Software Requirements Specification

for

Activation-Selection Model Simulation of Human Memory

Version 1.0

Prepared by:

Group Three

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1 Introduction

In this project, we aim to help the researchers in the field of cognitive psychology by providing them a versatile tool to create, modify, and visualize a live simulation of the Activation-Selection Model of human memory. This project will focus on implementing the model described in the paper which can be found here:

http://link.springer.com/article/10.3758%2FBF03192931

Using this simulation will reduce the need for human subject studies, which are comparatively both slow and expensive. Optimally, this project will emulate the human brain in selecting the meaning of ambiguous words in many different scenarios and confirm the findings of the paper cited above.

1.1 Document Purpose

Provide specifications for the simulation, including expected applications to be used, building specs, estimated time to complete, and work involved. We will provide the client with a multi platform graphical user interface, along with an implementation of their model and training on how to use/change the model in the future.

1.2 Product Scope

The software will allow for multiple modifications to the ASM model parameters such as, number of attributes representing each meaning or intensity of weight increments for each activiation. The graphic user interface will allow for a simulation mode in which the researcher can start priming the simulated memory model with primary or secondary meanings of the words. Upon each priming, the output values will change to reflect the strength of the meaning that the model would predict for that word. Attribute activation levels will increase and decrease in real-time.

1.3 Intended Audience and Document Overview

Intended audience: Dr. Kimberly Wear and the rest of the psychology professors at High Point University

1.4 Definitions, Acronyms and Abbreviations

ASM: Activation-Selection Model
GUI: Graphical User Interface

Acitivation-selection process: Priming the meaning of an ambiguous word activates attributes associated with that meaning; however, selecting a meaning for an ambiguous word results in a re-weighting of attributes of the word toward the meaning selected.

1. Words are represented by a weighted set of attributes.

2. The initial processing of a word activates a small number (N) of attributes; the number is determined by task constraints, and the processing time available.

3. Attributes are activated in proportion to their current weight.

4. The set principle: Processing a word in the context of an active attribute results in selection of that attribute whenever the current word possesses the active attribute as one of its features.

5. Attributes activated are increased in activity from their prior level by an amount that depends on the task requirements. Sampling of an associated attribute, as in the set principle, adds an additional increment to the activation level.

6. Activation of an attribute decays fairly quickly to a resting level as a function of the initial amount of activation.

7. When a meaning is selected, the weight of active attributes associated with that meaning are increased as a function of their recency. Incrementing the weight of an attribute has the effect of increasing the likelihood that attribute will be activated on subsequent encounters with the word.

2 Overall Description

2.1 Product Functionality

- Simulate different beginning biases towards either dominant or secondary meaning
- Take inputs from the user that resemble primary or secondary meaning priming
- manipulate attribute weights to change selection ratio
- select a meaning based on current activation levels

2.2 Users and Characteristics

Psychology Researcher

- Runs simulations

- Collects and interprets data
- Compares simulation output with human collected data and makes modifications to the model
- Optimally, can be anyone with a minimal working knowledge of computers who read the documentation that we will provide for our final simulation tool

2.3 Operating Environment

Expected to run on any platform (Linux, Windows, OS X), but will be specifically tested on both Windows 10 and Mac OS X. The operating environment will be similar to a web-based program. Program dependencies include Node.JS, HTML, CSS.

2.4 Design and Implementation Constraints

Because we are three college students working for free on this, our time and resources are, of course, limited. The amount of work that can be done depends on the amount of research we are able to complete in a shortened amount of time. Therefore, our primary constraint will be providing a robust documentation so that the customer can continue to develop the idea.

Other responsibilities include:

- Finding a satisfactory multi-platform GUI for the simulation
- Creating a model that can be primed and tested like a typical human brain in the original experiment
- Creating a user interface that is intuitive and easy to understand, generating data that can be read at a glance

3 Specific Requirements

3.1 External Interface Requirements

3.1.1 User Interfaces

We will use electron (http://electron.atom.io/) to create the User Interface. This will allow for the same logic to be bundled in executable formats for Windows and OS X. The program will consists of the following screens:

- Import/Export Screen: The user will be able to change the words themselves, along with the number of attributes associated with each word

- Tutorial: The user will be able to view a comprehensive document on how to use the simulation software and differnt modules/modifications that are accissible to them.

- Main Screen: This is where the trials will take place. The data will be visible and the user has the ability to set all the simulation parameters. Once they're satisfied with those

parameters, they will be able to simulate the priming process and after multiple repetitions of that they will be able to export the data using the export screen.

3.1.2 Hardware Interfaces

Mouse, Keyboard

3.1.3 Software Interfaces

It is our objective for this product to be standalone and require little to no other software interfaces.

