

Before starting the workshop, we need to make sure the students have the access to a computer, paper, pen or pencil, and calculator.

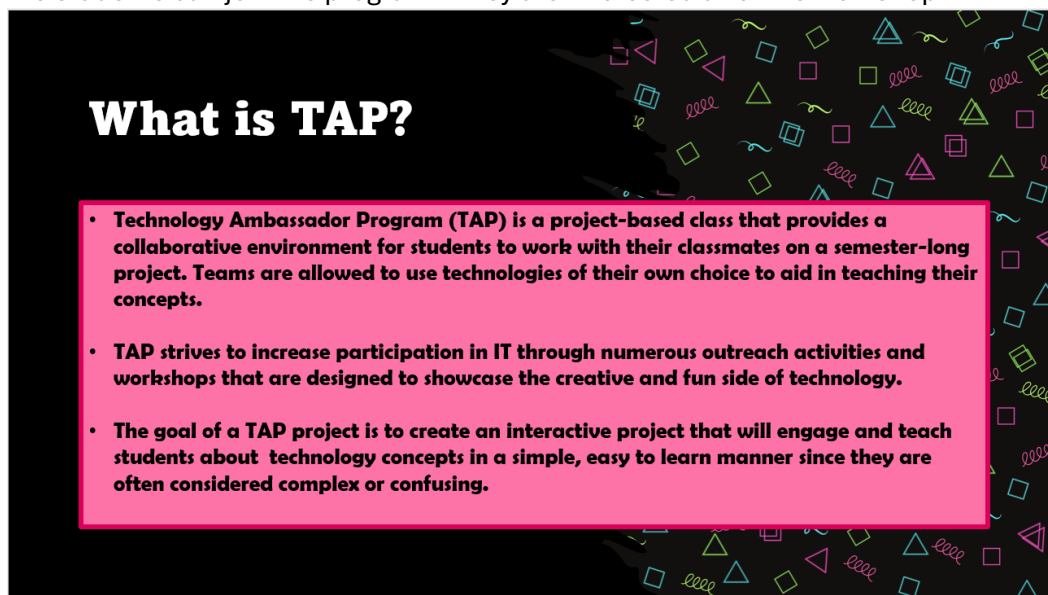
The workshop will start by going through the slides. Note: You might not need to use all these slides, but this is what was needed for our group.

## Workshop Slides:

The first slide will be an introduction of the team members as well as a title card of the game.



On the second slide we will be giving a description of what TAP. Not on this slide, we explain how the students can join the program if they are interested after the workshop.



On our third slide, we explain the goals of the project and what we are trying to achieve within this workshop. Our goal is to teach the concepts of binary through a video game and to see if this medium is a good way to teach students about technical concepts.

**Note: Something we did was also if the learning medium can be effective through online learning since the game is played on the browser.**

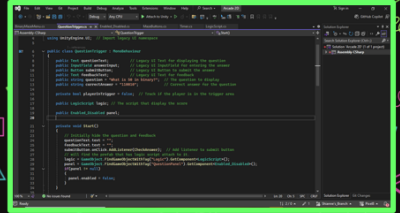
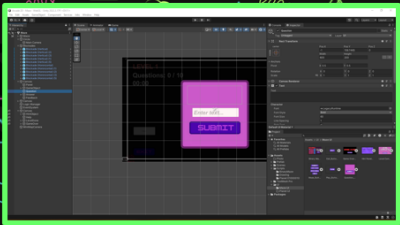

## Goals

- **This project is geared towards teaching middle school students up to college level students about binary and decimal conversion.**
- **This study is being conducted to see if video games are a valid medium of instructing students on complex technical concepts.**
- **This study will also compare the effectiveness of in-person learning to online learning.**
- **This project aims to be engaging for students so that they can learn binary through active learning without a lot of stress.**

On the fourth slide, we explain how this game was built using Unity and give a description of what Unity is. This slide can also be useful to students who have interest in game developing.

## Project Description

- **The project is built with Unity as the main technology.**
- **Unity is a popular cross-platform game engine used for developing 2D, 3D, AR, VR, and simulation-based projects.**
- **This technology was used to build an interactive 2D game that will instruct participants about the basics of binary.**



On the fifth slide, we explain what the game is about, and the name of the 3 mini games within display.



On the sixth slide, we go into further detail about each mini-game description and explains the order in which the games are played.

