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Факультет інформатики та обчислювальної техніки
Кафедра обчислювальної техніки

Лабораторна робота №5

з дисципліни
«Об’єктно-орієнтоване програмування»

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Варіант завдання

Singleton Маєрса

Файл Main.java.

```
import javafx.application.Application;

import javafx.scene.Scene;

import javafx.scene.layout.AnchorPane;

import javafx.scene.layout.BorderPane;

import javafx.stage.Stage;

import javafx.fxml.FXMLLoader;

import javafx.scene.control.ScrollPane;


public class Main extends Application {

  private final String pathToView = "./resources/Main.fxml";

  private final String pathToViewTable = "./resources/Table.fxml";

  private final String titleMain = "Lab 5";

  private final String titleTable = "Table";

  private final double width = 900;

  private final double height = 900;



  static void main(String[] args) {

    launch(args);

  }


  public Stage startTable() throws Exception {

    final var stage = new Stage();

    final ScrollPane root =
FXMLLoader.load(getClass().getResource(pathToViewTable));
```

```
  }

    final var scene = new Scene(root);
    stage.setScene(scene);
    stage.setTitle(titleTable);
    stage.setWidth(width);
    stage.setHeight(height);
    stage.show();
    return stage;
  }

  @Override
  public void start(Stage stage) throws Exception {
    final BorderPane root =
FXMLLoader.load(getClass().getResource(pathToView));
    final Scene scene = new Scene(root);
    final var pane = (AnchorPane)((BorderPane)root.getCenter()).getCenter();
    stage.setScene(scene);
    pane.setPrefWidth(width);
    pane.setPrefHeight(height);
    stage.setTitle(titleMain);
    final var tableStage = startTable();
    tableStage.setOnCloseRequest((_) -> { stage.close(); });
    stage.setOnCloseRequest((_) -> { tableStage.close(); });
    stage.show();
  }
}
```

Файл resources/Main.fxml.

```
<?xml version="1.0" encoding="UTF-8"?>


<?import javafx.scene.control.Button?>
<?import javafx.scene.control.Menu?>
<?import javafx.scene.control.MenuBar?>
<?import javafx.scene.control.MenuItem?>
<?import javafx.scene.control.RadioMenuItem?>
<?import javafx.scene.control.ToolBar?>
<?import javafx.scene.control.Tooltip?>
<?import javafx.scene.image.Image?>
<?import javafx.scene.image.ImageView?>
<?import javafx.scene.layout.AnchorPane?>
<?import javafx.scene.layout.BorderPane?>
<?import javafx.scene.canvas.Canvas?>


<BorderPane fx:id="borderPane" maxHeight="-Infinity" maxWidth="-Infinity"
minHeight="-Infinity" minWidth="-Infinity"
xmlns="http://javafx.com/javafx/22" xmlns:fx="http://javafx.com/fxml/1"
fx:controller="controllers.MenuController">
  <top>
    <MenuBar id="menuBar" BorderPane.alignment="CENTER">
      <menus>
        <Menu mnemonicParsing="false" text="File">
          <items>
            <MenuItem mnemonicParsing="false" onAction="#saveAs" text="Save
as..." />
```

```
          <MenuItem mnemonicParsing="false" onAction="#open"
text="Open..." />
          <MenuItem mnemonicParsing="false" onAction="#exit" text="Close" />
        </items>
      </Menu>
      <Menu fx:id="objectsMenu" mnemonicParsing="false" text="Objects">
        <items>
          <Menu mnemonicParsing="false" text="Rectangle">
            <items>
              <RadioMenuItem id="rectangleCenter" mnemonicParsing="false"
text="From center" />
              <RadioMenuItem id="rectangleCorner" mnemonicParsing="false"
text="From corner" />
            </items>
          </Menu>
          <Menu mnemonicParsing="false" text="Elipse">
            <items>
              <RadioMenuItem id="ellipseCenter" mnemonicParsing="false"
text="From center" />
              <RadioMenuItem id="ellipseCorner" mnemonicParsing="false"
text="From corner" />
            </items>
          </Menu>
          <RadioMenuItem id="cube" mnemonicParsing="false" text="Cube" />
          <RadioMenuItem id="line" mnemonicParsing="false" text="Line" />
          <RadioMenuItem id="line-ellipse" mnemonicParsing="false" text="Line
Ellipse" />
          <RadioMenuItem id="point" mnemonicParsing="false" text="Point" />
          <RadioMenuItem id="brush" mnemonicParsing="false" text="Brush" />
        </items>
      </Menu>
      <Menu mnemonicParsing="false" text="Reference">
        <items>
          <MenuItem mnemonicParsing="false" text="About" />
        </items>
      </Menu>
      <Menu mnemonicParsing="false" text="Settings">
        <items>
          <Menu fx:id="colors" mnemonicParsing="false" onAction="#colors"
text="Colors">
            <items>
            </items>
          </Menu>
          <RadioMenuItem mnemonicParsing="false" onAction="#fill"
text="Fill" />
        </items>
      </Menu>
     </menus>
   </MenuBar>
  </top>
   <center>
    <BorderPane BorderPane.alignment="CENTER">
     <top>
      <ToolBar BorderPane.alignment="CENTER" fx:id="toolBar">
```

```
<items>
  <Button id="rectangleCenter-button" mnemonicParsing="false">
    <graphic>
      <ImageView fitHeight="32.0" fitWidth="32.0">
        <image>
          <Image url="@icons/rectangle-center.png" />
        </image>
      </ImageView>
    </graphic>
    <tooltip>
      <Tooltip text="Rectangle Center" />
    </tooltip>
  </Button>
  <Button id="rectangleCorner-button" mnemonicParsing="false">
    <graphic>
      <ImageView fitHeight="32.0" fitWidth="32.0">
        <image>
          <Image url="@icons/rectangle-corner.png" />
        </image>
      </ImageView>
    </graphic>
    <tooltip>
      <Tooltip text="Rectangle Corner" />
    </tooltip>
  </Button>
  <Button id="cube-button" mnemonicParsing="false">
  <graphic>
    <ImageView fitHeight="32.0" fitWidth="32.0">
      <image>
        <Image url="@icons/cube.png" />
      </image>
    </ImageView>
  </graphic>
  <tooltip>
    <Tooltip text="Cube" />
  </tooltip>
</Button>
<Button id="ellipseCenter-button" mnemonicParsing="false">
  <graphic>
    <ImageView fitHeight="32.0" fitWidth="32.0">
      <image>
        <Image url="@icons/ellipse-center.png" />
      </image>
    </ImageView>
  </graphic>
  <tooltip>
    <Tooltip text="Ellipse Center" />
  </tooltip>
</Button>
<Button id="ellipseCorner-button" mnemonicParsing="false">
  <graphic>
    <ImageView fitHeight="32.0" fitWidth="32.0">
```

```
        <image>
          <Image url="@icons/ellipse-corner.png" />
        </image>
      </ImageView>
    </graphic>
    <tooltip>
      <Tooltip text="Elipce Corner" />
    </tooltip>
  </Button>
  <Button id="line-button" mnemonicParsing="false">
    <graphic>
      <ImageView fitHeight="32.0" fitWidth="32.0">
        <image>
          <Image url="@icons/line.png" />
        </image>
      </ImageView>
    </graphic>
    <tooltip>
      <Tooltip text="Line" />
    </tooltip>
  </Button>
  <Button id="line-ellipse-button" mnemonicParsing="false">
    <graphic>
      <ImageView fitHeight="32.0" fitWidth="32.0">
        <image>
          <Image url="@icons/line-ellipse.png" />
      </image>
    </ImageView>
  </graphic>
  <tooltip>
    <Tooltip text="Line ELlipse" />
  </tooltip>
</Button>
<Button id="point-button" mnemonicParsing="false">
  <graphic>
    <ImageView fitHeight="32.0" fitWidth="32.0">
      <image>
        <Image url="@icons/point.png" />
      </image>
    </ImageView>
  </graphic>
  <tooltip>
    <Tooltip text="Point" />
  </tooltip>
</Button>
<Button id="brush-button" mnemonicParsing="false">
  <graphic>
    <ImageView fitHeight="32.0" fitWidth="32.0">
      <image>
        <Image url="@icons/brush.png" />
      </image>
    </ImageView>
```

```
          </graphic>
          <tooltip>
            <Tooltip text="Brush" />
          </tooltip>
        </Button>
      </items>
    </ToolBar>
  </top>
  <center>
    <AnchorPane fx:id="anchorPane" BorderPane.alignment="CENTER">
      <Canvas fx:id="canvas" />
    </AnchorPane>
  </center>
 </BorderPane>
</center>
</BorderPane>
```

