Soil classification using machine learning on DC resistivity and geotechnical data

· Subject Area: Northeastern Thailand [Mukdahan]

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· Collaborating Investigator: Chatchai Vachiratienchai[2], Seong Kon Lee[3], Minkyu Bang[3]

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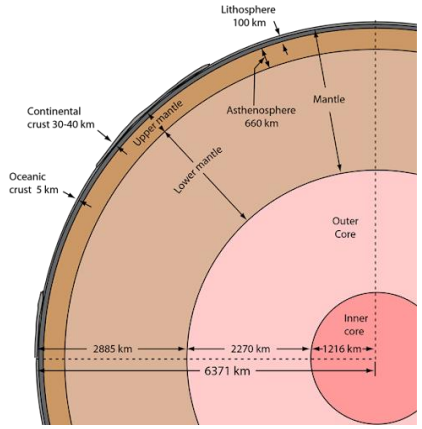
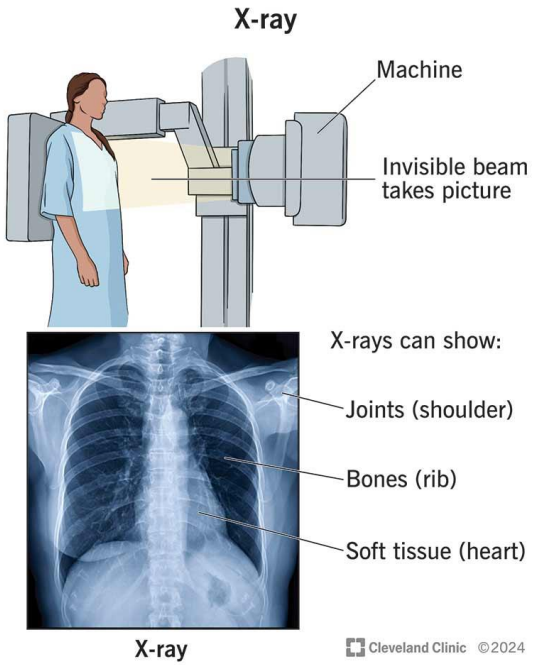
3. Mineral Resources Research Division, Korea Institute of Geoscience and Mineral Resources, Korea

https://my.clevelandclinic.org/-/scassets/images/org/health/articles/21818-x-ray

Project Summary(1/2)



