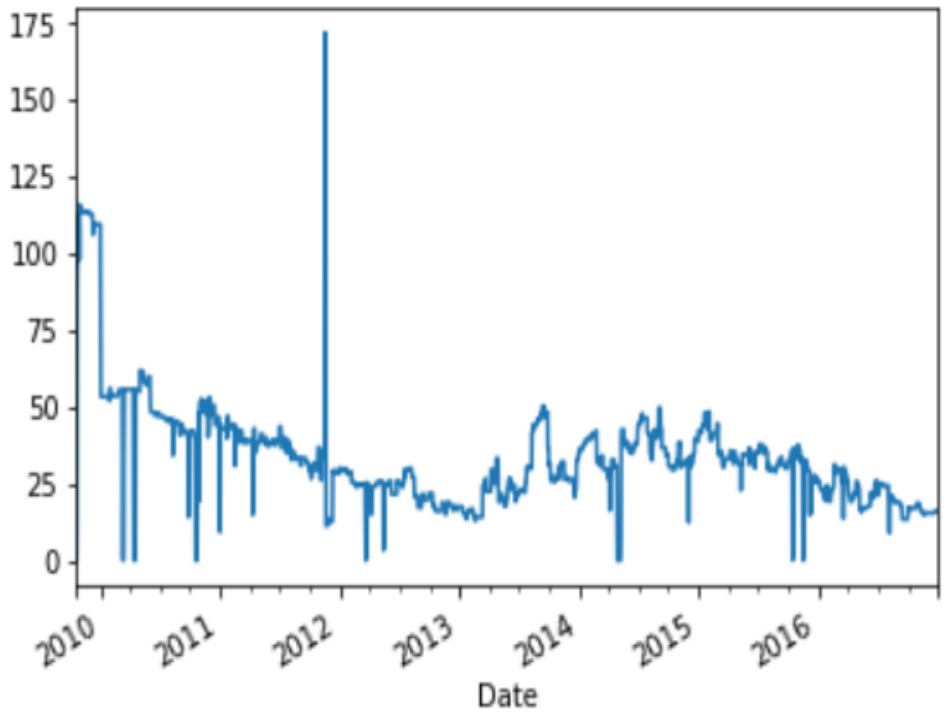
- FULLY CONNECTED NEURAL NETWORK
- CONVOLUTIONAL NEURAL NETWORK
- RECURRENT NEURAL NETWORKS
- OTHER DEEP NEURAL NETWORKS



TRIALS

```
oil_production_ws['WS-1012-AS11.2'].plot()
```

```
<matplotlib.axes._subplots.AxesSubplot at 0x21e25e526a0>
```



