# Milk Quality Classification using CNN

## Problem Statement

Ensuring the quality of milk is a critical task in the food and dairy industry. Traditional methods rely on manual inspection and lab testing, which are time-consuming and may introduce human bias. To address this, we aim to build a **Convolutional Neural Network (CNN)** based classification model that can predict the **Grade** of milk (Low, Medium, or High) based on its physicochemical and sensory attributes.

## Objective

Develop a deep learning model using **Convolutional Neural Networks (CNN)** to classify milk into one of three quality grades: **Low (Bad), Medium (Moderate), or High (Good)** using a structured dataset of milk attributes.

## Dataset Description

The dataset contains various features representing the milk’s quality parameters:

| Column Name | Description | Type | Range/Values |
| --- | --- | --- | --- |
| pH | pH value of the milk | Numerical | 3.0 – 9.5 |
| Temprature | Temperature of the milk (in °C) | Numerical | 34.0 – 90.0 |
| Taste | Taste of the milk | Categorical | 0 = Bad, 1 = Good |
| Odor | Odor of the milk | Categorical | 0 = Bad, 1 = Good |
| Fat | Fat content | Categorical | 0 = Low, 1 = High |
| Turbidity | Turbidity level | Categorical | 0 = Low, 1 = High |
| Colour | Colour intensity of the milk (measured on a scale) | Numerical | 240 – 255 |
| Grade | **Target variable**: Quality grade of the milk | Categorical | Low, Medium, High |

## Why CNN?

While CNNs are primarily used for image data, this project aims to explore the potential of using **1D CNNs** for structured/tabular data. CNNs can learn local patterns across features, potentially capturing subtle interactions better than traditional models.

## Tasks

1. **Data Preprocessing**
   * Encode categorical features if necessary.
   * Normalize numerical columns.
   * Convert the tabular data into a format compatible with 1D CNN input.
2. **Model Building**
   * Design and train a 1D CNN architecture.
   * Experiment with hyperparameters and layers (Conv1D, MaxPooling1D, Flatten, Dense).
3. **Evaluation**
   * Evaluate the model using accuracy, precision, recall, and F1-score.
   * Use confusion matrix to understand class-wise performance.
4. **Deployment (Optional)**
   * Build a simple UI to input new milk sample data and predict its grade.

## Expected Outcome

A working deep learning model that can classify milk samples into Low, Medium, or High quality with high accuracy using CNN-based architecture.