Міністерство освіти і науки України
Національний технічний університет України
«Київський політехнічний інститут імені Ігоря Сікорського»
Факультет інформатики та обчислювальної техніки
Кафедра обчислювальної техніки

Лабораторна робота №3

з дисципліни
«Об'єктно орієнтоване програмування»
на тему
"Розробка інтерфейсу користувача на С++"

Виконав:	Перевірив:
Студент групи ІМ-22	Порєв В.М.
Кушнір Микола Миколайович	
номер у списку групи: 13	

Київ 2023

Мета

Отримати вміння та навички використовувати інкапсуляцію, абстракцію типів, успадкування та поліморфізм на основі класів С++, запрограмувавши графічний інтерфейс користувача.

Завдання

1. Створити у середовищі MS Visual Studio C++ проект Win32 з ім'ям **Lab3**.
2. Написати вихідний текст програми згідно варіанту завдання.
3. Скомпілювати вихідний текст і отримати виконуваний файл програми.
4. Перевірити роботу програми. Налагодити програму.
5. Проаналізувати та прокоментувати результати та вихідний текст програми.
6. Оформити звіт.

Умови завдання за варіантом (Ж = $Ж_{лаб2}$ + 1 = 13 + 1 = 14):

- Масив вказівників для динамічних об'єктів типу Shape: статичний масив для Shape обсягом 114 елементів *(14 mod 3 = 2)*
- "Гумовий" слід при вводі об'єктів: суцільна лінія синього кольору *(14 mod 4 = 2)*
- Увід прямокутника: по двом протилежним кутам *(14 mod 2 = 0)*
- Відображення прямокутника: чорний контур прямокутника без заповнення *(14 mod 5 = 4)*
- Увід еліпса: від центру до одного з кутів охоплюючого прямокутника *(14 mod 2 = 0)*
- Відображення еліпса: чорний контур з кольоровим заповненням *(14 mod 5 = 4)*
- Колір заповнення еліпса: світло-зелений *(14 mod 6 = 2)*
- Позначка поточного типу об'єкту, що вводиться: в меню *(14 mod 2 = 0)*

Вихідні тексти файлів програми

Lab3.kt

```
package com.oop.lab3

import android.os.Bundle
import androidx.appcompat.app.AppCompatActivity

import com.oop.lab3.shape_editor.ShapeObjectsEditor
import com.oop.lab3.shape.Shape
import com.oop.lab3.paint_view.PaintView
import com.oop.lab3.main_toolbar.MainToolbar
import com.oop.lab3.objects_toolbar.ObjectsToolbar
```

```kotlin
class Lab3 : AppCompatActivity() {
    private lateinit var shapeObjEditor: ShapeObjectsEditor
    private lateinit var mainToolbar: MainToolbar
    private lateinit var objectsToolbar: ObjectsToolbar

    override fun onCreate(savedInstanceState: Bundle?) {
        super.onCreate(savedInstanceState)
        setContentView(R.layout.main_activity)

        shapeObjEditor = ShapeObjectsEditor(this)

        mainToolbar = findViewById(R.id.main_toolbar)
        mainToolbar.onCreate(shapeObjEditor)
        mainToolbar.setObjListeners(::onObjSelect, ::onObjCancel)

        objectsToolbar = findViewById(R.id.objects_toolbar)
        objectsToolbar.onCreate(shapeObjEditor)
        objectsToolbar.setObjListeners(::onObjSelect, ::onObjCancel)

        val paintView = findViewById<PaintView>(R.id.paint_view)
        paintView.handler = shapeObjEditor
        shapeObjEditor.paintUtils = paintView
    }

    private fun onObjSelect(shape: Shape) {
        mainToolbar.onObjSelect(shape)
        objectsToolbar.onObjSelect(shape)
        shapeObjEditor.startEditor(shape)
    }

    private fun onObjCancel() {
        mainToolbar.onObjCancel()
        objectsToolbar.onObjCancel()
        shapeObjEditor.closeEditor()
    }
}
```

PaintUtils.kt

```kotlin
package com.oop.lab3.paint_view

import android.graphics.Canvas

interface PaintUtils {
    val drawnShapesCanvas: Canvas
    val rubberTraceCanvas: Canvas

    fun repaint()
    fun clearCanvas(canvas: Canvas)
}
```

