Event-Driven Programming

1 Introduction

Through this training, the students should master GUI design using JavaFX and event handling.

1.1 Evaluation

- Code Correctness: 60%
- Experimental Report: 40%

1.2 Knowledge Points

- Event Object
- Event Source
- Event Handler
- Inner Class and Anonymous Class
- Lambda Expression for Event Handling

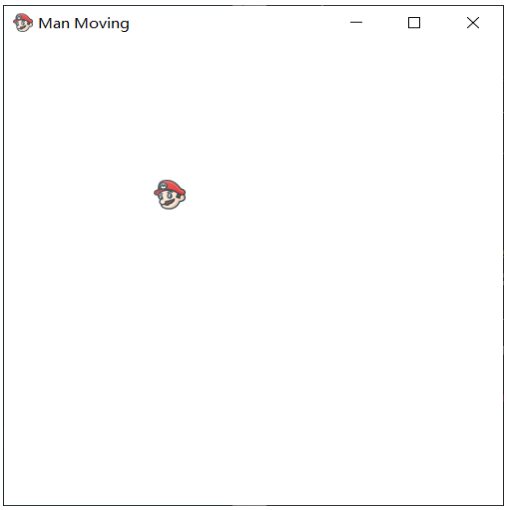
2 Demonstration

2.1 Man Moving

Implement a program simulating man moving.

```
public class TestApplication extends Application {

    @Override
    public void start(Stage primaryStage) throws Exception {

        ImageView m = new ImageView(new Image("file:mario.png"));
        m.setX(150);
        m.setY(150);

        Pane pane = new Pane();
        pane.getChildren().add(m);
        Scene scene = new Scene(pane, 500, 500);
        // Set event handler for keypressed event
        scene.setOnKeyPressed(new MoveHandler(m));

        primaryStage.setScene(scene);
        primaryStage.getIcons().add(new Image("file:mario.png"));
        primaryStage.setTitle("Man Moving");
        primaryStage.show();

    }

    public static void main(String[] args) {
        launch(args);
```

```
    }
}

// The handler class for moving
class MoveHandler implements EventHandler<KeyEvent>{
    private ImageView m;
    public MoveHandler(ImageView m) {
        this.m = m;
    }
    @Override
    public void handle(KeyEvent event) {
        switch(event.getCode()) {
            case LEFT: m.setX(m.getX() - 32);break;
            case RIGHT: m.setX(m.getX() + 32);break;
            case UP: m.setY(m.getY() - 32);break;
            case DOWN: m.setY(m.getY() + 32);break;
            default: break;
        }
    }

}
```



2.2 Simplify Program Using Anonymous Class

```
public class TestApplication extends Application {

    @Override
    public void start(Stage primaryStage) throws Exception {

        Man m = new Man(new Image("file:mario.png"));
        m.setX(150);
        m.setY(150);

        Pane pane = new Pane();
        pane.getChildren().add(m);
        Scene scene = new Scene(pane, 500, 500);
        scene.setOnKeyPressed(new EventHandler<KeyEvent>(){
```

```
            @Override
            public void handle(KeyEvent event) {
                switch(event.getCode()) {
                    case LEFT: m.setX(m.getX() - 32);break;
                    case RIGHT: m.setX(m.getX() + 32);break;
                    case UP: m.setY(m.getY() - 32);break;
                    case DOWN: m.setY(m.getY() + 32);break;
                    default: break;
                }
            }
        });

        primaryStage.setScene(scene);
        primaryStage.getIcons().add(new Image("file:mario.png"));
        primaryStage.setTitle("Man Moving");
        primaryStage.show();

    }

    public static void main(String[] args) {
        launch(args);
    }
}
```

