Hochschule Karlsruhe
Technik und Wirtschaft
UNIVERSITY OF APPLIED SCIENCES

Programming and Software Engineering

Project work

Hochschule für Technik und Wirtschaft, Karlsruhe

Geomatics (M.Sc. Int.)

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1 Introduction

The lecture “Programming and Software Engieering” is part of the Master program in Geomatics at “Hochschule Karlsruhe für Technik und Wirtschaft”. This documentation is about the Project work. The project goal is the Development of a Graphical User Interface (GUI) to organize graphical objects like coordinates, straight lines, triangles, and rectangles. The objects should be stored in a relational database. The GUI should support important elements for controlling objects and it should be possible to import objects from and store objects into a CSV-File. Besides it is mandatory to formulate a geometric range query.

2 Projectmanagement

Perfect scheduling is the basis of a successful Projectmanagement. A Gantt chart is a type of bar chart that represents the schedule. The following figures represent the scheduling for this Project.

Figure 1 shows a table which contains grouped work packages: Administrate Graphical User Interface, Design Phase, Basic Functionality, Database Connectivity, File Handling, GUI, Design, Implementation and Documentation and Presentation. Every work package has some sub-categories. The time span of each work package and sub-category has to be set. Than duration is calculated. The column “Predecessors” shows relationships and preconditions between work packages and subcategories. If a work package or sub-class is finished it is marked with a green hook and in column “Percent Work Complete” 100% needs to be written down.

Figure 2 shows the bar chart of the suggested durations for every work package and subclass.

		Name	Duration	Start	Finish	Predecessors	Percent Work Complete
1	✔	**Administrate Graphical...**	**35 days?**	**11/20/17 8:00 AM**	**1/5/18 5:00 PM**		**100%**
2	✔	**Project Begin**	**0.25 days?**	**11/20/17 8:00 AM**	**11/20/17 10:00 AM**		**100%**
3	✔	Kickoff Meeting	0.031 days?	11/20/17 8:00 AM	11/20/17 8:15 AM		100%
4	✔	Introductory Task Study	0.188 days?	11/20/17 8:15 AM	11/20/17 9:45 AM	3	100%
5	✔	Organizational Group ...	0.031 days?	11/20/17 9:45 AM	11/20/17 10:00 AM	4	100%
6	✔	**Design Phase**	**3.549 days?**	**11/22/17 8:00 AM**	**11/27/17 1:23 PM**	**2**	**100%**
7	✔	Project Planning	0.5 days?	11/22/17 8:00 AM	11/22/17 12:00 PM		100%
8	✔	Study The Geographic...	2 days?	11/23/17 8:00 AM	11/24/17 5:00 PM	7	100%
9	✔	Project Setup	0.031 days?	11/27/17 8:00 AM	11/27/17 8:15 AM	8	100%
10	✔	Weekly Group Meeting	0.031 days?	11/27/17 10:00 AM	11/27/17 10:15 AM	9	100%
11		Individual Project Work	0.174 days?	11/27/17 12:00 PM	11/27/17 1:23 PM	10	100%
12	✔	**Implementation of Fu...**	**21.451 day...**	**11/27/17 1:23 PM**	**12/26/17 5:28 PM**	**6**	**100%**
13	✔	**Basic Functionality**	**8.951 days?**	**11/27/17 1:23 PM**	**12/8/17 12:23 PM**		**100%**
14	✔	Definition	0.25 days?	11/27/17 1:23 PM	11/27/17 3:23 PM		100%
15	✔	**Implementation**	**8.5 days?**	**11/27/17 3:23 PM**	**12/8/17 10:23 AM**	**14**	**100%**
16	✔	**Create Object Fu...**	**1.5 days?**	**11/27/17 3:23 PM**	**11/29/17 10:23 AM**		**100%**
17	✔	Point Object	0.5 days?	11/27/17 3:23 PM	11/28/17 10:23 AM		100%
18	✔	Line Object	0.5 days?	11/28/17 10:23 AM	11/28/17 3:23 PM	17	100%
19	✔	Polygon Object	0.5 days?	11/28/17 3:23 PM	11/29/17 10:23 AM	18	100%
20	✔	Edit Object Function	1 day?	11/29/17 10:23 AM	11/30/17 10:23 AM	16	100%
21	✔	Erase Object Funct...	1 day?	11/30/17 10:23 AM	12/1/17 10:23 AM	20	100%
22	✔	Display Function	1 day?	12/1/17 10:23 AM	12/4/17 10:23 AM	21	100%
23	✔	Select Function	1 day?	12/4/17 10:23 AM	12/5/17 10:23 AM	22	100%
24	✔	Read From SCV Fu...	1 day?	12/5/17 10:23 AM	12/6/17 10:23 AM	23	100%
25	✔	Save To SCV Funct...	1 day?	12/6/17 10:23 AM	12/7/17 10:23 AM	24	100%
26	✔	Query Function	1 day?	12/7/17 10:23 AM	12/8/17 10:23 AM	25	100%
27	✔	Test (Quality Assura...	0.201 days?	12/8/17 10:23 AM	12/8/17 12:23 PM	15	100%
28	✔	**Data Base Connecti...**	**3.392 days?**	**12/8/17 12:00 PM**	**12/13/17 4:08 PM**	**13**	**100%**
29	✔	Definition	0.142 days?	12/8/17 12:00 PM	12/8/17 2:08 PM		100%
30	✔	**Implementation**	**3 days?**	**12/8/17 2:08 PM**	**12/13/17 2:08 PM**	**29**	**100%**
31	✔	Object creation in DB	1 day?	12/8/17 2:08 PM	12/11/17 2:08 PM		100%
32	✔	Auto-Reload From DB	1 day?	12/11/17 2:08 PM	12/12/17 2:08 PM	31	100%
33	✔	Connectivity	1 day?	12/12/17 2:08 PM	12/13/17 2:08 PM	32	100%
34	✔	Test (Quality Assura...	0.25 days?	12/13/17 2:08 PM	12/13/17 4:08 PM	30	100%

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		Name	Duration	Start	Finish	Predecessors	Percent Work Complete
35	✔	**File Handling**	**3.375 days?**	**12/13/17 4:08 PM**	**12/19/17 10:07 AM**	**28**	**100%**
36	✔	Definition	9.378 days?	12/13/17 4:08 PM	12/13/17 6:17 PM		100%
37	✔	**Implementation**	**3 days?**	**12/14/17 8:00 AM**	**12/18/17 5:00 PM**	**36**	**100%**
38	✔	Create File	1 day?	12/14/17 8:00 AM	12/14/17 5:00 PM		100%
39	✔	Write on a File	1 day?	12/15/17 8:00 AM	12/15/17 5:00 PM	38	100%
40	✔	Open File	1 day?	12/18/17 8:00 AM	12/18/17 5:00 PM	39	100%
41	✔	Test (Quality Assura...	6.267 days?	12/19/17 8:00 AM	12/19/17 10:07 AM	37	100%
42	✔	**GUI**	**5.733 days?**	**12/19/17 10:07 AM**	**12/26/17 5:28 PM**	**35**	**100%**
43	✔	Difinition	6.004 days?	12/19/17 10:07 AM	12/19/17 12:17 PM		100%
44	✔	**Design**	**4 days?**	**12/19/17 3:09 PM**	**12/25/17 3:09 PM**	**43**	**100%**
45	✔	**Main Window**	**4 days?**	**12/19/17 3:09 PM**	**12/25/17 3:09 PM**		**100%**
46	✔	BackGround	1 day?	12/19/17 3:09 PM	12/20/17 3:09 PM		100%
47	✔	Menu	1 day?	12/20/17 3:09 PM	12/21/17 3:09 PM	46	100%
48	✔	Toolset	1 day?	12/21/17 3:09 PM	12/22/17 3:09 PM	47	100%
49	✔	Message Window	1 day?	12/22/17 3:09 PM	12/25/17 3:09 PM	48	100%
50	✔	**Implementation**	**1 day?**	**12/25/17 3:09 PM**	**12/26/17 3:09 PM**	**44**	**100%**
51	✔	**Toolset (Control ...**	**1 day?**	**12/25/17 3:09 PM**	**12/26/17 3:09 PM**		**100%**
52	✔	Open File (CSV, ...	1 day?	12/25/17 3:09 PM	12/26/17 3:09 PM		100%
53	✔	Save File (SCV, D...	1 day?	12/25/17 3:09 PM	12/26/17 3:09 PM		100%
54	✔	Message window...	1 day?	12/25/17 3:09 PM	12/26/17 3:09 PM		100%
55	✔	Test (Quality Assura...	0.519 days?	12/26/17 3:09 PM	12/26/17 5:28 PM	50	100%
56	✔	**Documentation & Pre...**	**8 days?**	**12/27/17 8:00 AM**	**1/5/18 5:00 PM**	**12**	**100%**
57	✔	Report	3 days?	12/27/17 8:00 AM	12/29/17 5:00 PM		100%
58	✔	Presentation	5 days?	1/1/18 8:00 AM	1/5/18 5:00 PM	57	100%

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Figure 1: Gantt-chart Part 1