PaintView.kt

```
package com.oop.lab3.paint_view

import android.content.Context
import android.graphics.Bitmap
import android.graphics.Canvas
import android.graphics.Color
import android.graphics.PorterDuff
import android.util.AttributeSet
import android.view.MotionEvent
import android.view.View

import com.oop.lab3.shape_editor.PaintMessagesHandler

class PaintView(context: Context, attrs: AttributeSet?):
    View(context, attrs),
    PaintUtils {
    lateinit var handler: PaintMessagesHandler

    override lateinit var drawnShapesCanvas: Canvas
    override lateinit var rubberTraceCanvas: Canvas

private lateinit var drawnShapesBitmap: Bitmap
private lateinit var rubberTraceBitmap: Bitmap

override fun onSizeChanged(w: Int, h: Int, oldw: Int, oldh: Int) {
    super.onSizeChanged(w, h, oldw, oldh)
    drawnShapesBitmap = Bitmap.createBitmap(w, h, Bitmap.Config.ARGB_8888)
    drawnShapesCanvas = Canvas(drawnShapesBitmap)
    rubberTraceBitmap = Bitmap.createBitmap(w, h, Bitmap.Config.ARGB_8888)
    rubberTraceCanvas = Canvas(rubberTraceBitmap)
}

    override fun onDraw(canvas: Canvas) {
        super.onDraw(canvas)
        if (!handler.isRubberTraceModeOn) {
            handler.onPaint()
            canvas.drawBitmap(drawnShapesBitmap!!, 0F, 0F, null)
        } else {
            canvas.drawBitmap(drawnShapesBitmap!!, 0F, 0F, null)
            canvas.drawBitmap(rubberTraceBitmap!!, 0F, 0F, null)
        }
    }

    override fun onTouchEvent(event: MotionEvent): Boolean {
        super.onTouchEvent(event)
        val x = event.x
        val y = event.y
        when (event.action) {
            MotionEvent.ACTION_DOWN -> handler.onFingerTouch(x, y)
            MotionEvent.ACTION_MOVE -> handler.onFingerMove(x, y)
            MotionEvent.ACTION_UP -> handler.onFingerRelease()
        }
```

```kotlin
        return true
    }

    override fun repaint() {
        invalidate()
    }

    override fun clearCanvas(canvas: Canvas) {
        canvas.drawColor(Color.TRANSPARENT, PorterDuff.Mode.MULTIPLY)
    }
}
```

PaintMessagesHandler.kt

```kotlin
package com.oop.lab3.shape_editor

interface PaintMessagesHandler {
    var isRubberTraceModeOn: Boolean

    fun onFingerTouch(x: Float, y: Float)
    fun onFingerMove(x: Float, y:Float)
    fun onFingerRelease()
    fun onPaint()
}
```

ShapeObjectsEditor.kt

```kotlin
package com.oop.lab3.shape_editor

import android.content.Context

import com.oop.lab3.shape.Shape
import com.oop.lab3.shape.PointShape
import com.oop.lab3.shape.LineShape
import com.oop.lab3.shape.RectShape
import com.oop.lab3.shape.EllipseShape

import com.oop.lab3.editor.ShapeEditor
import com.oop.lab3.editor.PointShapeEditor
import com.oop.lab3.editor.LineShapeEditor
import com.oop.lab3.editor.RectShapeEditor
import com.oop.lab3.editor.EllipseShapeEditor

import com.oop.lab3.paint_view.PaintUtils

class ShapeObjectsEditor(context: Context): PaintMessagesHandler {
    lateinit var paintUtils: PaintUtils
    override var isRubberTraceModeOn = false

    val shapes = arrayOf(
        PointShape(context, PointShapeEditor()),
        LineShape(context, LineShapeEditor()),
        RectShape(context, RectShapeEditor()),
        EllipseShape(context, EllipseShapeEditor()),
    )
    var currentShape: Shape? = null
        private set
    private val drawnShapes = mutableListOf<Shape>()
    private var activeEditor: ShapeEditor? = null

    fun startEditor(shape: Shape) {
        currentShape = shape
        activeEditor = shape.editor
    }

    fun closeEditor() {
        currentShape = null
        activeEditor = null
    }

    override fun onFingerTouch(x: Float, y: Float) {
        activeEditor?.onFingerTouch(x, y)
    }

    override fun onFingerMove(x: Float, y:Float) {
        activeEditor?.let {
            isRubberTraceModeOn = true
            paintUtils.clearCanvas(paintUtils.rubberTraceCanvas)
            it.onFingerMove(paintUtils.rubberTraceCanvas, x, y)
            paintUtils.repaint()
        }
    }

    override fun onFingerRelease() {
        activeEditor?.let {
            isRubberTraceModeOn = false
            it.onFingerRelease(drawnShapes)
            paintUtils.repaint()
        }
    }

    override fun onPaint() {
        paintUtils.clearCanvas(paintUtils.rubberTraceCanvas)
        paintUtils.clearCanvas(paintUtils.drawnShapesCanvas)
        drawnShapes.forEach {
            it.showDefault(paintUtils.drawnShapesCanvas)
        }
    }

    fun undo() {
        if (drawnShapes.size > 0) {
            drawnShapes.removeLast()
            paintUtils.repaint()
        }
    }

    fun clearAll() {
        if (drawnShapes.size > 0) {
            drawnShapes.clear()
```

```
            paintUtils.repaint()
        }
    }
}
```

Shape.kt

```
package com.oop.lab3.shape

import android.content.Context
import android.graphics.Canvas
import android.graphics.Paint
import com.oop.lab3.R

import com.oop.lab3.editor.ShapeEditor

abstract class Shape(private val context: Context) {
    abstract val name: String
    val associatedIds = mutableMapOf<String, Int>()
    abstract val editor: ShapeEditor

    protected var startX: Float = 0F
    protected var startY: Float = 0F
    protected var endX: Float = 0F
    protected var endY: Float = 0F

    fun setStart(x: Float, y: Float) {
        startX = x
        startY = y
    }

    fun setEnd(x: Float, y: Float) {
        endX = x
        endY = y
    }

    abstract fun isValid(): Boolean

    abstract fun getInstance(): Shape

    protected open fun getOutlinePaint(): Paint {
        return Paint().apply {
            isAntiAlias = true
            style = Paint.Style.STROKE
            strokeWidth = 7F
            color = context.getColor(R.color.black)
        }
    }

    protected open fun getFillingPaint(): Paint {
        return Paint().apply {
            isAntiAlias = true
            style = Paint.Style.FILL
        }
    }

    protected open fun getRubberTracePaint(): Paint {
        val paint = getOutlinePaint()
        paint.color = context.getColor(R.color.dark_blue)
        return paint
    }

    abstract fun show(canvas: Canvas, outlinePaint: Paint, fillingPaint:
Paint?)

    abstract fun showDefault(canvas: Canvas)

    fun showRubberTrace(canvas: Canvas) {
        show(canvas, getRubberTracePaint(), null)
    }
}
```