2.2 Simplify Program Using Lambda Expression

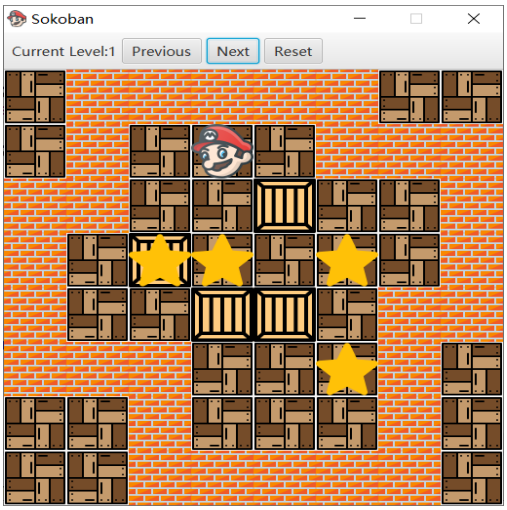
```
public class TestApplication extends Application {

    @Override
    public void start(Stage primaryStage) throws Exception {

        Man m = new Man(new Image("file:mario.png"));
        m.setX(150);
        m.setY(150);

        Pane pane = new Pane();
        pane.getChildren().add(m);
        Scene scene = new Scene(pane, 500, 500);
        scene.setOnKeyPressed(e -> {
            switch(e.getCode()) {
                case LEFT: m.setX(m.getX() - 32);break;
                case RIGHT: m.setX(m.getX() + 32);break;
                case UP: m.setY(m.getY() - 32);break;
                case DOWN: m.setY(m.getY() + 32);break;
                default: break;
            }
        });

        primaryStage.setScene(scene);
        primaryStage.getIcons().add(new Image("file:mario.png"));
        primaryStage.setTitle("Man Moving");
```

```
        primaryStage.show();

    }

    public static void main(String[] args) {
        launch(args);
    }
}
```

3 Experiment Content

3.1 Sokoban

Sokoban is a game genre in which the player pushes crates or boxes around in a warehouse, trying to get them to storage locations. The game interface is shown as follows:



1.Define image classes `Element`, `MovingElement`, `Man`, `Box`, `Wall` and `Target`.

```
public abstract class Element extends ImageView {
    // Image element types
    public final static int MAN = 0;
    public final static int BOX = 1;
    public final static int WALL = 2;
    public final static int TARGET = 3;
    public final static int BACKGROUND = 4;

    protected Element(Image img) {
        super(img);
        // Set the display size
        this.setFitHeight(MapPane.CELL_SIZE);
        this.setFitWidth(MapPane.CELL_SIZE);
    }
}

// The element can be moved
public class MovingElement extends Element {
    protected MovingElement(Image img) {
```

```
        super(img);
    }
    public void left() {
        this.setX(this.getX() - MapPane.CELL_SIZE);
    }
    public void right() {
        this.setX(this.getX() + MapPane.CELL_SIZE);
    }
    public void up() {
        this.setY(this.getY() - MapPane.CELL_SIZE);
    }
    public void down() {
        this.setY(this.getY() + MapPane.CELL_SIZE);
    }
}

// Two moving element classes
public class Man extends MovingElement {
    public Man(Image manImg) {
        super(manImg);
    }
}
public class Box extends MovingElement {
    public Box(Image img) {
        super(img);
    }
}

// Two fixed element classes
public class Target extends Element {
    public Target(Image img) {
        super(img);
    }
}
public class Wall extends Element {
    public Wall(Image img) {
        super(img);
    }
}
```