Файл resources/Table.fxml

```
<?xml version="1.0" encoding="UTF-8"?>

<?import javafx.scene.control.ScrollPane?>
<?import javafx.scene.control.TableColumn?>
<?import javafx.scene.control.TableView?>
<?import javafx.scene.layout.VBox?>
```

```
<ScrollPane fx:id="scrollPane" maxHeight="-Infinity" maxWidth="-Infinity"
minHeight="-Infinity" minWidth="-Infinity"
xmlns="http://javafx.com/javafx/22" xmlns:fx="http://javafx.com/fxml/1"
fx:controller="controllers.TableController" fitToWidth="true"
fitToHeight="true">
  <content>
    <VBox>
      <children>
        <TableView fx:id="tableView">
          <columns>
            <TableColumn fx:id="nameColumn" prefWidth="120.0" text="Name" />
            <TableColumn fx:id="x1Column" prefWidth="90.0" text="x1" />
            <TableColumn fx:id="y1Column" prefWidth="90.0" text="y1" />
            <TableColumn fx:id="x2Column" prefWidth="90.0" text="x2" />
            <TableColumn fx:id="y2Column" prefWidth="90.0" text="y2" />
          </columns>
        </TableView>
      </children>
    </VBox>
  </content>
</ScrollPane>
```

Файл tableview/PointPair.java

```
package tableview;


import javafx.beans.property.SimpleDoubleProperty;

import javafx.beans.property.SimpleStringProperty;


public class PointPair {

  private final SimpleStringProperty name;

  private final SimpleDoubleProperty x1;

  private final SimpleDoubleProperty y1;

  private final SimpleDoubleProperty x2;

  private final SimpleDoubleProperty y2;


  public PointPair(String name, double x1, double y1, double x2, double y2) {

    this.name = new SimpleStringProperty(name);

    this.x1 = new SimpleDoubleProperty(x1);

    this.y1 = new SimpleDoubleProperty(y1);

    this.x2 = new SimpleDoubleProperty(x2);

    this.y2 = new SimpleDoubleProperty(y2);

  }


  public PointPair setPoints(double x1, double y1, double x2, double y2) {

    this.x1.set(x1);

    this.y1.set(y1);

    this.x2.set(x2);

    this.y2.set(y2);
    return this;
  }

  public SimpleStringProperty getName() { return name; }
  public SimpleDoubleProperty getX1() { return x1; }
  public SimpleDoubleProperty getY1() { return y1; }
  public SimpleDoubleProperty getX2() { return x2; }
  public SimpleDoubleProperty getY2() { return y2; }
}
```