PointShape.kt

```
package com.oop.lab3.shape

import android.content.Context
import android.graphics.Canvas
import android.graphics.Paint
import com.oop.lab3.R

import com.oop.lab3.editor.ShapeEditor

class PointShape(private val context: Context, override val editor:
ShapeEditor):
    Shape(context) {
    init {
        editor.shape = this
    }
    override val name = context.getString(R.string.point)

    override fun isValid(): Boolean {
        return true
    }

    override fun getInstance(): Shape {
        return PointShape(context, editor).also {
            it.associatedIds.putAll(this.associatedIds)
        }
    }

    override fun getOutlinePaint(): Paint {
        return super.getOutlinePaint().apply {
            strokeWidth = 15F
        }
    }
    override fun getRubberTracePaint(): Paint {
        return super.getRubberTracePaint().apply {
            strokeWidth = 15F
        }
    }

    override fun show(canvas: Canvas, outlinePaint: Paint, fillingPaint:
Paint?) {
        canvas.drawPoint(startX, startY, outlinePaint)
    }

    override fun showDefault(canvas: Canvas) {
        show(canvas, getOutlinePaint(), null)
    }
}
```

LineShape.kt

```
package com.oop.lab3.shape

import android.content.Context
import android.graphics.Canvas
import android.graphics.Paint
import com.oop.lab3.R

import com.oop.lab3.editor.ShapeEditor

class LineShape(private val context: Context, override val editor:
ShapeEditor):
    Shape(context) {
    init {
        editor.shape = this
    }
    override val name = context.getString(R.string.line)

    override fun isValid(): Boolean {
        return (startX != endX || startY != endY)
    }

    override fun getInstance(): Shape {
        return LineShape(context, editor).also {
            it.associatedIds.putAll(this.associatedIds)
        }
    }

    override fun show(canvas: Canvas, outlinePaint: Paint, fillingPaint:
Paint?) {
        canvas.drawLine(startX, startY, endX, endY, outlinePaint)
    }

    override fun showDefault(canvas: Canvas) {
        show(canvas, getOutlinePaint(), null)
    }
}
```

RectShape.kt

```kotlin
package com.oop.lab3.shape

import android.content.Context
import android.graphics.Canvas
import android.graphics.Paint
import android.graphics.RectF
import com.oop.lab3.R

import com.oop.lab3.editor.ShapeEditor

class RectShape(private val context: Context, override val editor:
ShapeEditor):
    Shape(context) {
    init {
        editor.shape = this
    }
    override val name = context.getString(R.string.rectangle)

    override fun isValid(): Boolean {
        return (startX != endX || startY != endY)
    }

    override fun getInstance(): Shape {
        return RectShape(context, editor).also {
            it.associatedIds.putAll(this.associatedIds)
        }
    }

    override fun show(canvas: Canvas, outlinePaint: Paint, fillingPaint:
Paint?) {
        val rect = RectF(startX, startY, endX, endY)
        fillingPaint?.let {
            canvas.drawRect(rect, it)
        }
        canvas.drawRect(rect, outlinePaint)
    }

    override fun showDefault(canvas: Canvas) {
        show(canvas, getOutlinePaint(), null)
    }
}
```

EllipseShape.kt

```kotlin
package com.oop.lab3.shape

import android.content.Context
import android.graphics.Canvas
import android.graphics.Paint
import android.graphics.RectF
import com.oop.lab3.R
import com.oop.lab3.editor.ShapeEditor

class EllipseShape(private val context: Context, override val editor:
ShapeEditor):
    Shape(context) {
    init {
        editor.shape = this
    }
    override val name = context.getString(R.string.ellipse)

    override fun isValid(): Boolean {
        return (startX != endX || startY != endY)
    }

    override fun getInstance(): Shape {
        return EllipseShape(context, editor).also {
            it.associatedIds.putAll(this.associatedIds)
        }
    }

    override fun getFillingPaint(): Paint {
        return super.getFillingPaint().apply {
            color = context.getColor(R.color.light_green)
        }
    }

    override fun show(canvas: Canvas, outlinePaint: Paint, fillingPaint:
Paint?) {
        val rect = RectF(startX, startY, endX, endY)
        fillingPaint?.let {
            canvas.drawOval(rect, it)
        }
        canvas.drawOval(rect, outlinePaint)
    }

    override fun showDefault(canvas: Canvas) {
        show(canvas, getOutlinePaint(), getFillingPaint())
    }
}
```

Editor.kt

```
package com.oop.lab3.editor

import android.graphics.Canvas

import com.oop.lab2.shape.Shape

abstract class Editor {
    abstract fun onFingerTouch(x: Float, y: Float)

    abstract fun onFingerMove(canvas: Canvas, x: Float, y: Float)
    abstract fun onFingerRelease(drawnShapes: MutableList<Shape>)
}
```

