Лабораторна робота №5

Ієрархія об'єктів і групи. Агрегація. Композиція. Асоціація

Мета: Одержати практичні навички створення об'єктів-груп (агрегація, композиція, асоціація).

Хід роботи

Завдання 1

Розробити ієрархію класів яка включає агрегацію та композицію взявши тему з Лабораторної роботи №3

Код програми

Detail.h

```
#ifndef DETAIL_HPP
#define DETAIL_HPP

#include <string>
#include <iostream>

class Detail
{
private:
    std::string _d_name;

public:
    Detail();
    Detail(const std::string& name);

    std::string getName() const;
    void setName(const std::string& newName);

    void Show() const;
};

#endif // DETAIL_HPP
```

Detail.cpp

```
#include "Detail.hpp"

Detail::Detail() : _d_name("Unnamed detail")
{
    std::cout << "Detail::Detail() called\n";
}

Detail::Detail(const std::string& name) : _d_name(name)
{
    std::cout << "Detail::Detail(name) called\n";
}

std::string Detail::getName() const { return _d_name; }

void Detail::setName(const std::string& newName) { _d_name = newName; }

void Detail::Show() const
{
    std::cout << "Detail: " << _d_name << std::endl;;
}
```

Node.h

```
#ifndef NODE_HPP
#define NODE_HPP

#include <vector>
#include "Detail.hpp"

class Node
{
```

```
private:
    // Composition
    std::vector<Detail>* details_;

public:
    Node();
    void AddDetail(const Detail& newEl);
    void RemoveDetails();
    const std::vector<Detail> getDetails() const;

    void Show() const;
};

#endif // NODE_HPP
```

Node.cpp

```
#include "Node.hpp"
#include <iostream>

Node::Node() {
    std::cout << "Node::Node() called\n";
    details_ = new std::vector<Detail>();
}

void Node::AddDetail(const Detail& newEl) {
    details_->push_back(newEl);
}

void Node::RemoveDetails() {
    details_->clear();
}

const std::vector<Detail> Node::getDetails() const {
    return (*details_);
}

void Node::Show() const {
    std::cout << "Node has " << details_->size() << " details:" << std::endl;;
    std::cout << "Details: "<<std::endl;

    for (const auto& e : (*details_))
        e.Show();
}
```

Mechanism.h

```
#ifndef MECHANISM_HPP
#define MECHANISM_HPP

#include <vector>
#include "Node.hpp"

class Mechanism
{
private:
    // Agregation
    std::vector<Node> nodes_;

public:
    Mechanism(std::vector<Node> nodes);
    void AddNode(Node node);
    const std::vector<Node>& getNodes() const;

    void Show() const;
};

#endif // MECHANISM_HPP
```

Mechanism.cpp

```
#include "Mechanism.hpp"
#include <iostream>

Mechanism::Mechanism(std::vector<Node> nodes) {
```

```
        std::cout << "Mechanism::Mechanism() called\n";
        nodes_ = nodes;
}

void Mechanism::AddNode(Node node) {
        nodes_.push_back(node);
}

const std::vector<Node>& Mechanism::getNodes() const {
        return nodes_;
}

void Mechanism::Show() const {
        std::cout << "Mechanism contains " << nodes_.size() << " nodes." << std::endl;
        for (const auto node : nodes_)
                node.Show();
}
```

Product.h

```
#ifndef PRODUCT_HPP
#define PRODUCT_HPP

#include <vector>
#include "Mechanism.hpp"

class Product
{
private:
    std::vector<Mechanism> mechanisms_;

public:
    Product();

    void AddMechanism(const Mechanism& mech);
    void Show() const;
};

#endif // PRODUCT_HPP
```

Product.cpp

```
#include "Product.hpp"
#include <iostream>

Product::Product() {
    std::cout << "Product::Product() called\n";
}

void Product::AddMechanism(const Mechanism& mech) {
    mechanisms_.push_back(mech);
}

void Product::Show() const {
    std::cout << "Product has " << mechanisms_.size() << " mechanisms:\n";
    for (const auto& m : mechanisms_)
        m.Show();
}
```

Main.cpp

```
#include "Product.hpp"

int main() {
        Detail d1("Screw");
        Detail d2("Bolt");
        Detail d3("Gear");
        std::cout << "-----------------------------------------------------------------------" << std::endl;
        Node n1;
        n1.AddDetail(d1);
        n1.AddDetail(d2);

        Node n2;
        n2.AddDetail(d3);
        std::cout << "-----------------------------------------------------------------------" << std::endl;
        std::vector<Node> nl{ n1,n2 };
        Mechanism mech1(nl);
```

```
        Product product;
        product.AddMechanism(mech1);
        std::cout << "--------------------------------------------------------------------" << std::endl;
        product.Show();
}
```

