



sugarlabs

Google Summer of Code' 2024 Proposal

Project: Developing 8 Math games for Sugar

Project Idea : Math Games

Project Length : 350 hours

Coding Mentor : Ibiam Chihurumnaya

Assisting Mentor : Walter Bender

Basic Info

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Why Sugar Labs

I started Open Source around mid 2023 and I found Sugar Labs and thought it was something that could make an impact. Its all about making learning easier with technology. So, I started exploring its projects. By late November 2023, I got interested in open source contributions, especially because it was the fastest way to work on real-world projects and it aligned with my love for Python and game development, having experience with pygame.

What really hooked me was Sugar's mission to provide open-source educational tools and fun activities for kids. I appreciated their simplistic approach for teaching kids.

Although I started open-source development in 2023, I have already learnt so much and I am highly excited for GSoC 2024. I'm looking forward to potentially contributing to Sugar Labs and making a positive impact on education through technology.

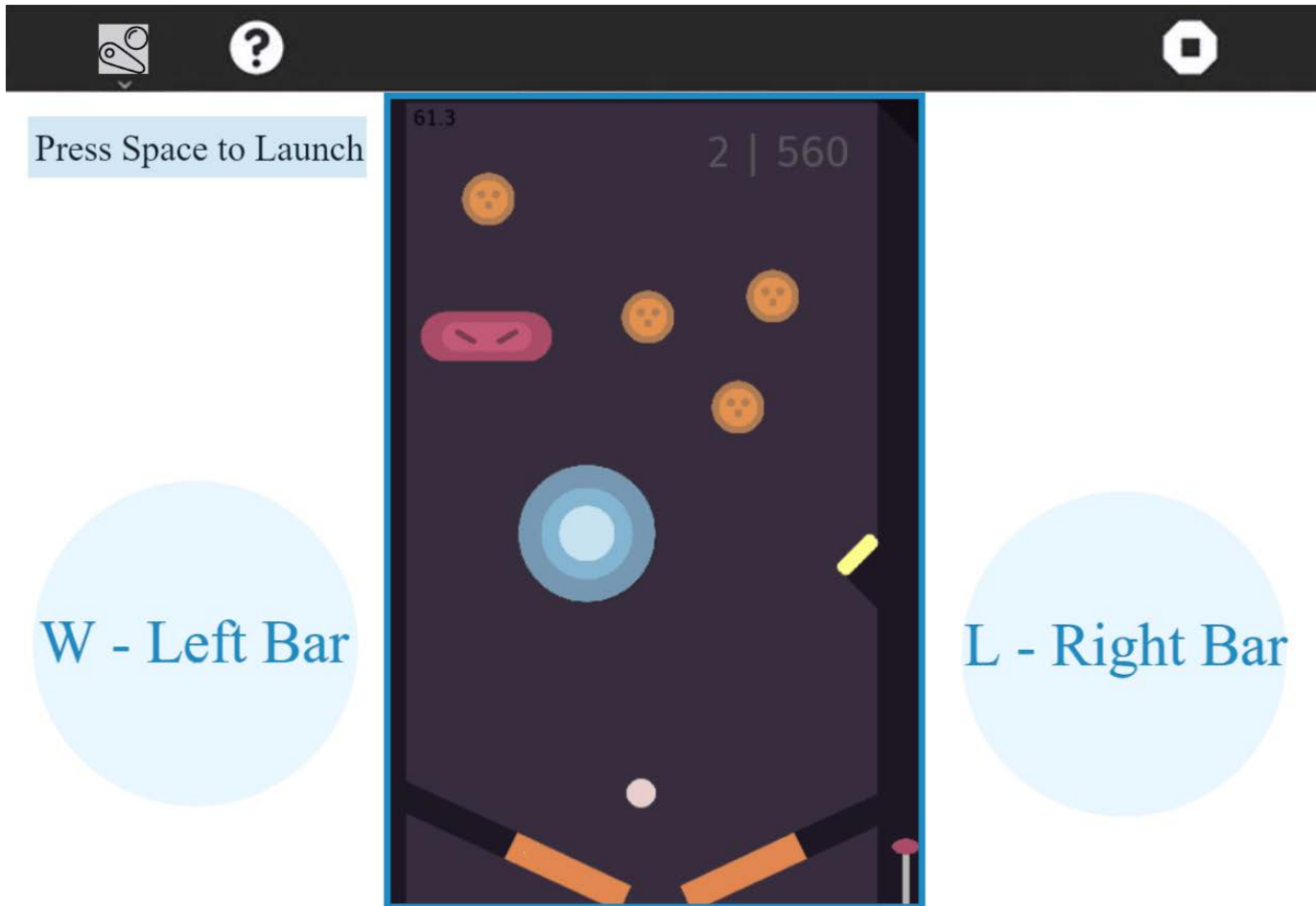
Highlighting my past Pull Requests to various SugarLabs Repositories