**Note: RGB Paint usually always be played last since game is more of an art interactive game that is more of an award after playing the other two games.**



On the 7<sup>th</sup>, 8<sup>th</sup>, and 9<sup>th</sup> slide, we go into introduction of explaining binary. These slides will explain the concepts of binary on how it works and the conversions between decimal to binary and vice versa.

**Note: These slides are important for students to remember because some of this information will be in the mini games.**

## Introduction to Binary

- Binary is a number system that uses only two digits: 0 and 1.
- It's the foundation of all computer systems.
- Each binary digit is called a **bit**.
- Example: Binary numbers like 101 represent values in the same way decimal numbers do but using only 0s and 1s.

1	1	0	0	1	0	1	0
↓	↓	↓	↓	↓	↓	↓	↓
2 <sup>7</sup>	2 <sup>6</sup>	2 <sup>5</sup>	2 <sup>4</sup>	2 <sup>3</sup>	2 <sup>2</sup>	2 <sup>1</sup>	2 <sup>0</sup>
↓	↓	↓	↓	↓	↓	↓	↓
128	64	0	0	8	0	2	0

## How Binary Works

- **Binary Place Values:**
- Each place in a binary number represents a power of 2.
- Starting from the right, the first position is:
- 2<sup>0</sup> = 1, then 2<sup>1</sup> = 2, 2<sup>2</sup> = 4, and so on.
- Example: The binary number 1000011 equals:

255 = 128 + 64 + 32 + 16 + 8 + 4 + 2 + 1

↑    ↑    ↑    ↑    ↑    ↑    ↑    ↑  
2<sup>7</sup> 2<sup>6</sup> 2<sup>5</sup> 2<sup>4</sup> 2<sup>3</sup> 2<sup>2</sup> 2<sup>1</sup> 2<sup>0</sup>

**Example:**

1	0	0	0	0	1	1	1
×	×	×	×	×	×	×	×
2 <sup>7</sup>	2 <sup>6</sup>	2 <sup>5</sup>	2 <sup>4</sup>	2 <sup>3</sup>	2 <sup>2</sup>	2 <sup>1</sup>	2 <sup>0</sup>
↓	↓	↓	↓	↓	↓	↓	↓
128	0	0	0	0	4	2	1

135 = 128 + 0 + 0 + 0 + 0 + 4 + 2 + 1

## Converting Decimal to Binary

- To convert a decimal number to binary:
- Find the highest power of 2 that fits into the number.
- Subtract that value and repeat for the remainder.

**Example:**

- Convert 9 to binary:

1001 (Binary Number)

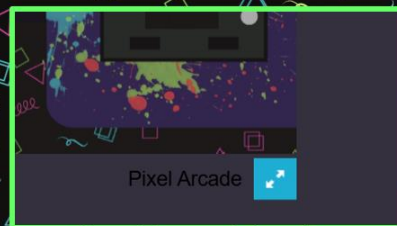
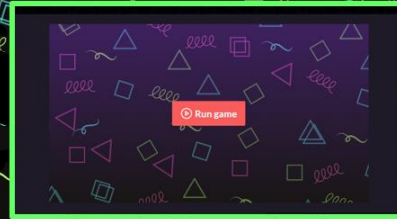
1	0	0	1
1 × 2 <sup>3</sup>	0 × 2 <sup>2</sup>	0 × 2 <sup>1</sup>	1 × 2 <sup>0</sup>
8	0	0	1
+	+	+	+
9 (Decimal Number)			

On the 10<sup>th</sup> slide, we explain how to get to the game and the instructions to play it. The instructions are brief because they are explained more within the game.