3.2 Functional Requirements

[FR - 1]: Multiple priming

The simulation will allow for the researcher to select between different priming sequence and frequencies. It is expected that a secondary, primary, neutral priming sequence produce the same output as the human data.

[FR - 2]: Export (stretch-goal)

Data must be available to the researcher in an easy to read format so that they can refer back to it to know which sequence of priming lead to which meaning and what strength of meaning selection.

3.3 Use Case

1. Follow Tutorial
    a. Open the main screen
    b. Click the tutorial module button to learn about the program
    c. Send emails to the support team for help if needed via the provided link

2. Import Data (stretch-goal)
    a. User inputs file for training - contains human data to be baseline
    b. program checks if file exists and is valid
    c. Training program adjusts attributes based on data given
        - possible training method: randomization until match
        - possible training method: equal porportaion initialization
        - possible training method: user input values

3. Setup Simulation Paramaters
    a. change/confirm the numebr of attributes per meaning

b. change/confirm the constant weight increment of the activated attributes
c. change/confirm between word or picture orienting task simulations
d. change/confirm the deactivation speed
e. change/confirm the number of activeated attributes for word or picture tasks

4. Run Simulation
    a. Select between primary vs. secondary vs. neutral meaning primings
    b. wait for the activation to spread through the attributes
    c. wait for the new attribute strengths to show
    d. wait for the attributes to decay based on their strengths
    e. repeat from step a) as many times as needed

3.4 Modules/Classes

❖ **Main Simulation Class (Entity)**
- Does most of the computation and randomization of initial values
- Is primed by input, takes new input in form of ambiguous words, and outputs one meaning or another
- feeds output into export data class
- Entities in this class are as follow:
    - Primary meaning attributes window
    - Secondary meaning attributes window
    - Simulation parameters
    - Final meaning strength output

❖ **Tutorial Class (Boundary)**
- is responsible for displaying the “how to” guides
- works as an independent module with text references to the other classes

❖ **Priming Class (Boundary)**
- Simulate the functionality of providing context for human subjects by introducing new weights for either primary or secondary meanings attributes in Main Simulation class
- Is divided into 3 main methods:
    - primary meaning
    - secondary meaning
    - neutral meaning

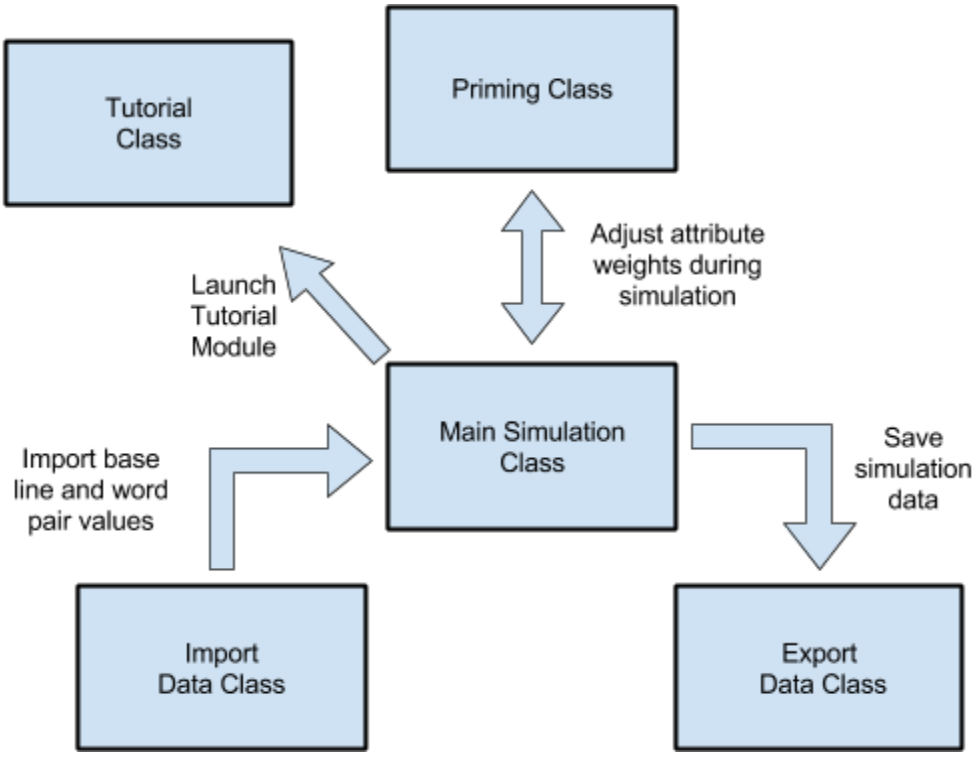
❖ **Import Data Class (Control)**
- Takes csv file, converts its contents to data that can be used for the attributes
- feeds formatted data to the simulation class
- Includes randomization functions as described in 3.3 point 2

