CREWES solutions for Machine Learning competitions in 2020

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CREWES Sponsors Meeting, December 4th, 2020

Agenda

2020 SEG Annual Meeting Machine Learning Interpretation Workshop

FORCE: Seismic Fault Mapping

FORCE: Machine Predicted Lithology

2020 SEG Annual Meeting Machine Learning Interpretation Workshop

Sun, J., Zhang, T., Niu, Z., Emery, D. J., Guarido, M., Trad, D. O., and Innanen, K. A. H., 2020, Deep learning for seismic facies classification in Parihaka: *CREWES Research Report*, **32**, 51.

Seismic facies classification

3D Parihaka, NZ

Training data – labels provide
Chevron

Six different classes (facies)

Blind volumes for testing

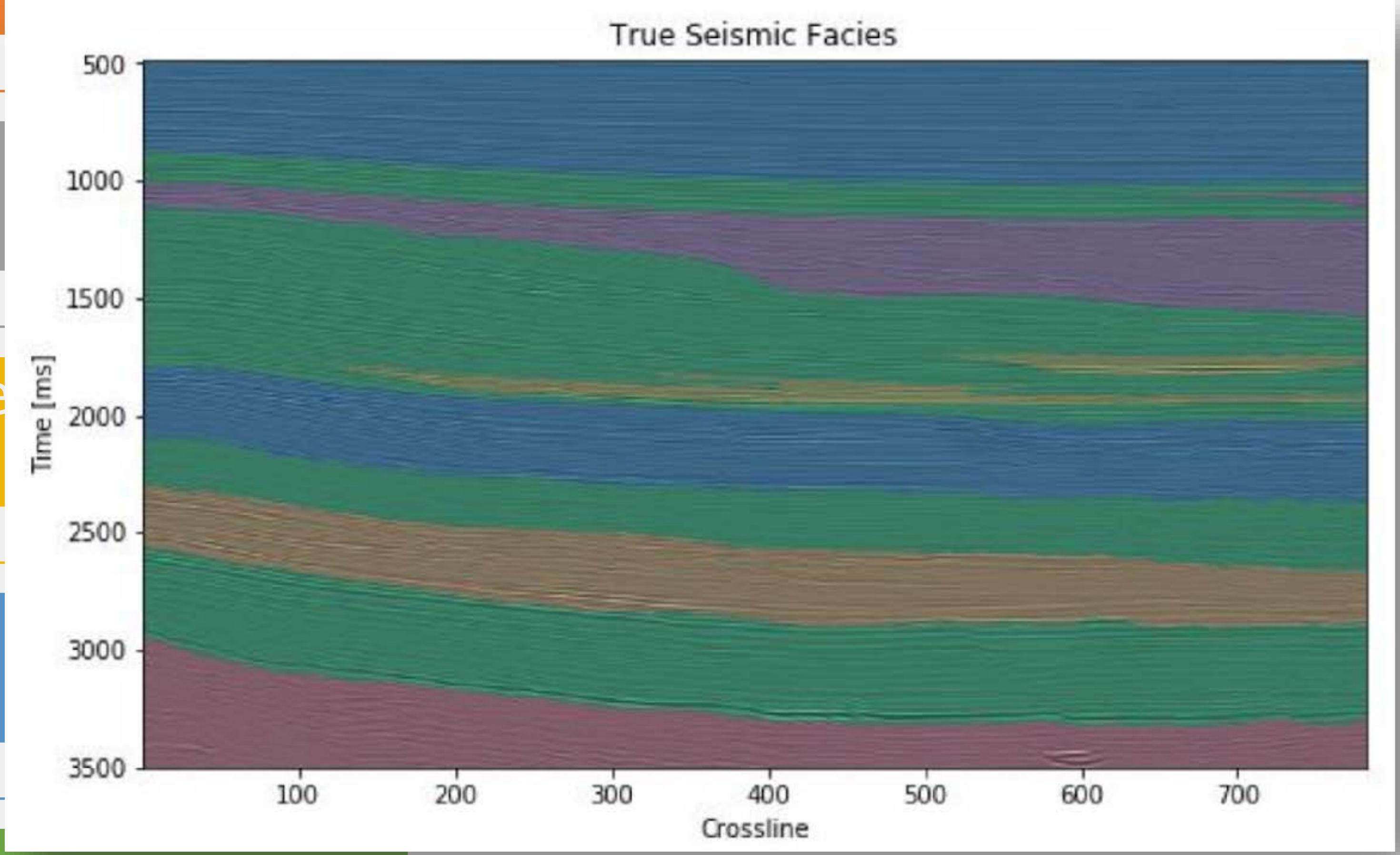
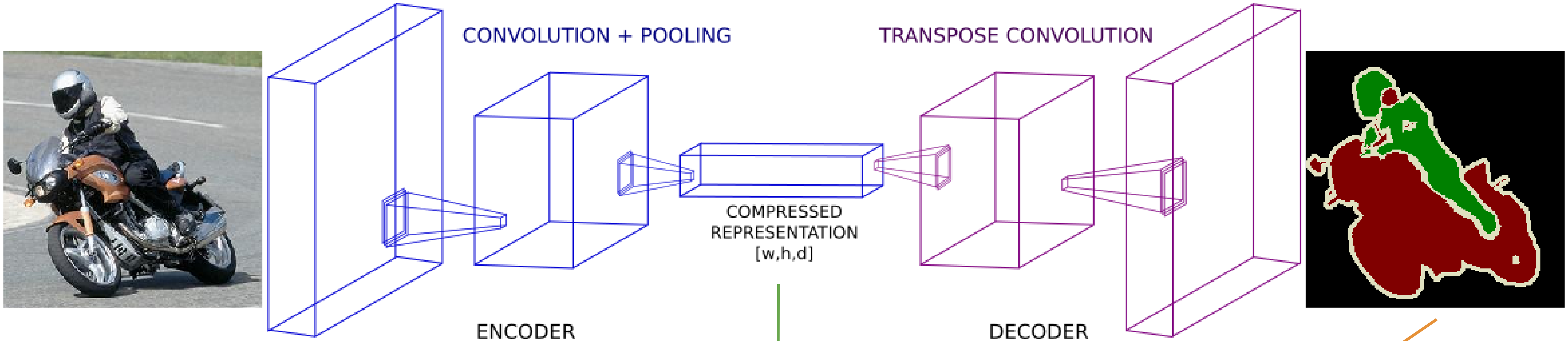


