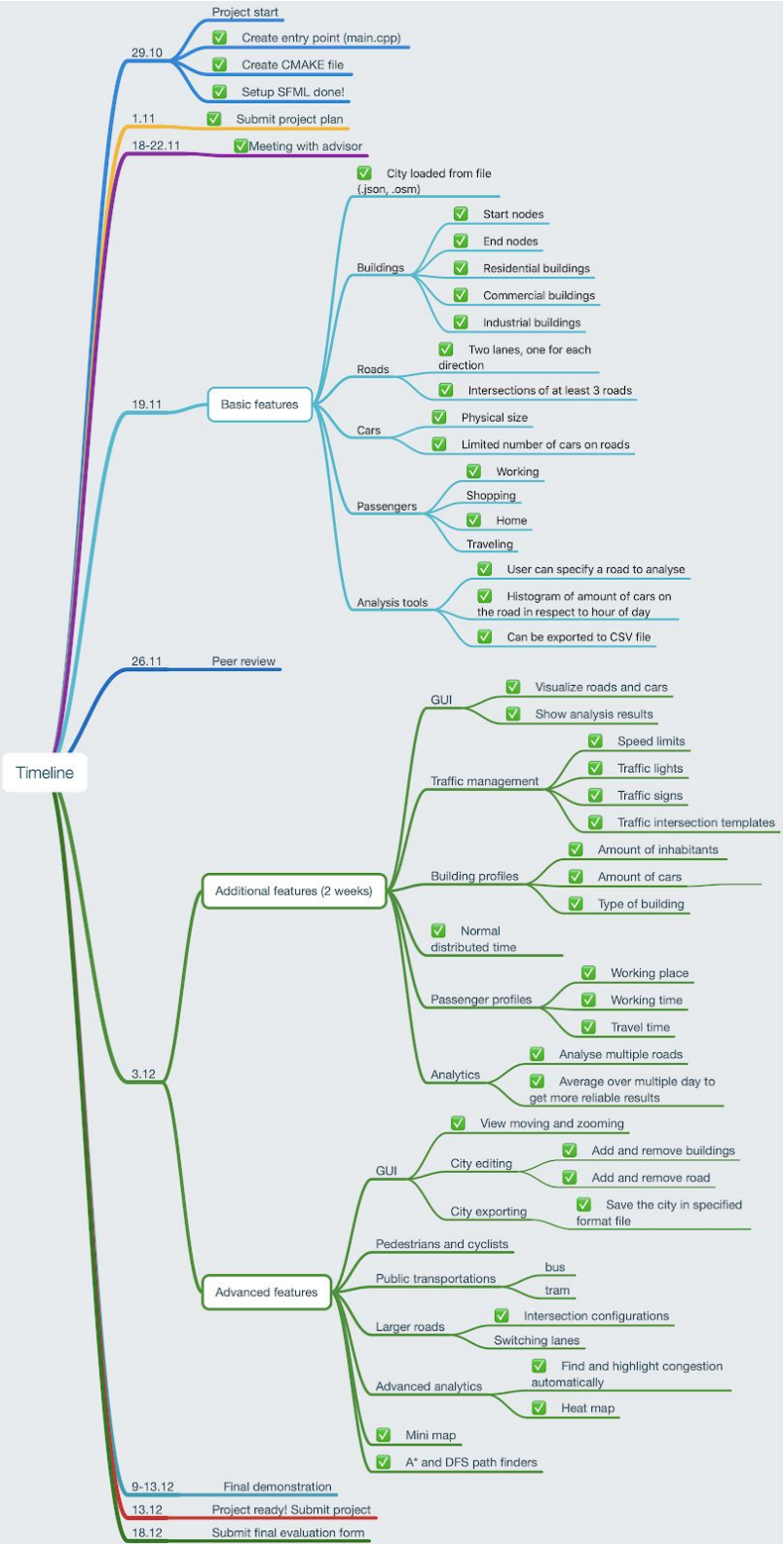
Project Documentation

1. Introduction

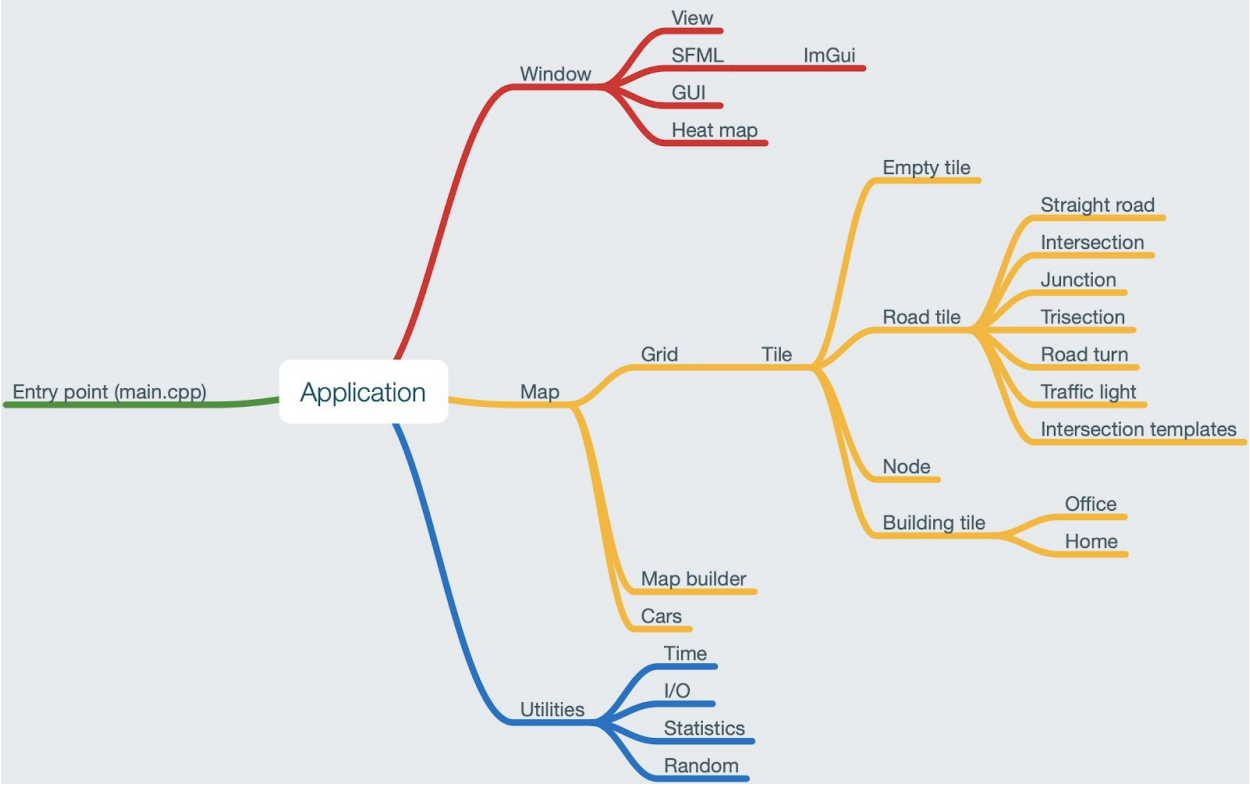
Project name: Traffic Simulator

The figure below presents all the features that have been done. The finished features are marked with green check mark.



2. Software structure

The below figure illustrates the structure of the application. They include all classes and external libraries implemented in the application.



3. Installation and user guide

3.1. Installation guide

The instruction for download and install the software is described as the following. It can also be found in the README file in the software's repository.