S.No.	Repository	Pull Request
1.	Musicblocks - (Merged)	#3666 Update activity.js - Added Ctrl+MouseWheel ZoomIn/Out Functionality
2.	Sugarizer	All PRs to Sugarizer
3.	Sugarizer-Implode, Labyrinth, SharedNotes	#1535 Added Undo Shortcut For 3 Activities - Implode, Labyrinth, SharedNotes
4.	Sugarizer - River Crossing	#1538 Added New Sugarizer Activity RiverCrossing
5.	Sugarizer - Nim Game	#1539 Added Nim Game

Contributions to Sugar

PINBALL ACTIVITY

Github Repo: <https://github.com/sonisumit7904/PinBall>



I have made a Pinball Activity for the sugar desktop environment. Pinball is a game in which a player presses two buttons on each side of a pinball machine in order to hit a small ball to the top of the machine. The aim of the game is to prevent the ball reaching the bottom of the machine by pressing the buttons.

Project Goal

I plan to at least develop 8 Math games for Sugar within the GSoC'24 timeline. The different visuals representations and assets in the below proposal are self designed. The development of these activities will include basic functionalities of the game.

How will it Impact Sugar Labs

Upon completion of this project, Sugar will have 8 more fully functional and developed math games activities. It will help children learn different difficult concepts like, Probability, Latin Squares, Graph Theory, Pascal's Theory and many more.

Tools and Technologies

Python, Pygame, Sugar

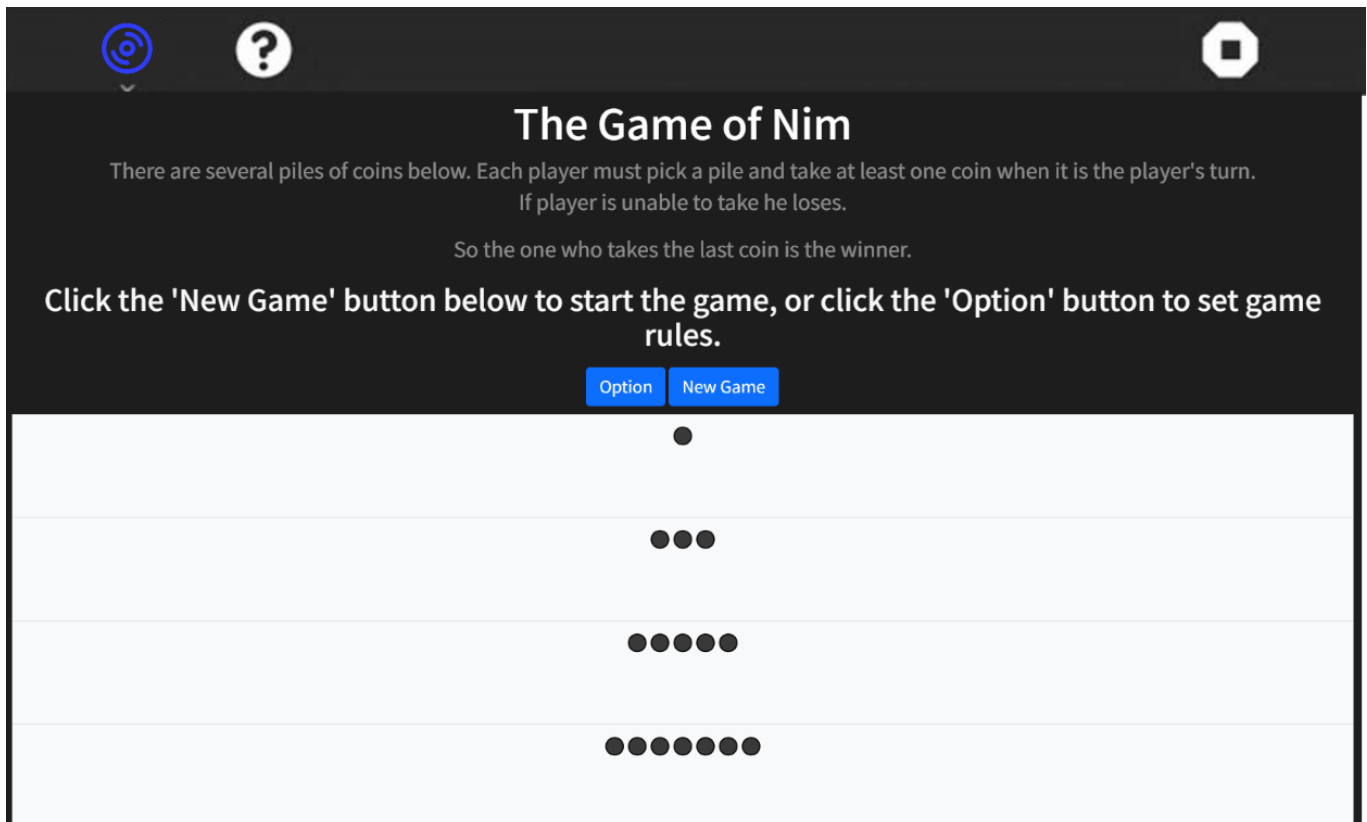
Project Type

350 hours

Following are the description of the activities I aim to develop:

1. NIM Game

The below images show a concept art made by me of how I envision the Nim activity to look like.