Image Segmentation

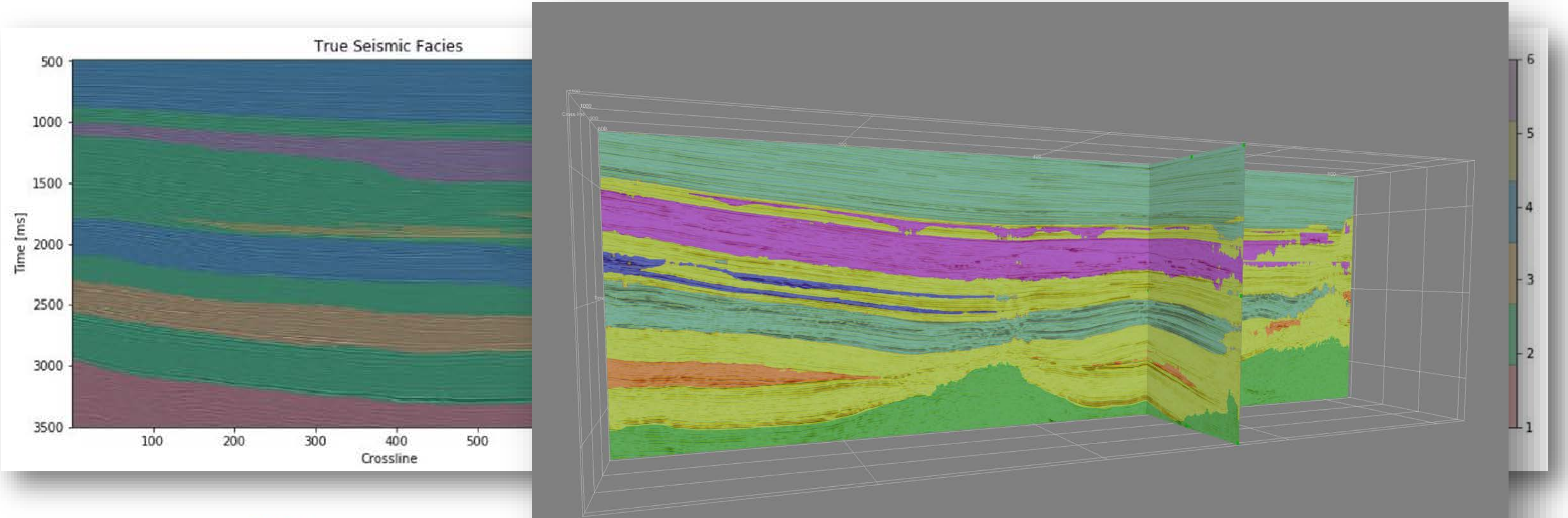


Number of convolutional filters

Extracted features

Class probability

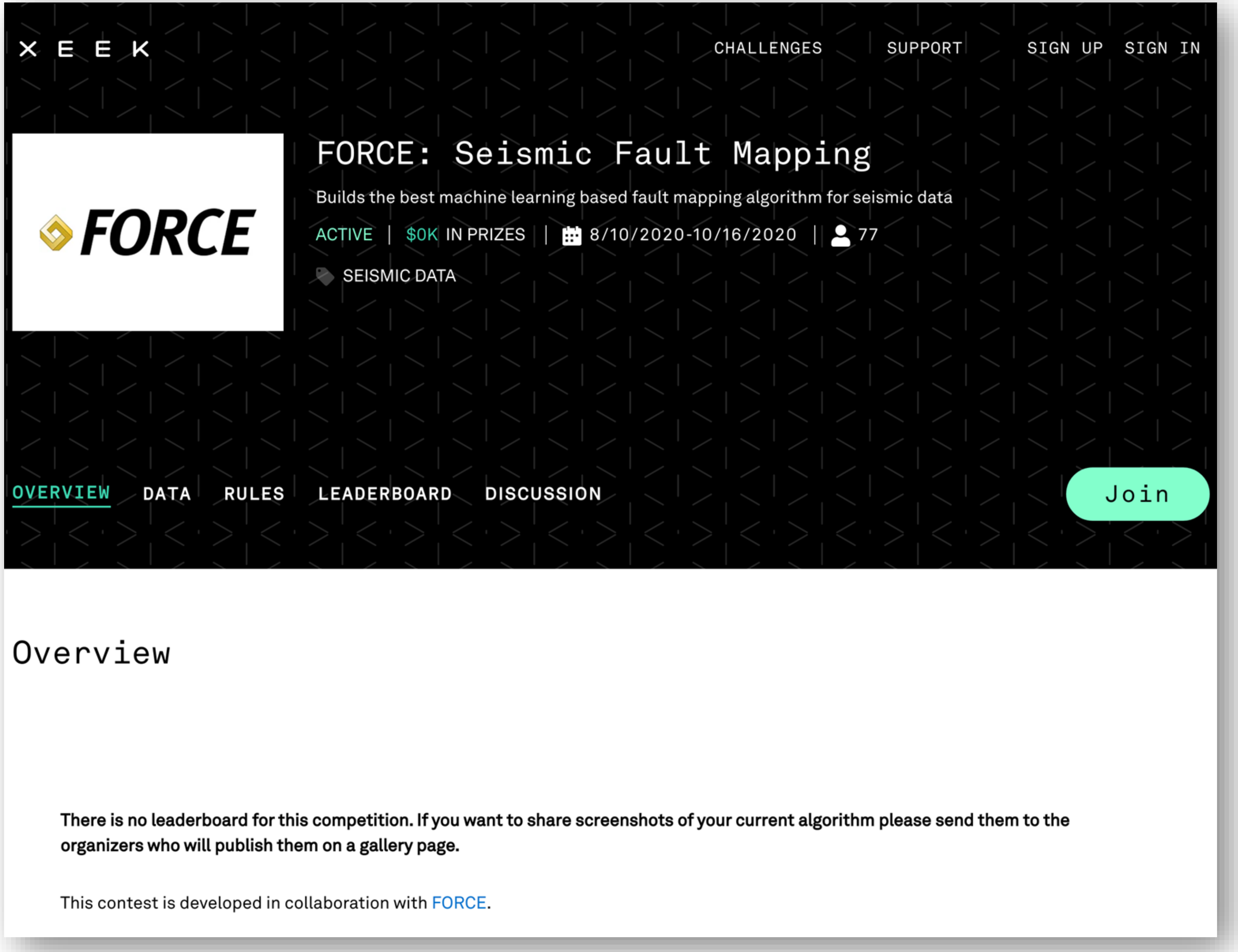
Results


True Seismic Facies
Time [ms]
500
1000
1500
2000
2500
3000
3500
100
200
300
400
500
Crossline
6
5
4
3
2
1

Team	Pixel Acc.	SSIM	Mean IoU	Channel IoU	Geology
A	3	2	5	3	3
B	6	6	6	6	4
C	5	5	3	2	2
D	4	3	3	4	4
E	8	8	8	7	7
F	7	7	7	8	8
G	9	9	9	9	9
H	10	10	10	10	10
I	2	3	2	5	4
K	1	1	1	1	1

Force: Seismic Fault Mapping

Wozniakowska, P., Guarido, M., Fathalian, A., Trad, D. O., and Emery, D. J., 2020, A 2.5D deep learning approach to identify faults in seismic sessions: CREWES Research Report, 32, 55.



[Competition link]

