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About Digital Simulator

Digital Simulator 1.0

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Digital simulator is a complete digital electronics lab. In Design Mode, you can place components from a palette including logic switches, gates, flip-flips, 7-segment displays, and RAM and ROM chips. In Run Mode, you can interact with the simulation by toggling the logic switches with the mouse. The displays will react appropriately in real time. Digital Simulator includes a logic analyzer which enables you to see a watch the status of points in the circuit over time with respect to other points. Digital Simulator also includes a comprehensive help system, which you are using.

Digital Simulator was written by Ara Knaian, a student at Newton North High School and a co-founder and co-president of the Electronics Club, because he had a budget of nearly zero thousand dollars per year, but access to a large computer lab, and wanted to teach Digital Electronics to club members.

If you like this program, please send a donation of \$20 to the author. Your donation will insure that he continues to write programs such as this, provide you with a reasonable amount of free technical support, notification of upgrades, and good karma.

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Overview

Digital simulator allows you to draw a schematic of a digital circuit on the screen, run and interact with it, and investigate its operation with a logic analyzer.

To draw a circuit, you place devices and draw wires to connect the devices. If you wish to use the logic analyzer, you can place logic analyzer probes in the circuit, and connect them to the circuit with wires like any other device. You must draw devices before connecting them with wires. You cannot draw a wire and place a device so that one of its nodes is on top of the wire.

You can place text in a circuit as if you were placing any other device.

If you make a mistake while drawing the circuit, you can use the eraser tool to erase devices and wires, by clicking on the eraser button in the upper-left corner of the screen, and then clicking on the device or wire. If you erase a wire, you must erase the entire wire. You may not erase part of a wire and continue it somewhere else.

To undo previous actions, click Undo on the Edit menu. This will erase the last device placed or wire drawn. You can continue to click Undo until your entire circuit has been erased.

When a component is erased, part of the grid is sometimes erased. To redraw the screen, click Redraw on the Options Menu.

You can cut or copy portions of a circuit and place them as a unit in any circuit. See Cutting and Pasting. You can paste circuit files into circuits. See Pasting Files into Circuits.

To run a circuit, click Run on the Run Menu. This places the program in Run Mode. While in run mode, you cannot place gates or draw wires. To toggle a logic switch, click on the circle in the middle of it. To return to design mode, click Stop on the run menu.

To save your circuit click Save on the File Menu. To load a previously saved circuit, click Open on the File Menu.

Placing Devices

To place a device, click the button with its icon on the left side of the screen. Then click the location where you want the upper-left corner of the device to be.

To place text, type the text into the box on the top of the screen. Then click the text button and place it as you would a normal device.

If you place a clock or ROM, a dialog box will appear so that you can enter the clocks frequency and duty cycle, or enter the ROM mask data.

Drawing Wires and Nodes

To draw a wire, click the button with the wire icon to the left of the screen. Press the left mouse button over one of a devices nodes, drag the mouse pointer to the intended endpoint of the wire fragment, and lift the mouse button. You may continue to do this, clicking on the endpoint of the last wire fragment drawn, and dragging the mouse to the wires new endpoint. To connect the wire, click the mouse on its last endpoint and drag it to a another node. Lift the mouse button

You must finish drawing a wire, by connecting it to two nodes, before you start to draw another wire.

If you want a wire to branch out in several directions, you can use a node. Click the node button on the left of the screen, and place the node as you would a device. When you attach a wire to one of the nodes nodes, all subsequent wires started on one of the nodes will behave electrically as if they were part of the original wire.

Erasing Wires and Devices

To erase a wire or device, click on the button to the left of the screen with the eraser icon, and then click on the wire or device that you want to erase.

If you want to undo placed wires or devices, click Undo on the Edit menu. This will erase the last wire or device created. You can continue to click Undo until you have erased your whole circuit.

Cutting and Pasting

You can cut or copy sections of your circuit to the clipboard, paste these sections into your circuit, and delete sections of your circuit. To Paste a saved circuit into your circuit from the disk, see [Pasting Files into Circuits](#). If you cut a portion of your circuit, the wires and devices in it will be erased from their present position. If you copy a portion of circuit, the wires and devices in it will not be erased. If you delete a portion of your circuit, the wires and devices in it will be erased, but will not be copied to the clipboard.

