SIGNAL FLOW GRAPH

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➢ Problem Statement:

Signal flow graph representation of the system. Given the total number of nodes and numeric branches gains are given.

Required:

1- Graphical interface.
2- Draw the signal flow graph showing nodes, branches, gains, …
3- Listing all forward paths, individual loops, all combination of n non-touching loops.
4- The values of delta.1 , delta.2 ,….,delta.m ,where m is number of forward paths.
5- Overall system transfer function.

➢ Main Features:

- Draw a signal flow graph: nodes, edges with their gain numerical values.
- Solve the signal flow graph giving :
    1- The overall transfer function
    2- All path giving :
        - The path
        - The gain
        - N individual loops
        - Delta
    3- Individual loops :
        - Delta
        - All N individual loops

➢ Data Structure

- Hash Table
- Hash set
- Array list
- Arrays

➢ Main modules

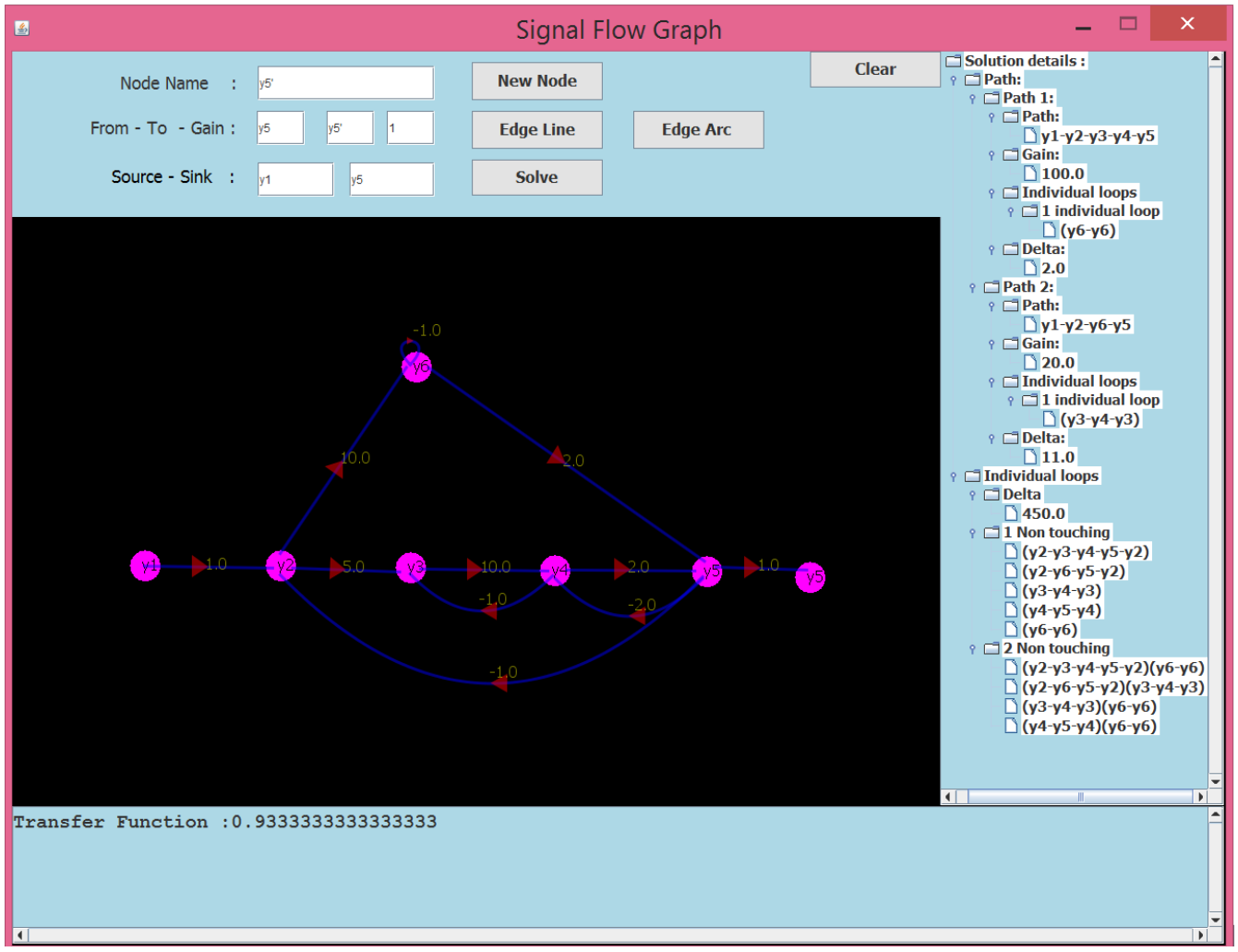
- Gui:
    1. SFG
    2. Drawing board
    3. Curve edge
- Graph (solving).