**Note: we visibility showed them how to get to the site in real time.**

## Workshop Description

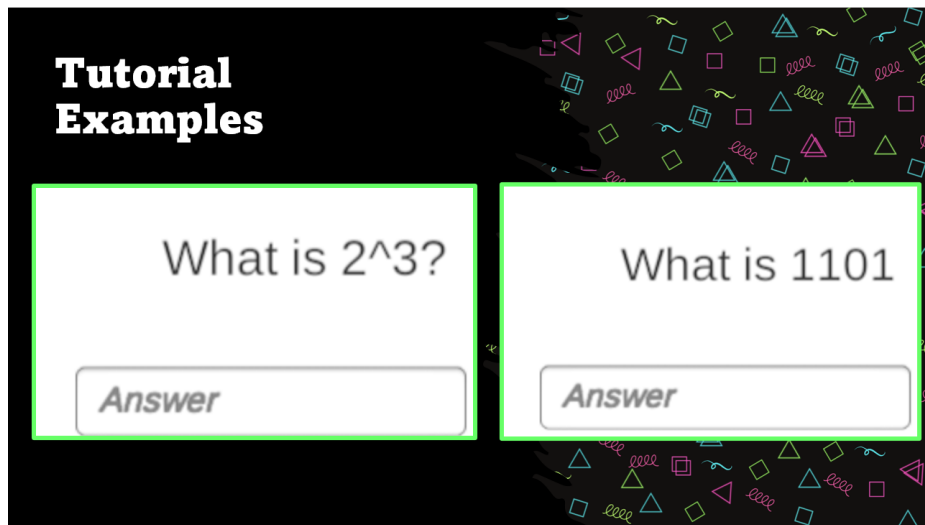
1. Go to <https://slesure.itch.io/pixel-arcade>.
2. Read the description under the game to understand the details.
3. When you're ready to play, click the "Run game" button.
4. Once the game loads, hit the full screen icon at the bottom right corner of the game view for the best experience.
5. Start by playing the assigned game.
6. If you finish early, feel free to explore and play the RGB paint game.





On the 11<sup>th</sup> & 12<sup>th</sup> slide, we go over the tutorial part of the game. This is done at the beginning of game before the students can get to the main menu.

We displayed the tutorial questions and asked them to solve the questions first before we went over the answers.



**Tutorial Examples**

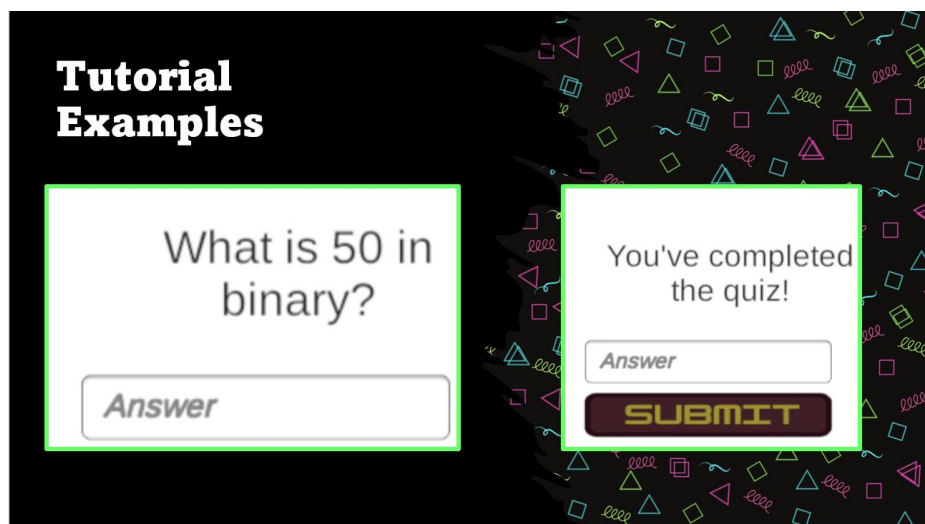
What is  $2^3$ ?

Answer

What is 1101

Answer

This slide features a black background with a pattern of colorful geometric shapes (squares, triangles, circles) and binary code (0s and 1s) in the top right corner. The title "Tutorial Examples" is in white bold text. Below it are two white rectangular boxes, each containing a question and an "Answer" input field. The first box asks "What is  $2^3$ ?" and the second asks "What is 1101".



**Tutorial Examples**

What is 50 in binary?