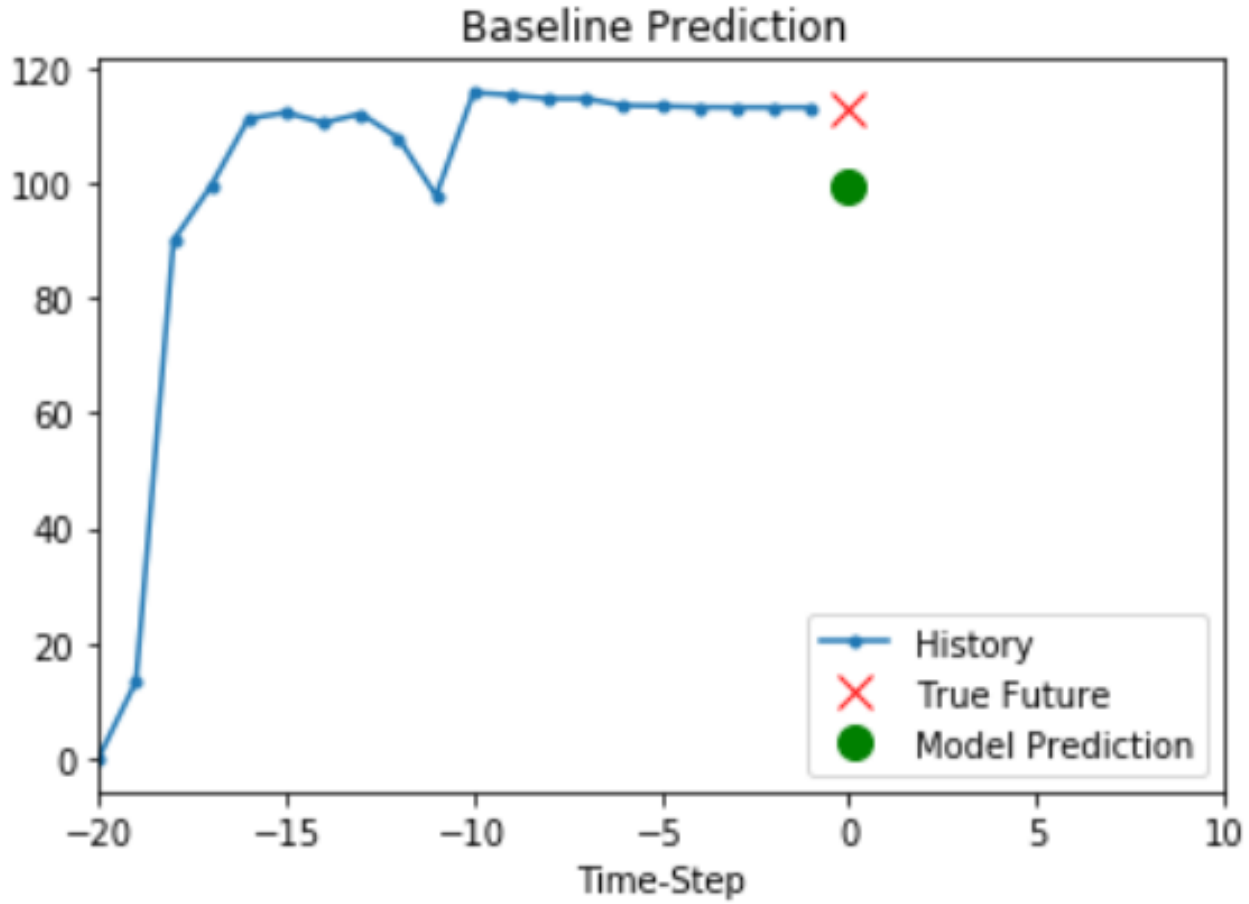
Description

- The objective of this study is to develop a waterflood model for oil production using artificial neural networks using daily water injection rates and oil production rates from year 2004 to 2016 for 577 injection wells and 1344 production wells. Application of different neural network models such MLPs, CNNs and LSTMs in Python for this time series data.

Data Processing

- Read data using sql function in jupyter
- Visualise the data using pandas
- Restructure the data per well by production
- Restructure the data per well by injection
- Extract oil production for a particular well
- Remove missing values & outliers
- Normalise the data

BASELINE MODEL

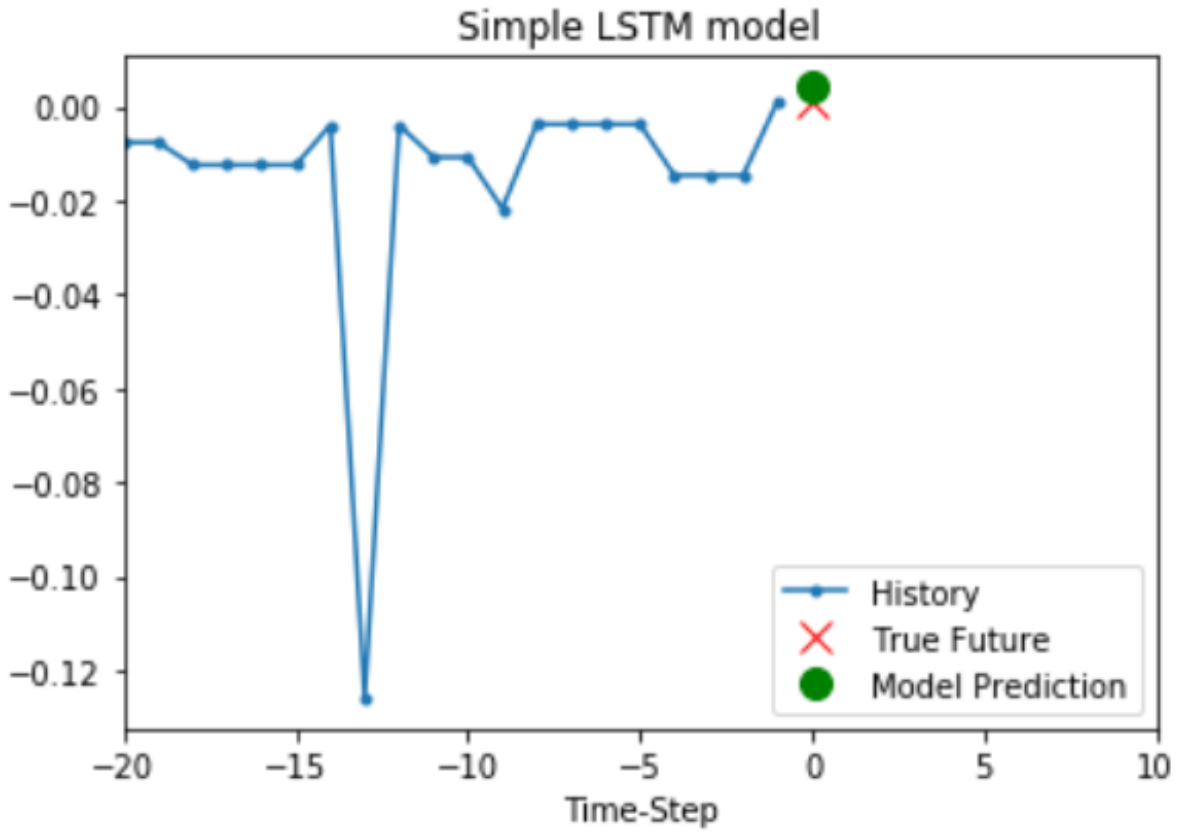


HOW IT WORKS & RESULTS

- Given an input point, the baseline method looks at all the history and predicts the next point to be the average of the last 20 observations.

- 1 point estimation

SIMPLE LSTM



loss: 0.0010

optimizer='adam', loss='mse'

LSTM(20Layers)

Dense(1)

HOW IT WORKS & RESULTS