Универзитет „Св. Кирил и Методиј“ во Скопје
ФАКУЛТЕТ ЗА ИНФОРМАТИЧКИ НАУКИ И КОМПЈУТЕРСКО ИНЖЕНЕРСТВО

-Video Game Programming-

Laboratory Exercise 1: Colour Fill Puzzle

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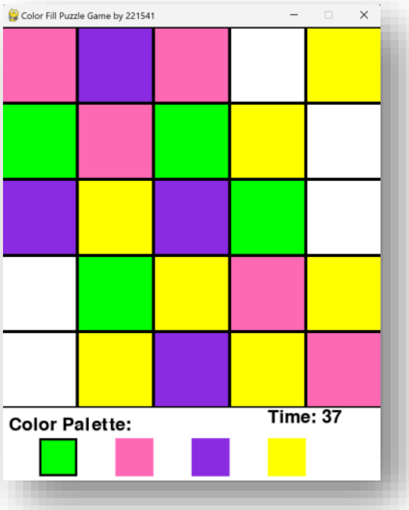
Description

Color Fill Puzzle is a challenging puzzle game where players must fill a 5x5 grid with four distinct colors while following specific rules. The goal is to fill all empty cells with valid colors, ensuring that no two adjacent cells share the same color. The game features multiple levels with varying time limits and pre-filled board percentages, gradually increasing in difficulty. Players must carefully select colors from a palette at the bottom of the screen and strategically fill the grid, all while racing against the clock. The game ends when the board is filled correctly or when no valid moves are left.

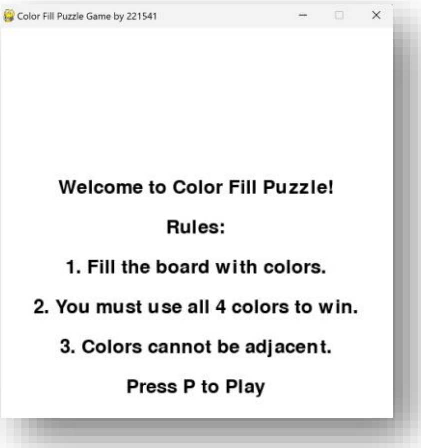


1.1 View of the game UI

Game Overview

- **Grid and Colors:** The game board consists of a 5x5 grid, and each square can hold one of four colors: green, pink, violet, and yellow. Initially, some squares are pre-filled with random colors, and others remain empty.
- **Color Palette:** At the bottom of the screen, players can select one of the four colors to fill the empty cells on the board.
- **Adjacency Rules:** Players must ensure that no two adjacent cells (horizontally or vertically) contain the same color. This rule adds a layer of strategy, as players need to consider surrounding cells before making a move.
- **Time Limits:** Each level has a time limit, which gradually decreases as the player progresses. Players must complete each level before time runs out.
- **Valid Moves:** To make a valid move, players must click on an empty square and select a color from the palette. The game checks that the selected color does not violate the adjacency rule.

Initially, rules of the game are shown and player has to start game by clicking the keyboard key P. ***(shown in image 2.1)***


Color Fill Puzzle Game by 221541

Welcome to Color Fill Puzzle!

Rules:

1. Fill the board with colors.

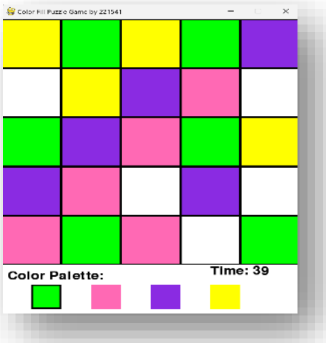
2. You must use all 4 colors to win.

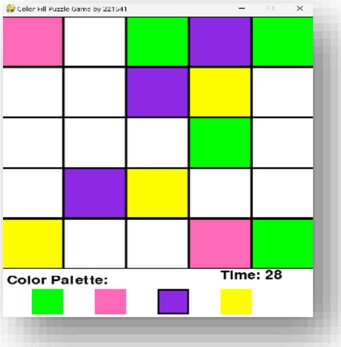
3. Colors cannot be adjacent.

