Self-Healing Performance Assessment of Bacterial-Based Healing Concrete Using Machine Learning Approaches

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Link to publication on Research at Birmingham portal

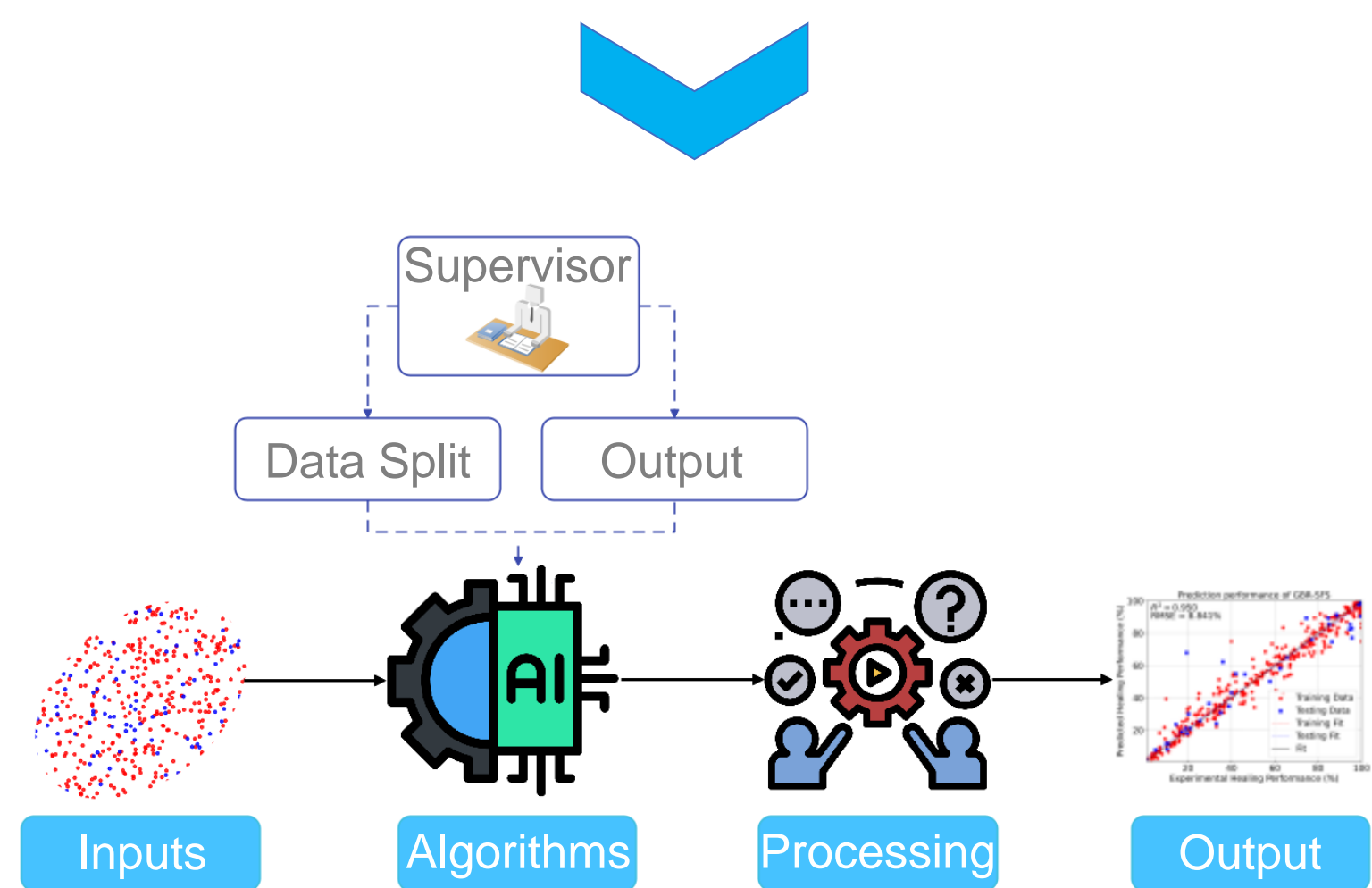# Self-Healing Performance Assessment of Bacterial-Based Healing Concrete Using Machine Learning Approaches