ShapeEditor.kt

```
package com.oop.lab3.editor

import com.oop.lab2.shape.Shape

abstract class ShapeEditor: Editor() {
    lateinit var shape: Shape

    override fun onFingerRelease(drawnShapes: MutableList<Shape>) {
        if (shape.isValid()) {
            drawnShapes.add(shape)
        }
        shape = shape.getInstance()
    }
}
```

PointShapeEditor.kt

```
package com.oop.lab3.editor

import android.graphics.Canvas

class PointShapeEditor: ShapeEditor() {
    override fun onFingerTouch(x: Float, y: Float) {
        shape.setStart(x, y)
    }

    override fun onFingerMove(canvas: Canvas, paint: Paint, x: Float, y:
Float) {
        shape.showRubberTrace(canvas)
    }
}
```

LineShapeEditor.kt

```
package com.oop.lab3.editor

import android.graphics.Canvas

class LineShapeEditor: ShapeEditor() {
    override fun onFingerTouch(x: Float, y: Float) {
        shape.setStart(x, y)
        shape.setEnd(x, y)
    }

    override fun onFingerMove(canvas: Canvas, paint: Paint, x: Float, y:
Float) {
        shape.setEnd(x, y)
        shape.showRubberTrace(canvas)
    }
}
```

RectShapeEditor.kt

```
package com.oop.lab3.editor

import android.graphics.Canvas

class RectShapeEditor: ShapeEditor() {
    override fun onFingerTouch(x: Float, y: Float) {
        shape.setStart(x, y)
        shape.setEnd(x, y)
    }

    override fun onFingerMove(canvas: Canvas, paint: Paint, x: Float, y:
Float) {
        shape.setEnd(x, y)
        shape.showRubberTrace(canvas)
    }
}
```

EllipseShapeEditor.kt

```
package com.oop.lab3.editor

import android.graphics.Canvas
import android.graphics.PointF
import android.graphics.RectF

class EllipseShapeEditor : ShapeEditor() {
    private val shapeCenterPoint = PointF()

    override fun onFingerTouch(x: Float, y: Float) {
        shapeCenterPoint.set(x, y)
        shape.setStart(x, y)
        shape.setEnd(x, y)
    }

    override fun onFingerMove(canvas: Canvas, x: Float, y: Float) {
        val dx = x -  shapeCenterPoint.x
        val oppositeX = shapeCenterPoint.x - dx
        val dy = y - shapeCenterPoint.y
        val oppositeY = shapeCenterPoint.y - dy
        val enclosingRect = RectF(oppositeX, oppositeY - dy, x, y).apply {
sort() }
        shape.setStart(enclosingRect.left, enclosingRect.top)
        shape.setEnd(enclosingRect.right, enclosingRect.bottom)
        shape.showRubberTrace(canvas)
    }
}
```

