

# Assignment 3

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## Student Name:

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## Group:

ОПД 2

## Task:

The main goal of this assignment is to extend the functionality of the previously developed blackboard system by implementing new commands and stricter requirements. This task strengthens practical skills in object-oriented programming (OOP), including inheritance, polymorphism, and dynamic memory management.

In this project, the blackboard system has been extended to support the following commands:

1. **Draw:** Render the blackboard with all shapes, using their respective colors and fill modes (frame or full).
2. **List:** Display a list of all added shapes, showing their ID and parameters.
3. **Add:** Add a shape (triangle, rectangle, circle, line) to the blackboard with specified color and fill mode.
4. **Select:** Select a shape either by its ID or by coordinates.
5. **Remove:** Remove the selected shape.
6. **Edit:** Modify the parameters of the selected shape (without changing the shape type).
7. **Paint:** Change the color of the selected shape.
8. **Move:** Move the selected shape to new coordinates and bring it to the foreground.
9. **Clear:** Clear the blackboard of all shapes.
10. **Save and Load:** Save the current state of the blackboard to a file or load it from a file.

System Model:

BOARD

FIGURE

- int x, y, width, height
- // BOARD

TRIANGLE

- int x, y, height
- // BOARD

CIRCLE

- int x, y, radius
- // BOARD

LINE

- int x, y, size
- // BOARD

BOARD

- print()
- draw()
- list()
- saveFormat()
- isPublicater()
- int boardWidth, height
- \* shared-ptrs

TRC L

FIGURES

- print()
- draw()
- list()
- saveFormat()
- isPublicater()
- int boardWidth, height
- \* shared-ptrs
- load()
- select()
- remove()
- edit()
- point()
- move()

// Friendship is not transitive and the one that is inherited  $\Rightarrow$  WERE NOT USED

Triangle::draw()

Rectangle::draw()

Circle::draw()

Line::draw()

// simpler variant of Bresenham's line algorithm

$x_1 = x, y_1 = y$  // start point ; size = 3

$x_2 = \min(x + size - 1, width - 1)$  // min(2+3-1, 7)

// RAII (Resource Acquisition Is Initialization) - ynpaBHKke pecyp cmm

npv6: 32ake go neumma coBekma

// ANSI for colour in console

Board

int shapeIDCounter  
int selectedID  
int boardWidth  
int boardHeight  
std::vector figures

- draw()
- list()
- add(std::string, std::string, int, int, int, FillMode)
- clear(std::string)
- save(std::string)
- load(std::string)
- select(int)
- select(int, int)
- remove()
- edit(int, int, int, std::string, std::string)
- paint(std::string)
- move(int, int)
- getFilePath() : std::string

Figure

int x  
int y  
Color color  
FillMode fillMode

- draw(Board)
- getInfo() : std::string
- getSaveFormat() : std::string
- isOutOfBounds(int, int) : bool
- setColor(ColorName)
- getShapeType() : std::string
- getParam1() : int
- getParam2() : int

Triangle

int height

- draw(Board)
- getInfo() : std::string
- getSaveFormat() : std::string
- isOutOfBounds(int, int) : bool
- getShapeType() : std::string
- getParam1() : int

Rectangle

int width  
int height

- draw(Board)
- getInfo() : std::string
- getSaveFormat() : std::string
- isOutOfBounds(int, int) : bool
- getShapeType() : std::string
- getParam1() : int
- getParam2() : int

Circle

int radius

- draw(Board)
- getInfo() : std::string
- getSaveFormat() : std::string
- isOutOfBounds(int, int) : bool
- getShapeType() : std::string
- getParam1() : int

Line

int x2  
int y2

- draw(Board)
- getInfo() : std::string
- getSaveFormat() : std::string
- isOutOfBounds(int, int) : bool
- getShapeType() : std::string
- getParam1() : int
- getParam2() : int

Color

ColorName name

- Color(ColorName name)
- getName() : std::string
- static fromString(std::string) : ColorName

ColorFormatter

- static getAnsiCode(Color) : std::string

ColorName

Red, Green, Blue, Yellow, Cyan, Magenta, White, Reset, Invalid

## GitHub Link:

<https://github.com/olesia-mykhailyshyn/Assignment-3.git>

## Solution Description:

The implemented solution is a console-based application for drawing geometric shapes on a grid-based blackboard. Users interact with the system through a command-line interface (CLI), issuing commands to manage the shapes.