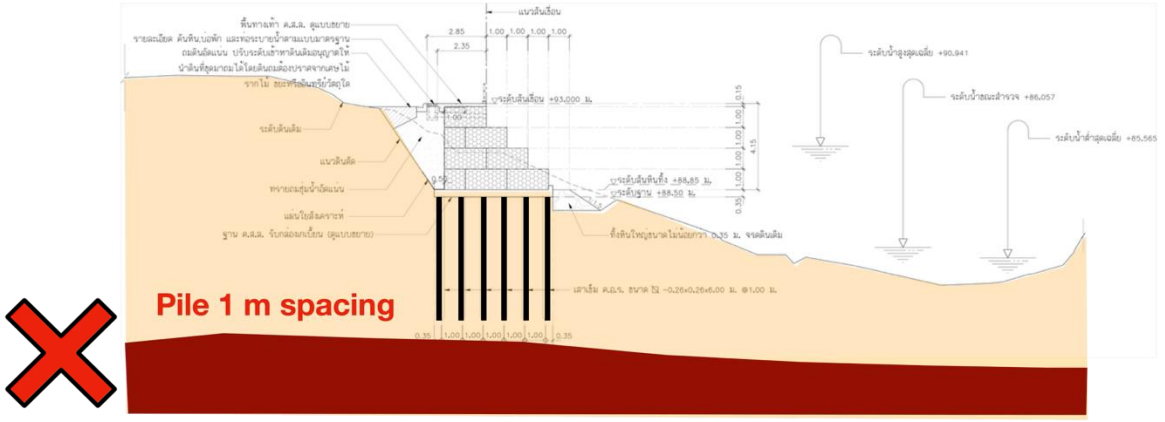


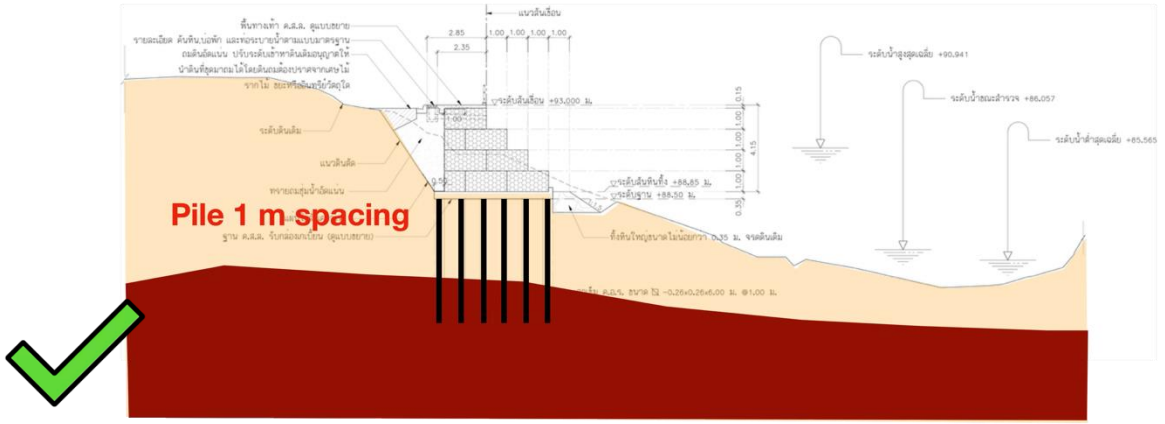
Problem: *concrete pile not reach basement*

https://www.matichon.co.th/wp-content/uploads/2016/09/201609221121341-20130724124631.jpg

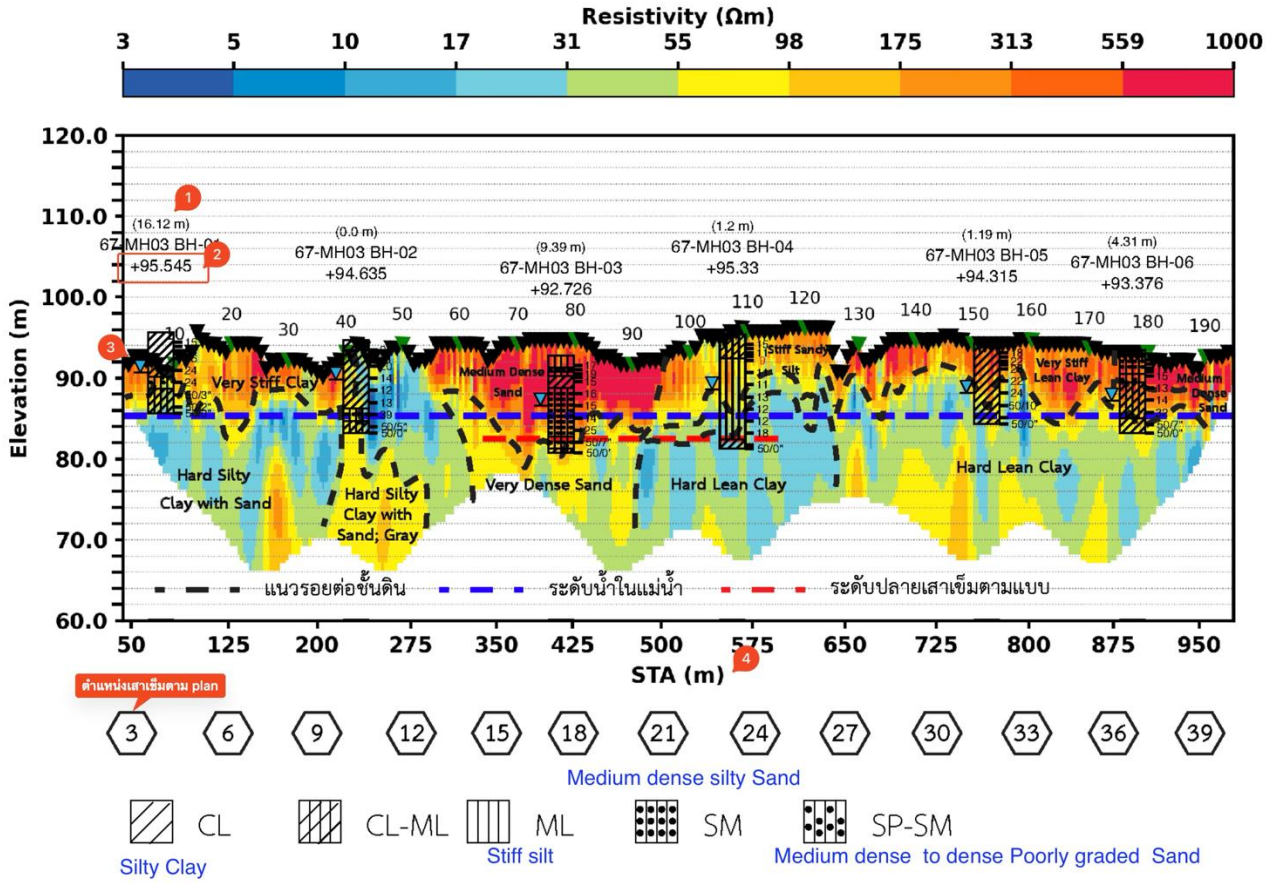
- *Objectives*

  - DC resistivity + ML to find basement





Project Summary(2/2)



