

## 1: Combinational Logic Circuit Design

*Logic Diagram - This is a graphical representation of a logic circuit that shows the wiring and connections of each individual logic gate, represented by a specific graphical symbol, that implements the logic circuit.*

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## 2: Digital electronics - Wikipedia

*This product is a simulator for logic circuits, allowing the student to better visualize and understand how a logic circuit works, by enabling him to build whatever logic circuit he wants, and.*

Tunnel diode logic TDL Exactly the same as diode logic but can perform at a higher speed. Core diode logic CDL Performed by semiconductor diodes and small ferrite toroidal cores for moderate speed and moderate power level. Direct-coupled transistor logic DCTL Uses transistors switching between saturated and cutoff states to perform logic. The transistors require carefully controlled parameters. Economical because few other components are needed, but tends to be susceptible to noise because of the lower voltage levels employed. Often considered to be the father to modern TTL logic. Current-mode logic CML Uses transistors to perform logic but biasing is from constant current sources to prevent saturation and allow extremely fast switching. Has high noise immunity despite fairly low logic levels. Quantum-dot cellular automata QCA Uses tunnelable q-bits for synthesizing the binary logic bits. The electrostatic repulsive force in between two electrons in the quantum dots assigns the electron configurations that defines high-level logic state 1 or low-level logic state 0 under the suitably driven polarizations. This is a transistorless, currentless, junctionless binary logic synthesis technique allowing it to have very fast operation speeds. Electronic logic gates differ significantly from their relay-and-switch equivalents. They are much faster, consume much less power, and are much smaller all by a factor of a million or more in most cases. Also, there is a fundamental structural difference. The switch circuit creates a continuous metallic path for current to flow in either direction between its input and its output. The semiconductor logic gate, on the other hand, acts as a high-gain voltage amplifier, which sinks a tiny current at its input and produces a low-impedance voltage at its output. It is not possible for current to flow between the output and the input of a semiconductor logic gate. Another important advantage of standardized integrated circuit logic families, such as the NAND families, is that they can be cascaded. This means that the output of one gate can be wired to the inputs of one or several other gates, and so on. Systems with varying degrees of complexity can be built without great concern of the designer for the internal workings of the gates, provided the limitations of each integrated circuit are considered. When gates are cascaded, the total propagation delay is approximately the sum of the individual delays, an effect which can become a problem in high-speed circuits. Additional delay can be caused when a large number of inputs are connected to an output, due to the distributed capacitance of all the inputs and wiring and the finite amount of current that each output can provide. In an 1841 letter, Charles Sanders Peirce described how logical operations could be carried out by electrical switching circuits. Ludwig Wittgenstein introduced a version of the row truth table as proposition 5. Walther Bothe, inventor of the coincidence circuit, got part of the Nobel Prize in physics, for the first modern electronic AND gate in 1924. Konrad Zuse designed and built electromechanical logic gates for his computer Z1 from 1938 to 1941. From 1941 to 1945, NEC engineer Akira Nakashima introduced switching circuit theory in a series of papers showing that two-valued Boolean algebra, which he discovered independently, can describe the operation of switching circuits. Shannon, who elaborated on the use of Boolean algebra in the analysis and design of switching circuits in 1937. Switching circuit theory became the foundation of digital circuit design, as it became widely known in the electrical engineering community during and after World War II, with theoretical rigor superseding the ad hoc methods that had prevailed previously. The "distinctive shape" set, based on traditional schematics, is used for simple drawings, and derives from MIL-STD of the S and s. It is sometimes unofficially described as "military", reflecting its origin. The mutual goal of IEEE Std and IEC was to provide a uniform method of describing the complex logic functions of digital circuits with schematic symbols. They could be medium scale circuits such as a 4-bit counter to a large scale circuit such as a microprocessor. IEC and its successor IEC do not explicitly show the "distinctive shape" symbols, but do not prohibit them. Usage of these other symbols in combination to form complex symbols for example, use as embedded symbols is discouraged. A third style of symbols was in use in Europe and is still widely used in European academia. In the 1950s, schematics were the predominant method to design both circuit boards and custom ICs known as gate arrays.