### Classes:

**Figure Class Hierarchy:** The system employs inheritance and polymorphism, with a base class `Figure` and derived classes (`Triangle`, `Rectangle`, `Circle`, `Line`). Each derived class implements specific shape-drawing logic and boundary-checking mechanisms.

**Board Class:** This class manages the board grid and all added shapes. It provides methods for rendering shapes, handling commands, and managing the overall board state.

**Color Class:** The color system is implemented using an enum `ColorName`, which supports multiple colors (e.g., Red, Green, Blue). The `ColorFormatter` class is used to apply ANSI codes to colorize the shapes in the console.

**Command Handling:** Command execution is mapped to corresponding methods in the `Board` class, allowing for interactive manipulation of shapes.

**Dynamic Shape Management:** Shapes are added to a list and can be drawn, modified, or removed from the board. Polymorphism ensures that different shapes are handled uniformly, but with specific logic for each shape type.

- **Encapsulation:** The board and figures manage their internal state.
- **Inheritance:** The base `Figure` class is extended by specific shapes.
- **Polymorphism:** Shapes are treated uniformly via the base class, but their specific behavior is determined at runtime using virtual methods.

## Testing:

### Example Commands:

- `draw`: Draws the current state of the blackboard.
- `add fill red triangle 5 5 3`: Adds a red-filled triangle at position (5, 5) with a height of 3.
- `list`: Lists all shapes added to the board with their IDs and parameters.

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):

draw

```
  0  1  2  3  4  5  6  7  8  9
+-----+
0|                                     |
1|                                     |
2|                                     |
3|                                     |
4|                                     |
5|                                     |
6|                                     |
7|                                     |
8|                                     |
9|                                     |
+-----+
```

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):

list

There are no figures on the board.

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):

shapes

List of available shapes and their parameters for the 'add' command:

> circle [x, y, radius]

> rectangle [x, y, width, height]

> triangle [x, y, height]

> line [x1, y1, x2, y2]

Available colors: Red, Green, Blue, Yellow, Cyan, Magenta, White, Reset (default).

Usage Example: add fill red circle 5 5 3 - This command creates a filled red circle at position (5, 5) with a radius of 3.

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):

select

Invalid select command. Please provide either an ID or coordinates.

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):

select 8

Shape with ID 8 not found.

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):

remove

No shape is currently selected. Please select a shape first.

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):

edit

Invalid parameters for edit command. Expected format: edit x y param1 param2 color fillMode

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):

paint

No shape is currently selected. Please select a shape first.

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):

clear

There are no figures. Clear command cannot be performed.

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):

save

There are no figures. An empty file will be saved.

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):

load

The file C:\KSE\OOP\_design\Assignment\_3\myFile.txt is empty. Nothing to load.

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):

load

The file C:\KSE\OOP\_design\Assignment\_3\myFile.txt is empty. Nothing to load.

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):

add fill red triangle 2 2 3

[0] triangle Red 2 2 3

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):