MainToolbar.kt

```
package com.oop.lab3.main_toolbar

import android.content.Context
import android.util.AttributeSet
import android.view.MenuItem
import android.view.View
import android.widget.ImageButton
import android.widget.PopupMenu
import android.widget.TextView
import androidx.appcompat.widget.Toolbar
import com.oop.lab3.R

import com.oop.lab3.shape_editor.ShapeObjectsEditor
import com.oop.lab3.shape.Shape
import com.oop.lab3.tooltip.Tooltip

class MainToolbar(context: Context, attrs: AttributeSet?):
    Toolbar(context, attrs) {
    private lateinit var optionsMenu: PopupMenu
    private lateinit var fileSubmenu: PopupMenu
    private lateinit var objSubmenu: PopupMenu

    private lateinit var shapeObjEditor: ShapeObjectsEditor
    private lateinit var objSubmenuItems: Array<MenuItem>

    private lateinit var onObjSelectListener: (Shape) -> Unit
    private lateinit var onObjCancelListener: () -> Unit

    private lateinit var currentObjTextView: TextView

    fun onCreate(shapeObjEditor: ShapeObjectsEditor) {
        val btnOptions = findViewById<ImageButton>(R.id.btn_options)
        btnOptions.setOnClickListener {
            optionsMenu.show()
        }
        optionsMenu = createOptionsMenu(btnOptions)
        fileSubmenu = createFileSubmenu(btnOptions)
        objSubmenu = createObjSubmenu(btnOptions)
        this.shapeObjEditor = shapeObjEditor
        objSubmenuItems = arrayOf(
            objSubmenu.menu.findItem(R.id.item_point),
            objSubmenu.menu.findItem(R.id.item_line),
            objSubmenu.menu.findItem(R.id.item_rectangle),
            objSubmenu.menu.findItem(R.id.item_ellipse),
        )
        for (index in objSubmenuItems.indices) {
            val shape = shapeObjEditor.shapes[index]
            val item = objSubmenuItems[index]
            shape.associatedIds["objSubmenuItem"] = item.itemId
        }
        currentObjTextView = findViewById(R.id.current_object)
    }

    private fun createOptionsMenu(anchor: View): PopupMenu {
        val popupMenu = PopupMenu(context, anchor)
        popupMenu.menuInflater.inflate(R.menu.main_toolbar_options_menu,
popupMenu.menu)
        popupMenu.setOnMenuItemClickListener { item ->
            when(item.itemId) {
                R.id.file -> {
                    fileSubmenu.show()
                    true
                }
                R.id.objects -> {
                    objSubmenu.show()
                    true
                }
                R.id.info -> {
                    val tooltip = Tooltip(context, attrs = null)
                    val text = "Ви натиснули кнопку\n\"Довідка\""
                    tooltip.create(this, text).show()
                    true
                }
                else -> {
                    false
                }
            }
        }
        return popupMenu
    }


    private fun createFileSubmenu(anchor: View): PopupMenu {
        val popupMenu = PopupMenu(context, anchor)
        popupMenu.menuInflater.inflate(R.menu.main_toolbar_file_submenu,
popupMenu.menu)
        popupMenu.setOnMenuItemClickListener { item ->
            when(item.itemId) {
                R.id.undo -> {
                    shapeObjEditor.undo()
                    true
                }
                R.id.clear_all -> {
                    shapeObjEditor.clearAll()
                    true
                }
                else -> {
                    false
                }
            }
        }
        return popupMenu
    }

    private fun createObjSubmenu(anchor: View): PopupMenu {
        val popupMenu = PopupMenu(context, anchor)
        popupMenu.menuInflater.inflate(R.menu.main_toolbar_objects_submenu,
popupMenu.menu)
        popupMenu.setOnMenuItemClickListener { clickedItem ->
            for (index in objSubmenuItems.indices) {
                val item = objSubmenuItems[index]
                if (item == clickedItem) {
                    if (!item.isChecked) {
                        val shape = shapeObjEditor.shapes[index]
                        onObjSelectListener(shape.getInstance())
                    } else {
                        onObjCancelListener()
                    }
                }
            }
            true
        }
        return popupMenu
    }

    fun setObjListeners(
        onSelectListener: (Shape) -> Unit,
        onCancelListener: () -> Unit
    ) {
        onObjSelectListener = onSelectListener
        onObjCancelListener = onCancelListener
    }

    fun onObjSelect(shape: Shape) {
        currentObjTextView.text = shape.name
        shapeObjEditor.currentShape?.let {
            val id = it.associatedIds["objSubmenuItem"]
            val item = objSubmenu.menu.findItem(id!!)
            item.isChecked = false
        }
        val id = shape.associatedIds["objSubmenuItem"]
        val item = objSubmenu.menu.findItem(id!!)
        item.isChecked = true
    }

    fun onObjCancel() {
        currentObjTextView.text = "Не вибрано"
        shapeObjEditor.currentShape?.let {
            val id = it.associatedIds["objSubmenuItem"]
            val item = objSubmenu.menu.findItem(id!!)
            item.isChecked = false
        }
    }
}
```

ObjectsToolbar.kt

```kotlin
package com.oop.lab3.objects_toolbar

import android.content.Context
import android.util.AttributeSet
import androidx.appcompat.widget.Toolbar
import com.oop.lab3.R

import com.oop.lab3.shape_editor.ShapeObjectsEditor
import com.oop.lab3.shape.Shape

class ObjectsToolbar(context: Context, attrs: AttributeSet?):
    Toolbar(context, attrs) {
    private lateinit var shapeObjEditor: ShapeObjectsEditor
    private lateinit var objButtons: Array<ObjectButton>

    private lateinit var onObjSelectListener: (Shape) -> Unit
    private lateinit var onObjCancelListener: () -> Unit

    fun onCreate(shapeObjEditor: ShapeObjectsEditor) {
        this.shapeObjEditor = shapeObjEditor
        objButtons = arrayOf(
            findViewById(R.id.btn_point),
            findViewById(R.id.btn_line),
            findViewById(R.id.btn_rectangle),
            findViewById(R.id.btn_ellipse),
        )
        for (index in objButtons.indices) {
            val shape = shapeObjEditor.shapes[index]
            val button = objButtons[index]
            shape.associatedIds["objButton"] = button.id
        }
    }

    fun setObjListeners(
        onSelectListener: (Shape) -> Unit,
        onCancelListener: () -> Unit
    ) {
        onObjSelectListener = onSelectListener
        onObjCancelListener = onCancelListener

        for (index in objButtons.indices) {
            val button = objButtons[index]
            val shape = shapeObjEditor.shapes[index]
            button.onCreate(shape)
            button.setObjListeners(onObjSelectListener, onObjCancelListener)
        }
    }

    fun onObjSelect(shape: Shape) {
        shapeObjEditor.currentShape?.let {
            val id = it.associatedIds["objButton"]
            val button = findViewById<ObjectButton>(id!!)
            button.onObjCancel()
        }
        val id = shape.associatedIds["objButton"]
        val button = findViewById<ObjectButton>(id!!)
        button.onObjSelect()
    }

    fun onObjCancel() {
        shapeObjEditor.currentShape?.let {
            val id = it.associatedIds["objButton"]
            val button = findViewById<ObjectButton>(id!!)
            button.onObjCancel()
        }
    }
}
```