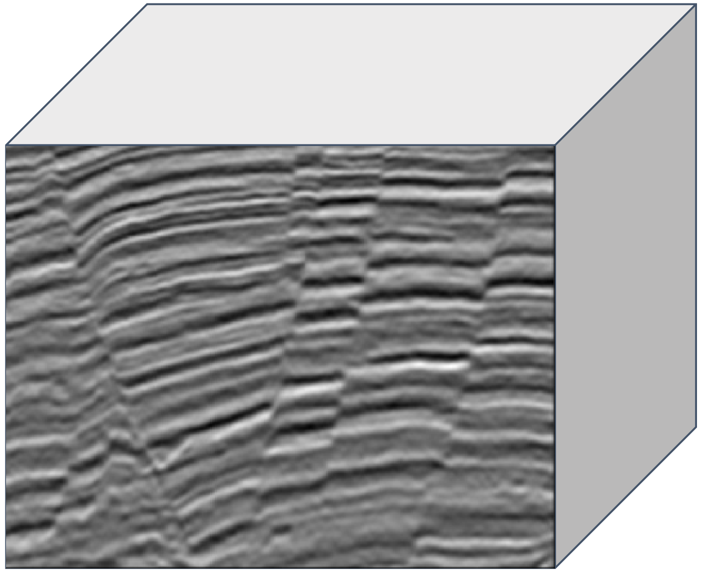
Seismic fault detection

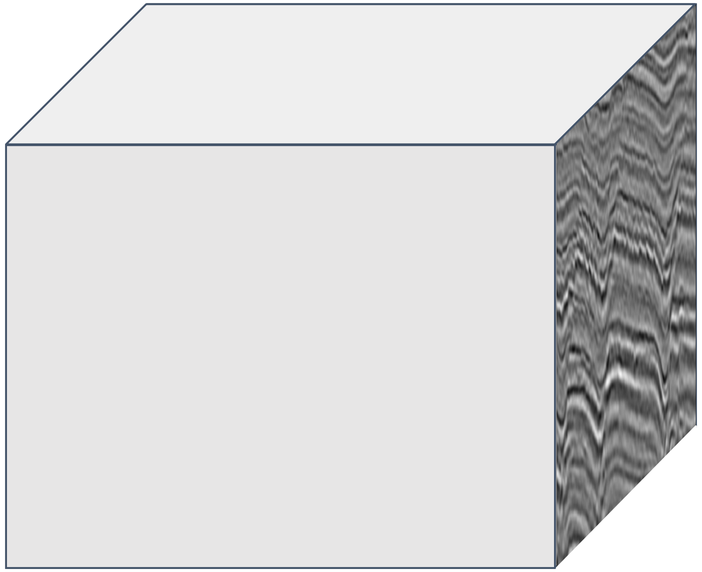
3D volume

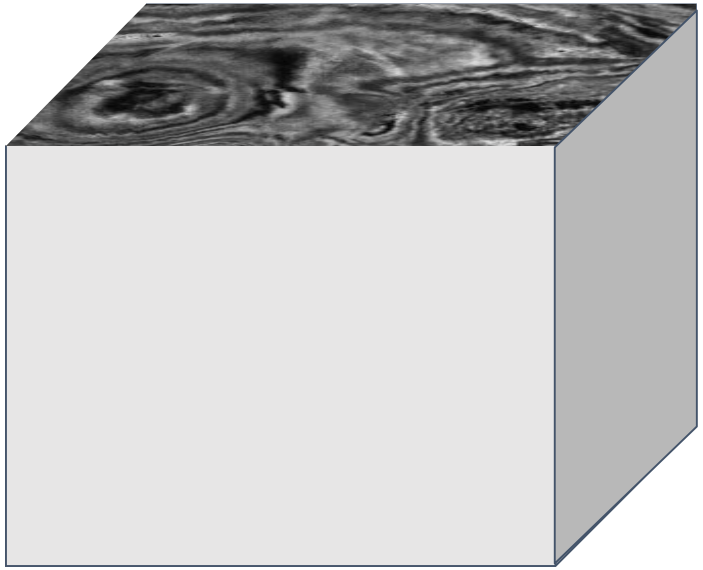
Training on synthetic data

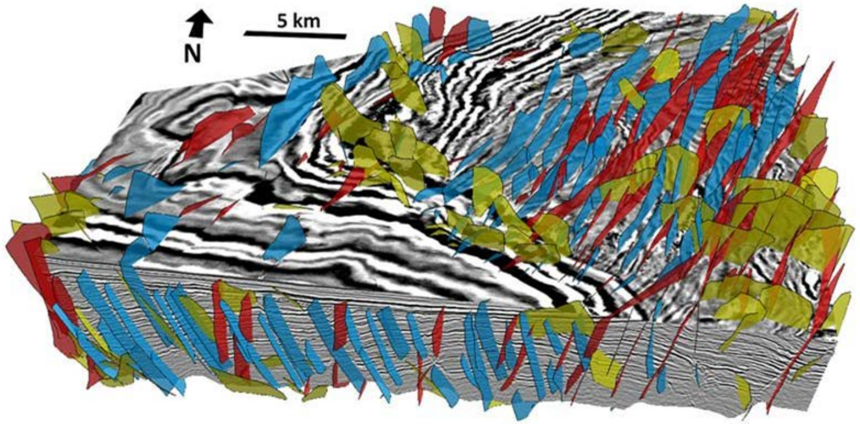
2.5D approach

2.5D Approximation

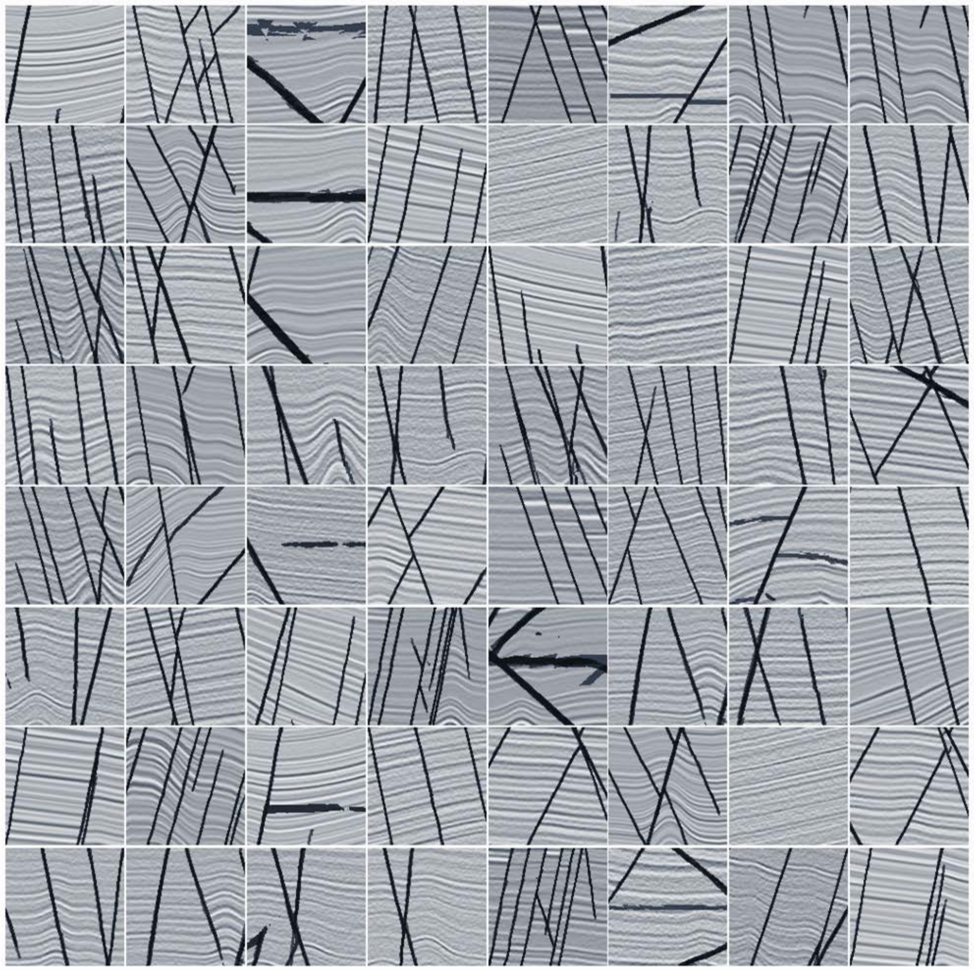