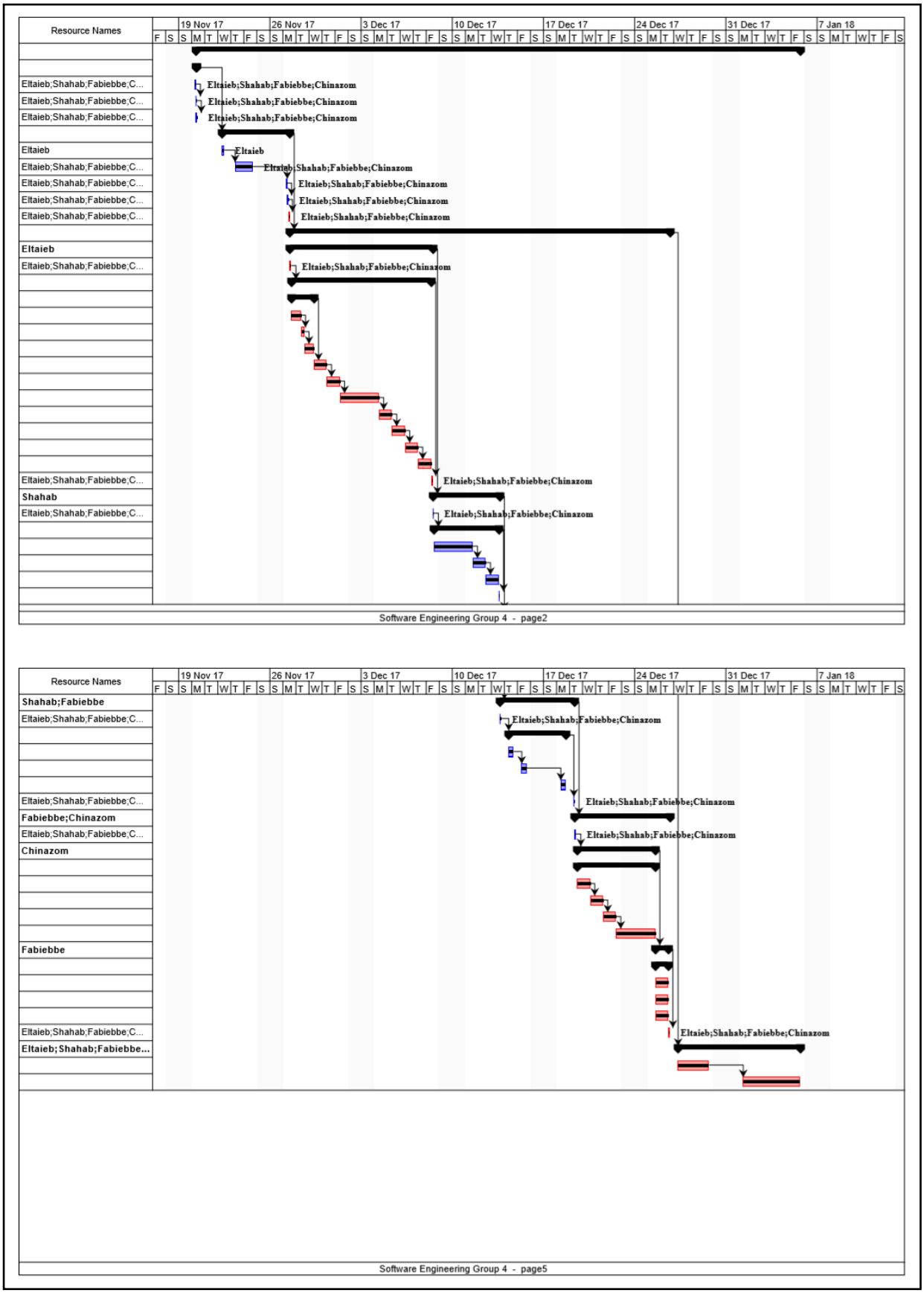
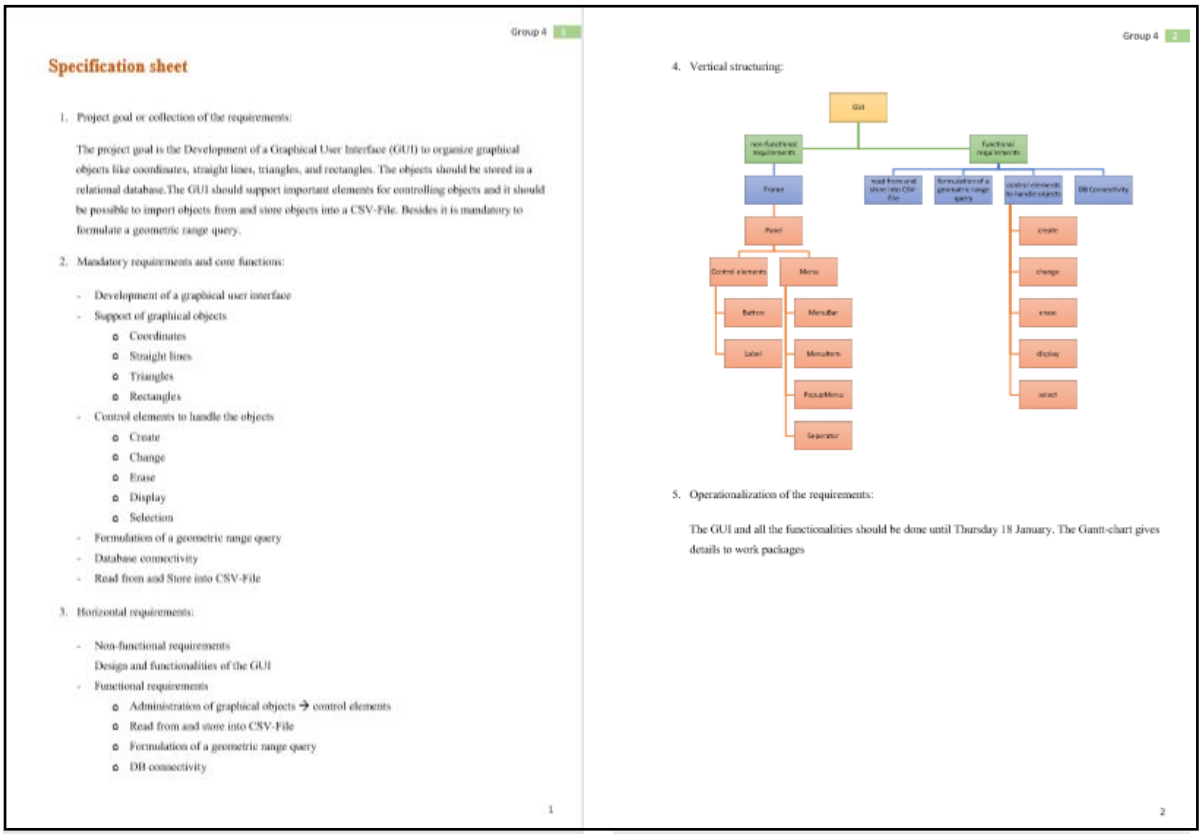


Figure 2: Gantt-chart Part 2

3 Analysis results

The idea of Object-oriented Analysis is combining objects in different classes and structuring the classes afterwards. The precondition is determining the requirements. A specification sheet (Figure 3) contains a comprehensive description of the intended purpose and specifications.



Group 4 1

Specification sheet

1. Project goal or collection of the requirements:

The project goal is the Development of a Graphical User Interface (GUI) to organize graphical objects like coordinates, straight lines, triangles, and rectangles. The objects should be stored in a relational database. The GUI should support important elements for controlling objects and it should be possible to import objects from and store objects into a CSV-File. Besides it is mandatory to formulate a geometric range query.

2. Mandatory requirements and core functions:

- Development of a graphical user interface
- Support of graphical objects
  - Coordinates
  - Straight lines
  - Triangles
  - Rectangles
- Control elements to handle the objects
  - Create
  - Change
  - Erase
  - Display
  - Selection
- Formulation of a geometric range query
- Database connectivity
- Read from and Store into CSV-File

3. Horizontal requirements:

- Non-functional requirements
  Design and functionalities of the GUI
- Functional requirements
  - Administration of graphical objects → control elements
  - Read from and store into CSV-File
  - Formulation of a geometric range query
  - DB connectivity

1

Group 4 2

4. Vertical structuring:

5. Operationalization of the requirements:

The GUI and all the functionalities should be done until Thursday 18 January. The Gantt-chart gives details to work packages

2

Figure 3: Specification sheet

In part one the project goal and the specifications are written down. Part two is about listing the mandatory requirements. After that, part three divides the requirements in functional and non-functional requirements. The diagram in part four shows a hierarchy of the non-functional and functional requirements. Finally, in part five the deadline for submission is set.

4 Design results

After the requirements are specified. UML-Diagrams are used to visualize the software program. The first step was a use case diagram which shows the behaviour of the different cases (Figure 4).