The activity will consist of an item which will be arranged in rows and each participant will take turns removing a number of these items. The participants will be the user and the computer (Robot). The last person to remove an item will win the game.

- Options will be included in the game which will let you customize the configurations of the game like Game mode.
- Since the aforementioned game demo makes it impossible for the player to win, It will also be true if a perfect strategy bot is implemented, thus adding difficulties will be important. Normal / Difficult / Impossible modes will be added to the game. The difficulty modes will be implemented by having a chance for the computer to intentionally make a mistake.

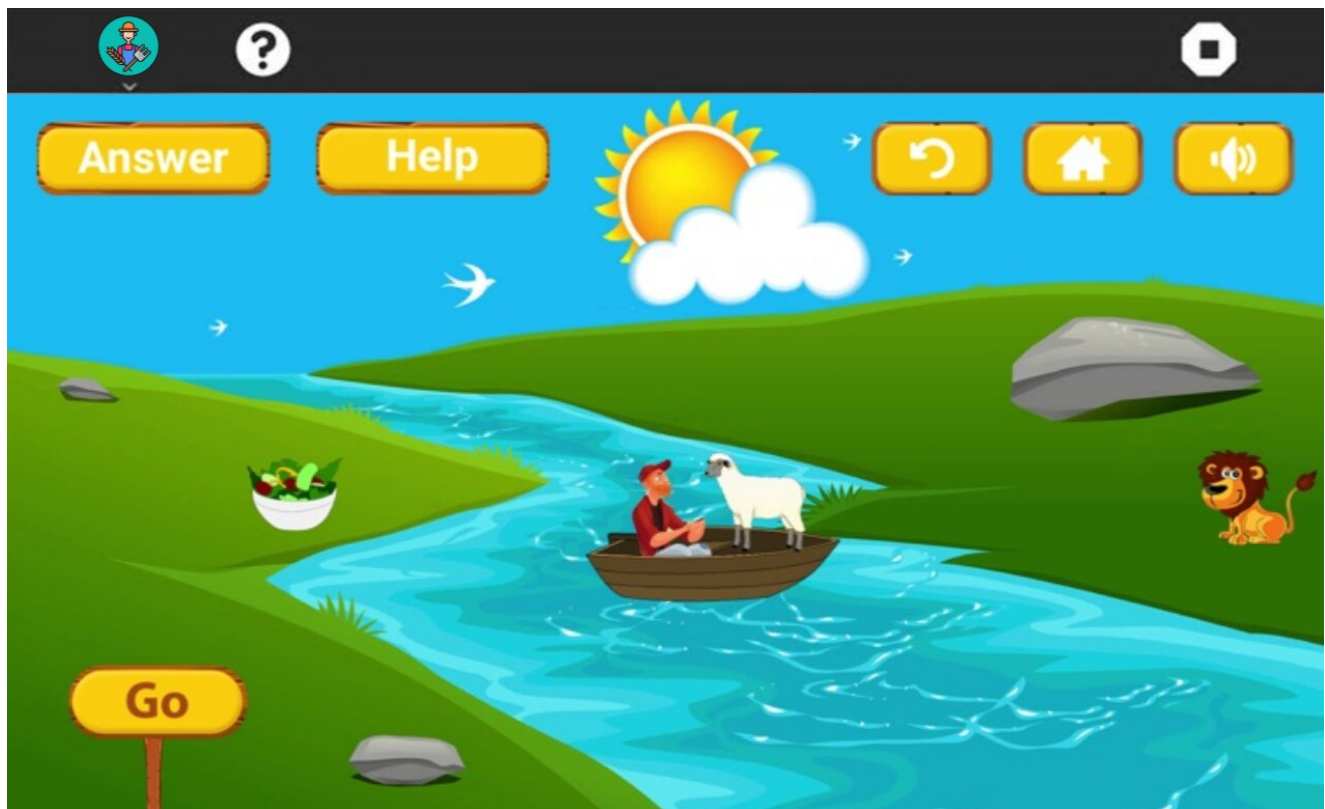
2. Goat, Cabbage and Wolf

A farmer is to ferry across a river a goat, a cabbage, and a wolf. Besides the farmer himself, the boat allows him to carry only one of them at a time. Without supervision, the goat will gobble the cabbage whereas the wolf will not hesitate to feast on the goat. Clickable are the three shapes by the river and the arrow that indicates the position of the boat (and, of course, the farmer.)