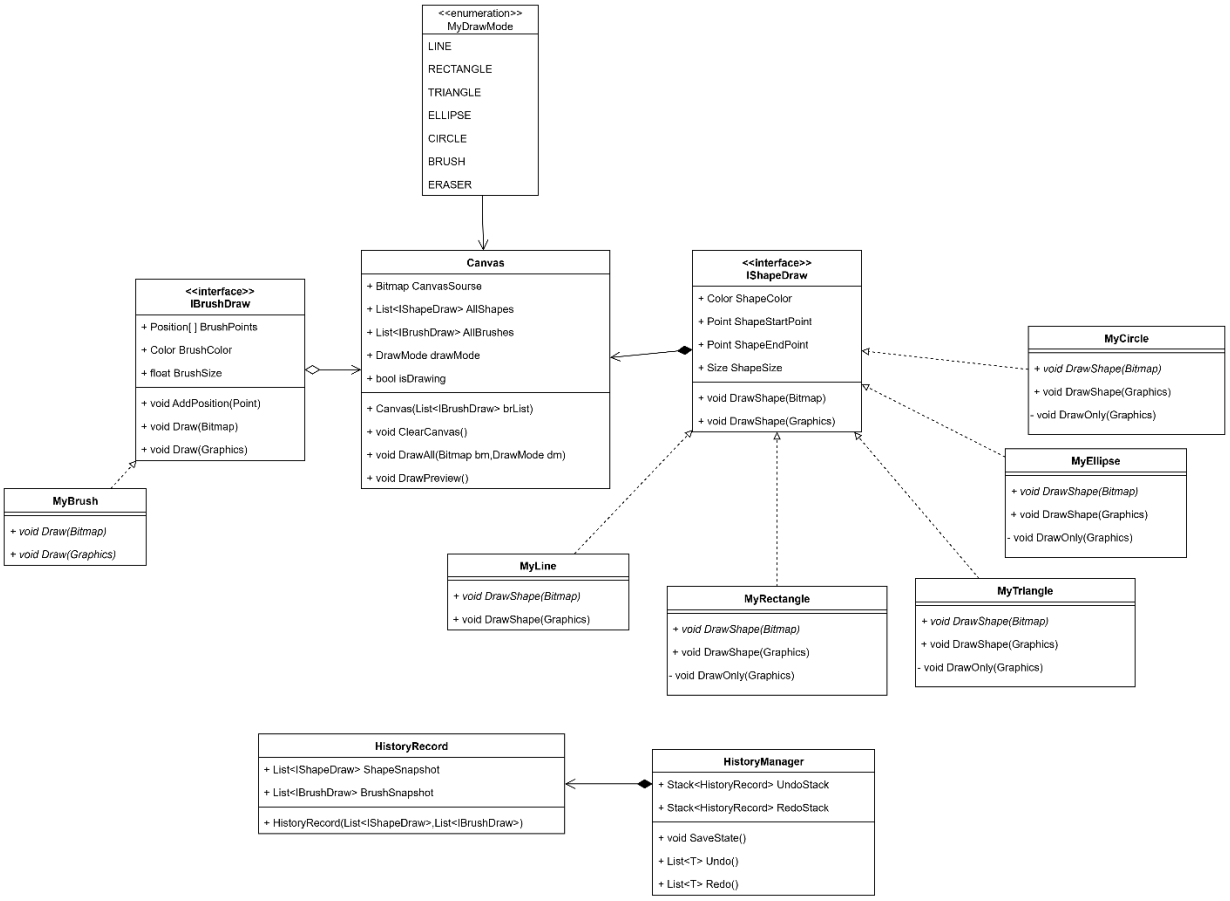
Результат

```
Detail::Detail(name) called
Detail::Detail(name) called
Detail::Detail(name) called
--------------------------------------------------------------------
Node::Node() called
Node::Node() called
--------------------------------------------------------------------
Mechanism::Mechanism() called
Product::Product() called
--------------------------------------------------------------------
Product has 1 mechanisms:
Mechanism contains 2 nodes.
Node has 2 details:
Details:
Detail: Screw
Detail: Bolt
Node has 1 details:
Details:
Detail: Gear
```