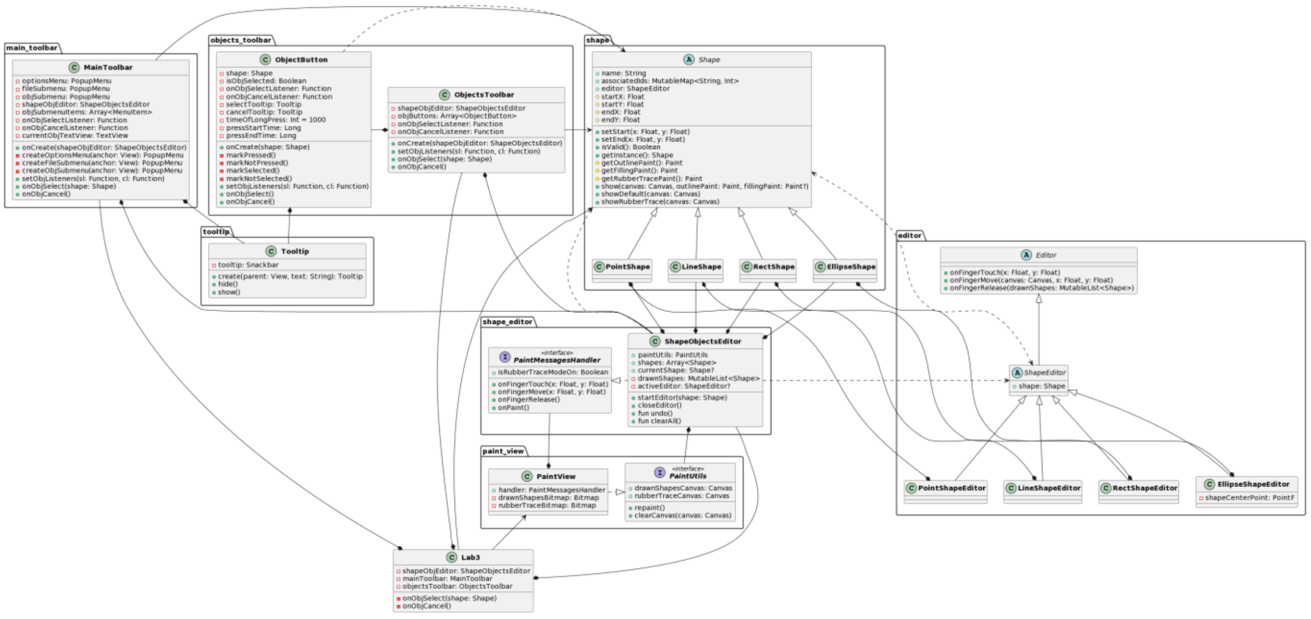
ObjectButton.kt

```
package com.oop.lab3.objects_toolbar

import android.content.Context
import android.graphics.PorterDuff
import android.graphics.PorterDuffColorFilter
import android.util.AttributeSet
import android.view.MotionEvent
import com.oop.lab3.R

import com.oop.lab3.shape.Shape
import com.oop.lab3.tooltip.Tooltip

class ObjectButton(context: Context, attrs: AttributeSet?):
    androidx.appcompat.widget.AppCompatImageButton(context, attrs) {
    private lateinit var shape: Shape

    private var isObjSelected = false
    private lateinit var onObjSelectListener: (Shape) -> Unit
    private lateinit var onObjCancelListener: () -> Unit

    private val selectTooltip = Tooltip(context, attrs)
    private val cancelTooltip = Tooltip(context, attrs)

    private val timeOfLongPress = 1000
    private var pressStartTime: Long = 0
    private var pressEndTime: Long = 0

    fun onCreate(shape: Shape) {
        this.shape = shape
        val selectTooltipText = "Вибрати об\'єкт\n\"${shape.name}\""
        selectTooltip.create(this, selectTooltipText)
        val cancelTooltipText = "Вимкнути режим\nредагування"
        cancelTooltip.create(this, cancelTooltipText)
    }

    override fun onTouchEvent(event: MotionEvent): Boolean {
        when (event.action) {
            MotionEvent.ACTION_DOWN -> {
                markPressed()
                pressStartTime = System.currentTimeMillis()
            }
            MotionEvent.ACTION_UP -> {
                pressEndTime = System.currentTimeMillis()
                val pressDuration = pressEndTime - pressStartTime
                if (pressDuration < timeOfLongPress) {
                    performClick()
                } else {
                    performLongClick()
                }
                pressStartTime = 0
                pressEndTime = 0
            }
        }
        return true
    }

    override fun performClick(): Boolean {
        super.performClick()
        if (!isObjSelected) {
            onObjSelectListener(shape.getInstance())
        } else {
            onObjCancelListener()
        }
        return true
    }

    override fun performLongClick(): Boolean {
        super.performLongClick()
        if (!isObjSelected) {
            markNotPressed()
            selectTooltip.show()
        } else {
            markSelected()
            cancelTooltip.show()
        }
        return true
    }

    private fun markPressed() {
        val backgroundColorId = R.color.pressed_btn_background_color
        backgroundTintList = context.getColorStateList(backgroundColorId)
    }

    private fun markNotPressed() {
        val backgroundColorId = R.color.transparent
        backgroundTintList = context.getColorStateList(backgroundColorId)
    }

    private fun markSelected() {
        val backgroundColorId = R.color.selected_btn_background_color
        backgroundTintList = context.getColorStateList(backgroundColorId)
        val iconColor = context.getColor(R.color.selected_btn_icon_color)
        colorFilter = PorterDuffColorFilter(iconColor,
PorterDuff.Mode.SRC_IN)
    }
    private fun markNotSelected() {
        val backgroundColorId = R.color.transparent
        backgroundTintList = context.getColorStateList(backgroundColorId)
        val iconColor = context.getColor(R.color.on_objects_toolbar_color)
        colorFilter = PorterDuffColorFilter(iconColor,
PorterDuff.Mode.SRC_IN)
    }

    fun setObjListeners(
        onSelectListener: (Shape) -> Unit,
        onCancelListener: () -> Unit
    ) {
        onObjSelectListener = onSelectListener
        onObjCancelListener = onCancelListener
    }

    fun onObjSelect() {
        isObjSelected = true
        markSelected()
    }

    fun onObjCancel() {
        isObjSelected = false
        markNotSelected()
    }
}
```