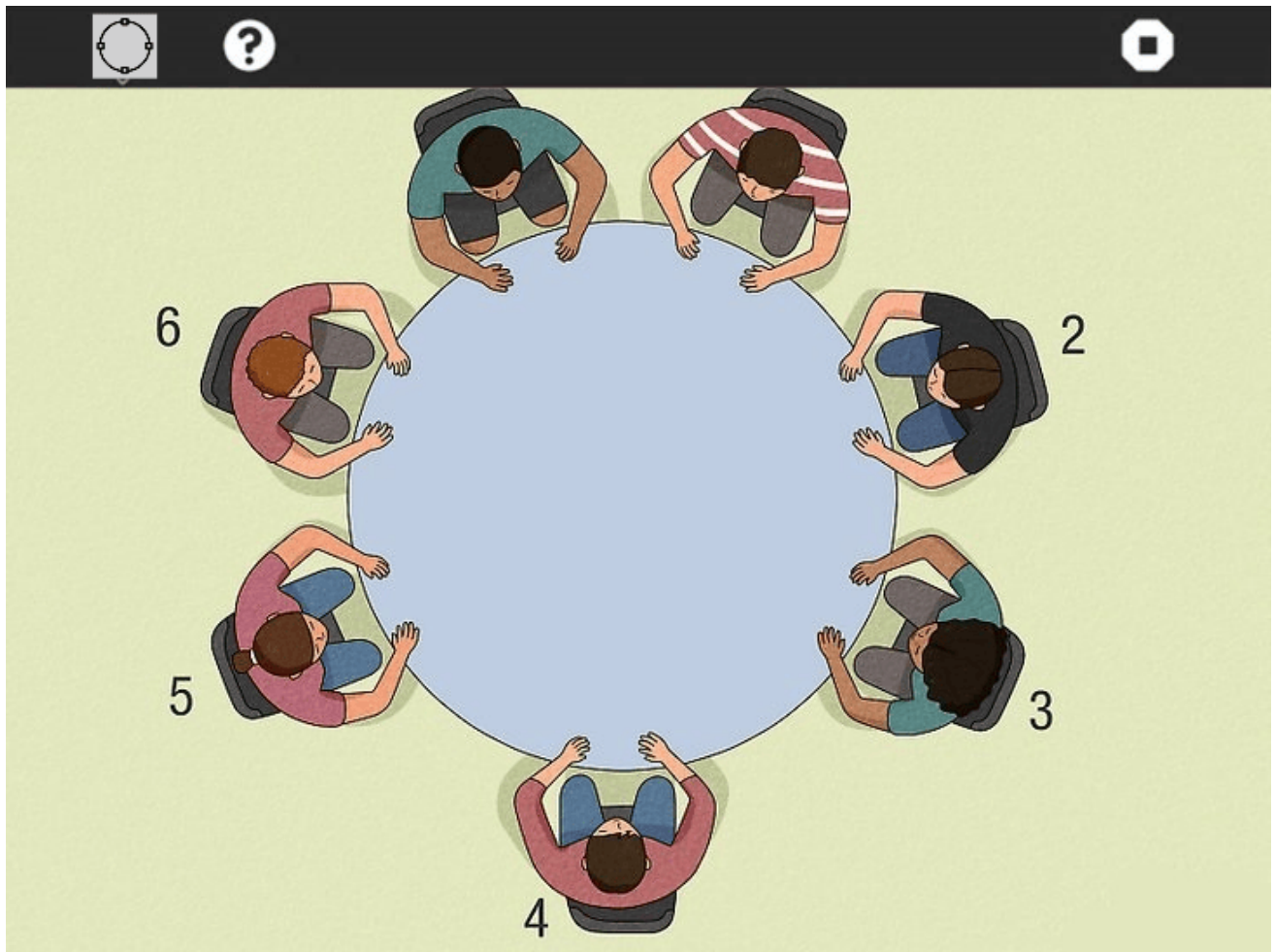
- I plan to make the game more interesting by introducing various difficulty levels.

Along with the actual game, it will also contain some other buttons:

- Home - for choosing difficulty for the gameplay.
- Answer - For seeking help as to how the puzzle can be solved in least steps possible
- Help - Hint about the next step.



3. The Candy Game



The game of candy will have the following game in perspective of the player:

1. **Selecting the Number of Children:** Players can choose the number of children to distribute the candies among.
2. **Initial Candy Distribution:** Following this, a random distribution among the children will be done ensuring each child receives an even number of candies.