Файл settings/Color.java

```
package settings;


import java.util.Map;

import java.util.Collection;


public class Color {

  static private Color instance = new Color();

  private javafx.scene.paint.Color currentColor =
javafx.scene.paint.Color.BLACK;

  private Map<String, javafx.scene.paint.Color> colors = Map.of(

    "black", javafx.scene.paint.Color.BLACK,

    "red", javafx.scene.paint.Color.RED,

    "blue", javafx.scene.paint.Color.BLUE,

    "green", javafx.scene.paint.Color.GREEN,

    "yellow", javafx.scene.paint.Color.YELLOW,

    "purple", javafx.scene.paint.Color.PURPLE,

    "pink", javafx.scene.paint.Color.PINK,

    "gold", javafx.scene.paint.Color.GOLD,

    "brown", javafx.scene.paint.Color.BROWN,

    "light blue", javafx.scene.paint.Color.LIGHTBLUE

  );


  public void setColor(final String color) {

    if (!colors.containsKey(color)) return;

    currentColor = colors.get(color);
  }

  public javafx.scene.paint.Color getCurrentColor() {
    return currentColor;
  }

  public Collection<? extends String> getStringColors() {
    return colors.keySet();
  }

  public Collection<? extends javafx.scene.paint.Color> getColors() {
    return colors.values();
  }

  public static Color getInstance() {
    return instance;
  }
}
```

Файл settings/Fill.java

```
package settings;


public class Fill {
  private static Fill instance = new Fill();
  private boolean fill = false;


  public boolean getFill() {
    return fill;
  }


  public void setFill(final boolean flag) {
    fill = flag;
  }


  public static Fill getInstance() {
    return instance;
  }
}
```

```
}
```

Файл shapes/Shape.java

```
package shapes;

import javafx.scene.canvas.GraphicsContext;
import javafx.scene.paint.Color;

import java.util.ArrayList;
import java.util.List;
import javafx.util.Pair;

public abstract class Shape {
  protected List<Double> coords;
  public Color color = Color.BLACK;
  public boolean fill = false;
  public double dashes = 0;
  public boolean useDashes = true;

  public Shape() {
    this(new ArrayList<>(List.of(0.0, 0.0, 0.0, 0.0)));
  }

  public Shape(final List<Double> points) {
    coords = points;
  }

  protected void prepareContext(final GraphicsContext context) {
    context.setStroke(color);
    context.setFill(color);
    context.setLineDashes(dashes);
  }


  public abstract void draw(final GraphicsContext context);


  public abstract void setCoords(double x1, double y1, double x2, double y2);
  public void onStart(GraphicsContext context, double x, double y) {


  }
  public abstract Pair<Pair<Double, Double>, Pair<Double, Double>>
getDisplayCoords();
  public abstract String getName();
  public List<Double> getCoords() {
    return List.copyOf(coords);
  }
}
```

Файл shapes/RectangleCorner.java

```
package shapes;


import javafx.scene.canvas.GraphicsContext;
import javafx.util.Pair;
import java.util.List;


public class RectangleCorner extends Shape implements Rectangable {
  public RectangleCorner() {
    super();
  }


  public RectangleCorner(final List<Double> coords) {
    super(coords);
  }


  @Override
  public void draw(GraphicsContext context) {
    prepareContext(context);
    Rectangable.super.drawRectangle(
      context,
      coords.get(0),
      coords.get(1),
      coords.get(2),
      coords.get(3),
      fill
    );
  }

  @Override
  public void setCoords(double x1, double y1, double x2, double y2) {

    coords.set(0, Math.min(x1, x2));
    coords.set(1, Math.min(y1, y2));
    coords.set(2, Math.abs(x2 - x1));
    coords.set(3, Math.abs(y2 - y1));
  }

  @Override
  public Pair<Pair<Double, Double>, Pair<Double, Double>> getDisplayCoords()
{
    final var first = new Pair<>(coords.get(0), coords.get(1));
    final var second = new Pair<>(coords.get(2), coords.get(3));
    return new Pair<>(first, second);
  }

  @Override
  public String getName() {
    return "Rectangle";
  }
}
```

Файл shapes/RectangleCenter.java

```
package shapes;


public class RectangleCenter extends RectangleCorner {
  @Override
  public void setCoords(double x1, double y1, double x2, double y2) {
    super.setCoords(2 * x1 - x2, 2 * y1 - y2, x2, y2);
  }
}
```

Файл shapes/Rectangable.java

```
package shapes;


import javafx.scene.canvas.GraphicsContext;


public interface Rectangable {
  default void drawRectangle(GraphicsContext context, double x, double y,
double dx, double dy, boolean fill) {
    final var width = context.getLineWidth();
    if (fill) context.fillRect(x, y, dx + width, dy + width);
    else context.strokeRect(x, y, dx + width, dy + width);
  }
}
```

Файл shapes/Point.java

```
package shapes;


import java.util.ArrayList;

import java.util.List;

import javafx.scene.canvas.GraphicsContext;

import javafx.util.Pair;


public class Point extends Shape {


  public Point() {

    this(new ArrayList<Double>(List.of(0.0, 0.0)));

  }


  public Point(final List<Double> coords) {

    super(coords);

  }


  @Override

  public void onStart(GraphicsContext context, double x, double y) {

    this.setCoords(0, 0, x, y);

    this.draw(context);

  }


  @Override

  public void draw(GraphicsContext context) {
    prepareContext(context);

    final var x = coords.get(0);

    final var y = coords.get(1);

    final var width = context.getLineWidth();

    context.fillOval(x - width, y - width, width * 2, width * 2);

  }


  @Override

  public void setCoords(double x1, double y1, double x2, double y2) {

    coords.set(0, x2);

    coords.set(1, y2);

  }


  @Override

  public Pair<Pair<Double, Double>, Pair<Double, Double>> getDisplayCoords()
{

    final var x = coords.get(0);

    final var y = coords.get(1);

    final var point = new Pair<>(x, y);

    return new Pair<>(point, point);

  }


  @Override

  public String getName() {

    return "Point";

  }
```

```
}
```