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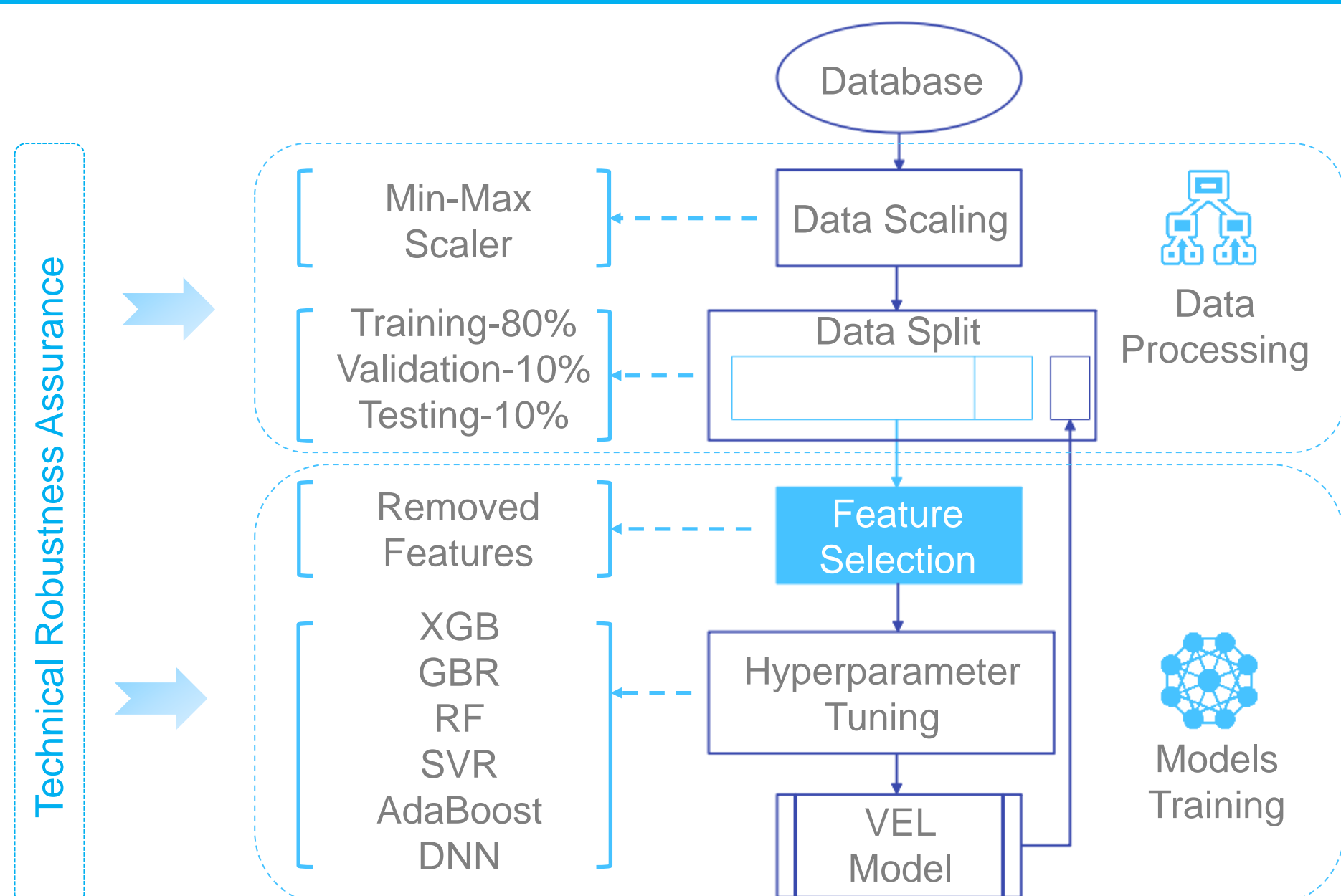
UNIVERSITY OF BIRMINGHAM

