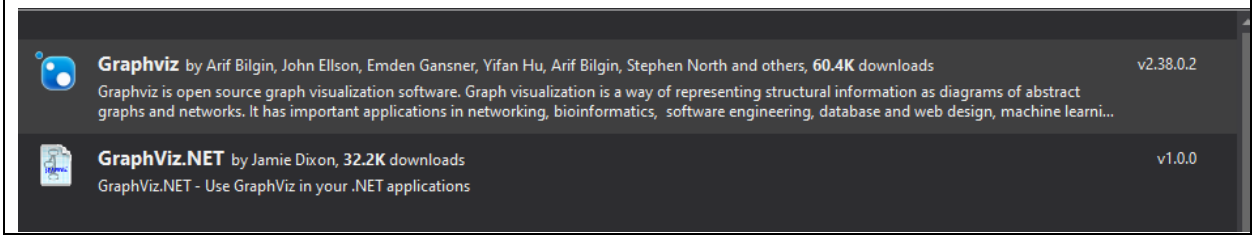
CPSC 5031 Homework 6

Visualizing Graphs

Name: David Nguyen

Description
Write a program that can take an adjacencymatrixfile and generate a GraphViz “dot file”. Run the dot files through `dot`(one of the GraphViz command line tools) and generate a PNG file.

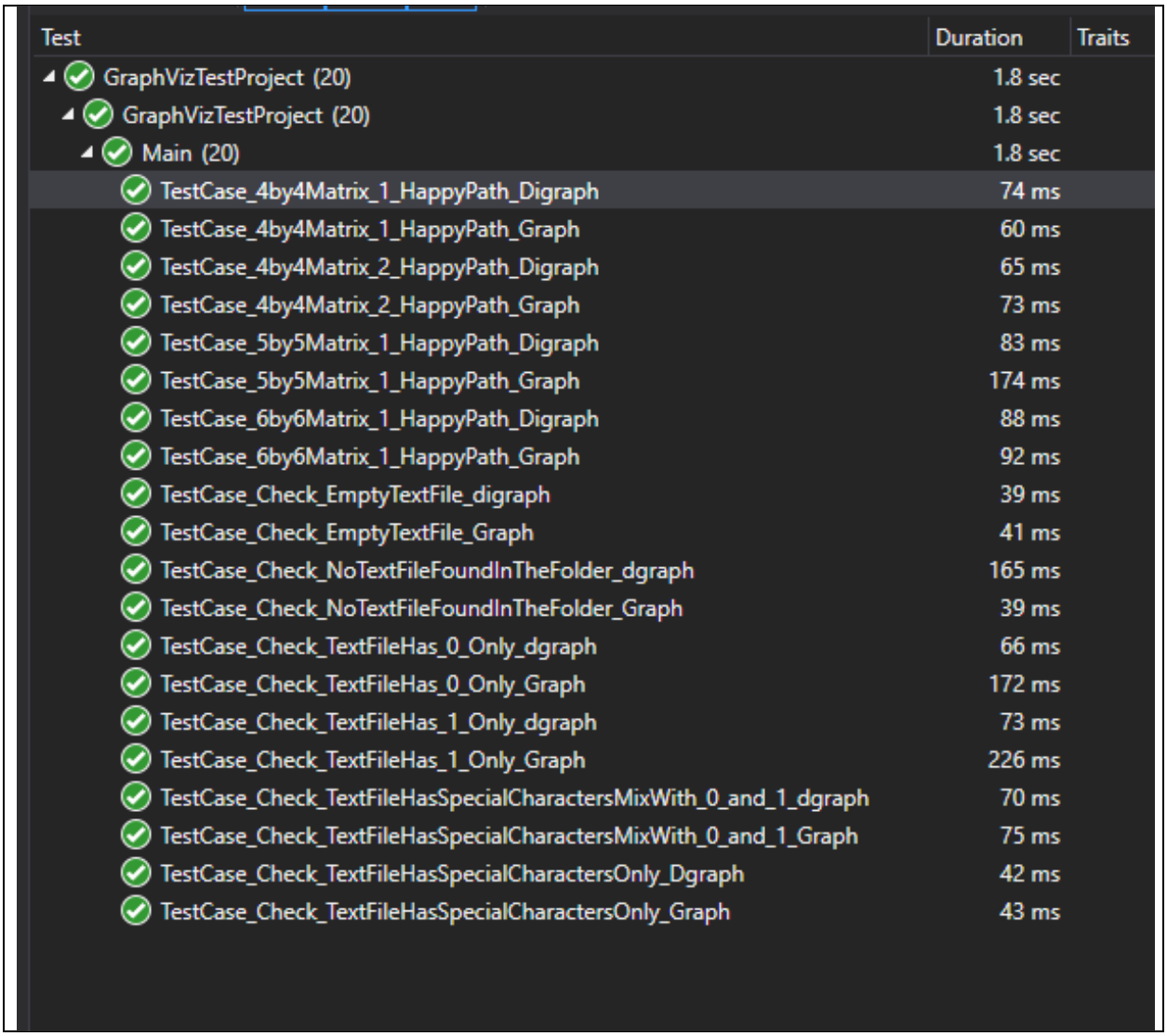
Summary after completed the homework
It is a great way to build a graph using GraphViz and it is even more fun to build a tool in my own favorite language to implement this GraphViz API. I started using MS-Test to add test cases for my program. One lesson I have learned, that the more test cases I added, the more updates I need to add into my function/methods. Clearly, adding test cases is a great way to see what are you missing in your function and discover the bugs at very early stage. After finishing this homework, I also discovery some develop already built Nuget package that I can use for real application in the future.   

Assumption to run this tool
1. Maximum of nodes for a graph is 24 (starting with letter A to Z) 2. Required user to provide text file and its location 3. Tool only run on Windows OS

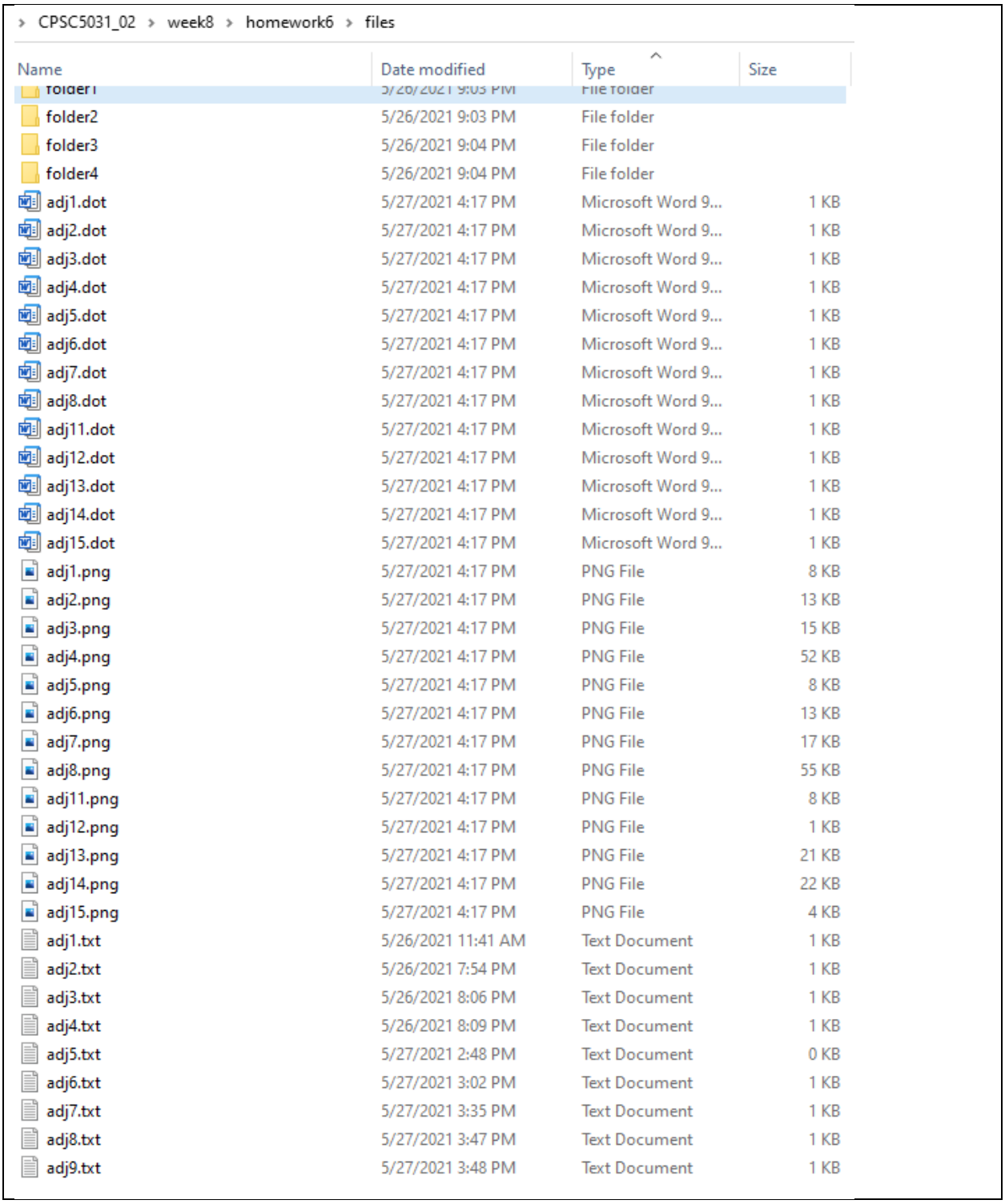
Source code
https://github.com/davednguyen/cpsc5031_hw6.git
Branch
Develop

Total test cases: 20

Test framework: MS Test		
Language: C3		
Test case name	Expected result	Actual result
TestCase_4by4Matrix_1_HappyPath_Graph	True	True
TestCase_4by4Matrix_2_HappyPath_Graph	True	True
TestCase_5by5Matrix_1_HappyPath_Graph	True	True
TestCase_6by6Matrix_1_HappyPath_Graph	True	True
TestCase_4by4Matrix_1_HappyPath_Digraph	True	True
TestCase_4by4Matrix_2_HappyPath_Digraph	True	True
TestCase_5by5Matrix_1_HappyPath_Digraph	True	True
TestCase_6by6Matrix_1_HappyPath_Digraph	True	True
TestCase_Check_EmptyTextFile_Graph	False	False
TestCase_Check_EmptyTextFile_digraph	False	False
TestCase_Check_NoTextFileFoundInTheFolder_Graph	False	False
TestCase_Check_NoTextFileFoundInTheFolder_dgraph	False	False
TestCase_Check_TextFileHasSpecialCharactersMixWith_0_and_1_Graph	True	True
TestCase_Check_TextFileHasSpecialCharactersMixWith_0_and_1_dgraph	True	True
TestCase_Check_TextFileHasSpecialCharactersOnly_Graph	True	True
TestCase_Check_TextFileHasSpecialCharactersOnly_Dgraph	True	True
TestCase_Check_TextFileHas_1_Only_Graph	True	True
TestCase_Check_TextFileHas_1_Only_dgraph	True	True
TestCase_Check_TextFileHas_0_Only_Graph	True	True
TestCase_Check_TextFileHas_0_Only_dgraph	True	True



Test	Duration	Traits
GraphVizTestProject (20)	1.8 sec	
GraphVizTestProject (20)	1.8 sec	
Main (20)	1.8 sec	
TestCase_4by4Matrix_1_HappyPath_Digraph	74 ms	
TestCase_4by4Matrix_1_HappyPath_Graph	60 ms	
TestCase_4by4Matrix_2_HappyPath_Digraph	65 ms	