To cut or copy devices, click the arrow button in the upper-left corner of the screen. Press the left mouse button on the upper-left corner of the area you wish to cut, copy, or delete, and drag the mouse to the lower-right corner. Lift the button. A dashed box will appear around the selected circuit fragment. Click Cut, Copy, or Delete on the Edit menu, and the appropriate action will be performed.

To paste a circuit fragment on the clipboard into your circuit, click the arrow button in the upper-left corner of the screen. Click where you want the upper-left corner of the fragment to be placed. A cross will appear at that point. Click the Paste button on the Edit Menu, and the fragment will be pasted into your circuit.

Pasting Files into Circuits

You can circuit files into circuits, much as you would paste circuit fragments from the clipboard. To cut, copy, and paste with the clipboard, see [Cutting and Pasting](#).

Click on the arrow button in the upper-left corner of the screen. Click where you want the upper-left corner of the circuit fragment to appear. Click Paste In on the file menu, and select a circuit file from the dialog box. The file will be pasted into your circuit.

Run Mode

To simulate the operation of a circuit, switch the program to Run Mode. To switch to Run Mode, click Run on the Run Menu. To switch back to Design Mode, click Stop on the Run Menu. To Pause the simulation momentarily, click Pause on the Run Menu. To resume the simulation, click Pause again.

While the program is in Run Mode, you can toggle the logic switches in your circuit. The display components will respond in real time. If you double-click a momentary pushbutton, it will be permanently toggled. If the circuit enters an uncontrolled or very fast oscillation, the cursor may flicker while on top of the circuit. If this occurs, you can stop the simulation, or pause it and toggle the switches to stop the oscillation.

While the program is in run mode, you cannot place devices, draw wires, cut, paste, paste in, erase, or undo.

Logic Analyzer

You can view the state of points in your circuit over time with respect to other points to explore or debug a circuit.

To use the logic analyzer, you must place logic analyzer probes. To place probes, click the button with the picture of a logic analyzer display on the left of the screen and place and connect the probes as you would a normal device.

The probe labeled #1 is the clock. The Logic Analyzer display is updated on a positive transition of the clock, so all signals are viewed with respect to it. All other probes control individual traces.

When you are ready to run the circuit, if you have not already done so, click Load Logic Analyzer on the Run Menu. Resize the schematic window so that you can see the Logic Analyzer Icon at the bottom of the main window. Click on the logic analyzer and resize both windows for convenient use. When you enter Run Mode, the Logic Analyzer will register the state of the probes on each positive transition of the clock.

To change the maximum length of the traces, change the number labeled trace length in the lower-left corner of the Logic Analyzer window, and click the Update button in the lower-right corner of the window.

Loading and Saving Circuits

You can save circuits on a disk, and load circuits from a disk. To Paste a circuit fragment into your circuit from a disk, see [Pasting Files into Circuits](#).

To load a circuit, click Open on the File Menu. Select the appropriate file from the dialog box and click the OK button.

To save a circuit, Click save on the File Menu. If you have not saved the circuit before, enter a file name in the dialog box and click the OK button.

To save a circuit under a new name, click Save As on the File Menu.

To erase the current circuit without saving it, click New on the File Menu.

Options

You can change the page size, enable or disable the grid, and enable or disable the beep when you click on an enabled gate.

To change the page size, click Page Size on the Option Menu. You can enter the page size in inches, centimeters, or pixels. When you have set the page size, click OK.

To toggle the grid, click Show Grid on the Options Menu. If a check appears next to Show Grid, the grid is currently enabled.

To toggle the beep, click Sound on the Options Menu. If a check appears next to Sound, sound is currently enabled.

To save the above settings so that they are the defaults for all future Digital Simulator sessions, click Save Settings on the Options Menu.

Redraw

When you erase a device or wire, portions of the grid or other devices or wires can appear to be erased. The screen is automatically redrawn when the program switches from Design to Run Mode. To redraw the circuit at any other time, click Redraw on the Options Menu.