Файл shapes/LineEllipse.java

```
package shapes;



import java.util.List;
import javafx.scene.canvas.GraphicsContext;
import javafx.util.Pair;

public class LineEllipse extends Shape implements Linable, Ellipsable {
  final static int ellipseRadius = 20;

  public LineEllipse() {
    super();
  }

  public LineEllipse(final List<Double> coords) {
    super(coords);
  }

  @Override
  public void draw(GraphicsContext context) {
    prepareContext(context);
    final var x1 = coords.get(0);
    final var y1 = coords.get(1);
    final var x2 = coords.get(2);
    final var y2 = coords.get(3);
final var dx = x2 - x1;
final var dy = y2 - y1;
final var angle = Math.atan2(dy, dx);
final var lineWidth = context.getLineWidth();
final var length = ellipseRadius / 2 + lineWidth;
Linable.super.drawLine(
  context,
  x1 + length * Math.cos(angle),
  y1 + length * Math.sin(angle),
  x2 + length * Math.cos(Math.PI + angle),
  y2 + length * Math.sin(Math.PI + angle)
);
Ellipsable.super.drawEllipse(context,
  x1 - ellipseRadius / 2,
  y1 - ellipseRadius / 2,
  ellipseRadius,
  ellipseRadius,
  fill
);
Ellipsable.super.drawEllipse(context,
  x2 - ellipseRadius / 2,
  y2 - ellipseRadius / 2,
  ellipseRadius,
  ellipseRadius,
  fill
);
```

```
  }

  @Override
  public void setCoords(double x1, double y1, double x2, double y2) {
    coords.set(0, x1);
    coords.set(1, y1);
    coords.set(2, x2);
    coords.set(3, y2);
  }

  @Override
  public Pair<Pair<Double, Double>, Pair<Double, Double>> getDisplayCoords()
{
    final var first = new Pair<>(coords.get(0), coords.get(1));
    final var second = new Pair<>(coords.get(2), coords.get(3));
    return new Pair<>(first, second);
  }

  @Override
  public String getName() {
    return "LineEllipse";
  }
}
```

Файл shapes/Line.java

```
package shapes;


import java.util.List;

import javafx.scene.canvas.GraphicsContext;

import javafx.util.Pair;


public class Line extends Shape implements Linable {


  public Line() {

    super();

  }


  public Line(final List<Double> coords) {

    super(coords);

  }


  @Override

  public void draw(GraphicsContext context) {

    prepareContext(context);

    Linable.super.drawLine(

      context,

      coords.get(0),

      coords.get(1),

      coords.get(2),

      coords.get(3)
    );
  }

  @Override
  public void setCoords(double x1, double y1, double x2, double y2) {
    coords.set(0, x1);
    coords.set(1, y1);
    coords.set(2, x2);
    coords.set(3, y2);
  }

  @Override
  public Pair<Pair<Double, Double>, Pair<Double, Double>> getDisplayCoords()
{
    final var first = new Pair<>(coords.get(0), coords.get(1));
    final var second = new Pair<>(coords.get(2), coords.get(3));
    return new Pair<>(first, second);
  }

  @Override
  public String getName() {
    return "Line";
  }
}
```

Файл shapes/Linable.java

```
package shapes;


import javafx.scene.canvas.GraphicsContext;


public interface Linable {
  public default void drawLine(GraphicsContext context, double x1, double y1,
double x2, double y2) {
    context.strokeLine(x1, y1, x2, y2);
  }
}
```

Файл shapes/ElipseCorner.java

```
package shapes;


import java.util.List;

import javafx.scene.canvas.GraphicsContext;

import javafx.util.Pair;


public class EllipseCorner extends Shape implements Ellipsable {


  public EllipseCorner() {

    super();

  }


  public EllipseCorner(final List<Double> coords) {

    super(coords);

  }


  @Override

  public void draw(GraphicsContext context) {

    prepareContext(context);

    Ellipsable.super.drawEllipse(

      context,

      coords.get(0),

      coords.get(1),

      coords.get(2),

      coords.get(3),
      fill
    );
  }

  @Override
  public void setCoords(double x1, double y1, double x2, double y2) {
    final double dx = Math.abs(x2 - x1);
    final double dy = Math.abs(y2 - y1);
    coords.set(0, (x1 + x2 - dx) / 2);
    coords.set(1, (y1 + y2 - dy) / 2);
    coords.set(2, dx);
    coords.set(3, dy);
  }

  @Override
  public Pair<Pair<Double, Double>, Pair<Double, Double>> getDisplayCoords()
{
    final var first = new Pair<>(coords.get(0), coords.get(1));
    final var second = new Pair<>(coords.get(2), coords.get(3));
    return new Pair<>(first, second);
  }

  @Override
  public String getName() {
    return "Ellipse";
  }
```

```
}
```

Файл shapes/EllipseCenter.java

```
package shapes;


public class EllipseCenter extends EllipseCorner {
  @Override
  public void setCoords(double x1, double y1, double x2, double y2) {
    super.setCoords(2 * x1 - x2, 2 * y1 - y2, x2, y2);
  }
}
```

Файд shapes/Ellipsable.java

```java
package shapes;


import javafx.scene.canvas.GraphicsContext;


public interface Ellipsable {
  public default void drawEllipse(GraphicsContext context, double x, double y,
double dx, double dy, boolean fill) {
    final var width = context.getLineWidth();
    if (fill) context.fillOval(x, y, dx + width, dy + width);
    else context.strokeOval(x, y, dx + width, dy + width);
  }
}
```