TestCase_4by4Matrix_2_HappyPath_Graph	73 ms	
TestCase_5by5Matrix_1_HappyPath_Digraph	83 ms	
TestCase_5by5Matrix_1_HappyPath_Graph	174 ms	
TestCase_6by6Matrix_1_HappyPath_Digraph	88 ms	
TestCase_6by6Matrix_1_HappyPath_Graph	92 ms	
TestCase_Check_EmptyTextFile_digraph	39 ms	
TestCase_Check_EmptyTextFile_Graph	41 ms	
TestCase_Check_NoTextFileFoundInTheFolder_dgraph	165 ms	
TestCase_Check_NoTextFileFoundInTheFolder_Graph	39 ms	
TestCase_Check_TextFileHas_0_Only_dgraph	66 ms	
TestCase_Check_TextFileHas_0_Only_Graph	172 ms	
TestCase_Check_TextFileHas_1_Only_dgraph	73 ms	
TestCase_Check_TextFileHas_1_Only_Graph	226 ms	
TestCase_Check_TextFileHasSpecialCharactersMixWith_0_and_1_dgraph	70 ms	
TestCase_Check_TextFileHasSpecialCharactersMixWith_0_and_1_Graph	75 ms	
TestCase_Check_TextFileHasSpecialCharactersOnly_Dgraph	42 ms	
TestCase_Check_TextFileHasSpecialCharactersOnly_Graph	43 ms	



CPSC5031_02 › week8 › homework6 › files

Name	Date modified	Type	Size
folder1	5/26/2021 9:03 PM	File folder	
folder2	5/26/2021 9:03 PM	File folder	
folder3	5/26/2021 9:04 PM	File folder	
folder4	5/26/2021 9:04 PM	File folder	
adj1.dot	5/27/2021 4:17 PM	Microsoft Word 9...	1 KB
adj2.dot	5/27/2021 4:17 PM	Microsoft Word 9...	1 KB
adj3.dot	5/27/2021 4:17 PM	Microsoft Word 9...	1 KB
adj4.dot	5/27/2021 4:17 PM	Microsoft Word 9...	1 KB
adj5.dot	5/27/2021 4:17 PM	Microsoft Word 9...	1 KB
adj6.dot	5/27/2021 4:17 PM	Microsoft Word 9...	1 KB
adj7.dot	5/27/2021 4:17 PM	Microsoft Word 9...	1 KB
adj8.dot	5/27/2021 4:17 PM	Microsoft Word 9...	1 KB
adj11.dot	5/27/2021 4:17 PM	Microsoft Word 9...	1 KB
adj12.dot	5/27/2021 4:17 PM	Microsoft Word 9...	1 KB
adj13.dot	5/27/2021 4:17 PM	Microsoft Word 9...	1 KB
adj14.dot	5/27/2021 4:17 PM	Microsoft Word 9...	1 KB
adj15.dot	5/27/2021 4:17 PM	Microsoft Word 9...	1 KB
adj1.png	5/27/2021 4:17 PM	PNG File	8 KB
adj2.png	5/27/2021 4:17 PM	PNG File	13 KB
adj3.png	5/27/2021 4:17 PM	PNG File	15 KB
adj4.png	5/27/2021 4:17 PM	PNG File	52 KB
adj5.png	5/27/2021 4:17 PM	PNG File	8 KB
adj6.png	5/27/2021 4:17 PM	PNG File	13 KB
adj7.png	5/27/2021 4:17 PM	PNG File	17 KB
adj8.png	5/27/2021 4:17 PM	PNG File	55 KB
adj11.png	5/27/2021 4:17 PM	PNG File	8 KB
adj12.png	5/27/2021 4:17 PM	PNG File	1 KB
adj13.png	5/27/2021 4:17 PM	PNG File	21 KB
adj14.png	5/27/2021 4:17 PM	PNG File	22 KB
adj15.png	5/27/2021 4:17 PM	PNG File	4 KB
adj1.txt	5/26/2021 11:41 AM	Text Document	1 KB
adj2.txt	5/26/2021 7:54 PM	Text Document	1 KB
adj3.txt	5/26/2021 8:06 PM	Text Document	1 KB
adj4.txt	5/26/2021 8:09 PM	Text Document	1 KB
adj5.txt	5/27/2021 2:48 PM	Text Document	0 KB
adj6.txt	5/27/2021 3:02 PM	Text Document	1 KB
adj7.txt	5/27/2021 3:35 PM	Text Document	1 KB
adj8.txt	5/27/2021 3:47 PM	Text Document	1 KB
