Software Engineering 2
SUPD REPORT

Status Update Report

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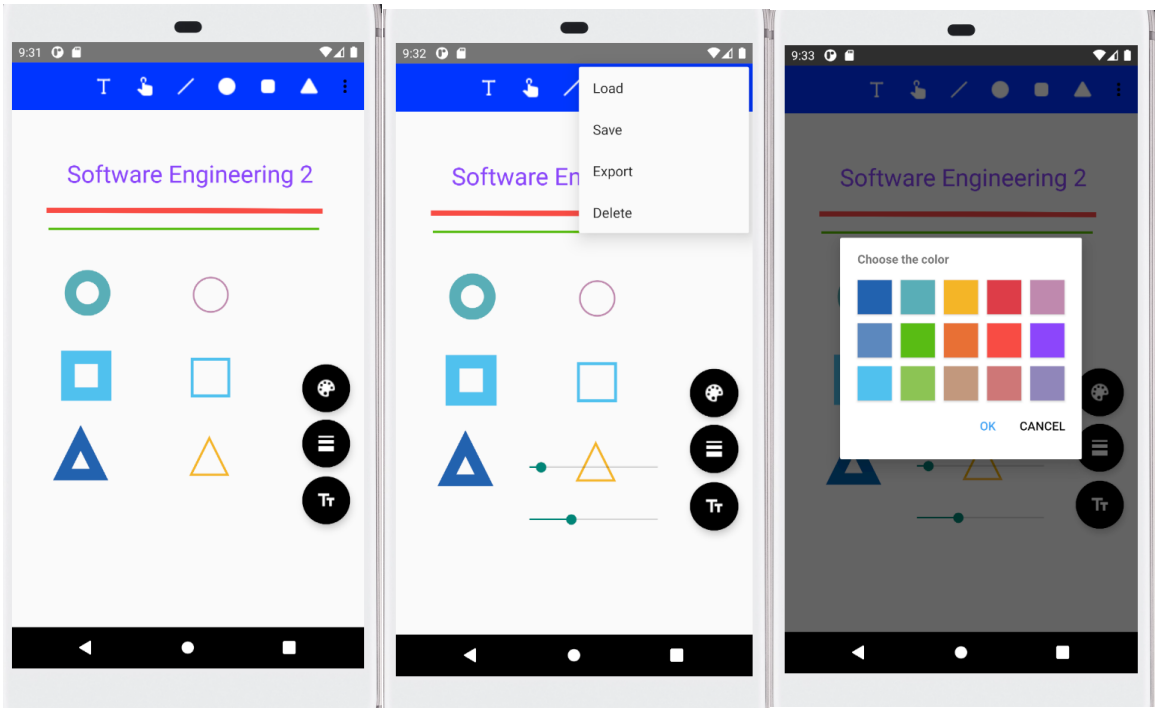
1 Design Draft

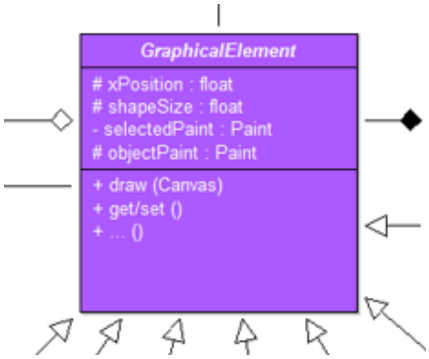
1.1 Design Approach and Overview

Our application presents itself to the user as a single screen on which all sketching-relevant functionalities (text, freehand drawing & shapes) are attached to the upper menu in the AppBar. Additionally, on the right hand of this menu the user can access options like loading or deleting sketches. Lastly, on the bottom right corner we implemented three floating buttons which enable the user to further modify his drawings regarding size and colour.