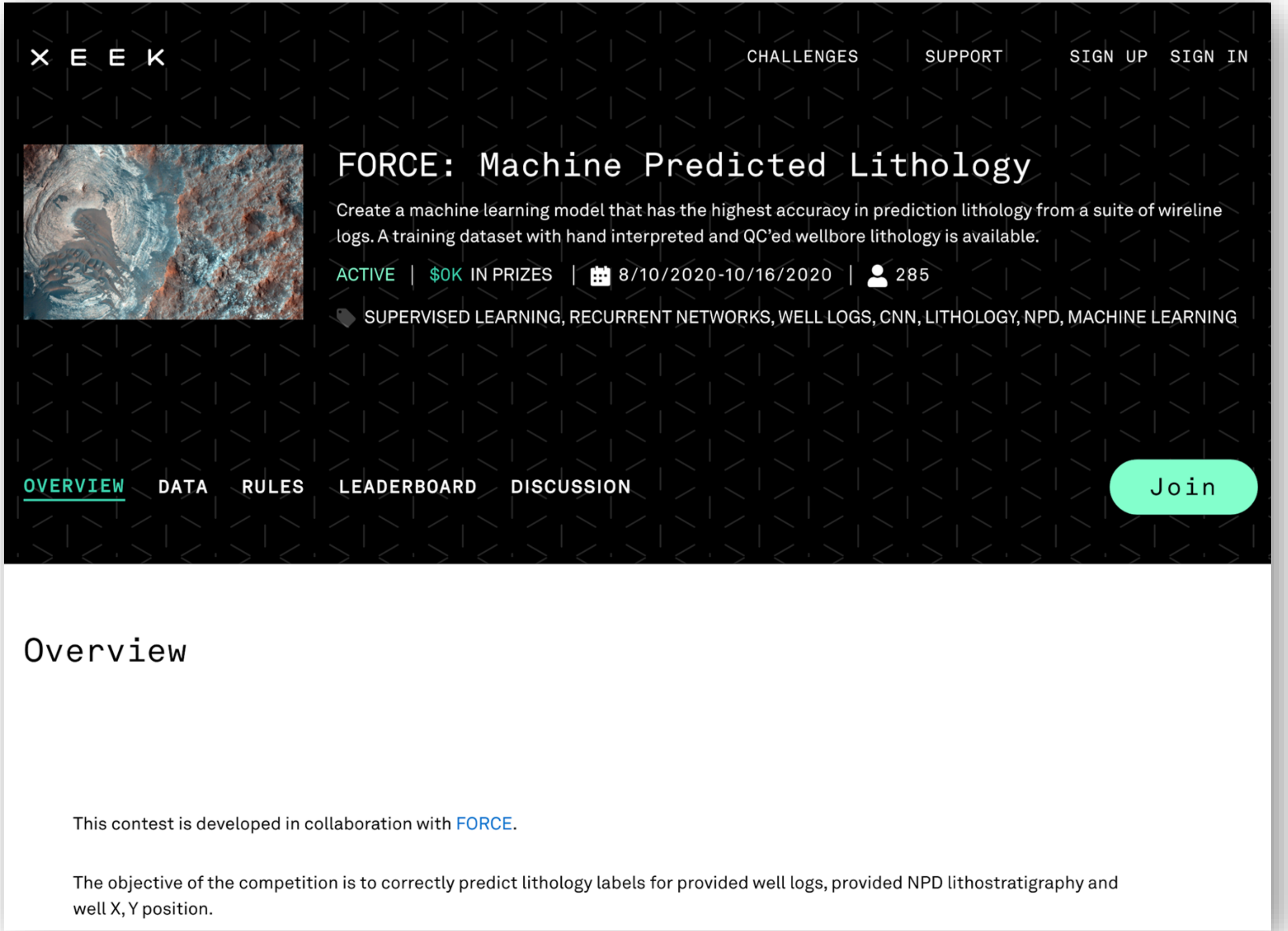


Synthetic Data



Force: Machine Predicted Lithology

Guarido, M., Emery, D. J., Macquet, M., Trad, D. O., and Innanen, K. A. H., 2020, The Pitfalls and Insights of Log Facies Classification for a Machine Learning Contest: CREWES Research Report, 32, 18.



[Competition link]