2.Define the map class `MapPane`.

```
public class MapPane extends Pane {
    // The cell size
    public final static int CELL_SIZE = 64;

    // All images for element displaying
    private Image[] icons;
    // Logical storage space for all elements
    private ImageView[][] map;
    // Controlled object
    private Man man;
```

```
    // Mission points
    private List<ImageView> targets;
    // Number of cells
    private int xlength;
    private int ylength;

    // Constructor.
    public MapPane(Image[] iconList, File mapFile) {
        icons = iconList;
        // Load map
        this.loadMap(mapFile);

        // Set background
        Background bg = new Background(
                new BackgroundImage(
                        iconList[Element.BACKGROUND],
                        BackgroundRepeat.REPEAT,
                        BackgroundRepeat.REPEAT,
                        BackgroundPosition.DEFAULT,
                        new BackgroundSize(
                                BackgroundSize.AUTO,
                                BackgroundSize.AUTO,
                                true, true, false, false)
                        )
                );
        setBackground(bg);
    }

    // Clear old data and load new map data
    public void loadMap(File mapFile) {
        try(Scanner input = new Scanner(mapFile)){
            // Get length information from the first line in the map file
            String[] items = input.nextLine().split(",");
            int xlen = Integer.parseInt(items[0]);
            int ylen = Integer.parseInt(items[1]);
            xlength = xlen;
            ylength = ylen;

            // Initialize and clear the map pane
            this.map = new ImageView[xlen][ylen];
            targets = new ArrayList<ImageView>();
            this.getChildren().clear();

            // Read file and add elements to the map pane
            while(input.hasNextLine()) {
                // Get information of a element from string parsing
                items = input.nextLine().split(",");
                int x = Integer.parseInt(items[0]);
                int y = Integer.parseInt(items[1]);
                int type = Integer.parseInt(items[2]);

                // Create an element
                Element e = null;
                switch(type) {
```

```
                    case Element.MAN: e = this.man = new Man(icons[Element.MAN]);
break;
                    case Element.BOX: ...;break;
                    case Element.WALL: ...;break;
                    case Element.TARGET: ...;break;
                    default:break;
                }

                // Set the position and display the element
                e.setX(x * CELL_SIZE);
                e.setY(y * CELL_SIZE);
                getChildren().add(e);
                // Add element to the logical map
                if(e instanceof Target) {
                    targets.add(e);
                }else {
                    this.map[x][y] = e;
                }

            }
        }catch(IOException e) {
            e.printStackTrace();
        }
    }

    // Judge the state of the game
    public boolean judge() {
        boolean win = true;
        for(...) {
            int x = (int) (img.getX() / CELL_SIZE);
            int y = (int) (img.getY() / CELL_SIZE);
            if(...)) {
                win = false;
                break;
            }
        }
        return win;
    }

    // How to move the man and boxes in the upward direction
    public void moveManUp(){
        int manX = (int) (man.getX() / CELL_SIZE);
        int manY = (int) (man.getY() / CELL_SIZE);
        if(manY > 0) {
            if(map[manX][manY - 1] == null) {
                man.up();
                map[manX][manY] = null;
                map[manX][manY - 1] = man;
            }else if(map[manX][manY - 1] instanceof Box) {
                System.out.println("hahah");
                if(manY - 1 > 0 && map[manX][manY - 2] == null) {
                    Box b = (Box) map[manX][manY - 1];
                    b.up();
                    map[manX][manY - 2] = b;
```

```
                    man.up();
                    map[manX][manY] = null;
                    map[manX][manY - 1] = man;
                }
            }
        }
    }

    // How to move the man and boxes in the downward direction
    public void moveManDown() {
        ...
    }
    // How to move the man and boxes in the leftward direction
    public void moveManLeft(){
        ...
    }
    // How to move the man and boxes in the rightward direction
    public void moveManRight() {
        ...
    }
}
```

3.The structure of the map file is as follows:

```
xlength,ylength
x0,y0,elementType1
x1,y1,elementType2
x2,y2,elementType3
```

