Short-term Wind Power Prediction: A Deep Learning Predictive Model Using Reanalysis and Ground Station Data

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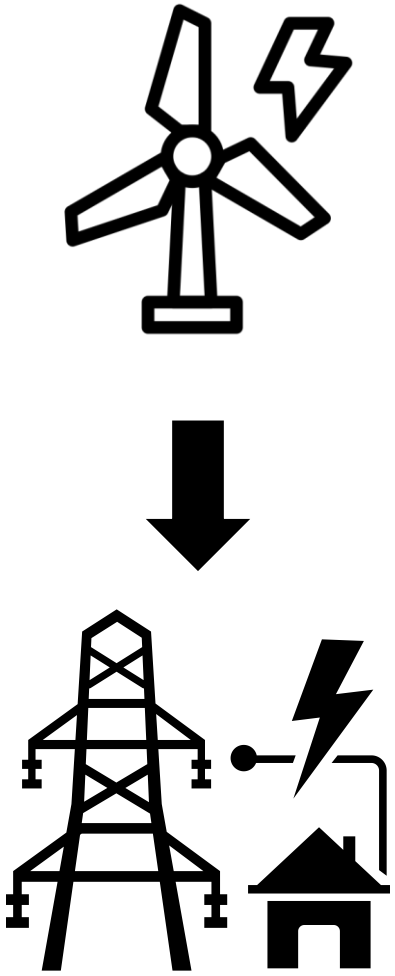
Energy Economy Environment
E3 Group

National Taiwan University

I/ Background



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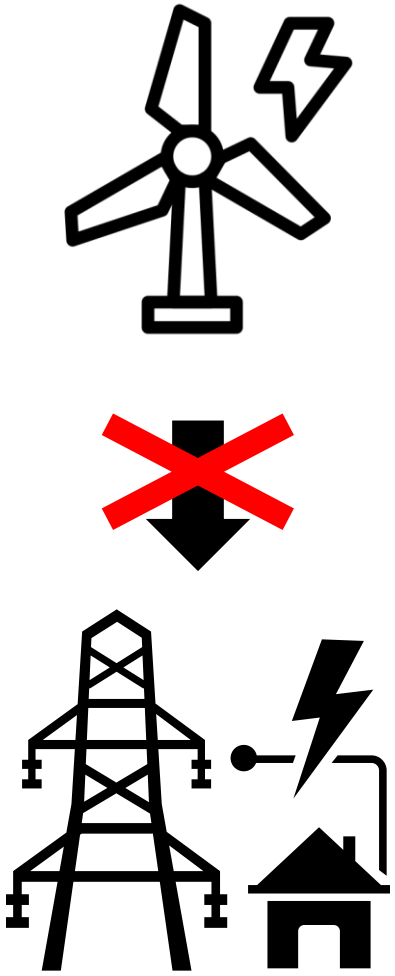

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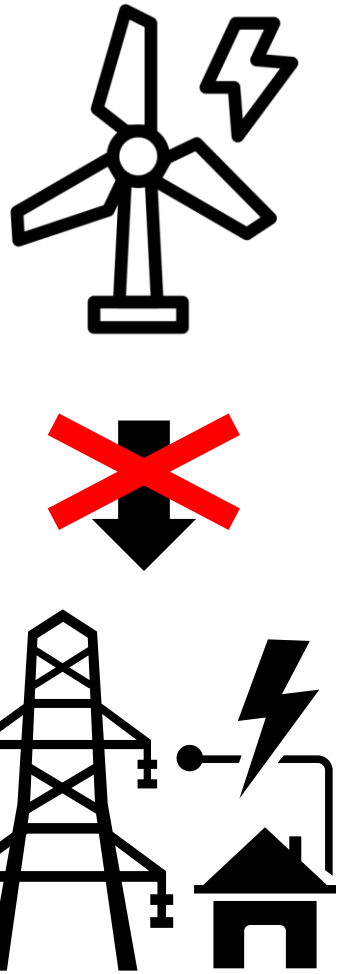

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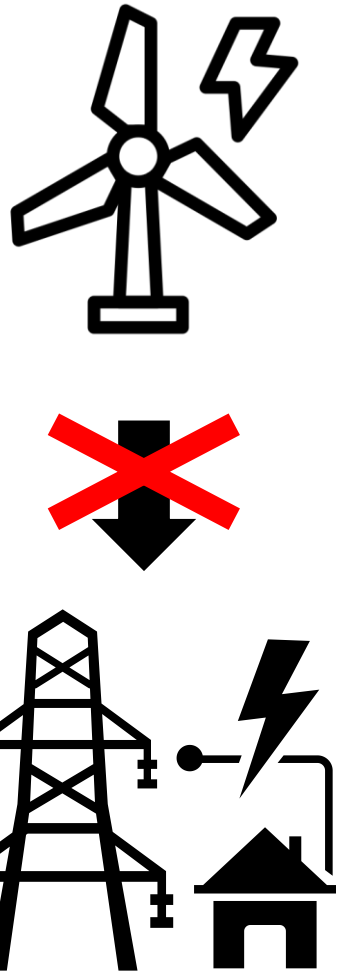

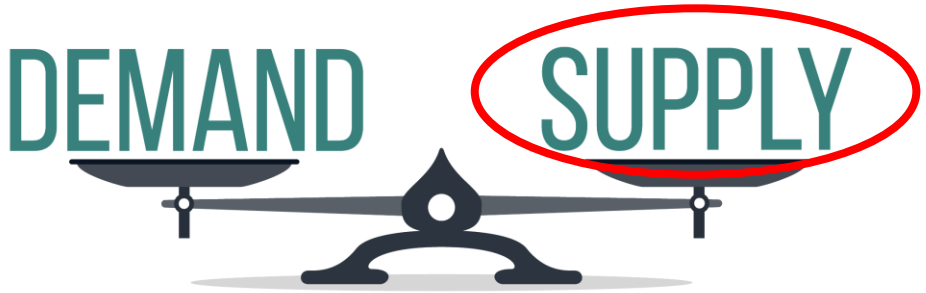

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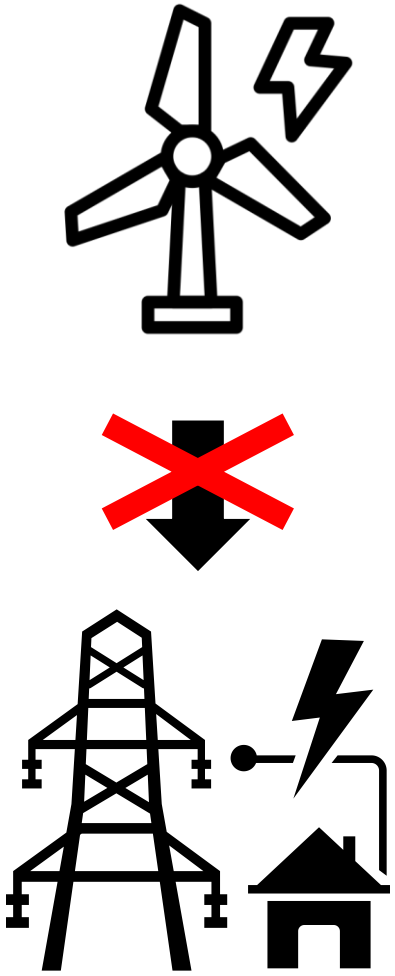