Tooltip.kt

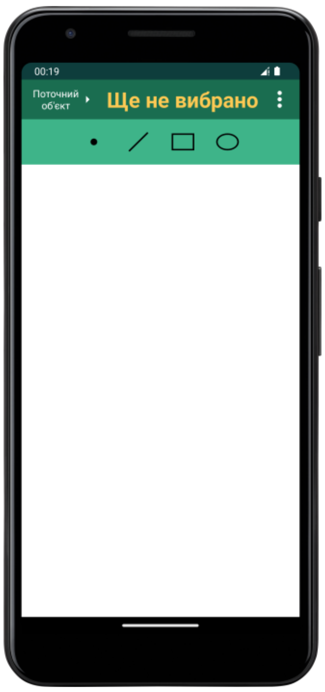
```
package com.oop.lab3.tooltip

import android.content.Context
import android.util.AttributeSet
import android.view.View
import android.widget.Button
import android.widget.TextView
import com.google.android.material.snackbar.Snackbar
import com.oop.lab3.R

class Tooltip(context: Context, attrs: AttributeSet?): View(context, attrs) {
    private lateinit var tooltip: Snackbar

    fun create(parent: View, text: String): Tooltip {
        val displayDuration = Snackbar.LENGTH_LONG
        tooltip = Snackbar.make(parent, "", displayDuration)

        val backgroundColor = context.getColor(R.color.transparent)
        tooltip.view.setBackgroundColor(backgroundColor)

        val layout = tooltip.view as Snackbar.SnackbarLayout
        val view = inflate(context, R.layout.tooltip, null)
        layout.addView(view)
        val textView = view.findViewById<TextView>(R.id.tooltip_text)
        textView.text = text

        val btnHide = view.findViewById<Button>(R.id.tooltip_hide)
        btnHide.setOnClickListener {
            val textColor =
context.getColor(R.color.tooltip_bnt_clicked_text_color)
            btnHide.setTextColor(textColor)
            hide()
        }
        return this
    }

    fun hide() {
        tooltip.dismiss()
    }

    fun show() {
        tooltip.show()
    }
}
```

