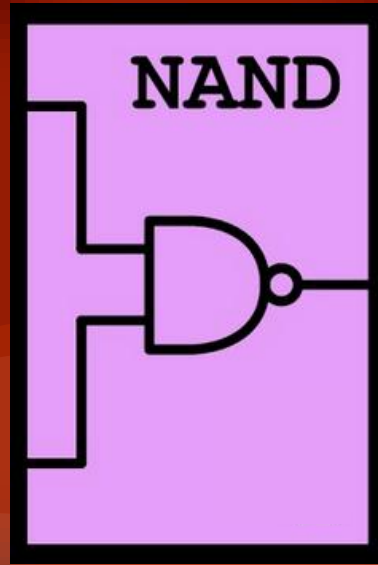


NUCLEAR AVOIDANT NON-DETONATORS

Grading on a curve has never been more explosive!



By:

Kate Lyman

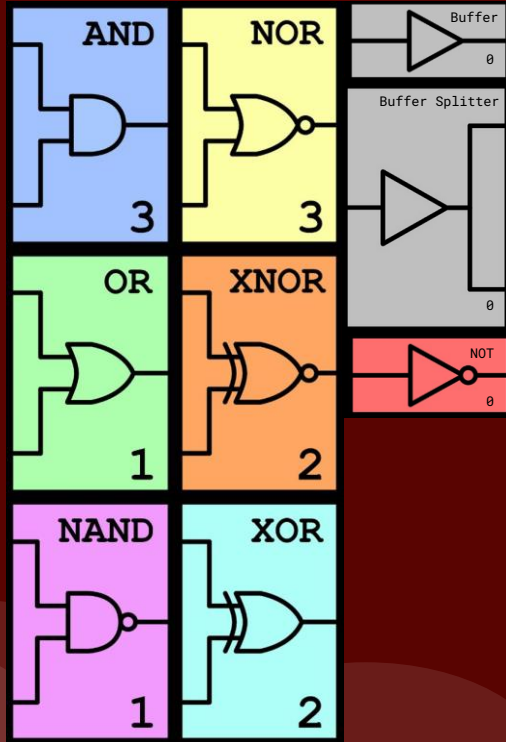
Maya Burke

Andrew Chung

What is NAND? (the game)

- A **competitive turn-based card game** where each player is a student finishing their final bomb-defusal exam to earn their Nuclear Avoidant Non-Detonator license.
- Each player **strategically places their logic gate cards to maximize their number of points**.
- **3-4 players** will play for **20-30 minutes**.
- **Beginner programmers** and middle and high-schoolers will learn the fundamental computer science concept of **Boolean logic** by letting playfully thinking about **logic gates**.

Materials List



Logic Gate Cards



Goal Cards



Binary Tokens

NAND CHEAT SHEET

GATES INPUTS & OUTPUTS CHART:

A	B	AND ₃	NAND ₃	OR ₃	NOR ₃	XOR ₃	XNOR ₃	NOT ₄	BUFFER ₂	SPLITTER ₄
0	0	0	1	0	1	0	1			
0	1	0	1	1	0	1	0			
1	0	0	1	1	0	1	0			
1	1	1	0	1	0	0	1			
0								1	0	0
1								0	1	1

ON YOUR TURN, TAKE ANY TWO OF THE FOLLOWING ACTIONS:

- ☐ **PLAY:** Place one logic gate card from your hand on your system.
- ☐ **NOT:** Place one NOT card from the NOT deck on your system.
- ☐ **SABOTAGE:** Flip one of your own binary tokens to flip an opponent's token.
- ☐ **DRAW:** Take one card from the main logic gate deck to be in your hand.
- ☐ **DISCARD:** Discard your entire hand. Draw the same number of cards from the main logic gate deck.
- ☐ **EQUIVALENCE:** Use at least one card in your hand, the NOT deck, and/or the splitter deck to replace at least one card in your system that is logically equivalent to the used cards. "Bank" the replaced card(s) on the side.