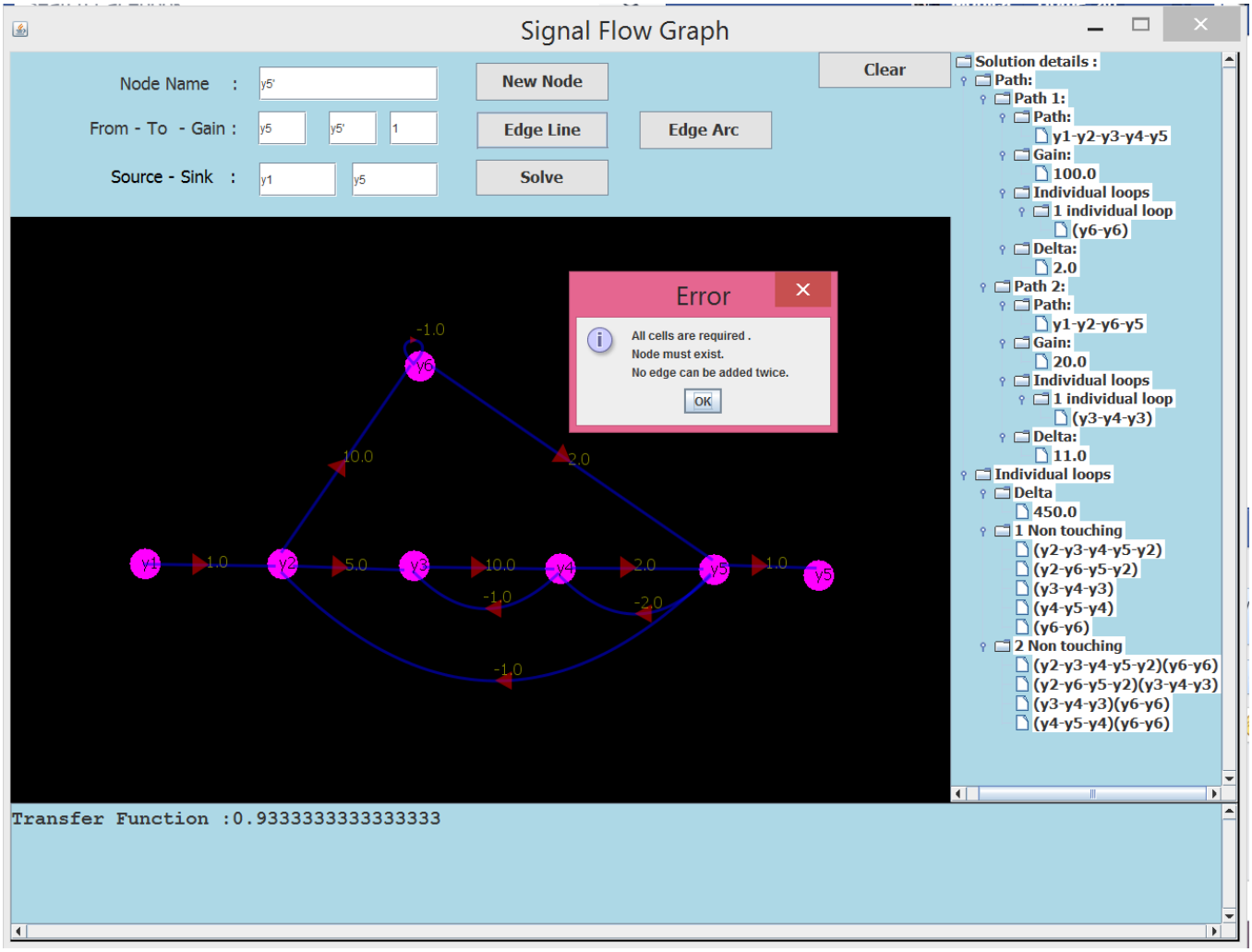
➢ Algorithms used:

- ✓ Forward paths: Using DFS to get all paths from source to sink node.
- ✓ Loops: Using complete search, starting from each node in the graph.
- ✓ Non-touching loops: using bit masking, for each path and loop there exist a number in which the digits are set the ones, if the node with its position is in the path.
  Bit masking is used to detect non-touching loop.