3. **Visual Setup:** Once candies are distributed, The player is presented with a visual representation of the children arranged in a circle, each with their allocated candies.
4. **Initiating Candy Exchange:** The Player can initiate the candy exchange by clicking the "Blow Whistle" / "Next Step" button. The candies will be distributed as per the game's logic (*each student simultaneously gives half of his or her own candy to the neighbor on the right. Any student who ends up with an odd number of pieces of candy gets one more piece from the teacher.*)
5. **Error Handling:** If any child ends up with an odd number of candies after the exchange, the whistle button will be disabled. The Player will then be asked to give one candy to the affected child to ensure an even distribution.
6. **Repetition:** The process continues until all children possess the same number of candies.

One suitable data structure for this game can be a circular linked list. Each node in the linked list represents a child, with attributes such as the number of candies they possess and a reference to the next child in the circle.

4. Number Guessing Game

In this, the player first guesses a number between 1 and 100. After the guess, the game presents some numbers on screen. The player provides feedback whether the guessed number is present on screen or not. The computer continues guessing until they find the correct number.

Number Guessing Game

pick a number from 1
is your number here?

1	3	5	7
9	11	13	15
17	19	21	23
25	27	29	31
33	35	37	39
41	43	45	47
49	51	53	55
57	59	61	63

yes no

The user thinks of a positive integer less than or equal to 100. At any time, the computer will display a set of numbers. In response to that the user presses either "Yes" or "No" depending on whether the number to be guessed is on the screen or not. After a while the computer will guess the number.

5. Latin Squares

Latin Square Puzzle 1

$$\begin{array}{cccc} 2 & \times & [] & + & [] & - & 5 & = & 15 \\ \times & & \times & & \times & & \times & & \\ [] & \times & 5 & + & 2 & - & [] & = & 14 \\ + & & + & & + & & + & & \\ [] & \times & 2 & + & 5 & - & [] & = & 17 \\ - & & - & & - & & - & & \\ 5 & \times & [] & + & [] & - & 2 & = & 26 \\ = & & = & & = & & = & & \\ 11 & & 38 & & 5 & & 42 & & \end{array}$$

Puzzle 1: Drag the digits onto the grid (instructions below).

Clear

Imagine a Sudoku puzzle, but instead of just numbers, you have plus and multiply signs between some squares. Here's the catch:

Like Sudoku, you still gotta use each number (1 to 4) only once in each row and column. But this time, you gotta solve the little math problems between the numbers to get the row and column totals to match.

The good news is, you don't have to worry about any tricky order of operations (PEMDAS stuff). Just solve left to right, like normal.

So it's basically Sudoku with a little math twist, but without the order of operations headache!

6. Pascal's Triangle

This activity offers an interactive exploration of Pascal's Triangle, a mathematical concept used in various calculations. Here are the key points to consider:

Customization: Players can modify three settings to experiment with the triangle's structure:

Modulo: This determines the range of values within the triangle. Selecting "modulo 3" would result in cells containing only 0, 1, or 2.

Rows: This sets the number of rows displayed in the triangle.

Player: This allows players to input values for the first and last cells in specific rows (up to a chosen number of rows).

Visualization: The activity displays the triangle with either numbers or colors based on player preference. This offers a more engaging way to explore patterns.

Calculation: Each cell's value is calculated using a formula that considers the values directly above it and the chosen "modulo." This reinforces the underlying mathematical structure.

Overall, this activity provides a user-friendly platform for individuals to explore Pascal's Triangle at their own pace. By customizing the settings and switching between number and color displays, players can gain a deeper understanding of the patterns and relationships within the triangle.

I took reference from : <https://demonstrations.wolfram.com/PascallikeTrianglesModK/>

7. Three Utilities Puzzle

Imagine a puzzle where you connect houses to utilities (water, electricity, etc.) with pipes. The challenge is that pipes cannot cross each other.

This game shows that some connections are impossible, like connecting 3 houses to 3 utilities without crossed pipes. There's no solution! The game helps you see why certain connections are tricky in the world of maps and drawings.



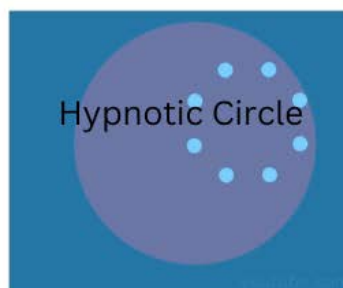
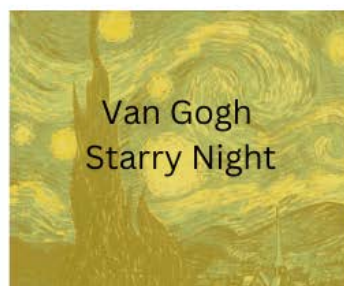
8. Map of Illusion

Illusions are a great way to know about working of our mind. These illusions can be incorporated into a single activity. Some of these illusions can be interactive also.