Файл shapes/Cube.java

```
package shapes;


import java.util.List;


import javafx.scene.canvas.GraphicsContext;
import javafx.util.Pair;


public class Cube extends Shape implements Linable, Rectangable {


  private static final int deltaX = 50;
  private static final int deltaY = -40;


  public Cube() {
    super();
  }


  public Cube(final List<Double> coords) {
    super(coords);
  }


  @Override
  public void draw(GraphicsContext context) {
    prepareContext(context);
    fill = false;
    final var x1 = coords.get(0);
    final var y1 = coords.get(1);
    final var dx = coords.get(2);
    final var dy = coords.get(3);
    Rectangable.super.drawRectangle(context, x1, y1, dx, dy, fill);
    Rectangable.super.drawRectangle(context, x1 + deltaX, y1 + deltaY, dx, dy,
fill);
    Linable.super.drawLine(context, x1, y1, x1 + deltaX, y1 + deltaY);
    Linable.super.drawLine(context, x1 + dx, y1, x1 + dx + deltaX, y1 + deltaY);
    Linable.super.drawLine(context, x1, y1 + dy, x1 + deltaX, y1 + dy + deltaY);
    Linable.super.drawLine(context, x1 + dx, y1 + dy, x1 + dx + deltaX, y1 + dy +
deltaY);
  }

  @Override
  public void setCoords(double x1, double y1, double x2, double y2) {
    coords.set(0, Math.min(x1, x2));
    coords.set(1, Math.min(y1, y2));
    coords.set(2, Math.abs(x2 - x1));
    coords.set(3, Math.abs(y2 - y1));
  }

  @Override
  public Pair<Pair<Double, Double>, Pair<Double, Double>> getDisplayCoords()
{
    final var first = new Pair<>(coords.get(0), coords.get(1));
    final var second = new Pair<>(coords.get(2), coords.get(3));
    return new Pair<>(first, second);
  }

  @Override
  public String getName() {
    return "Cube";
  }
}
```

Файл editors/Brush.java

```
package shapes;

import java.util.ArrayList;
import java.util.List;

import javafx.scene.canvas.GraphicsContext;
import javafx.util.Pair;

public class Brush extends Shape {

  public Brush(final List<Double> coords) {
    super(coords);
    useDashes = false;
  }

  public Brush() {
    this(new ArrayList<>());
  }

  @Override
  public void onStart(GraphicsContext context, double x, double y) {
    this.setCoords(0, 0, x, y);
  }

  @Override
  public void draw(GraphicsContext context) {
    prepareContext(context);
    final var size = coords.size();
    if (size <= 2) return;
    var prevX = coords.get(0);
    var prevY = coords.get(1);
    for (int i = 2; i < size; i += 2) {
      final var x = coords.get(i);
      final var y = coords.get(i + 1);
      context.strokeLine(prevX, prevY, x, y);
      prevX = x;
      prevY = y;
    }
  }

  @Override
  public void setCoords(double x1, double y1, double x2, double y2) {
    coords.add(x2);
    coords.add(y2);
  }

  @Override
  public Pair<Pair<Double, Double>, Pair<Double, Double>> getDisplayCoords()
{
    final var x1 = coords.get(0);
    final var y1 = coords.get(1);
    final var x2 = coords.get(coords.size() - 2);
    final var y2 = coords.get(coords.size() - 1);
    final var first = new Pair<>(x1, y1);
    final var second = new Pair<>(x2, y2);
    return new Pair<>(first, second);
  }

  @Override
  public String getName() {
    return "Brush";
  }
}
```

Файл editors/Editor.java

```
package editors;


import shapes.Shape;
import java.util.List;
import java.util.Map;
import java.util.ArrayList;
import java.util.HashMap;
import javafx.scene.canvas.Canvas;
import javafx.scene.canvas.GraphicsContext;
import settings.Color;
import settings.Fill;
import java.util.function.Consumer;


public class Editor {
  private static final double lineDashes = 10;
  private double startX = 0;
  private double startY = 0;
  private boolean drawing = false;
  private List<Shape> shapes = new ArrayList<Shape>();
  private Canvas canvas;
  private GraphicsContext context;
  private Map<String, List<Consumer<Shape>>> listeners = new HashMap<>();


  private static Editor instance = null;
```

```
public Editor setCanvas(final Canvas canvas) {
  this.canvas = canvas;
  context = canvas.getGraphicsContext2D();
  canvas.widthProperty().addListener((_) -> {
    clear();
    drawAll();
  });
  canvas.heightProperty().addListener((_) -> {
    clear();
    drawAll();
  });
  return this;
}

public static Editor getInstance() {
  instance = instance == null ? new Editor() : instance;
  return instance;
}

private void redraw() {
  clear();
  drawAll();
}

private void drawAll() {
  for (final var shape: shapes) shape.draw(context);
```

```
}

private void clear() {
  context.clearRect(0, 0, canvas.getWidth(), canvas.getHeight());
}

public void add(final Shape shape) {
  shapes.add(shape);
}

public void addToCanvas(final Shape shape) {
  this.add(shape);
  redraw();
  this.emit("create", shape);
}

public void pop() {
  if (shapes.size() == 0) return;
  final var shape = shapes.removeLast();
  redraw();
  this.emit("delete", shape);
}

public void onLeftButtonDown(double x, double y) {
  startX = x;
  startY = y;
  final var shape = shapes.getLast();
  shape.dashes = shape.useDashes ? lineDashes : 0;
  shape.color = Color.getInstance().getCurrentColor();
  shape.fill = Fill.getInstance().getFill();
  shape.onStart(context, x, y);
}

public void onMouseMove(double x, double y) {
  if (drawing) clear();
  else drawing = true;
  shapes.getLast().setCoords(startX, startY, x, y);
  drawAll();
}

public void onLeftButtonUp(double x, double y) {
  clear();
  final var shape = shapes.getLast();
  shape.setCoords(startX, startY, x, y);
  shape.dashes = 0;
  drawAll();
  drawing = false;
  emit("create", shape);
}

public Editor on(final String eventName, final Consumer<Shape> listener) {
  final var exists = listeners.containsKey(eventName);
```

```
    if (exists) listeners.get(eventName).add(listener);
    else listeners.put(eventName, List.of(listener));
    return this;
  }

  public Editor emit(final String eventName, final Shape shape) {
    final var exists = listeners.containsKey(eventName);
    if (!exists) return this;
    for (final var listener: listeners.get(eventName)) {
      listener.accept(shape);
    }
    return this;
  }

  public Editor reset() {
    for (final var shape: shapes) emit("delete", shape);
    shapes.clear();
    clear();
    return this;
  }

  public List<Shape> shapes() {
    return List.copyOf(shapes);
  }
}
```