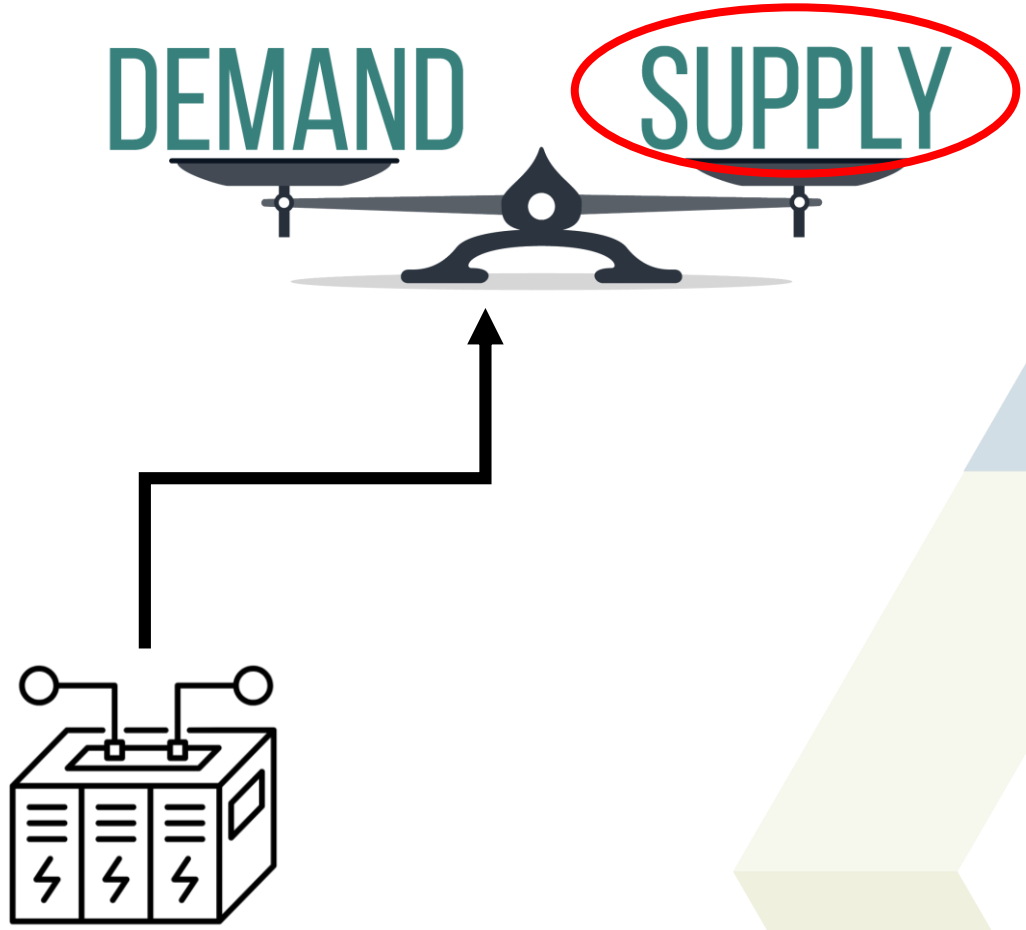

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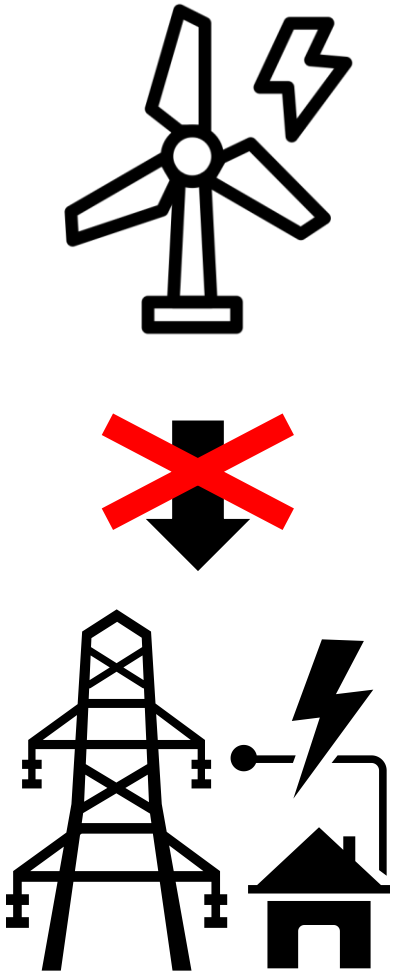
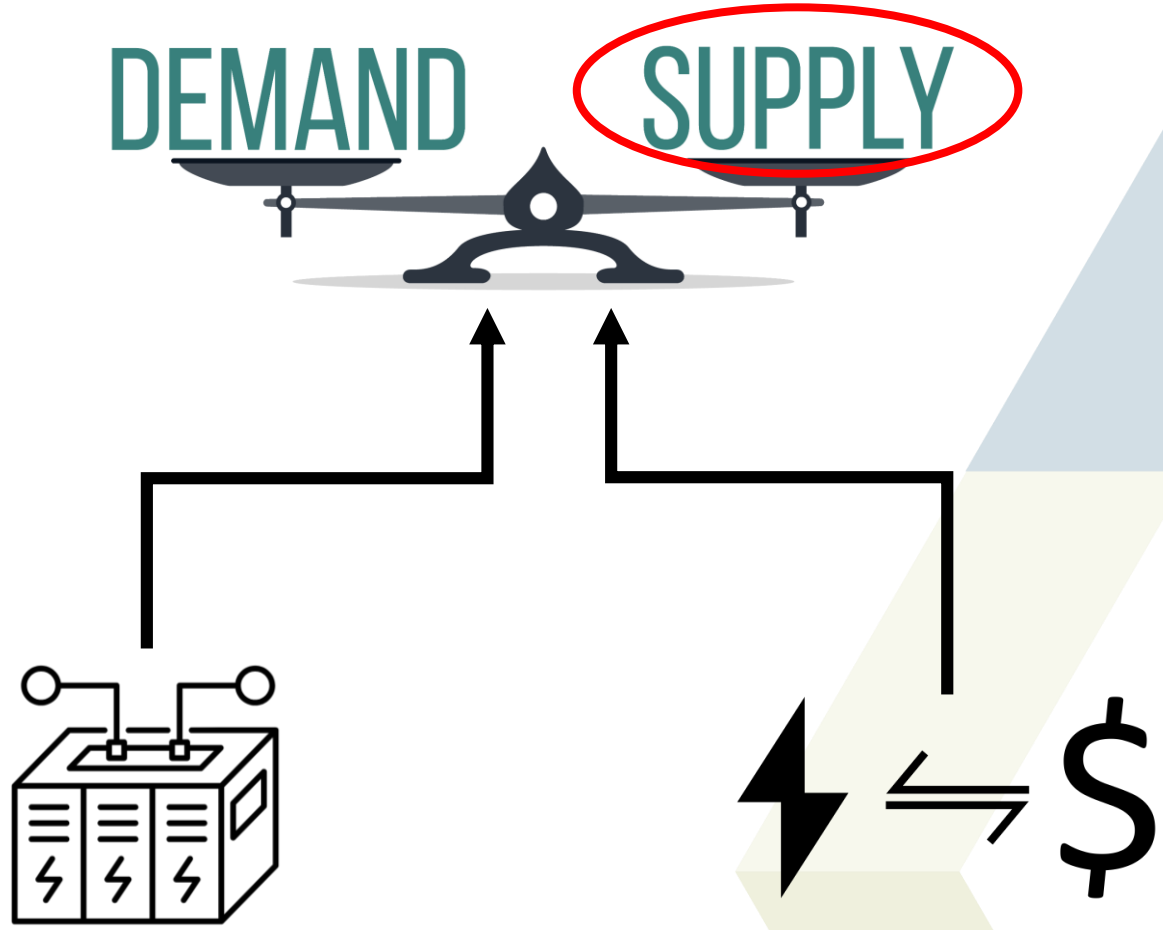




