ADSA - 2019-2020

Tutorial 8-9

Mini-Project: The Joker

- To do this mini-project, create group for one or two students only (group of 3 students are forbidden)
- You have two class sessions to do this mini project. Drop your report on DVO at the end of last session.
- For all questions you must argue your answers with code and detailed exploration and justify your answers in report (minimum 5 pages)

Score (percent)

Part 1: 25%
Part 2: 25%
Part 3: 25%
Part 4: 25%

PART 1: Connecting the people

Gotham City, August 1982, the city is subject to fire and sword. The whole district is under the Jokers and the police browse across the battlefield like scared dogs. Your new organization need a communication network to build a lasting resistance to the corrupted government. You decide to place some radio substation in each railway stations, each substation have a wired connection to at least another substation to create a connected network (in Uptown, Midtown and Downtown, see the map above).

Code all algorithm and justify your answer in the report

1. Create and display a graph representing the Gotham City's railways and subways below (10%)

Les étudiants doivent représenter la carte ci-après dans un graphe non orienté pondéré, le poids représente la distance entre deux stations de métro.

2. Which kind of algorithm create a connected graph while minimizing the total amount of distance? Show the algorithm? What is its complexity? (5%)

Le problème à résoudre est un Minimal Spanning Tree, soit par la méthode de Prim, soit par la méthode de Kruskal.

3. Show and display a solution of the connected network. (10%)


TRANSIT INFORMATION
GCR GOTHAM CITY RAIL
Key to Line Names.
Tri-Rail Lines
Red Line
Yellow Line
Green Line
Intermediate Line
Steel Line
White Line
Black Line
Brown Line
Orange Line
Ground level Lines
Steel Line
Green Line
Orange Line
Brown Line
International Line
Yellow Line
UPTOWN
HARROW
JEROLD
MIDTOWN
GAINSLY
HAYSVILLE
DOWNTOWN
WEST HARLOW
GCR GOTHAM CITY RAIL

Part 2: Spread the revolution

Since Gotham is in your hand, the revolution needs to be disseminated into other cities. You have many volunteers, but you want to optimize the process. Following the matrix of distance below, you want to compute the shortest path from to Gotham City (first line/column) to the others. At each path from Gotham to an endpoint, a volunteer is sent.

	g_1	g_2	g_3	g_4	g_5	g_6	g_7	g_8	g_9	g_{10}
g_1	0.0	8.1	9.2	7.7	9.3	2.3	5.1	10.2	6.1	7.0
g_2	8.1	0.0	12.0	0.9	12.0	9.5	10.1	12.8	2.0	1.0
g_3	9.2	12.0	0.0	11.2	0.7	11.1	8.1	1.1	10.5	11.5
g_4	7.7	0.9	11.2	0.0	11.2	9.2	9.5	12.0	1.6	1.1
g_5	9.3	12.0	0.7	11.2	0.0	11.2	8.5	1.0	10.6	11.6
g_6	2.3	9.5	11.1	9.2	11.2	0.0	5.6	12.1	7.7	8.5
g_7	5.1	10.1	8.1	9.5	8.5	5.6	0.0	9.1	8.3	9.3
g_8	10.2	12.8	1.1	12.0	1.0	12.1	9.1	0.0	11.4	12.4
g_9	6.1	2.0	10.5	1.6	10.6	7.7	8.3	11.4	0.0	1.1
g_{10}	7.0	1.0	11.5	1.1	11.6	8.5	9.3	12.4	1.1	0.0

