CSE 326: Software Engineering

Final Project Proposal

Authors:

Cole Johnson - *cole.johnson@student.nmt.edu*
Colin Grandjean - *colin.grandjean@student.nmt.edu*
John Runyon - *john.runyon@student.nmt.edu*
Lauren Giles - *lauren.giles@student.nmt.edu*

New Mexico Institute of Mining and Technology
Socorro, NM 87801, USA

Date: February 13, 2025

Contents

1 Introduction

1.1 Project Overview and Statement of Proposal

OCR (Optical Character Recognition) is a technique that a program can use to parse individual or stream images into a matched set of some written alphabet; often just a set of alphanumeric characters. OCR is used in banking, note taking applications, and many other services used on a daily basis. One of the most common implementations of OCR is the use of neural networks, often through supervised learning methods. We propose to create a simple neural network that will be trained and tested to classify a single image into an alphanumeric character using one such supervised learning technique. In the process of developing the neural network, we'll develop a host of tools to test and view the networks created and some performance metrics to gauge effectiveness.

1.2 Project Scope and Objectives

The initial scope of the project, as outlined in the overview, will be to create a simple Optical Character Recognition (OCR) system using a neural network and employ supervised learning techniques to test and train our model. Our main objectives for the project include:

(a.) Build the components of neural network using object-oriented design principles and programming language (like Java).

(b.) A training and test environment for our neural network.

(c.) A graphical user interface (GUI) that the user can draw characters for the model to classify them.

(d.) A graphical user interface (GUI) to view the created neural networks to visually see how each model works.

2 Risk Management Strategy

2.1 Risk Table

Category Values

- **BU** - Business Impact Risk
- **CU** - Customer Risk
- **DE** - Development Environment Risk
- **PR** - Process Risk
- **PS** - Product Size Risk
- **ST** - Risk Associated with Staff Size and Experience
- **TE** - Technology Risk

Impact Values:

- **4** - catastrophic
- **3** - critical
- **2** - marginal
- **1** - negligible

Table 1: Risk Table

Risks	Category	Probability	Impact	RMMM
Project scope may increase due to feature additions	**BU**	Possible	2	**Mitigation** - Define strict requirements at the beginning and have periodic reviews to control feature creep.
Model may not generalize well to unseen characters	**CU**	Likely	3	**Mitigation** - Incorporate diverse training data, test edge cases, and implement validation methods.
Members on the project use a variety of different hardware and software, complicating the development process	**DE**	Very Likely	1	**Mitigation** - Use a virtual machine to help simplify the process of developing the software and make diagnosing issues easier by sticking to one platform.

Continued on the next page

Continued from previous page				
Risks	**Category**	**Probability**	**Impact**	**RMMM**
No robust method for testing whether our model works	**PR**	Very Likely	2	**Mitigation** - Introduce unit tests to test the functioning of individual components of the neural network to avoid errors made earlier in the development process.
Neural network may be too computationally expensive to run efficiently	**PS**	Likely	2	**Mitigation** - Optimize the network design to reduce complexity using different algorithms.
Most members on the project do not have a lot of experience with NNs	**ST**	Likely	3	**Mitigation** - Hold meetings to review neural network knowledge and carefully plan the learning strategy, including which technologies to involve.
Technology stack may not support required performance	**TE**	Possible	3	**Mitigation** - Evaluate and select technologies that are proven for neural network applications, conduct early performance tests to not be stuck later.

2.2 Discussion of Risks to Be Managed

The risk to be managed for this project will primarily involve managing the technical complexity, and dealing with public-facing risks like product size or customer relations. The risks for this project require mitigation measures that attempt to alleviate technical risks. For example, one mitigation effort requires unit testing to help ensure the behavior of each component of the neural network is functioning as expected.

2.3 Risk Mitigation, Monitoring, and Management Plan

2.3.1 Risk Mitigation

1. **No Robust Testing Method to Evaluate the Whole Neural Network - Process Risk:**

   It's very difficult to evaluate how a neural network is flawed, since it's connections are often elaborate and difficult to understand (the black box effect). Instead, to help mitigate this risk we propose to introduce unit testing inside the components, and test smaller version of the models we will ultimately create.

2. **Inexperience in Neural Networks - Staff Risk:**

   If this risk becomes a problem, our mitigation efforts involve holding meetings to review relevant information about neural networks. Writing unit tests should also help, since they help the writer understand how each component is supposed to function

3. **Team Members Use a Variety Different Hardware and Software - Development Environment Risk:**

   If different hardware and software environments poses a risk, we can use a virtual machine to create a single development environment.

