

Digital Logic in Minecraft

MITRE STEM Outreach

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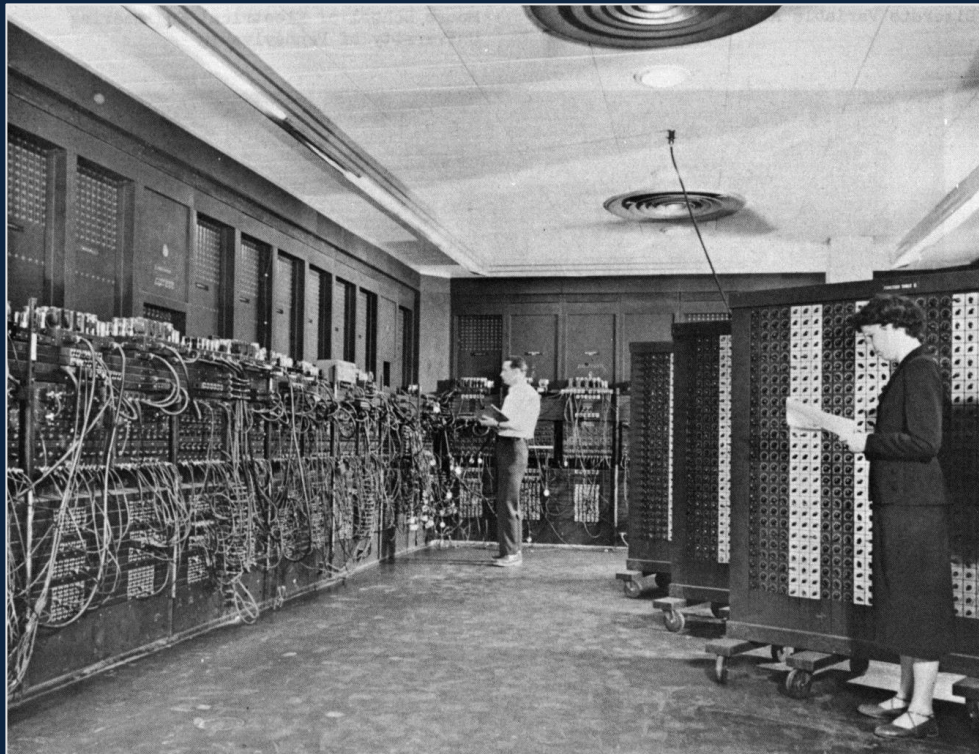


OUR VISION

pioneering for
a better future

How do computers work?

ENIAC
U.S. Army
Photo



Summit Supercomputer
Photo by Carlos Jones of ORNL



Minecraft Redstone operates on the same principles as digital computers





Digital logic is a method of solving problems using **binary** signals



1010
1010

Digital systems process information that can be represented as "true" or "false" (1 or 0)

The temperature outside is freezing

TRUE



FALSE

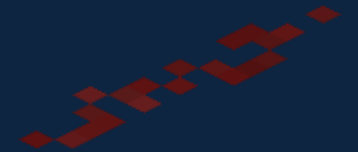


The Redstone dust is powered

TRUE



FALSE



A digital logic function (a.k.a. Boolean function) maps a set of binary inputs to a set of binary outputs

If the temperature outside is freezing, put on a hat

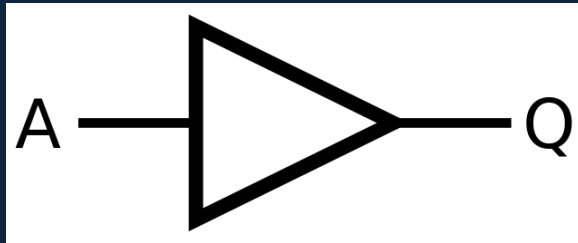
FALSE



TRUE



Boolean functions are composed of simple building blocks called gates



Buffer (Unity)

