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UQ-CCSG Annual Research Review
Centre for Coal Seam Gas
2018

Using an artificial neural network (ANN) to identify coals from drilling and logging-while-drilling (LWD) data

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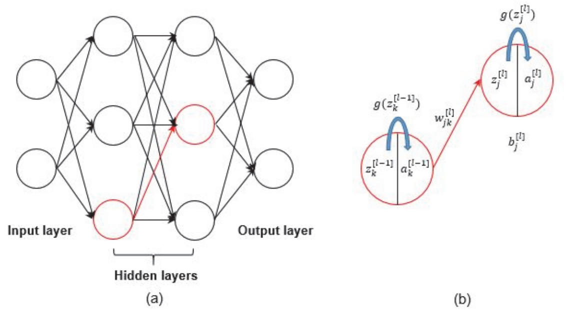
Objective

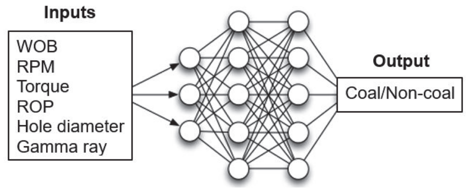
Saving logging cost by quickly identifying coal pay zones for completion packers and slotted casing placement.

Method	Disadvantages
Well logging	Expensive (tool and rig time) Acquired on a few wells Potential logging failure (especially in deviated and horizontal sections)
Laboratory tests	Scale effects Time/resource intensive Require lab & quality samples

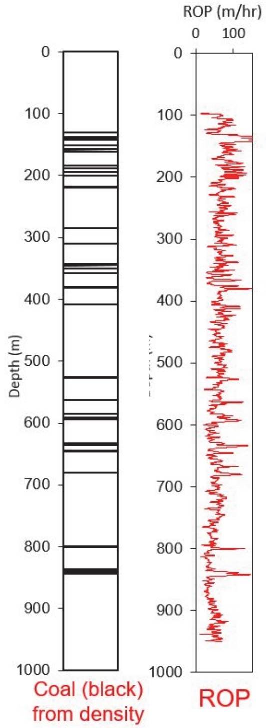
Machine learning: fast, accurate, and low-cost.

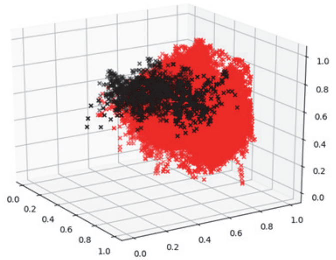
Methodology



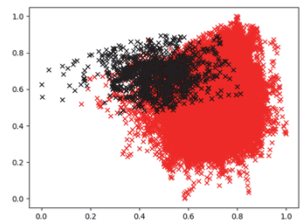


Drilling data vs. coal





Principal component analysis (3D)



Principal component analysis (2D)

Confusion matrix

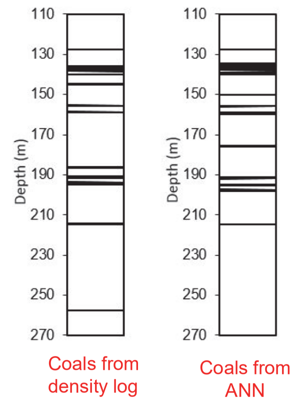
		True Condition	
		Coal	Non-coal
Predicted Condition	Coal	True positive	False positive
	Non-coal	False negative	True negative

$$\text{Precision} = \frac{\text{Ture positve}}{\text{True positive+False positive}}$$

$$\text{Recall} = \frac{\text{Ture positve}}{\text{True positive+False negative}}$$

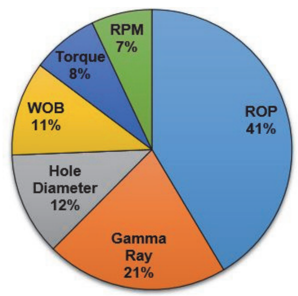
$$\text{F1 Score} = 2\,\frac{\text{Precision}\cdot\text{Recall}}{\text{Precision+Recall}}$$

Results



Summary of results for the test section

	Precision	Recall	F1 score	Samples
0 (non-coal)	0.98	0.99	0.98	1318
1 (coal)	0.77	0.79	0.78	135
Avg/totoal	0.96	0.96	0.96	1453



Feature importance

Acknowledgements

This research has been conducted with the support of The University of Queensland Centre for Coal Seam Gas (UQ-CCSG) and its industry members: APLNG, Arrow Energy, and Santos.