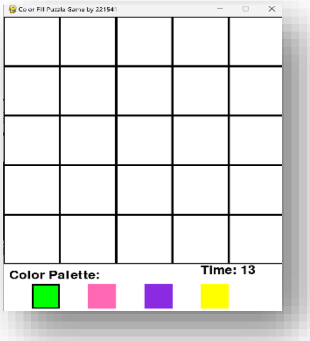
Press P to Play

2.1 First window of game

In the first level of the game, the board is generated randomly 80% filled and a time limit of 40 seconds. When player successfully fills board of first level, he moves to second level, where the board is again 50% prefilled and randomly generated but the time limit is 30 seconds. The last level, third, board is initially empty and player has 20 seconds to fill it. ***(Shown below in images 2.2, 2.3 and 2.4)***







2.2 First level

2.3 Second level

2.4 Third level

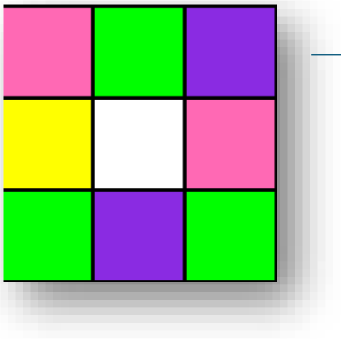
Constraints

Game is lost if:

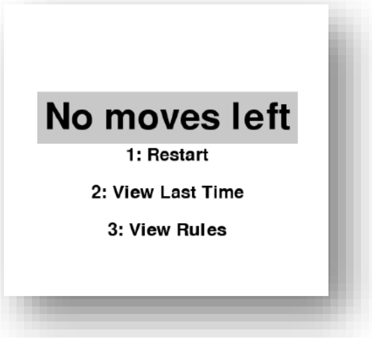
-Player runs out of time

-Player has no moves left ***(shown in image 3.1 and 3.2)***

-Player doesn't use all 4 colours to fill the board, in this case game doesn't end until player runs out of time, but even if the board is filled, the game is lost. (***Shown in image 3.3 and 3.4)***



3.1 impossible move



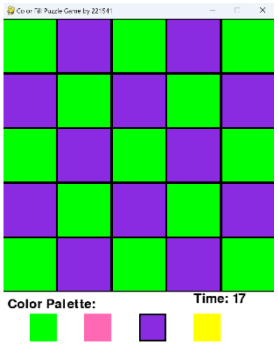
No moves left

1: Restart

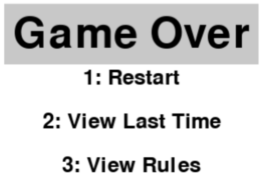
2: View Last Time

3: View Rules

3.2 Output message



3.3 Player used only 2 colours



Game Over

1: Restart

2: View Last Time

3: View Rules

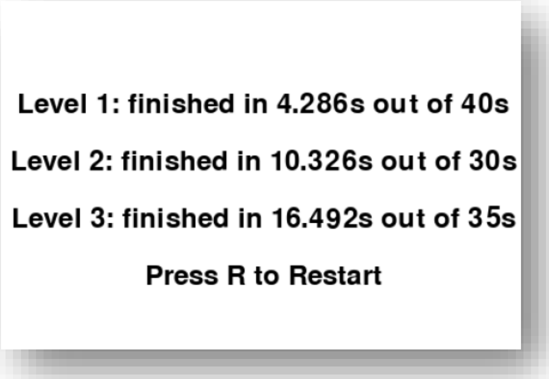
3.4 Output message

Invalid Move:

-Player tries to put two adjacent colors, whether vertically or horizontally, wont be able to, nothing will happen, tile remains uncolored, so player has to select another color to fill it.

Additional Feature

Additionally, after game ends, player can check his level finishing time by clicking “2” on keyboard. On the window player will be able to see for each level in how many seconds he managed to finish it out of the time limit per level. ***(Image 4.1)***



Level 1: finished in 4.286s out of 40s

Level 2: finished in 10.326s out of 30s

Level 3: finished in 16.492s out of 35s

Press R to Restart

4.1 Player’s winning time for each level

Code Overview

The code for **Color Fill Puzzle** game is designed to create an engaging puzzle experience using **PyGame**. Here's a breakdown of its main components and functionalities:

- **Board Setup and Initialization**
- **Color Palette and User Interaction**
- **Board State Management**
- **Levels and Difficulty**.
- **Game Progression and Win Conditions**
- **Timers and Game Over**
- **End Screen and Navigation**
- **Random Board Setup**

1. **Game Initialization and Constants**

The game begins by initializing the PyGame library with pygame.init(), which is required for creating and managing the game window, rendering graphics, handling input, and managing events.

Constants: Various constants are defined for the game's dimensions (SCREEN_WIDTH, SCREEN_HEIGHT), the grid size (GRID_SIZE), and the color palette (COLORS), which uses RGB values to represent different colors (Green, Pink, Violet, Yellow). This is used throughout the game to draw the grid, palette, and game elements.

Board Initialization: A 5x5 grid is set up where each cell starts as -1, meaning they are empty. This grid is used to track the colors in the game.