Aims and Objectives

- This research aims to understand and predict the self-healing performance of bacterial-based self-healing concrete by applying machine learning approaches.
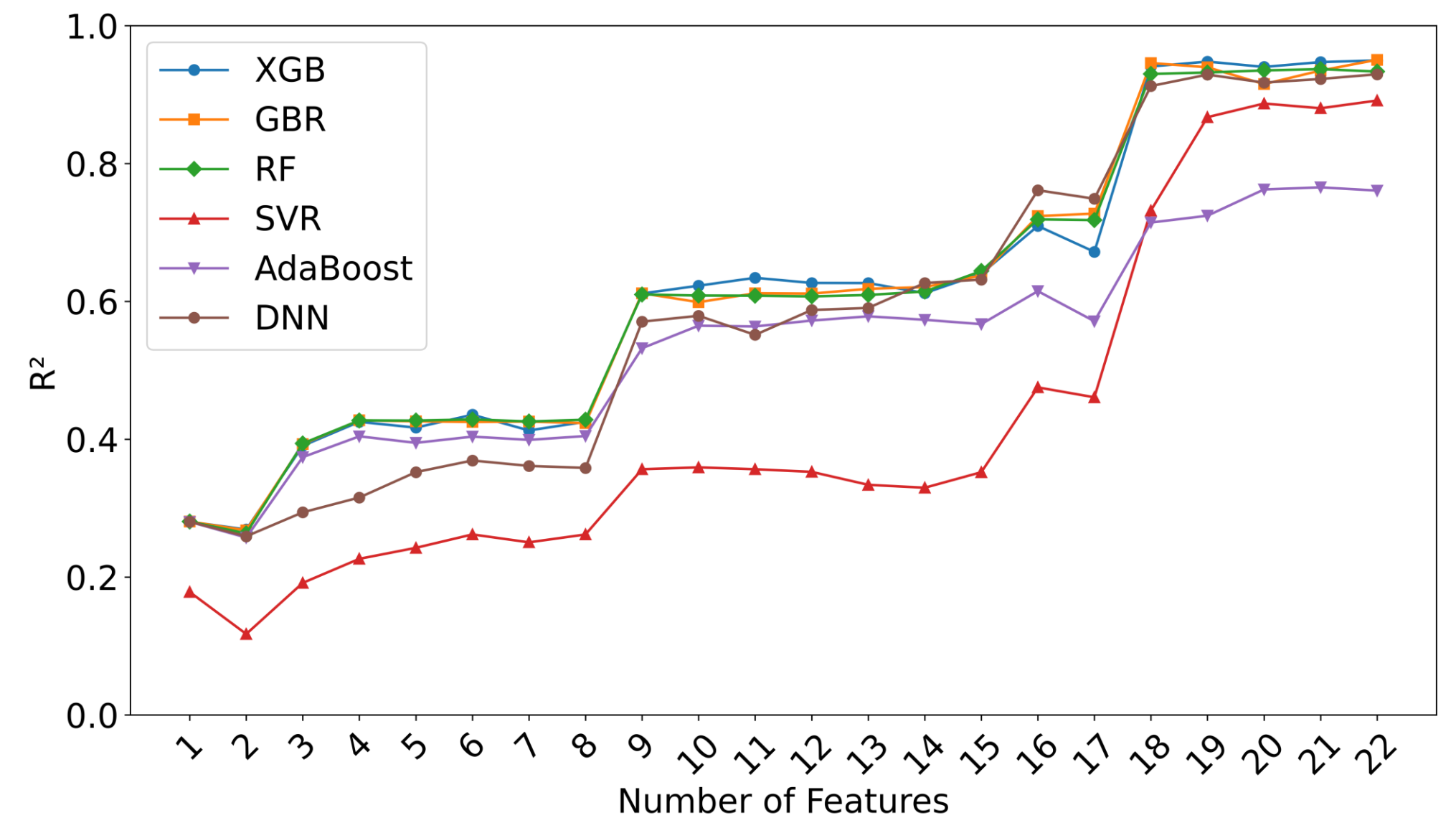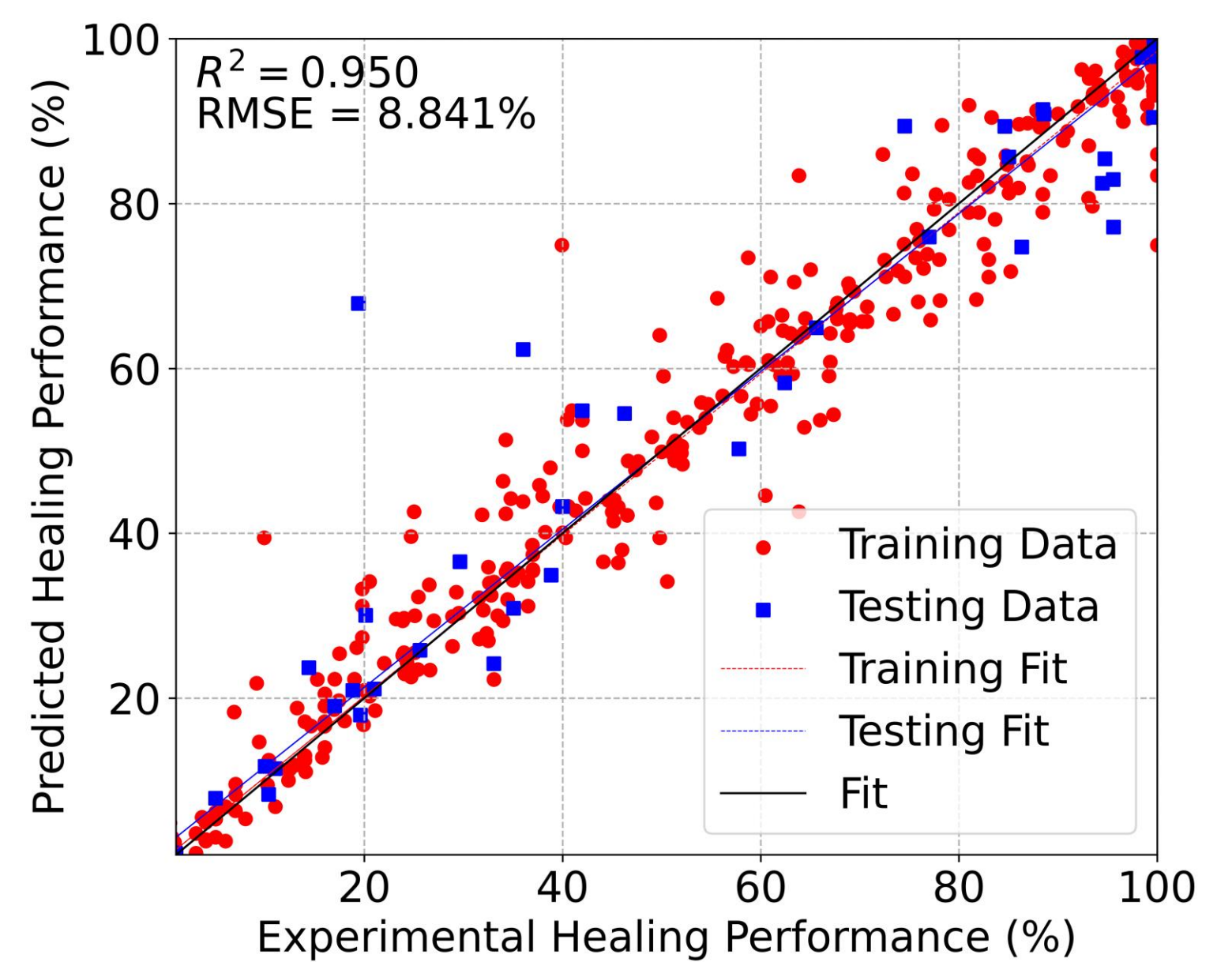
Contextual Background