The illusions I plan to include in the activity are:



Experience the World of Illusions



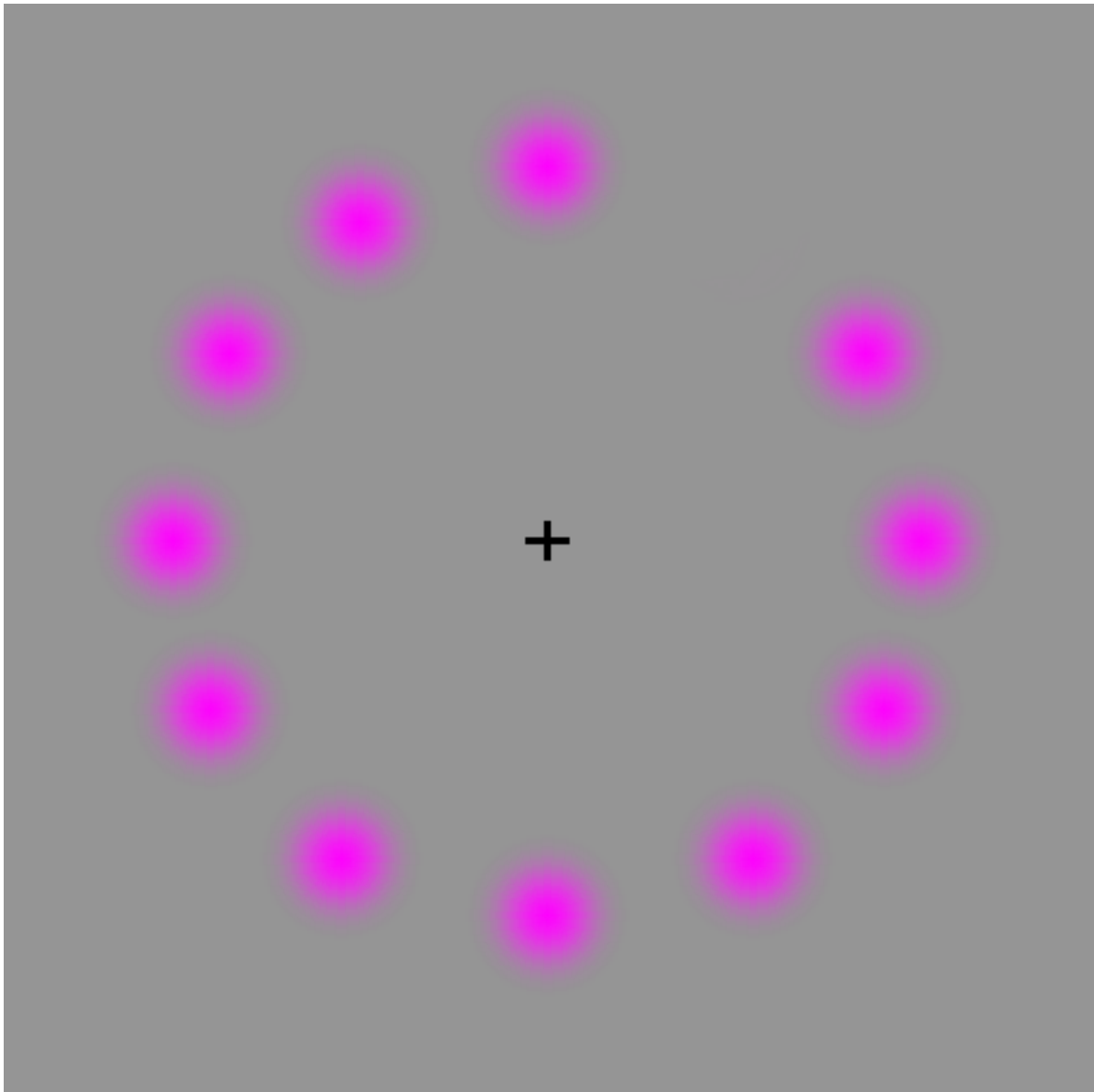
1. Disappearing Dots - works with animated gif

If your eyes follow the movement of the rotating pink dot, the dots will remain only one color, pink.

However if you stare at the black "+" in the center, the moving dots turns to green.

Now, concentrate on the black "+" in the center of the picture. After a short period, all the pink dots will slowly disappear, and you will only see only a single green dot rotating.