adj9.txt	5/27/2021 3:48 PM	Text Document	1 KB

Main tool codes (for better view, please refer to text file attachment) best application to view C# codes is NodePad++ - (file name: MainToolCodesInCSharp.txt)

```
using System;
using System.Collections.Generic;
```

```
using System.Diagnostics;
using System.IO;

/// <summary>
/// Homework 6
/// developer: David Nguyen
/// </summary>
namespace cpsc5031_hw6
{
   public class Program
   {
      public static void Main(string[] args)
      {
         Console.WriteLine("Homework 6");
         string directory = @"C:\Users\dzzn\Desktop\CPSC5031_02\week8\homework6\files\";
         //string directory =
@"C:\Users\mr4eyesn\Desktop\CPSC5031_2\week8\homework\code\cpsc5031_hw6\files\"
;
         GraphVizGenerator("adj1.txt", "adj1.png", "adj1.dot", directory, false);
         GraphVizGenerator("adj2.txt", "adj2.png", "adj2.dot", directory, false);
         GraphVizGenerator("adj3.txt", "adj3.png", "adj3.dot", directory, false);
         GraphVizGenerator("adj4.txt", "adj4.png", "adj4.dot", directory, false);

         GraphVizGenerator("adj1.txt", "adj5.png", "adj5.dot", directory, true);
         GraphVizGenerator("adj2.txt", "adj6.png", "adj6.dot", directory, true);
         GraphVizGenerator("adj3.txt", "adj7.png", "adj7.dot", directory, true);
         GraphVizGenerator("adj4.txt", "adj8.png", "adj8.dot", directory, true);
      }

      /// <summary>
      /// Generate a graph base on matrix of binary number (0 and 1)
      /// </summary>
      /// <param name="textFileName">matrix text file name provide by user</param>
      /// <param name="imageFileName">image file name provide by user</param>
      /// <param name="dotFileName">dot file name provide by user</param>
      /// <param name="directory">location where to get text file, to save dot file and to save
image file</param>
      public static bool GraphVizGenerator(string textFileName, string imageFileName, string
dotFileName, string directory, bool digraph)
      {
         //null check for all required inputs
         if(textFileName != null || imageFileName != null || dotFileName != null || directory !=
null)
         {
```

```
            //check to make sure user don't provide empty string for any inputs
            if(!textFileName.Equals(string.Empty) || !imageFileName.Equals(string.Empty) ||
!dotFileName.Equals(string.Empty) || !directory.Equals(string.Empty))
            {
               var lines = readTextFile(directory + textFileName);
               var dotFileBody = generateDotFileBody(lines, digraph);
               var dotFilePath = directory + dotFileName;
               var dotFile = dotFileCompose(dotFileBody, dotFilePath);
               generateImage(dotFile, imageFileName, directory);