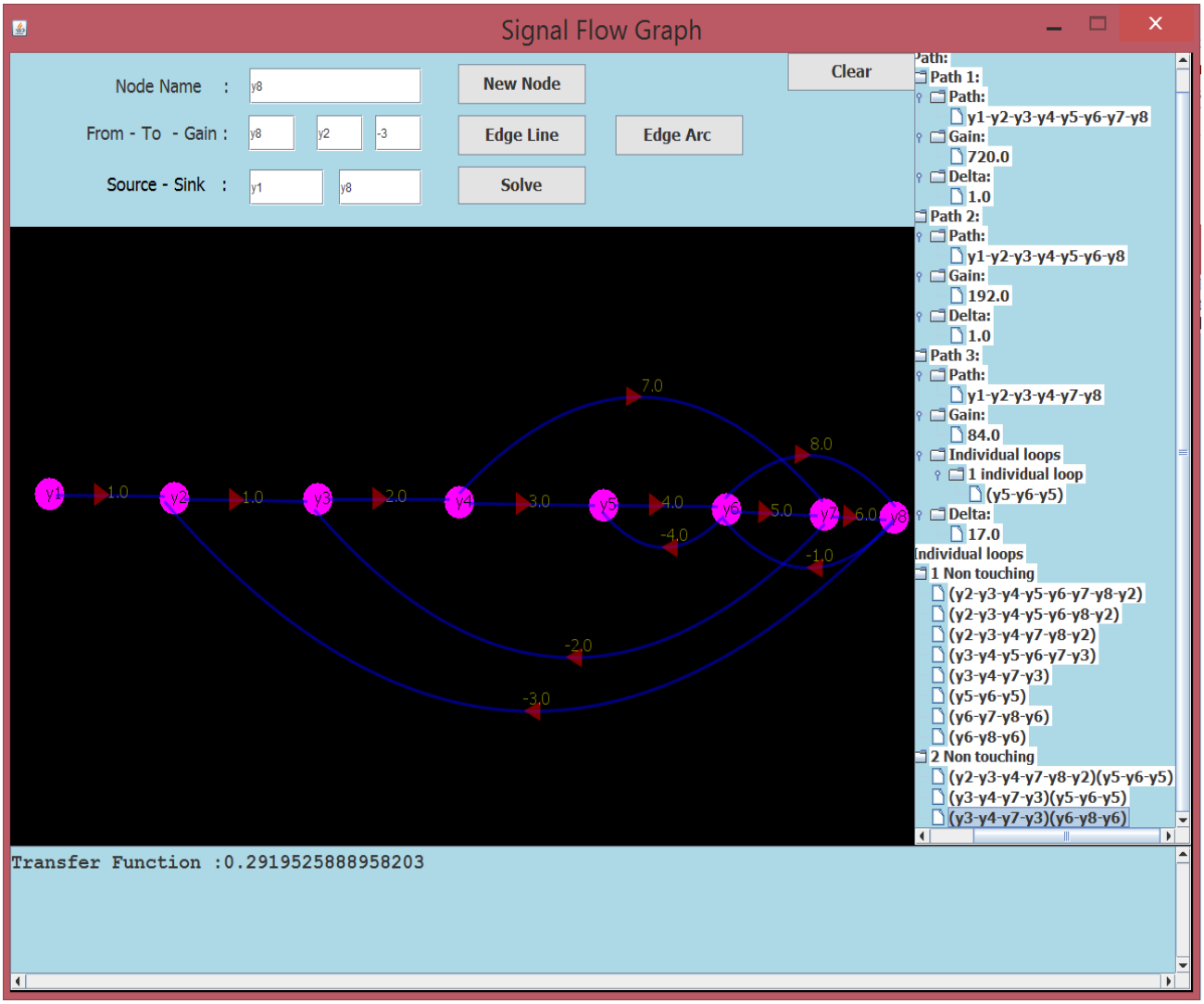
➢Sample Runs