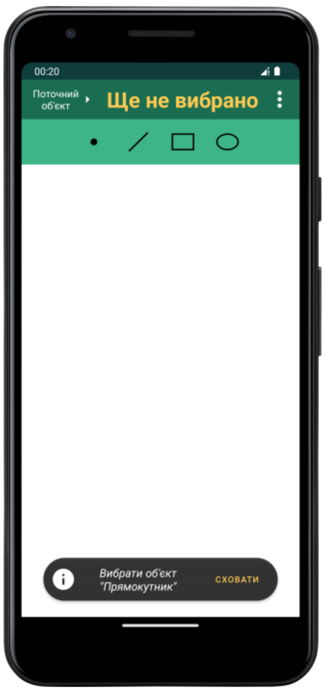
Діаграма класів програми



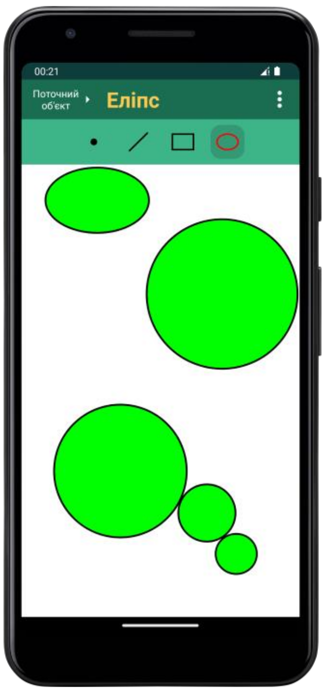
main_toolbar
MainToolbar
optionsMenu: PopupMenu
fileSubmenu: PopupMenu
objSubmenu: PopupMenu
shapeObjEditor: ShapeObjectsEditor
objSubmenuItems: Array<MenuItem>
onObjSelectListener: Function
onObjCancelListener: Function
currentObjTextView: TextView
onCreate(shapeObjEditor: ShapeObjectsEditor)
createOptionsMenu(anchor: View): PopupMenu
createFileSubmenu(anchor: View): PopupMenu
createObjSubmenu(anchor: View): PopupMenu
setObjListeners(sl: Function, cl: Function)
onObjSelect(shape: Shape)
onObjCancel()
objects_toolbar
ObjectButton
shape: Shape
isObjSelected: Boolean
onObjSelectListener: Function
onObjCancelListener: Function
selectTooltip: Tooltip
cancelTooltip: Tooltip
timeOfLongPress: Int = 1000
pressStartTime: Long
pressEndTime: Long
onCreate(shape: Shape)
markPressed()
markNotPressed()
markSelected()
markNotSelected()
setObjListeners(sl: Function, cl: Function)
onObjSelect()
onObjCancel()
ObjectsToolbar
shapeObjEditor: ShapeObjectsEditor
objButtons: Array<ObjectButton>
onObjSelectListener: Function
onObjCancelListener: Function
onCreate(shapeObjEditor: ShapeObjectsEditor)
setObjListeners(sl: Function, cl: Function)
onObjSelect(shape: Shape)
onObjCancel()
tooltip
Tooltip
tooltip: Snackbar
create(parent: View, text: String): Tooltip
hide()
show()
shape
Shape
name: String
associatedIds: MutableMap<String, Int>
editor: ShapeEditor
startX: Float
startY: Float
endX: Float
endY: Float
setStart(x: Float, y: Float)
setEnd(x: Float, y: Float)
isValid(): Boolean
getInstance(): Shape
getOutlinePaint(): Paint
getFillingPaint(): Paint
getRubberTracePaint(): Paint
show(canvas: Canvas, outlinePaint: Paint, fillingPaint: Paint?)
showDefault(canvas: Canvas)
showRubberTrace(canvas: Canvas)
PointShape
LineShape
RectShape
EllipseShape
shape_editor
«interface»
PaintMessagesHandler
isRubberTraceModeOn: Boolean
onFingerTouch(x: Float, y: Float)
onFingerMove(x: Float, y: Float)
onFingerRelease()
onPaint()
ShapeObjectsEditor
paintUtils: PaintUtils
shapes: Array<Shape>
currentShape: Shape?
drawnShapes: MutableList<Shape>
activeEditor: ShapeEditor?
startEditor(shape: Shape)
closeEditor()
fun undo()
fun clearAll()
paint_view
PaintView
handler: PaintMessagesHandler
drawnShapesBitmap: Bitmap
rubberTraceBitmap: Bitmap
«interface»
PaintUtils
drawnShapesCanvas: Canvas
rubberTraceCanvas: Canvas
repaint()
clearCanvas(canvas: Canvas)
Lab3
shapeObjEditor: ShapeObjectsEditor
mainToolbar: MainToolbar
objectsToolbar: ObjectsToolbar
onObjSelect(shape: Shape)
onObjCancel()
editor
Editor
onFingerTouch(x: Float, y: Float)
onFingerMove(canvas: Canvas, x: Float, y: Float)
onFingerRelease(drawnShapes: MutableList<Shape>)
ShapeEditor
shape: Shape
PointShapeEditor
LineShapeEditor
RectShapeEditor
EllipseShapeEditor
shapeCenterPoint: PointF

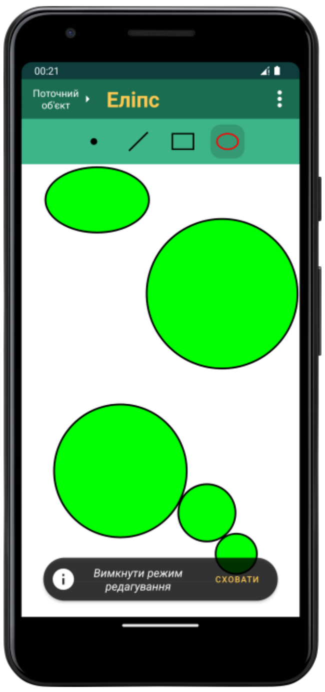
Ілюстрації виконання програми



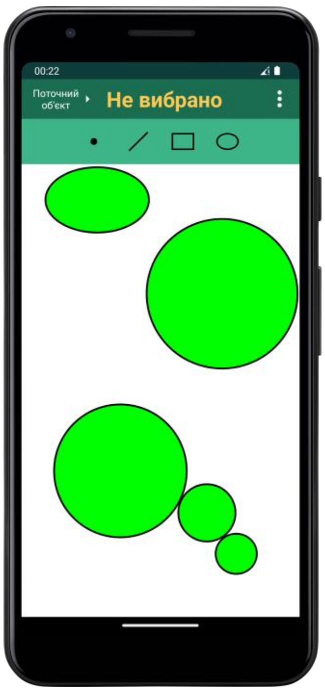


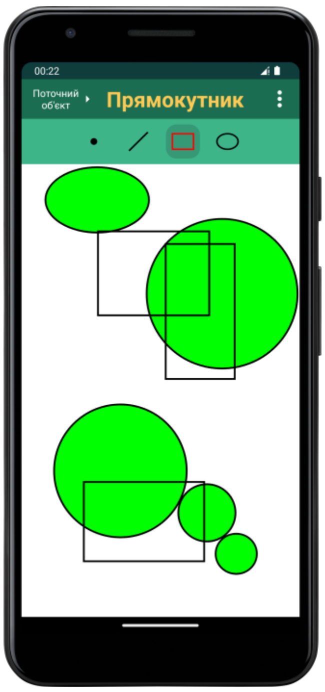
Вибрати об'єкт "Прямокутник"





Вимкнути режим редагування





Висновки

Ця лабораторна робота допомогла мені навчитися використовувати інкапсуляцію, абстракцію типів, успадкування та поліморфізм на основі класів мови програмування ***Kotlin***. Я запрограмував простий графічний інтерфейс користувача в об'єктно-орієнтованому стилі, Він дозволяє зручно застосовувати основні можливості графічного редактора для платформи ***Android***, створеного у ході виконання 2-ї лабораторної роботи.