Code all algorithm and justify your answer in the report

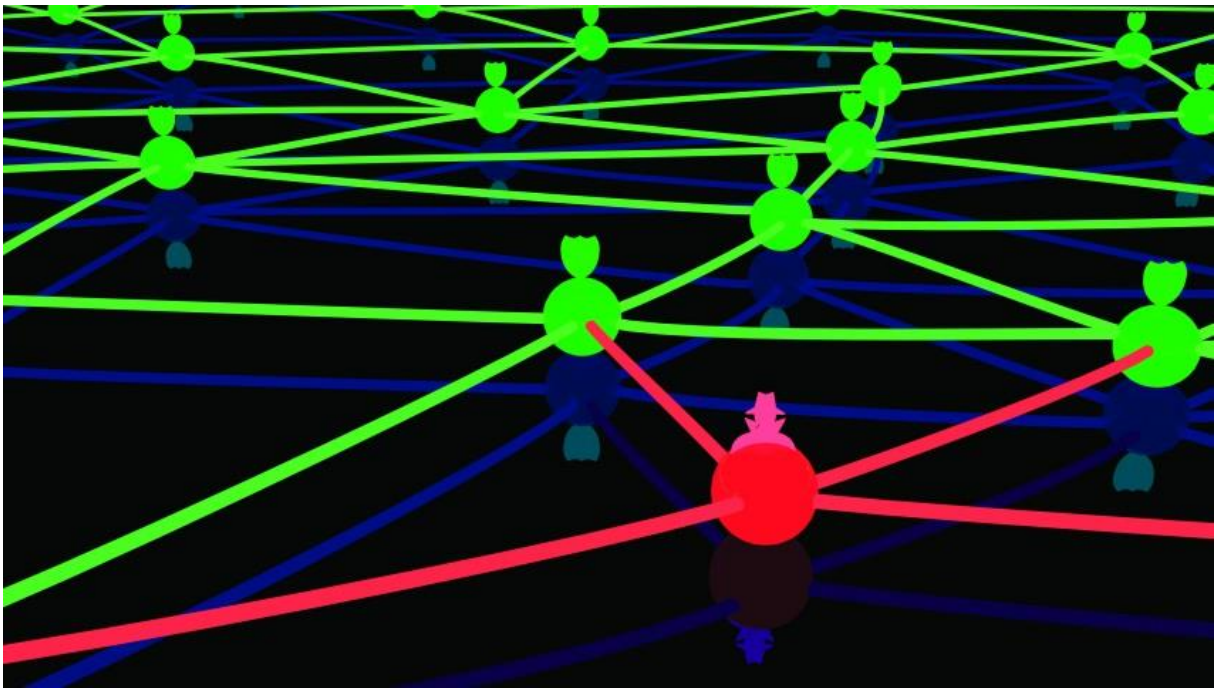
1. Which kind of algorithm create a connected graph while minimizing the distance to a unique city? What is its complexity? (5%)

L'algorithme en question est pour résoudre un Shortest Path, le plus simple a utiliser dans les contraintes de poids positifs est l'algorithme de Dijkstra.

2. Show and display a solution of the proposed algorithm. (10%)
3. Show and display a solution of the problem. (5%)

Le problème est de trouver le nombre de personne à envoyer. Ce nombre correspond au nombre de feuilles de l'arbre de plus court chemin établi avec Dijkstra.

Part 3: Organize the Jokers



The organization is growing so fast that some corrupted contact infested your new world. Most of the supporters are registered in a database which is informed by confirmed Jokers. While meeting another supporter, one may identify the other one in the database.

Code all algorithm and justify your answer in the report

1. Suggest and show a greedy method to find an ID in a (linear) database. What is its complexity? (5%)

Il suffit de parcourir la liste des données jusqu'à tomber sur le bon numéro.

2. Suggest and show a divide and conquer method to find an ID in a (linear) database. What is its complexity? (5%)

Il s'agit de la recherche dichotomique.

3. Suggest and show a method that sort the (linear) database and find an ID. What is its complexity? (5%)

Méthode de tri d'un tableau. L'ID a trouvé est alors facile à trouver par dichotomie (vérifier si le milieu est sup ou inf et aller dans la partie correspondante).

4. Show and display the three methods with an example of database of your choice (at least 50 data). (10%)

ADSA - 2019-2020

Part 4: The Jokefather

Your organization is worldwide, you are the Jokefather, the cradle of crimes and filths. The Empire is so big and manage so much people and malicious business, dishonest acts and unfair actions that ever the best IT crews have a hard time to handle so much information. You need to find a better management of those data. Knowing the great engineering school named ESILV, you ask them to find a solution.

Code all algorithm and justify your answer in the report

1. Suggest and show a method to manage a database in a binary tree; present a method to find any value in the tree (show both complexity). Show the methods with your own example (at least 50 data). (5%)
2. Suggest and show a method to improve the database management thanks to the works of the soviets Adelson-Velsky and Landis with the previous database. (10%)
3. Suggest and show a method that sort the database un a tree where the node can store multiple value like the works of Bayer and McCreight. Take your own example (at least 100 data) where each node can store up to 5 values. (10%)