               if (File.Exists(directory + imageFileName))
               {
                  return true;
               }
               else
               {
                  return false;
               }
            }
            else
            {
               return false;
            }
         }
         else
         {
            return false;
         }
      }

      /// <summary>
      ///
      /// </summary>
      /// <param name="textFileName"></param>
      /// <param name="imageFileName"></param>
      /// <param name="dotFileName"></param>
      /// <param name="directory"></param>
      /// <returns></returns>
      public bool GraphVizGeneratorV2(string textFileName, string imageFileName, string
dotFileName, string directory, bool digraph)
      {
         return GraphVizGenerator(textFileName, imageFileName, dotFileName, directory,
digraph);
      }
      /// <summary>
```

```
        /// read text file
        /// </summary>
        /// <param name="path">file location</param>
        /// <returns>lines of text files</returns>
        private static string[] readTextFile(string path)
        {
            //check if the text file provided by user is
            //existed in the foler
            if (File.Exists(path))
            {
                if (path != null)
                {
                    string[] lines;
                    lines = File.ReadAllLines(path);
                    File.Exists(path);
                    if (lines.Length > 0)
                    {
                        return lines;
                    }
                    else
                    {
                        return null;
                    }
                }
                else
                {
                    return null;
                }
            }
            else
            {
                return null;
            }
        }

        /// <summary>
        /// List of pre-populated Node name for a graph
        /// assuming the maximum nodes for a graph is 24
        /// </summary>
        /// <returns>list of node names</returns>
        private static char[] Letters()
        {
            char[] letters =  { 'A', 'B', 'C', 'D', 'E', 'F', 'G', 'H', 'I', 'J', 'K', 'L', 'M', 'N', 'O', 'P', 'Q', 'R', 'S',
 'T', 'U', 'V', 'W', 'X', 'Y', 'Z'};
```

```
        return letters;
    }

    /// <summary>
    /// Take array of string and generate a file body for a dot file
    /// list of connect between nodes within a graph
    /// </summary>
    /// <param name="lines">list of lines between two nodes</param>
    /// <returns>string body for a dot file</returns>
    private static string generateDotFileBody(string[] lines, bool digraph)
    {