- *Expected Outcomes*

 - Soil classification model using ***DC resistivity data***, ***Borehole*** *data*

- *Basement boundary (automatically)*
- *SPT , Water content transfer cross section*

reduce drilling and Lab cost

Project Description(1/4)

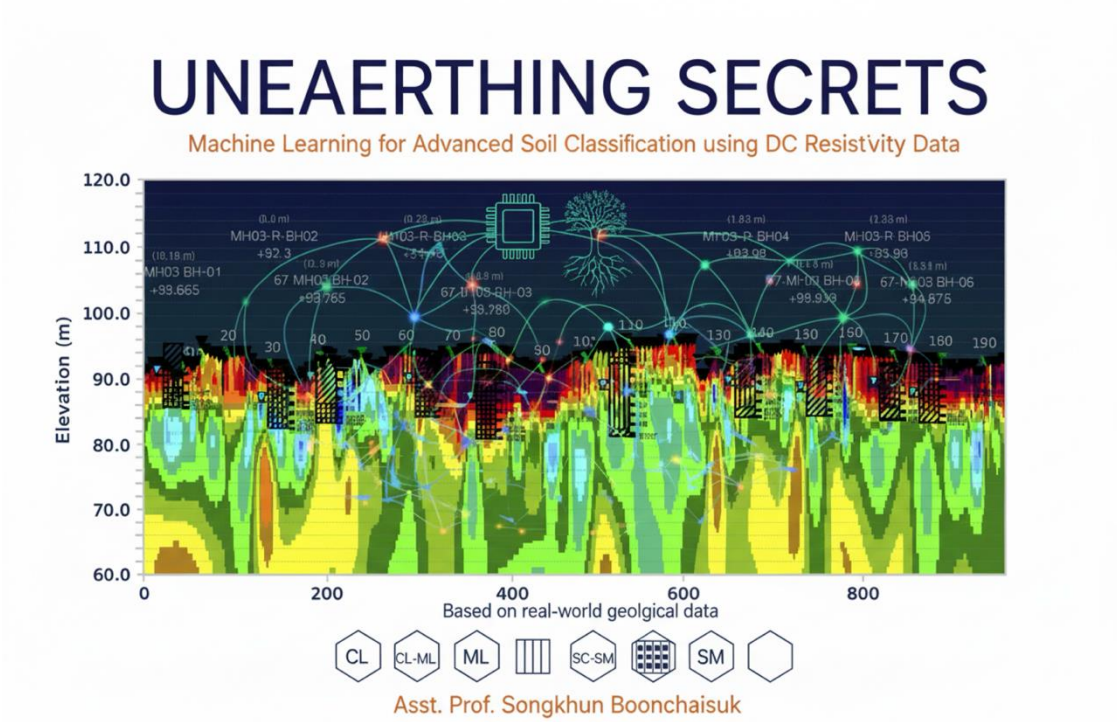
- *Specific Aims*

  *- Find the most suitable **ML model for Soil classification** model using DC resistivity data, Borehole data and soil description*

