**Senior Project – Defense Documentation**

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**Degree and Major:** Bachelor of Arts in Applied Computing, Business Concentration

**Project Advisor:** Prof. O’Neill

**Expected Graduation Date:** Indefinite

**Project Title:** Cognitive Trainer for Computer Science Professionals

**Statement of Purpose:**

Within the realm of systems programming and development, computer science professionals are regularly faced with intangible technical challenges that require accurate and decisive resolution—an analytical skill that is traditionally not exercised until it must be applied, often with varying success. To these ends, research has shown that routine engagement of activities which stimulate critical thinking can lead to neuroplasticity, increasing one’s ability to more quickly and precisely apply their knowledge at higher-orders of cognizance/domains of [Bloom’s Taxonomy](https://bloomstaxonomy.net/). This project is one such proposed application to facilitate thought and ability development of this nature, requiring minimal time commitment, with the additional benefit of taking place in a zero-stakes environment.

**Research & Background:**

When presented with high risk and/or time-constrained situations, proficient computer science professionals should ideally be able to perform with the same efficiency and accuracy as they otherwise would without such challenges or limitations. However, one’s ability to think critically (e.g., at the ‘Analyzing’ and ‘Evaluating’ domains of Bloom’s Taxonomy) is often hindered when faced with external, situational dilemmas, especially those that are of a nonroutine nature. Problem resolution that takes place under stress is an analytical skill that is often underdeveloped and for the computer science professional, lapses in judgement and indecisiveness can have detrimental effects on the welfare of society. A case study conducted by Leveson and Turner (1993), exemplifies the potential for extreme harm in this regard.

To that extent, professionals wishing to develop their ability to apply knowledge at higher-orders of cognizance can engage in brief, routine stimuli of activities that require critical thinking. By creating a program that utilizes basic information the user has already mastered (such as colors, numbers, and shapes), new knowledge is not required to be assimilated; rather, the application isolates the way known information is analyzed and evaluated. Facilitating complex thought and ability development of this nature will allow the user to conduct brain plasticity training with direct correlations to problem solving (e.g., the application, analysis, and evaluation of compound data and information) (Green & Bavelier, 2008). Similar to the phenomena of how solving crossword puzzles can lead to an increased vocabulary, this project aims to improve the user’s ability to accurately and decisively resolve technical challenges.

**Project Languages, Software, and Hardware:**

* Implementation Languages:
  + Primary: C#
  + Supporting: HTML, CSS
* Integrated Development Environment (IDE): Unity Professional
  + Version: LTS 2021.3.16f1
  + Source Code Editor: Visual Studio Code 1.82.2
* Internet Browser: Google Chrome
  + Version: 117.0.5938.89 (64-bit)
* Hardware: Dell Precision-5550
  + CPU: Intel(R) Core(TM) i7-10750H CPU @ 2.60GHz
  + GPU: NVIDIA Quadro T1000 4.0 GB
  + RAM: 32.0 GB
* Operating System: Windows 10 Pro
  + Version: 22H2
  + Build: 19045.3348
  + WFE Pack: 1000.19044.1000.0

**Project Requirements:**

* <https://github.com/jflum/CSU-Senior-Project/blob/master/docs/Requirements.pptx>

**Project Implementation Description & Explanation:**

* User Guide: <https://github.com/jflum/CSU-Senior-Project/blob/master/docs/tutorial.pdf>
* Source Code: <https://github.com/jflum/CSU-Senior-Project/tree/master/src>
  + (specifically, [/Assets/Scripts](https://github.com/jflum/CSU-Senior-Project/tree/master/src/Assets/Scripts))

**Test Plan & Results:**

* <https://github.com/jflum/CSU-Senior-Project/blob/master/docs/Test_Plan.docx>

**Challenges Overcome:**

Technical challenges of a significant manner did not arise during this program’s development, however time and workflow management became a critical component in its successful implementation. A brief context: I became a first time, new father two months prior to undertaking CSCI 498 – Senior Project Construction, and while I possessed a comprehensive and well-developed phase plan from the previous semester, finding the occasion (and mental capacity) to make meaningful, programmatic progress posed unforeseen challenges. In fact, I found myself stalled in productivity for the first several weeks of the course, unsure of the likelihood that I would be able to present a minimally viable product.

Typically, I prefer to code in longer sessions, developing major components and their associated functions in a front-to-back fashion, testing at a granular level throughout. It was immediately apparent, for a number of reasons, that this methodology would not be compatible with a newborn. In other words, my availability for production often was limited to many five- and ten-minute increments throughout the day, instead of all at once. To that extent, I employed a considerable amount problem decomposition, wherein my development strategy was broken down into numerous, more feasible micro tasks, allowing for their completion in shorter periods of time, while also reducing the overall mental load of implementation complexities.

**Future Enhancements:**

Possible extensions of the program include: a user account mechanism that allows for performance tracking over time, metric comparisons with other users or groups of users (leaderboards, e.g.), and administration functionality suitable for potential academic or professional implementations. In addition, perhaps during graduate studies, a controlled experiment should be conducted comparing the academic performance of students within a specific course of study who engage in a prescribed use of the program versus those who do not. This will be necessary in order to either substantiate or invalidate its effect on neuroplasticity in its current state, prior to subsequent revision or iteration.

Practical application feasibility notwithstanding, the opportunity for smaller-scope enhancements, especially with regard to user experience, also exist. For example, the present “tutorial” is limited to documentation a user must read and understand. This inherently does not account for new players who may be primarily visual, auditory, or kinesthetic/tactile learners. Implementing an interactive tutorial and providing a video demonstration as additional approach methods would lessen user burden, ensuring maximum accessibility and conversion. Other modern gamification improvements (i.e., experience, ranks, achievements, etc.) could also be leveraged, in an effort to increase mid- and long-term engagement.

**Defense Presentation Slides:**

* <https://github.com/jflum/CSU-Senior-Project/blob/master/docs/Presentation.pptx>

**References**

Green, C. S., & Bavelier, D. (2008). Exercising your brain: A review of human brain plasticity and training-induced learning. *Psychology and Aging*, *23*(4), 692–701. https://doi.org/10.1037/a0014345

Leveson, N., & Turner, C. (1993). An investigation of the Therac-25 accidents. *Computer*, *26*(7), 18–41. https://doi.org/10.1109/mc.1993.274940