UVSim Design Document

High-Level Functionality:

UVSim is a simple software simulator built to help computer science students learn about machine language and computer architecture. It features a 100-word memory, the ability to load and execute programs written in Basic Machine Language (BasicML), and serves as an accumulator. Each word is a signed 4-digit number, where the first two digits represent the operation codes and the last two digits represent the memory address.

UVSim can perform input/output (READ, WRITE), arithmetic (ADD, SUBTRACT, MULTIPLY, DIVIDE), load/store (LOAD, STORE), and control operations (BRANCH, BRANCHNEG, BRANCHZERO, HALT). Programs are loaded into memory, start running at address 00, and stop when they hit a HALT instruction. The simulator runs in the command line and talks to the user through basic input and output.

User Stories:

- As a student, I want to run a BasicML program on UVSim so I can practice and see how the instructions work.
- As a professor, I want UVSim to show the result of the program so students can understand how the instructions change the memory and the accumulator.

Use Cases

Read Input – The user types a number, and UVSim saves it in memory.

Write Output – UVSim shows the number from memory on the screen.

Load Value – UVSim puts a number from memory into the accumulator.

Store Value – UVSim saves the accumulator's number into memory.

Add Value – UVSim adds a number from memory to the accumulator.

Subtract Value – UVSim subtracts a number from memory from the accumulator.

Multiply Value – UVSim multiplies the accumulator by a number from memory.

Divide Value – UVSim divides the accumulator by a number from memory (stops with an error if it's zero).

Branch – UVSim jumps to a new line in memory, regardless of the context.

Branch if Negative – UVSim jumps if the accumulator is less than zero.

Branch if Zero – UVSim jumps if the accumulator equals zero.

Halt Program – UVSim stops running.

Handle Invalid Opcode – UVSim shows an error if it finds an instruction it doesn't know.

Handle Out-of-Range Input – UVSim warns if a number is not between –9999 and +9999 and asks again.

Execute Full Program – UVSim runs the whole program from the start (00) until HALT.