        if(lines != null && lines.Length > 0)
        {
            string graph = "graph matrix {";
            string dgraph = "digraph matrix {";
            string lastLine = "}";
            string gconnector = "--";
            string dgconnector = "->";
            string connector = "";
            //assign name for each node in the graph
            var nodes = Letters();
            string dotFileoBody;
            if (digraph)
            {
                dotFileoBody = dgraph + "\n";
                connector = dgconnector;
            }
            else
            {
                dotFileoBody = graph + "\n";
                connector = gconnector;
            }

            //to keep track of all the nodes
            List<string> completedNodes = new List<string>();
            for (int i = 0; i < lines.Length; i++)
            {
                var list = lines[i].Trim().Replace(" ", string.Empty);
                for (int j = 0; j < list.Length; j++)
                {
                    if (list[j].Equals('1'))
                    {
                        string part1 = nodes[i] + connector + nodes[j];
                        string part2 = nodes[j] + connector + nodes[i];
```

```
                if (!completedNodes.Contains(part1) && !completedNodes.Contains(part2))
                {
                    dotFileoBody = dotFileoBody + nodes[i] + connector + nodes[j] + "\n";
                    completedNodes.Add(part1);
                    completedNodes.Add(part2);
                }
            }
            else if (list[j].Equals('0'))
            {
                string part1 = nodes[i].ToString();
                string part2 = nodes[j].ToString();
                if (!completedNodes.Contains(part1) && !completedNodes.Contains(part2))
                {
                    dotFileoBody = dotFileoBody + nodes[j] + "\n";
                    completedNodes.Add(part1);
                    completedNodes.Add(part2);
                }
            }
        }
    }
    dotFileoBody = dotFileoBody + lastLine;
    return dotFileoBody;
  }
  else
  {
    return null;
  }
}

/// <summary>
/// Build a dot file for graph
/// </summary>
/// <param name="stringbody">Dot file string body</param>
/// <param name="path">location and file name for the dot file</param>
private static string dotFileCompose(string stringbody, string path)
{
  //delete the file if it already exsited in the foler
  if (File.Exists(path))
  {
    File.Delete(path);
  }
  //write text into dot file
  if(stringbody != null && !stringbody.Equals(string.Empty))
  {
```

```
            using (StreamWriter writer = File.CreateText(path))
            {
                writer.Write(stringbody);