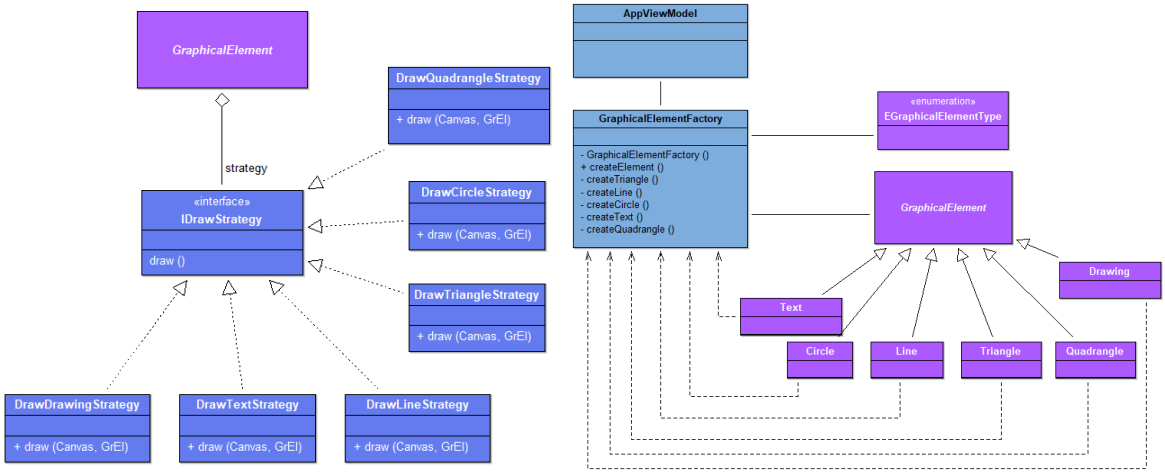


Our internal software design is based on the Model – View – ViewModel approach. We thought, this might be a good idea, due to the model's ability to provide cohesive, externally low coupled classes and structure highly interactive systems in a maintainable manner. The "View-part" of the model is responsible for displaying our design and fetching user inputs. The "Model-part is mostly used for storing data. Both carry no logic for themselves. In contrast the "ViewModel-part" has logic and its job is to process the user input and depending on the user actions populate the "View" with certain data from the "Model", such as drawing a circle on the screen.

In addition to this major design decision, we also had to come up with an internal structure for our graphical elements. Our design gravitates around the abstract class “GraphicalElement”.