1. Increase more training data
(No. of data, soil color, soil description, etc.)

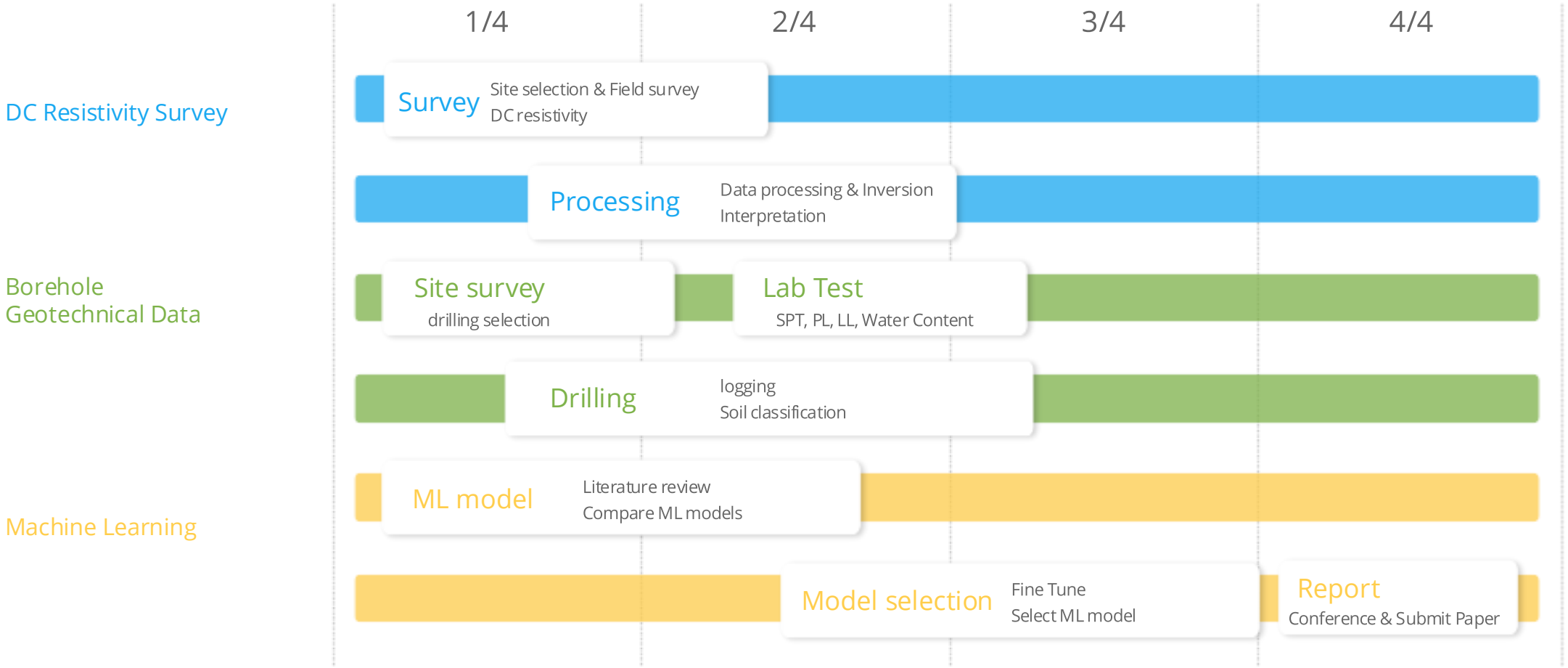
*2. **Find parameters correlation***
(rho vs SPT, rho vs wn, etc.)

*3. **Apply various ML model***



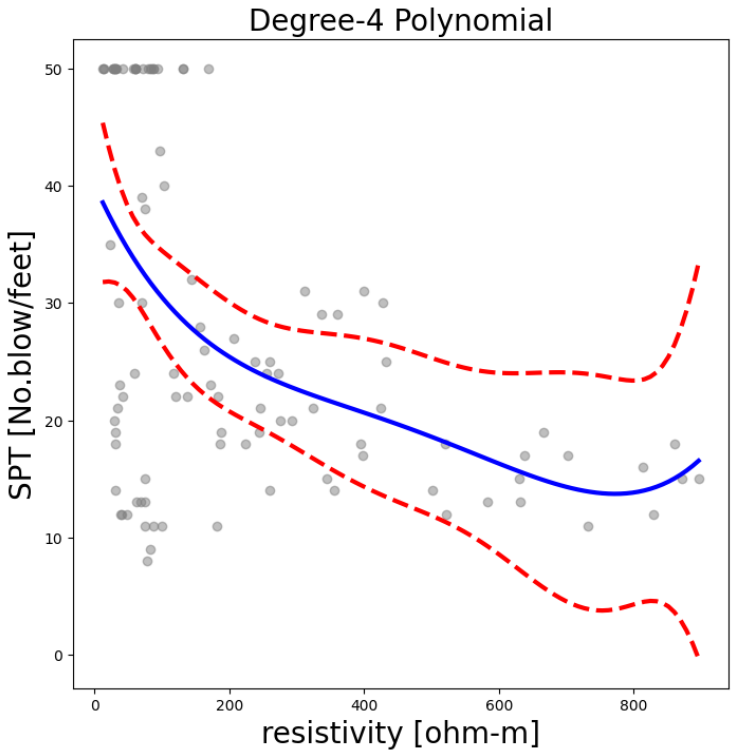
Project Description(2/4)