## 3: Logic circuit – Official Minecraft Wiki

*Logic Circuit. LogicCircuit - is free, open source educational software for designing and simulating digital logic circuits. Intuitive graphical user interface, allows you to create unrestricted circuit hierarchy with multi bit buses, debug circuits behavior with oscilloscope, and navigate running circuits hierarchy.*

History[ edit ] The binary number system was refined by Gottfried Wilhelm Leibniz published in and he also established that by using the binary system, the principles of arithmetic and logic could be joined. Digital logic as we know it was the brain-child of George Boole in the mid 19th century. In an letter, Charles Sanders Peirce described how logical operations could be carried out by electrical switching circuits. Ludwig Wittgenstein introduced a version of the row truth table as proposition 5. Walther Bothe , inventor of the coincidence circuit , shared the Nobel Prize in physics, for the first modern electronic AND gate in Mechanical analog computers started appearing in the first century and were later used in the medieval era for astronomical calculations. In World War II , mechanical analog computers were used for specialized military applications such as calculating torpedo aiming. During this time the first electronic digital computers were developed. Originally they were the size of a large room, consuming as much power as several hundred modern personal computers PCs. At the same time that digital calculation replaced analog, purely electronic circuit elements soon replaced their mechanical and electromechanical equivalents. The bipolar junction transistor was invented in From onwards, transistors replaced vacuum tubes in computer designs, giving rise to the "second generation" of computers. Compared to vacuum tubes, transistors have many advantages: Silicon junction transistors were much more reliable than vacuum tubes and had longer, indefinite, service life. Transistorized computers could contain tens of thousands of binary logic circuits in a relatively compact space. At the University of Manchester , a team under the leadership of Tom Kilburn designed and built a machine using the newly developed transistors instead of vacuum tubes. While working at Texas Instruments in July , Jack Kilby recorded his initial ideas concerning the integrated circuit then successfully demonstrated the first working integrated on 12 September In the early days of integrated circuits, each chip was limited to only a few transistors, and the low degree of integration meant the design process was relatively simple. As the technology progressed, millions, then billions [7] of transistors could be placed on one chip, and good designs required thorough planning, giving rise to new design methods. Properties[ edit ] An advantage of digital circuits when compared to analog circuits is that signals represented digitally can be transmitted without degradation caused by noise. In a digital system, a more precise representation of a signal can be obtained by using more binary digits to represent it. While this requires more digital circuits to process the signals, each digit is handled by the same kind of hardware, resulting in an easily scalable system. In an analog system, additional resolution requires fundamental improvements in the linearity and noise characteristics of each step of the signal chain. With computer-controlled digital systems, new functions to be added through software revision and no hardware changes. Information storage can be easier in digital systems than in analog ones. The noise immunity of digital systems permits data to be stored and retrieved without degradation. In an analog system, noise from aging and wear degrade the information stored. In a digital system, as long as the total noise is below a certain level, the information can be recovered perfectly. Even when more significant noise is present, the use of redundancy permits the recovery of the original data provided too many errors do not occur. In some cases, digital circuits use more energy than analog circuits to accomplish the same tasks, thus producing more heat which increases the complexity of the circuits such as the inclusion of heat sinks. In portable or battery-powered systems this can limit use of digital systems. For example, battery-powered cellular telephones often use a low-power analog front-end to amplify and tune in the radio signals from the base station. However, a base station has grid power and can use power-hungry, but very flexible software radios. Such base stations can be easily reprogrammed to process the signals used in new cellular standards. Digital circuits are sometimes more expensive, especially in small quantities. Most useful digital systems must translate from continuous analog signals to discrete digital signals. This causes quantization errors. Quantization error can be reduced if the system stores enough digital data to represent the signal to the desired