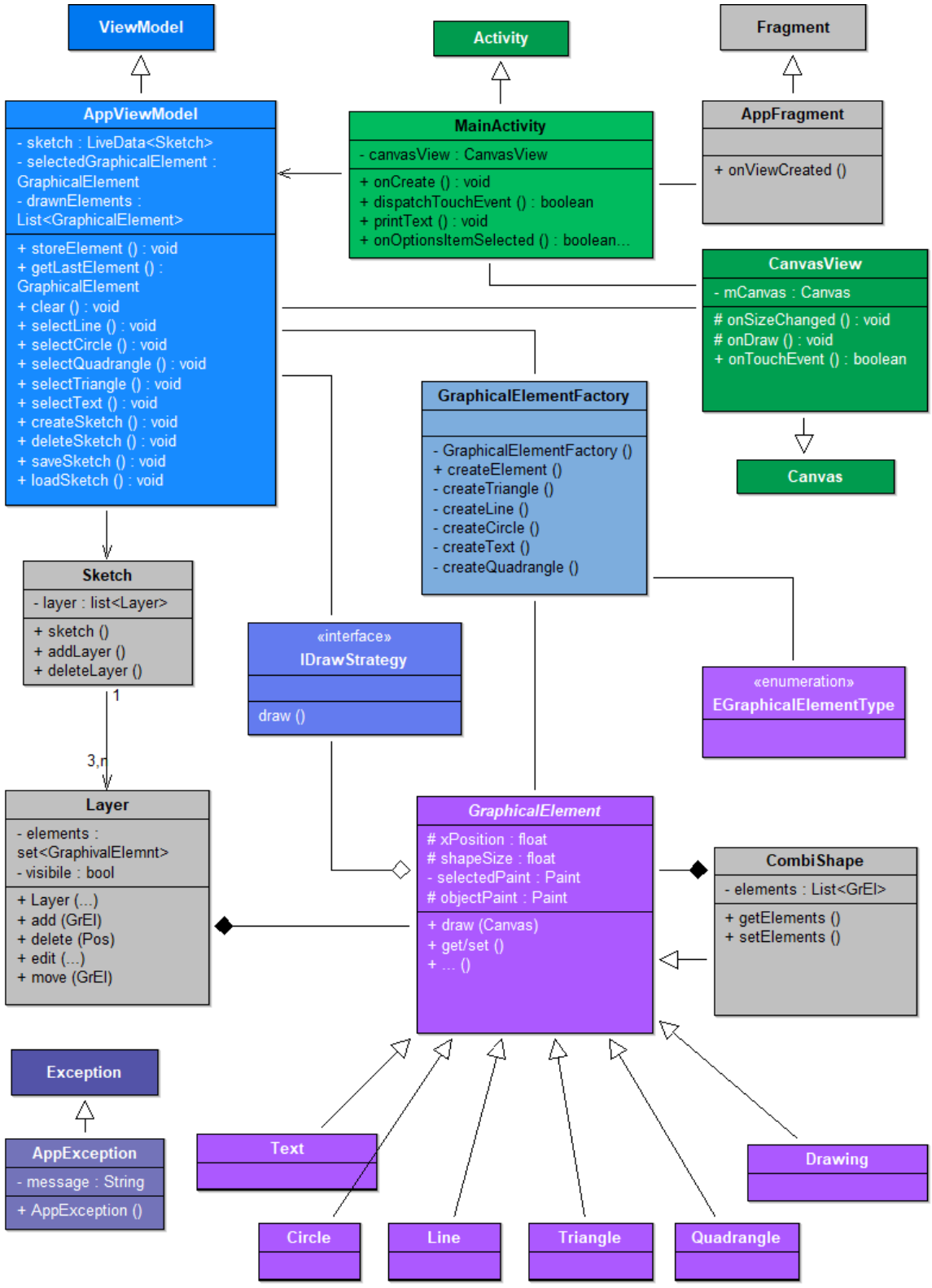
From this class all sketching functionalities (freehand drawing, text & all shapes) inherit their attributes and methods. This is useful, since most graphical elements have a similar structure. Furthermore, this abstract class is connected to both of our currently used design patterns. On the one hand, we employ the Strategy pattern to organize the information how each graphical element should be represented on the View. By this means, we avoid many conditional statements which would have been necessary otherwise. implementing an Interface, which is connected to interchangeable solutions for each of the graphical elements seemed to be a better design decision.



Our second design pattern is the Factory method which has the purpose to create our graphical elements from the Model. By moving all creational tasks of our program into one class, our code becomes easier to support and we follow the separation of concerns principle. The ViewModel executes calls to the Model using the Factory method class and executes operations on the View using the different Strategy pattern implementations.

1.1.1 Class Diagrams

Our class diagram follows the Model-View-Viewmodel pattern. Classes colored in green represent our View, classes in blue belong to the ViewModel and Classes colored in purple belong to the Model. Classes in grey will be implemented later.



1.1.2 Technology Stack

Name	Website link	Version	Purpose and Reasoning
ColorPicker	https://github.com/kristiyanP/colorpicker	1.1.10	Is implementing the color palette for the color change of objects, which is linked to the floating button in the bottom left corner. Considered alternatives where the Holopicker (by M. Schweiz) and ColorPickerView (by skydoves). Holopicker was not fitting to our design so well, and the documentation of ColorPickerView was not as extensive as the ColorPicker library.