                writer.Flush();
                writer.Dispose();
                writer.Close();
            }
            File.Exists(path);
            return path;
        }
        else
        {
            return null;
        }
    }

    /// <summary>
    /// Generate Graph based on dot file
    /// </summary>
    /// <param name="dotFile">dot file name</param>
    /// <param name="imageFile">image file name</param>
    /// <param name="directory"></param>
    private static void generateImage(string dotFile, string imageFile, string directory)
    {
        //delete the image file if it already exsited in the foler
        string exisitingImageFile = directory + imageFile;
        if (File.Exists(exisitingImageFile))
        {
            File.Delete(exisitingImageFile);
        }
        //command to generage image file
        string commandTemplate = "dot -Tpng {0} -o {1}";
        //where to run the command
        string application = "cmd.exe";
        //complete command
        string command = String.Format(commandTemplate, dotFile, imageFile);
        using(Process process = new Process())
        {
            process.StartInfo = new ProcessStartInfo(application)
            {
                RedirectStandardInput = true,
                UseShellExecute = false,
                WorkingDirectory = directory
            };
```

```
            process.Start();
            process.StandardInput.WriteLine(command);
            process.StandardInput.Close();
            process.WaitForExit();
            process.CloseMainWindow();
            process.Close();
        }
    }
  }
}
```

Test cases in codes (for better view, please refer to text file attachment) best application to view C# codes is NodePad++ - (file name: MainToolCodesInCSharp.txt)

```
using Microsoft.VisualStudio.TestTools.UnitTesting;
using cpsc5031_hw6;

namespace GraphVizTestProject
{
    [TestClass]
    public class Main
    {
        //set initial directory for testing
        //string directory =
@"C:\Users\mr4eyesn\Desktop\CPSC5031_2\week8\homework\code\cpsc5031_hw6\files\";
        string directory = @"C:\Users\dzzn\Desktop\CPSC5031_02\week8\homework6\files\";
        [TestMethod]
        public void TestCase_4by4Matrix_1_HappyPath_Graph()
        {
            Program graph = new Program();
            var check = graph.GraphVizGeneratorV2("adj1.txt", "adj1.png", "adj1.dot",
directory, false);
            Assert.AreEqual(true, check);
        }

        [TestMethod]
        public void TestCase_4by4Matrix_2_HappyPath_Graph()
        {
            Program graph = new Program();
            var check = graph.GraphVizGeneratorV2("adj2.txt", "adj2.png", "adj2.dot",
directory, false);
            Assert.AreEqual(true, check);
