The code for all three problems is in a single python file. The different functions that are included in the program are:

i)   **__init__(self):** It is the constructor to set all the object variables.

ii)   **Main(self):** It is the main/first function that takes input from the user either by command line or by file. It then sets the object variables as required. It checks for back edge using pre and post number to verify if it's a DAG. It also prints the linearization and the longest path starting from vertex 1 of the graph, if DAG.

iii)   **DFS(self):** It is the function where the core algorithm actually operates. It is implemented using DFS algorithm.

iv)   **Explore(self, u):** It is a part of the DFS algorithm which assigns the pre and post number as well as marks the vertex(u) as visited.

v)   **PreVisit(self, u):** It assigns the pre number to the vertex(u).

vi)   **PostVisit (self, u):** It assigns the post number to the vertex(u).

vii)   **LongestPath(self):** It finds the longest path in the graph starting from vertex 1 using the result of linearization.

To run this program, the user should just compile the DAG.py file and follow the on-screen options. Sample of them are attached here as screenshot.

When the program prompts for the user to select an option, to choose for the input option (i.e. **command line** or **file**), the user must input '**c' or 'C'** for command line and **'f' or 'F'** for file. Its screenshot is:

```
Do you want to provide the input from the command line or a .txt file?
Type c for command line else type f for .txt file: c

Enter the number of vetrices: 5

Enter the edges (u,v) or press enter if finished: 1,2

Enter the edges (u,v) or press enter if finished: 2,3

Enter the edges (u,v) or press enter if finished:
YES
5, 4, 1, 2, 3
2
```

Fig: For Input through Command Line

```
Do you want to provide the input from the command line or a .txt file?
Type c for command line else type f for .txt file: f

Enter the full file path including .txt: C:\Users\Pioneer\Desktop
\Algorithm\Assignment\PA2\DAG_Input.txt
YES
1, 2, 3, 4, 5
4
```

Fig: For Input through file

NOTE:

1. For Input through **command line**, after all the edges are entered, then simply **press enter** (to denote that all the edges have been entered).
2. For Input through **file**, the **full path** of the file should be **provided including the file extension.** I have only tested for .txt file. So, I suggest to use the **.txt** file included with this document for the file input. In addition, there can be no empty lines with white spaces. The first line should be the number of vertices and all the following lines should be edges in the format u,v.

OUTPUT:

The output adheres to the specification as mentioned by Dr. Nirman Kumar.

1. The first line of the output indicates if the directed graph is a DAG or not. It prints "YES" if the graph is a DAG and "NO" if it is not a DAG.
2. If it is a DAG, the second lines outputs the linearization of the input graph.
3. If it is a DAG, the third line prints the longest path in the graph starting from vertex 1.