degree of fidelity. The Nyquist-Shannon sampling theorem provides an important guideline as to how much digital data is needed to accurately portray a given analog signal. In some systems, if a single piece of digital data is lost or misinterpreted, the meaning of large blocks of related data can completely change. Because of the cliff effect, it can be difficult for users to tell if a particular system is right on the edge of failure, or if it can tolerate much more noise before failing. Digital fragility can be reduced by designing a digital system for robustness. For example, a parity bit or other error management method can be inserted into the signal path. These schemes help the system detect errors, and then either correct the errors, or at least ask for a new copy of the data. In a state-machine, the state transition logic can be designed to catch unused states and trigger a reset sequence or other error recovery routine. Digital memory and transmission systems can use techniques such as error detection and correction to use additional data to correct any errors in transmission and storage. On the other hand, some techniques used in digital systems make those systems more vulnerable to single-bit errors. These techniques are acceptable when the underlying bits are reliable enough that such errors are highly unlikely. A single-bit error in audio data stored directly as linear pulse code modulation such as on a CD-ROM causes, at worst, a single click. Instead, many people use audio compression to save storage space and download time, even though a single-bit error may corrupt the entire song. A binary clock, hand-wired on breadboards

A digital circuit is typically constructed from small electronic circuits called logic gates that can be used to create combinational logic. Each logic gate is designed to perform a function of boolean logic when acting on logic signals. A logic gate is generally created from one or more electrically controlled switches, usually transistors but thermionic valves have seen historic use. The output of a logic gate can, in turn, control or feed into more logic gates. Integrated circuits consist of multiple transistors on one silicon chip, and are the least expensive way to make large number of interconnected logic gates. Integrated circuits are usually designed by engineers using electronic design automation software see below for more information to perform some type of function. Integrated circuits are usually interconnected on a printed circuit board which is a board which holds electrical components, and connects them together with copper traces. Design[ edit ] Each logic symbol is represented by a different shape. Lookup tables can perform the same functions as machines based on logic gates, but can be easily reprogrammed without changing the wiring. This means that a designer can often repair design errors without changing the arrangement of wires. Therefore, in small volume products, programmable logic devices are often the preferred solution. They are usually designed by engineers using electronic design automation software. When the volumes are medium to large, and the logic can be slow, or involves complex algorithms or sequences, often a small microcontroller is programmed to make an embedded system. These are usually programmed by software engineers. When only one digital circuit is needed, and its design is totally customized, as for a factory production line controller, the conventional solution is a programmable logic controller, or PLC. These are usually programmed by electricians, using ladder logic. When the complexity is less, the circuit also has fewer errors and less electronics, and is therefore less expensive. Some analysis methods only work with particular representations. The classical way to represent a digital circuit is with an equivalent set of logic gates. Another way, often with the least electronics, is to construct an equivalent system of electronic switches usually transistors. One of the easiest ways is to simply have a memory containing a truth table. The inputs are fed into the address of the memory, and the data outputs of the memory become the outputs. For automated analysis, these representations have digital file formats that can be processed by computer programs. Most digital engineers are very careful to select computer programs "tools" with compatible file formats. Sequential[ edit ] To choose representations, engineers consider types of digital systems. Most digital systems divide into "combinational systems" and "sequential systems". It is basically a representation of a set of logic functions, as already discussed. A sequential system is a combinational system with some of the outputs fed back as inputs. This makes the digital machine perform a "sequence" of operations. The simplest sequential system is probably a flip flop, a mechanism that represents a binary digit or "bit". Sequential systems are often designed as state machines. Sequential systems divide into two further subcategories. Synchronous sequential systems are made of well-characterized asynchronous circuits such as flip-flops, that change only when the clock changes, and which have carefully designed timing margins. Synchronous systems[ edit ] A 4-bit ring counter using D-type