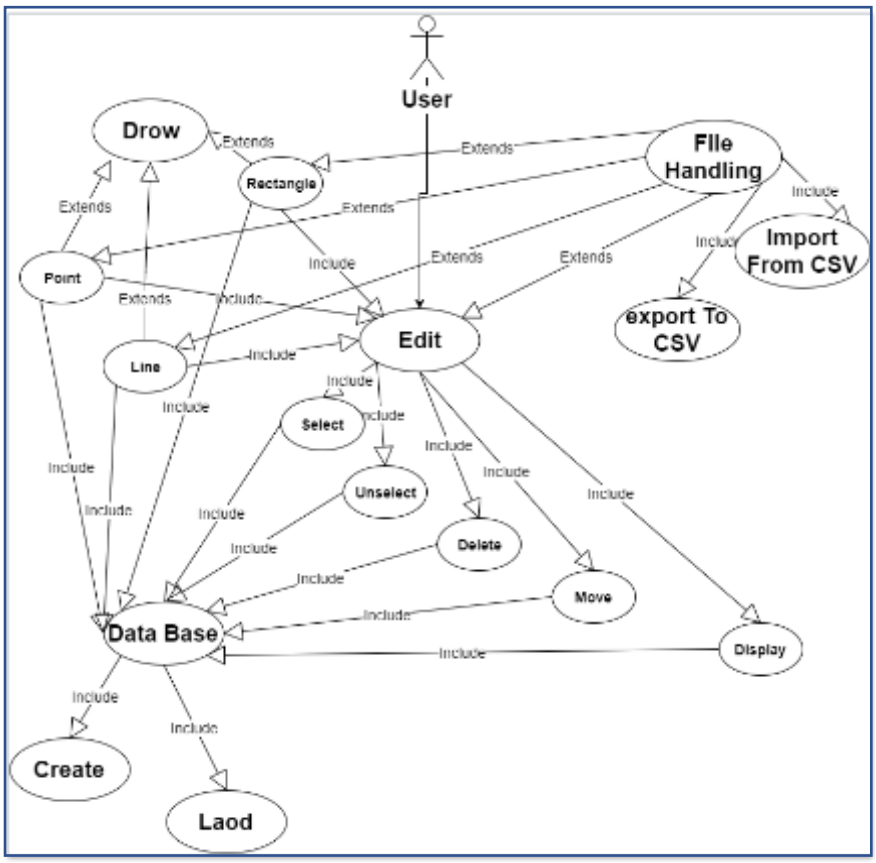


Figure 4: Use case diagram

After that an Activity diagrams visualises the work flow from activity to activity (Figure 5).

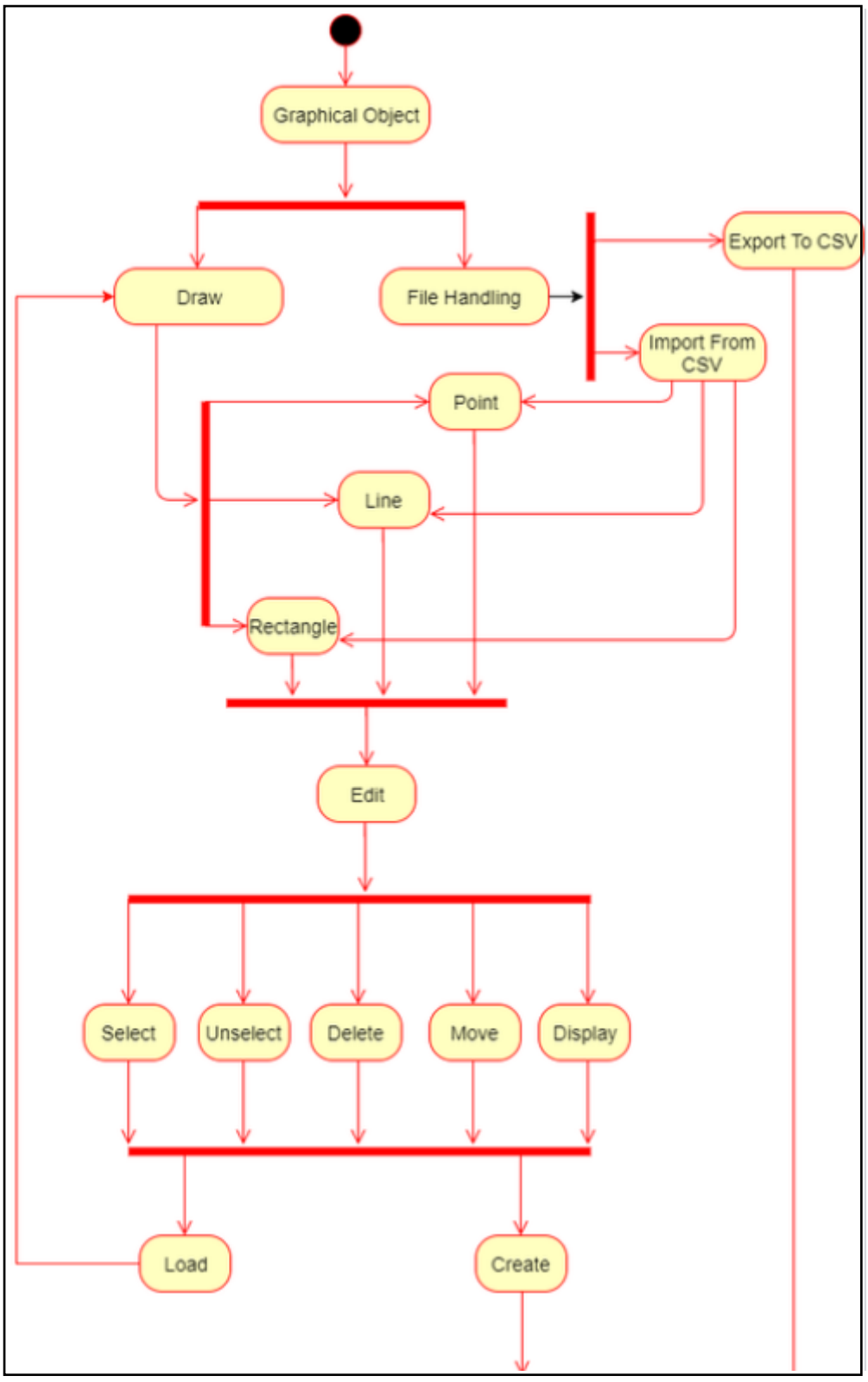


Figure 5: Activity diagram

Finally, the class diagram (Figure 6) models the static structure of a system. It divides objects into classes and structures the classes. Additionally, it shows the relationships between classes and Objects.

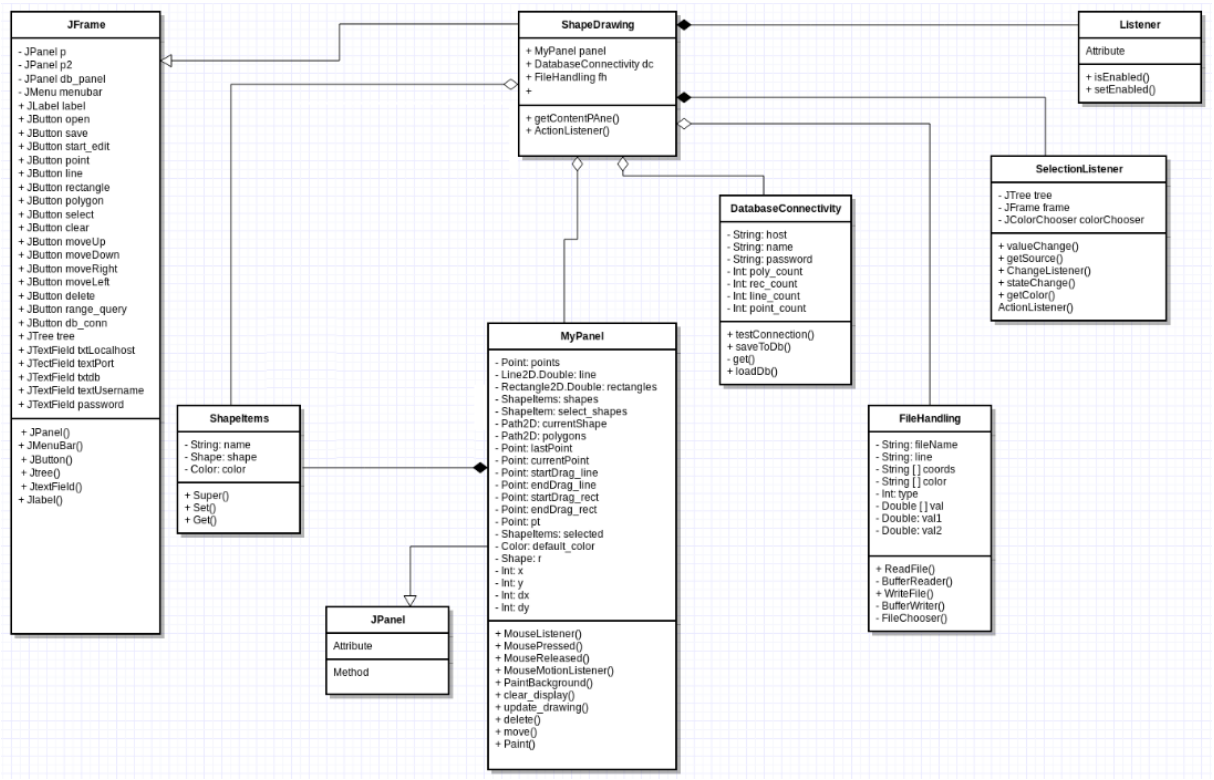


Figure 6: class diagram

5 Testing

Software testing consists of Software Validation and Verification. Both are independent procedures that are used to check if a program system meets requirements and specifications. They mean two different types of analysis and must be applied at each stage in the software process. Verification checks whether the program meets the specification and if it is well engineered and error-free while Validation checks whether the program system satisfies the wishes of the costumer and makes sure that it will meet the customer's needs.

One method to organize Verification is an Inspection. An Inspection takes place after each phase of a software developing process. During an inspection a team searches for defects. On the other hand, testing means looking for defects in the program code by running the program with concrete test cases. It takes place after implementation. Testing can prove that there is a defect but never that there is no defect.

