

## Research Project: The von Neumann Boutique

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### Abstract:

It is generally acknowledged that fundamental concepts in computer science are intimidating to audiences with limited or no knowledge of the field. My research seeks to bridge a widening chasm between “techies” and everyone else, especially young audiences in middle school and high school.

In the summer of 2020, I developed a prototype story-telling method that introduces young readers to concepts in computer science. To complete this project, I learned about parallel computing and von Neumann architecture, and I experimented with different ways of presenting an overview of these technical topics. My final product is a 119-page paperback book with hand-drawn illustrations, *The von Neumann Boutique*, self-published with Kindle Direct Publishing and made available on Amazon.

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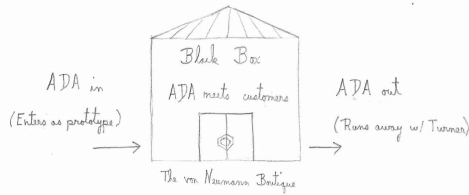
### Independent Studies:

This project in computer science outreach is an interdisciplinary effort. Its content includes research on parallel computing, von Neumann architecture, the life of Ada Lovelace, and interactions between humans and smart technologies.

Concepts and models introduced in the story include: the black box, serial computations, the bottleneck issue, embarrassingly parallel computations, components of von Neumann architecture (memory, CPU/processor, input/output), multiple instruction multiple data (MIMD) parallel processing architecture, interconnecting network, data exchange topology, fault tolerance, fault resistance, and redundancy.

The main character is loosely based on the historical figure, Ada Lovelace (1815-1852), who is considered the first female computer scientist. Most of the smart technologies' characters are inspired by people who influenced Lovelace. The plot is based on a recorded event that happened to Lovelace in her late teenage years.

The plot line explores interactions between humans and smart technologies from the machines' perspectives. At the beginning of each section, a digital log displays the current state of the robots. Each section demonstrates how a human causes robots to deviate and change states unexpectedly.

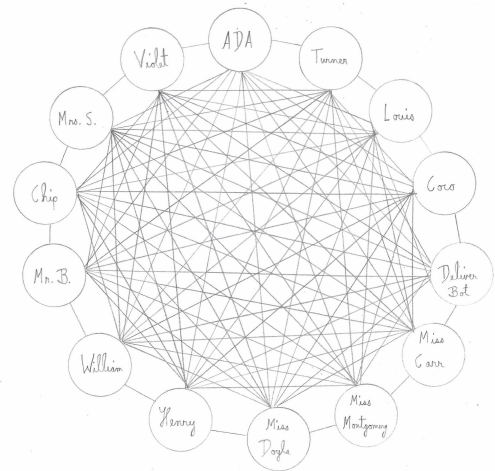


Layout :

This book is divided into four sections. Part 0, the *Prologue*, introduces the reader to ADA, a fashion mirror who “wakes up” in the boutique.

The other three sections model the von Neumann architecture. Part 1, *Central Processing Units*, introduces the robots as individual processes and demonstrates their roles and functionalities. Part 2, *Main Memory Units*, dives into the boutique’s memory and explores why the processes evolved from being serial to parallel. Part 3, *Input/Output*, demonstrates the results of ADA’s interactions in the boutique (how she enters as a young, naive mirror and exits with a transformed personality).

Data Exchange Topology



Throughout the book, there are hand-drawn illustrations that visually demonstrate parallels between computer science and social interactions. The illustrations are designed to help readers of all ages engage with the textual material.

The meat of the computer science is explained in the appendix. This section is where I explain the technical aspects of the concepts interwoven throughout the story. It summarizes my research, including a biography of Ada Lovelace.

Results:

Current forms of youth literature, such as the traditional young adult novel or graphic novel, are not sufficient to share advanced technical concepts to a young audience. A new form of literature is necessary to entice young future scientists. This book models a possible direction for a new form of tech-based literature.



Paperback copies of my prototype

In the future, I plan to write new books that integrate additional computer science topics into the boutique framework by expanding on the characters I have already developed. Potential topics include: data structures, algorithms, machine learning, and cyber security. I’d like to digitize this research by creating an interactive web-based presence. When COVID-19 restrictions permit, I will organize focus groups to test the effectiveness of my prototype.

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