Facies classification

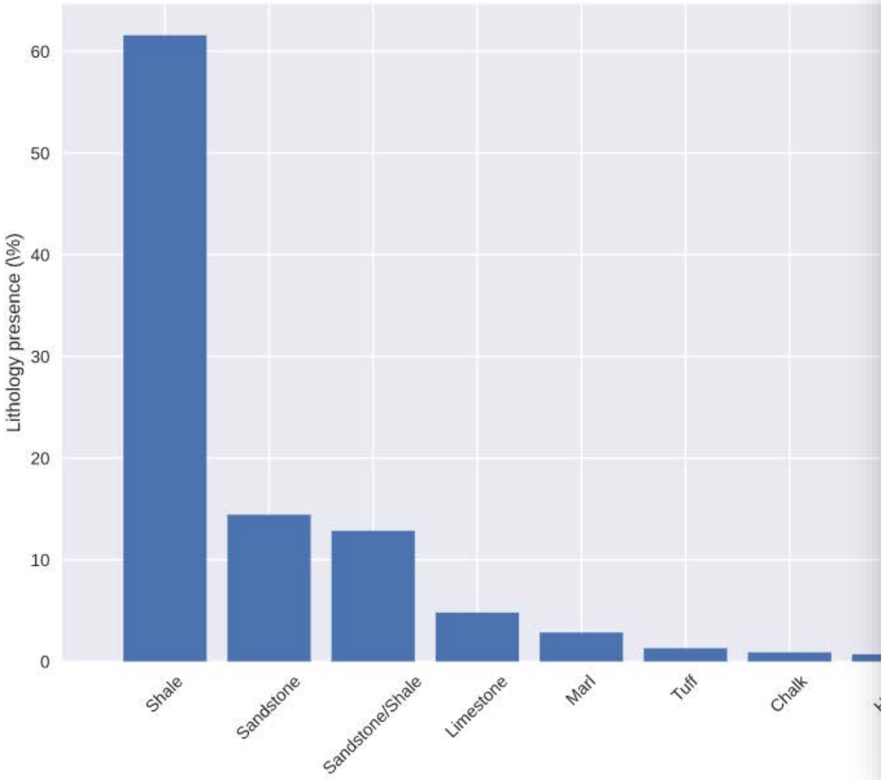
Well logs

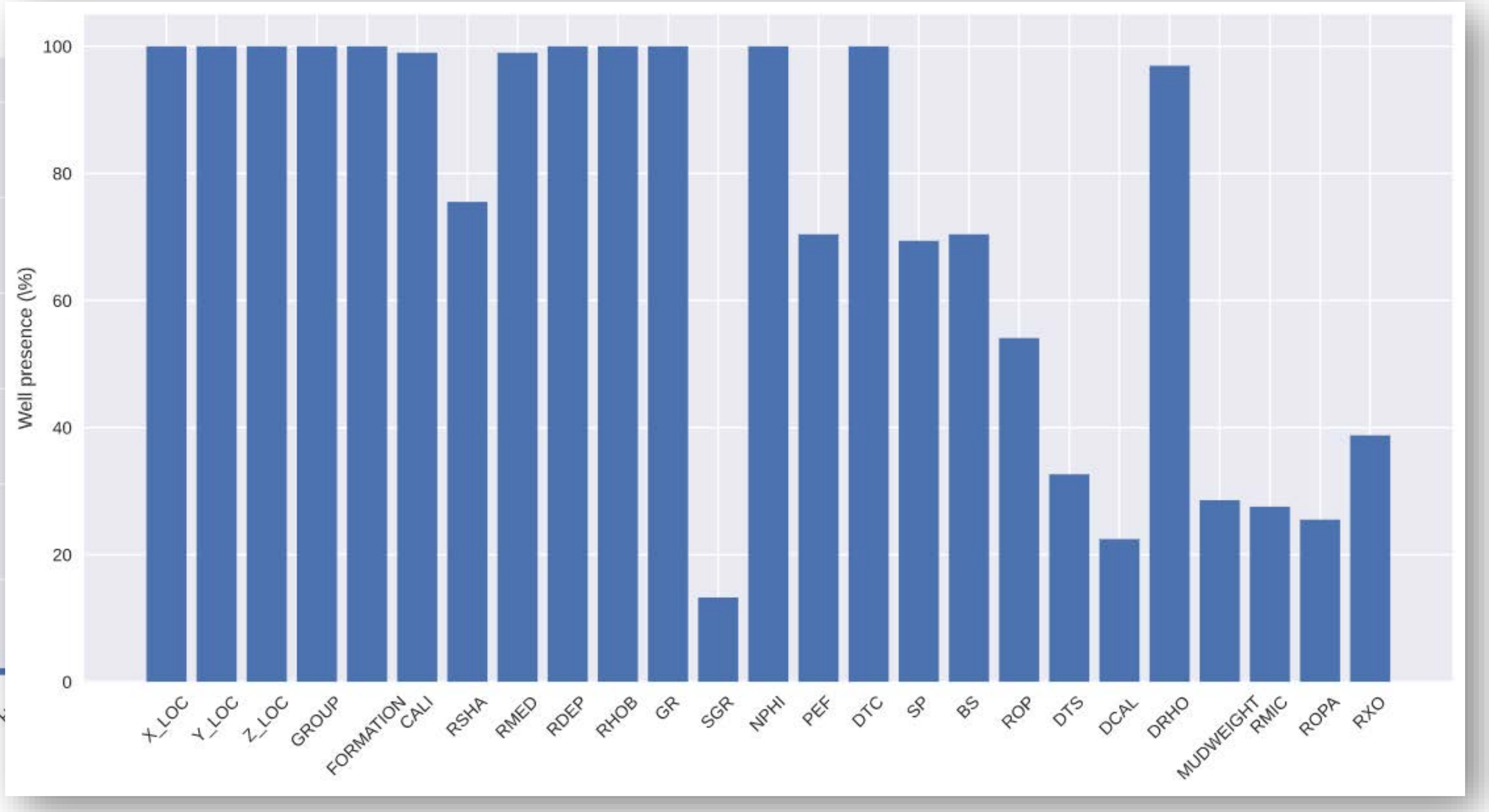
Raw data

Tricky data and goals

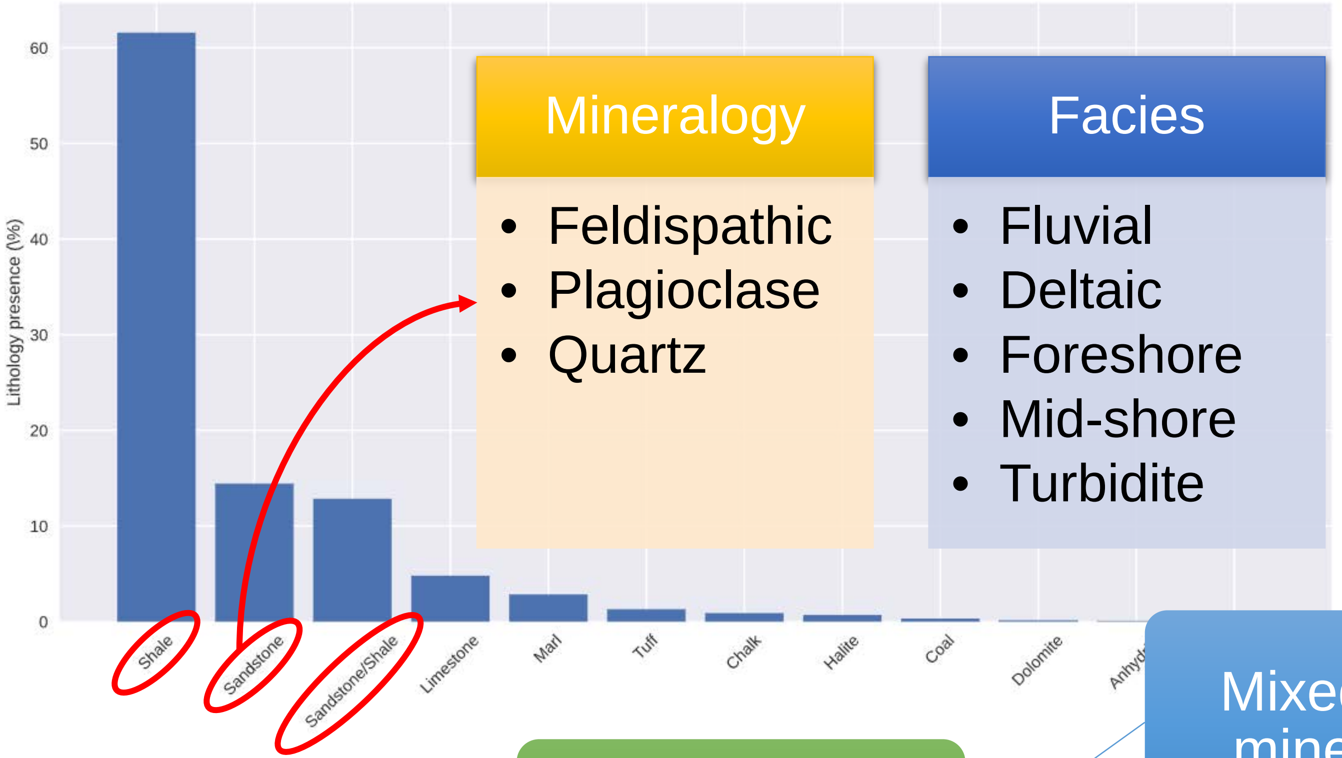
Data Analysis

98 Wells





First Pitfall – Classes Mineralogy



Mineralogy

- Feldispathic
- Plagioclase
- Quartz

Facies

- Fluvial
- Deltaic
- Foreshore
- Mid-shore
- Turbidite

Sandstone/Shale

% of shale?