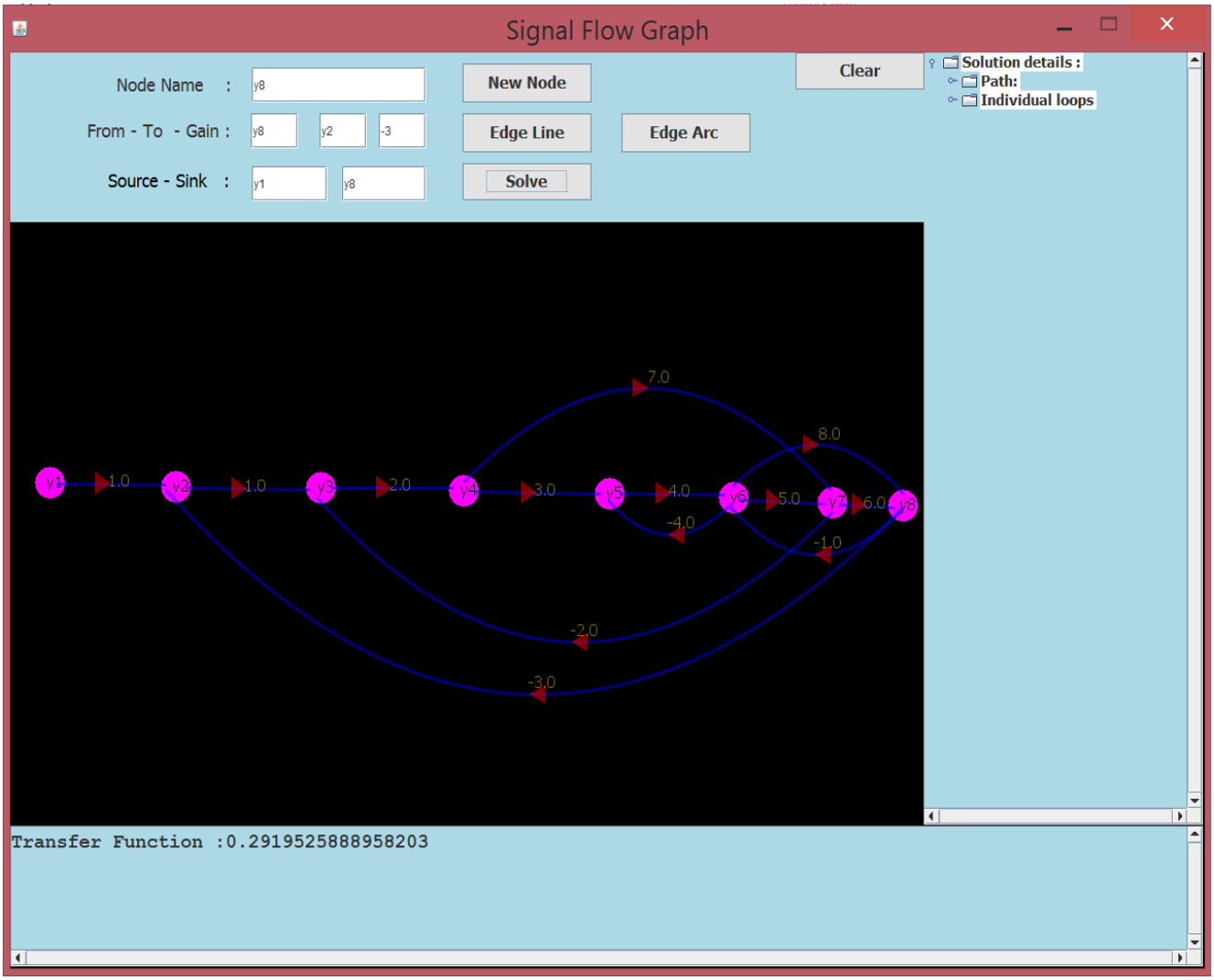
Sheet number 3:



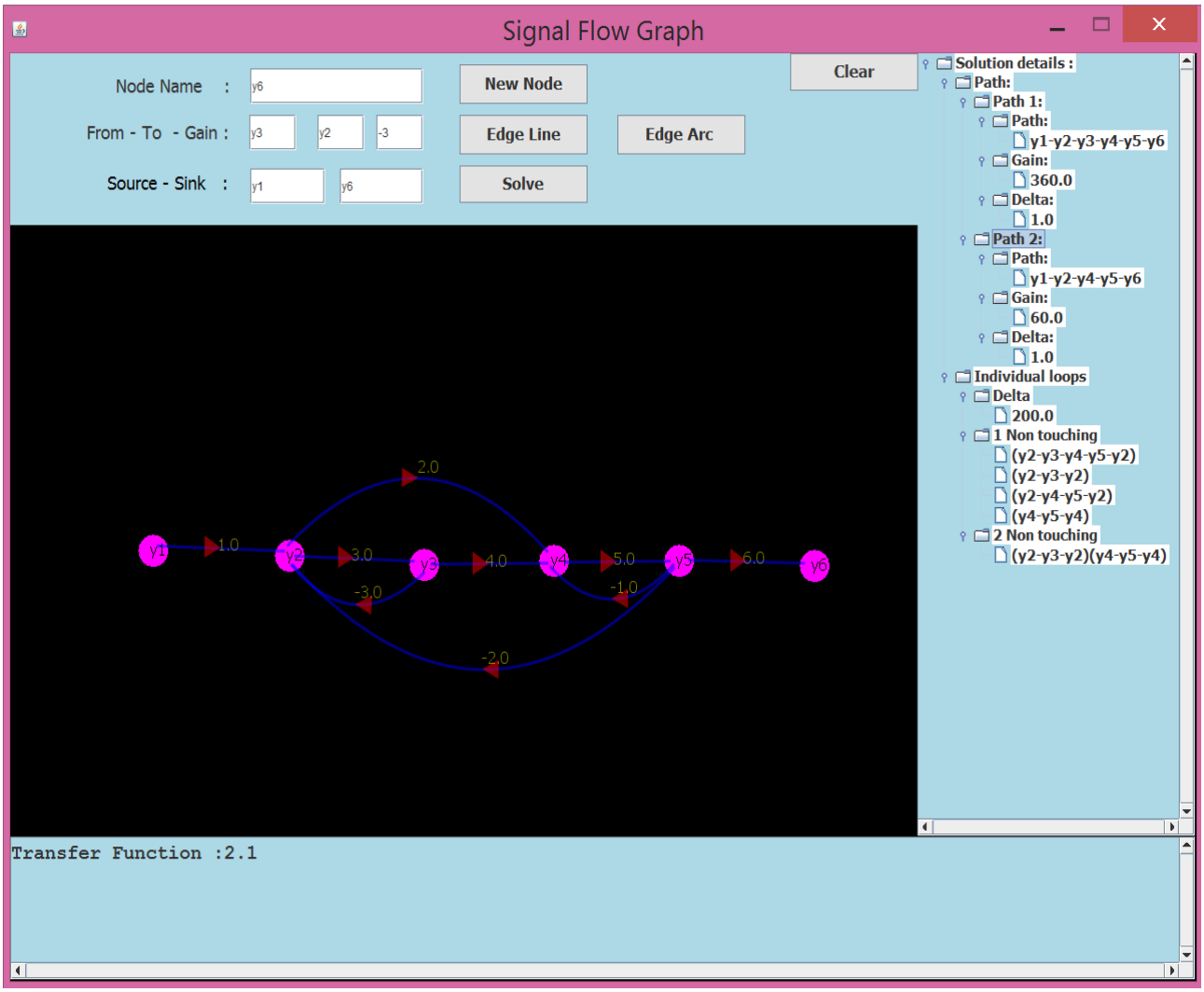

Signal Flow Graph
Node Name :
y5'
New Node
From - To - Gain :
y5
y5'
1
Edge Line
Edge Arc
Source - Sink :
y1
y5
Solve
Clear
Error
All cells are required .
Node must exist.
No edge can be added twice.
OK
Solution details :
Path:
Path 1:
Path:
y1-y2-y3-y4-y5
Gain:
100.0
Individual loops
1 individual loop
(y6-y6)
Delta:
2.0
Path 2:
Path:
y1-y2-y6-y5
Gain:
20.0
Individual loops
1 individual loop
(y3-y4-y3)
Delta:
11.0
Individual loops
Delta
450.0
1 Non touching
(y2-y3-y4-y5-y2)
(y2-y6-y5-y2)
(y3-y4-y3)
(y4-y5-y4)
(y6-y6)
2 Non touching
(y2-y3-y4-y5-y2)(y6-y6)
(y2-y6-y5-y2)(y3-y4-y3)
(y3-y4-y3)(y6-y6)
(y4-y5-y4)(y6-y6)
-1.0
y6
10.0
2.0
y1
1.0
y2
5.0
y3
10.0
y4
2.0
y5
1.0
y5
-1.0
-2.0
-1.0
Transfer Function :0.9333333333333333

