CS 796 - Advanced Artificial Intelligence

Final Report

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1. Problem Description

In probability theory and statistics, the gamma distribution is a two-parameter family of continuous probability distributions. The exponential distribution, Erlang distribution, and chi-squared distribution are special cases of the gamma distribution.

The density function of gamma distribution is: $f(x, \beta, \alpha) = \frac{\beta^{\alpha}}{\Gamma(\alpha)} x^{\alpha-1} e^{-\beta x}, x > 0$

Given a dataset with data from gamma distribution density function, build an artificial neural network regression model to fit the dataset.

2. Approach

Use TensorFlow to build the artificial neural network.

1) Read the dataset from "gamma2.csv" which contains 10,000 records generated from gamma distribution with different $\alpha, \beta, x, \text{and } y$.
2) Split the whole dataset into training (first 70%), validation (middle 10%) and test (last 20%) sets.
3) Build the neural network of 5 hidden layers with the number of neurons 128, 64, 32, 16, and 8 respectively.
4) Use sigmoid as the activation function for all hidden layers.
5) Use mean square percentage error (MSPE) as the loss function, which makes the model less sensitive to outliers.
6) Use Adam Optimizer which is less likely to be trapped in local minimum.
7) Set the termination rule as: the max percentage error of validation dataset is no more than 1% and the percentage error starts to increase. This termination rule will help the model have a small enough max percentage error.

3. Result

After 92,341 epochs, the final model was trained with training MSPE 3.54×10^{-6} and max validation percentage error 0.95%.

Use test data to evaluate the model, and get the test MSPE 3.50×10^{-6}, the max test percentage error 1.40%.