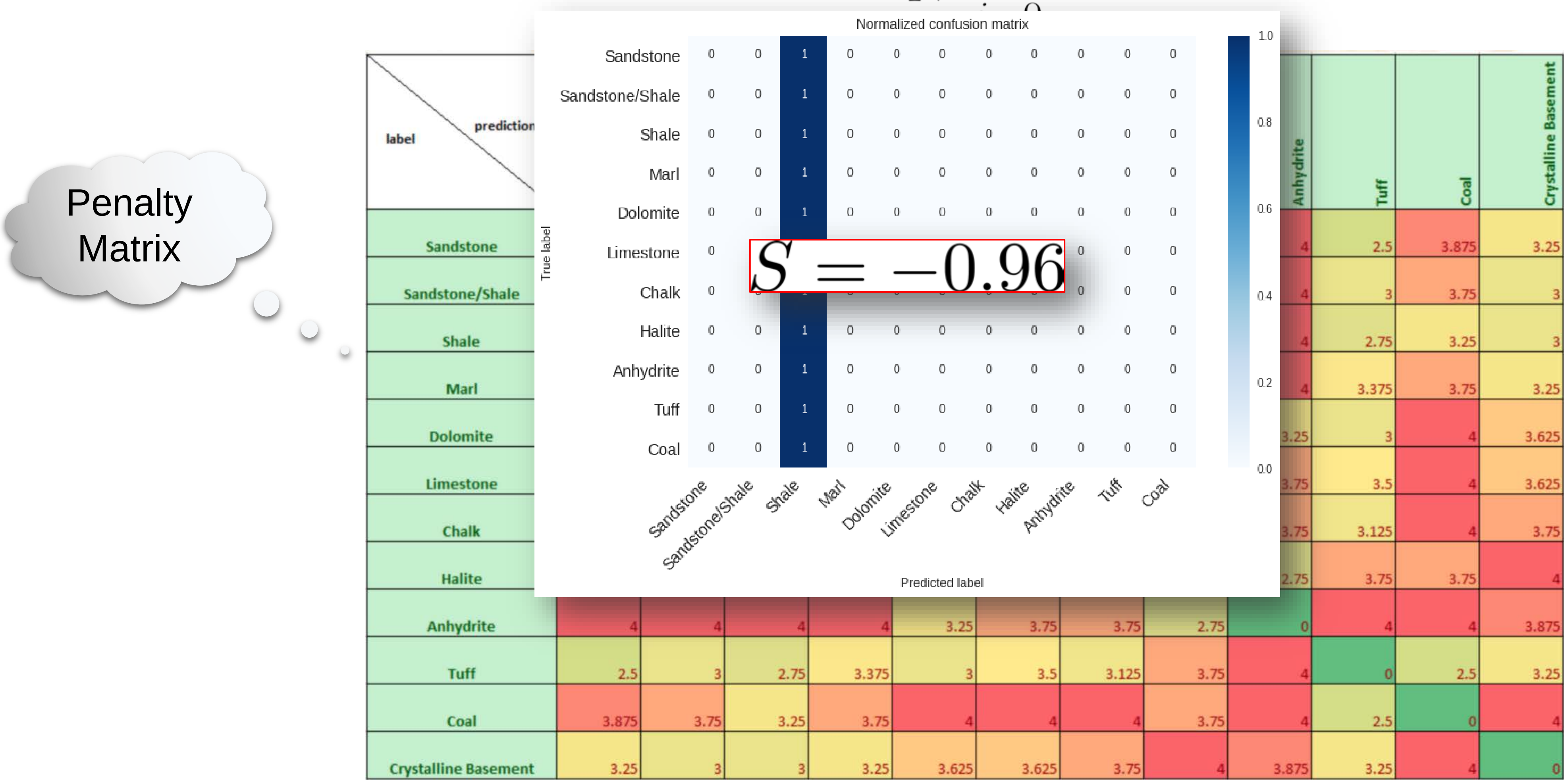
% of sandstone?

Mixed shale mineralogy

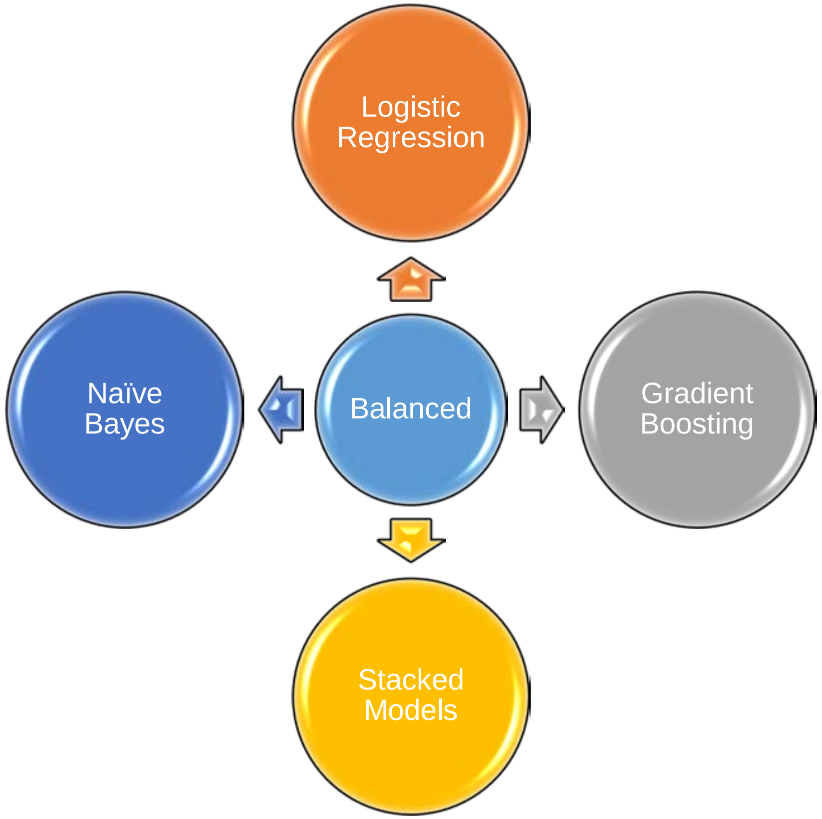
Mixed facies?