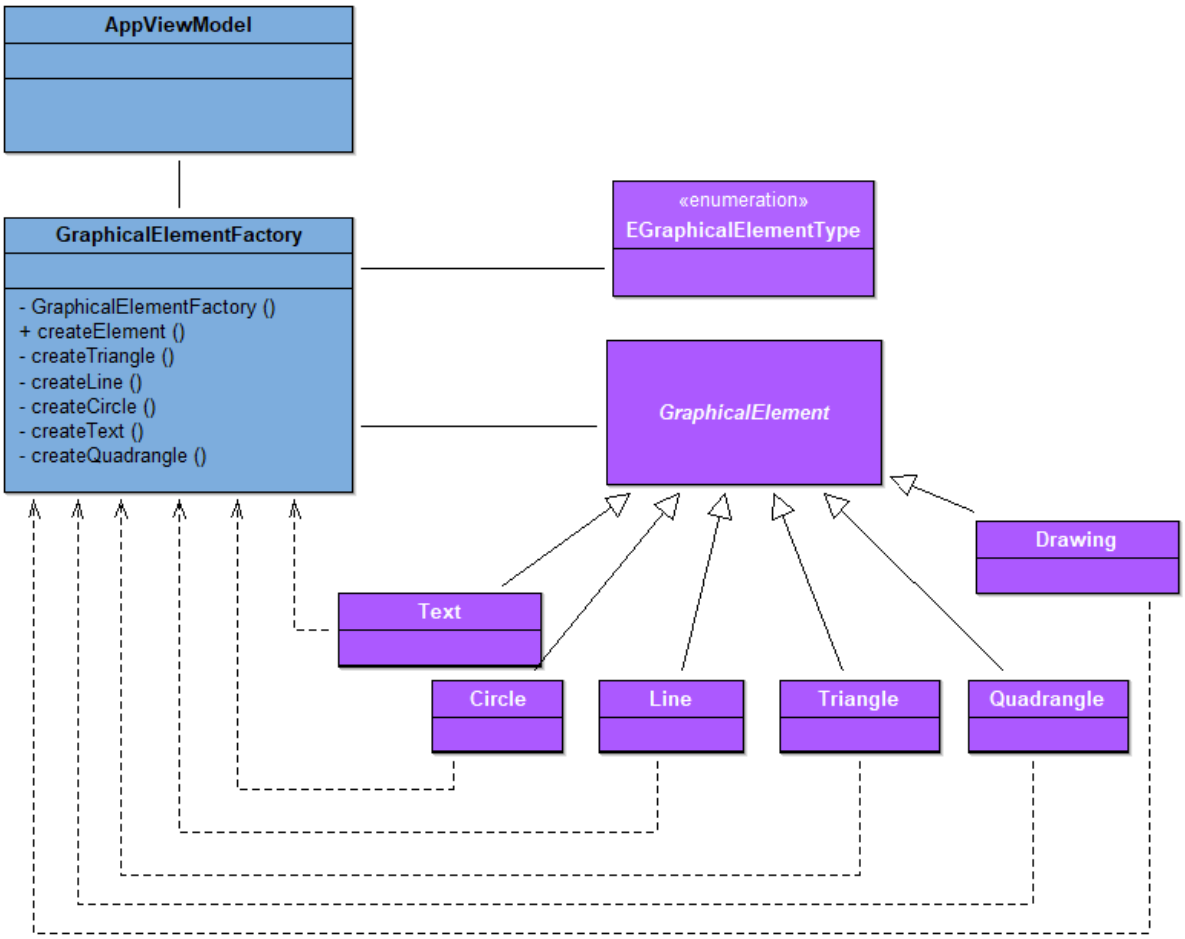
1.2 Design Patterns

1.2.1 Design Pattern 1: Factory Method Pattern

The Factory Method Pattern is useful for delegating the creation of new objects to a dedicated class. This is useful in order to better split the code and avoid bugs. The required attributes and constructor of a concrete object might also change over time and having the creation logic in one determined class makes it easier to address the changes.

In our project we needed to implement the Factory Method pattern to create objects of the GraphicalElement type from our Model. These objects are being later displayed on the View.

This design pattern relates to the Functional Requirements FR1-FR4, requiring new Graphical Elements to be created and displayed on the View. The creation happens after the user selects a graphical element. The creation is an intermediary step between the data saved in the Model and the representation of the data in the View.



