Lab Report

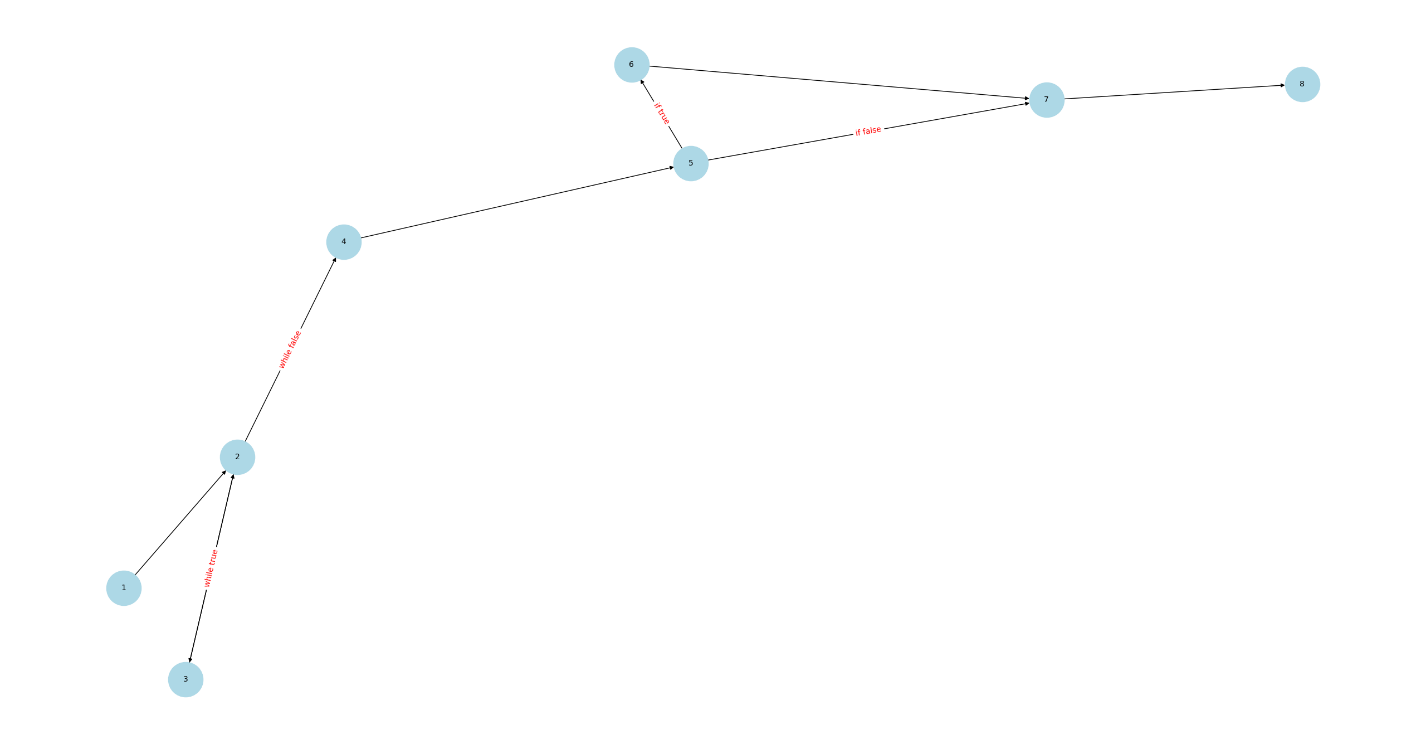
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# Observations and Analysis

## Q1:

Data Flow Graph:

|  |  |
| --- | --- |
| Node | Lines |
| 1 | 1,2,3,4 |
| 2 | 5 |
| 3 | 6, 7 |
| 4 | 8 |
| 5 | 9 |
| 6 | 10 |
| 7 | 11 |
| 8 | 12, 13 |



Output:

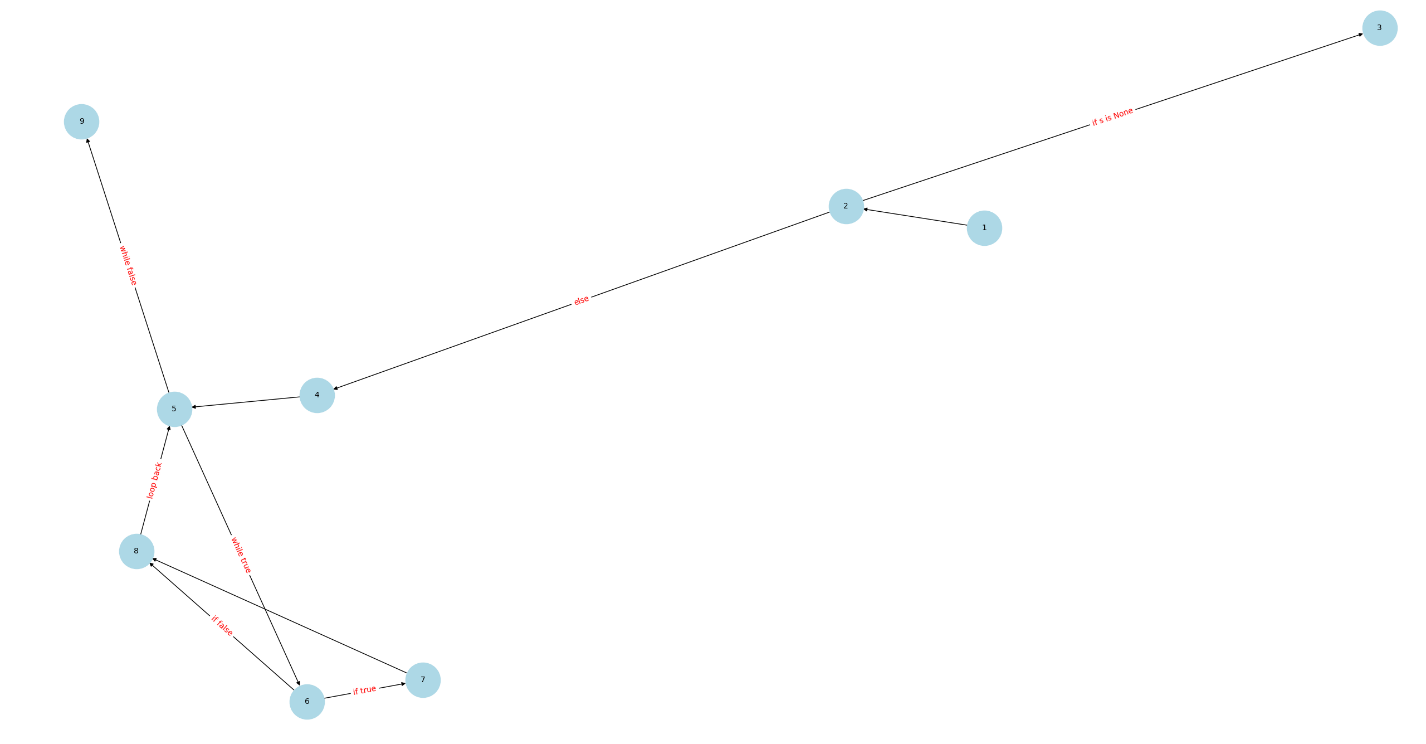
A screen shot of a computer program

AI-generated content may be incorrect.

## Q2:

Data Flow Graph:

|  |  |
| --- | --- |
| Node | Lines |
| 1 | 1 |
| 2 | 2 |
| 3 | 3 |
| 4 | 4, 5, 6 |
| 5 | 7 |
| 6 | 8 |
| 7 | 9 |
| 8 | 10, 11 |
| 9 | 12, 13 |



Output:

A computer screen shot of white text

AI-generated content may be incorrect.

