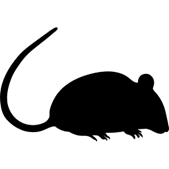
Machine Learning Approach to Identifying Neural Features That Predict Rodent Behavior

**Requirements and Specifications**

Washington State University - Department of Psychology



Nunnerson Computing



Aidan Nunn, Charlie Nickerson

9/21/22

**TABLE OF CONTENTS**

**I. Introduction 3**

**II. System Requirements and Specifications 3**

**II.1. Use Cases 3**

**II.2. Functional Requirement 3**

**II.3. Non-Functional Requirements 4**

**III. System Evolution 4**

**IV. Glossary 5**

**V. References 5**

**I. Introduction**

Provide a brief description of your project and summarize the objectives. Yes, this is somewhat

lifted from the first writing assignment, but this document needs to be self contained and so a

new reader needs a 1-2 paragraph introduction to know what the project is about.

This will describe in detail the desired requirements and specifications of the Nunnerson Computing Project. Nunnerson Computing is tasked with designing a machine learning model that can predict imminent alcohol drinking in male and female rodents addicted to alcohol. Nunnerson Computing is also charged with creating a protocol that can assist future researchers in utilizing this model even if they have no experience in coding.

The purpose of this project is to help Angela Hendricks and her team of graduate and undergraduate researchers with speeding up their data collection process. In the past Hendricks and her team have had to manually record video of rodents and record data based on when the rodents looked like they were in the decision making process of consuming alcohol. This project will streamline this process by automating data collection so it no longer needs to be done by a human. Additionally, the data collected from the rodents won’t be based on what the researcher observed and instead be based on the statistical probability of the model thus making the data more reliable and less prone to human error.

**II. System Requirements and Specification**

In this section you will describe the features, functions and other specifications that are

requirements for your product. You will also specify the client/stakeholder need(s) that

requirement maps to. If you find a stakeholder that your first assignment did not identify, feel

free to add them here as required.

Please refer to Section 4.4 in the CptS 322 &&/|| CptS 422 textbooks like “Object-Oriented

Software Engineering” to refresh your knowledge on software requirements.

**II.1. Use Cases**

if applicable, provide some major use-cases that illustrate scenarios for using your product1.

Use cases tell a story about how an end user interacts with the system under a specific set of

circumstances. You may illustrate the use-cases with UML diagrams.

For each use case, identify the related requirements (you may directly refer to the requirements

listed in Section II.2).

**Story:** Kelly Hewitt is a neuropsychologist at WSU who is researching rodent behavior. Kelly is currently studying four groups of rodents: non-alcohol dependent males, non-alcohol dependent females, alcohol dependent males, and alcohol dependent females. For each group of rodents, Kelly measures the local field potentials in three parts of the rodent's brain. After collecting the data, Kelly would like to preprocess the data, so she only gets the LFP values measured when the rodent was in the decision-making process of drinking alcohol. To do this, Kelly opens our desktop application.

Once the application is opened, Kelly uploads LFP data for male alcoholic rodents into the app. Kelly then uses the program to clean the data by converting the LFP values to power and coherence values. Our machine learning model will then take these values and return the start and end timestamps of the recorded data, along with the power and coherence values derived from the LFP values recorded during this time for each rodent in the group. The timestamp outputs represent the period in which a rodent considers consuming alcohol. After preprocessing the data, Kelly saves the outputted data onto her computer and repeats the same process on the remaining three rodent groups. Kelly then closes the desktop application and begins her analysis of the newly processed data.

**Story:** Angela Henricks is a researcher at WSU who is researching rodent behavior. Angela uses a machine learning model to predict the actions of rodents who are dependent on alcohol. However, the model has been giving low accuracy on its predictions and Angela would like to retrain the model using a larger data pool. In order to accurately train the model, Angela needs to process an enormous amount of data, enough that it would take a very long time on a desktop computer. Angela needs to use the Kamiak Cluster to process the data efficiently.

Angela begins by opening our desktop application. She then loads each data file she would like the model to learn from into the application. Once the files are loaded, she can give the application her login credentials for Kamiak and command the application to ssh into the Kamiak server. The job will be sent to Kamiak, and Kamiak will build the model. The model file will be returned and can be saved onto Angela’s local PC for use in the future.

**Story:** Angela Henricks is a researcher at WSU who is researching rodent behavior. Angela uses a machine learning model to predict the actions of rodents who are dependent on alcohol. She has recently computed a new model and hopes that it will have better accuracy than the previous one. Angela can use our desktop application to test the accuracy of the new model.

