

Boolean Algebra

CS 2130: Computer Systems and Organization 1
August 29, 2025

Welcome!

Announcements

If you need to switch labs:

- Send me an email if you are unable to swap

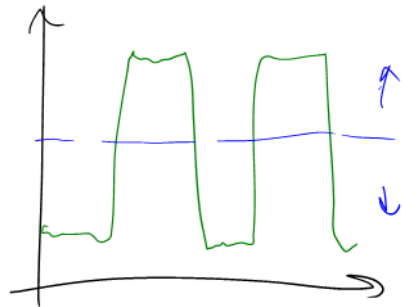
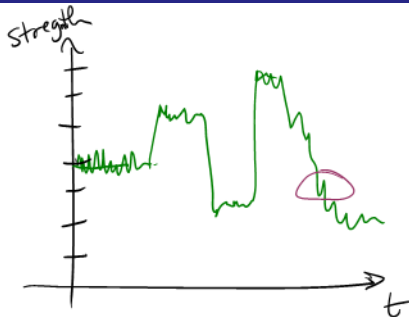
Quiz 0 opens tonight, due Sunday 11:59pm

Why only 0 and 1?

Claude Shannon



Photo by Jacobs, Konrad, CC BY-SA 2.0 DE, via Wikimedia Commons



Why only 0 and 1?

Vocabulary

- **bit** - either a 0 or 1
- **binary** - a system that has only two positions
- **trinary** - a system that has only three positions
- **quadrinary** - a system that has only four positions
- ...

Vocabulary

- **bit** - either a 0 or 1
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- ...
- **decinary** - ...

Vocabulary

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- **binary** - a system that has only two positions
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- ...

- **decimal** - system that has ten positions

Boolean Algebra

python: and or not
java: && || !

George Boole

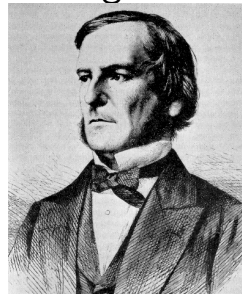


Photo Public Domain

Putting it together

Overall idea:

- Only need two things (Shannon)
- We can do math with two things (Boole)

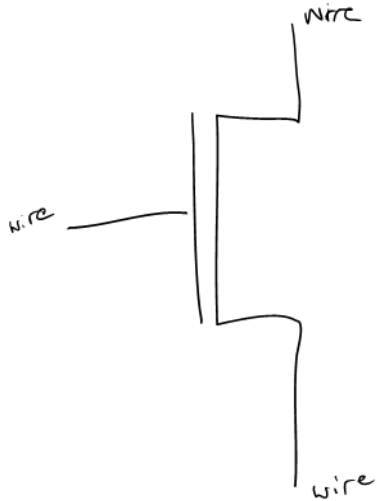
Putting it together

Overall idea:

- Only need two things (Shannon)
- We can do math with two things (Boole)

Now we need a physical device that deals in two levels

Transistors



More Vocabulary

Electricity (conceptually) - involves flow of electrons or other charged carriers through a conductive material

- **current** - rate of flow
- **voltage** - pressure of flow

Examples in water

More Vocabulary

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Examples in water

- High pressure, low flow - squirt gun

More Vocabulary

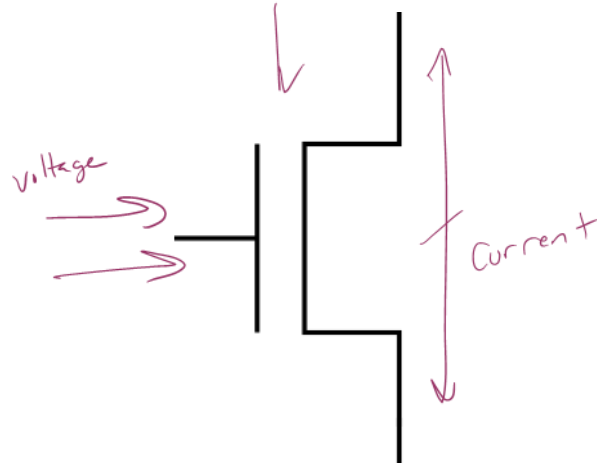
Electricity (conceptually) - involves flow of electrons or other charged carriers through a conductive material

- **current** - rate of flow
- **voltage** - pressure of flow

Examples in water

- High pressure, low flow - squirt gun
- Low pressure, high flow - bucket of water

Transistors



Transistors

Transistors act like an electrically-triggered switch

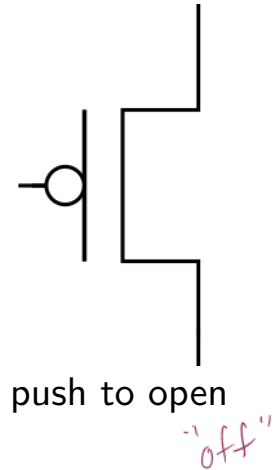
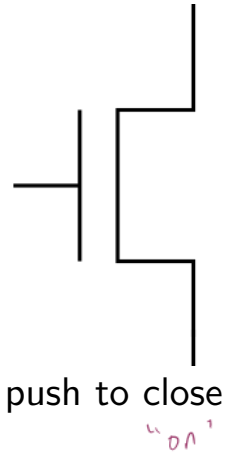
- No voltage, no current
- Apply voltage to allow current to flow

Transistors

Transistors act like an electrically-triggered switch

- No voltage, no current
- Apply voltage to allow current to flow
- The amount of voltage needed to close the gate is boundary between 0 and 1
- Central technique for how we are going to build binary computers

Transistors



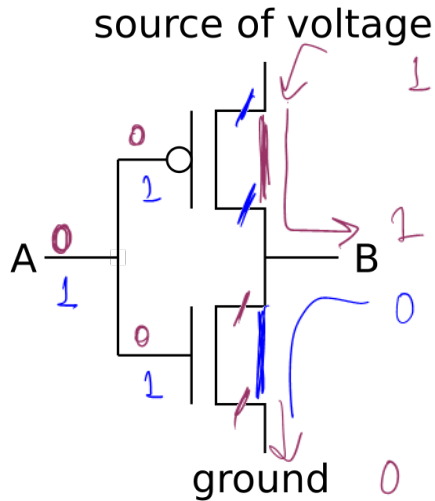
Circuit Diagram

truth table

A	B
0	1
1	0

no voltage

not



Circuit Diagram