Sheet number 5:




Signal Flow Graph
Node Name :
y8
New Node
From - To - Gain :
y8
y2
-3
Edge Line
Edge Arc
Source - Sink :
y1
y8
Solve
Clear
Solution details :
Path:
Individual loops
y1
1.0
y2
1.0
y3
2.0
y4
3.0
y5
4.0
y6
5.0
y7
6.0
y8
7.0
8.0
-4.0
-1.0
-2.0
-3.0
Transfer Function :0.2919525888958203

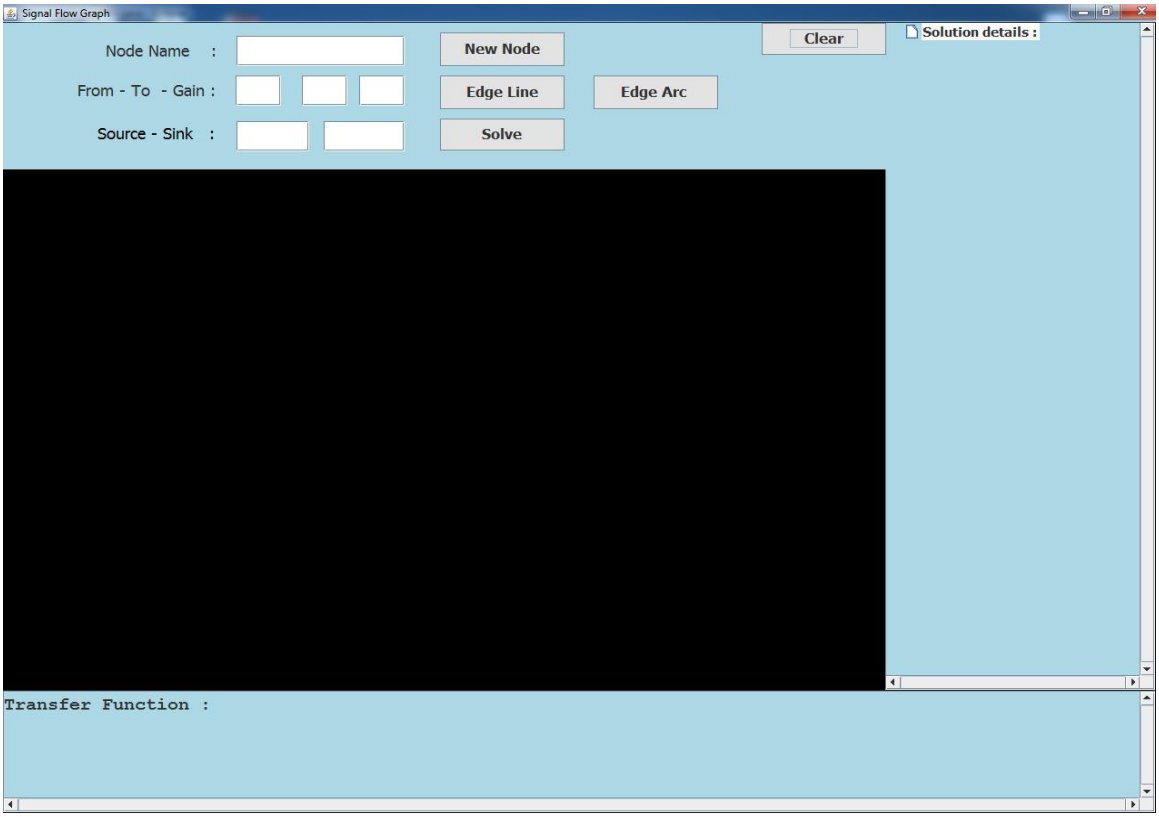
Sheet number 2:



➢ User guide

This program can run from external jar as shown in fig 1

When you run the program this window will appear



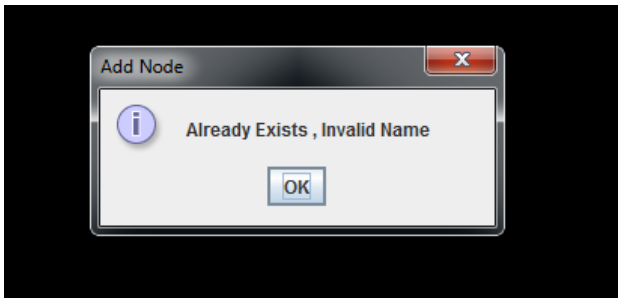
In this program you will be able to draw a signal flow graph and solve it

1. Drawing node

It‘s permitted to draw nodes and edges only in the black area.