draw

```

 0 1 2 3 4 5 6 7 8 9
+-----+
0|                                     |
1|                                     |
2|          R                         |
3|      R  R  R                       |
4|  R  R  R  R  R                     |
5|                                     |
6|                                     |
7|                                     |
8|                                     |
9|                                     |
+-----+

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
add frame blue rectangle 5 5 3 2
[1] rectangle Blue 5 5 3 2
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
draw
 0 1 2 3 4 5 6 7 8 9
+-----+
0|                                     |
1|                                     |
2|          R                         |
3|      R  R  R                       |
4|  R  R  R  R  R                     |
5|                                     B B B |
6|                                     B B B |
7|                                     |
8|                                     |
9|                                     |
+-----+

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
list
Figures on the board:
[0] Triangle at (2, 2), height: 3 Color: Red FillMode: Fill
[1] Rectangle at (5, 5), width: 3, height: 2 Color: Blue FillMode: Frame
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
add fill green circle 7 7 2
[2] circle Green 7 7 2
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
draw
 0 1 2 3 4 5 6 7 8 9
+-----+
0|                                     |
1|                                     |
2|          R                         |
3|      R  R  R                       |
4|  R  R  R  R  R                     |
5|                                     B B G |
6|                                     B G G G |
7|                                     G G G G G |
8|                                     G G G |
9|                                     G |
+-----+

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
select 0
Shape [0] selected: Triangle at (2, 2), height: 3
```

```
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
move 1 1
Shape [0] moved to (1, 1).

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
draw
  0  1  2  3  4  5  6  7  8  9
+-----+
0|                                     |
1|      R                             |
2| R  R  R                             |
3| R  R  R  R                         |
4|                                     |
5|                                     |
6|                                     |
7|                                     |
8|                                     |
9|                                     |
+-----+
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
select 0
Shape [0] selected: Triangle at (2, 2), height: 3

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
move 1 1
Shape [0] moved to (1, 1).

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
draw
  0  1  2  3  4  5  6  7  8  9
+-----+
0|                                     |
1|      R                             |
2| R  R  R                             |
3| R  R  R  R                         |
4|                                     |
5|                                     |
6|                                     |
7|                                     |
8|                                     |
9|                                     |
+-----+
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
list
Figures on the board:
[0] Triangle at (1, 1), height: 3 Color: Red FillMode: Fill
[1] Rectangle at (5, 5), width: 3, height: 2 Color: Blue FillMode: Frame
[2] Circle at (7, 7), radius: 2 Color: Green FillMode: Fill

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
select 1 1
Shape [0] at (1, 1) selected: Triangle at (1, 1), height: 3

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
remove
Shape [0] removed.
```

```
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
draw
  0  1  2  3  4  5  6  7  8  9
+-----+
0|                                     |
1|                                     |
2|                                     |
3|                                     |
4|                                     |
5|           B  B  G                 |
6|         B  G  G  G                 |
7|       G  G  G  G  G                 |
8|         G  G  G                 |
9|           G                       |
+-----+

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
list
Figures on the board:
[0] Rectangle at (5, 5), width: 3, height: 2 Color: Blue FillMode: Frame
[1] Circle at (7, 7), radius: 2 Color: Green FillMode: Fill

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
select 1
Shape [1] selected: Circle at (7, 7), radius: 2

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
edit 5 5 4 3 magenta frame
Shape [1] edited: New properties set.
```

```
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
draw
  0  1  2  3  4  5  6  7  8  9
+-----+
0|                                     |
1|           M                       |
2|       M           M               |
3|     M           M               |
4|                                     |
5|  M           B  B  B  M           |
6|           B  B  B                 |
7|     M           M               |
8|       M           M               |
9|           M                       |
+-----+

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
list
Figures on the board:
[0] Rectangle at (5, 5), width: 3, height: 2 Color: Blue FillMode: Frame
[1] Circle at (5, 5), radius: 4 Color: Magenta FillMode: Frame

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
paint yellow
Shape [1] painted Yellow.
```



```
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
draw
  0  1  2  3  4  5  6  7  8  9
+-----+
0|                                     |
1|           Y                       |
2|         Y       Y                 |
3|       Y           Y               |
4|                                     |
5|   Y           B B B   Y           |
6|           B B B                   |
7|       Y           Y               |
8|         Y       Y                 |
9|           Y                       |
+-----+
```

```
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
list
```

Figures on the board:  
[0] Rectangle at (5, 5), width: 3, height: 2 Color: Blue FillMode: Frame  
[1] Circle at (5, 5), radius: 4 Color: Yellow FillMode: Frame

```
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
list
```