Завдання 2

В проекті Windows Form створити зв’язки класів за своєю темою використовуючи композицію агрегацію та асоціацію

Діаграма класів



Код програми

FileManager.cs

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Runtime;
using System.Text;
using System.Threading.Tasks;

namespace LW_Daryev_WinForm_NewEdition.File
{
    public static class FileManager
    {
        public static Bitmap? LoadFromFile()
        {
            using OpenFileDialog ofd = new OpenFileDialog();
            ofd.Filter = "PNG Image|*.png|JPEG Image|*.jpg;*.jpeg|All files|*.*";
            if (ofd.ShowDialog() == DialogResult.OK)
            {
                try
                {
                    return new Bitmap(ofd.FileName);
                }
                catch (Exception)
                {
                    MessageBox.Show("Cannot open this file as a image.", "ERROR", MessageBoxButtons.OK,
MessageBoxIcon.Error);
                    return null;
                }
            }
            return null;
        }

        public static void SaveAsToFile(Bitmap bmp)
        {
            if (bmp == null)
                throw new ArgumentNullException(nameof(bmp));

            using SaveFileDialog sfd = new SaveFileDialog();
            sfd.Filter = "PNG Image|*.png|JPEG Image|*.jpg;*.jpeg";
            if (sfd.ShowDialog() == DialogResult.OK)
            {
                try
                {
                    bmp.Save(sfd.FileName);
                }
                catch (Exception ex)
                {
                    MessageBox.Show($"Save file error: {ex.Message}", "Error", MessageBoxButtons.OK,
MessageBoxIcon.Error);
                }
            }
        }
    }
}
```

NormaliseMachine.cs

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;

namespace LW_Daryev_WinForm_NewEdition.Nomalisation
{
    public static class NormaliseMashine
    {
        /// <summary>
        /// Function to denormalise a point from [0, 1] range to actual pixel coordinates based on the form's
client size.
        /// </summary>
        /// <param name="form"></param>
        /// <param name="x"></param>
        /// <param name="y"></param>
        /// <returns></returns>
        /// <exception cref="ArgumentNullException"></exception>
        /// <exception cref="ArgumentOutOfRangeException"></exception>
        public static Point DenormalisePoint(Form form, float x, float y)
```

```
        {
            if (form == null)
                throw new ArgumentNullException(nameof(form));

            if (x < 0 || x > 1 || y < 0 || y > 1)
                throw new ArgumentOutOfRangeException(nameof(x), "x and y must be in the range [0, 1]");


            int denormX = (int)(x * form.ClientSize.Width);
            int denormY = (int)(y * form.ClientSize.Height);

            return new Point(denormX, denormY);
        }
        public static Point DenormalisePoint(Form form, PointF pointF)
        {
            if (form == null)
                throw new ArgumentNullException(nameof(form));

            if (pointF.X < 0 || pointF.X > 1 || pointF.Y < 0 || pointF.Y > 1)
                throw new ArgumentOutOfRangeException(nameof(pointF), "x and y must be in the range [0, 1]");

            int denormX = (int)(pointF.X * form.ClientSize.Width);
            int denormY = (int)(pointF.Y * form.ClientSize.Height);

            return new Point(denormX, denormY);
        }
        public static Size DenormaliseSize(Form form, float width, float height)
        {
            if (form == null)
                throw new ArgumentNullException(nameof(form));

            if (width < 0 || width > 1 || height < 0 || height > 1)
                throw new ArgumentOutOfRangeException(nameof(width), "width and height must be in the range [0,
1]");

            int denormWidth = (int)(width * form.ClientSize.Width);
            int denormHeight = (int)(height * form.ClientSize.Height);
            return new Size(denormWidth, denormHeight);
        }
        public static Size DenormaliseSize(Form form, SizeF sizeF)
        {
            if (form == null)
                throw new ArgumentNullException(nameof(form));
            if (sizeF.Width < 0 || sizeF.Width > 1 || sizeF.Height < 0 || sizeF.Height > 1)
                throw new ArgumentOutOfRangeException(nameof(sizeF), "width and height must be in the range [0,
1]");
            int denormWidth = (int)(sizeF.Width * form.ClientSize.Width);
            int denormHeight = (int)(sizeF.Height * form.ClientSize.Height);
            return new Size(denormWidth, denormHeight);
        }
    }
}
```