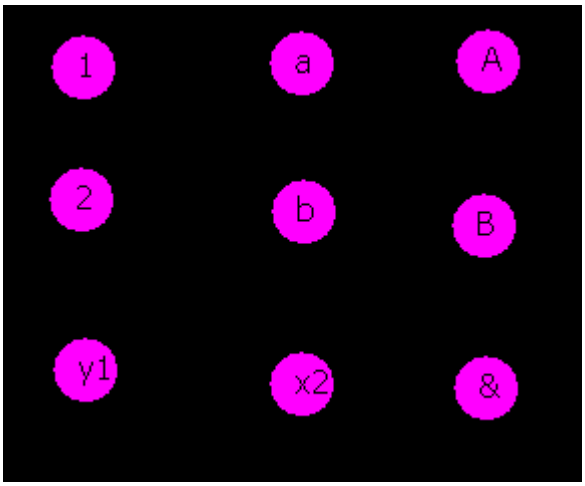
Steps

- Enter the node name
- Node ‘s name must be unique

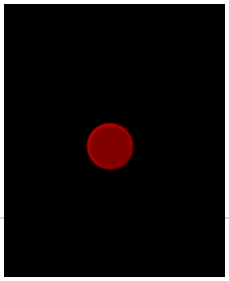


- Its name can be any string (uppercase or lower case) or digit or symbol as node name
- Node ‘s name is sensitive case

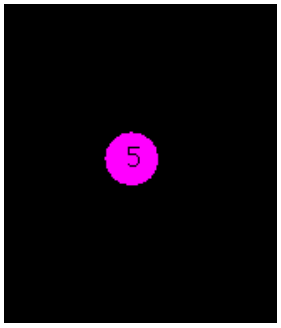
- It’s recommended for the node ‘s name to be 2 characters to fit in the node in Gui.
  - Example



- To draw a new node :
  - Write node‘s name in the corresponding text field.
  - Press on “New Node” button.
  - Move the mouse to the black area
  - A transparent red circle will appear



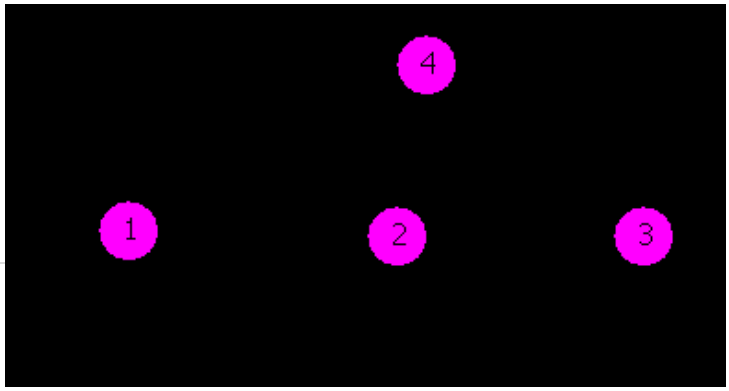
- Press the mouse wherever you want to place the node.



- The node will be drawn with its name in its middle

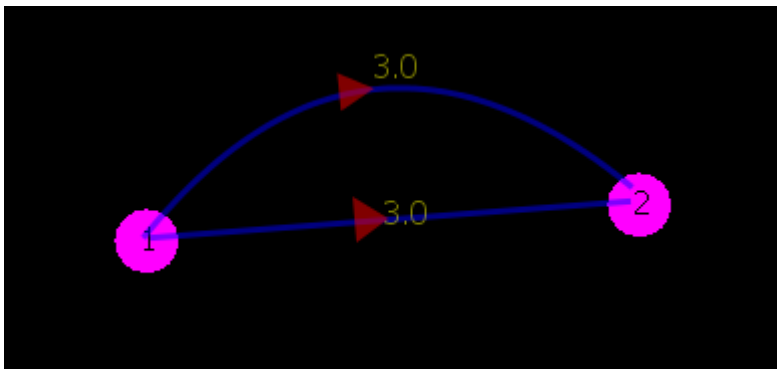
Note that:

- You can't place a node outside the boarders of the black area.
- Try not to add more than one node at the same place, the user won't be able to see both of them.
- To get a good graph , it's recommended to leave a space between nodes as in the pic.