flip flops is an example of synchronous logic. Each device is connected to the clock signal, and update together. The fastest rate of the clock is set by the most time-consuming logic calculation in the combinational logic. The state register is just a representation of a binary number. If the states in the state machine are numbered easy to arrange, the logic function is some combinational logic that produces the number of the next state. Asynchronous systems[ edit ] As of, most digital logic is synchronous because it is easier to create and verify a synchronous design. However, asynchronous logic is thought can be superior because its speed is not constrained by an arbitrary clock; instead, it runs at the maximum speed of its logic gates. Building an asynchronous system using faster parts makes the circuit faster. Nevertheless, most systems need circuits that allow external unsynchronized signals to enter synchronous logic circuits. These are inherently asynchronous in their design and must be analyzed as such. Examples of widely used asynchronous circuits include synchronizer flip-flops, switch debouncers and arbiters. Asynchronous logic components can be hard to design because all possible states, in all possible timings must be considered. The usual method is to construct a table of the minimum and maximum time that each such state can exist, and then adjust the circuit to minimize the number of such states. Then the designer must force the circuit to periodically wait for all of its parts to enter a compatible state this is called "self-resynchronization". Without such careful design, it is easy to accidentally produce asynchronous logic that is "unstable," that is, real electronics will have unpredictable results because of the cumulative delays caused by small variations in the values of the electronic components. Register transfer systems[ edit ] Example of a simple circuit with a toggling output.

## 4: CircuitVerse - Online Digital Logic Circuit Simulator

*Combinational Logic Circuit Design. Even though CAD tools are used to create combinational logic circuits in practice, it is important that a digital designer should learn how to generate a logic circuit from a specification.*

The system should tell the user which parking section has the most amount of free If all free spaces are taken in the parking lot, new cars should not be allowed to enter Any other efficient additions that may be Vending Machine A Vending machine with full display for cash submitted and change returned as well as items dispensed. Keyboard Word Detection Interfacing a keyboard to a logic circuit that detects at run-time the occurrence of 5- letter words or one particular word while a user types in a paragraph of English. A running counter increments every time this condition is met. The shooting range should provide the user with a LASER gun, which the user will point towards specific targets. There should be at least 4 targets, and all of them should be switching randomly from one to another after a fixed time period. The person gets a point if he points accurately towards the target that is currently switched on. Water Tank Control Mechanism A water-tank fill-up and overflow control mechanism with alarm. A circuit needs to be designed that displays the present level of water in the tank. The circuit also opens an outlet valve when the level in the tank exceeds a particular level, and finally opens the inlet valve when the water in the tank falls below a particular level. A state machine maintains the temperature of the house between two extreme limits set by the user, as well as the intensity of lights in the room and secures the perimeter using input taken from temperature, light and IR sensors. A circuit is required that would act like a bridge between the electrical appliance in the house and the land-line telephone set. The user should be able to remotely switch on or off appliances in his house by dialing his home telephone number, entering a password and then selecting the device to be turned on or off. Clap Lock Voice clap only activated Moore state machine design with synchronous reset. A state-machine based digital combination lock circuit which transitions from one state to the next at the clap of hands, not on the clock. The circuit should be intelligent enough not to trigger at other sounds. The decision must be taken after the entire code has been entered. The lock must have at least 10, possible combinations. The transition from one type of pulse to the next must always occur at the 1-sec boundary. A detector circuit should be able to successfully detect all pulses with a period less than 1 sec i. Keypad Calculator The calculator should take in a maximum decimal number of 32 and perform the following functions: The result should appear on 7-segment displays. Keypad Number Guessing Game A reference number between 1 and 30 is fed to the circuit beforehand. The user guesses the stored number by typing it onto the keypad. The user has 5 tries to guess the number. Also capable of giving average speed on vehicles.