MainForm.cs

```
using LW_Daryev_WinForm_NewEdition.Nomalisation;
using LW_Daryev_WinForm_NewEdition.File;
using LW_Daryev_WinForm_NewEdition.Draw;
using LW_Daryev_WinForm_NewEdition.Shape;
using LW_Daryev_WinForm_NewEdition.Brush;
using LW_Daryev_WinForm_NewEdition.HisotyManagment;

namespace LW_Daryev_WinForm_NewEdition
{
    public delegate void AddShapeToListDelegate(IShapeDraw shape);
    public delegate void ShowDrModeOnStatusStripDelegate(string mode);
    public partial class MainForm : Form
    {
        HistoryManager HistoryOnMainForm = new HistoryManager();
        public UserCanvas CanvasOnMainForm;
        AddShapeToListDelegate AddShapeToList;
        public ShowDrModeOnStatusStripDelegate ShowDrModeOnStatusStrip;
        public MainForm()
        {
            InitializeComponent();
            InitializeControlsLS();
            mainPicture.Image = new Bitmap(mainPicture.Width, mainPicture.Height);
            CanvasOnMainForm = new UserCanvas((mainPicture.Image as Bitmap), new List<IBrushDraw>());
            SizeToolStripComboBox.Items.AddRange(new object[] { "1", "2", "3", "4", "5", "6", "7", "8", "9", "10",
"12", "14", "16", "18", "20", "24", "28", "32" });
            SizeToolStripComboBox.SelectedIndex = 4;
```

```
        AddShapeToList += (IShapeDraw obj) => { CanvasOnMainForm.ShapesList.Add(obj); };
        ShowDrModeOnStatusStrip += (string mode) => { StatusModeStripValue.Text = $"{mode}"; };
    }
    public void InitializeControlsLS()
    {
        menuBarStrip.Location = NormaliseMashine.DenormalisePoint(this, 0.0f, 0.0f);
        menuBarStrip.Size = NormaliseMashine.DenormaliseSize(this, 1.0f, 0.05f);

        toolsToolStrip.Location = NormaliseMashine.DenormalisePoint(this, 0.0f, 0.1f);
        toolsToolStrip.Size = NormaliseMashine.DenormaliseSize(this, 0.11f, 1.0f);

        propToolStrip.Location = NormaliseMashine.DenormalisePoint(this, 0.11f, 0.05f);
        propToolStrip.Size = NormaliseMashine.DenormaliseSize(this, 0.89f, 0.05f);

        mainPicture.Location = NormaliseMashine.DenormalisePoint(this, 0.13f, 0.13f);
        mainPicture.Size = NormaliseMashine.DenormaliseSize(this, 0.85f, 0.85f);


    }
    public void SetControlsLS()
    {
        mainPicture.Location = NormaliseMashine.DenormalisePoint(this, 0.13f, 0.08f);
        mainPicture.Size = NormaliseMashine.DenormaliseSize(this, 0.85f, 0.85f);
    }
    private void mainPicture_MouseDown(object sender, MouseEventArgs e)
    {
        if (CanvasOnMainForm.IsDrawing) return;


        CanvasOnMainForm.IsDrawing = true;
        float SizeValue;
        Color ColorValue = ColorInfoAndChangeToolStripButton.BackColor;
        try
        {
            SizeValue = float.Parse(SizeToolStripComboBox.SelectedItem.ToString());
        }
        catch
        {
            SizeToolStripComboBox.SelectedIndex = 4;
            SizeValue = float.Parse(SizeToolStripComboBox.SelectedItem.ToString());
        }
        switch (CanvasOnMainForm.DrMode)
        {
            case MyDrawMode.NONE: return;
            case MyDrawMode.LINE:
                AddShapeToList(new MyLine(e.Location, e.Location, ColorValue, SizeValue));
                break;
            case MyDrawMode.RECTANGLE:
                AddShapeToList(new MyRectangle(e.Location, e.Location, ColorValue, SizeValue));
                break;
            case MyDrawMode.TRIANGLE:
                AddShapeToList(new MyTriangle(e.Location, e.Location, ColorValue, SizeValue));
                break;
            case MyDrawMode.ELLIPSE:
                AddShapeToList(new MyEllipse(e.Location, e.Location, ColorValue, SizeValue));
                break;
            case MyDrawMode.CIRCLE:
                AddShapeToList(new MyCircle(e.Location, e.Location, ColorValue, SizeValue));
                break;
            case MyDrawMode.BRUSH:
                CanvasOnMainForm.BrushList.Add(new MyBrush(e.Location, ColorValue, SizeValue));
                break;
            case MyDrawMode.ERRASER:
                CanvasOnMainForm.BrushList.Add(new MyBrush(e.Location, Color.White, SizeValue));
                break;
            default: return;

        }

    }
    private void mainPicture_MouseMove(object sender, MouseEventArgs e)
    {
        if (CanvasOnMainForm.DrMode == MyDrawMode.NONE) return;
        if (CanvasOnMainForm.IsDrawing)
        {
            if (CanvasOnMainForm.DrMode == MyDrawMode.BRUSH || CanvasOnMainForm.DrMode == MyDrawMode.ERRASER)
            {
                if (CanvasOnMainForm.BrushList.Any())
                    CanvasOnMainForm.BrushList.Last().AddPosition(e.Location);
            }
```

```
                else
                {
                    CanvasOnMainForm.ShapesList.Last().EndPoint = e.Location;
                }
                mainPicture.Invalidate();

            }
        }
        private void mainPicture_MouseUp(object sender, MouseEventArgs e)
        {
            if (CanvasOnMainForm.DrMode == MyDrawMode.NONE) return;
            if (CanvasOnMainForm.IsDrawing)
            {
                if (CanvasOnMainForm.DrMode == MyDrawMode.BRUSH)
                {
                    if (CanvasOnMainForm.BrushList.Any())
                        CanvasOnMainForm.BrushList.Last().AddPosition(e.Location);
                }
                else { CanvasOnMainForm.ShapesList.Last().EndPoint = e.Location; }

                CanvasOnMainForm.DrawAll();
                mainPicture.Invalidate();
                CanvasOnMainForm.IsDrawing = false;
                HistoryOnMainForm.SaveState(CanvasOnMainForm.ShapesList, CanvasOnMainForm.BrushList);
            }
        }
        private void mainPicture_Paint(object sender, PaintEventArgs e)
        {
            CanvasOnMainForm.DrawPreview(e.Graphics);
        }
        private void ColorInfoAndChangeToolStripButton_Click(object sender, EventArgs e)
        {
            ColorDialog colorDialog = new ColorDialog();
            if (colorDialog.ShowDialog() == DialogResult.OK)
            {
                ColorInfoAndChangeToolStripButton.BackColor = colorDialog.Color;
            }
        }

        private void toolStripLabel3_Click(object sender, EventArgs e) //Undo
        {
            var state = HistoryOnMainForm.Undo();
            if (state == null) return;

            CanvasOnMainForm.ShapesList = new List<IShapeDraw>(state.ShapesSnapshot);
            CanvasOnMainForm.BrushList = new List<IBrushDraw>(state.BrushSnapshot);

            CanvasOnMainForm.ClearCanvas();
            CanvasOnMainForm.DrawAll();
            mainPicture.Invalidate();
        }
        private void toolStripLabel5_Click(object sender, EventArgs e) //Redo
        {
            var state = HistoryOnMainForm.Redo();
            if (state == null) return;

            CanvasOnMainForm.ShapesList = new List<IShapeDraw>(state.ShapesSnapshot);
            CanvasOnMainForm.BrushList = new List<IBrushDraw>(state.BrushSnapshot);

            CanvasOnMainForm.ClearCanvas();
            CanvasOnMainForm.DrawAll();
            mainPicture.Invalidate();
        }
    }
}
```

