**DOCUMENTATION**

INTRODUCTION

1. THE TASK

We consider a graph that models a network (social, transport, etc.). The graph will be taken from a data set stored in a file. To write an application with the following requirements:

1. using the input data from the file, create a representation of the graph in the form of an adjacency list, adjacency matrix, edge list, etc.
2. at least 4 functions that apply one algorithm each to solve four real problems related to the studied graph. The algorithms must each belong to the following problems:
3. Connectivity, topological sorting
4. Shortest path
5. Minimal spanning tree
6. Eulerian, Hamlitonian cycles
7. Couplings in graphs (Matching)
8. Flows and transport networks (Maximum flow)
9. the project will also contain a documentation describing the domain that the graph models, the problems that will be solved by using algorithms, observations regarding performance, operating time, optimizations, etc.

PROJECT DESCRIPTION

1. THE DATASET

I got the data set from a site called: Network Repository. There are a lot of huge data sets in different formats on it: <https://networkrepository.com/index.php>.

My dataset is on the topic „**Infrastructure Networks**”: <https://networkrepository.com/inf-power.php.>.

1. PROJECT

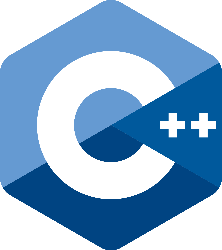
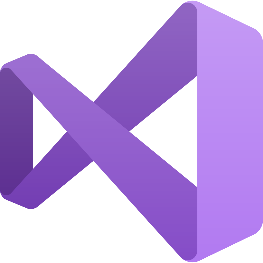
My project consists of two sections:

* **Coding**
* **Network visualisation**

In the coding section I develop **OOP** based algorithms in **C++** in order to solve the tasks.

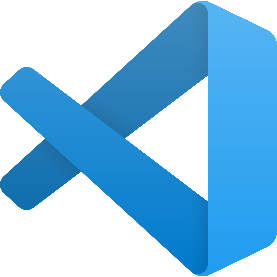
The network visualisation is a suplimentary thing. It’s a small **python** project that helps me visualise the graph and export the adjacency list, adjacency matrix and incidence matrix faster (task **a)**).

1. TOOL USED

For the coding part I used the following tools:

1Visual Studio 2022

2C++ programming language

For the network visualisation I used the following tools:



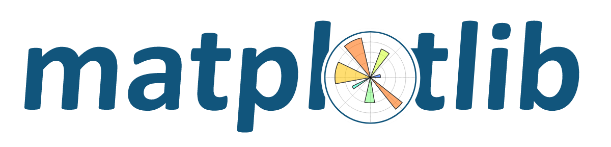
3Visual Studio Code

4Python programming language



5Networkx python library

6Pandas python library



7Numpy python library

8Matplotlib python library

Other tools:



9Git CVS

10Excel

TASK SOLVING

1. GENERAL

The tasks are solved in the coding section. In the **„Coding/Graph network”** folder we can find all the files used to solve the tasks: sources, headers and resources.

There are two sources files:

* **Source.cpp**
* **inputData.cpp**

Source.cpp is used to declare an object of the Graph class and call the method used to solve the tasks.

**inputData.cpp** contains the method used for importing the edges from dataset.

There are three header files:

* **Graph.h**
* **sparseMatrix.h**
* **stringToType.h**

**Graph.h** contains the structure of our class and it’s main method.

**sparseMatrix.h** contains the sparseMatrix class wich helps us store the data for the adjacency and incidence matrices of our graph.

**stringToType.h** contains a template class used for converting data from string to a template type.

The resources folder contains another folder in wich we have our dataset in **csv** format. In the conding section, the **inf-power-1.csv** file is used.

BIBLIOGRAPHY