The following paragraphs describe the testing of the program code with different test cases. The test cases where chosen according to the fixed specifications and they cover a variation of possible program activities.

5.1 Single Module Test

Test case 1: Testing the control elements

The scope of tasks determines that the GUI should content all control elements to handle the objects. These are: create, change, erase, display and select All of them can be used by clicking on the relevant Button. So, the first test case is creating and display a Rectangle, change the color,

move and select it and erase it at the end. The editing can be started clicking on the “Start/Stop Editing” Button (Figure 7). In Figure 8 the Button “Rectangle“ is clicked. With drag and drop a rectangle can be created.

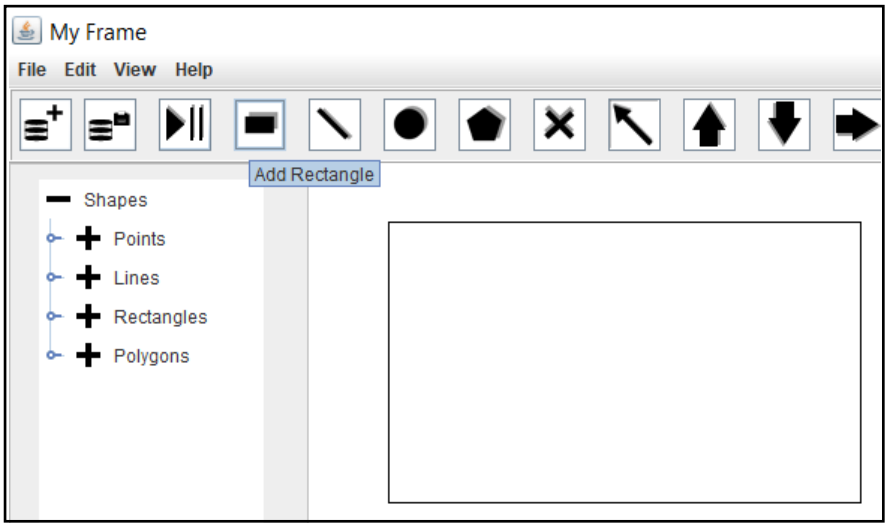


Figure 7: Start/Stop Button

Afterwards it is possible to select the rectangle. The rectangle is selected through clicking on the “Select” Button (Figure 9). It is possible to change the color of the rectangle using the color chooser which is integrated in the JTree on the left side of the GUI. In Figure the color chooser was used and a color for the rectangle chosen (Figure 10). Figure 11 shows the result: a blue rectangle.

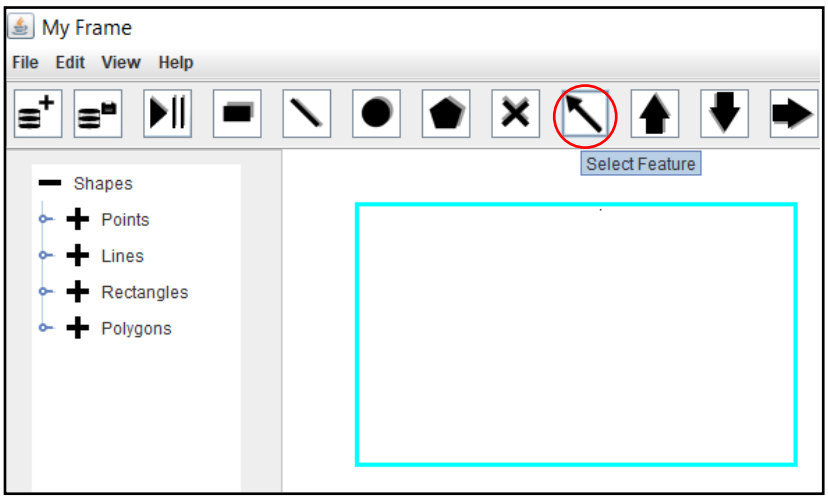


Figure 8: Rectangle selected

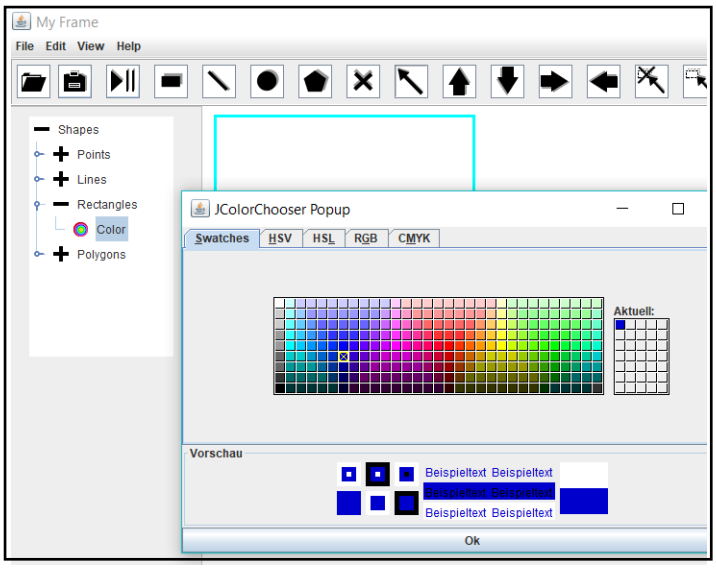


Figure 10: Changing color of Rectangle

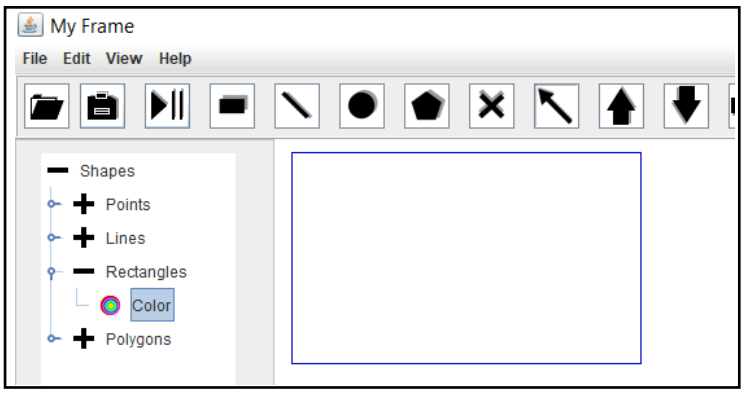


Figure 9: Color of Rectangle changed

It is also possible to erase the created rectangle. There is a Button “Clear” in the Toolbar (Figure 11).

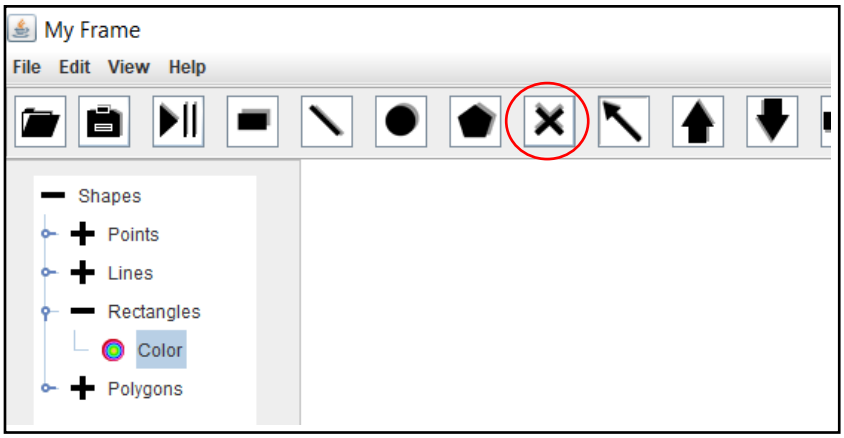


Figure 11: Clear Display

The control elements pass the test.

Test case 2: Testing input objects via a CSV-File and store objects into a CSV-File

Saved shapes can be loaded from the system. It is set in menu “File” (Figure 12). After clicking “Load from File” the File Chooser opens and it is possible to load objects via CSV (Figure 13).

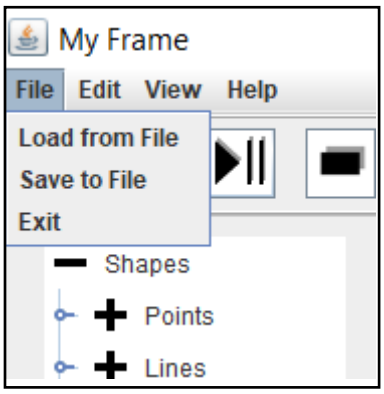


Figure 12: MenuItem "Load from File"

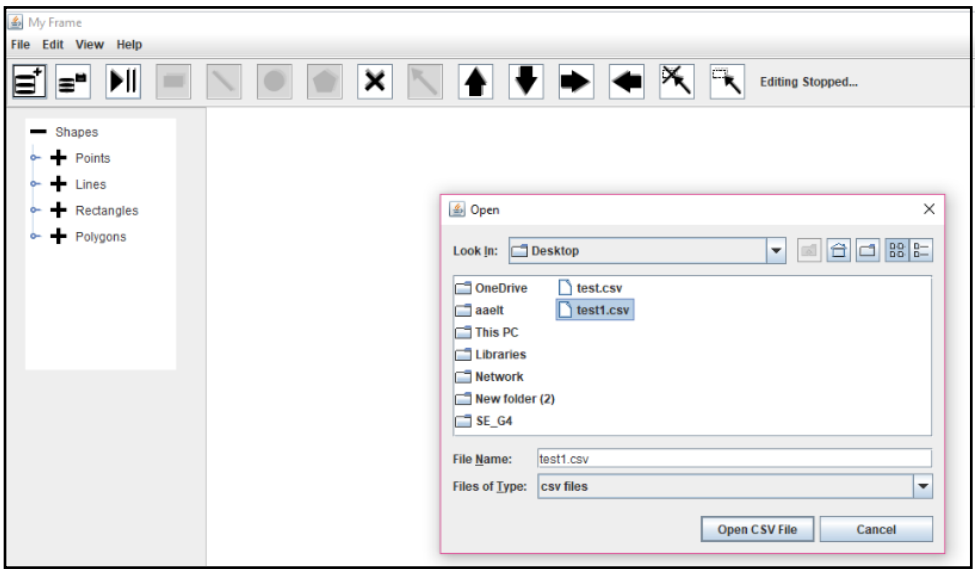


Figure 13: Input via CSV

The File Chooser opens also when MenuItem “Save to File” is clicked and the objects can be saved as CSV (Figure 14).