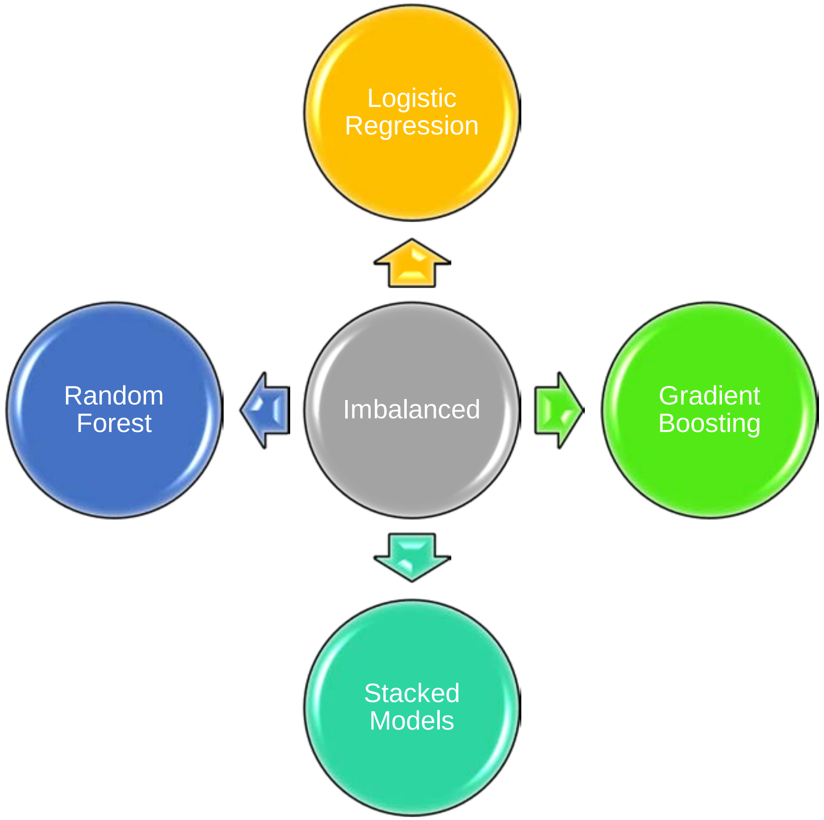
Second Pitfall – Contest Metric

$$S = -\frac{1}{N}\sum_{i=0}^{N} \mathbf{A}_{\hat{y}_i y_i}$$



Models


Logistic
Regression
Naïve
Bayes
Balanced
Gradient
Boosting
Stacked
Models

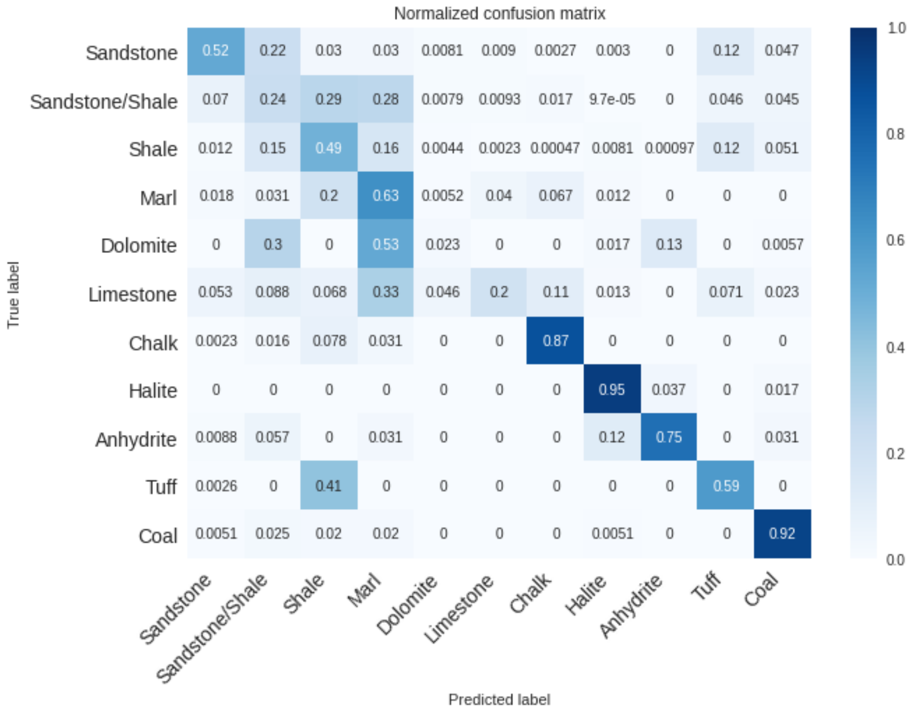

Logistic
Regression
Random
Forest
Imbalanced
Gradient
Boosting
Stacked
Models

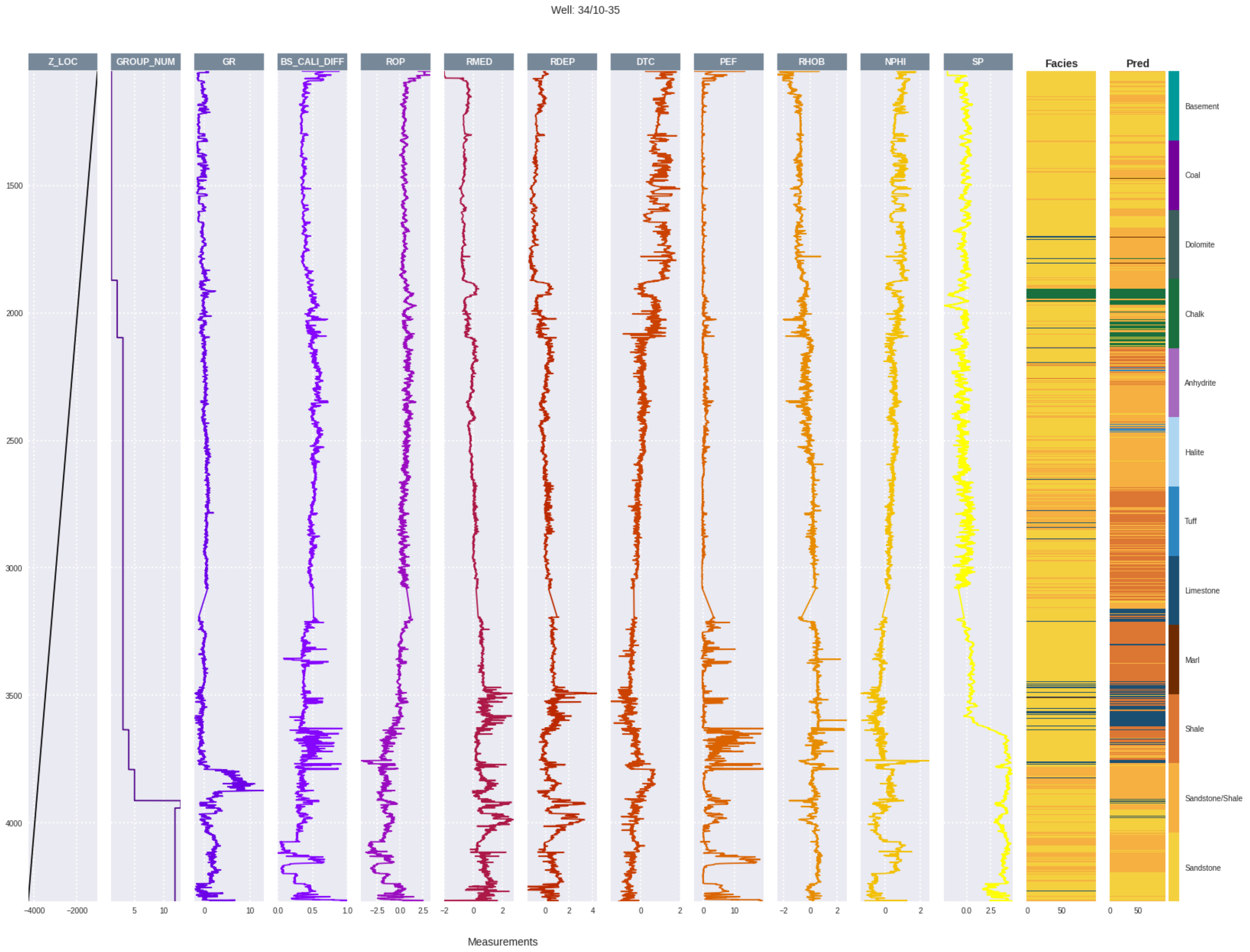
Balanced Models

Metrics

Balanced accuracy: 0.56

Contest’s metric: -1.35



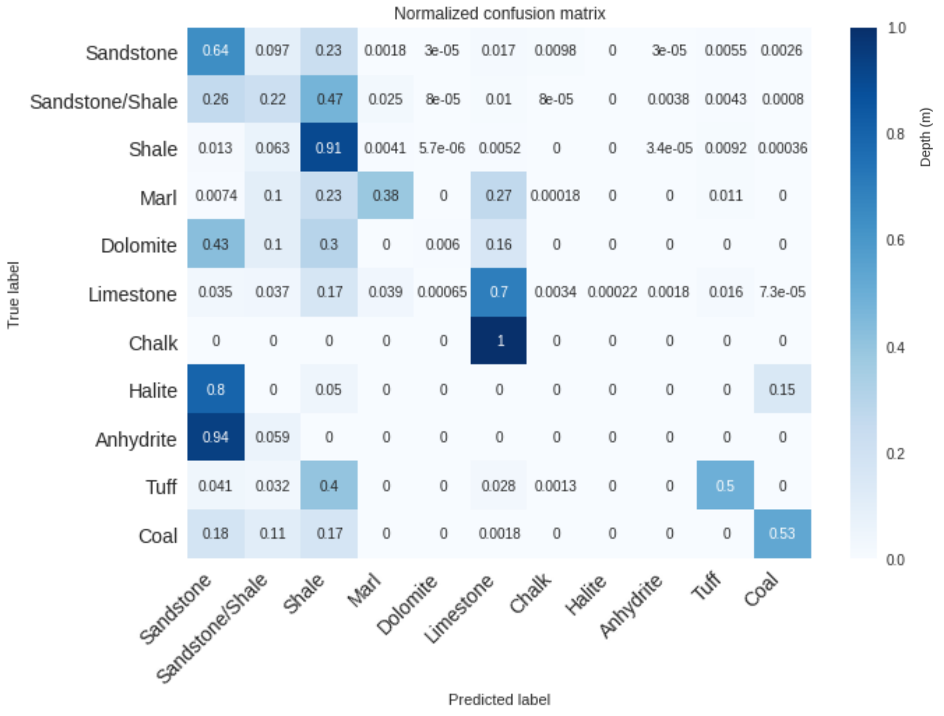


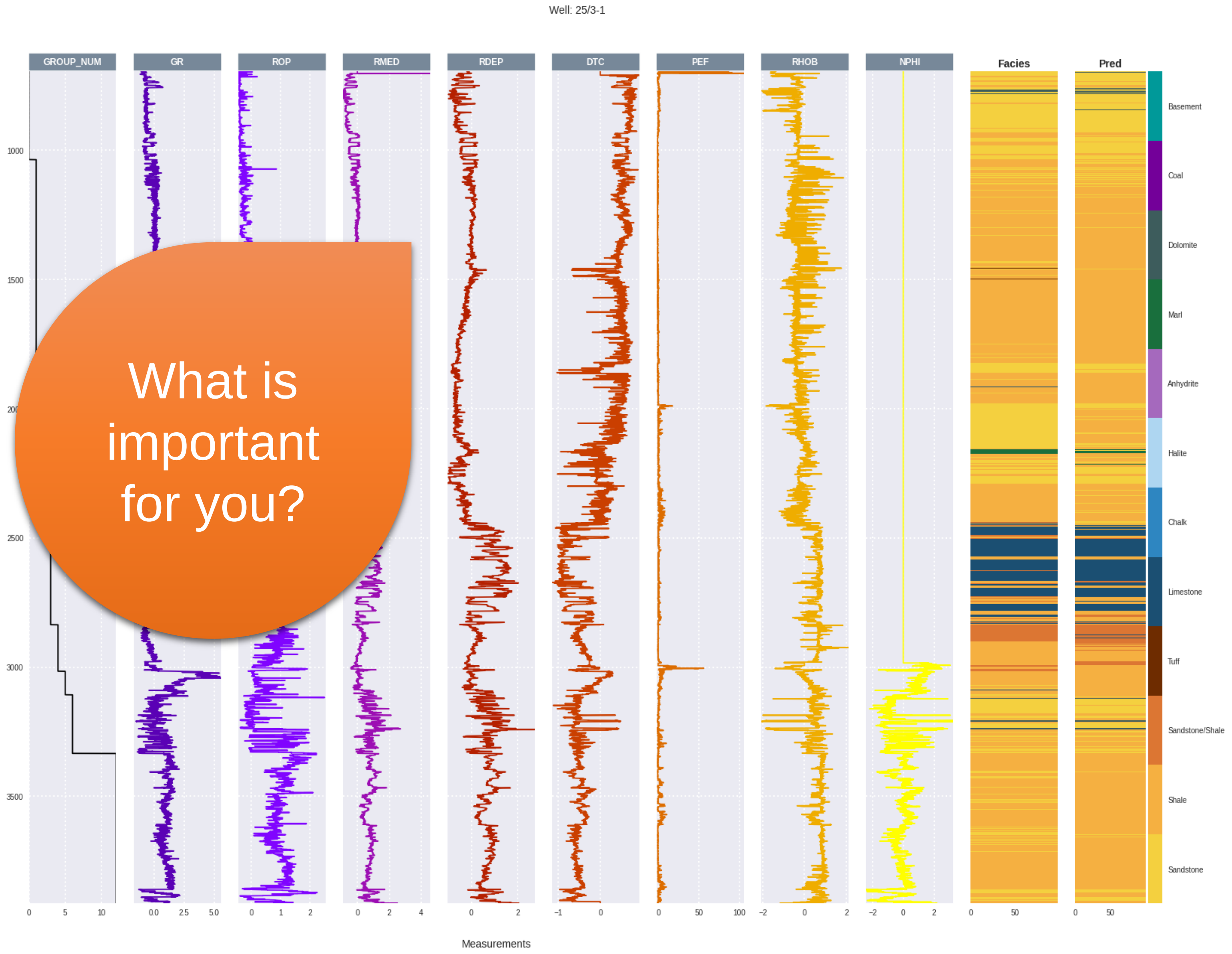
Imbalanced Models

Metrics

Balanced accuracy: 0.41

Contest’s metric: -0.58





What is important for you?

Models Performance