I/ Background

Data Acquirement

Data Quality

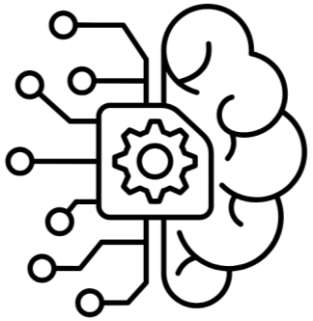
Model Generalization

M/ Project Aims

Data Collection

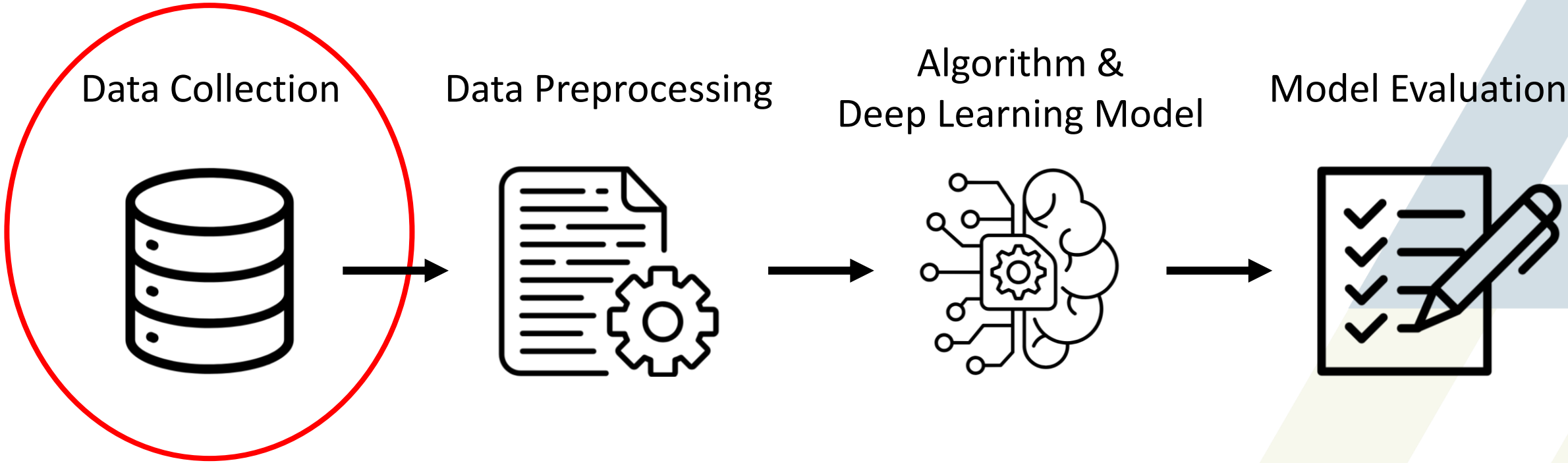
Data Preprocessing

Algorithm &
Deep Learning Model



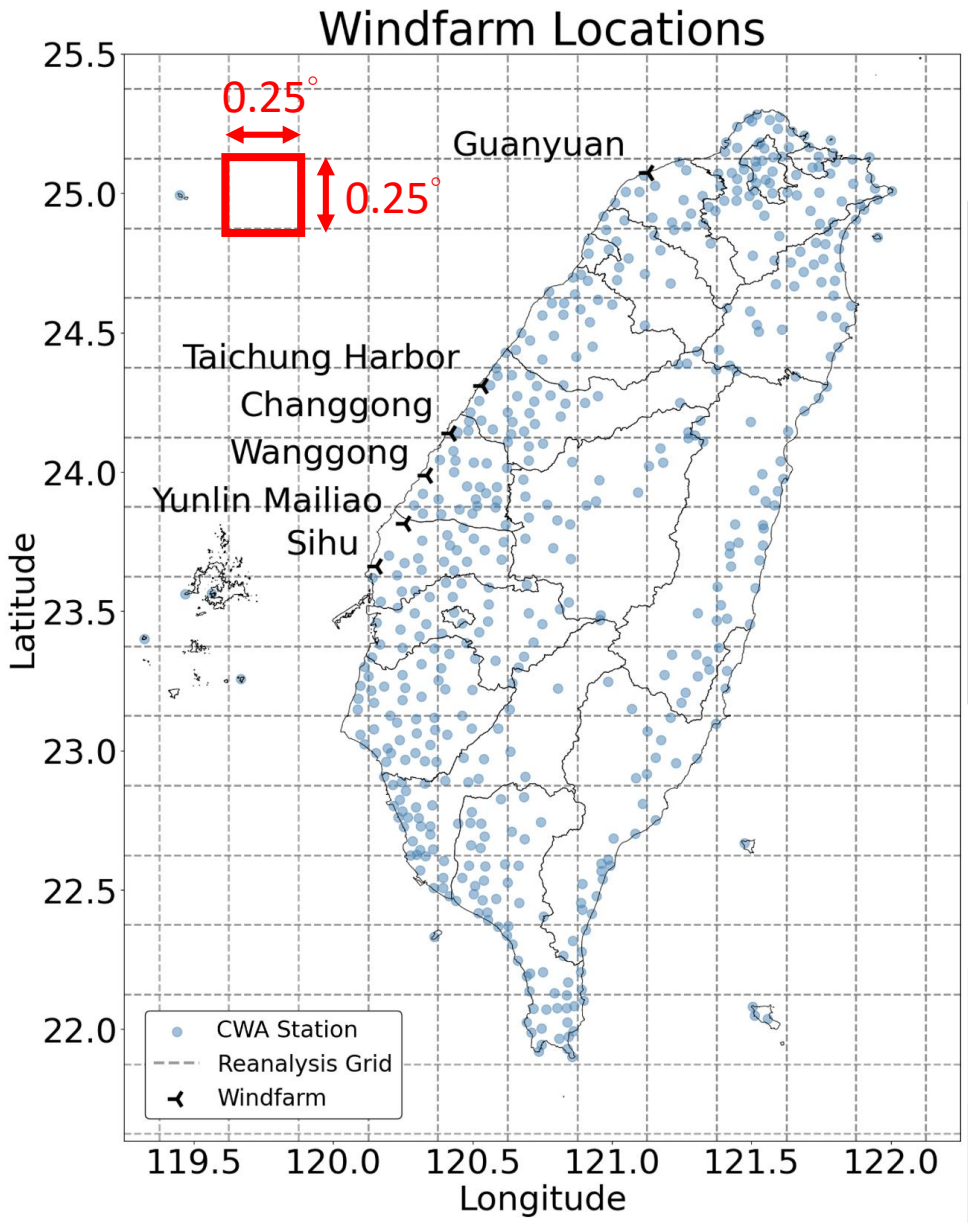
Model Evaluation

M/ Project Aims



M/ Meteorological Data

- Reanalysis Data
  - ✓ ERA5 on single level
- Ground Station Data
- Hybrid Data