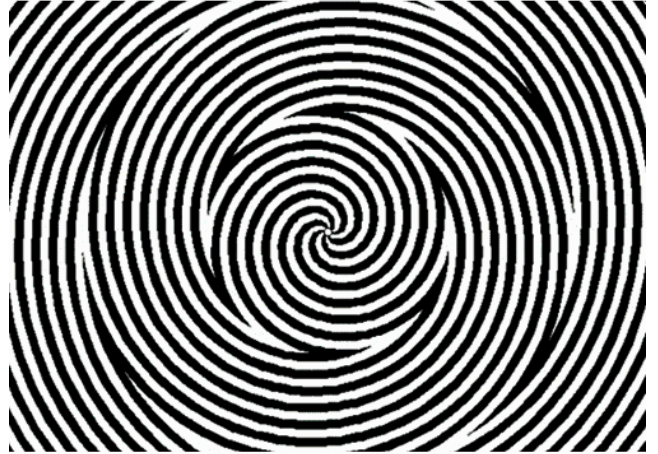
It's amazing how our brain works. There really is no green dot, and the pink ones really don't disappear. This should be proof enough, we don't always see what we think we see.



2. Van Gogh Starry Night optical illusion

By staring at the rotating image above, the famous illustration will come to life in a flurry of swirls and movement. It's a great example of how our brains will twist an image based on how our eyes adjust to what they're seeing, and I could stare it for hours. Considering the original painter was a well-known addict to anise-flavoured spirit absinthe, maybe this is exactly how he envisioned the original painting.

Stare at the center of the top image for 30 seconds then check out Starry Night



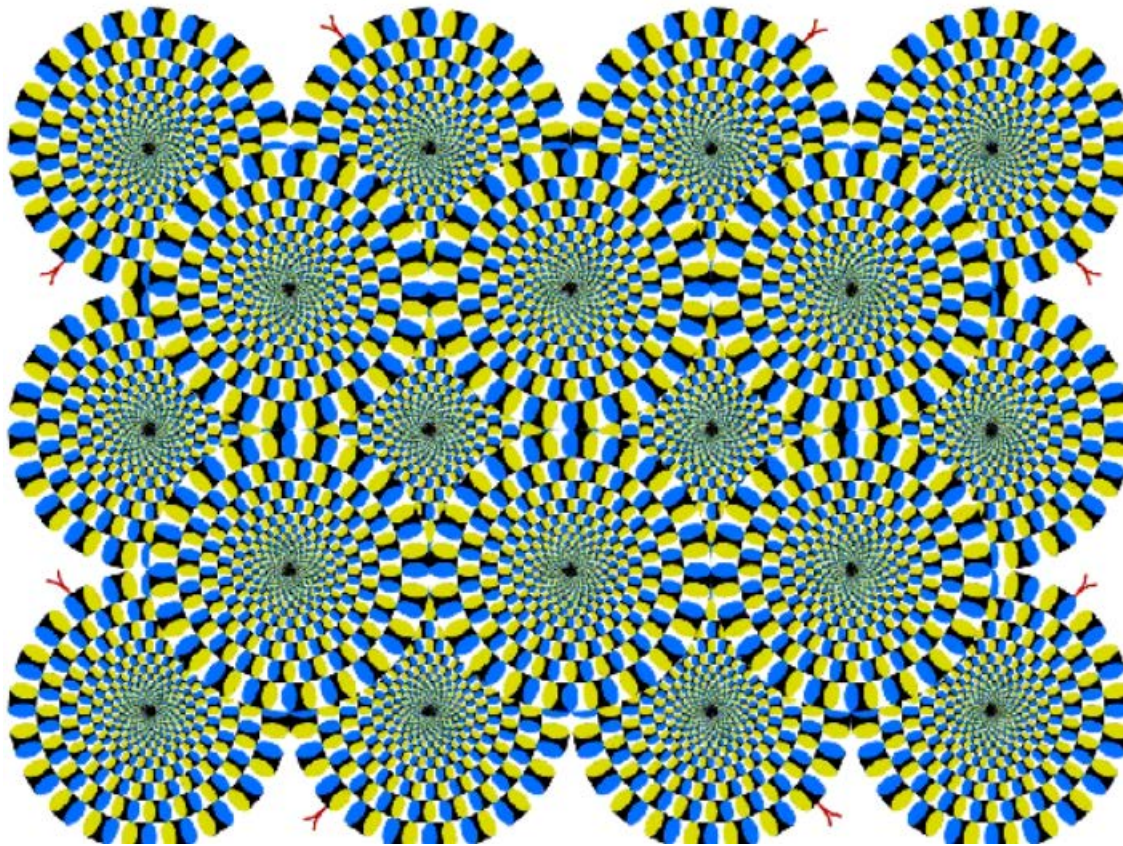
3. The spinning vortex optical illusion

One type of optical illusion that we can't get enough of are those that appear to be moving but they're actually still images. These are examples of what are known as physiological optical illusions – they're caused by the over stimulation of the brain's senses as a result fo the eye seeing too much colour, light, movement or dimensions to be able to process.



4. Spinning Disk Optical Illusion

Your eyes are making them move. To test this, stare at one spot in each picture for a few seconds and everything will stop moving; OR look at the black center of each circle in the first picture, and it will stop moving; but when you move your eyes to the next black center, the previous one will move after you take your eyes away from it.



If time permits I will also add more illusions to this activity.