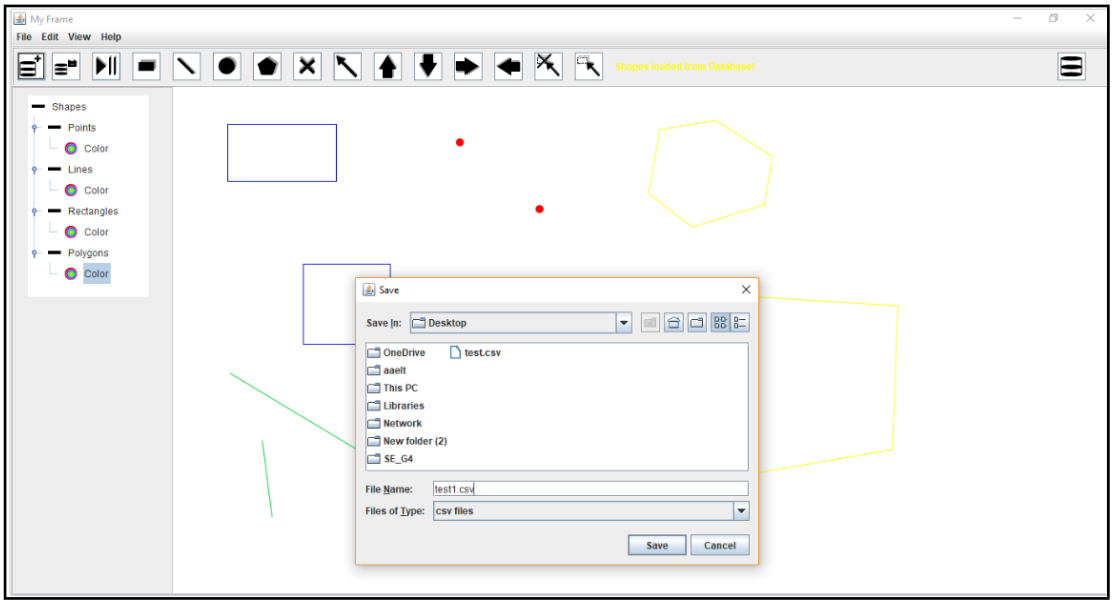
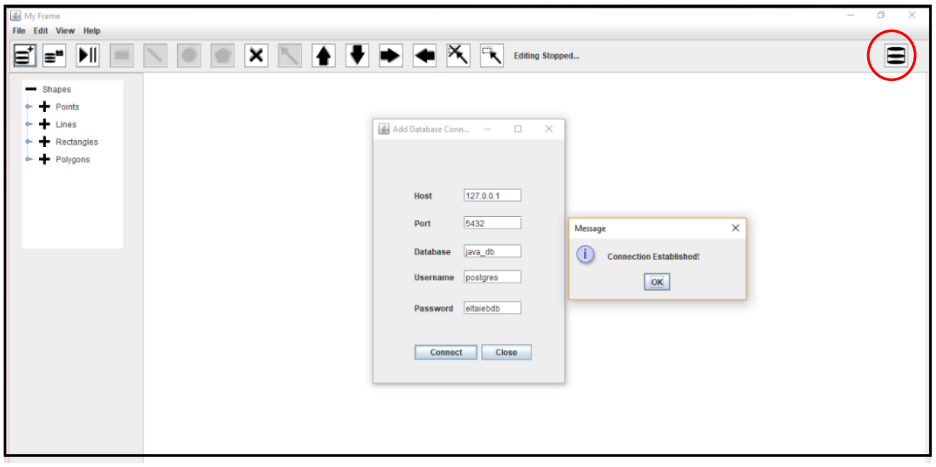


Figure 14: Store into CSV

Test case 3: Database Connectivity, Load from Database and save to Database

Test case 2 showed that objects can be loaded via CSV and stored into CSV. But it is also possible to load objects from the database and add them to the database. At first the Database Connectivity must be successfully enabled (Figure 15). When the Connectivity is tied up two implemented Buttons can be clicked to load from and save to Database (Figure 16).



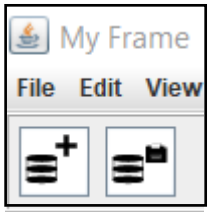


Figure 16: Database connectivity enabled

Figure 15:Button Load from Database" and "Save to Database"

Figure 17 shows drawn objects which are getting saved to the database. In Figure 18 they are loaded again from the database.

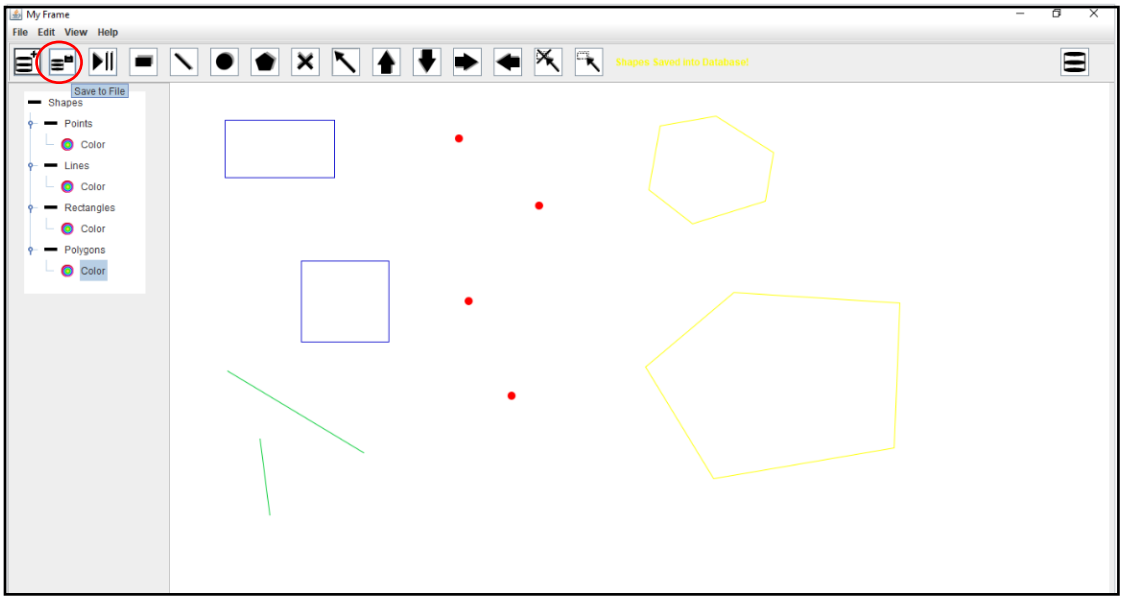


Figure 17: Save Objects to Database

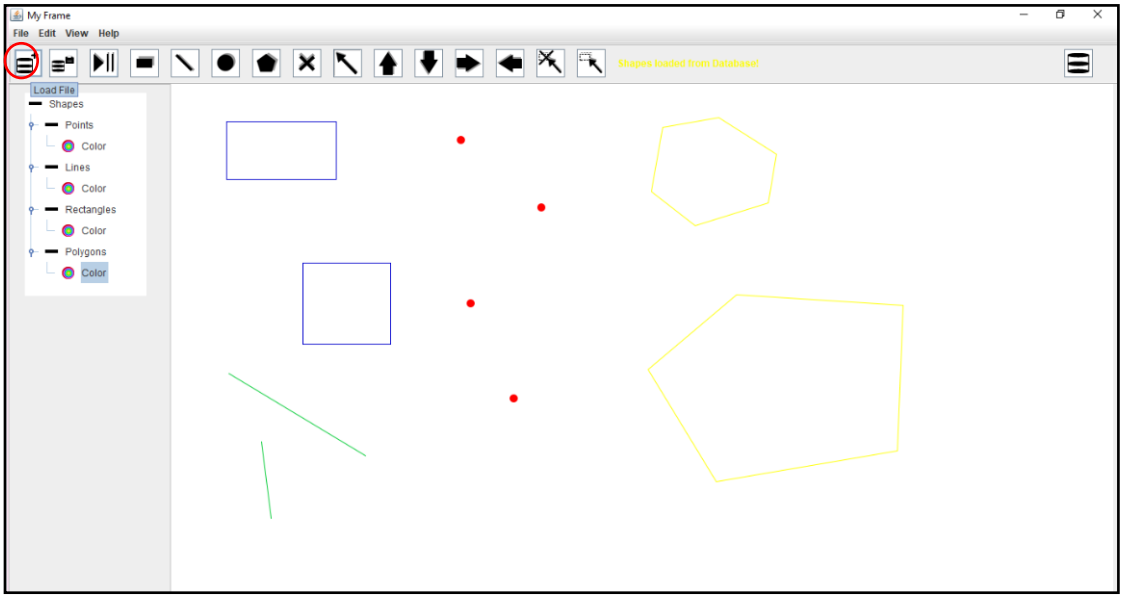


Figure 18: Load Objects from Database

Test case 4: Formulate a geometric range query

This Text case is about testing the geometric range query. Four points have been created (Figure 19) and the Button “Select multiple objects” clicked. The result is that the black rectangle appears dragging and dropping and the four points are selected (Figure 20). So, the geometric range query passes also the test.