- Clone the software: `git clone https://courses-git.comnet.aalto.fi/CPlusPlus/traffic-simulator-2019-1.git` or download zip package and unzip.
- Create build directory inside of the project folder: `mkdir build`
- Open navigate into new "build" folder with terminal: `cd build`
- Generate makefile with CMake: `cmake ..`
- Build generated makefile: `make`
- Run it: `./a`

3.2. User guide

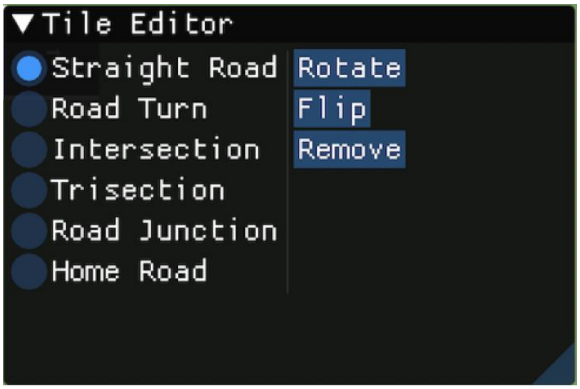
The user guide presents the basic instruction on how to use the application. The software includes three components in the main screen, which are the navigation bar, the action menus and the map. The application has two modes – editing and simulating. The guide structure is divided into two main parts based on the modes of the software.

