Core Feature Extraction with Computer Vision

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What Is Core?

- Core: intact, cylindrical piece of rock coming from wellbore
- Brought to surface for analysis
- Collected during drilling of exploratory wells
    - At novel sites or untapped reservoir depths
- Core analysis evaluates economic viability of exploratory wells and surrounding reservoirs

The Problem

- Analysis is done at a maximum of one-foot intervals which generates a representative data set
    - Reservoir may not be homogenous
- Manual core analysis prone to human errors and time-consuming

The Solution

- Artificial intelligence can be used to overcome many of the flaws of conventional core analysis
    - Convolutional neural networks can analyze core images and generate a continuous analysis
    - Convolutional neural networks can generate an analysis of the core almost instantly and save time
    - Convolutional neural networks can analyze core images at no cost
    - Convolutional neural networks can analyze core images and eliminate human error and subjectivity

Industry Partners

AERA Great Todays Better Tomorrows

California Resources Corporation

Core Lab Reservoir Optimization

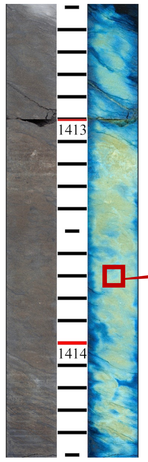
Best Core Services

E&B Natural Resources

Crimson Resource Management

Implementation

To train the neural networks to make predictions about a core's oil saturation level and saturation category, we collected a large inventory of core slab images from our partner companies along with the corresponding core analysis reports. For every oil saturation report value, a crop of the core slab was taken at the equivalent depth.



Sample Number	Depth ft	Perm. Kair md	Porosity %	Fluid Saturation Oil %	Water %	O/W Ratio	Total %
53	1362.3	1.8	12.3	21.6	72.8	0.30	94.4
54	1380.7	247.5	29.5	18.3	68.4	0.27	86.7
55	1382.3	2865.6	33.3	55.3	17.1	3.23	72.4
56	1386.2	181.3	24.7	35.6	56.8	0.63	92.4
57	1413.7	35.1	22.1	15.9	72.5	0.22	88.4
58	1423.4	1789.5	35.1	58.1	16.9	3.43	75.0
59	1432.8 F/	109.7	29.6	29.9	56.5	0.53	86.4
60	1434.9	46.0	29.2	38.2	52.4	0.73	90.6
61	1437.0	61.2	26.3	43.8	50.2	0.87	94.0
62	1440.9	12.3	28.0	30.8	63.6	0.48	94.3
63	1447.5	32.3	26.4	34.8	58.3	0.60	93.2
64	1449.8	47.3	26.9	39.5	55.9	0.71	95.4

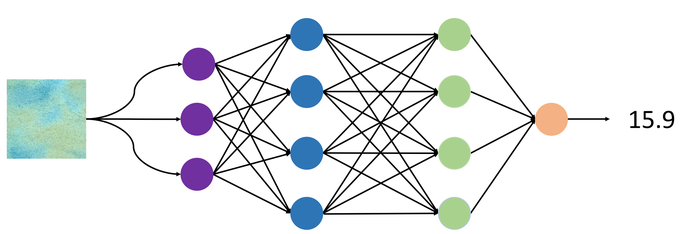
We used neural networks to perform two distinct tasks – classification and regression. For classification, the images were given as input to the neural networks along with a label. For regression, the images were given as input to the neural networks along with the reported saturation value.

 - (3.1, low)

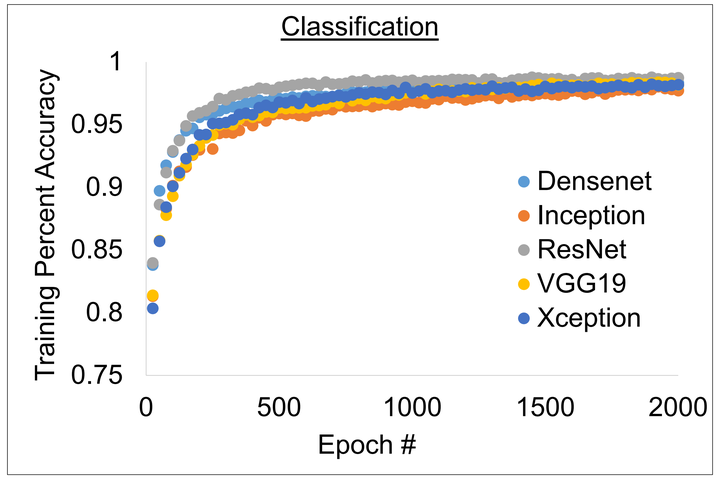
 - (15.9, medium)

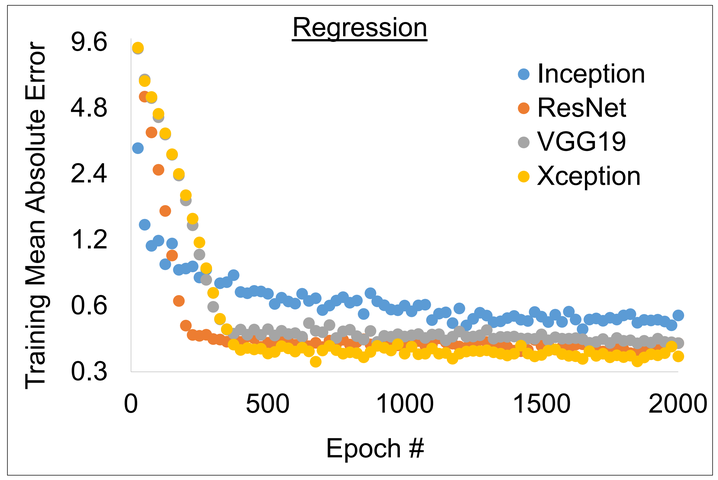
 - (66.1, high)

The neural networks went through 2000 iterations of training each to refine their predictive capabilities.



Results





- Outcome aligns with expectations – ultraviolet light images generate most accurate results for oil saturation detection
- Classification models categorize core images (high, medium, low) with a high degree of accuracy
    - 87% accuracy (ultraviolet light)
    - 78% accuracy (white light)
- Regression models were trained to generate an average mean absolute error of 9.28 surpassing the ability of a human core analyst
- Future work will involve adding more core data to improve the predictive capabilities of the models and adding an automated lithology describer