- *Project Milestones (1-year plan)*



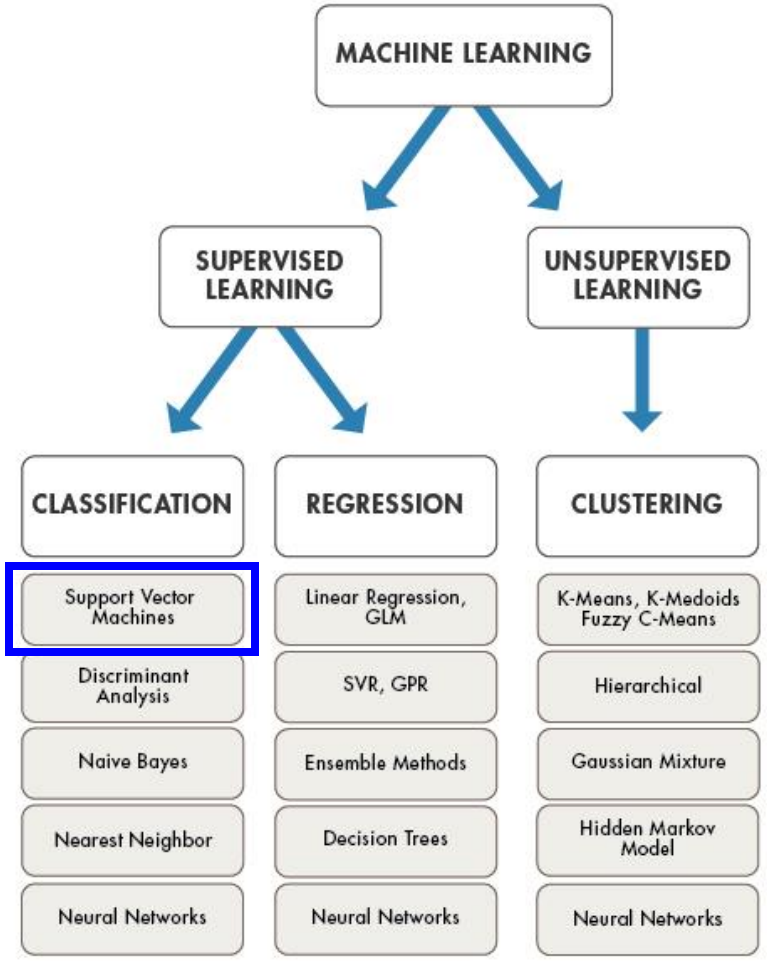
Project Description(3/4)

1. ***Increase more training data*** *(gray dot)*
2. *2.* ***Find parameters correlation*** *(blue line)*



Preliminary results

3. ***Apply various ML model***



https://www.mathworks.com/help/stats/machinelearningtypes.jpg

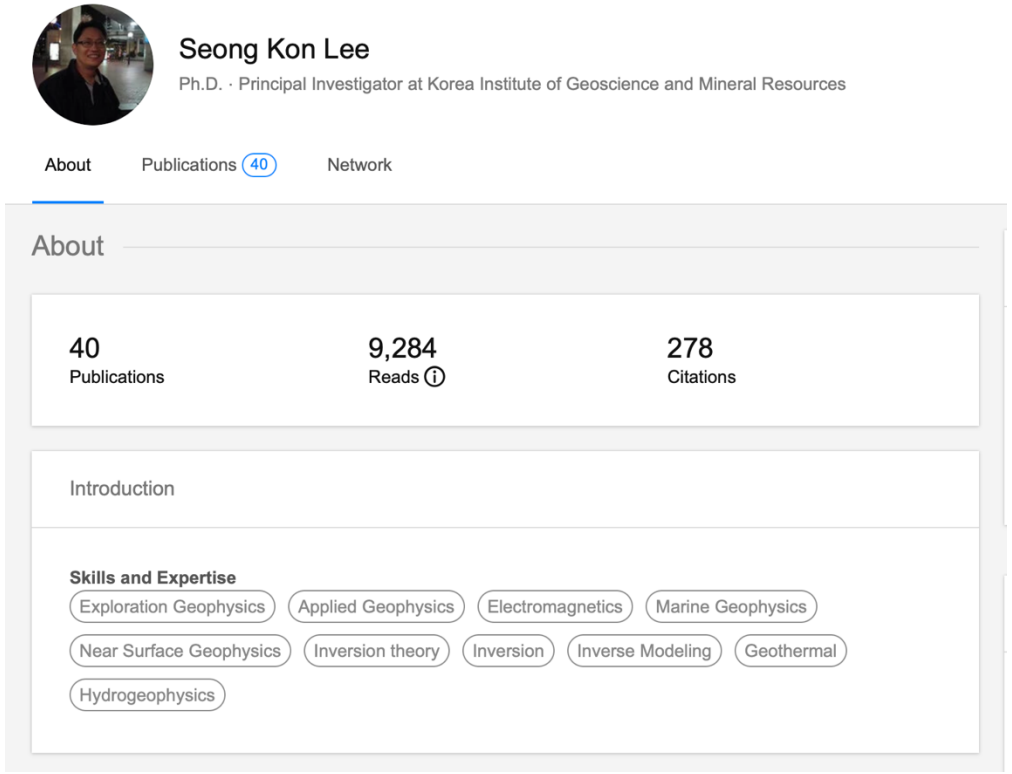
Project Description(4/4)