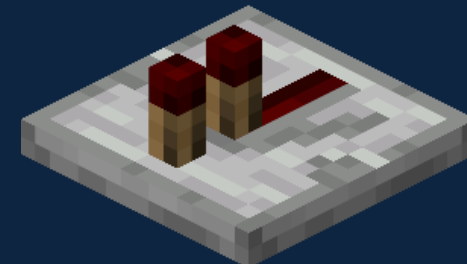
INPUT	OUTPUT
A	Q
0	0
1	1

A truth table lists the resulting output for each input combination

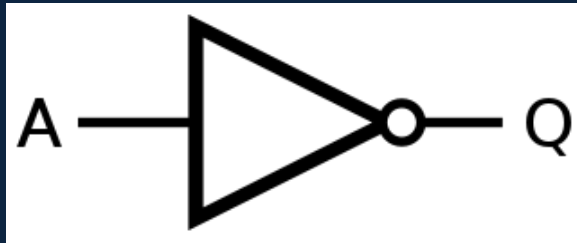
If the temperature outside is freezing, put on a hat



The Redstone Repeater outputs whatever signal it sees on the input



The NOT gate inverts the signal; the output is the opposite of the input



NOT (Inverter)

INPUT	OUTPUT
A	Q
0	1
1	0

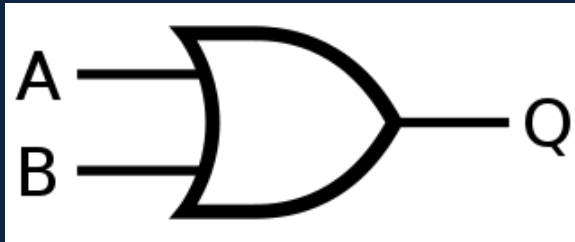
If the temperature is freezing, do NOT go swimming



The Redstone Torch turns off when the block it is attached to is powered



The OR gate outputs a 1 if *either* input is a 1;
the AND gate outputs a 1 if *both* inputs are a 1

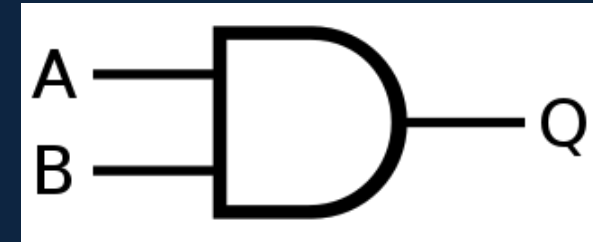


If it is freezing OR it is raining, put on a coat

OR

INPUT		OUTPUT
A	B	Q
0	0	0
0	1	1
1	0	1
1	1	1

If it is hot AND it is sunny, go swimming

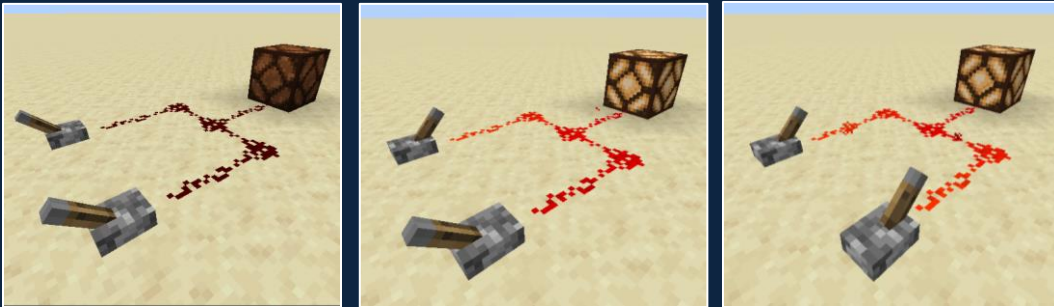


AND

INPUT		OUTPUT
A	B	Q
0	0	0
0	1	0
1	0	0
1	1	1

Challenge: Create an AND gate from an OR gate and three NOT gates

In Minecraft, you can easily create an OR by connecting the inputs with Redstone dust