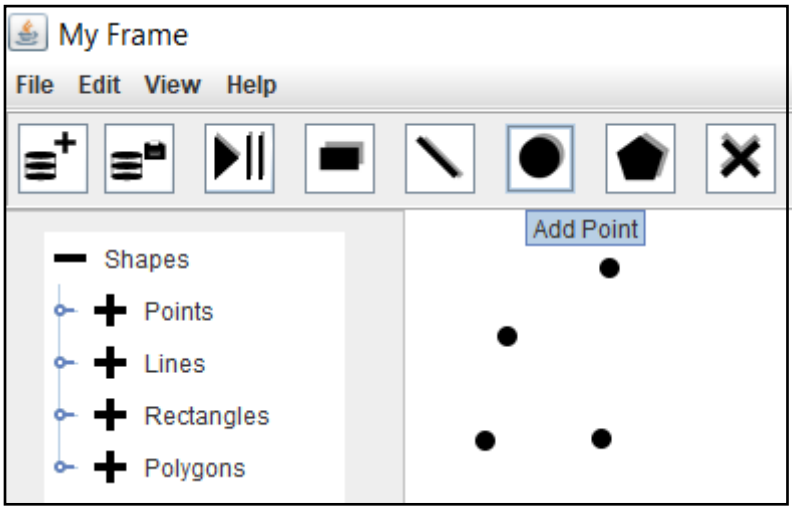


Figure 19: Create four Points

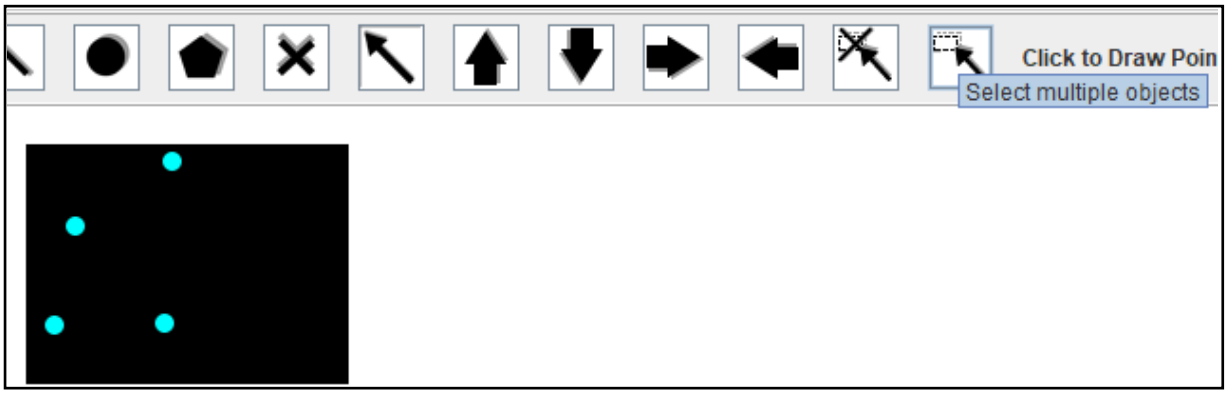


Figure 20: Select multiple Objects

5.2 Module integration test

After the modules are tested separately they are combined together and the interaction is tested. Three points are drawn (Figure 21), saved as a csv, loaded as a csv (Figure 22), saved to the data base and loaded from the database and selected all at ones (Figure 24).