The navigation bar is positioned on the top of the application. It contains three tabs – File, Mode, and Scale. File tab allows to save and load the map. There is one input area which requires users to insert a name for the file. Users have to remember the name of the save file for further loading. If the map is successfully saved or loaded, a message will be displayed in the Log table. Map overrides old file if there is one with the same name. When loading map, it is required to leave ".csv" ending. Maps are saved into "/build/" folder. There are maps provided for testing which can be seen in "res" folder. They will be copied into "build" folder every time program starts. Don't name your map with the same name as testing maps.

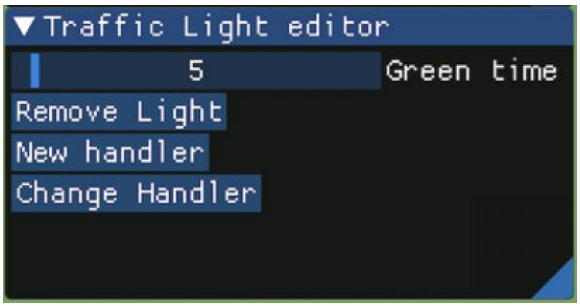
On the Mode tab, it is to change the mode of the application between editing and simulating modes. Editing mode allows users to build the map for simulation. After the map is ready, it is able to change to simulating mode to start to simulate the traffic. Scale tab is the place to change the font size of the text in the software. It depends on the user's screen resolution, a suitable scale number can be chosen. The shortcuts for scaling are "shift + up/down" or "ctrl + 1/2/3/4/5/6".

3.2.1. Editing mode

By selecting Editing on the Mode tab, the screen is switched to editing mode. There is an action menu, named Map Editor, in which various building actions can be selected. The below table of the menu is the submenu, the content is changed corresponding to the selected section on the top table. From the menu, users have many supported choices to build the city map.



- Inspect: it is to inspect the map. Pressing left mouse button is to move the map around, and mouse scroller to zoom in and out the map.
- Add road: it is to add various kinds of road into the map. By selecting Add Road, users can see different kind of road in the sub menu. The road can be added by pressing the right mouse button on the desired places on the map. For quick build, it is recommended to press Ctrl and left mouse button. In order to change the type of the road and its direction, it is to click on the road tile, a popup menu appears, which is named Tile Editor. In the menu, users are allowed to switch between six types of road, change its direction, and remove the road itself. In order to remove multiple roads, users can hold the Shift button and left mouse button to remove the desired roads.
- Add building: there are two kinds of building which are home and office building. The buildings should be added next to the road. If there is no building on the map, there is no car in the simulation. Every building should have a close road which is not a dead end. If you want to get map working properly do not make any dead ends.
- Add template: the templates are some pre-building roads including cross intersection, T-intersection, and roundabout.
- Add light: the traffic light can be found in the section. After selecting Add light, pressing right mouse button will help to add traffic light to road. Traffic lights are managed in networks. If the traffic lights are in a same network, there is only one green light at the same time. The setting for traffic light is in the popup menu named Traffic Light editor by clicking on the

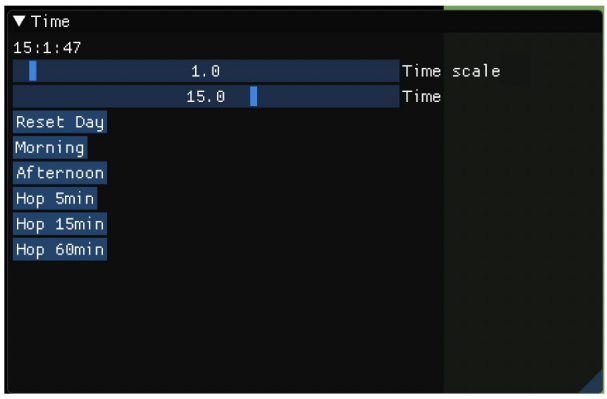


traffic light on the map. In setting menu, users can edit the green time, add and move the traffic light to a specific network. Traffic Light networks are displayed as connections with blue lines. Also new traffic light network can be added with button. If one light network has only one light in it, no connections are visible.