MainForm.Events.cs

```
using LW_Daryev_WinForm_NewEdition.Draw;
using LW_Daryev_WinForm_NewEdition.File;
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;

namespace LW_Daryev_WinForm_NewEdition
{
    public partial class MainForm
    {
        private void MainForm_SizeChanged(object sender, EventArgs e)
```

```
        {
            SetControlsLS();
        }
        private void openFileTSMI_Click(object sender, EventArgs e)
        {
            mainPicture.Image = FileManager.LoadFromFile();
        }
        private void saveAsTSMI_Click(object sender, EventArgs e)
        {
            if (mainPicture.Image == null)
                return;

            FileManager.SaveAsToFile((mainPicture.Image as Bitmap));
        }
        private void rectDrawTSSB_ButtonClick(object sender, EventArgs e)
        {
            CanvasOnMainForm.DrMode = MyDrawMode.RECTANGLE;
            ShowDrModeOnStatusStrip(MyDrawMode.RECTANGLE.ToString());
        }

        private void lineDrawTSSB_ButtonClick(object sender, EventArgs e)
        {
            CanvasOnMainForm.DrMode = MyDrawMode.LINE;
            ShowDrModeOnStatusStrip(MyDrawMode.LINE.ToString());

        }

        private void tianDrawTSSB_ButtonClick(object sender, EventArgs e)
        {
            CanvasOnMainForm.DrMode = MyDrawMode.TRIANGLE;
            ShowDrModeOnStatusStrip(MyDrawMode.TRIANGLE.ToString());

        }

        private void ellipseDrawTSSB_ButtonClick(object sender, EventArgs e)
        {
            CanvasOnMainForm.DrMode = MyDrawMode.ELLIPSE;
            ShowDrModeOnStatusStrip(MyDrawMode.ELLIPSE.ToString());

        }

        private void circleDrawTSSB_ButtonClick(object sender, EventArgs e)
        {
            CanvasOnMainForm.DrMode = MyDrawMode.CIRCLE;
            ShowDrModeOnStatusStrip(MyDrawMode.CIRCLE.ToString());

        }

        private void brushDrawTSSB_ButtonClick(object sender, EventArgs e)
        {
            CanvasOnMainForm.DrMode = MyDrawMode.BRUSH;
            ShowDrModeOnStatusStrip(MyDrawMode.BRUSH.ToString());

        }

        private void erraseToolTSSB_ButtonClick(object sender, EventArgs e)
        {
            CanvasOnMainForm.DrMode = MyDrawMode.ERRASER;
            ShowDrModeOnStatusStrip(MyDrawMode.ERRASER.ToString());

        }

    }
}
```