        }

        [TestMethod]
        public void TestCase_5by5Matrix_1_HappyPath_Graph()
        {
            Program graph = new Program();
            var check = graph.GraphVizGeneratorV2("adj3.txt", "adj3.png", "adj3.dot",
directory, false);
            Assert.AreEqual(true, check);
        }

        [TestMethod]
```

```
        public void TestCase_6by6Matrix_1_HappyPath_Graph()
        {
            Program graph = new Program();
            var check = graph.GraphVizGeneratorV2("adj4.txt", "adj4.png", "adj4.dot",
directory, false);
            Assert.AreEqual(true, check);
        }

        [TestMethod]
        public void TestCase_4by4Matrix_1_HappyPath_Digraph()
        {
            Program graph = new Program();
            var check = graph.GraphVizGeneratorV2("adj1.txt", "adj5.png", "adj5.dot",
directory, true);
            Assert.AreEqual(true, check);
        }

        [TestMethod]
        public void TestCase_4by4Matrix_2_HappyPath_Digraph()
        {
            Program graph = new Program();
            var check = graph.GraphVizGeneratorV2("adj2.txt", "adj6.png", "adj6.dot",
directory, true);
            Assert.AreEqual(true, check);
        }

        [TestMethod]
        public void TestCase_5by5Matrix_1_HappyPath_Digraph()
        {
            Program graph = new Program();
            var check = graph.GraphVizGeneratorV2("adj3.txt", "adj7.png", "adj7.dot",
directory, true);
            Assert.AreEqual(true, check);
        }

        [TestMethod]
        public void TestCase_6by6Matrix_1_HappyPath_Digraph()
        {
            Program graph = new Program();
            var check = graph.GraphVizGeneratorV2("adj4.txt", "adj8.png", "adj8.dot",
directory, true);
            Assert.AreEqual(true, check);
        }

        [TestMethod]
        public void TestCase_Check_EmptyTextFile_Graph()
        {
            Program graph = new Program();
            var check = graph.GraphVizGeneratorV2("adj5.txt", "adj9.png", "adj9.dot",
directory, false);
            Assert.AreEqual(false, check);
        }

        [TestMethod]
        public void TestCase_Check_EmptyTextFile_digraph()
        {
            Program graph = new Program();
```

```
            var check = graph.GraphVizGeneratorV2("adj5.txt", "adj10.png", "adj10.dot",
directory, true);
            Assert.AreEqual(false, check);
        }

        [TestMethod]
        public void TestCase_Check_NoTextFileFoundInTheFolder_Graph()
        {
            Program graph = new Program();
            var check = graph.GraphVizGeneratorV2("adj20.txt", "adj9.png", "adj9.dot",
directory, false);
            Assert.AreEqual(false, check);
        }

        [TestMethod]