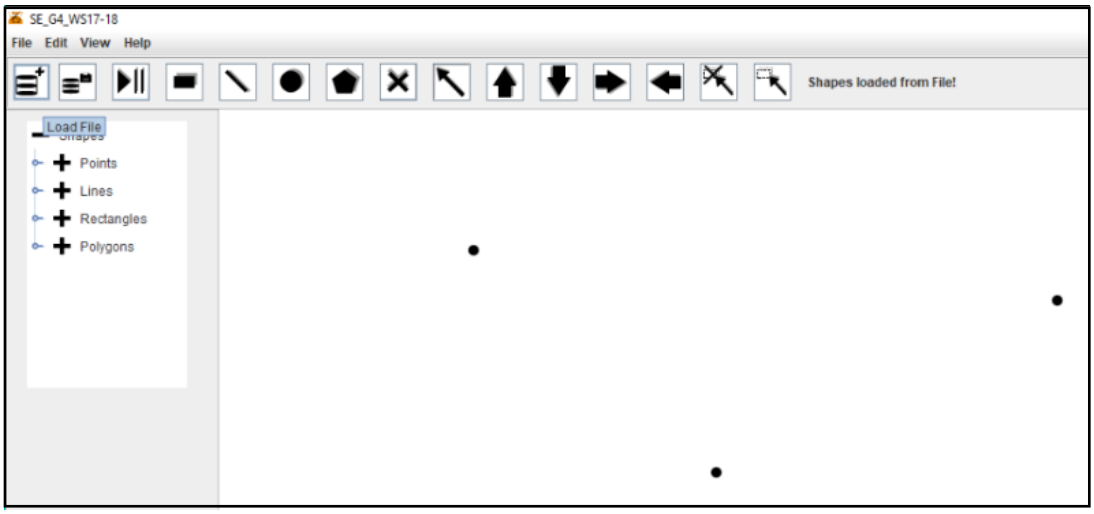


Figure 21: Points created

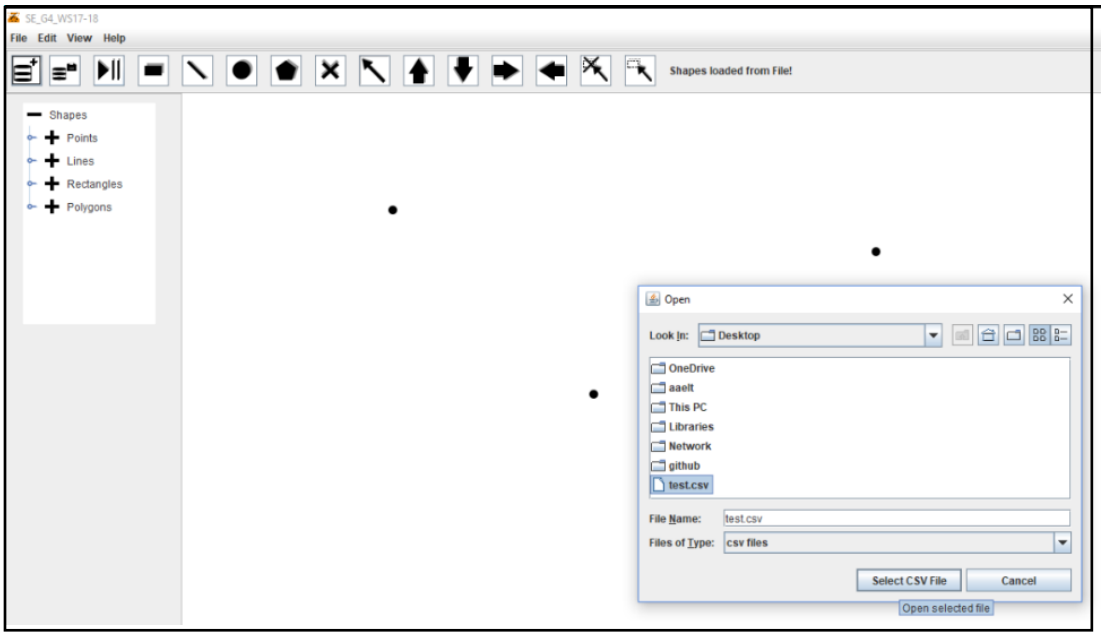


Figure 22: Load Objects which have been saved via CSV

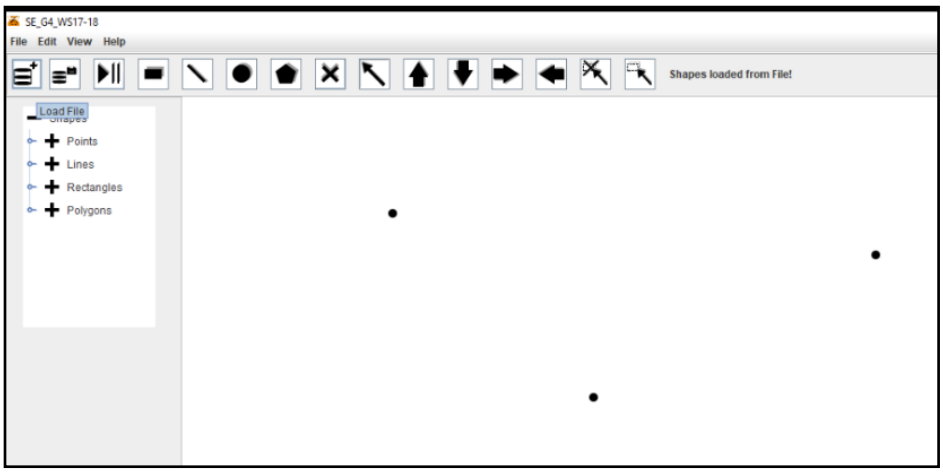


Figure 23: Load objects which have been saved to Database

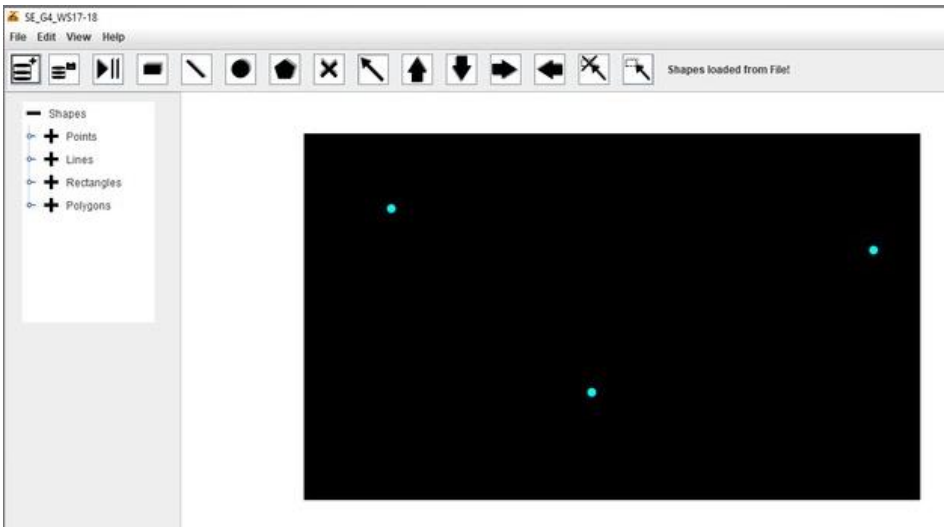


Figure 24: Select the points

Now the modules and their interactions are tested.

Appendix

Gantt-chart

	Name	Duration	Start	Finish	Predecessors	Percent Work Complete
1	**Administrate Graphical...**	**35 days?**	**11/20/17 8:00 AM**	**1/5/18 5:00 PM**		**100%**
2	**Project Begin**	**0.25 days?**	**11/20/17 8:00 AM**	**11/20/17 10:00 AM**		**100%**
3	Kickoff Meeting	0.031 days?	11/20/17 8:00 AM	11/20/17 8:15 AM		100%
4	Introductory Task Study	0.188 days?	11/20/17 8:15 AM	11/20/17 9:45 AM	3	100%
5	Organizational Group	0.031 days?	11/20/17 9:45 AM	11/20/17 10:00 AM	4	100%
6	**Design Phase**	**3.549 days?**	**11/22/17 8:00 AM**	**11/27/17 1:23 PM**	**2**	**100%**
7	Project Planning	0.5 days?	11/22/17 8:00 AM	11/22/17 12:00 PM		100%
8	Study The Geographic...	2 days?	11/23/17 8:00 AM	11/24/17 5:00 PM	7	100%
9	Project Setup	0.031 days?	11/27/17 8:00 AM	11/27/17 8:15 AM	8	100%
10	Weekly Group Meeting	0.031 days?	11/27/17 10:00 AM	11/27/17 10:15 AM	9	100%
11	Individual Project Work	0.174 days?	11/27/17 12:00 PM	11/27/17 1:23 PM	10	100%
12	**Implementation of Fu...**	**21.451 day...**	**11/27/17 1:23 PM**	**12/26/17 5:28 PM**	**6**	**100%**
13	**Basic Functionality**	**8.951 days?**	**11/27/17 1:23 PM**	**12/8/17 12:23 PM**		**100%**
14	Definition	0.25 days?	11/27/17 1:23 PM	11/27/17 3:23 PM		100%
15	**Implementation**	**8.5 days?**	**11/27/17 3:23 PM**	**12/8/17 10:23 AM**	**14**	**100%**
16	**Create Object Fu...**	**1.5 days?**	**11/27/17 3:23 PM**	**11/29/17 10:23 AM**		**100%**
17	Point Object	0.5 days?	11/27/17 3:23 PM	11/28/17 10:23 AM		100%
18	Line Object	0.5 days?	11/28/17 10:23 AM	11/28/17 3:23 PM	17	100%
19	Polygon Object	0.5 days?	11/28/17 3:23 PM	11/29/17 10:23 AM	18	100%
20	Edit Object Function	1 day?	11/29/17 10:23 AM	11/30/17 10:23 AM	16	100%
21	Erase Object Funct...	1 day?	11/30/17 10:23 AM	12/1/17 10:23 AM	20	100%
22	Display Function	1 day?	12/1/17 10:23 AM	12/4/17 10:23 AM	21	100%
23	Select Function	1 day?	12/4/17 10:23 AM	12/5/17 10:23 AM	22	100%
24	Read From SCV Fu...	1 day?	12/5/17 10:23 AM	12/6/17 10:23 AM	23	100%
25	Save To SCV Funct...	1 day?	12/6/17 10:23 AM	12/7/17 10:23 AM	24	100%
26	Query Function	1 day?	12/7/17 10:23 AM	12/8/17 10:23 AM	25	100%
27	Test (Quality Assura...	0.201 days?	12/8/17 10:23 AM	12/8/17 12:23 PM	15	100%
28	**Data Base Connecti...**	**3.392 days?**	**12/8/17 12:00 PM**	**12/13/17 4:08 PM**	**13**	**100%**
29	Definition	0.142 days?	12/8/17 12:00 PM	12/8/17 2:08 PM		100%
30	**Implementation**	**3 days?**	**12/8/17 2:08 PM**	**12/13/17 2:08 PM**	**29**	**100%**
31	Object creation in DB	1 day?	12/8/17 2:08 PM	12/11/17 2:08 PM		100%
32	Auto-Reload From DB	1 day?	12/11/17 2:08 PM	12/12/17 2:08 PM	31	100%
33	Connectivity	1 day?	12/12/17 2:08 PM	12/13/17 2:08 PM	32	100%
34	Test (Quality Assura...	0.25 days?	12/13/17 2:08 PM	12/13/17 4:08 PM	30	100%