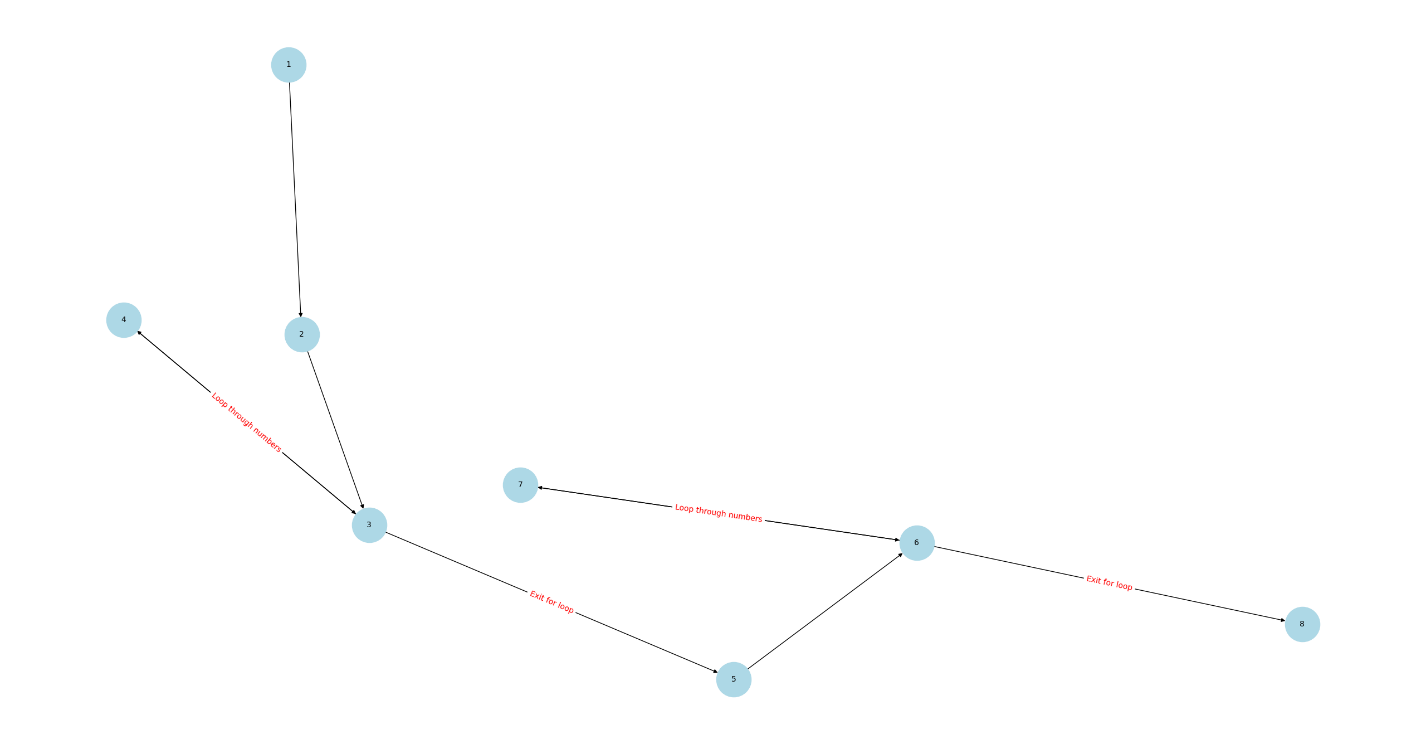
A computer screen with a black background

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## Q3:

1. Control flow and data flow coverage graph

|  |  |
| --- | --- |
| Node | Lines |
| 1 | 1 |
| 2 | 2, 3,4 |
| 3 | 5 |
| 4 | 6 |
| 5 | 7, 8, 9 |
| 6 | 10 |
| 7 | 11 |
| 8 | 12 to 19 |



1. DU Pairs (Node Pairs) for Each Variable

DU pairs are pairs of nodes where a variable is defined (D) and used (U).