Файл controllers/MenuController.java

```
package controllers;


import javafx.event.ActionEvent;
import javafx.fxml.FXML;
import javafx.scene.layout.AnchorPane;
import javafx.scene.layout.BorderPane;
import javafx.stage.FileChooser;
import javafx.stage.Stage;
import javafx.scene.canvas.Canvas;
import javafx.scene.control.Button;
import javafx.scene.control.Menu;
import javafx.scene.control.RadioMenuItem;
import javafx.scene.control.ToolBar;
import javafx.scene.input.MouseButton;
import javafx.scene.input.MouseEvent;
import javafx.scene.control.MenuItem;
import javafx.application.Platform;
import javafx.scene.input.KeyCode;


import java.io.BufferedReader;
import java.io.BufferedWriter;
import java.io.FileWriter;
import java.io.IOException;
import java.nio.file.Files;
import java.util.ArrayList;
import java.util.List;

import settings.Color;
import settings.Fill;
import shapes.*;
import java.util.Map;

import editors.Editor;

public class MenuController {

  @FXML
  private BorderPane borderPane;

  @FXML
  private Menu objectsMenu;

  @FXML
  private AnchorPane anchorPane;

  @FXML
  private Menu colors;

  @FXML
  private RadioMenuItem lastSelected = null;
```

```java
@FXML
private Canvas canvas;

@FXML
private ToolBar toolBar;

private final Map<String, Class<? extends Shape>> editors = Map.of(
  "rectangleCenter", RectangleCenter.class,
  "rectangleCorner", RectangleCorner.class,
  "ellipseCenter", EllipseCenter.class,
  "ellipseCorner", EllipseCorner.class,
  "line", Line.class,
  "point", Point.class,
  "brush", Brush.class,
  "line-ellipse", LineEllipse.class,
  "cube", Cube.class
);

private final Map<String, Class<? extends Shape>> shapes = Map.of(
  "Brush", Brush.class,
  "Cube", Cube.class,
  "Ellipse", EllipseCorner.class,
  "Line", Line.class,
  "LineEllipse", LineEllipse.class,
  "Point", Point.class,
  "Rectangle", RectangleCorner.class
);

private boolean isPrimary(final MouseEvent event) {
  return event.getButton().equals(MouseButton.PRIMARY);
}

private void processEvent(final Shape shape, final RadioMenuItem item) {
  final var editor = Editor.getInstance();
  anchorPane.setOnMousePressed((event) -> {
    if (isPrimary(event) && item.isSelected()) {
      editor.add(shape);
      editor.onLeftButtonDown(event.getX(), event.getY());
    }
  });
  anchorPane.setOnMouseDragged((event) -> {
    if (isPrimary(event) && item.isSelected()) {
      editor.onMouseMove(event.getX(), event.getY());
    }
  });
  anchorPane.setOnMouseReleased((event) -> {
    if (isPrimary(event) && item.isSelected()) {
      editor.onLeftButtonUp(event.getX(), event.getY());
      processEvent(getShape(item.getId()), item);
    }
  });
}
```

```
@FXML
private void exit() {
  Platform.exit();
}

@FXML
private void saveAs() throws IOException {
  final var stage = (Stage)borderPane.getScene().getWindow();
  final var savefile = new FileChooser();
  savefile.setTitle("Save File");
  final var file = savefile.showSaveDialog(stage);
  if (file == null) return;
  final var filewriter = new FileWriter(file, false);
  try (BufferedWriter writer = new BufferedWriter(filewriter)) {
    final var shapes = Editor.getInstance().shapes();
    for (final var shape: shapes) {
      writer.write(shape.getName() + " ");
      final var coords = shape.getCoords();
      for (final var coord: coords) {
        writer.write(String.valueOf(coord) + " ");
      }
      writer.newLine();
    }
  } catch (IOException e) {
    e.printStackTrace();
  }
}

@FXML
private void colors(final ActionEvent event) {
  final var item = (MenuItem)event.getTarget();
  final var text = item.getText();
  Color.getInstance().setColor(text);
}

@FXML
private void fill() {
  final var fill =  Fill.getInstance().getFill();
  Fill.getInstance().setFill(!fill);
}

private void drawShape(String name, final List<Double> coords) {
  final var exists = shapes.containsKey(name);
  if (!exists) return;
  final var constructor = shapes.get(name);
  try {
    final var declared = constructor.getDeclaredConstructor(List.class);
    final var shape = declared.newInstance(coords);
    Editor.getInstance().addToCanvas(shape);
  } catch (Exception e) {
    e.printStackTrace();
  }
}

@FXML
private void open() {
  final var stage = (Stage)borderPane.getScene().getWindow();
  final var fileChooser = new FileChooser();
  final var extention = new FileChooser.ExtensionFilter("Text Files", "*.txt");
  fileChooser.getExtensionFilters().add(extention);
  final var file = fileChooser.showOpenDialog(stage);
  if (file == null) return;
  try (BufferedReader reader = Files.newBufferedReader(file.toPath())) {
    Editor.getInstance().reset();
    while (true) {
      final var line = reader.readLine();
      if (line == null) return;
      final var columns = line.split("\\s+");
      final var name = columns[0];
      final var numbers = new ArrayList<Double>();
      for (int index = 1; index < columns.length; index++) {
        final var column = columns[index];
        final var number = Double.parseDouble(column);
        numbers.add(number);
      }
      drawShape(name, numbers);
    }
  } catch (Exception e) {
    e.printStackTrace();
  }
}

private void addColors() {
  final var items = new ArrayList<MenuItem>();
  for (final var color: Color.getInstance().getStringColors()) {
    items.addLast(new MenuItem(color));
  }
  colors.getItems().addAll(items);
}

private Shape getShape(final String id) {
  final var constructor = editors.get(id);
  try {
    final var declared = constructor.getDeclaredConstructor();
    final var shape = declared.newInstance();
    return shape;
  } catch (Exception e) {
    e.printStackTrace();
    return null;
  }
}

@SuppressWarnings("unused")
```

```
}

private void addItemsEvenets(final Menu root) {
  for (final var item: root.getItems()) {
    if (item instanceof Menu menu) {
      addItemsEvenets(menu);
      continue;
    }
    final var selected = (RadioMenuItem)item;
    final var fullPath = getFullName(selected, objectsMenu);
    item.setOnAction((event) -> {
      if (lastSelected != null) lastSelected.setSelected(false);
      selected.setSelected(true);
      lastSelected = selected;
      final var window = (Stage)borderPane.getScene().getWindow();
      window.setTitle(fullPath);
      final var shape = getShape(selected.getId());
      processEvent(shape, selected);
    });
    final var buttonId = selected.getId() + "-button";
    final var button = (Button)toolBar.getItems().filtered((node) -> {
      return node.getId().equals(buttonId);
    }).getFirst();
    button.setOnAction((event) -> item.fire());
  }
}

@FXML
```

```
private void initialize() {
  canvas.widthProperty().bind(anchorPane.widthProperty());
  canvas.heightProperty().bind(anchorPane.heightProperty());
  addColors();
  addItemsEvenets(objectsMenu);
  final var editor = Editor.getInstance().setCanvas(canvas);
  borderPane.sceneProperty().addListener((_) -> {
    final var scene = borderPane.getScene();
    scene.setOnKeyPressed((event) -> {
      if (event.isControlDown() && (event.getCode() == KeyCode.Z)) editor.pop();
  });
  });
}

private String getFullName(final MenuItem selected, final Menu root) {
  final StringBuilder result = new StringBuilder(root.getText() + " -> ");
  boolean find = false;
  for (final MenuItem item: root.getItems()) {
    if (item instanceof final Menu menu) {
      final var subpath = getFullName(selected, menu);
      if (subpath.length() == 0) continue;
      find = true;
      result.append(subpath);
      break;
    }
    if (!item.equals(selected)) continue;
```