2. Drawing Edges

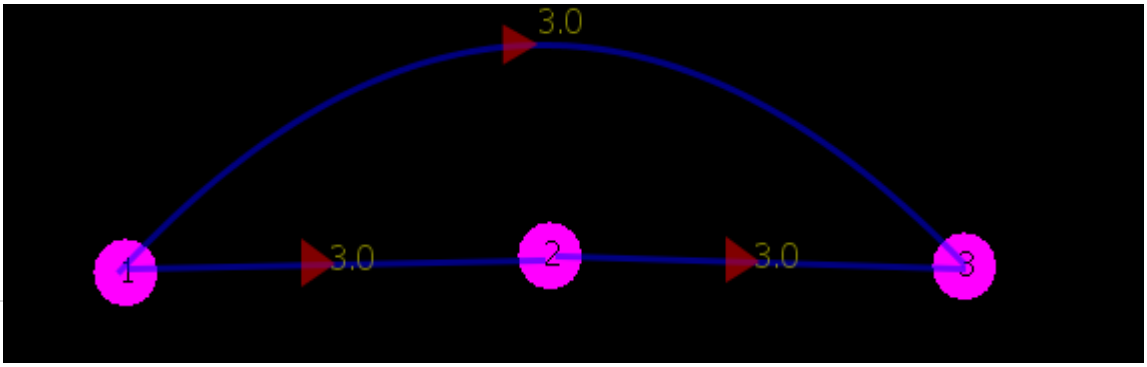
The user will be able to connect nodes using edges and choose their numerical gain value.



Steps:

- Enter the starting node
- Enter the ending node
- Enter the numerical gain

- Press on “Edge Line” or “Edge arc”- as you wish-.
- Click on the starting node and drag to the ending node.
- If you clicked on anywhere other than the starting node, nothing will be drawn.
- If you dragged and clicked anywhere other than the destination node, the edge won’t be drawn.



Note that:

- The starting and ending node mush exist in the drawn graph otherwise an error message will appear.
  Take care, the node‘s node is case sensitive, node a is not node A.
- Gain must be numeric otherwise aa popup error message will appear

- To draw an edge, the user have 2 options:
  1) Line

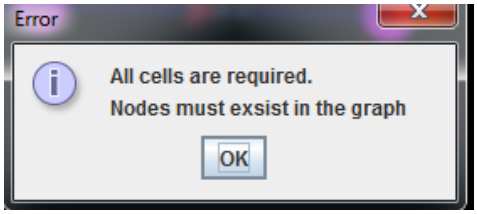
2) Arc

- To get a good graph, it's recommended to draw a line edge between 2 successive nodes , And an arc edge between non neighbor nodes.
- It's not recommended to draw two edges over each other's it will give an ugly view.

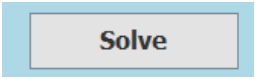
3. Solving Graph

- User must enter the name of source and sink node

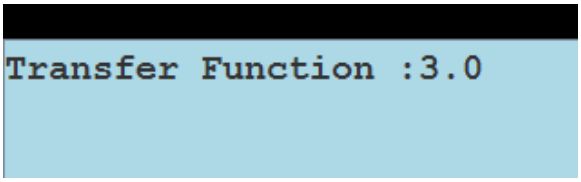
- The source and sink nodes must exist in the drawn graph.



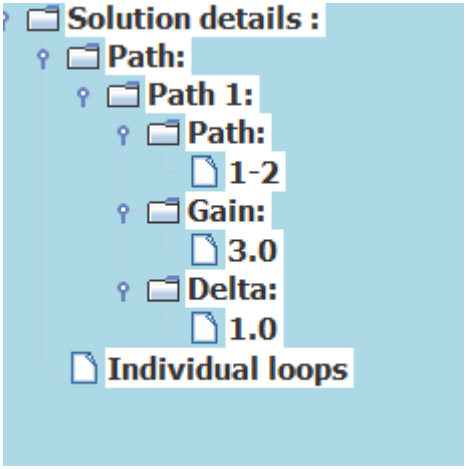
- To solve press "solve "



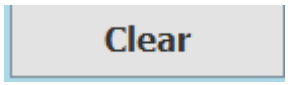
- The overall gain function will appear at the button.



- All solution details will be found on the right of the screen.



4. Clear



_ User can clear all the graph by clicking the “clear “button.