



Course Name: Software Engineering  
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# VirtualLogicLabs User Document

Demo 1

Github: <https://github.com/SagarPhanda/VirtualLogicLabs>

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# VirtualLogicLabs: User Documentation

The documentation in this document is sorted in the order that it will be seen by the User when running the program. For questions regarding a specific area, refer to the table of contents to find where to look for further information.

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## 1. Initial Logon

As soon as VirtualLogicLabs is opened, a login screen is displayed. This login screen has two fields, username and password.

- In this field, the username and password must be filled out. This default username/password combo that is currently set up with the system is:
  - Username: student
  - Password: student

Once these fields are correctly filled out, the display will transition to the Lab Selection screen.

## 2. Lab Selection

This interface allows the student to select which lab they would like to complete. Additionally, users are sent back to this screen once they complete any of the Labs or if they choose to exit Sandbox Mode via the 'Main Menu' button. The options the user has on this screen are:

- a) Sandbox Mode: Selecting this will transport users to sandbox mode, where they can build various circuits of their choosing
- b) Lab 1: Selecting this will transport users to the prelab interface for Lab 1
- c) Lab 2 / Lab 3: Selecting Lab 2 or Lab 3 will eventually lead the users to the respective prelab interfaces, but currently these buttons are not functional, as the labs have not yet been implemented

### 2.1: Sandbox Mode

Sandbox mode can be entered through the student subsystem by clicking the button labeled "Sandbox Mode". It offers students a practice / sandbox where they can build circuits and test the outputs. There are no requirements in sandbox mode, as it just offers students a chance to experiment with the circuitry, with no grading consequences.

- **Protoboard**: The protoboard is where all of the circuits will be built.
  - It is arranged in the typical fashion. The nodes in the two columns on each end (denoted by red and blue lines down the side of the board) are all connected. Also, each row of 5 nodes is connected.
  - Items can be dragged onto the protoboard, where they will "snap" into place when released over the nodes
  - Nodes will light up when connected to either a 5 volt high voltage (when they will light up green), or a 0 volt low voltage (when they will light up red)
- **Equipment List**: Located at the top right corner of the interface, this allows users to select the types of circuit elements that they wish to use while constructing his/her circuit. Clicking the drop down menu, then selecting the desired element will cause it to appear on the screen, and the user can then click and drag it to the desired spot on the circuit board.
  - **74LS00**: quad 2-input NAND gate
  - **74LS04**: hex inverter
  - **74LS32**: quad 2-input OR gate
  - **74LS08**: quad 2-input AND gate

- **LED:** Light Emitting Diode used to test the output of circuits
  - Lights up while connected to logic high
- **SPDT:** Single-pole double-throw switch, used to control whether inputs are high or low
  - The switches must be logic high on one end, and logic low on the other. The middle pin will either be high or low depending on where the switch is pointed.
  - Switch orientation is changed by right-clicking on the switch
- **Trash Can:**

(Located in the bottom right, below the magnifying glass and above the finish button)

  - Dragging circuit elements that are no longer in use to the trash can will remove them
- **Magnifying Glass:**

(Located above the Trash Can)

  - Clicking and dragging the magnifying glass over any chip will cause a diagram of that specific chip to appear in the lower right corner of the screen. Students can use these diagrams to determine the functionality of each of pin.
- **Voltage Source:**

(Located in the top left of the screen, controlling the input voltage)

  - The left node represents input voltage of 5 volts
  - The right node represents ground, or a voltage level of 0 volts.
- **Wires:** Used to connect circuit elements to one another. Wires can be activated by clicking from the voltage source and dragging to the desired destination, or by selecting the “W” key from the keyboard.

## 2.2: Lab 1

The first lab is accessed through the the Lab Selection menu, which appears after the user has passed the Initial Logon page and has chosen the “Lab 1” button. This will take the student to the first lab, where they must complete the prelab, lab, and postlab.

- **Prelab:** Once entering lab 1, the user will be brought to a prelab screen, where they will be asked to complete a truth table based on a logic function
  - In each box, the user must enter a “1” or a “0” in order to determine the correct truth-table output.
  - Once completed, the user will click the “Check” button, and their work will be checked
    - If their answer is incorrect, the user will be presented with a message saying that they are wrong, and to try again.
    - If their answer is correct, they will be told so, and after 5 seconds, will be taken to the lab workspace
- **Lab Workspace:** The lab workspace is very similar to Sandbox Mode, with the exception that here, the user will be given a task to complete
  - In this lab, the user will be asked to implement the logic function

- $F(A,B,C) = A*B*C' + A*B + B*C$
  - If the user forgets the inside of a chip and needs a refresher, they can use the Magnifying Glass which is located above the trash can.
  - If the user takes out more elements than needed, they can use the trash can to dispose of the extra equipment.
  - After completion, the user will place the 'A', 'B', and 'C' tags over the respective switches, and the 'F' tag over the LED representing the output.
  - Following that, the user clicks the "Check" button, and the system runs through every possible combination of inputs and will either display a checkmark, indicating that the circuit output is correct for that set of inputs, or an "X", indicating that the output is incorrect
  - If all of them are correct, the user will be told that they are correct, and after 5 seconds, they will be brought to the postlab interface.
- **Postlab:** After completing the Lab, the user will be brought to the postlab screen, where they will be asked to complete a Karnaugh Map
  - Much like the prelab, users will need to complete a K-Map by filling out each box with either 1 or 0
  - After completion, the user clicks the "Check" button, and the system checks to see if the inputs are correct
    - If correct, the system will display the congratulations message, and after 5 seconds, take the user back to the lab selection interface
    - If incorrect, the lab will tell the user that he/she is incorrect, and they will have to try again
    - If correct, the system will display "That's right!" message and the users will also be provided with the reduction function based on the K-map. Then the system will wait for 5 seconds and exit to the main menu.

### 2.3: Lab 2 / Lab 3

When either of these buttons are pressed, nothing will happen. Functionality will be added to these buttons corresponding to Lab 2 and Lab 3 in the following release.

## 3. Ending the program

Once the final stage of the lab, the postlab, is completed, the system will take the user back to the main menu, where they are able to see the Sandbox Mode, Lab 1, Lab 2 and Lab3. Since the application itself is an executable, the user is able to close it out from their computer's taskbar.