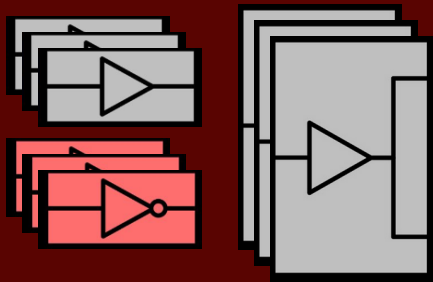
On your turn, you may use as many buffer and splitter cards as you want without costing an action.

Cheat Sheet

Round Counter



How to Play: Setup



The buffer, splitter, and NOT cards are in separate decks.

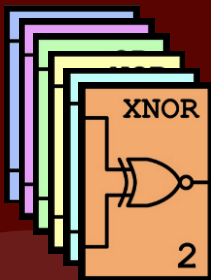


Deal 8 binary tokens to each player. Shuffle them and line them up.

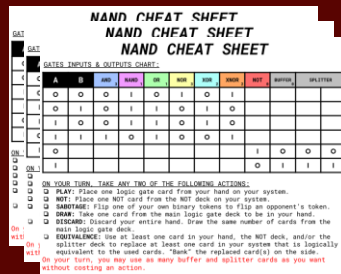
+5 pts. Group	+5 pts. Group
LEAST GATES (excluding buffer & splitters)	MOST NANDs

+5 pts. Individual
NO ORs

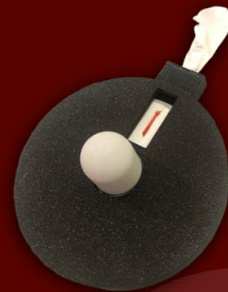
Randomly reveal 2 group goals and deal an individual goal to each player.



Shuffle the deck with the main logic gate cards. Deal 3 cards to each player.



Each player gets a cheat sheet.



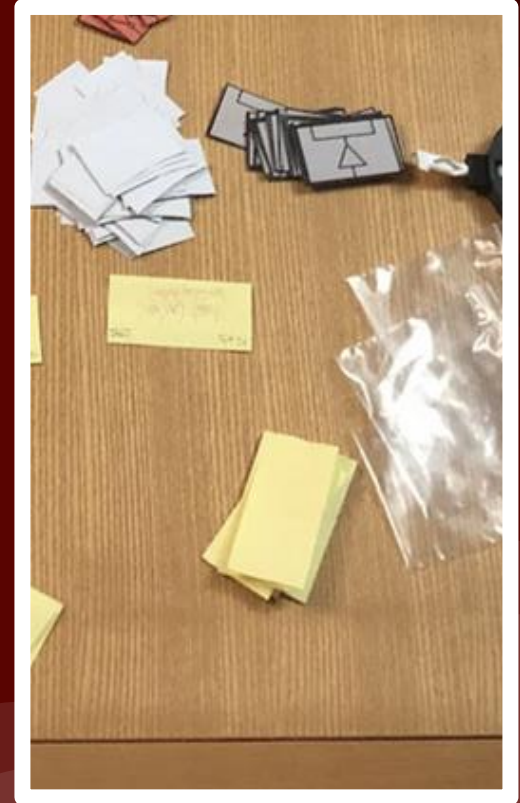
A new round begins with the youngest player's turn. Play proceeds clockwise. Keep track of the round number with the counter.

How to Play: It's Your Turn!

On your turn, take any two of the following actions:

- **PLAY** one logic gate in your hand above two inputs in your system.
- Place one **NOT** gate above one input in your system.
- **SABOTAGE** by flipping one of your and an opponent's binary token.
- **DRAW** one main logic gate.
- **DISCARD** your hand and draw the same number of cards from the main logic gate deck.
- Use logical **EQUIVALENCE** to replace a gate(s) in your system with a gate(s) from your hand, the NOT deck, and/or from the splitter deck.
“Bank” the replaced gate(s) by putting them to the side.