Ca^{2+} + CO_3^{2-} → $CaCO_3$

Supervisor

Data Split | Output

Inputs | Algorithms | Processing | Output

Methods

Database

Min-Max Scaler → Data Scaling — Data Processing

Training-80% Validation-10% Testing-10% → Data Split

Technical Robustness Assurance

Removed Features → Feature Selection

XGB GBR RF SVR AdaBoost DNN → Hyperparameter Tuning → VEL Model — Models Training
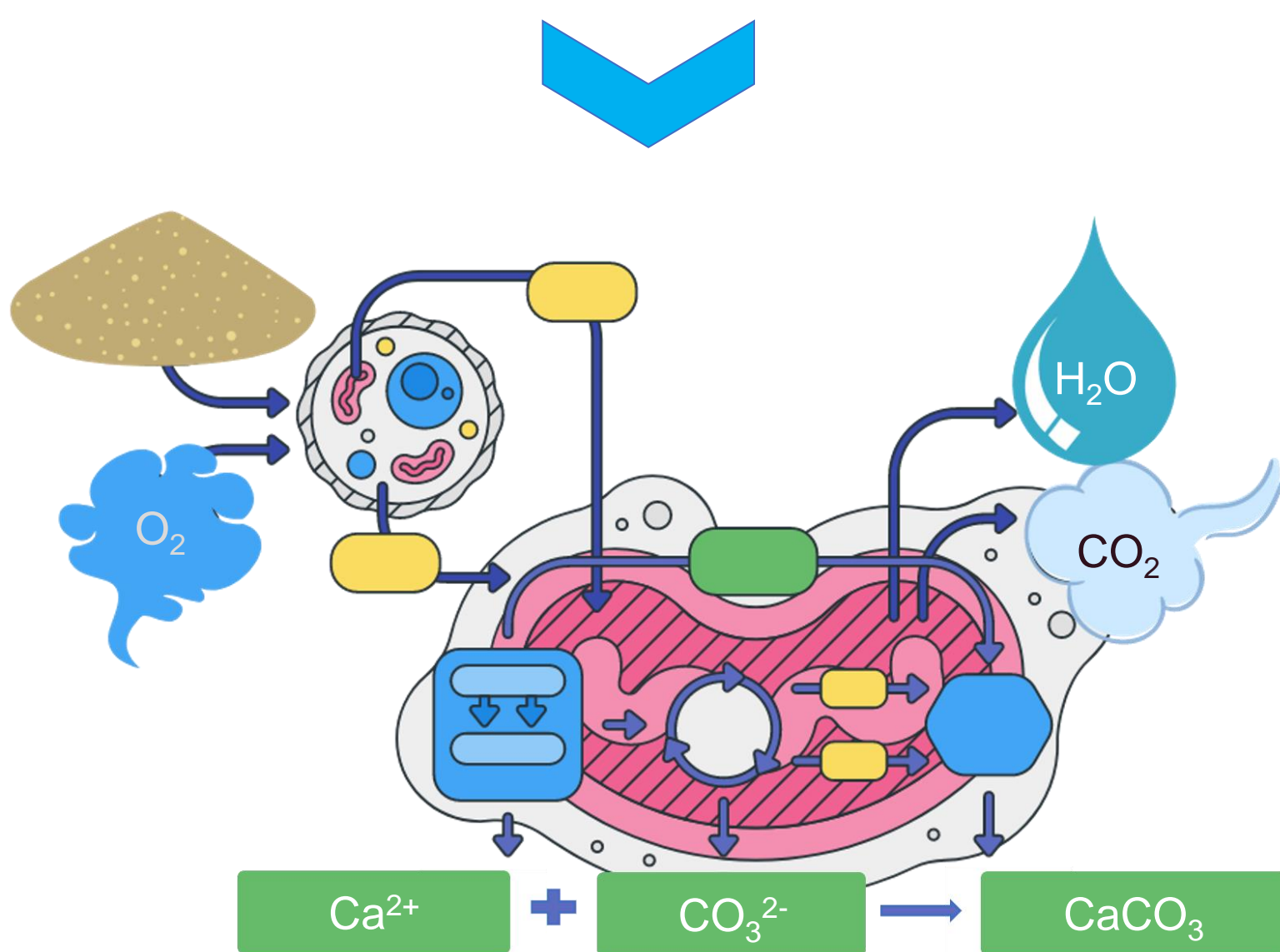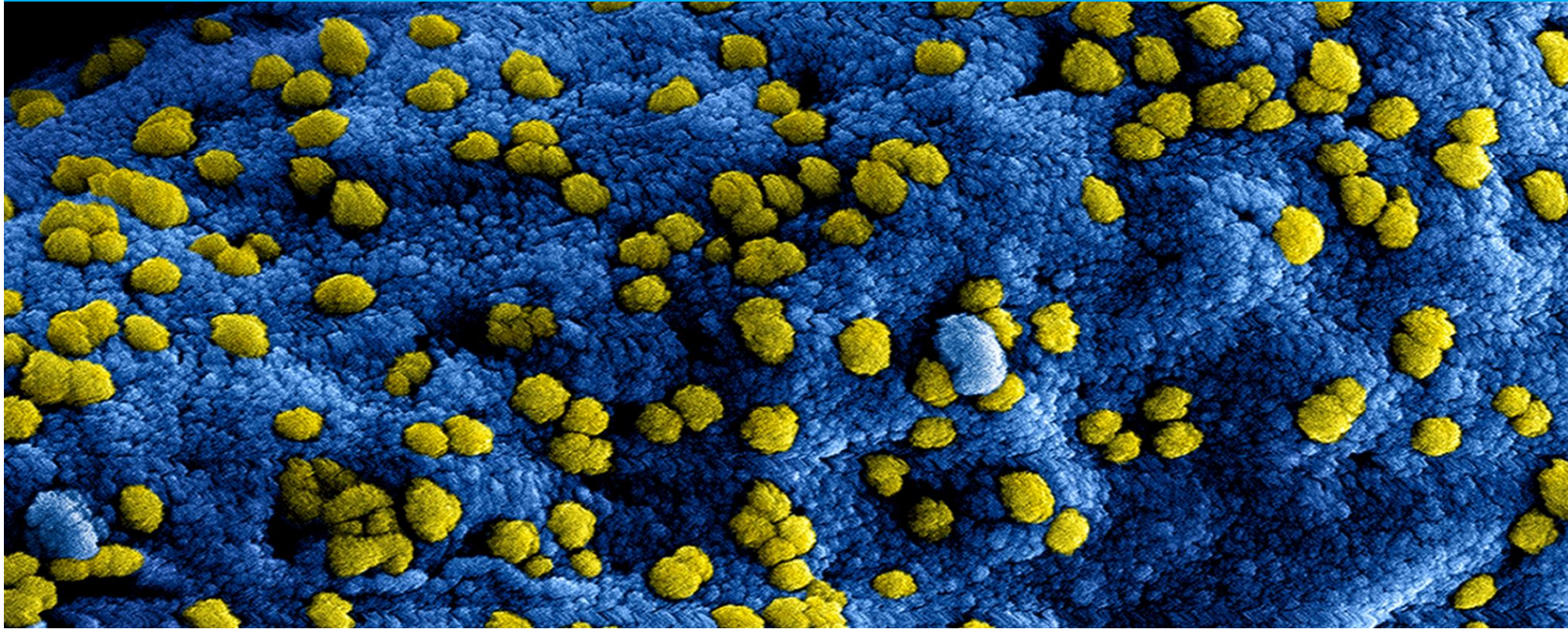
Results

