

# Programming Assignment 2

## All Pairs Shortest Path

### Problem Description

*Input:* A graph  $G = (V, E)$

*Output:* An  $n \times n$  table of the shortest path between every pair of vertices  $v_i, v_j \in V$

### Bellman-Ford

First, implement a “naive” solution which runs Bellman-Ford’s algorithm, as described in the lecture slides, once for each vertex. Each run will give you one row of the final table.

### Floyd-Warshall

Implement Floyd-Warshall’s algorithm, as described in the lecture slides, to solve the problem.

### Programming Requirements

- You will be writing the program in Python 3, using the provided template.
- The allPairsShortestPath.py script should run through the command line. A argument parser has been added to the template. (<https://docs.python.org/3/library/argparse.html>)
- The output should be a file named <dataset>\_shortestPaths.txt formatted according to Fig. 1 (b).
- The input will be a .txt file with the first line containing the number of vertices (n) and the number of edges (m) (separated by a space). The following m lines will be the edges formatted as “<source> <sink> <weight>” where the weight can be positive or negative. An example is shown in Fig. 1 (a).

dataset1.txt	dataset1_shortestPaths.txt
<pre> 4 5 1 2 1 2 3 2 3 4 3 4 2 7 4 1 4 </pre>	<pre> d[1,1] d[1,2] d[1,3] d[1,4] d[2,1] d[2,2] d[2,3] d[2,4] d[3,1] d[3,2] d[3,3] d[3,4] d[4,1] d[4,2] d[4,3] d[4,4] </pre>
(a)	(b)

Figure 1. (a) Input and (b) output file formats. Command:  
`$python3 --algorithm a dataset1.txt`

## Profiling

You will be using the [profile](#) package in python to profile your program.

## Report

The report needs to contain the following (use the provided LaTeX template):

- A run-time analysis of the Bellman-Ford algorithm vs. the Floyd-Warshall algorithm described
- A table showing the run-time of each algorithm on all data sets provided
- A discussion of the theoretical run-time (justify the theoretical run-time for both algorithms)
- A discussion of the theoretical run-time, and how it is shown in the real example (how does the real run-time scale as predicted by the asymptotic run time)
- A section discussing what you learned about Python this quarter. This can simply be a short section about what you learned that was new or interesting.

# Submission

You will be submitting a .zip file with the following components

- allPairsShortestPath.py - *The code that you wrote*
- Report.pdf - *Report of the results of your experiments (written in LaTeX)*
- README.txt - *Describing how to run the program*

*Please name all the files correctly and submit in this format, if you do not you will be lose points.*

The simple reasoning for this is that it is good practice to be able to follow conventions as the company you go work for will have conventions you must follow. Additionally, it enables us as graders to write scripts to do some of the tedious grading tasks (does your code work on large datasets).