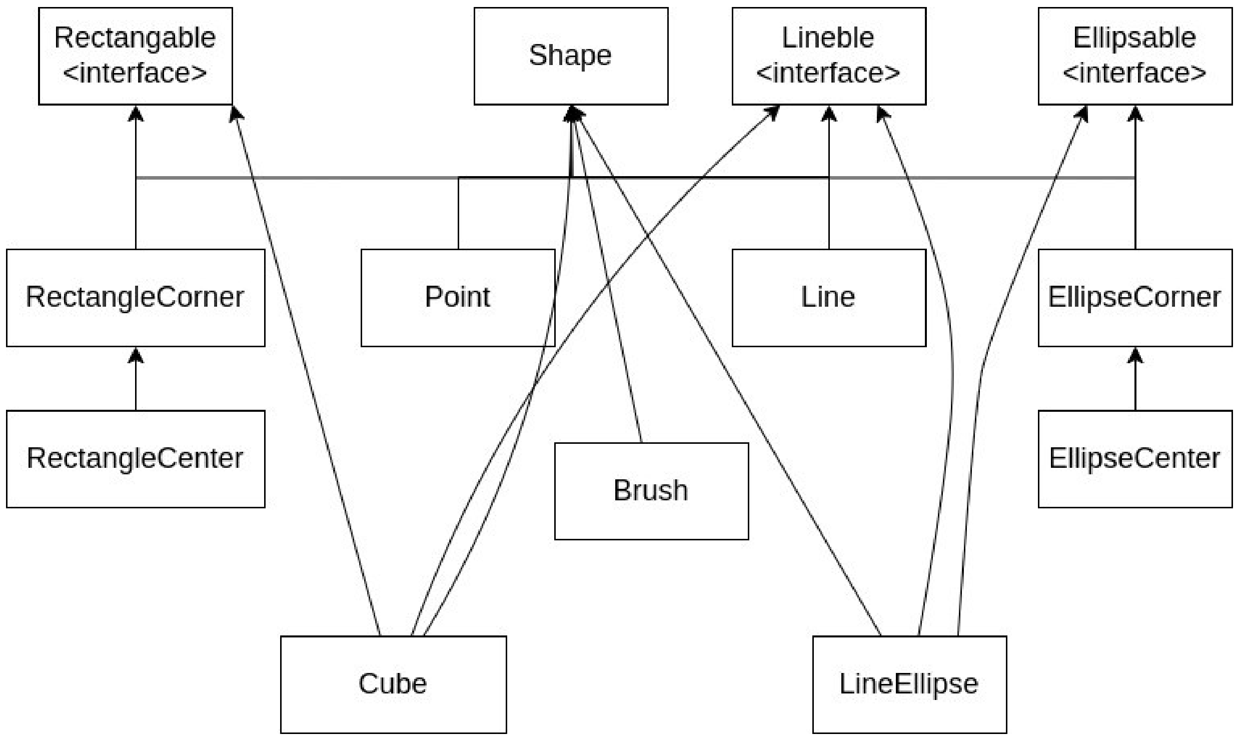
```
      find = true;

      result.append(item.getText());

      break;

    }

    return find ? result.toString() : "";

  }

}
```