UserCanvas.cs

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using LW_Daryev_WinForm_NewEdition.Brush;
using LW_Daryev_WinForm_NewEdition.Shape;

namespace LW_Daryev_WinForm_NewEdition.Draw
{
    public enum MyDrawMode
    {
        NONE,
        LINE,
```

```
        RECTANGLE,
        TRIANGLE,
        ELLIPSE,
        CIRCLE,
        BRUSH,
        ERRASER
    }
    public class UserCanvas
    {
        public Bitmap CanvasSourse { get; set; }
        public List<IShapeDraw> ShapesList;
        public List<IBrushDraw> BrushList;
        public bool IsDrawing { get; set; }
        public MyDrawMode DrMode { get; set; }
        public UserCanvas(Bitmap bmpSource,List<IBrushDraw> brushList)
        {
            CanvasSourse = bmpSource;
            ShapesList = new List<IShapeDraw>();
            BrushList = brushList;
            IsDrawing = false;
            DrMode = MyDrawMode.NONE;
        }
        public void ClearCanvas()
        {
            ShapesList.Clear();
            BrushList.Clear();
            using (Graphics g = Graphics.FromImage(CanvasSourse))
            {
                g.Clear(Color.White);
            }
        }
        public void DrawAll()
        {
            foreach (var shape in ShapesList)
            {
                shape.DrawShape(CanvasSourse);
            }
            foreach (var brush in BrushList)
            {
                brush.DrawBrush(CanvasSourse);
            }

        }
        public void DrawPreview(Graphics graphics)
        {
            foreach (var shape in ShapesList)
            {
                if (shape == ShapesList.Last())
                {
                    shape.DrawShape(graphics);
                }
            }
            foreach (var brush in BrushList)
            {
                if (brush == BrushList.Last())
                {
                    brush.DrawBrush(graphics);
                }
            }
        }
    }
}
```

IShapeDraw.cs

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;

namespace LW_Daryev_WinForm_NewEdition.Shape
{
    public interface IShapeDraw
    {
        public Point StartPoint { get; set; }
        public Point EndPoint { get; set; }
        public Color ShapeColor { get; set; }
        public float ShapeSize { get; set; }
```

```
        public void DrawShape(Bitmap bmp);
        public void DrawShape(Graphics graphics); // Preview drawing

    }
}
```

IBrushDraw.cs

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;

namespace LW_Daryev_WinForm_NewEdition.Brush
{
    public interface IBrushDraw
    {
        public Point[] Position { get; set; }
        public Color BrushColor { get; set; }
        public float BrushSize { get; set; }
        public void AddPosition(Point position);
        public void DrawBrush(Bitmap bmp);
        public void DrawBrush(Graphics graphics);
    }
}
```

MyLine.cs

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using LW_Daryev_WinForm_NewEdition.Draw;


namespace LW_Daryev_WinForm_NewEdition.Shape
{
    internal class MyLine : IShapeDraw
    {
        public Point StartPoint { get; set; }
        public Point EndPoint { get; set; }
        public Color ShapeColor { get; set; }
        public float ShapeSize { get; set; }
        public MyLine(Point startPoint, Point endPoint, Color shapeColor, float shapeSize)
        {
            StartPoint = startPoint;
            EndPoint = endPoint;
            ShapeColor = shapeColor;
            ShapeSize = shapeSize;
        }
        public void DrawShape(Bitmap bmp)
        {
            using (Graphics graphics = Graphics.FromImage(bmp))
            {
                using (Pen pen = new Pen(ShapeColor, ShapeSize))
                {
                    graphics.DrawLine(pen, StartPoint, EndPoint);
                }
            }
        }
        public void DrawShape(Graphics graphics)
        {
            using (Pen pen = new Pen(ShapeColor, ShapeSize))
            {
                graphics.DrawLine(pen, StartPoint, EndPoint);
            }
        }
    }
}
```