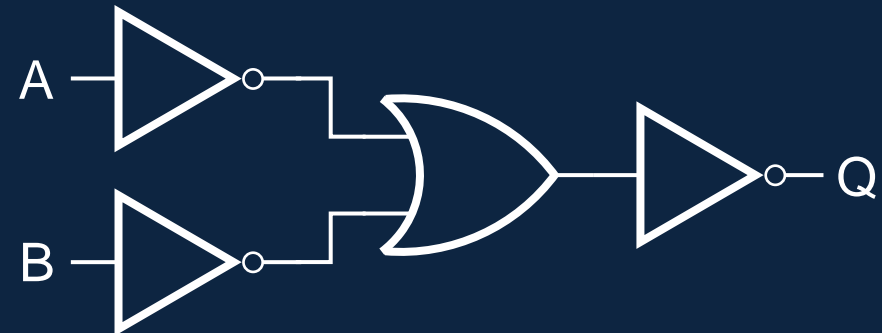
However, there is no built-in AND function

Hint: Try expressing this without using AND

If it is hot AND it is sunny, go swimming

Answer:

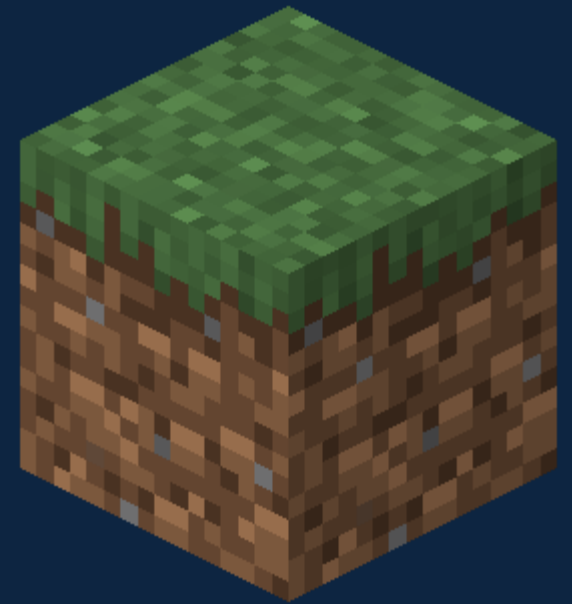
If it is NOT hot OR it is NOT sunny, do NOT go swimming



Quiz:

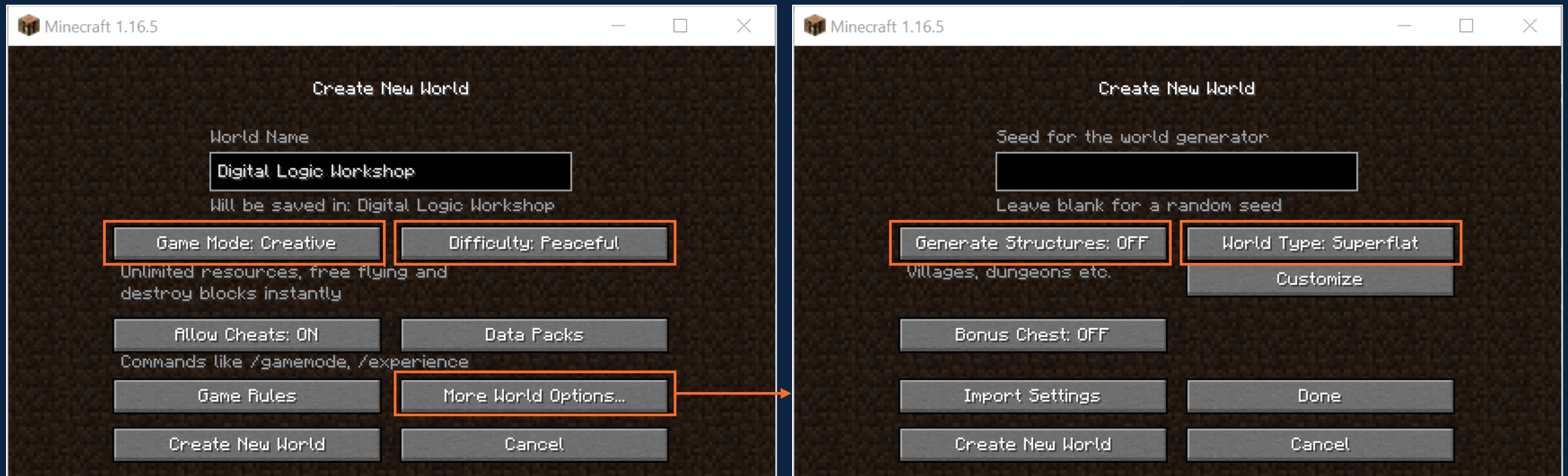
What is Digital Logic?