## 5: Basic Logic Gates

*Build. Design logic circuits online. Simulate. Test your logic circuit in real-time. Collaborate. Work with a team on a single synchronized circuit.*

A NOT gate aka "inverter" turns on if its input is off. Torch Inverter 1-wide, flat horizontal only, silent, tileable circuit delay: One drawback of the torch inverter is that it will "burn out" if run on a clock cycle faster than a 3-clock 3 ticks on, 3 ticks off. A burnt out torch inverter will turn back on after a random time, which may produce undesired pulses in a circuit. Subtraction Inverter flat, silent circuit delay: The powered lever can be replaced with another always-on power component. If the input power level is known because the circuit design is fixed, so it can be calculated, the repeater can be removed by replacing the powered lever with a container which will produce the same power level. Alternatively, the repeater can be removed if the output continues to a length of redstone wire which will reduce the subtracted signal enough that the signal is inverted eventually. Instant Inverter circuit delay: The "ground" version has the largest volume, but is shorter and fits easily with flatter circuits. The "tall" version not actually tallest is the smallest in volume and resources, but has an input and output at inconvenient locations though not necessarily for "in-the-sky" builds. The "long" version is larger but has input and output at a convenient ground level. An instant inverter has two sticky pistons -- one to move a block to cut off the output, and one to move a block of redstone power source. When the input is off, the block of redstone powers the output. At the same time, the redstone repeater gets powered, but before it can power the output, the other block has moved into place to cut off the output. While the input is on, the redstone repeater is trying to power the output, but the output is cut off by the moving block. As soon as the output turns off, the block starts to retract, immediately allowing the power through instantly inverting the input. The repeater will only continue to power the output for 2 tick before it turns off, but by that time the block of redstone has arrived back in its original position to continue powering the output. When fitting an instant inverter into a larger build which may require the inputs or outputs to be moved around, there are three components that need to be powered simultaneously: Getting the input line to all three can be tricky. The "tall" version solves this problem by placing all three components next to a single input block, while the other versions need to split the input line to reach all components. The three circuits shown below illustrate ways of powering the output line from above, below, and from the side.

## 6: Logic gate - Wikipedia

*Combinational logic circuits that were described earlier have the property that the output of a logic block is only a function of the current input values, assuming that enough time has elapsed for the logic gates to settle.*

Here we go through a step by step analysis of the various characteristics of CMOS logic gates with the help of circuit schematics and understand their simple configurations through some practical logic design projects. It totally changed the concept and the way electronics used to work prior to this invention. The rapid advancement in electronics that we are able to witness today is just because of this CMOS technology. Right from your cell phones and laptops to the satellites, all involve and depend on a network of logic gates. A basic form of a CMOS IC may be discreetly made up of a single or many individually analyzing devices called the logic gates. If we take human analogy and compare a computer to a human brain, then each logic gate involved in the computer circuit corresponds to each neuron present in our brain. Thus, a single CMOS logic gate may be considered as the basic building block of this technology and through intelligent combinations of these gates, complex and amazing results can be obtained, quite similar to the human brain. These instructions are specific to each type of gate and can be found through their Truth Tables. The most important and identifiable feature of these gates is that they will not respond to any intermediate values or levels of voltages. Any voltage below 3 volts approx. A typical CMOS gate basically comprises of an input and an output. The output is the function of its input and will respond to it as per its particular specifications. As the name suggests, the function of this particular gate is to invert or produce exactly the opposite result to that of its input status, i. An IC may comprise many digital logic gates in one package for example, the IC consists of 6 NOT gates, but in a schematic diagram these gates may be shown scattered all over, individually wired into separate circuits. Since all gates are identical, taking the help of the datasheet, you may just confirm the pin outs of the gates and connect them as shown in the particular schematic while constructing a circuit. Referring to the along side diagram we see how a NOT gate may be wired into an accurate light sensor circuit. Here, its input is connected to a potential divider network made up of an LDR and a variable resistor or a preset P. As long as the light falling over the LDR does not produce a potential level greater than the set level of P1, the output of the gate remains stationary. The next circuit shows how a NOT gate may be configured as a simple timer, perhaps the simplest and the most accurate short duration timer. Also, a capacitor C1 is attached to this input via resistor R1. Now suppose we connect a positive voltage to the junction of R1 and C1. Now what happens if the positive trigger is removed? The gate continues to sustain its position because of the stored charge in C1, until C1 completely discharges via R2 and the gate returns to its original position. The value of C1 and R2 determines the time period for which the gate remains latched. This configuration shows see figure how simply by adding a capacitor and a resistor to a couple of NOT gates a beautiful LED flasher can be made. The rate of flashing can be adjusted or varied by changing the values of either the capacitor or the resistor. By adding another gate to its output you can convert it into an astable multivibrator producing alternate flashing of two LEDs. Now if you take the IC, which contains 6 inverters in one pack, means you can construct three separate flashers or oscillators with different flashing rates and produce interesting flashing effects or results. They are as follows: Supply voltage should remain strictly within 5 to 15 volts DC. Input to the gates should never exceed the supply voltage. Supply terminals should be preferably make it a practice fitted with a decoupling capacitor. Once you grasp the basic rules regarding the functioning of logic gates as explained above, you should be able to build your own logic circuit design projects effortlessly. Next time we will discuss regarding a few practical circuits using NAND gates.

