Project Proposal

SEN402 GRADUATION PROJECT-II

DEEP LEARNING FRAMEWORK

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1. Introduction

The aim of this project is to design and develop a custom deep learning framework from scratch in C++ in a modular structure by abiding to ceratin design princible rules and Object Oriented Programming style for a reusable, scalable, extendable and flexible format. The framework allows users to create a neural network, define its layers and hyper parameters, and then train-test the network and generate a model. The framework will later be intergrated to a full stack application where users can perform all these processes from the user interface, without needing to write code, and also visualize the process of developing the model, the training process and the results.

2. Motivation

As AI field becoming more popular day by day and companies or individuals seek for utilization of machine learning models to solve their problems, predict future possibilities, making decisions such as classification of a problem (like cancer diagnoses of a patient), they start searching for a way that makes it easier for them to develop such machine learning-deep learning models and start using them for their task.

Today there are public frameworks available for users to use and develop models for their preference, where most popular of them being Tensorlow and Pytorch. These frameworks are powerful and provides a clear document for ease of use and understandability. But the problem is despite this, they require setting up the environment every time, needing to write the necessary code that relates to specific needs which requires too many look ups from documentations and know each function which can be complicated since there aare too many distinct concepts. This requires to be familiar and expert on using these tools, so not everyone can directly use them.

Besides this, the training process of the models can take too long due to the complex algorithms and the way these frameworks work through API's instead of directly running the low level target main code.

So we, as senior software engineering student, aimed to develop this project at first as a hobby and to improve our technical knowledge in deep learning by implementing the detailed concept of these complex algorithms in practise, after learning them in theory. But later we

realised the situation we mentioned in the previous paragraph, that our product can differentiate and bypass the existing solutions, so we wanted to evaluate the potential that can we can have a better product of our owns where we can scale it up later as we wish, and customize it for usability. We also aim to give this project as our graduation project in our own university.

The main difference we aimed to achieve is integrating the framework with a full stack application where users can easily develop and train a model using the user interface, monitor and control the training and testing by visualizing the process and all of these can be done without needing to write a single line of code.

3. Project Details

In the project, the main focus is implementing every core fucntionalities needed to develop and train, test, deploy a custom deep learning model. C++ programming language is used for development, due to its low level feature and thus achieving high performance in run time when comparing to other relative programming languages such as python and java, and also because of its support for Object Oriented Programming nature which is why we choose C++ rather than C programming language since C doesn't support it. The reason OOP is important is to be able to develop the code in a more scalable, flexible, modifiable, maintainable, reusable and modular way. This improves the development process for us as developers and change or add to any part of the code as we wish without effecting other components (low coupling). Also the design princibles that are applicable for our case will be used, such as factory pattern for selecting the appropriate activation functions of loss function types in run time based on user input.

Besides the framework, the frontend application that will face the user and the backend that will handle the requests for database will be developed. React.js and Boostrap tools will be used for frontend development and Node-Express.js and PostgreSQL database will be used for backend development. The database will contain user information and their saved works. User authentication will be handled in backend using JWT.

The unit test of each component will be handled with various testing methods such as black bo testing.

In final, there would be a C++ framework component, a node.js backend component, frontend

react component and a PostgreSQL database component and Render platform will be used to deploy each distinct module. Modules will exchange data and request with each other using REST API communication architecture.

4. Expected Outcomes

As an outcome of this project, we aim to produce a full stack application where users can login, create work spaces where they can create an arbitrary deep learning model by defining hyperparameters such as adding layers, specifying the layer types (Dense layer, CNN layer, RNN layer etc.), learning rate, activation function types for each layer, loss function type that will be used to optimize the network during training (like sigmoid cross entropy for binary classification tasks) etc. And after creating the network, they will be able to upload the training-test sets and start the training process.

5. Future Goals

Process after composing the base structure mentioned, the algorithms provided in the framework will be diversified by adding more layer types, other traditional machine learning algorithms maybe which are not included in deep learning etc. And also the user interface and backend will be improved based on certain metrics.

If the product recieves good feedback and gains interest, it could be used for commercial purpose and customized for certain customers.

6. Conclusion

Our initial aim is to develop this application and present it to our instructors for graduation project, but if we can achieve what we aim in terms of the general functionality of the application, we can start specifying the target audience and contact for commercial or aggrement purpose (like providing service to a company or for education purpose where students can visually track the process).