Minecraft Time!



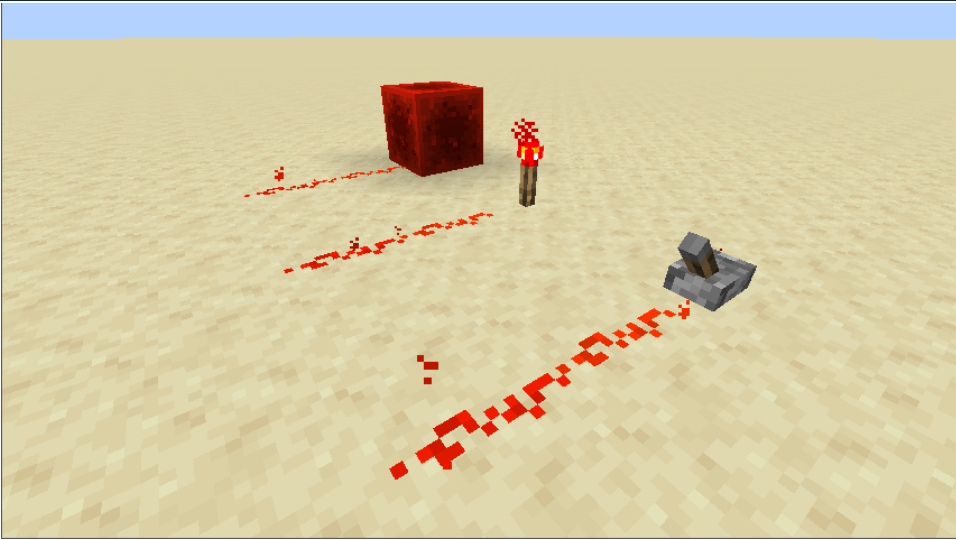
Minecraft Time!

Open Minecraft on your computer and create a *Superflat* world in *Creative* mode on *Peaceful* difficulty with *Generate Structures* OFF