        public void TestCase_Check_NoTextFileFoundInTheFolder_dgraph()
        {
            Program graph = new Program();
            var check = graph.GraphVizGeneratorV2("adj20.txt", "adj10.png",
"adj10.dot", directory, true);
            Assert.AreEqual(false, check);
        }

        [TestMethod]
        public void TestCase_Check_TextFileHasSpecialCharactersMixWith_0_and_1_Graph()
        {
            Program graph = new Program();
            var check = graph.GraphVizGeneratorV2("adj6.txt", "adj11.png", "adj11.dot",
directory, false);
            Assert.AreEqual(true, check);
        }

        [TestMethod]
        public void TestCase_Check_TextFileHasSpecialCharactersMixWith_0_and_1_dgraph()
        {
            Program graph = new Program();
            var check = graph.GraphVizGeneratorV2("adj6.txt", "adj12.png", "adj12.dot",
directory, true);
            Assert.AreEqual(true, check);
        }

        [TestMethod]
        public void TestCase_Check_TextFileHasSpecialCharactersOnly_Graph()
        {
            Program graph = new Program();
            var check = graph.GraphVizGeneratorV2("adj7.txt", "adj12.png", "adj12.dot",
directory, false);
            Assert.AreEqual(true, check);
        }

        [TestMethod]
        public void TestCase_Check_TextFileHasSpecialCharactersOnly_Dgraph()
        {
            Program graph = new Program();
            var check = graph.GraphVizGeneratorV2("adj7.txt", "adj13.png", "adj13.dot",
directory, true);
            Assert.AreEqual(true, check);
        }
```

```
        [TestMethod]
        public void TestCase_Check_TextFileHas_1_Only_Graph()
        {
            Program graph = new Program();
            var check = graph.GraphVizGeneratorV2("adj8.txt", "adj13.png", "adj13.dot",
directory, false);
            Assert.AreEqual(true, check);
        }

        [TestMethod]
        public void TestCase_Check_TextFileHas_1_Only_dgraph()
        {
            Program graph = new Program();
            var check = graph.GraphVizGeneratorV2("adj8.txt", "adj14.png", "adj14.dot",
directory, true);
            Assert.AreEqual(true, check);
        }

        [TestMethod]
        public void TestCase_Check_TextFileHas_0_Only_Graph()
        {
            Program graph = new Program();
            var check = graph.GraphVizGeneratorV2("adj9.txt", "adj14.png", "adj14.dot",
directory, false);
            Assert.AreEqual(true, check);
        }

        [TestMethod]
        public void TestCase_Check_TextFileHas_0_Only_dgraph()
        {
            Program graph = new Program();
            var check = graph.GraphVizGeneratorV2("adj9.txt", "adj15.png", "adj15.dot",
directory, true);
            Assert.AreEqual(true, check);
        }
    }
}
```