2. Rendering the Board

The function draw_board() is responsible for rendering the game grid on the screen. Each cell in the board is drawn as a rectangle using the pygame.draw.rect() function. If a cell contains a color (i.e., not -1), that color is used to fill the rectangle; otherwise, the cell remains empty (white).

The grid is outlined with black borders, and this helps the player distinguish each individual cell.

3. Color Palette

The function draw_color_palette() renders the color palette at the bottom of the screen, displaying 4 color blocks that players can choose from. The selected color is highlighted by drawing a black border around the corresponding color block. Players can select a color by clicking on these blocks, which is handled by get_color_from_click().

4. Color Selection Mechanism

The get_color_from_click() function is used to detect which color the player selects from the palette. It takes the mouse click position as input and checks if it lies within the bounds of one of the color blocks. It returns the index of the selected color (0-3) or None if the click wasn't on the palette.

5. Filling the Grid with Colors

The function fill_random_squares_with_validity() is responsible for filling some of the grid's cells at the start of each level. The number of filled cells is determined by the percent_filled value for that level (e.g., 80% for level 1). The function ensures that no two adjacent cells have the same color by checking the validity of each color placement using is_valid_color().

6. Grid Validation

The is_valid_color() function checks whether the player is allowed to place a specific color in a given cell. It looks at the neighboring cells (up, down, left, and right) and ensures that the same color is not adjacent to the selected cell. If any neighboring cells have the same color, the placement is invalid, and the color can't be placed in that cell.

7. Checking for a Completed Board

The function is_board_filled() checks whether all cells on the grid are filled with a color. It does so by iterating through each cell in the board and verifying that none of them contain -1 (empty).

8. Checking for Valid Moves

The function no_valid_moves_left() checks if there are any valid moves left on the board. If there are empty cells (-1), it checks if placing any of the available colors would be valid (not adjacent to the same color). If no valid colors are available for any empty cell, the game ends with a "No Moves Left" message.

9. Displaying Text

The display_text() function is used to render text on the screen, such as level instructions, timer, or game-over messages. It centers the text on the screen, optionally adding a background rectangle for better visibility.

10. Game Over / Win Screen

The end_screen() function is used to display a screen at the end of each level or the game. It shows a message ("You Win!" or "Game Over") and provides options for the player to restart the game, view time records, or see the rules.

It also tracks the best time, updating it if the player achieves a new record.

11. Time Tracking

The start_ticks variable is used to track the starting time for each level (in milliseconds). The remaining time is calculated by subtracting the elapsed time from the level's time limit.

The time is displayed on the screen in the format "Time: xx", and when the time runs out, the game moves to the "Game Over" screen.

12. Level Progression and Transition

After completing a level, the game transitions to the next level by calling show_next_level_screen(), which displays a "Next Level" message and waits for 2 seconds before proceeding. If all levels are completed, the player wins the game.

13. Game Loop

The main() function contains the core game loop. It handles the following:

The initialization of each level (board setup, color selection, etc.).

Managing player input (mouse clicks for color selection and cell filling).

Checking for level completion (filled board and color constraints).

Checking for time expiry or game over conditions.

Handling level transitions or game over.

Restarting the game or moving to the next level based on the player's input.

14. End-of-Game and Restart Options

The game provides options to the player at the end of each level or the entire game:

Restart: Restarts the current level or the entire game.

View Time: Displays the time records for each level.

View Rules: Shows the game rules screen again.

These options are controlled via keyboard inputs (1, 2, or 3).

15. Rules Screen

The rules_screen() function displays the rules of the game at the beginning, explaining the objective (fill the grid with four colors), the constraint (no adjacent cells with the same color), and the goal to complete the board. The player can start playing by pressing the P key.

Conclusion

Color Fill Puzzle offers a captivating blend of strategy and time management. With its simple yet challenging gameplay mechanics, the game tests players' problem-solving skills as they navigate through increasingly difficult levels. The unique requirement of using all four colors while avoiding adjacent duplicates keeps players engaged and encourages careful planning. Whether you're a casual player looking for a quick challenge or a puzzle enthusiast seeking to sharpen your strategic thinking, Color Fill Puzzle provides an exciting and rewarding experience. Keep an eye on the clock and fill the grid with the right colors—your path to victory depends on it!

Review on How to Play:

1. **Start the Game:** Begin by reading the rules and pressing "P" to start.
2. **Select a Color:** Choose a color from the palette at the bottom of the screen.
3. **Fill the Grid:** Click on an empty square in the grid and fill it with the selected color. Ensure the color does not match adjacent cells.
4. **Progress Through Levels:** Complete the board for each level within the time limit. Once a level is completed, the game moves to the next, with increased difficulty.
5. **Game Over/Win:** The game ends if all levels are completed or if there are no valid moves left before time runs out.