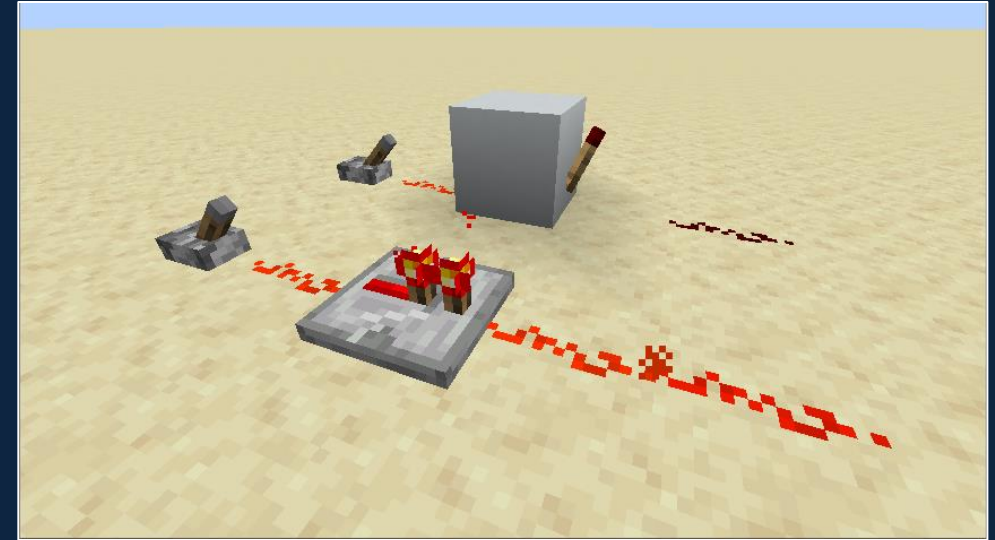


Minecraft Redstone Basics

Power sources are used to create a digital signal

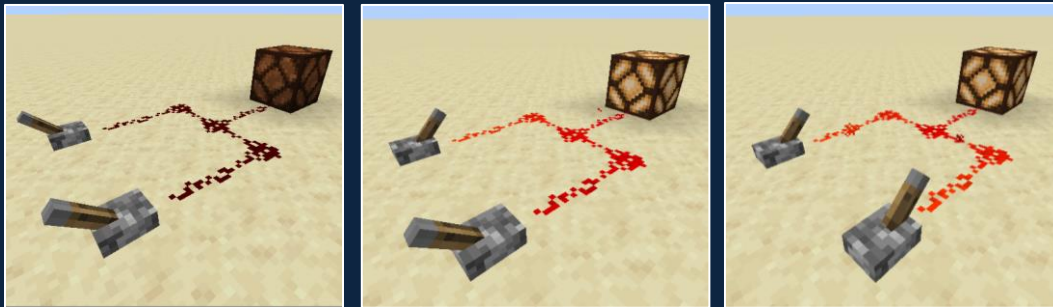


Repeaters act as buffers; torches as inverters



Redstone Logic Gates

OR: Connect inputs with Redstone wire

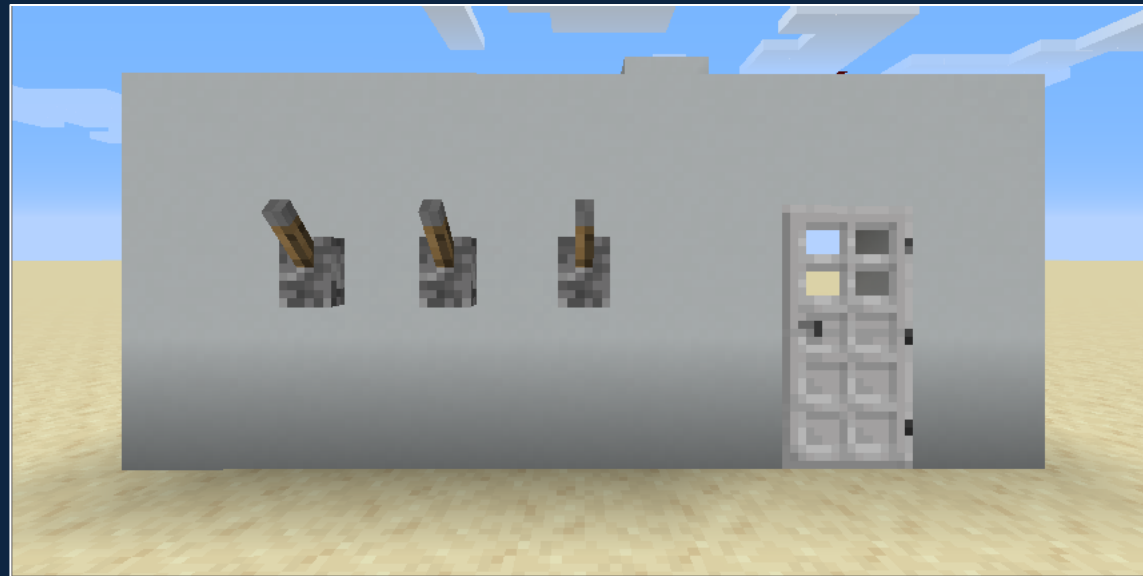


AND: Invert the inputs and output of OR



Challenge:

Use digital logic to build a door that unlocks when the right combination of levers is activated



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