- *Collaboration & Exchange*

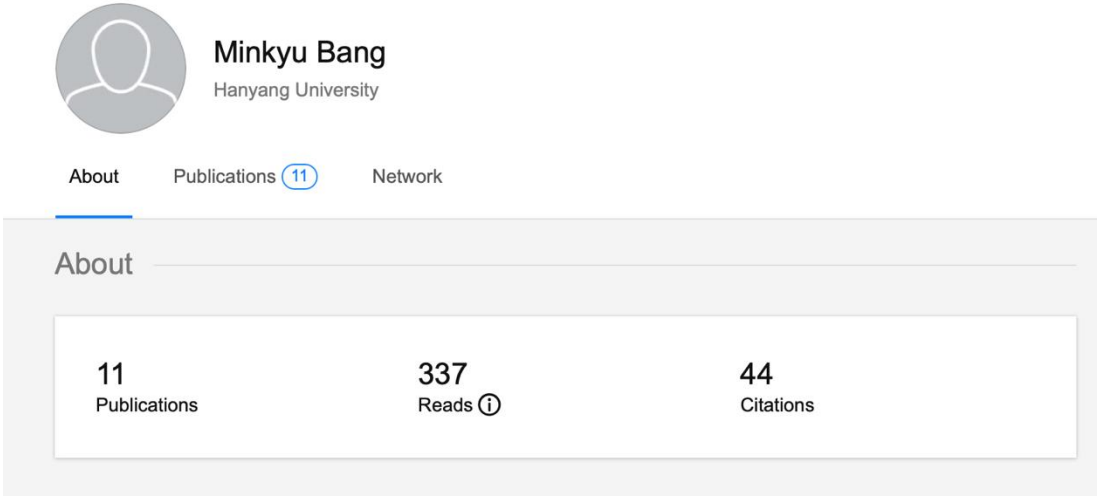
Machine learning on Geophysics data

Machine learning on Inversion Technique

Future corroborations



https://www.researchgate.net/profile/Seong-Kon-Lee

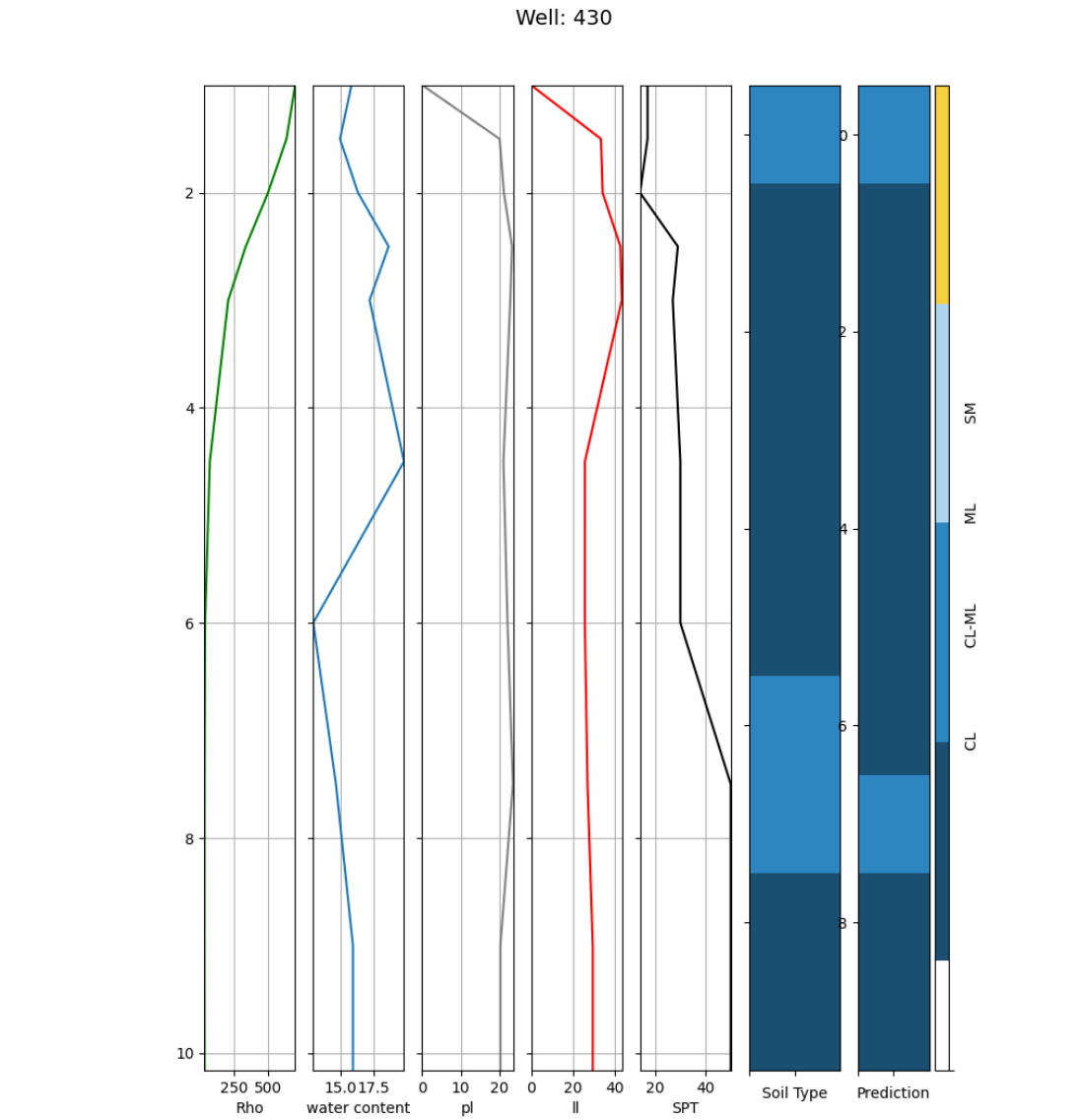


https://www.researchgate.net/profile/Minkyu-Bang

Expected Outcomes & Impact

- *1 publications*
- *Machine learning for Soil classification using DC resistivity and Geotechnical data*