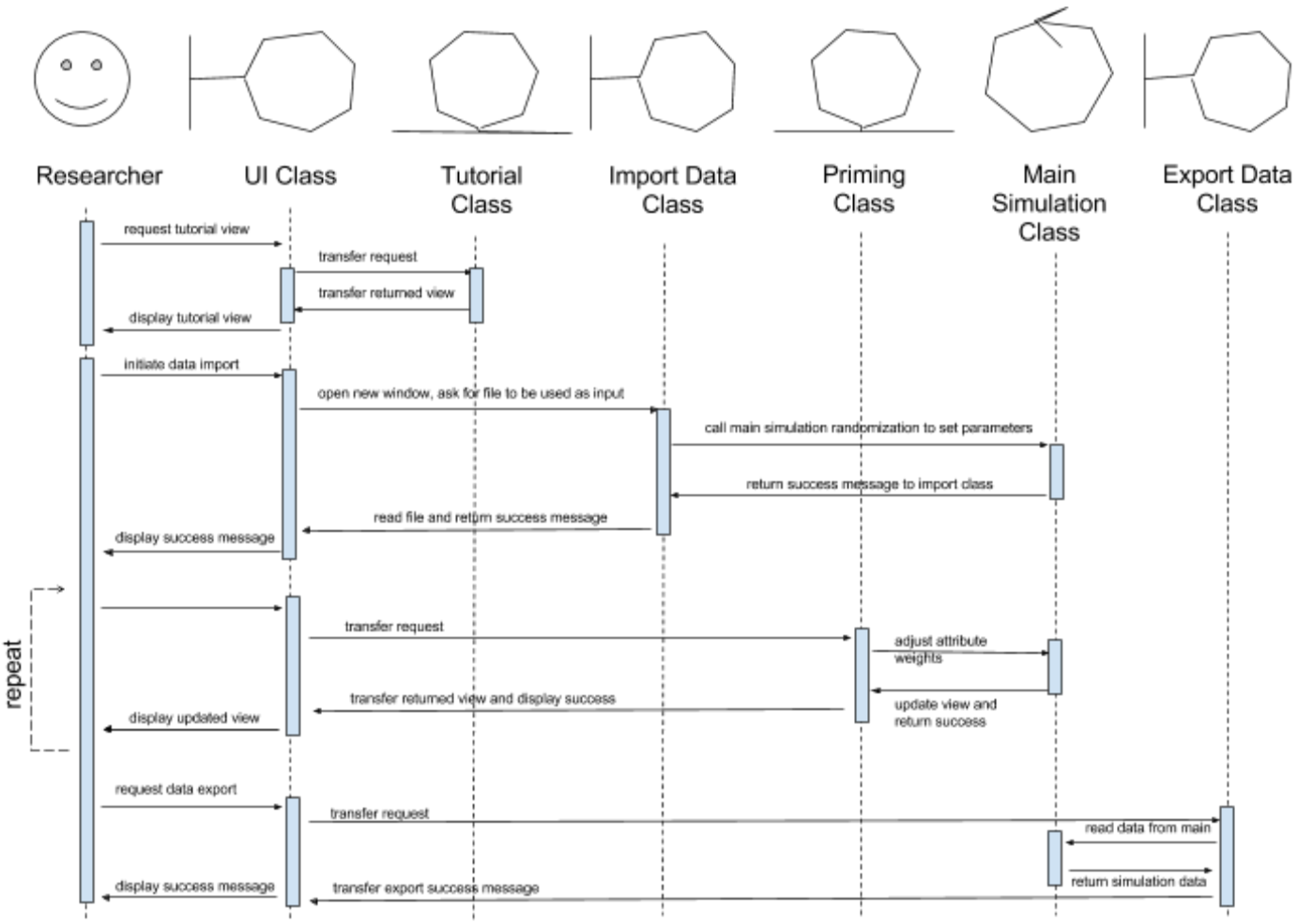
❖ **Export Data Class (Control)**

- Takes data from simulation class, puts it in format readable by human user
- saves output file for later review

PLEASE NOTE:
Import and export classes are currently not implemented.

The Relationship between these classes are shown below.





4 Other Non-functional Requirements

4.1 Performance Requirements

[NR - 1]: User Friendliness

Since the primaty audience will be psychology professors, the software must be easy enough for a non-programmer to use, demo, and even modify. This requirement is essential given the client's background in Computer Science and programming and the fact that there are no scheduled maintenance for this product.

[NR - 2]: Time of Execution

The simulation must be able to complete within reasonable time so that modifications to the model can be easily studied. Since one of the objectives of this simulation is to reduce the time and cost of running experiments with human subjects, the efficiency needed to train, run, modify, and verify this simulation must be really high.