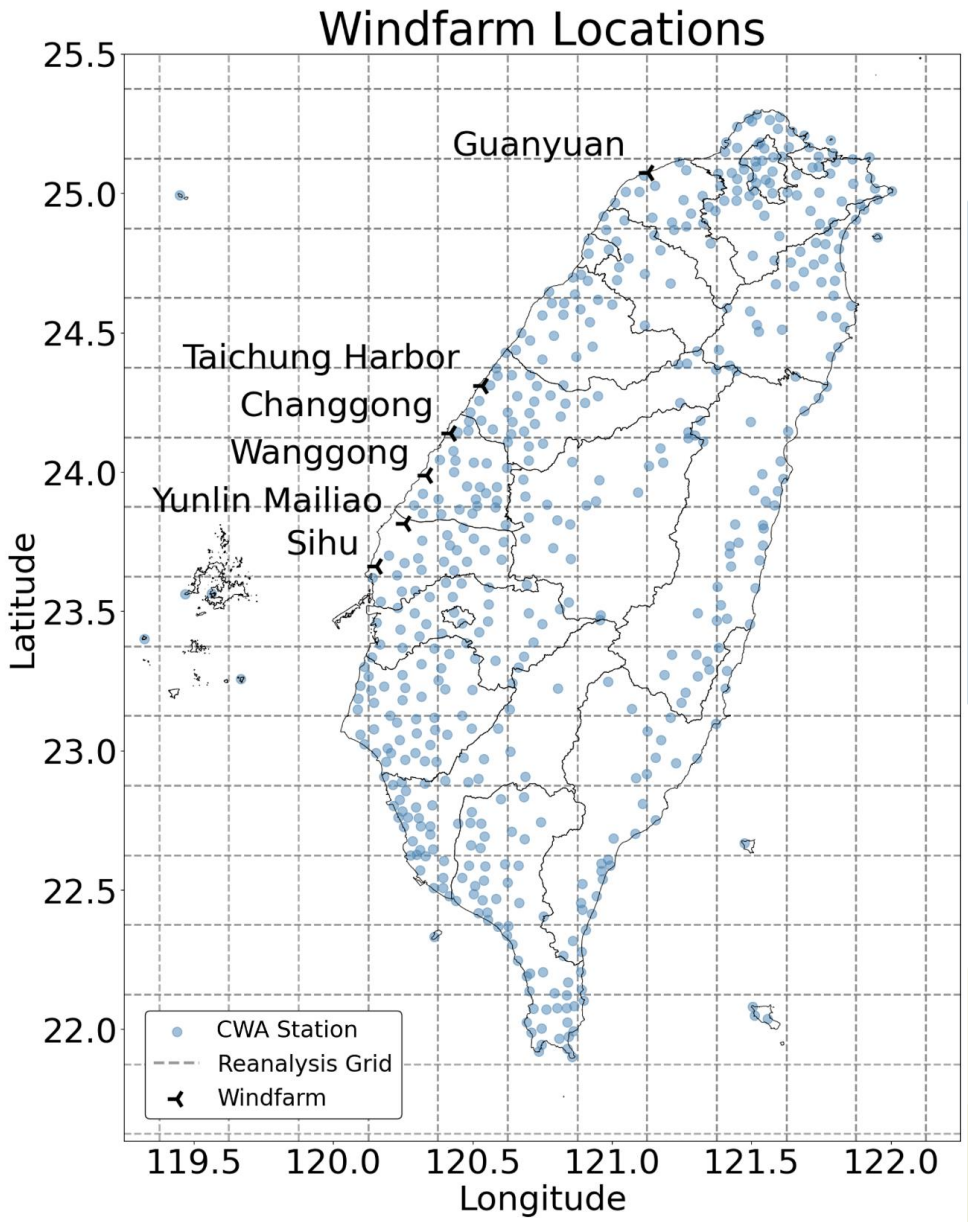


M/ Wind Farm Data

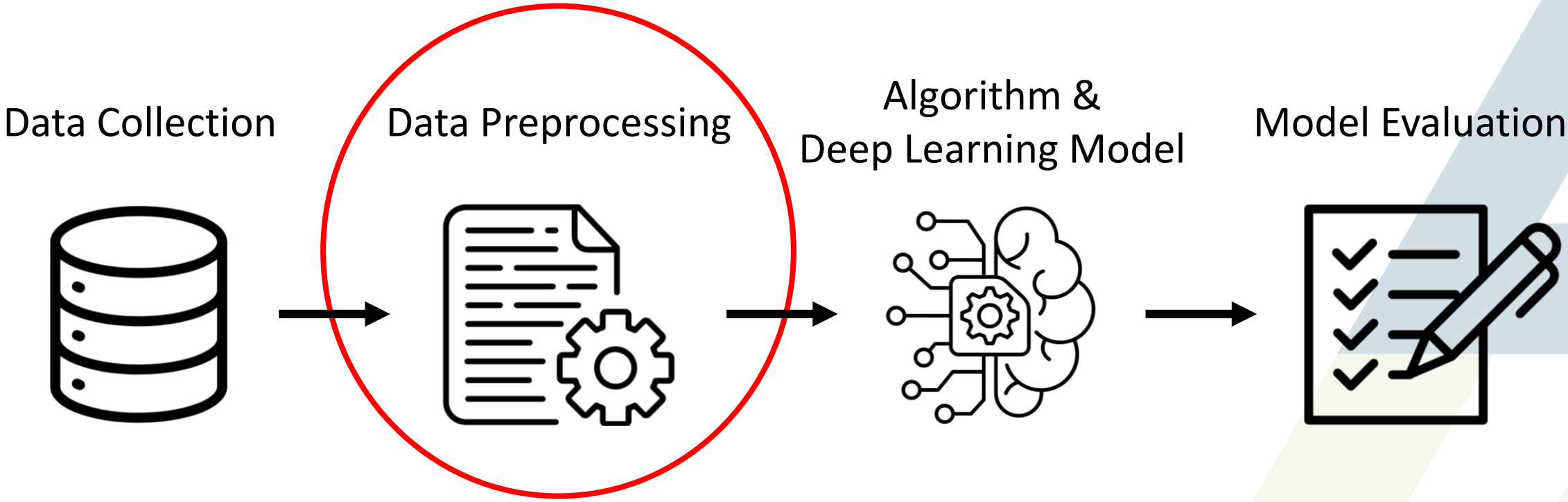
- Wind Power Generation

$$\text{Capacity factor} = \frac{\text{Generation}(MkWh)}{1(h)\times\text{Capacity}(MkW)}$$

- Informational Factors
  - ✓ Numerical Factors
  - ✓ Categorical Factors



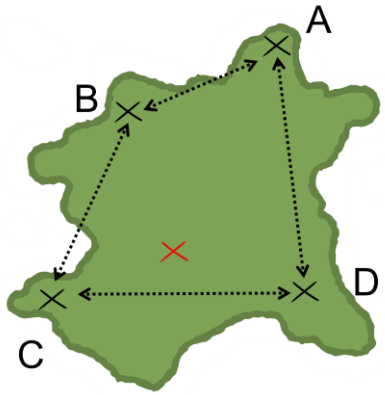
M/ Project Aims



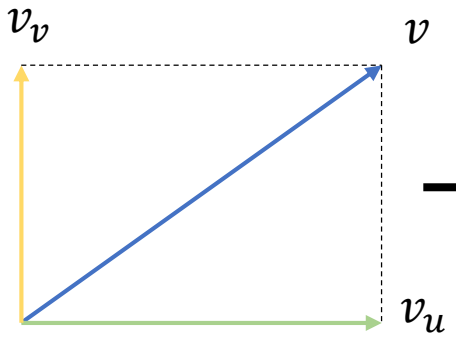
M/ Ground Station Data - Component Kriging Interpolation