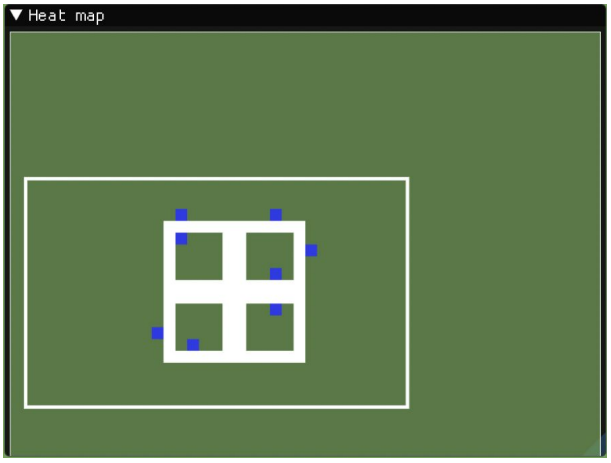
- Rotate: it aims to assist road rotation. After selecting Rotate, using right mouse click to rotate roads.
- Flip: it is to flip roads by using the right mouse button.
- Remove: using the right mouse button to click on the road or building will remove it. It is suggested that holding Shift button and left mouse button for faster roads and building removal.

3.2.2. Simulation mode

Simulation mode can be accessed by selecting Simulating in the Mode tab in the navigation bar. In this mode, users can see four popup menus.



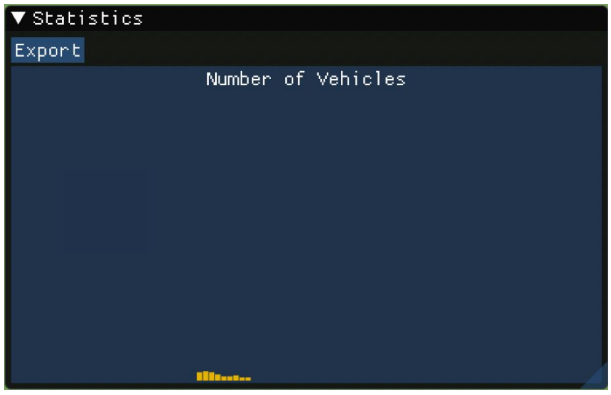
- Time menu: it allows users to control the time in the software. It simulates the real-time of a day. In the below photo, the clock is the first line, which display the time in the application. The second line is the Time scale used to adjust the speed of time. By changing the slider, the time speed can be slower or faster. The third line is the time which corresponds to the time in the first line. The time in the application can be controlled via this slider. The remaining buttons have different features. Reset Day to reset the time. Morning is used to set the time at 7:00 am. Afternoon adjusts the time to 3:00 pm. Hop 5, 15 and 60 mins to add that amount of time to the application's time.



- Heat map: is a mini map which displays the traffic heatmap. If the traffic gets heavy on specific road, the color of that road will change. In addition, it is able to navigate to the map via the mini map.

- Statistics: is the histogram representing the amounts of vehicles moving across the specific road for a day. There are 96 columns.

Each column displays the amounts of vehicles for 15 minutes. The histogram can be interpreted that if there are 8 cars in columns number 30, it means that the amounts cars go through that road between 7:15 to 7:30 are 8. The statistics data can be exported to csv file by pressing on Export button. The file is saved under the name histogram.csv.