Players can **use as many buffer and splitter cards** as they desire for visual clarity.



How to Play: Scoring and Winning

Each player's score depends on the following:

- +X pts. for the point value of each logic gate card they placed and have on the side.
- +5 pts. for each individual and group goal they fulfilled. Cards on the side do not count to the goals unless specified by the goals.
- Verify your system has a final output of 1. If not...

**The player with the most points wins
and earns their license!**



-10 pts.



Development Process

Conception

- We wanted an **informal screen-free** way to **teach computer science**.
- **Logic gates** are more visual and **Boolean logic** is a fundamental.

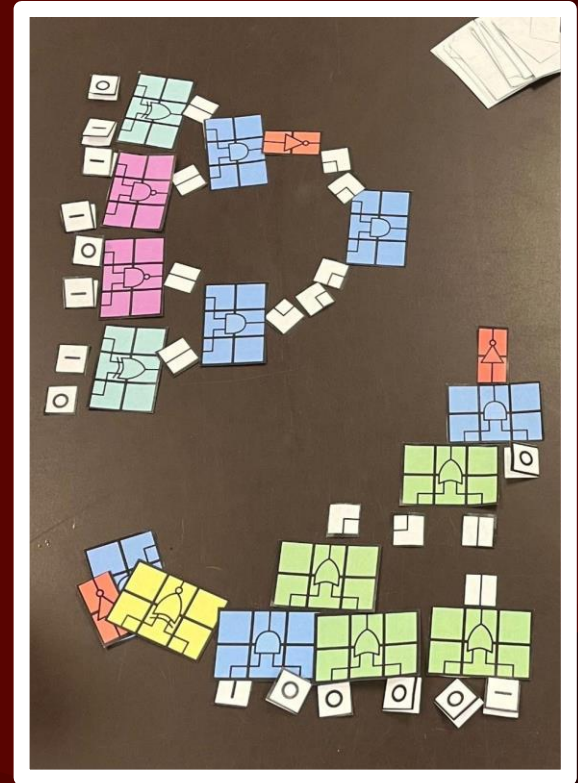
Creation

- We quickly knew the logic gate cards and a few basic player actions.
- It took a while to **figure out the player goals** and **how the actions would be done per turn**.

Changes

- Added **group and individual goals** to add more **excitement** and **thinking** to the game.
- Added the unique **Buffer splitter card** to open more **in-game opportunities** for the player.

(a prototype)



What Do You Learn?

STEM Field

Fosters stressless excitement and interest about computers and STEM in general.

Boolean Algebra

Exposes students to binary, the language used by all computers.

Digital Literacy

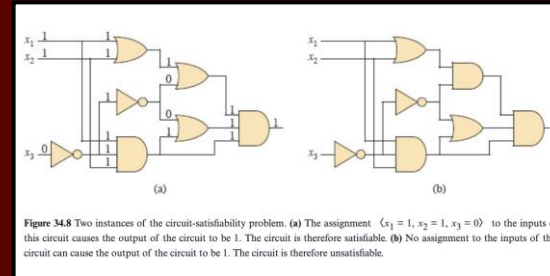
Educates students how computers broadly work, a necessary lesson even if not interested in coding.

Efficiency

Encourages students to optimize their system with logical equivalence and a score system.

Logic Gates

Makes students actively think about and utilize logic gates, a relevant topic in college-level computer science.



From the textbook used in Wesleyan's algorithms course!

Debrief Learning Questions

Students can discuss the following questions upon completing a game:

- What did you learn about logic gates?
- How did this game made you think about using your logic gates?
- Did you follow a specific strategy playing this game? Did it work and why or why not?
- How can the problem-solving mindset used in this game be similarly used in real-life when it comes to programming and computers?

Thanks!



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