Code snippet (GraphicalElementFactory.java):

```java
public static GraphicalElement createElement(EGraphicalElementType type) throws AppException {
    switch (type) {
        case LINE:
            return createLine();
        case CIRCLE:
            return createCircle();
        case DRAWING:
        case COMPOSITE_SHAPE:
            break;
        case TRIANGLE:
            return createTriangle();
        case QUADRANGLE:
            return createQuadrangle();
        case TEXT_FIELD:
            return createText();
        default:
            throw new AppException("Unknown type: " + type);
    }
```

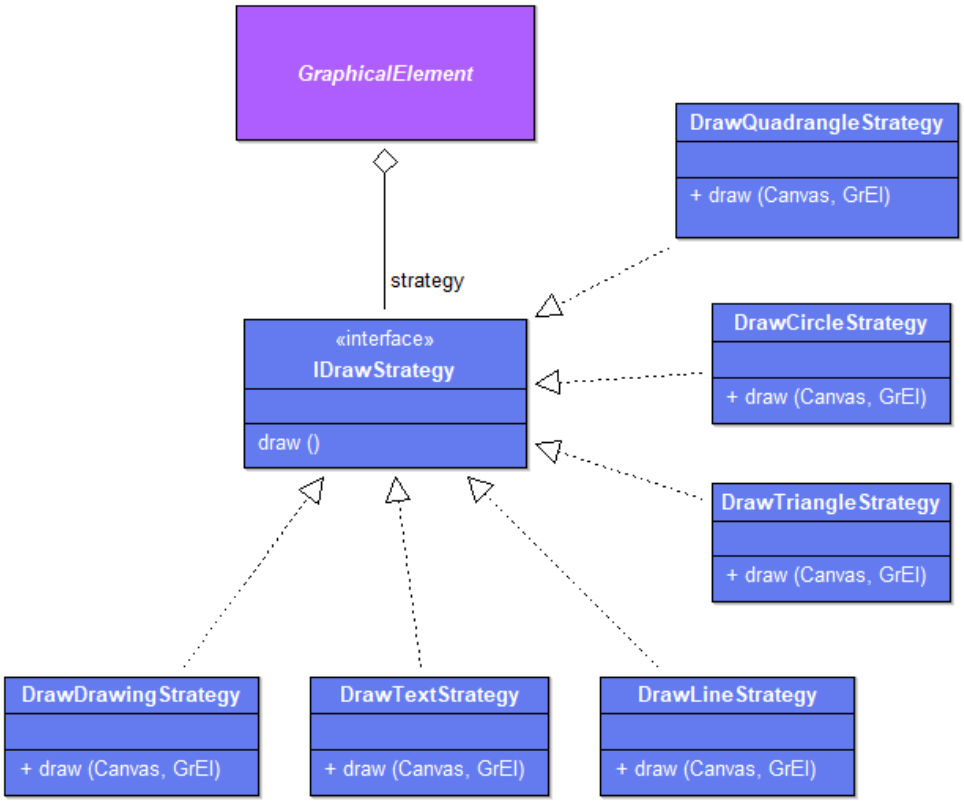
```
private static Circle createCircle() {
    Circle mCircle = new Circle(new DrawCircleStrategy());
    Paint mPaint = new Paint(MainActivity.getSelectedPaint());
    mCircle.setObjectPaint(mPaint);
    mCircle.setShapeSize(70);
    return mCircle;
}
```

1.2.2 Strategy Pattern

The Strategy Pattern is useful when there are multiple algorithms which solve a problem, and they can be used interchangeably, according to the concrete context. It is an alternative to implementing behavioural logic in subclasses of a Context, which has the benefit of separating business logic from Context state and thus making the code easier to read and maintain. Moreover, conditional statements for selecting the behaviour are also avoided thanks to this pattern.

In our project, the Strategy Pattern turned out useful to avoid adding logic for drawing on the Canvas directly in our concrete subclasses of GraphicalElement. The logic for drawing is different for each graphical element, different Strategies have been implemented.

This design pattern relates to the Functional Requirements FR1-FR4, requiring new Graphical Elements to be created and displayed (drawn) on the View. The Strategy pattern is executed when the whole View is being drawn again, by going through each graphical element and invoking the corresponding Strategy object. The drawing is performed by the ViewModel and used to represent the data on the View.