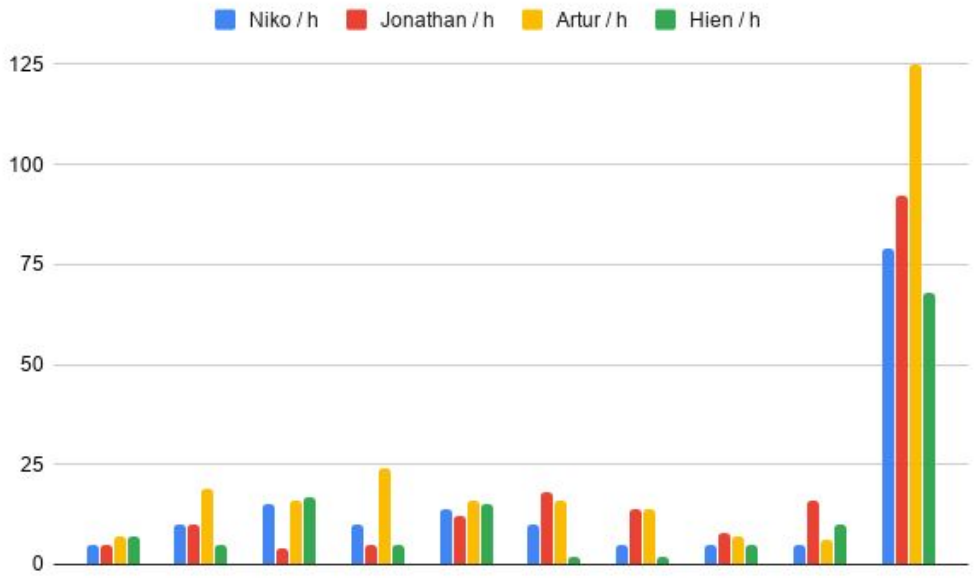
4. Testing

We implemented all the different modules one week before the project deadline and then started testing phase. Everybody had their own modules to test. Bugs were patched as they were found, and taken care of. The test cases can be found from the work log table.

Unit testing were carried out by a different student who wrote code and sometimes the testing were taken care of another student.

User acceptance or usability testing were done in some part of the software, for example some users tried to test the GUI for implementing the traffic simulator map by themselves.

5. Work log



Weeks	Niko	Niko / h	Jonathan	Jonathan / h	Artur	Artur / h	Hien	Hien / h
42	Propject plan, project meeting,	5	Project plan,Project meeting (cmake stuff), sfml	5	Project plan, Tile, ---de, Window, Application	7	Project plan + mind map	7
43	Building class, project plan ,Pro meet	10	Project plan, Car class	10	RoadClass (later RoadTile), VectorMath. project meet	19	Drawing the cars, group meeting	5
44	HomeRoad,project meet	15	Project meeting	4	Map, Car, Intersection (later deleted),DFS-algorithm, Road Textures, project meet	16	Statistics - Histogram - ImGui, group meeting	17
45	OfficeBuilding class,project meet	10	Project documentation	5	MapBuilder, Grid, View moving/zooming, project meeting	24	Exports histogram data to csv	5
46	Random generator, road remover,pro meet	14	SFML/ImGui linking with CMake, Save	12	TrafficLight, TrafficLightNetwork, project meeting	16	Intersect templates, group meeting, peer-review	15
47	project meet,Buildings	10	Project meet, Saving the map	18	RoadTemplates, TimeLine, meeting	16	Group meeting	2
48	project meet, Search, road slider rotation	5	Project meet,Loading the map	14	Heatmap, meeting, testing and bug fixes	14	Exporting message to logs	2
49	testing, Road	5	Project meet, GUI inputs,file exceptions, saving	8	testing, bug fixing, QoL features, code cleaning	7	Testing	5
50	Tile rotation, bug fixing, final presentation	5	Testing, Saving the map	16	meeting, bug fixing	6	User guide, Project documentation, final presentation	10
TOTAL		79		92		125		68

Features	Deadline		Basic Features		Advanced features	Status
Map	19.11.2019		Yes		---	Completed
Road	19.11.2019		Yes		---	Completed
Nodes	19.11.2019		Yes		---	Completed
Building	19.11.2019		Yes		---	Completed
Car	19.11.2019		Yes		---	Completed
Passenger	28.11.2019		Yes		---	Completed
Analysis tools	28.11.2019		---		Yes	Completed
City Editing	28.11.2019		---		Yes	Completed
GUI	28.11.2019		---		Yes	Completed
Traffic Management	6.12.2019		---		Yes	Completed
Building profiles	6.12.2019		---		Yes	Completed
Advanced analytics	6.12.2019		---		Yes	Completed