MyTriangle.cs

```
using LW_Daryev_WinForm_NewEdition.Draw;
using System;
using System.Collections.Generic;
using System.Linq;
```

```
using System.Text;
using System.Threading.Tasks;

namespace LW_Daryev_WinForm_NewEdition.Shape
{
    internal class MyTriangle : IShapeDraw
    {
        public Point StartPoint { get; set; }
        public Point EndPoint { get; set; }
        public Color ShapeColor { get; set; }
        public float ShapeSize { get; set; }
        public MyTriangle(Point startPoint, Point endPoint, Color shapeColor, float shapeSize)
        {
            StartPoint = startPoint;
            EndPoint = endPoint;
            ShapeColor = shapeColor;
            ShapeSize = shapeSize;
        }
        private void DrawOnly(Graphics graphics)
        {
            using (Pen pen = new Pen(ShapeColor, ShapeSize))
            {
                Point point1 = new Point((StartPoint.X + EndPoint.X) / 2, StartPoint.Y);
                Point point2 = new Point(StartPoint.X, EndPoint.Y);
                Point point3 = new Point(EndPoint.X, EndPoint.Y);
                graphics.DrawPolygon(pen, new Point[] { point1, point2, point3 });
            }
        }
        public void DrawShape(Bitmap bmp)
        {
            using (Graphics graphics = Graphics.FromImage(bmp))
            {
                DrawOnly(graphics);
            }
        }
        public void DrawShape(Graphics graphics)
        {
            using (Pen pen = new Pen(ShapeColor, ShapeSize))
            {
                DrawOnly(graphics);
            }
        }
    }
}
```

MyRectangle.cs

```
using LW_Daryev_WinForm_NewEdition.Draw;
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;

namespace LW_Daryev_WinForm_NewEdition.Shape
{
    internal class MyRectangle : IShapeDraw
    {
        public Point StartPoint { get; set; }
        public Point EndPoint { get; set; }
        public Color ShapeColor { get; set; }
        public float ShapeSize { get; set; }
        public MyRectangle(Point startPoint, Point endPoint, Color shapeColor, float shapeSize)
        {
            StartPoint = startPoint;
            EndPoint = endPoint;
            ShapeColor = shapeColor;
            ShapeSize = shapeSize;
        }
        private void DrawOnly(Graphics graphics)
        {
            using (Pen pen = new Pen(ShapeColor, ShapeSize))
            {
                int x = Math.Min(StartPoint.X, EndPoint.X);
                int y = Math.Min(StartPoint.Y, EndPoint.Y);
```

```
                int width = Math.Abs(StartPoint.X - EndPoint.X);
                int height = Math.Abs(StartPoint.Y - EndPoint.Y);
                graphics.DrawRectangle(pen, x, y, width, height);
            }
        }
        public void DrawShape(Bitmap bmp)
        {
            using (Graphics graphics = Graphics.FromImage(bmp))
            {
                DrawOnly(graphics);
            }
        }
        public void DrawShape(Graphics graphics)
        {
            using (Pen pen = new Pen(ShapeColor, ShapeSize))
            {
                DrawOnly(graphics);
            }
        }
    }
}
```

