In Class 8

Tuesday, May 30, 2023 3:55 PM

CS2023 - Inclass Lab

Week 12 - SSSP

Note: You are required to answer the below questions and submit a PDF to the submission link provided under this week before the deadline (no extensions will be provided). You can either write / type your answers, but either way your answers should be readable.

Add the link to the GitHub repository

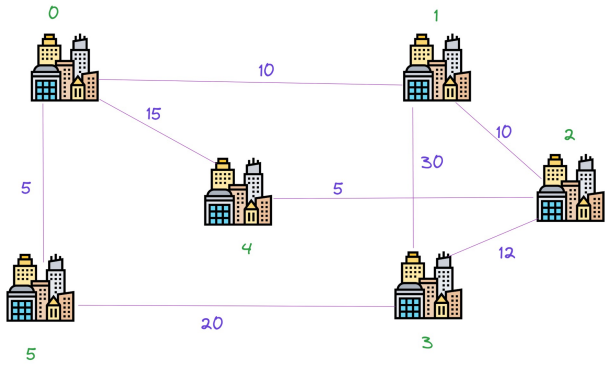


Figure 1: City graph

Lab instruction

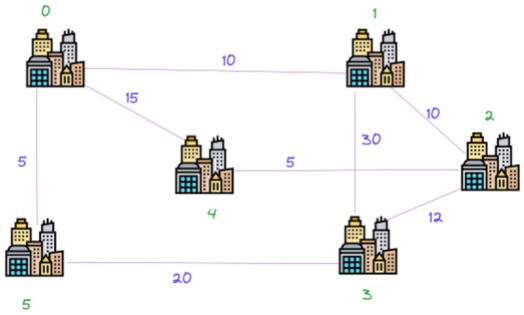
Here we have 6 cities in a rural area. It has been estimated that for the population of all 6 cities building 1 hospital is sufficient and cost effective. As part of the City planning division, you are tasked to decide which city we must build the hospital in. To do this one must think of alot constraints, eg: one can decide to place the hospital at the city with the highest population among the 6 cities. Assume that all the other constraints are equal in each city. You must place the hospital such that the ambulances in the hospital can attend to each city at the shortest time. The weighted undirected graph provided in Fig.1 has cities as nodes and edges as average time taken from each city to another city(where possible not all cities have roads between them).
Expected submission

1. Write the weighted adajaceny matrix for the graph on Fig 1.
2. Implement SSSP Dijkstra's Algorithm
3. By changing the source node in your algorithm take the shortest time between source city to all the other cities. (Eg: if source city 0, then you must calculate the shortest time between City 0 to City 1, City 0 to City 2, City 0 to City 3... etc). Take screenshot of the output for each source city.
4. Calculate the average time taken from each source city to the other cities. Pick the city with the smallest average time (if more than 1 city has the same smallest average give all of them)