Model	Balanced Accuracy	Contest Metric
Gradient Boosting (balanced)	0.56	-1.35
Naïve Bayes	0.40	-1.86
Logistic Regression (balanced)	0.32	-2.17
Stacked Models (balanced)	0.56	-1.38
Logistic Regression	0.08	-0.96
Gradient Boosting	0.42	-0.59
Random Forest (balanced)	0.40	-2.00
Stacked Models	0.41	-0.58

Closing Notes

What's next?

Competitions

Source of data

Keeps motivation

Not easy

Insights

What do you want from your data?
What is your goal?

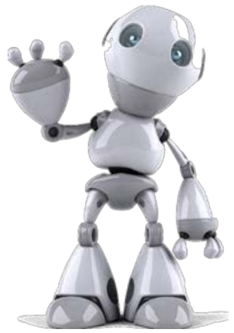
Acknowledgements

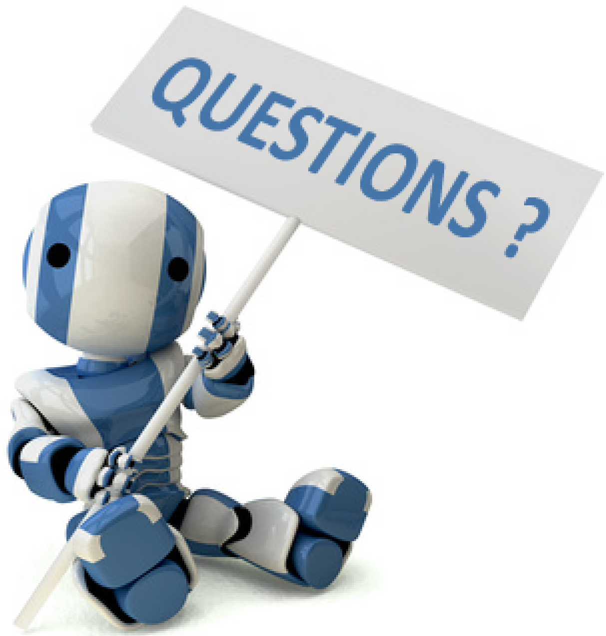
CREWES Sponsors

NSERC CRDPJ 461179-13 and CRDPJ 543578-19

CFREF

CREWES Staff and Students




QUESTIONS ?