- *Automatically soil classification*
- *Basement boundary*
- *reduce drilling cost*



Estimated Budget

1
- *1 line DC resistivity survey*

500 m : 100,000 baht [4.35M won]

2
- *Geotechnical data*
- *5 boreholes, 100 samples*
- *264,825 baht [11.5M won]*

3
- *Operations & manpower [~3M won]*
- *Conference*
- *publication*

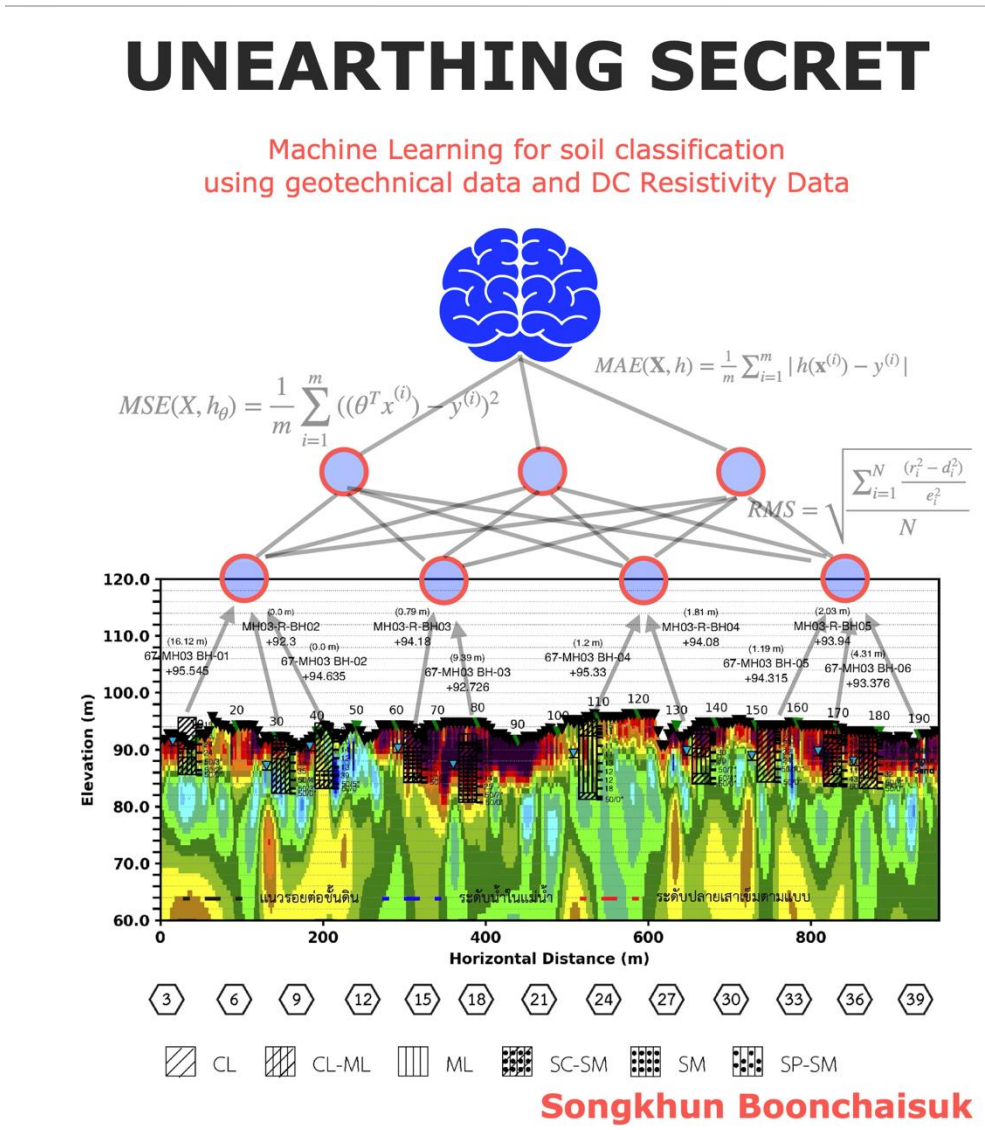
1 area *~ 15M won (5 boreholes and 100 sample*