Prediction performance of the machine learning models

$R^2 = 0.950$
RMSE = 8.841%

Prediction performance of GBR model with 22 features

- The **GBR** model with 22 features presents a relatively superior prediction performance in terms of **R² (0.950)** and **RMSE (8.841%)**, compared to the other models.

The Findings in Context

- The **GBR model with 22 features** demonstrates the **best prediction performance** among the other GBR models.

- **HT, DCI, CA, DN and B** have **positive effects** on HP, while **CW, HTM, S and DC** show **negative effects** on HP. **FA, HT, CW and C** exert a **greater influence** on HP.

Conclusions

- The healing performance of bacterial-based healing concrete can be predicted by applying the GBR model with 22 features.

- This technique has the potential to assist engineers in the design of bacterial-based healing concrete, saving the time, resources, and costs associated with laboratory tests.

Key Publications

- Huang, X., Sresakoolchai, J., Qin, X., Ho, Y.F. and Kaewunruen, S., 2022. Self-Healing Performance Assessment of Bacterial-Based Concrete Using Machine Learning Approaches. Materials, 15(13), p.4436.
- Huang, X., Wasouf, M., Sresakoolchai, J. and Kaewunruen, S., 2021. Prediction of healing performance of autogenous healing concrete using machine learning. Materials, 14(15), p.4068.
- Huang, X., Ge, J., Kaewunruen, S. and Su, Q., 2020. The self-sealing capacity of environmentally friendly, highly damped, fibre-reinforced concrete. Materials, 13(2), p.298.