To start, Angela loads the new model into our desktop app. Then, she selects the option to test the accuracy. She is prompted to upload her own sample data or use one that is preinstalled into the app. Regardless of the option chosen, the application will run the model against the sample and return its accuracy. The preinstalled sample will be small enough that it can be used on a desktop computer, but not too small as to undermine the accuracy of the test.

**II.2. Functional Requirements**

List the functional requirements in this section 2.

Include a subsection for each main part/module of your product and list the requirements for the

module in that subsection. (Please note that we are not considering any design issues yet. Each

module (subsection) refers to a major part/functionality of the product, not to sub-section in the

architecture. This classification of requirements is intended to improve the readability of the

document.)

Generally, functional requirements are expressed in the form "system must do <requirement>”

Briefly describe each requirement and specify the client/stakeholder need(s) that requirement maps to. Each requirement should appear in ONLY ONE sub-section of the document.

Here is an example template for requirement specification: (the requirement template is formatted with blue for readability. Please remove the color formatting in your document.)

**II.2.1. [Machine Learning Model]**

**Rodent Decision Making Recognition Tool:** This machine learning model tool must be able to recognize when a rodent is in the decision making process of consuming alcohol. This model will be tested on female and male rodents that are either addicted to alcohol or are sober. This will be important for knowing when to start and end data collection.

**Source:** Dr. Hendricks and her team have requested that this be in the project

**Priority:** Priority Level 0: Essential and required functionality

**II.2.2 [Automated Data Collection]**

**Local Field Potential Data Collection Tool:** One the machine learning model recognizes when a rodent is in the decision making process, this tool must begin collecting local field potential data (LFPs) in order to calculate the coherence and power values taking place within the rodent's brain. This is important data for Dr. Hendricks research and is essential to the project

**Source:** Dr. Hendricks and her team have requested that this be in the project

**Priority:** Priority Level 0: Essential and required for functionality

**II.2.3. [Graphic User Interface]**

**User Interface for Automated Data Collection of Rodent LFPs:** This tool is important for assisting users with using the predictive model to collect data. Users should be able easily import data into the program. This program should then neatly output the LFP data with timestamps of when that data was recorded. This entire process should be intuitive for the user and easily accessible for people who have little experience with coding.

**Source:** Dr. Hendricks and her team have expressed their desires for having this function in the project.

**Priority:** Priority Level 1: Desirable Function

**II.2.4 [Power and Coherence Calculator]**

**Power and Coherence Calculator:** This tool will take in the recorded LFP data and convert it into coherence and power values. These values will be taken in 5 second chunks of time. These values are important because they will be used for testing and training data in our machine learning model.

**Source:** Dr. Hendricks has informed us that the power and coherence values have been shown to work well for training a predictive model in the past.

**Priority:** Priority Level 0: Essential and required for functionality

List your requirements for the next project module here based on the requirements template

described above. Include a subsection for each part.

**II.3. Non-Functional Requirements**

**Easy to Use:** The final product should be easy to use by future researchers who have little to no knowledge in coding.

**Readable Code:** Once this project is complete the codebase should be easy to understand. All the code should have comments to describe the functionality of the code so future developers of the product can add to and maintain the code.

**Fast:** The speed it takes to process the data and calculate the outputs should berelatively fast. To speed up processing time we will be using WSUs Kamiak supercomputer.

**Extensible:** The code should be easily expandable by future developers who want to add features.

List the non-functional requirements in this section. Non-functional requirements define system

properties (e.g. reliability, response time and storage requirements, etc.) and constraints (e.g.

I/O device capability, system representations, etc.)

Generally, non-functional requirements take the form "system shall be <requirement>."

Process requirements may also be listed here (e.g. specifying a particular programming

language or development method.) This will include any general testing plans, but there is a

later assignment that will go into much greater depth about testing the product.

Please refer to Section 4.4.7 in the book “Object-Oriented Software Engineering” for example

categories of non-functional requirements.

You may use the following template for non-functional requirements (Please remove the color

formatting in your final document):

[Enter a Concise Requirement Name]:

[provide a concise description, in clear and easily understandable language to specify

the requirement]

**III. System Evolution**

This should describe the fundamental assumptions on which your project is based, and any

anticipated changes due to hardware evolution, changing user needs, and so on. This section is

useful as it may help avoid design decisions that would constrain likely future changes to your

project. They are also designed to identify risk points in your design process, which need to be

kept in mind as your development continues. These can be hardware, software, or client issues

where your assumptions about what will work or be required end up being incorrect. For

example, if you think the computer platform you’re choosing might have driver issues you’ll have

to either do significant extra work to fix the drivers or find another platform on a short timeline.

That’s something you should note in this section as an anticipated change point

**IV. Glossary**

**V. References**