* + length:
    - Defined at node 2
    - Used at nodes 3, 5, 6, 8
  + sum\_values:
    - Defined at node 2
    - Used at nodes 4, 5
  + numbers\_sorted:
    - Defined at node 5
    - Used at node 5
  + median:
    - Defined at node 5
    - Used at node 8
  + mean:
    - Defined at node 5
    - Used at nodes 7, 8
  + varsum:
    - Defined at node 5
    - Used at nodes 7, 8
  + variance:
    - Defined at node 8
    - Used at node 8
  + standard\_deviation:
    - Defined at node 8
    - Used at node 8

1. DU Paths for Each DU Pair for Each Variable

DU paths are paths from a definition to a use of a variable.

* + length:
    - (2, 3): length is defined at node 2 and used at node 3
    - (2, 5): length is defined at node 2 and used at node 5
    - (2, 6): length is defined at node 2 and used at node 6
    - (2, 8): length is defined at node 2 and used at node 8
  + sum\_values:
    - (2, 4): sum\_values is defined at node 2 and used at node 4
    - (2, 5): sum\_values is defined at node 2 and used at node 5
  + numbers\_sorted:
    - (5, 5): numbers\_sorted is defined and used at node 5
  + median:
    - (5, 8): median is defined at node 5 and used at node 8
  + mean:
    - (5, 7): mean is defined at node 5 and used at node 7
    - (5, 8): mean is defined at node 5 and used at node 8
  + varsum:
    - (5, 7): varsum is defined at node 5 and used at node 7
    - (5, 8): varsum is defined at node 5 and used at node 8
  + variance:
    - (8, 8): variance is defined and used at node 8
  + standard\_deviation:
    - (8, 8): standard\_deviation is defined and used at node 8

1. Test cases to cover du paths

A screenshot of a computer program

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1. Can’t run all test cases to cover du paths
   * IndexError: This occurs because the program tries to access an element in an empty list. Specifically, numbers\_sorted[length // 2] tries to access an element at index 0, which does not exist in an empty list.
   * ZeroDivisionError: This occurs because the program tries to divide by zero. Specifically, mean = sum\_values / length and variance = varsum / (length - 1) both involve division by zero when length is 0 or 1.

## Q4:

1. Control flow and data flow coverage graph

|  |  |
| --- | --- |
| Node | Lines |
| 1 | 1, 2, 3, 4 |
| 2 | 5 to 12 |
| 3 | 13 |
| 4 | 14, 15 |
| 5 | 16 |
| 6 | 17 |
| 7 | 18 to 22 |
| 8 | 23 |
| 9 | 24, to 27 |
| 10 | 28 |
| 11 | 29 |
| 12 | 30 |

A drawing of a diagram

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1. Test Case: n = 1

When n = 1, the initial value of num\_primes is 1. The while loop condition num\_primes < n will be 1 < 1, which is false. Therefore, the while loop body will not be executed, and the control will directly move to the for loop that prints the primes

1. Test Paths for Edge Coverage but Not Prime Path Coverage
   * Input: n = 1
     + Path 1: 1 -> 2 -> 3 -> 10 -> 11 -> 10 -> 12
     + This path covers the edges from the start to the initialization, checks the while loop condition (which is false), and then moves to the for loop to print the primes.
   * Input: n = 2
     + Path 2: 1 -> 2 -> 3 -> 4 -> 5 -> 6 -> 5 -> 8 -> 9 -> 3 -> 10 -> 11 -> 10 -> 12
     + This path covers the edges from the start to the initialization, checks the while loop condition (which is true), executes the while loop body, checks the for loop condition, finds a prime, and then moves to the for loop to print the primes.
2. Unit Tests

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# Appendix:

## Q1:

## A screen shot of a computer program AI-generated content may be incorrect.

A screen shot of a computer program

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## Q2:

A screen shot of a computer program

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## Q3:

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## Q4:

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