The standard averaging method is not applicable to **Wind Direction.**

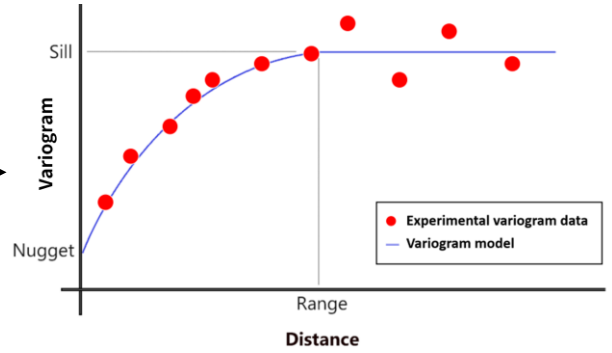
Observed Value



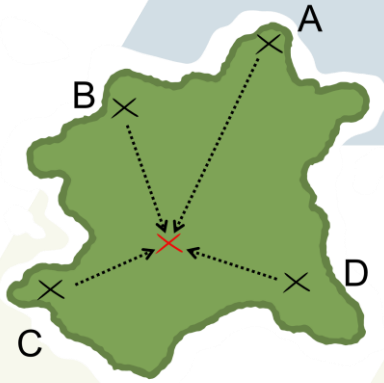
Vector Decomposition



Variogram Model

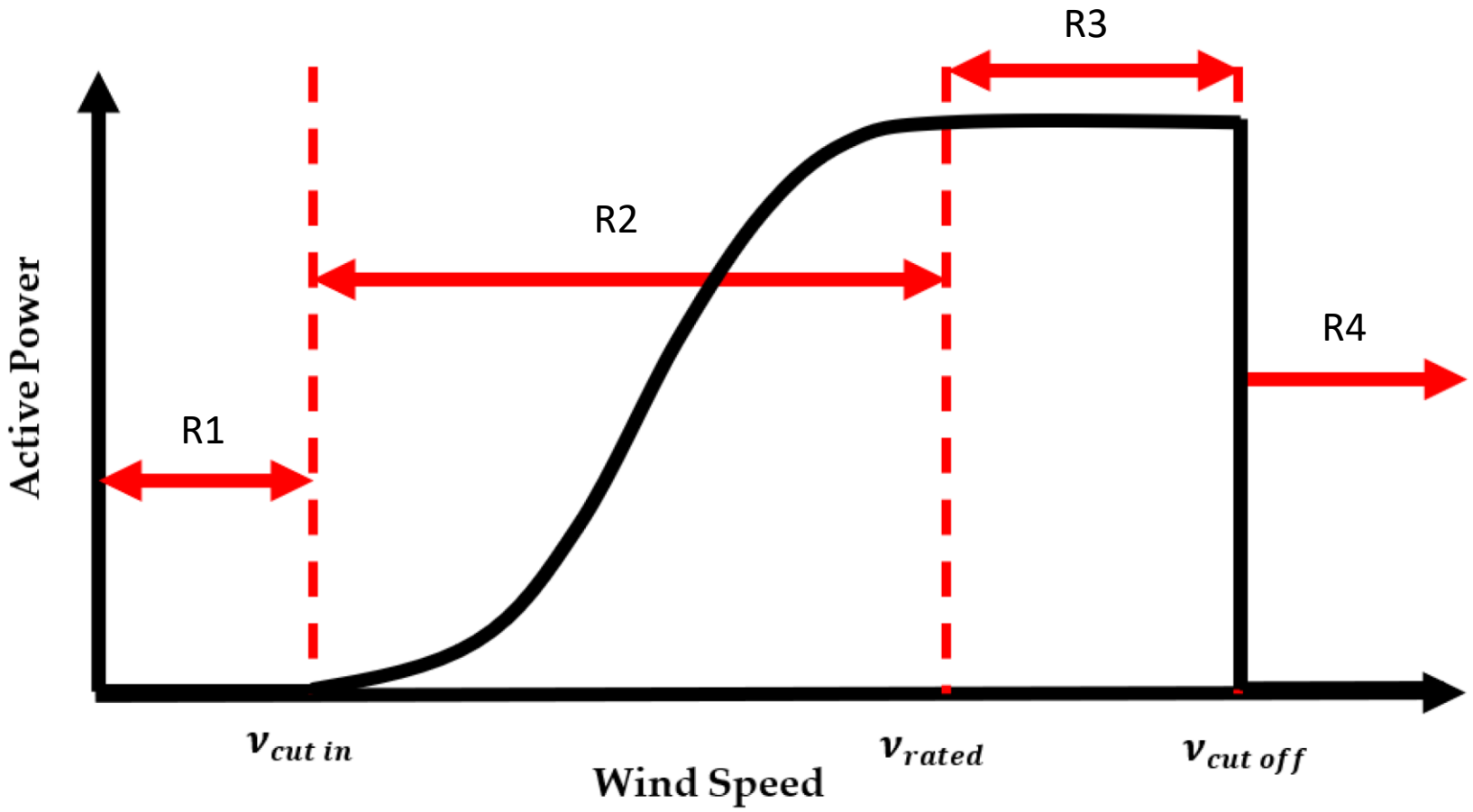


Interpolated Value



M/ Wind Power – Wind Power Curve

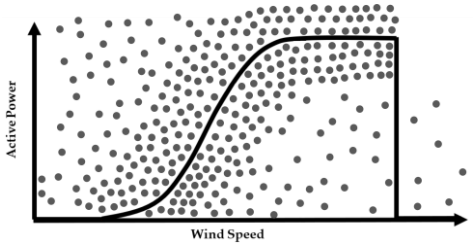
Theoretical relation between wind speed and wind power