Answer

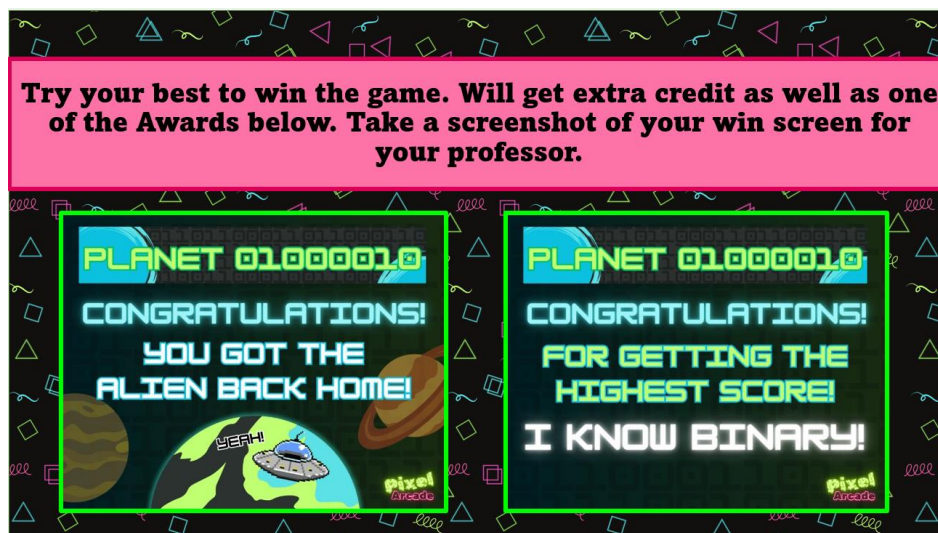
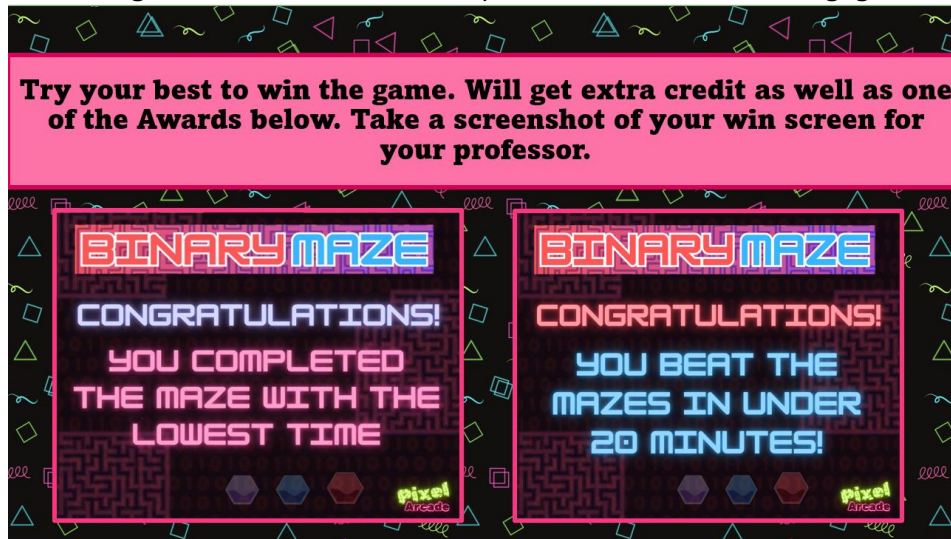
You've completed the quiz!

Answer

**SUBMIT**

This slide continues the tutorial with a similar black background and colorful geometric shapes. The title "Tutorial Examples" is in white bold text. Below it are two white rectangular boxes. The first box contains the question "What is 50 in binary?" and an "Answer" input field. The second box contains the text "You've completed the quiz!" and a "SUBMIT" button.

On the 13<sup>th</sup> & 14<sup>th</sup> slide, we show the students the awards that they can win if they were to win the game. We did this to try to the students be more engage into learning the concepts. Students were also given extra credit from their professors to further the engagement.



On the 15<sup>th</sup> & 16<sup>th</sup> slide, we ask the students if they have any more questions before we start the mini-games and thanked them for taking part within our workshop.



## During Game:

While the students are playing the mini games, we played some music to drown out the silence since there is no audio within the games.

Here is a link to the music we played: <https://www.youtube.com/watch?v=UlvNT7NOY9A>

Because we usually only had an hour for our workshop, we would only allow for the students to play only one of the main games. So, some workshops, they played **Binary Maze & RGB Paint** while the other workshops would play **Planet 01000010 & RGB Paint**.

During our workshop, we would have students write their name and score either on a white board or a blank piece of paper, so we could see who won which awards and send that list to their professors.

The professors also had them screen shot their score to get their extra credit.

Here is an example layout of what it looks like for each game.

### Binary Maze Game

Name	Maze Final Time	Did you beat it under 20 mins?
John Walker	15:46	Yes

### Planet 01000010

Name	Game Score	Did you get the alien back home?
John Walker	9 / 12	Yes

***Note: not everyone's score will be the same because not everyone will get the same number of questions.***

The great thing about this workshop is that the if the student didn't like the score they got, they can keep playing until the end of the workshop or can draw and paint within the RGB Paint game because now the game would be disabled for the students to engage with.