There is a example:

```
6,6
3,1,0
2,3,1
4,4,2
5,5,3
```

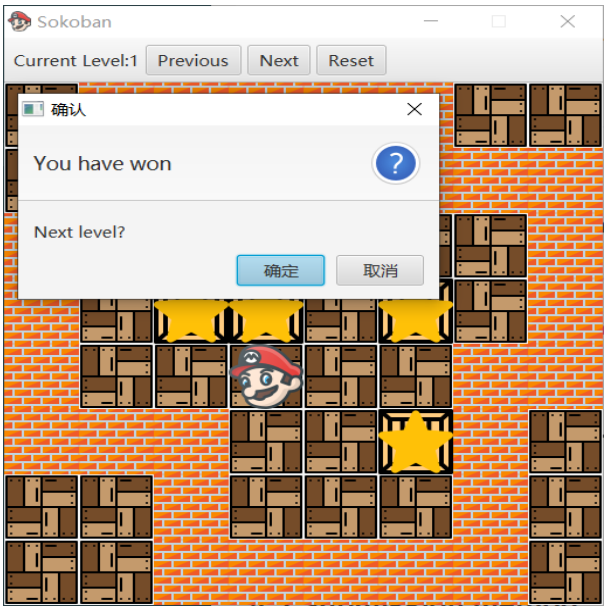
4.Define the main class Sokoban:

```
public class Sokoban extends Application {
    // File root paths
    private final String mapDir = "maps";
    private final String imgDir = "imgs";

    // All map files
    private List<File> mapFiles;
    // Current game level
```

```
    private int currentLevel = 0;
    // Current map
    private MapPane currentMap = null;

    // Load all map files in the application
    public void loadMapFiles() {
        mapFiles = new ArrayList<File>();
        File dir = new File(mapDir);
        for(File f:dir.listFiles()) {
            mapFiles.add(f);
        }
    }

    public void start(Stage primaryStage) throws Exception {

        loadMapFiles();

        VBox vb = new VBox();

        ToolBar tb = new ToolBar();
        Label label = new Label("Current Level:" + currentLevel);
        // Click button for changing to prevoies level map
        Button preBtn = new Button("Previous");
        preBtn.setOnAction(e -> {
            if(currentLevel > 0) {
                currentLevel--;
                currentMap.loadMap(mapFiles.get(currentLevel));
                label.setText("Current Level:" + currentLevel);
                primaryStage.sizeToScene();
            }
        });
        // Click button for changing to next level map
        Button nextBtn = new Button("Next");
        nextBtn.setOnAction(e -> {
            ...
        });
        // Click button for resetting this map
        Button resetBtn = new Button("Reset");
        resetBtn.setOnAction(e -> {
            ...
        });
        tb.getItems().addAll(label, preBtn, nextBtn, resetBtn);

        // Add an alert dialog box
        Alert a = new Alert(Alert.AlertType.CONFIRMATION);
        a.setHeaderText("You have won");
        a.setContentText("Next level?");
        a.setOnCloseRequest(e -> {
            if(currentLevel < mapFiles.size() - 1) {
                currentLevel++;
                currentMap.loadMap(mapFiles.get(currentLevel));
                label.setText("Current Level:" + currentLevel);
                primaryStage.sizeToScene();
            }
```

```
        });

        // Add a map pane and load the first level map data
        Image[] icons = new Image[5];
        icons[Element.MAN] = new Image("file:" + imgDir + "/man.png");
        icons[Element.BOX] = new Image("file:" + imgDir + "/box.png");
        icons[Element.WALL] = new Image("file:" + imgDir + "/wall.png");
        icons[Element.TARGET] = new Image("file:" + imgDir + "/target.png");
        icons[Element.BACKGROUND] = new Image("file:" + imgDir + "/floor.png");
        currentMap = new MapPane(icons, mapFiles.get(currentLevel));

        vb.getChildren().addAll(tb, currentMap);
        Scene scene = new Scene(vb);
        scene.setOnKeyPressed(e -> {
            switch(e.getCode()) {
                case LEFT: currentMap.moveManLeft();break;
                case RIGHT: ...;break;
                case UP: ...;break;
                case DOWN: ...;break;
                default: break;
            }
            if(currentMap.judge()) {
                a.show();
            }
        });
        primaryStage.sizeToScene();
        primaryStage.setResizable(false);
        primaryStage.setScene(scene);
        primaryStage.getIcons().add(new Image("file:" + imgDir + "/man.png"));
        primaryStage.setTitle("Sokoban");
        primaryStage.show();
    }
}
```

5.Implement and test the program.



4 Experiment Report Requirements

4.1 Think and answer the question

(1) What else can be improved in the program?

(2) How to develop a map editing program for this game?

4.2 Experiment report content

(1) Answer the above questions.

(2) All codes.

4.3 Submission method

(1) Upload the report by ftp:(Address:ftp://172.18.5.102; UserName:wangxiaomeng; Password: wangxiaomeng)

(2) File name format: StudentID+Name. For example, `20191234小明.docx`

4.4 Other Instructions

You can obtain experiment course resources through the web platform (URL: https://www.lanqiao.cn; InvitationCode: `ZF0XA4Y1`)