MyEllipse.cs

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using LW_Daryev_WinForm_NewEdition.Draw;

namespace LW_Daryev_WinForm_NewEdition.Shape
{
    internal class MyEllipse : IShapeDraw
    {
        public Point StartPoint { get; set; }
        public Point EndPoint { get; set; }
        public Color ShapeColor { get; set; }
        public float ShapeSize { get; set; }
        public MyEllipse(Point startPoint, Point endPoint, Color shapeColor, float shapeSize)
        {
            StartPoint = startPoint;
            EndPoint = endPoint;
            ShapeColor = shapeColor;
            ShapeSize = shapeSize;
        }
        private void DrawOnly(Graphics graphics)
        {
            using (Pen pen = new Pen(ShapeColor, ShapeSize))
            {
                int x = Math.Min(StartPoint.X, EndPoint.X);
                int y = Math.Min(StartPoint.Y, EndPoint.Y);
                int width = Math.Abs(StartPoint.X - EndPoint.X);
                int height = Math.Abs(StartPoint.Y - EndPoint.Y);
                graphics.DrawEllipse(pen, x, y, width, height);
            }
        }
        public void DrawShape(Bitmap bmp)
        {
            using (Graphics graphics = Graphics.FromImage(bmp))
            {
                DrawOnly(graphics);
            }
        }
        public void DrawShape(Graphics graphics)
        {
            using (Pen pen = new Pen(ShapeColor, ShapeSize))
            {
                DrawOnly(graphics);
            }
```

```
        }
    }
}
```

MyCircle.cs

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using LW_Daryev_WinForm_NewEdition.Draw;

namespace LW_Daryev_WinForm_NewEdition.Shape
{
    public class MyCircle : IShapeDraw
    {
        public Point StartPoint { get; set; }
        public Point EndPoint { get; set; }
        public Color ShapeColor { get; set; }
        public float ShapeSize { get; set; }
        public MyCircle(Point startPoint, Point endPoint, Color shapeColor, float shapeSize)
        {
            StartPoint = startPoint;
            EndPoint = endPoint;
            ShapeColor = shapeColor;
            ShapeSize = shapeSize;
        }
        private void DrawOnly(Graphics graphics)
        {
            using (Pen pen = new Pen(ShapeColor, ShapeSize))
            {
                int x = Math.Min(StartPoint.X, EndPoint.X);
                int y = Math.Min(StartPoint.Y, EndPoint.Y);
                int diameter = Math.Max(Math.Abs(StartPoint.X - EndPoint.X), Math.Abs(StartPoint.Y - EndPoint.Y));
                graphics.DrawEllipse(pen, x, y, diameter, diameter);
            }
        }
        public void DrawShape(Bitmap bmp)
        {
            using (Graphics graphics = Graphics.FromImage(bmp))
            {
                DrawOnly(graphics);
            }
        }
        public void DrawShape(Graphics graphics)
        {
            using (Pen pen = new Pen(ShapeColor, ShapeSize))
            {
                DrawOnly(graphics);
            }
        }
    }
}
```

MyBrush.cs

```
using LW_Daryev_WinForm_NewEdition.Brush;
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;

namespace LW_Daryev_WinForm_NewEdition.Brush
{
    internal class MyBrush : IBrushDraw
    {
        public Point[] Position { get; set; }
        public Color BrushColor { get; set; }
        public float BrushSize { get; set; }
        public MyBrush(Point position, Color brushColor, float brushSize)
        {
            Position = new Point[0];
            Position = Position.Append(position).ToArray();
            BrushColor = brushColor;
            BrushSize = brushSize;
        }
        public void AddPosition(Point position)
        {
```

```
            if (Position.Length > 0)
            {
                Point last = Position[^1]; // остання точка
                                           // Додавання проміжних точок для плавності
                int dx = position.X - last.X;
                int dy = position.Y - last.Y;
                int steps = Math.Max(Math.Abs(dx), Math.Abs(dy));
                for (int i = 1; i <= steps; i++)
                {
                    int x = last.X + dx * i / steps;
                    int y = last.Y + dy * i / steps;
                    Position = Position.Append(new Point(x, y)).ToArray();
                }
            }
            else
            {
                Position = Position.Append(position).ToArray();
            }
        }

        public void DrawBrush(Bitmap bmp)
        {
            using (Graphics graphics = Graphics.FromImage(bmp))
            using (Pen pen = new Pen(BrushColor, BrushSize))
                for (int i = 1; i < Position.Length; i++)
                    graphics.DrawEllipse(pen, Position[i].X, Position[i].Y, BrushSize, BrushSize);

        }
        public void DrawBrush(Graphics graphics)
        {
            using (Pen pen = new Pen(BrushColor, BrushSize))
                for (int i = 1; i < Position.Length; i++)
                    graphics.DrawEllipse(pen, Position[i].X, Position[i].Y, BrushSize, BrushSize);
        }

    }
}
```

Висновок:

На лабораторній роботі було одержано практичні навички створення об'єктів-груп з використанням таких зв’язків як агрегація, композиція, асоціація).