Code snippet: (IDrawStrategy.java):

```
public interface IDrawStrategy {
    void draw(Canvas canvas, GraphicalElement graphicalElement);
}
```

```
        // in Anlehnung an: https://kylewbanks.com/blog/drawing-triangles-rhombuses-
        float halfWidth = graphicalElement.getShapeSize() / 2;
        float x = graphicalElement.getxPosition();
        float y = graphicalElement.getyPosition();

        Path path = new Path();
        path.moveTo(x,  y: y - halfWidth); // Top
        path.lineTo( x: x - halfWidth,  y: y + halfWidth); // Bottom left
        path.lineTo( x: x + halfWidth,  y: y + halfWidth); // Bottom right
        path.lineTo(x,  y: y - halfWidth); // Back to Top
        path.close();

        canvas.drawPath(path, graphicalElement.getObjectPaint());
    }
}
```

```
public class DrawQuadrangle implements IDrawStrategy {

    @Override
    public void draw(Canvas canvas, GraphicalElement graphicalElement) {
        canvas.drawRect(graphicalElement.getxPosition(), graphicalElement.getyPosition(),
                right: graphicalElement.getxPosition() + ((Quadrangle) graphicalElement).getLength(),
                bottom: graphicalElement.getyPosition() + ((Quadrangle) graphicalElement).getHeight(),
                graphicalElement.getObjectPaint());
    }
}
```

2 Code Metrics

(Metrics calculated with the 'Statistic' plugin for Android studio)
Number of packages: 6
Lines of code: 1748
Comment lines of code: 70
Number of classes: 21

Code bugs and testing

Before running the final lint-test, the implementation showed around 70 errors. The majority of them were:

- Un-used resources which had piled up over the development process
- Display attributes of UI elements being missing (e.g. focusability)
- The non-local declaration of local variables
- Unused import-statements from the development process
- Usage of hardcoded values instead of flexible resources (strings)

The current implementation shows 21 warnings, whereas Java accounts for 8 and Android of the rest. The majority of Android errors recurs to our use of Resource ID's in the switch-case statement in the main activity – which should be avoided in this context. We will eliminate this error and come up with another solution.

The rest of the warnings in the Android context recurs to minor aspects, we have considered these hints and came up with a suitable solution in these cases.

We have explicitly implemented three different Unit tests regarding methods in the Class CanvasViewTest for the setting of X and Y, as well as the selection of graphical elements. Through the latter, we gained an insight on the bug of selecting a text size/and or color when there has been no graphical element instantiated. This bug could be fixed. Furthermore, we had multiple phases of code reviews. Each team member checked the other program parts and used the TODO-function of Android studio to make suggestions on code improvement.

Moreover, we have conducted multiple End-to-End/Integration tests via the espresso testing framework. We have included a Shape construction test in the view folder on androidTest.

3 Team Contribution

3.1 Project Tasks and Schedule

		October				November				December				January	
		1	2	3	4	1	2	3	4	1	2	3	4	1	2
JanPreparation/Planning	Requirements checking														
	Task distribution														
	Architectural decisions														
Development/ Test	GitLab Setup														
	Implementation & Testing														
	SUPD submission														
	Further Implementation & Testing														
Implementation	Check on Design Pattern Use														
	Final Testing														
	Final Code Clean-Up														
	DEAD submission														

3.2 Distribution of Work and Efforts

Task	Distribution	Time
Android research and tutorials	All	30h
Design draft	All	3h
Design Pattern research	All	5h
UML class diagrams MVVM, Design Patterns	Leyla	6h
UML class diagram Model	Felix	1h
Graphical user interface	Felix	11h
Factory pattern implementation	Leyla	2h
Strategy pattern implementation	Leyla	3h
Circle implementation	Jonas	4h
Quadrangle implementation	Jonas	4h
Line implementation	Jonas	5h
Triangle implementation	Jonas	3h
Text field implementation	Sandra	8h
Free hand drawing implementation	Christian	6h
Draw width & and colour picker implementation	Felix	5h
“Graphical element” functionality implementation	Jonas	4h
Text size implementation	Sandra	2h
“Clear” functionality	Sandra, Jonas	1h
Software architecture review	Leyla & Jonas	8h
Static code analysis tool	Felix	4h
Testing	Felix & Christian	3h
Code review	All	10h
Documentation	Leyla, Christian, Felix	9h