Introduction

- Machine Learning (ML): A computer algorithm learns "cause-effect" correlations during training, and then leverages such knowledge to make predictions in new data-domains.

- Types of machine learning algorithms:
  - Supervised learning: The algorithm trains the machine using the training dataset, and generate reasonable predictions for the response to the new dataset.
  - Unsupervised learning: Find the underlying structure or distribution of the dataset without any training process.

- Applications:
  - Online recommendation offer
  - Self-Driving car

Why ML for Concrete?

- Extremely large compositional degrees of freedom (i.e., permutations and combinations of mixture design variables can significantly influence on properties).
- Materials theory based models cannot make a good prediction on properties of concrete (i.e., chloride concentration on the surface of concrete (Figure 1)).
- Non-linear relationships between mixture design variables and properties of concrete (i.e., coarse aggregate content vs. modulus of elasticity (Figure 2)).

Results

- Figure A-C shows that three machine learning models predicted modulus of elasticity (MOE) of concrete. The RF model exhibits the best performance.
- Figure D-F shows that three machine learning models predicted chloride concentration on the surface of concrete (C_{cl}) under three environments. The RF model exhibits the best performance.
- Figure G-I shows that three machine learning models predicted the compressive strength of concrete. The RF model exhibits the best performance.

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References