4 area ~

			Ten Consultants Co., Ltd.		
No.	list	unit	rate (baht/unit)	unit	amount bath
1)Price for geotechnical data					
	1) Transportation (Onland Drilling)				
	- round-trip	trip/car	50,000.00	1	50,000.00
	- between borehole	trip/car	1,500.00	5	7,500.00
	Drilling				
	- drilling with SPT test (SPT)	meter	1,000.00	100	100,000.00
	- การทดสอบการรั่วซึมแบบ Gravity Test ในชั้นดิน	hole	500.00	0	0.00
	2) Lab samples				
	1) Sieve Analysis	ตัวอย่าง	300.00	100	30,000.00
	2) Hydrometer Analysis	ตัวอย่าง	400.00	100	40,000.00
	3) Atterberg Limits	ตัวอย่าง	200.00	100	20,000.00
	4) Standard Compaction Test	ตัวอย่าง	1,500.00	0	0.00
	5) Permeability Test	ตัวอย่าง	1,700.00	0	0.00
	6) Dispersion (Pinhole Test)	ตัวอย่าง	1,200.00	0	0.00
	7) Direct Shear Test	ตัวอย่าง	3,000.00	0	0.00
	sum				**247,500.00**
Vat 7 %					**17,325.00**
Total					**264,825.00**

Conclusion

- *Reduces (drilling)* ***cost***
- *ML to find* ***insight*** *correlation*
- *Reduce* ***time*** *& Increase* ***accuracy*** *for interpretation (boundaries)*
- *Apply ML to many Geophysical techniques*



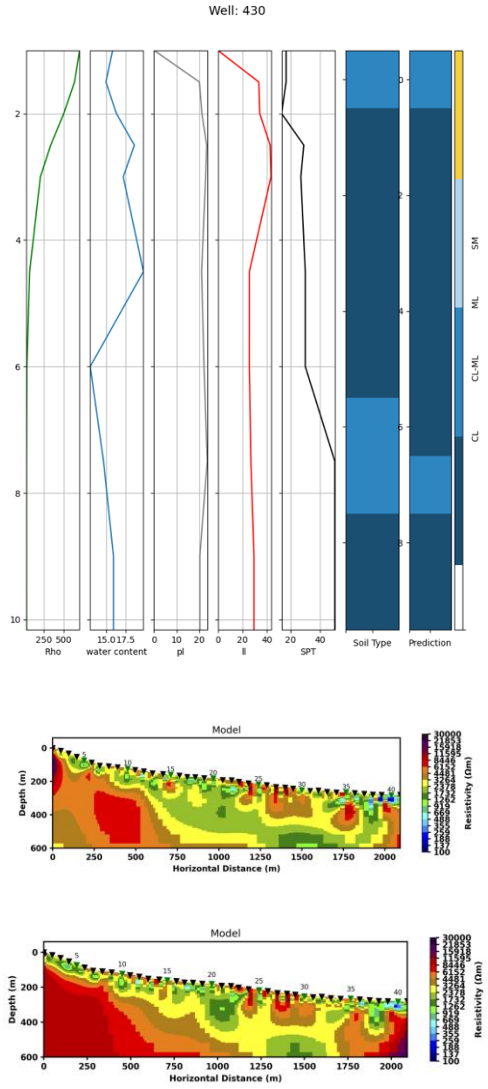
References

1. *Hastie, T., Tibshirani, R., & Friedman, J. (2009). The Elements of Statistical Learning: Data Mining, Inference, and Prediction. Springer Series in Statistics.*
2. *McKinney, W. (2017). Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython. O-Reilly Media.*
3. *Hall, B. (2016). Facies classification using machine learning. The Leading Edge 35: 906–909. https://doi.org/10.1190/tle35100906.1*
4. *Pedregosa, F., et al. (2011). Scikit-learn: Machine Learning in Python. Journal of Machine Learning Research, 12, 2825-2830.*

https://github.com/Songkhun/SIP2025

Activities & Experiences in Korea

Preliminary result: ML on DC resisitivity



APEC Scientist Invitation Program to Korea 2025

THANK YOU FOR YOUR ATTENTION

https://github.com/Songkhun/SIP2025