Figures on the board:  
[0] Rectangle at (5, 5), width: 3, height: 2 Color: Blue FillMode: Frame  
[1] Circle at (5, 5), radius: 4 Color: Yellow FillMode: Frame

```
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
move 2 3
Shape [1] moved to (2, 3).
```

```
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
draw
  0  1  2  3  4  5  6  7  8  9
+-----+
0| Y           Y                       |
1|           Y                       |
2|                                     |
3|           Y                       |
4|                                     |
5|           Y B B                     |
6| Y           Y B B B                   |
7|       Y                                     |
8|                                     |
9|                                     |
+-----+
```

```
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
clear
All shapes are removed from the board. File is empty as well.
```



```
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
list
There are no figures on the board.
```

```
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
draw
  0  1  2  3  4  5  6  7  8  9
+-----+
0|                                     |
1|                                     |
2|                                     |
3|                                     |
4|                                     |
5|                                     |
6|                                     |
7|                                     |
8|                                     |
9|                                     |
+-----+
```

```
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
add fill cyan line 1 1 7 7
[3] line Cyan 1 1 7 7
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
draw
```

```
+-----+
0|                                     |
1|      C                             |
2|     C                              |
3|    C                               |
4|   C                                |
5|  C                                 |
6| C                                 |
7|  C                                 |
8|                                     |
9|                                     |
+-----+
```

```
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
save
Figures saved to C:\KSE\00P_design\Assignment_3\myFile.txt
```

```
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
load
Figures loaded successfully from C:\KSE\00P_design\Assignment_3\myFile.txt
```

```
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
add fill yellow rectangle 9 9 -1 -2
Error: Figure is too large to fit on the board and cannot be added.
```

```
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
draw
  0  1  2  3  4  5  6  7  8  9
+-----+
0|                                     |
1|      C                             |
2|     C                              R |
3|    C   R R R R R R R R R R |
4|   R R R R R R R R R R |
5|  R R R R R R R R R R |
6| R R R R R R R R R R |
7| R R R R R R R R R R |
8| R R R R R R R R R R |
9| R R R R R R R R R R |
+-----+
```

```
Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
select 20 20
No shape found at (20, 20).
```

```

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
save
Figures saved to C:\KSE\00P_design\Assignment_3\myFile.txt

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
load
Figures loaded successfully from C:\KSE\00P_design\Assignment_3\myFile.txt

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
draw
  0  1  2  3  4  5  6  7  8  9
+-----+
0|                                     |
1|      C                             |
2|      C                             R |
3|      C R R R R R R R |
4|      R R R R R R R R |
5|      R R R R R R R R |
6|      R R R R R R R R |
7|      R R R R R R R R |
8|      R R R R R R R R |
9|      R R R R R R R R |
+-----+

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
load
Error: Invalid shape type triangle found in file. Aborting load.
Failed to load file: C:\KSE\00P_design\Assignment_3\myFile.txt. Aborting load due to errors.

Enter command (draw/list/shapes/add/select/remove/edit/paint/move/clear/save/load/exit):
list
Figures on the board:
[5] Line from (1, 1) to (7, 7) Color: Cyan FillMode: Fill

```

## Conclusions:

- Successfully extended the blackboard system with additional functionality.
- Utilized OOP principles such as inheritance and polymorphism for flexible shape management.
- Implemented file saving and loading with robust error handling.
- Implemented a stricter validation process for file loading, ensuring that corrupted or incomplete files are rejected.
- Added detailed error handling during file operations and shape manipulations to provide better user feedback.

**Challenges:** Complex algorithms were required for shape rendering, particularly for circles and lines.

## Appendices:

[https://www.youtube.com/watch?time\\_continue=423&v=S\\_isDjezoz8&embeds\\_referring\\_euri=https%3A%2F%2Fwww.google.com%2Fsearch%3Fq%3Dhow%2Bto%2Bdraw%2Brectangle%2Bc%252B%252B%2Bby%2Bcoordinates%26oq%3Dhow%2Bto%2Bdraw%2Brectangle%2Bc%252B%252B%2Bby%2Bcoordinates%26gs\\_&source\\_ve\\_path=MTM5MTE3LDEzOTExNywyMzg1MQ](https://www.youtube.com/watch?time_continue=423&v=S_isDjezoz8&embeds_referring_euri=https%3A%2F%2Fwww.google.com%2Fsearch%3Fq%3Dhow%2Bto%2Bdraw%2Brectangle%2Bc%252B%252B%2Bby%2Bcoordinates%26oq%3Dhow%2Bto%2Bdraw%2Brectangle%2Bc%252B%252B%2Bby%2Bcoordinates%26gs_&source_ve_path=MTM5MTE3LDEzOTExNywyMzg1MQ) --- drawing the rectangle

<https://www.geeksforgeeks.org/program-print-circle-pattern/> --- circle

<https://www.youtube.com/watch?v=HaZh4SVCXyg> --- circle

<https://qna.habr.com/q/574775> -- line

<https://www.plantuml.com/plantuml/uml/SyfFKj2rKt3CoKnELR1Io4ZDoSa70000> --- diagram

<https://gist.github.com/fnky/458719343aabd01cfb17a3a4f7296797> --- for ansi

reg add HKCU\Console /f /v VirtualTerminalLevel /t REG\_DWORD /d 1 ---- this was used in terminal for setting up ansi

it is command for running in terminal to make charakters colored