Cyclomatic Complexity-

Cyclomatic Complexity may be defined as-

- It is a software metric that measures the logical complexity of the program code.
- It counts the number of decisions in the given program code.
- It measures the number of linearly independent paths through the program code.

Cyclomatic complexity indicates several information about the program code-

Cyclomatic Complexity	Meaning
1 – 10	• Structured and Well Written Code • High Testability • Less Cost and Effort
10 – 20	• Complex Code • Medium Testability • Medium Cost and Effort
20 – 40	• Very Complex Code • Low Testability • High Cost and Effort
> 40	• Highly Complex Code • Not at all Testable • Very High Cost and Effort

Importance of Cyclomatic Complexity-

- It helps in determining the software quality.
- It is an important indicator of program code's readability, maintainability and portability.
- It helps the developers and testers to determine independent path executions.
- It helps to focus more on the uncovered paths.
- It evaluates the risk associated with the application or program.
- It provides assurance to the developers that all the paths have been tested at least once.

Properties of Cyclomatic Complexity-

- It is the maximum number of independent paths through the program code.
- It depends only on the number of decisions in the program code.
- Insertion or deletion of functional statements from the code does not affect its cyclomatic complexity.
- It is always greater than or equal to 1.

Calculating Cyclomatic Complexity-

Cyclomatic complexity is calculated using the control flow representation of the program code.

In control flow representation of the program code,

- Nodes represent parts of the code having no branches.
- Edges represent possible control flow transfers during program execution

There are 3 commonly used methods for calculating the cyclomatic complexity-

Method-01:

Cyclomatic Complexity = Total number of closed regions in the control flow graph + 1

Method-02:

Cyclomatic Complexity = E – N + 2

Here-

- E = Total number of edges in the control flow graph
- N = Total number of nodes in the control flow graph

Method-03:

Cyclomatic Complexity = P + 1

Here,

P = Total number of predicate nodes contained in the control flow graph

Note-

- Predicate nodes are the conditional nodes.
- They give rise to two branches in the control flow graph.

PRACTICE PROBLEMS BASED ON CYCLOMATIC COMPLEXITY-

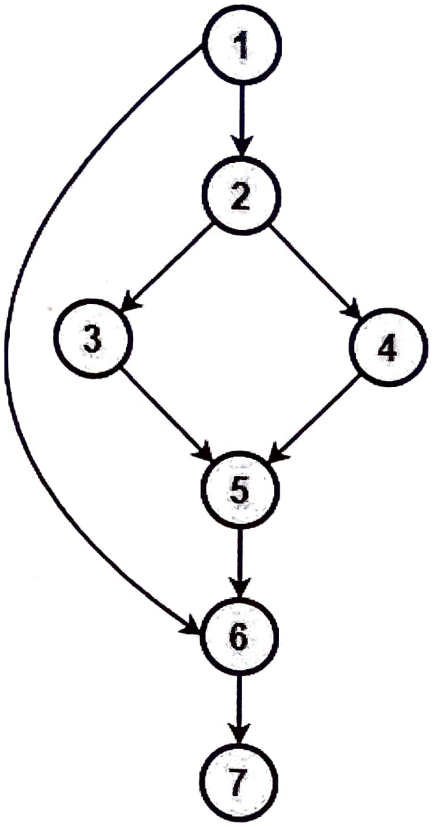
Problem-01:

Calculate cyclomatic complexity for the given code-

```
IF A = 354
   THEN IF B > C
        THEN A = B
        ELSE A = C
   END IF
END IF
PRINT A
```

Solution-

We draw the following control flow graph for the given code-



Control Flow Graph

Using the above control flow graph, the cyclomatic complexity may be calculated as-

Method-01:

Cyclomatic Complexity

= Total number of closed regions in the control flow graph + 1

= 2 + 1

= 3

Method-02:

Cyclomatic Complexity

= E – N + 2

= 8 – 7 + 2

= 3

Method-03:

Cyclomatic Complexity

= 2 + 1

= 3

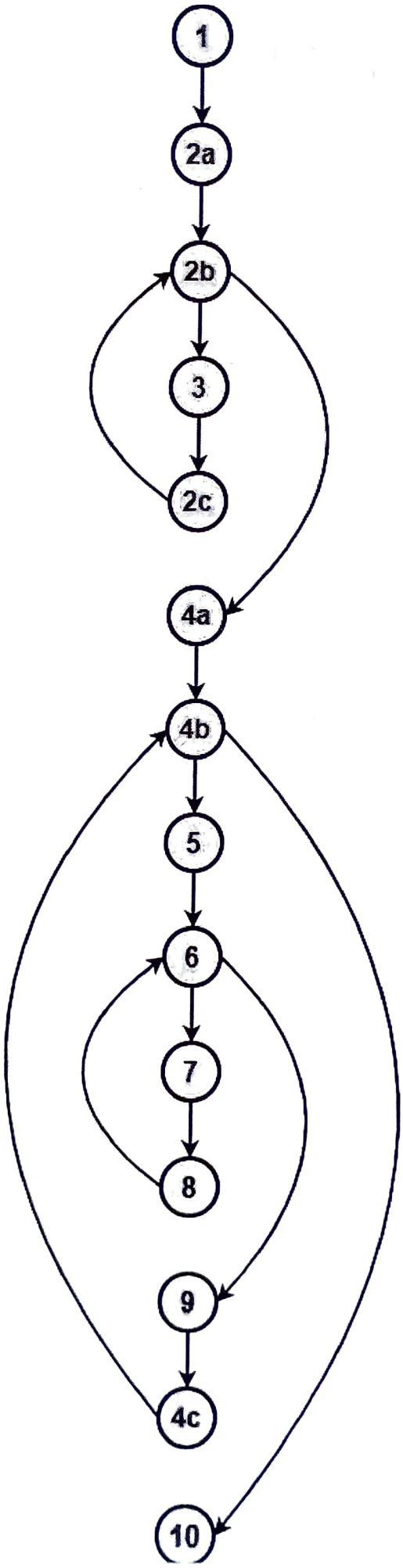
Problem-02:

Calculate cyclomatic complexity for the given code-

```
{ int i, j, k;
  for (i=0 ; i<=N ; i++)
  p[i] = 1;
  for (i=2 ; i<=N ; i++)
  {
     k = p[i]; j=1;
     while (a[p[j-1]] > a[k] {
         p[j] = p[j-1];
         j--;
  }
     p[j]=k;
}
```

Solution-

We draw the following control flow graph for the given code-


1
2a
2b
3
2c
4a
4b
5
6
7
8
9
4c
10

Control Flow Graph

Using the above control flow graph, the cyclomatic complexity may be calculated as-

Method-01:

Cyclomatic Complexity

= Total number of closed regions in the control flow graph + 1

= 3 + 1

= 4

Method-02:

Cyclomatic Complexity

= E – N + 2

= 16 – 14 + 2

= 4

Method-03:

Cyclomatic Complexity

= P + 1

= 3 + 1

= 4

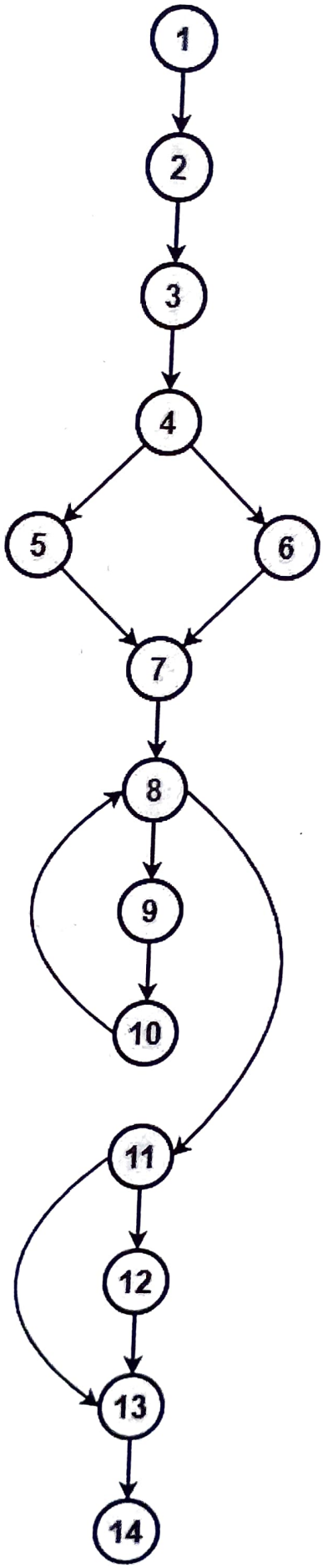
Problem-03:

Calculate cyclomatic complexity for the given code-

```
begin int x, y, power;
      float z;
      input(x, y);
      if(y<0)
      power = -y;
      else power = y;
      z=1;
      while(power!=0)
      {     z=z*x;
            power=power-1;
      } if(y<0)
      z=1/z;
      output(z);
      end
```

Solution-

We draw the following control flow graph for the given code-



Using the above control flow graph, the cyclomatic complexity may be calculated as-

Method-01:

Cyclomatic Complexity

= Total number of closed regions in the control flow graph + 1

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Method-02:

Cyclomatic Complexity

= E – N + 2

= 16 – 14 + 2

= 4

Method-03:

Cyclomatic Complexity

= P + 1

= 3 + 1

= 4