Project Timeline

<p>Community Bonding Period 1st May - 26th May</p>	<ul style="list-style-type: none">➤ Design various assets for the first 4 games.➤ Implement game design and algorithms for different games.➤ Create player flowcharts for all the games.➤ Maintain regular updates with mentors and seek possible modifications and feedback on any game.
<p>Week 1 27th May - 2nd June</p>	<ul style="list-style-type: none">➤ Start working on the NIM Game Activity. Develop the basic structure and functionality of it➤ Integrate customizable settings to permit players to adjust game parameters and further Implement difficulty settings to adapt the AI's strategy.➤ testing the NIM activity to identify and resolve any bugs or errors.
<p>Week 2 3rd June - 9th June</p>	<ul style="list-style-type: none">➤ Develop game mechanics of Goat Cabbage Wolf with existing assets, integrating player interaction.➤ Describe various rules and working mechanics➤ Implement interactive features like Solve
<p>Week 3 10th June - 16th June</p>	<ul style="list-style-type: none">➤ Bug test the previous developed activity, Receive feedback from mentors, apply any changes if proposed.➤ Initiate development of the Candy Game activity by designing the menu screen and implementing the pre-game window.➤ Write and implement the application's logic,

	<p>ensuring functionality, and conduct thorough testing to validate its operation.</p>
<p>Week 4 17th June - 23rd June</p>	<ul style="list-style-type: none"> ➤ Design in game visual setup and other functionalities, integration with assets. ➤ Create the end game screen and Test the activity thoroughly, identifying and resolving any bugs or errors ➤ Start with the 4th activity, Number-guessing-game and make the initial setup and menu for the activity.
<p>Week 5 24th June - 30th July</p>	<ul style="list-style-type: none"> ➤ Make the Gameplay for the activity and implement different difficulty levels in it. ➤ Start with the Gameplay and test for the bugs in the Gameplay.
<p>Week 6 1st July - 7th July</p>	<ul style="list-style-type: none"> ➤ Document the work done till now in these 4 activities, Continuously receive feedback from mentors and include them in the documentation for future considerations.
<p>Week 7 (5 Days) Mid Term evaluation 8th July - 12th July</p>	<ul style="list-style-type: none"> ➤ Submit the Mid-Term Evaluation, By now 4 activities will be completed. ➤ Design assets for the next 4 games.
<p>Week 8 (9 Days) 13th July - 21st July</p>	<ul style="list-style-type: none"> ➤ Start working on the Latin Squares activity. ➤ Make the menu screen and basic gameplay. ➤ Make a game loop and also introduce different

	<p>levels in the game.</p> <ul style="list-style-type: none"> ➤ Add score and High-Score features to the activity. ➤ Test for any bugs in the activity.
<p>Week 9 22nd July - 28th July</p>	<ul style="list-style-type: none"> ➤ Start with the Pascal's Triangle. ➤ Make the visual representation more appealing for the activity. ➤ Make basic Functionality as desired. <ul style="list-style-type: none"> ➤ Test the Pascal's Triangle activity and resolve any bugs if found.
<p>Week 10 29th July - 4th August</p>	<ul style="list-style-type: none"> ➤ Start with the Three-Utilities-Puzzle Activity. ➤ Develop Graph representation logic. ➤ Adding a button to learn the solution to the puzzle is impossible. ➤ Add an explanation for why this happens and attach further resources.
<p>Week 11 5th August - 11th August</p>	<ul style="list-style-type: none"> ➤ Debug the Three-Utilities-Puzzle activity and resolve any bug if found. ➤ Start with the Map of Illusion activity. Make the menu screen of the activity. Add different options to select any particular illusion. ➤ Make the First 2 illusions and test them.
<p>Week 12 12th August - 18th August</p>	<ul style="list-style-type: none"> ➤ Start with the next 2 illusions and finally complete the activity. If time permits add more illusions to this activity.

	<ul style="list-style-type: none">➤ Document the final work, seek feedback on the final documentation from the mentors.
Final Evaluation 19th August - 26th August	<ul style="list-style-type: none">➤ By this time, Successfully at least 8 activities will be developed for Sugar.➤ Submit the final evaluation for Google Summer of Code' 2024, and all the documented work.

Other Commitments

Sugar labs is the only organization I'm applying to and thus have no commitment under GSoC towards any other organization.

My summer vacations align with the GSoC timeline thus I have no special commitments towards my college, no exams are scheduled during this period either.

I would be awake 9:00 IST to 02:00 IST (as per 24hr format) and would be completely reachable within these times

Post GSoC'24 Plan

I aim to firstly keep these activities updated, the ones I worked on during my GSoC period and regularly maintain them. I also plan on continuing contributing to Sugar Labs after my GSoC period, in other activities as well. I also wish to become a mentor for the next GSoC session.