## 7: Logic Circuit official web site

*Logisim is an educational tool for designing and simulating digital logic circuits. With its simple toolbar interface and simulation of circuits as you build them, it is simple enough to facilitate learning the most basic concepts related to logic circuits.*

### 8: Logic Circuit Designer - Free download and software reviews - CNET [www.enganchecubano.com](http://www.enganchecubano.com)

*Truth Tables. Truth tables are used to help show the function of a logic gate. If you are unsure about truth tables and need guidance on how to go about drawing them for individual gates or logic circuits then use the truth table section link.*

### 9: + digital logic design projects list with logic gates for beginners

*In electronics, a logic gate is an idealized or physical device implementing a Boolean function; that is, it performs a logical operation on one or more binary inputs and produces a single binary output.*

*Living the life you love A Nineteenth-Century Musical Chronicle English kumarbharati 9th textbook Multimedia :  
transitioning from call center to contact center Mini Shopaholic (Shopaholic, #6) The clinical practice of chinese medicine  
The investment of trust funds High school musical novel Eddie the raccoon The Resonance of Time Infinite-Dimensional  
Lie Algebras (Translations of Mathematical Monographs) Traumatic brain injury Elie Elovic . [et al.] Introduction to  
nanoscience and nanotechnology Necessities and niceties : what does baby really need? Essential X-Men, Vol. 4  
Understanding analysis second edition abbot Foundations of Operations Management (Cram101 Textbook Outlines  
Textbook NOT Included) Forever undecided Here comes the circus! Citizen photojournalism during crisis events Sophia  
B. Liu . [et al.] Learning About African Animals (Learning about Books Ukiyo-e Explained Yoga Beyond Belief The role of  
a pastor, coach, or elder in developing missional small groups Supervision and administration of business education  
Prac Rehab Geriatric Aides Pwc-working capital-retail-inventory-management. Romancero Tradicional De Costa Rica  
(Juan de la Cuesta Hispanic monographs (Juan de la Cuesta Hispanic mo Australia (In the Hands of a Child: Project  
Pack Continent Study) Forests And Frontiers Catholic writers and spontaneous generation. British history for American  
students Alabama Gardeners Almanac Mekong Corporation and the Viet Nam motor vehicle industry Minutes and  
proceedings of the . annual Convention for the Improvement of the Free People of Colour in th Movements and lunar  
phenomena Twelve Great Western Philosophers Filter applications in product recovery processes Omnibus  
transportation bill. Fur elise for piano*