Файл controllers/TableController.java

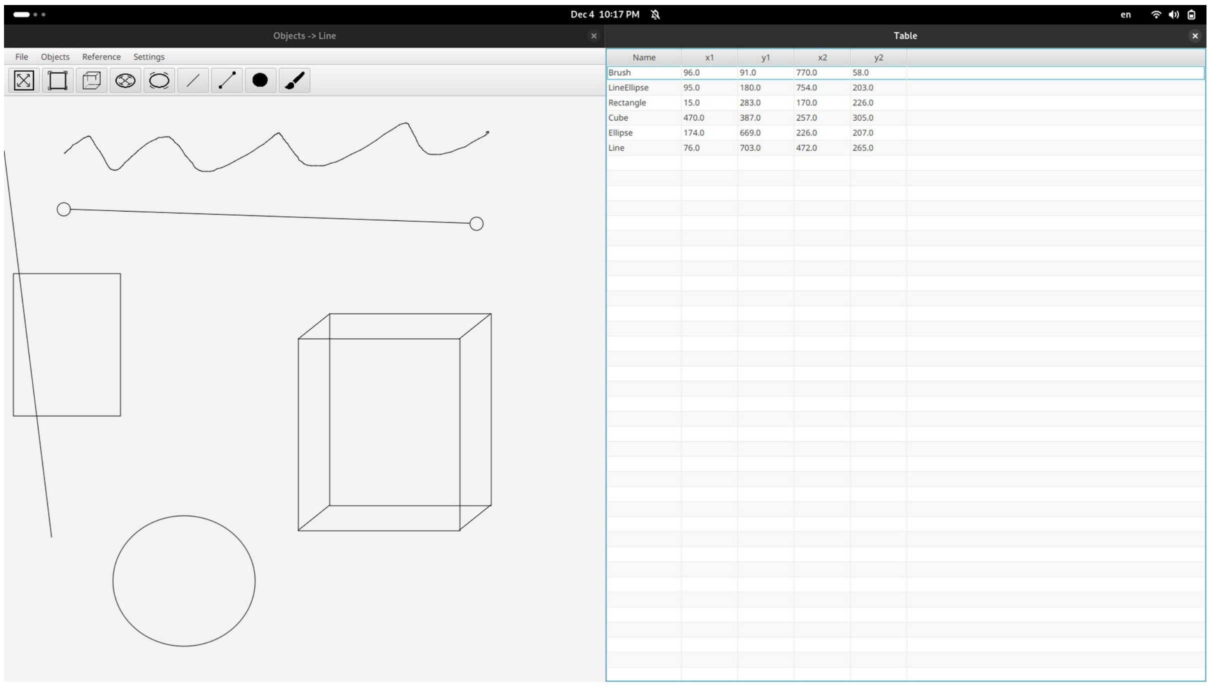
```
package controllers;


import java.util.Map;
import java.util.HashMap;
import javafx.collections.FXCollections;
import javafx.collections.ObservableList;
import javafx.fxml.FXML;
import javafx.scene.control.TableView;
import shapes.Shape;
import javafx.scene.control.ScrollPane;
import tableview.PointPair;
import javafx.scene.control.TableColumn;
import editors.Editor;

public class TableController {

  @FXML
  private ScrollPane scrollPane;

  @FXML
  private TableView<PointPair> tableView;

  @FXML
  private TableColumn<PointPair, String> nameColumn;
  @FXML
  private TableColumn<PointPair, Double> x1Column;

  @FXML
  private TableColumn<PointPair, Double> y1Column;

  @FXML
  private TableColumn<PointPair, Double> x2Column;

  @FXML
  private TableColumn<PointPair, Double> y2Column;

  private ObservableList<PointPair> points =
FXCollections.observableArrayList();

  @FXML
  private void initialize() {
    tableView.prefWidthProperty().bind(scrollPane.widthProperty());
    tableView.prefHeightProperty().bind(scrollPane.heightProperty());
    nameColumn.setCellValueFactory((cellData) ->
cellData.getValue().getName());
    x1Column.setCellValueFactory((cellData) ->
cellData.getValue().getX1().asObject());
    y1Column.setCellValueFactory((cellData) ->
cellData.getValue().getY1().asObject());
    x2Column.setCellValueFactory((cellData) ->
cellData.getValue().getX2().asObject());
```

```
  }

    y2Column.setCellValueFactory((cellData) ->
cellData.getValue().getY2().asObject());
    final var editor = Editor.getInstance();
    tableView.setItems(points);
    final Map<Shape, PointPair> shapes = new HashMap<>();
    editor.on("create", (shape) -> {
      final var pair = shape.getDisplayCoords();
      final var first = pair.getKey();
      final var second = pair.getValue();
      final var point = new PointPair(
        shape.getName(),
        first.getKey(),
        first.getValue(),
        second.getKey(),
        second.getValue()
      );
      points.add(point);
      shapes.put(shape, point);
    });
    editor.on("delete", (shape) -> {
      final var point = shapes.get(shape);
      points.remove(point);
    });
  }
}
```

Діаграма наслідування



Скріншоти виконання



Name	x1	y1	x2	y2
Brush	96.0	91.0	770.0	58.0
LineEllipse	95.0	180.0	754.0	203.0
Rectangle	15.0	283.0	170.0	226.0
Cube	470.0	387.0	257.0	305.0
Ellipse	174.0	669.0	226.0	207.0
Line	76.0	703.0	472.0	265.0

Висновки

Під час виконання лабораторної роботи я здобув навички використання інкапсуляції, абстрактних типів, успадкування та поліморфізму, вичвив патерни Singleton та Observer, створив простий графічний редактор та вдосконалив свої вміння програмування на Java. Протягом виконання я отримав теоретичні знання з архітектури розробки графічних додатків, та дізнався про кращі практики написання коду в об’єктно орієнтованому стилі використовуючи поліморфізм.