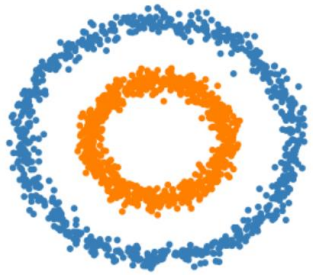
M/ Outlier Removal

Given that the data will align with the wind power curve

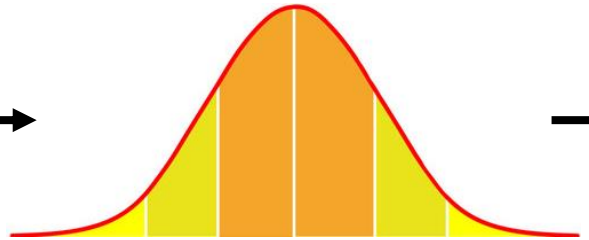
Raw Data



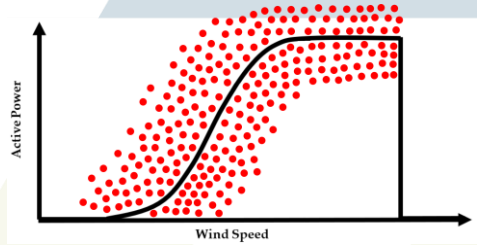
DBSCAN Algorithm



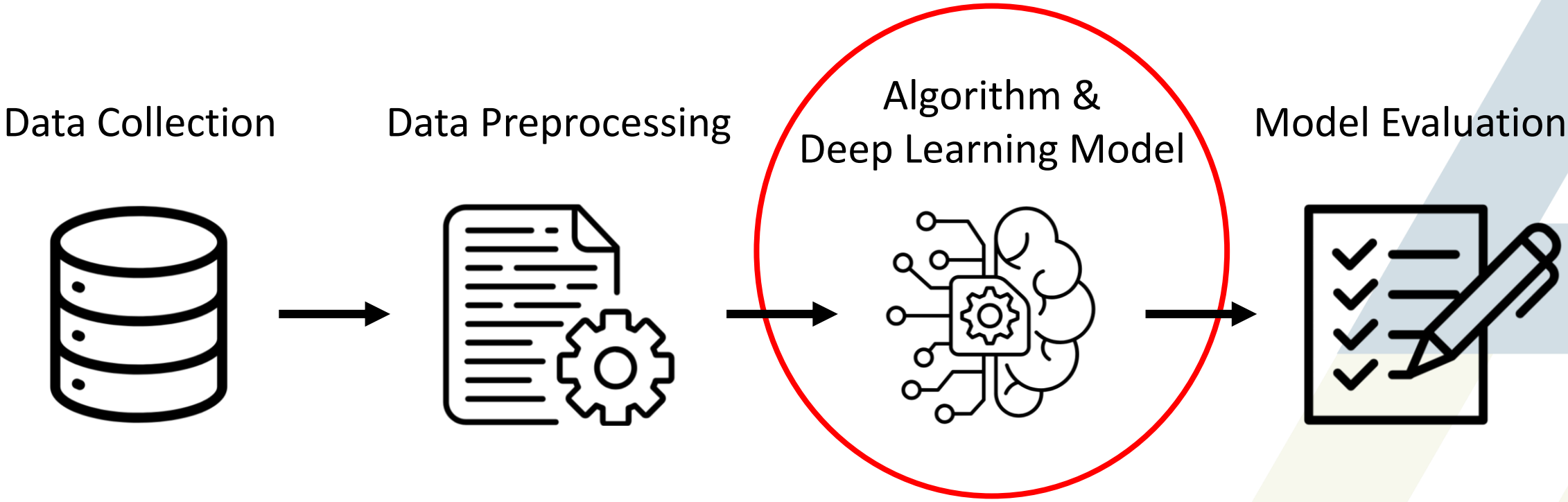
3 Sigma Principle



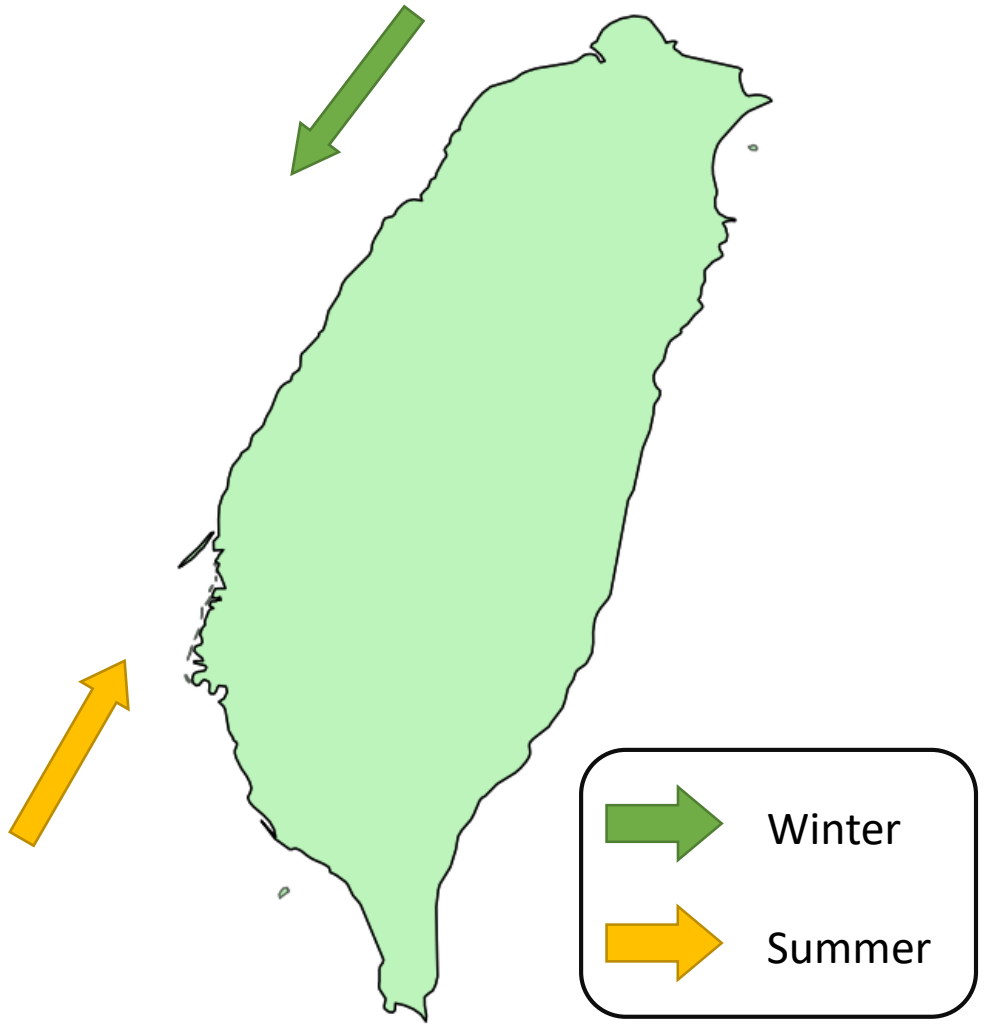
Normal Data

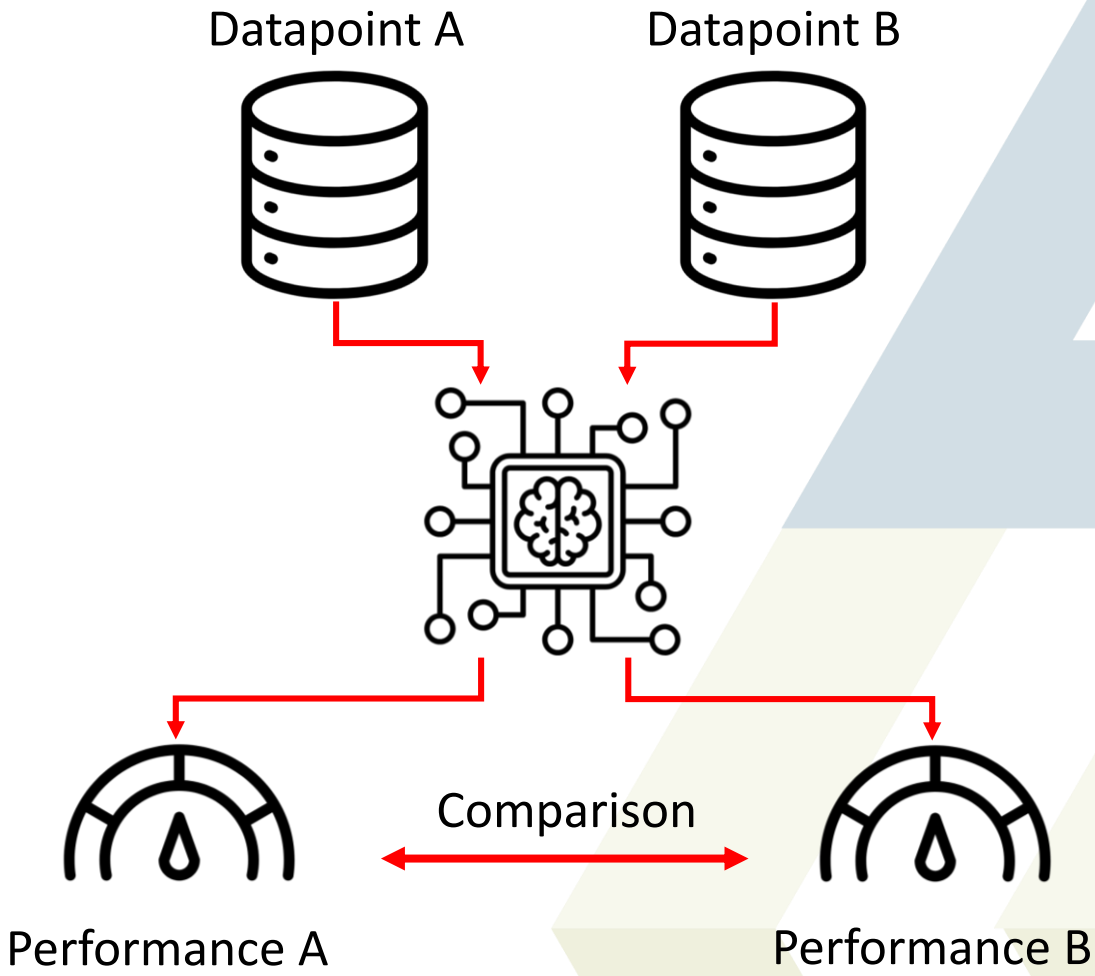


M/ Project Aims



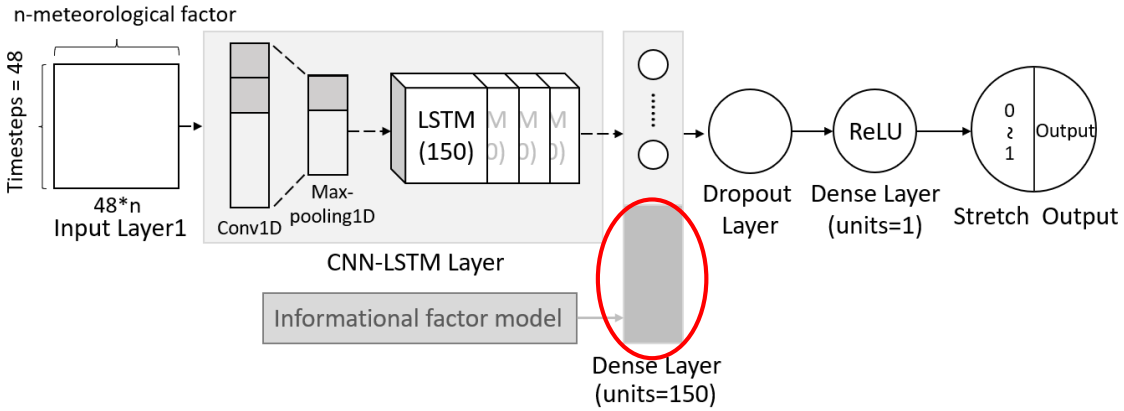
M/ Performance Based Clustering



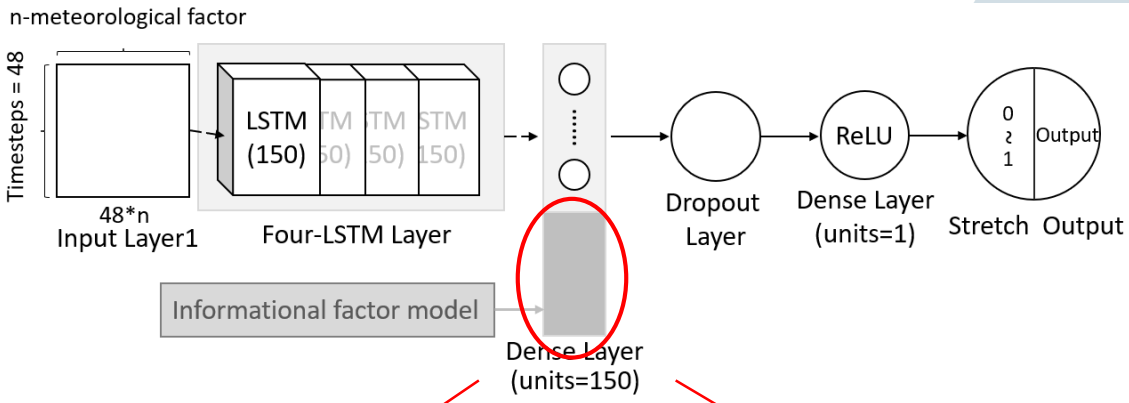


M/ Deep Learning Model