Lab instruction

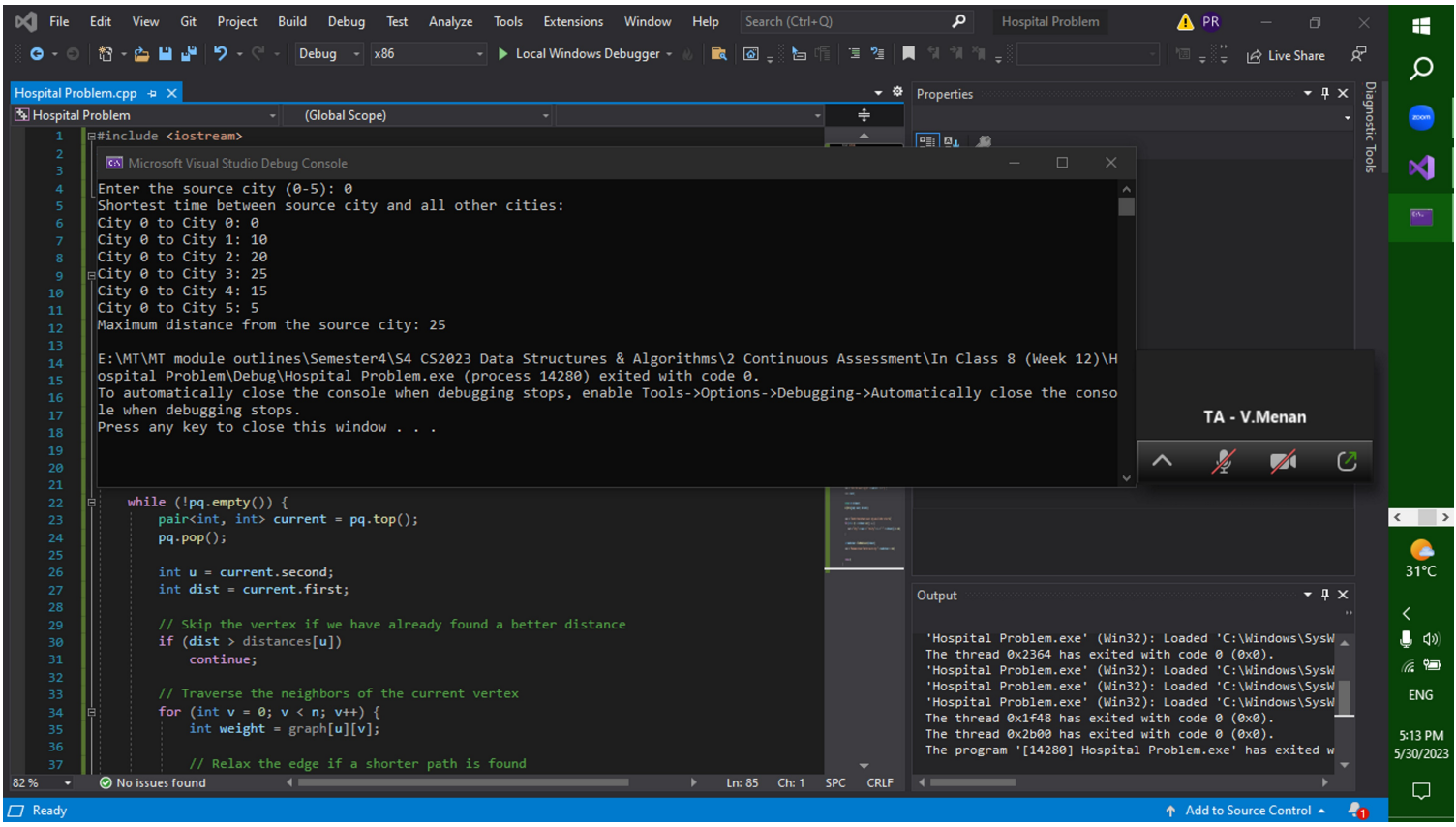
Here we have 6 cities in a rural area. It has been estimated that for the population of all 6 cities building 1 hospital is sufficient and cost effective. As part of the City planning division, you are tasked to decide which city we must build the hospital in. To do this one must think of alot constraints, eg: one can decide to place the hospital at the city with the highest population among the 6 cities. Assume that all the other constraints are equal in each city. You must place the hospital such that the ambulances in the hospital can attend to each city at the shortest time. The weighted undirected graph provided in Fig.1 has cities as nodes and edges as average time taken from each city to another city(where possible not all cities have roads between them).
Expected submission

