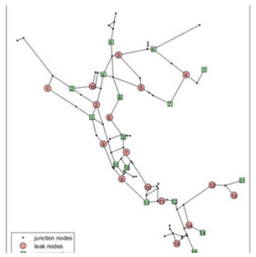
Shri Ramdeobaba College of Engineering & Management, Nagpur
(An Autonomous College under RTM Nagpur University)
Topic :- Smart Water Techniques To Detect And Reduce Water Leakage

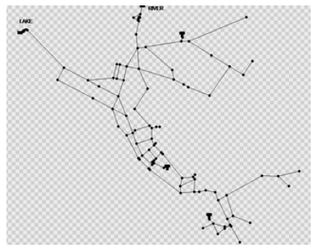
Introduction & Motivation

Water leakage in large distribution networks poses a dual threat to environmental sustainability and infrastructure integrity. Our project leverages advanced smart water technologies to tackle this challenge through the deployment of neural network models. This poster introduces two models tailored for leak detection based on pressure data: one utilizing MLP activation and the other employing ReLU activation for binary classification. These models represent cutting-edge solutions aimed at enhancing the accuracy and efficiency of leak detection processes, contributing to the sustainable management of water resources and the preservation of essential infrastructure.

Dataset

- The dataset employed in this study was meticulously crafted using the EPANET software, a robust tool for simulating water distribution systems [1]. The dataset comprises leak values and pressure values from a network featuring 16 leak nodes and 16 pressure sensors
- To generate the dataset, leak nodes and pressure sensors were strategically positioned, simulating real-world scenarios. The leak dataset (Fig. 2) encompasses responses for leaks with sizes ranging from 1 to 10, totaling 10,000 realizations. Similarly, the pressure dataset captures the corresponding pressure values due to the presence of leaks.



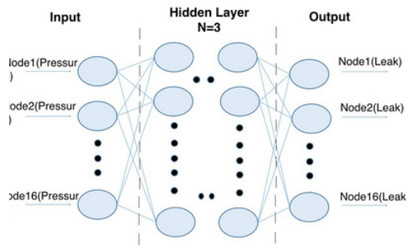


Method

Multi-Layer Perceptrons (MLPs) a powerful neural networks used for diverse applications. In this project, we employ MLPs for detecting leaks in pipeline transport systems, specifically predicting regressed continuous leak values based on pressure inputs.
The MLP model, comprising input, hidden, and output layers, predicts leak values for nodes. Classification as a leak depends on whether the predicted value exceeds a predefined threshold.

Summary Of Model 1

1. **Problem Type:** Regression task predicting leakage values.
2. **Data Handling:** Loads data from CSV,normalizes input and output. Splits into train and test sets.
3. **Neural Network:** Sequential model with 'sigmoid' and leaky ReLU trained activation with mean squared error.



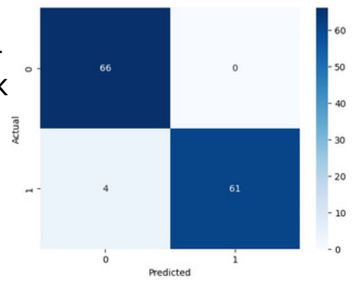
4 .**Evaluation:** Calculates MAE, evaluates accuracy for thresholds, and generates various plots.
5. **Model Handling:** Saves and loads model architecture and weights.
6. Visualization : Graphs like Scatter - Plot and Accuracy vs treshold curves were used to study the accuracy of the model

Summary Of Model 2

1. **Problem Type:** Binary classification task.
2. **Data Handling:** Loads data from Excel, separates features and labels.
3. **Neural Network:** Sequential model with 'relu' and 'sigmoid' activations, trained with binary crossentropy.
4. **Evaluation:** Computes accuracy metrics, converts predictions to binary based on threshold.
5. **Data Analysis:** Concatenates data for analysis, visualizes scatter plots, and identifies incorrect predictions.

Results after Experimentation

- After a good amount of trial and error we have got the following things as the observations
- The maximum accuracy obtained by Regression task predicting Leak Values was **79%** where activation functions were ReLU and Leaky ReLU in the model with Highest accuracy and lowest Mean Absoluete Error
- The second model was a binary classification task and it was able to give the value till **93.3% of the accuracy**
- The confusion matrix obtained by the model 2 at the maximum accuracy



Final Goals

Our Final goals aims at building a complete integrated and deployed model which will take the data from the sensors in real time and will predict the leakage whether there is a leakage or not in all the cases
We have prepared the complete Front-end of the product and are currently worrking on the back - end of the end user product

References

https://ieeexplore.ieee.org/document/8030701
https://ieeexplore.ieee.org/document/5536510
https://ieeexplore.ieee.org/document/8540733

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