2.3.2 Risk Monitoring

Risk monitoring involves gauging understanding of each component of the project, ensure that each part is properly understood and that tests are written properly to ensure each component is working as intended and understood by members of the project.

2.3.3 Risk Management (Contingency Plans)

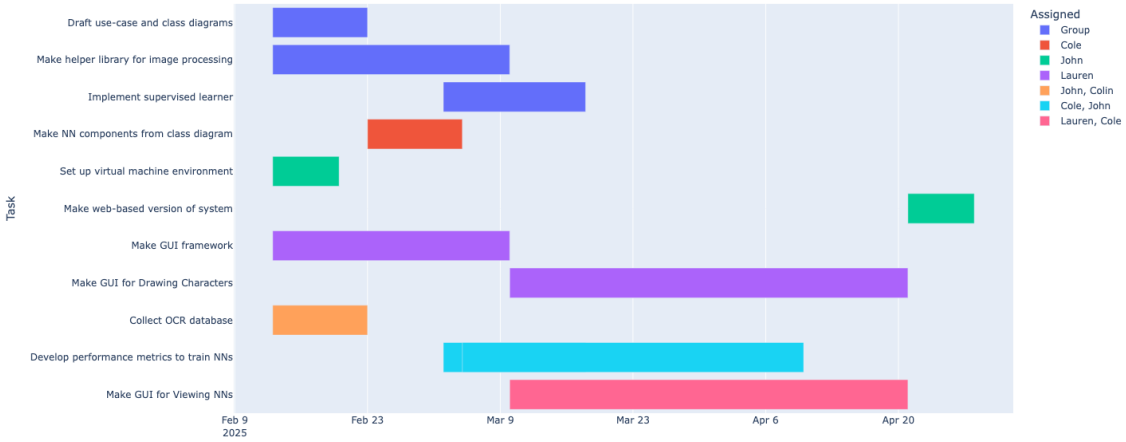
Contingency plans to reduce risk involve creating and utilizing many different neural network performance metrics, like hamming distances and F1 scores, the ensure the accuracy of our model and the soundness of our training process. If we encounter issues implementing the supervised learning process, we can try other techniques instead.

3 Schedule

3.1 Task List

1. Term Proposal
2. Create UML Use Case/Class Diagrams
3. Set up VM Environment
4. Collect OCR Dataset
5. Create Basic NN Components
6. Interim Report
7. Create Windowing Framework
8. Develop Performance Metrics to Train NNs
9. Draft Supervised Learning Technique (CNN)
10. Draft GUI for Drawing Characters
11. Make GUI for Viewing NNs
12. Make Web-Based Version of the System
13. Project Presentation 1
14. Project Presentation 2
15. Final Report

3.2 Timeline Chart



3.3 Resource Table

Table 2: Resource Table

Task	People	Hardware and Software	Special
Term Proposal	Group	Latex and Excel	None
Create UML Use Case/Class Diagrams	Group	*Dia* and *draw.io*	None
Set Up VM Environment	John Runyon	Computer and VM	None
Collect OCR Dataset	Colin and John	Computer and VM	None
Create Basic NN Components	Cole Johnson	*openJDK22* and *Java Programming Language*	None
Interim Report	Group	*LaTex*	None
Create Windowing Framework	Lauren	*openJDK22* and *Java Language*	None

Develop Performance Metrics to Train NNs	Cole and John	*openJDK22* and *Java Language*	None
Draft Supervised Learning Technique (CNN)	Group	Computer and VM	None
Draft GUI for Drawing Characters	Lauren	*openJDK22* and *Java Language*	None
Make GUI for Viewing NNs	Cole and Lauren	*openJDK22* and *Java Language*	None
Make Web-Based Version of the System	John	(Change later)	None
Project Presentation	Group	*Google Slides* and *LaTex*	None
Final Report	Group	Latex	None

4 Project Resources

4.1 People

1. Colin Grandjean
2. Lauren Giles
3. Cole Johnson (Team Leader)
4. John Runyon

4.2 Hardware and Software Resources

We plan to create our project using Java, version 22. To help automate our build and deployment processes, we are using Gradle. In order to facilitate version control, we use GitHub with Jira to keep track of our development process and task management. Each team member uses different code editors, depending on their preferences.

4.3 Special Resources

The only possible special resource we may need for the project is a Virtual Machine to manage the running and building of the final project, since it will be hosted online.

5 Appendices