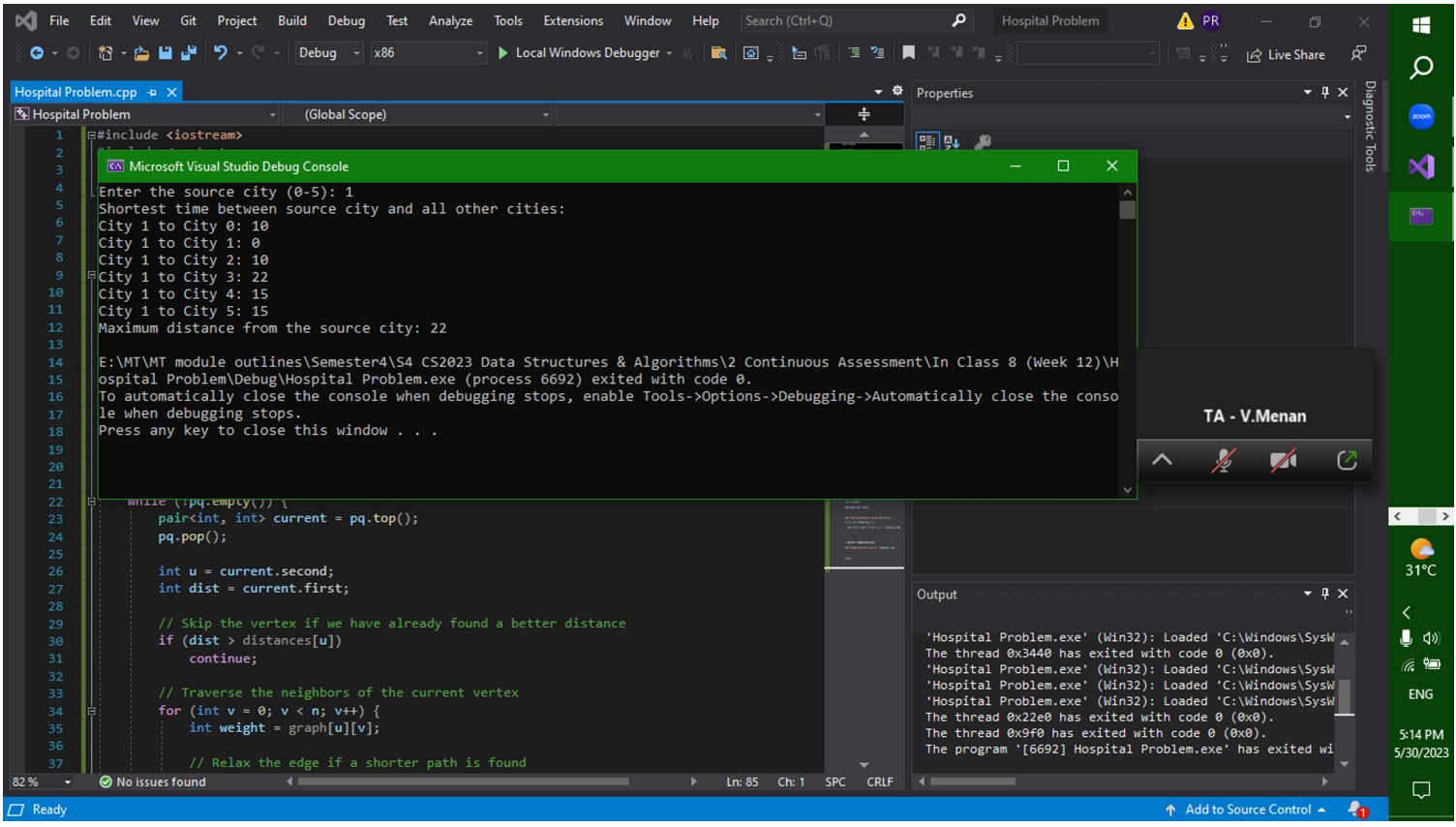
1. Write the weighted adajaceny matrix for the graph on Fig 1.