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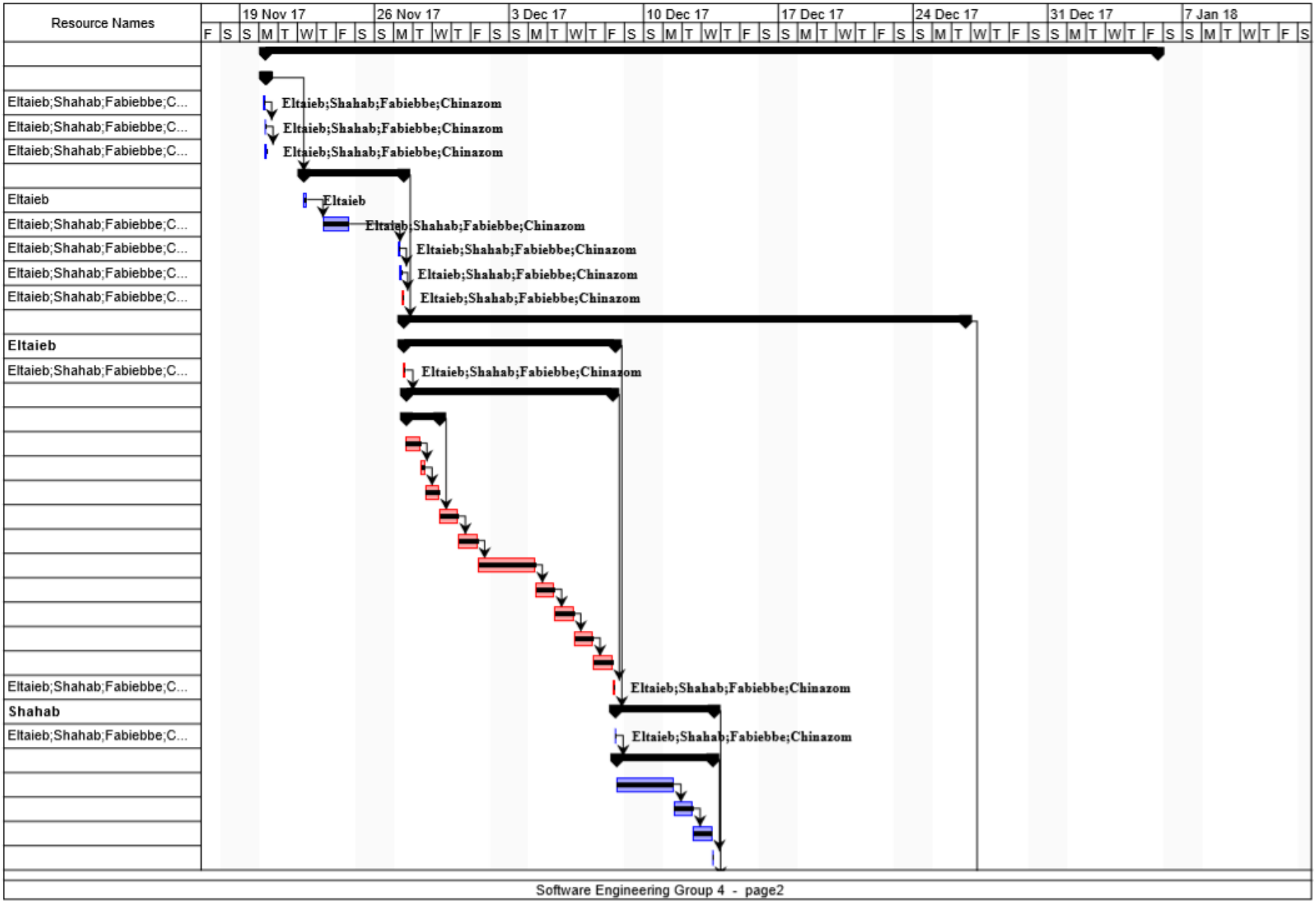
Resource Names
19 Nov 17
26 Nov 17
3 Dec 17
10 Dec 17
17 Dec 17
24 Dec 17
31 Dec 17
7 Jan 18
F S S M T W T F S S M T W T F S S M T W T F S S M T W T F S S M T W T F S S M T W T F S S M T W T F S S M T W T F S
Eltaieb;Shahab;Fabiebbe;C...
Eltaieb;Shahab;Fabiebbe;C...
Eltaieb;Shahab;Fabiebbe;C...
Eltaieb
Eltaieb;Shahab;Fabiebbe;C...
Eltaieb;Shahab;Fabiebbe;C...
Eltaieb;Shahab;Fabiebbe;C...
Eltaieb;Shahab;Fabiebbe;C...
Eltaieb
Eltaieb;Shahab;Fabiebbe;C...
Eltaieb;Shahab;Fabiebbe;C...
Shahab
Eltaieb;Shahab;Fabiebbe;C...
Eltaieb;Shahab;Fabiebbe;Chinazom
Eltaieb;Shahab;Fabiebbe;Chinazom
Eltaieb;Shahab;Fabiebbe;Chinazom
Eltaieb
Eltaieb;Shahab;Fabiebbe;Chinazom
Eltaieb;Shahab;Fabiebbe;Chinazom
Eltaieb;Shahab;Fabiebbe;Chinazom
Eltaieb;Shahab;Fabiebbe;Chinazom
Eltaieb;Shahab;Fabiebbe;Chinazom
Eltaieb;Shahab;Fabiebbe;Chinazom
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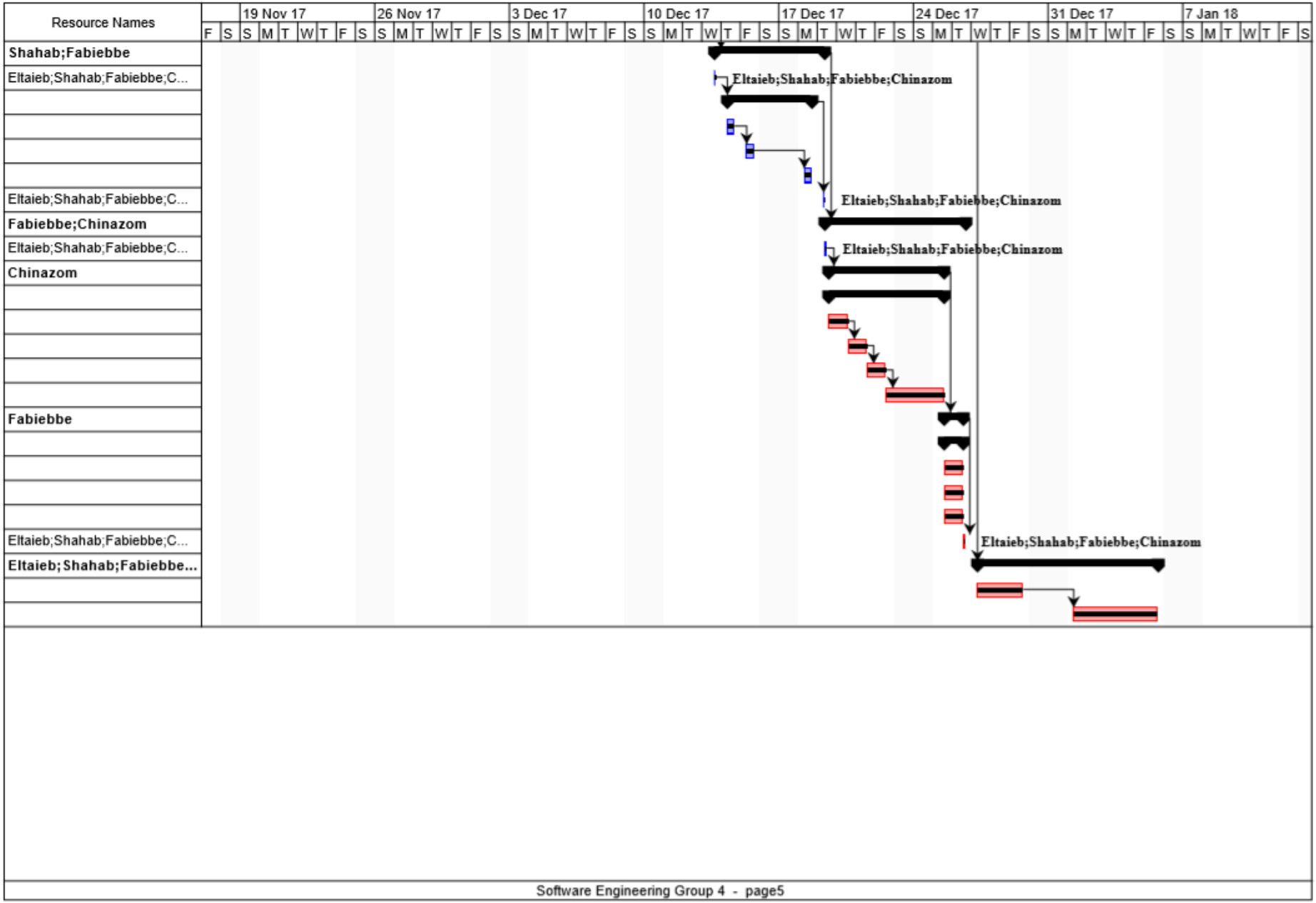
		Name	Duration	Start	Finish	Predecessors	Percent Work Complete
35	✔	**File Handling**	**3.375 days?**	**12/13/17 4:08 PM**	**12/19/17 10:07 AM**	**28**	**100%**
36	✔	Definition	9.378 days?	12/13/17 4:08 PM	12/13/17 6:17 PM		100%
37	✔	**Implementation**	**3 days?**	**12/14/17 8:00 AM**	**12/18/17 5:00 PM**	**36**	**100%**
38	✔	Create File	1 day?	12/14/17 8:00 AM	12/14/17 5:00 PM		100%
39	✔	Write on a File	1 day?	12/15/17 8:00 AM	12/15/17 5:00 PM	38	100%
40	✔	Open File	1 day?	12/18/17 8:00 AM	12/18/17 5:00 PM	39	100%
41	✔	Test (Quality Assura...	6.267 days?	12/19/17 8:00 AM	12/19/17 10:07 AM	37	100%
42	✔	**GUI**	**5.733 days?**	**12/19/17 10:07 AM**	**12/26/17 5:28 PM**	**35**	**100%**
43	✔	Difinition	6.004 days?	12/19/17 10:07 AM	12/19/17 12:17 PM		100%
44	✔	**Design**	**4 days?**	**12/19/17 3:09 PM**	**12/25/17 3:09 PM**	**43**	**100%**
45	✔	**Main Window**	**4 days?**	**12/19/17 3:09 PM**	**12/25/17 3:09 PM**		**100%**
46	✔	BackGround	1 day?	12/19/17 3:09 PM	12/20/17 3:09 PM		100%
47	✔	Menu	1 day?	12/20/17 3:09 PM	12/21/17 3:09 PM	46	100%
48	✔	Toolset	1 day?	12/21/17 3:09 PM	12/22/17 3:09 PM	47	100%
49	✔	Message Window	1 day?	12/22/17 3:09 PM	12/25/17 3:09 PM	48	100%
50	✔	**Implementation**	**1 day?**	**12/25/17 3:09 PM**	**12/26/17 3:09 PM**	**44**	**100%**
51	✔	**Toolset (Control ...**	**1 day?**	**12/25/17 3:09 PM**	**12/26/17 3:09 PM**		**100%**
52	✔	Open File (CSV, ...	1 day?	12/25/17 3:09 PM	12/26/17 3:09 PM		100%
53	✔	Save File (SCV, D...	1 day?	12/25/17 3:09 PM	12/26/17 3:09 PM		100%
54	✔	Message window...	1 day?	12/25/17 3:09 PM	12/26/17 3:09 PM		100%
55	✔	Test (Quality Assura...	0.519 days?	12/26/17 3:09 PM	12/26/17 5:28 PM	50	100%
56	✔	**Documentation & Pre...**	**8 days?**	**12/27/17 8:00 AM**	**1/5/18 5:00 PM**	**12**	**100%**
57	✔	Report	3 days?	12/27/17 8:00 AM	12/29/17 5:00 PM		100%
58	✔	Presentation	5 days?	1/1/18 8:00 AM	1/5/18 5:00 PM	57	100%



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UML diagramm