

Project on

Predicting Compressive Strength of Concrete using
IBM Watson AutoAI Experiment.

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RSIP Career Basic ML 170

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1 Introduction

1.1 Overview

Concrete is a material used in construction that has great versatility and which is used across the globe. Concrete has several advantages, including good compressive strength, durability, workability, construction availability, and low cost. Determining accurate concrete strength is a major civil engineering problem. Test results of 28-day concrete cylinder represent the characteristic strength of the concrete that has been prepared and cast to form the concrete work. It is important to wait 28 days to ensure the quality control of the process, although it is very time consuming. Machine learning techniques are progressively used to simulate the characteristic of concrete materials and have developed into an important research area. This study proposed a comprehensive study using an advanced machine learning technique to predict the compressive strength of concrete from early age test results.

1.2 Purpose

An ability to predict the compression strength of concrete early allows constructors to quickly understand the concrete's probable weaknesses and decide to manage a destruction process or continue with construction. Further, to the benefit of both user (and purchaser) and producer, reliably and rapidly predicting the results of a 28-day test would benefit all stakeholders as opposed to waiting the full, conventional, 28 days.

2 Literature Survey

2.1 Existing Problem

This is generally determined by a standard crushing test on a concrete cylinder. This requires engineers to build small concrete cylinders with different combinations of raw materials and test these cylinders for strength variations with a change in each raw material. The recommended wait time for testing the cylinder is 28 days to ensure correct results. This consumes a lot of time and requires a lot of labour to prepare different prototypes and test them. Also, this method is prone to human error and one small mistake can cause the wait time to drastically increase.

2.2 Proposed Solution

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3 Theoretical Analysis

3.1 Block Diagram

3.2 Software Designing

IBM Cloud Computing

It is a set of cloud computing services for business offered by the information technology company IBM. IBM Cloud includes infrastructure as a service (IaaS), software as a service (SaaS) and platform as a service (PaaS) offered through public, private and hybrid cloud delivery models, in addition to the components that make up those clouds.

IBM Watson Studio

IBM Watson Studio helps data scientists and analysts prepare data and build models at scale across any cloud. With its open, flexible multi cloud architecture, Watson Studio provides capabilities that empower businesses to simplify enterprise data science and AI, such as:

1. Automate AI lifecycle management with Auto AI.
2. Visually prepare and build models with IBM SPSS Modeler.
3. Build models using images with IBM Watson Visual Recognition and texts with IBM Watson Natural Language Classifier.
4. Deploy and run models through one-click integration with IBM Watson Machine Learning
5. Manage and monitor models through integration with IBM Watson Open scale.

Node Red

1. Node-RED is a flow-based development tool for visual programming developed originally by IBM for wiring together hardware devices, APIs and online services as part of the Internet of Things.
2. Node-RED provides a web browser-based flow editor, which can be used to create JavaScript functions. Elements of applications can be saved or shared for re-use. The runtime is built on Node.js. The flows created in Node-RED are stored using JSON. Since version 0.14, MQTT nodes can make properly configured TLS connections.
3. In 2016, IBM contributed Node-RED as an open source JS Foundation project.

4 Experimental Investigation

The compressive strength data for the present work was obtained from the experiments. For generating a reliable data bank on concrete compressive strength, he had considered five parameters, namely, water-cementitious material ratio, cementitious content, water content, workability, and curing ages in the experimental program.

The casting and testing of specimens for generating the data bank were performed in controlled laboratory condition.

6 Result

We have analysed the Compressive Strength Data and used Machine Learning to Predict the Compressive Strength of Concrete. We have used Linear Regression and its variations, Lasso, Ridge and Random Forests to make predictions and compared their performance. Random Forest Regressor has highest accuracy and is a good choice for this problem. Random Forest Regressor trains randomly initialized trees with random subsets of data sampled from the training data, this will make our model more robust

7 Advantages & Disadvantages

Advantages

1. Useful for Civil Engineers to predict the strength of Concrete.
2. Decide which infrastructure can be made for strength concrete.
3. Helps to reduce the cost invested in construction.
4. Use the best quality cement based on their strength and ensure full safety.
5. Reduced errors and faults in construction.

Disadvantages

1. Loss to the low-quality cement manufacturing companies.
2. Loss of money, income, profits, to the middlemen.
3. Reduced work, reduced labour, reduction in the source of income for labourers as the constructions made from perfect and the right quality cement will definitely last long.

Application

1. House, Society, Offices constructions.
2. Children Parks, Monuments, Sculptures constructions.
3. Bridges, Highways, Metro Pillars constructions.
4. Theme parks, Resorts, Amusement Parks constructions.

8 Conclusion

We have successfully built a Machine Learning model to predict the compressive strength of concrete using IBM Watson Auto AI Machine Learning Service. The model is deployed on IBM cloud to get scoring end point which can be used as API in mobile app or web app building. We

have developed a web application which is built using node red service. We make use of the scoring end point to give user input values to the deployed model. The model prediction is then showcased on User Interface with minimum RMSE (root mean square value metrics evaluation technique)

9 Future Scope

This model can predict the outcome with many different inputs within seconds. The model will save a lot of time of the construction companies and the civil engineers. Experiment cost is also reduced with creates a bigger opportunity for construction companies in cost effectiveness work.

10 Bibliography

<https://archive.ics.uci.edu/ml/machine-learning-databases/concrete/compressive/>

<https://cloud.ibm.com/>