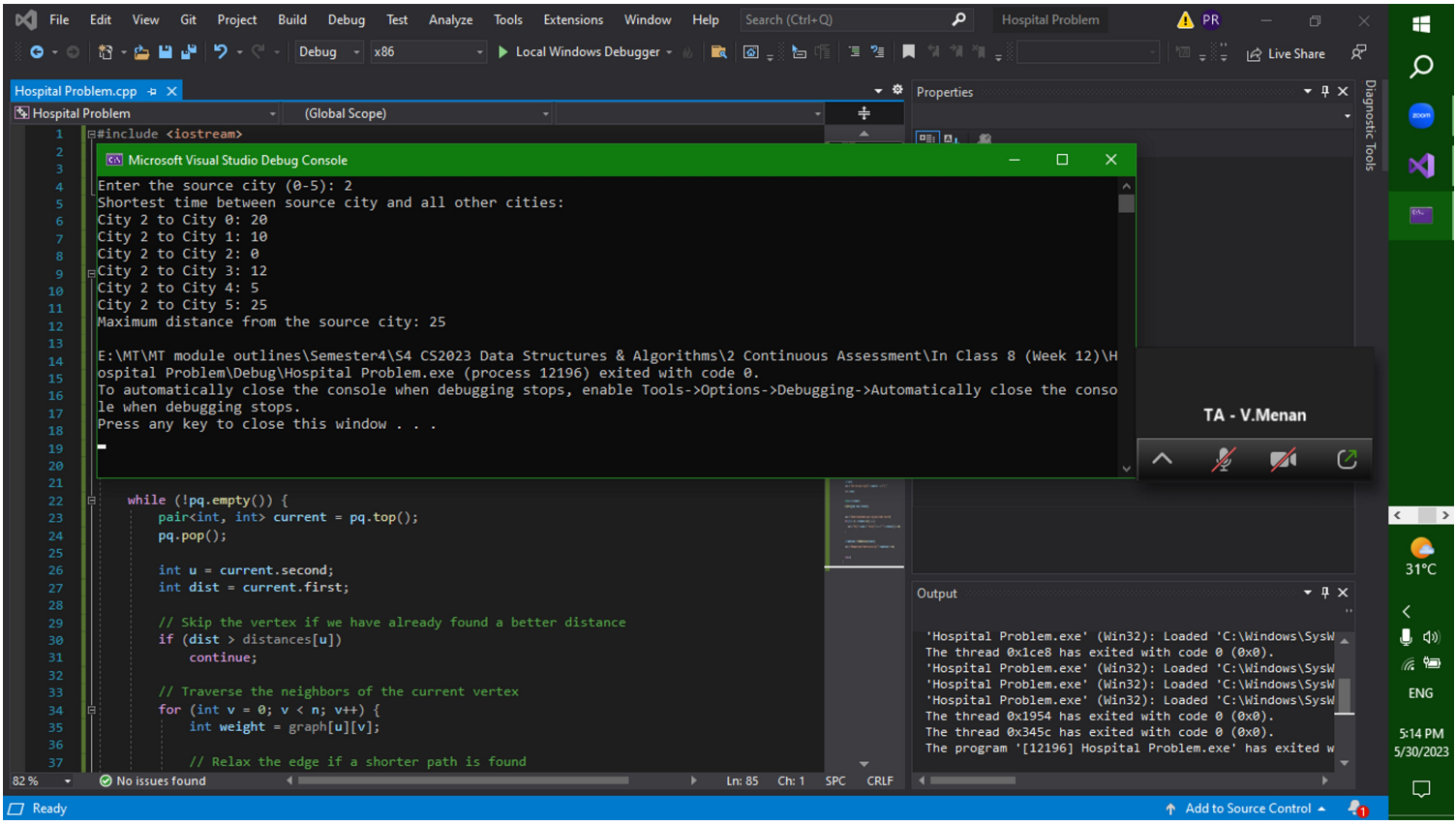


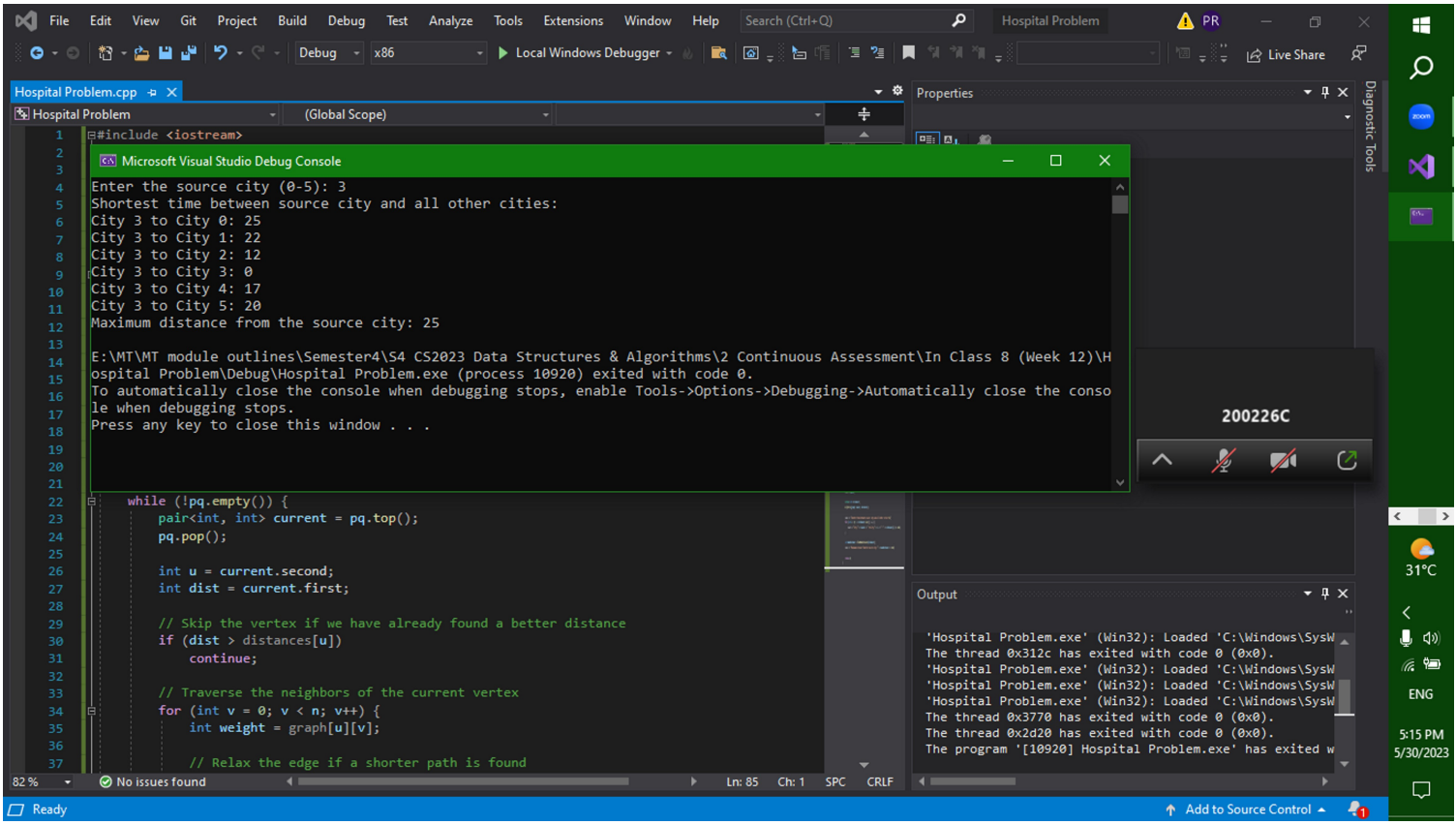
$$\begin{pmatrix} 0 & 10 & 0 & 0 & 15 & 5 \\ 10 & 0 & 10 & 30 & 0 & 0 \\ 0 & 10 & 0 & 12 & 5 & 0 \\ 0 & 30 & 12 & 0 & 0 & 20 \\ 15 & 0 & 5 & 0 & 0 & 0 \\ 5 & 0 & 0 & 20 & 0 & 0 \end{pmatrix}$$