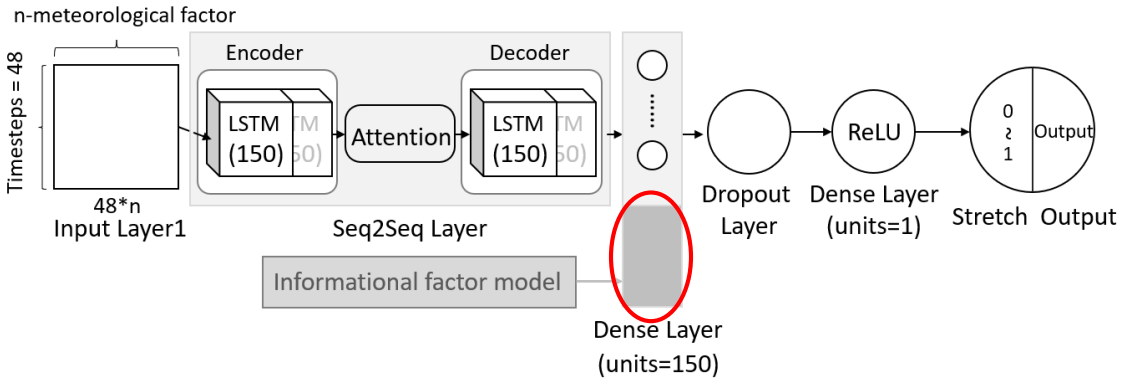
CNN-LSTM



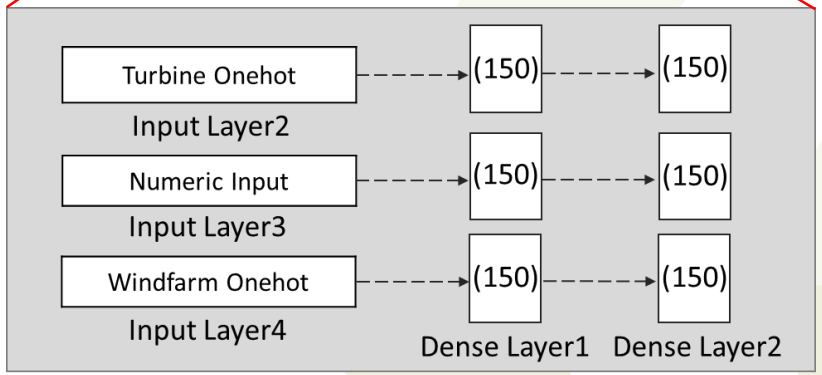
LSTM



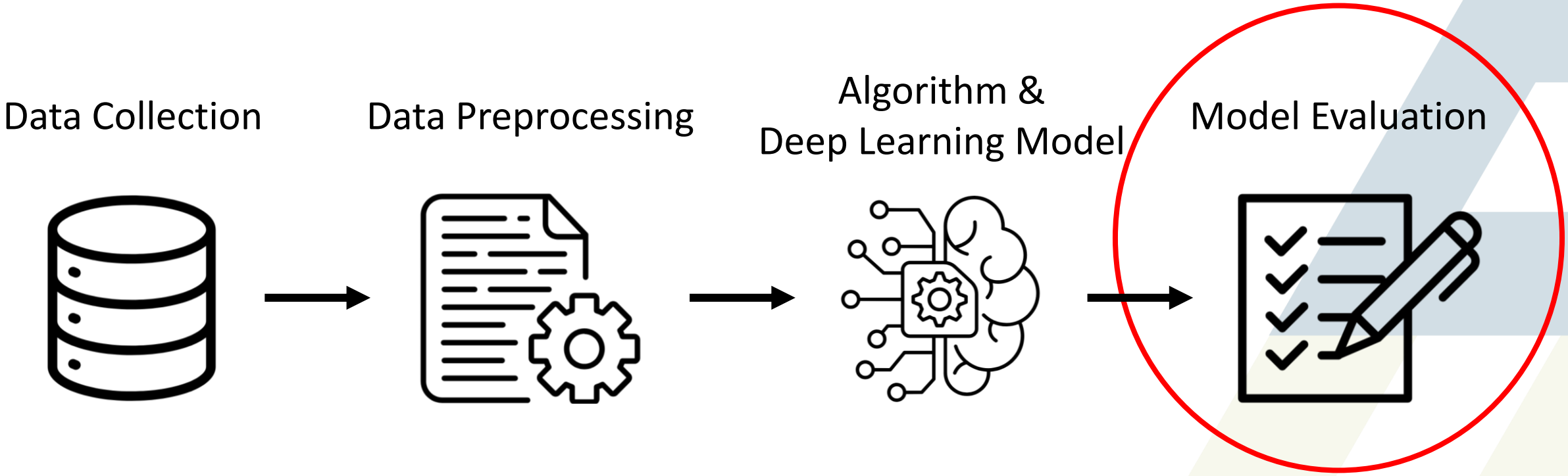
Seq2Seq



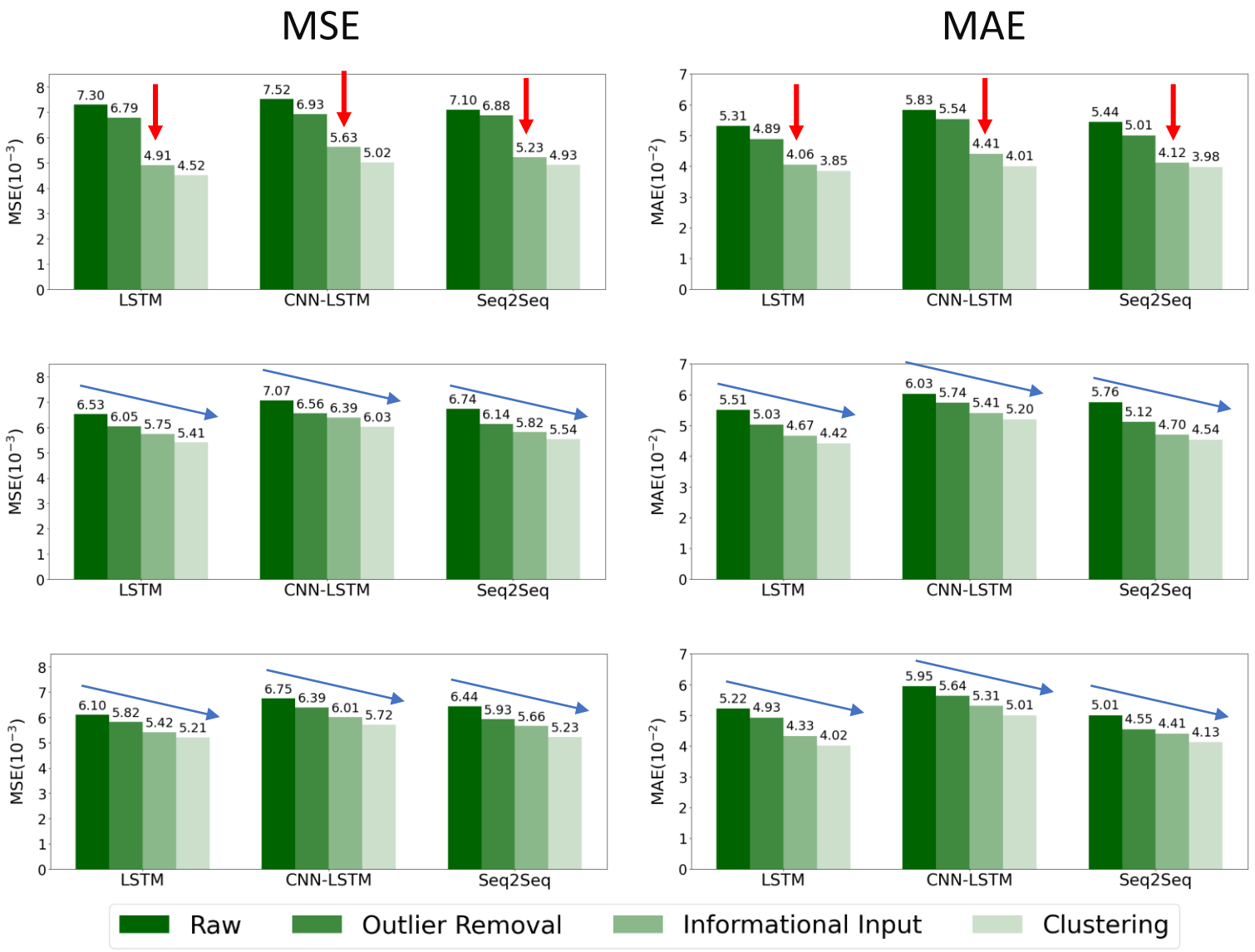
Informational MLP



M/ Project Aims



R/ Data Preprocessing



R/ Consolidated Data Processing

	Data	Processing	Wind Farm					
			Guanyuan	Taichung Harbor	Changgong	Wanggong	Yunmai	Sihu
R^2	Reanalysis	Consolidated	**0.958**	**0.951**	**0.953**	**0.973**	**0.943**	**0.938**
		Individual	0.939	0.941	0.939	0.956	0.926	0.921
	Ground Station	Consolidated	0.935	0.933	**0.952**	**0.954**	**0.943**	**0.928**
		Individual	**0.942**	**0.942**	0.943	0.953	0.935	0.922
	Hybrid	Consolidated	0.944	0.940	**0.953**	0.951	**0.945**	**0.940**
		Individual	**0.948**	**0.949**	0.945	**0.958**	0.939	0.929

Future Work

- The **timely acquisition** of reanalysis data still need to be explored.
- A broader exploration of **variables** is crucial for the more precise forecasting goals.
- The **applicability** of the proposed framework to other energy sources, such as offshore wind power or PV, still needs to be investigated.

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