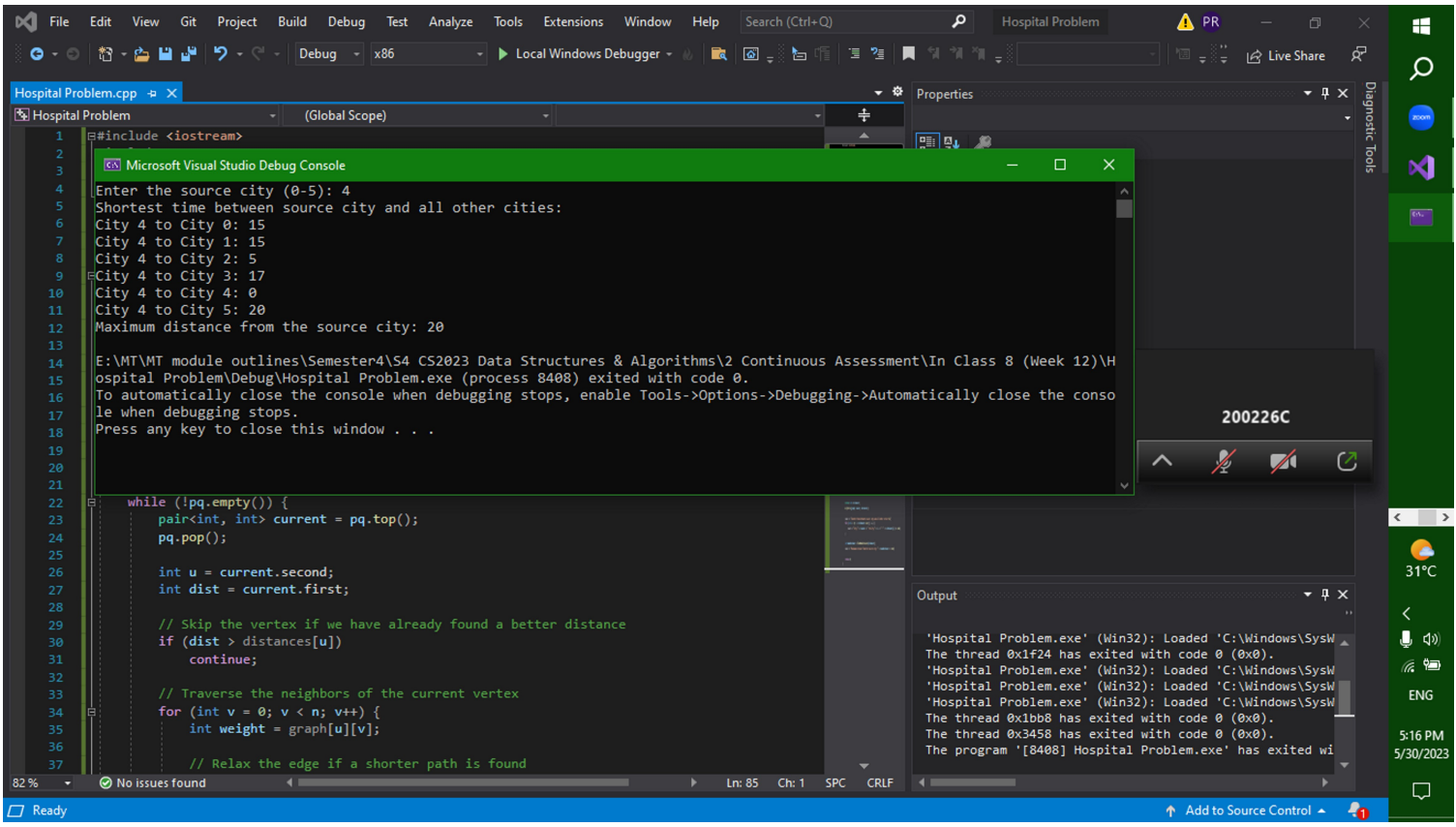
2. Implement SSSP Dijkstra's Algorithm
3. By changing the source node in your algorithm take the shortest time between source city to all the other cities. (Eg: if source city 0, then you must calculate the shortest time between City 0 to City 1, City 0 to City 2, City 0 to City 3... etc). Take screenshot of the output for each source city.

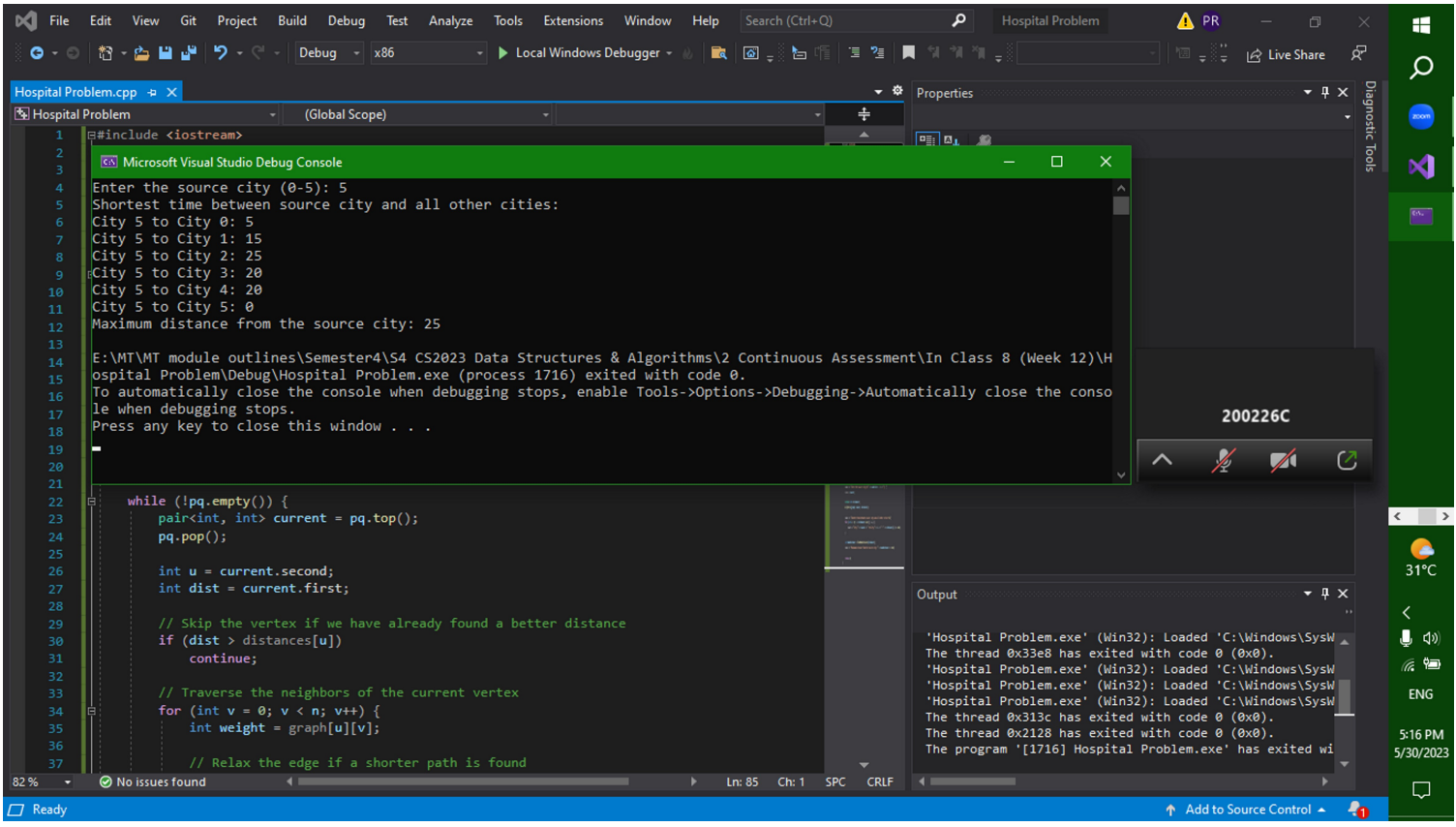

Hospital Problem.cpp
Hospital Problem
(Global Scope)
Microsoft Visual Studio Debug Console
Enter the source city (0-5): 0
Shortest time between source city and all other cities:
City 0 to City 0: 0
City 0 to City 1: 10
City 0 to City 2: 20
City 0 to City 3: 25
City 0 to City 4: 15
City 0 to City 5: 5
Maximum distance from the source city: 25
E:\MT\MT module outlines\Semester4\S4 CS2023 Data Structures & Algorithms\2 Continuous Assessment\In Class 8 (Week 12)\Hospital Problem\Debug\Hospital Problem.exe (process 14280) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->Debugging->Automatically close the console when debugging stops.
Press any key to close this window . . .
TA - V.Menan
Output
'Hospital Problem.exe' (Win32): Loaded 'C:\Windows\SysW
The thread 0x2364 has exited with code 0 (0x0).
'Hospital Problem.exe' (Win32): Loaded 'C:\Windows\SysW
'Hospital Problem.exe' (Win32): Loaded 'C:\Windows\SysW
'Hospital Problem.exe' (Win32): Loaded 'C:\Windows\SysW
The thread 0x1f48 has exited with code 0 (0x0).
The thread 0x2b00 has exited with code 0 (0x0).
The program '[14280] Hospital Problem.exe' has exited w
No issues found
Ln: 85 Ch: 1 SPC CRLF
Ready
Add to Source Control


Hospital Problem.cpp
Hospital Problem
(Global Scope)
Microsoft Visual Studio Debug Console
Enter the source city (0-5): 1
Shortest time between source city and all other cities:
City 1 to City 0: 10
City 1 to City 1: 0
City 1 to City 2: 10
City 1 to City 3: 22
City 1 to City 4: 15
City 1 to City 5: 15
Maximum distance from the source city: 22
E:\MT\MT module outlines\Semester4\S4 CS2023 Data Structures & Algorithms\2 Continuous Assessment\In Class 8 (Week 12)\Hospital Problem\Debug\Hospital Problem.exe (process 6692) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->Debugging->Automatically close the console when debugging stops.
Press any key to close this window . . .
TA - V.Menan
Output
'Hospital Problem.exe' (Win32): Loaded 'C:\Windows\SysW
The thread 0x3440 has exited with code 0 (0x0).
'Hospital Problem.exe' (Win32): Loaded 'C:\Windows\SysW
'Hospital Problem.exe' (Win32): Loaded 'C:\Windows\SysW
'Hospital Problem.exe' (Win32): Loaded 'C:\Windows\SysW
The thread 0x22e0 has exited with code 0 (0x0).
The thread 0x9f0 has exited with code 0 (0x0).
The program '[6692] Hospital Problem.exe' has exited wi
No issues found
Ln: 85 Ch: 1 SPC CRLF
Ready
Add to Source Control


Microsoft Visual Studio Debug Console
Enter the source city (0-5): 2
Shortest time between source city and all other cities:
City 2 to City 0: 20
City 2 to City 1: 10
City 2 to City 2: 0
City 2 to City 3: 12
City 2 to City 4: 5
City 2 to City 5: 25
Maximum distance from the source city: 25
E:\MT\MT module outlines\Semester4\S4 CS2023 Data Structures & Algorithms\2 Continuous Assessment\In Class 8 (Week 12)\Hospital Problem\Debug\Hospital Problem.exe (process 12196) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->Debugging->Automatically close the console when debugging stops.
Press any key to close this window . . .
TA - V.Menan


Microsoft Visual Studio Debug Console
Enter the source city (0-5): 3
Shortest time between source city and all other cities:
City 3 to City 0: 25
City 3 to City 1: 22
City 3 to City 2: 12
City 3 to City 3: 0
City 3 to City 4: 17
City 3 to City 5: 20
Maximum distance from the source city: 25
E:\MT\MT module outlines\Semester4\S4 CS2023 Data Structures & Algorithms\2 Continuous Assessment\In Class 8 (Week 12)\Hospital Problem\Debug\Hospital Problem.exe (process 10920) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->Debugging->Automatically close the console when debugging stops.
Press any key to close this window . . .
200226C

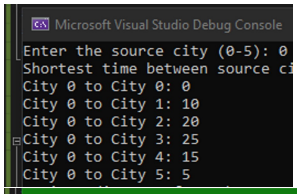

Microsoft Visual Studio Debug Console
Enter the source city (0-5): 4
Shortest time between source city and all other cities:
City 4 to City 0: 15
City 4 to City 1: 15
City 4 to City 2: 5
City 4 to City 3: 17
City 4 to City 4: 0
City 4 to City 5: 20
Maximum distance from the source city: 20
E:\MT\MT module outlines\Semester4\S4 CS2023 Data Structures & Algorithms\2 Continuous Assessment\In Class 8 (Week 12)\Hospital Problem\Debug\Hospital Problem.exe (process 8408) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->Debugging->Automatically close the console when debugging stops.
Press any key to close this window . . .
200226C


Microsoft Visual Studio Debug Console
Enter the source city (0-5): 5
Shortest time between source city and all other cities:
City 5 to City 0: 5
City 5 to City 1: 15
City 5 to City 2: 25
City 5 to City 3: 20
City 5 to City 4: 20
City 5 to City 5: 0
Maximum distance from the source city: 25
E:\MT\MT module outlines\Semester4\S4 CS2023 Data Structures & Algorithms\2 Continuous Assessment\In Class 8 (Week 12)\Hospital Problem\Debug\Hospital Problem.exe (process 1716) exited with code 0.
To automatically close the console when debugging stops, enable Tools->Options->Debugging->Automatically close the console when debugging stops.
Press any key to close this window . . .
200226C

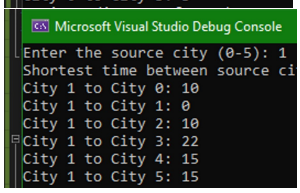
4. Calculate the average time taken from each source city to the other cities. Pick the city with the smallest average time (if more than 1 city has the same smallest average give all of them)

$$\text{Average time taken} = \frac{t_0 + t_1 + t_2 + t_3 + t_4 + t_5}{6}$$

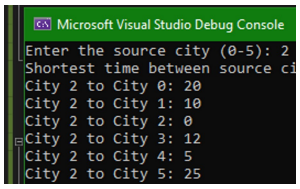
$$(\text{Average time})_0 = \frac{0+10+20+25+15+5}{6} = 12.5 \text{ units}$$



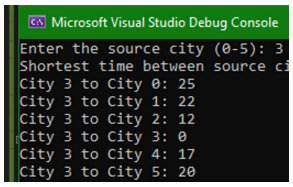
$$(\text{Average time})_1 = \frac{10+0+10+22+15+15}{6} = 12 \text{ units}$$



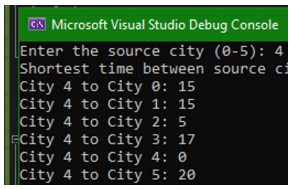
$$(\text{Average time})_2 = \frac{20+10+0+12+5+25}{6} = 12 \text{ units}$$



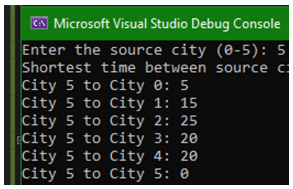
$$(\text{Average time})_3 = \frac{25+12+12+0+17+20}{6} = 16 \text{ units}$$



$$(\text{Average time})_4 = \frac{15+15+5+17+0+20}{6} = 12 \text{ units}$$



$$(\text{Average time})_5 = \frac{5+15+25+20+20+0}{6} = 14.17 \text{ units}$$



By above calculations, there are 3 cities with least 13.17 units.

Cities with the smallest average time = City ①, City ②, City ④

GitHub Link

https://github.com/200542P-MT-20/S4-CS2023-Data-Structures-Algorithms

The file is a Visual Studio file with .sln extension
Under In Class 8 (Week 12)