Ahmad Wali CP220 Lab 6

Circuitverse Drawing and Simulation

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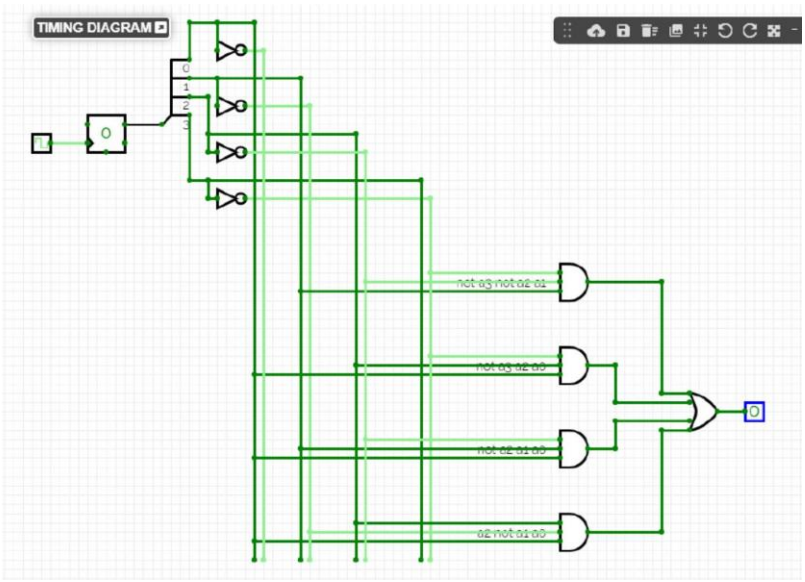
Continuing from lab 5, we concluded that we can find prime numbers from this equation:

$$prime = \overline{a_3}\ \overline{a_2}\ a_1 + \overline{a_3}\ a_2\ a_0 + \overline{a_2}\ a_1\ a_0 + a_2\ \overline{a_1}\ a_0$$

We define a prime number as any positive integer > 1, that is not a composite number.

We can build a circuit that models the prime equation:

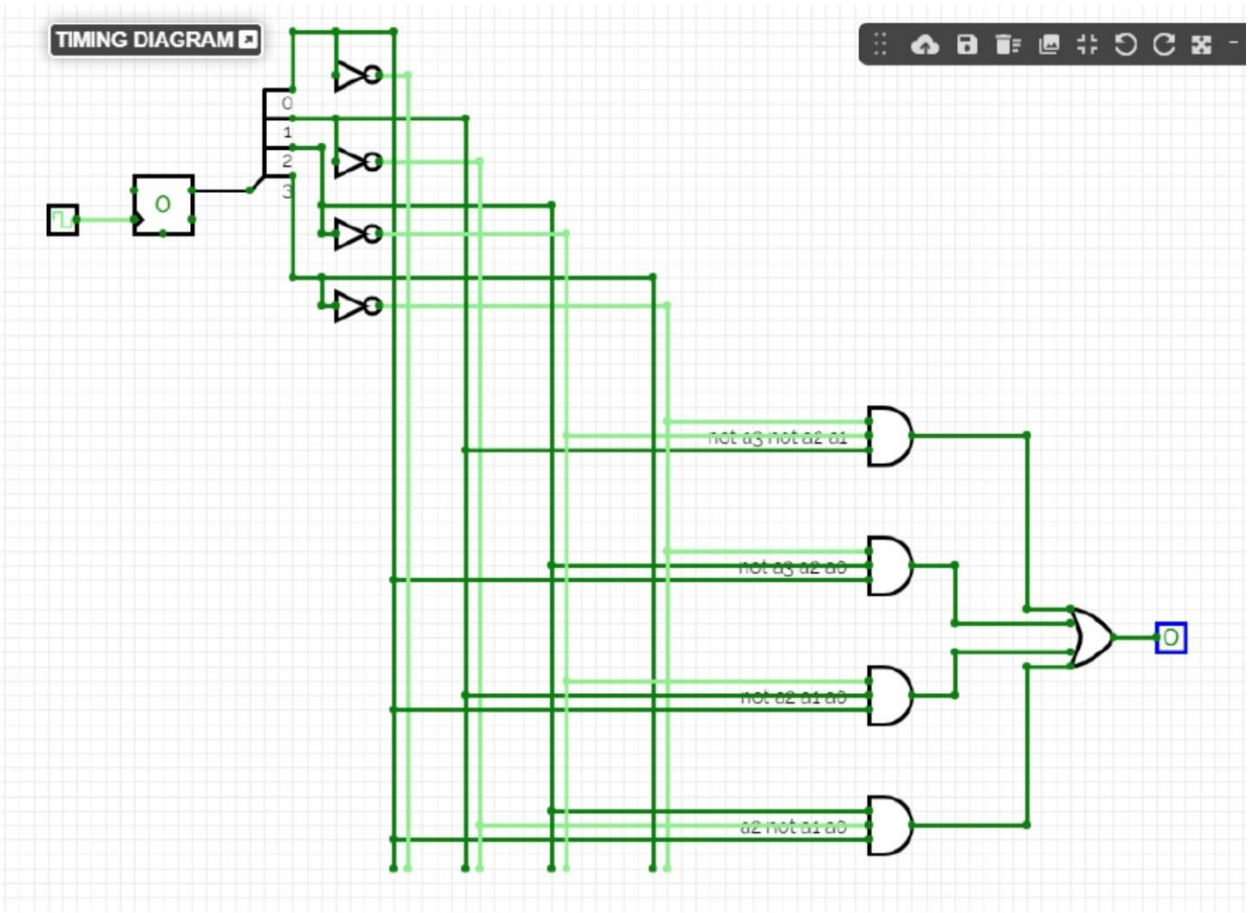


Description of circuit:

- The circuit begins with a binary counter, which helps us choose which number to test
- The circuit branches off into 4, to represent a0,a1,a2,a3
- The circuits then travel through negation gates, which helps setup out prime # equation
- By using and gates we are able to find the products of these inputs
- The 4 input OR gate then creates the sum of products.
- A 0 output indicates NOT a prime, and 1 output indicates a prime.

Next will be the respective testing for each circuit:

INPUT 0:

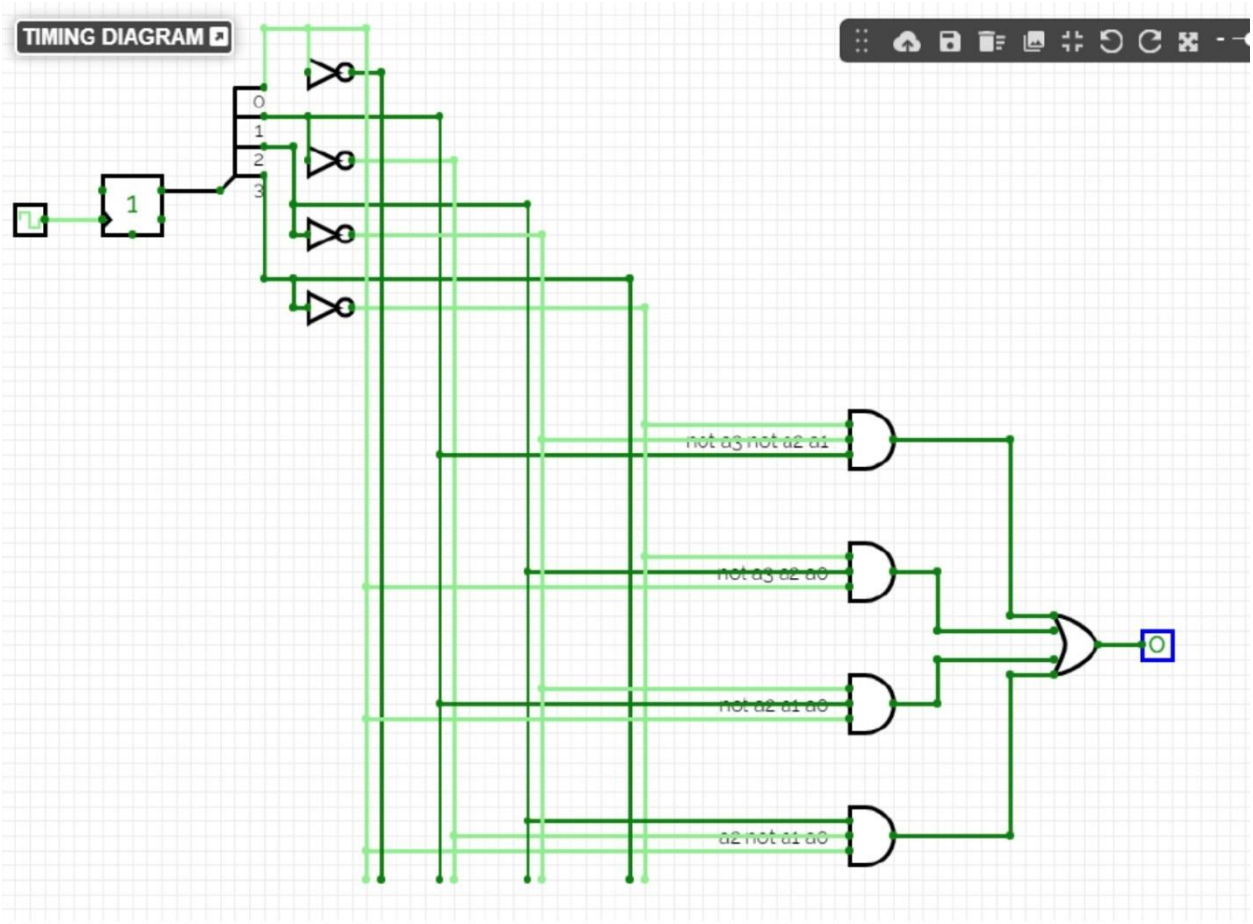



```
(%i6)  prime, a0 = false, a1 = false, a2 = false, a3 = false;

(%o6)  false
```

As evaluated by the circuit, we can see that 0 is not prime (it is not a greater than 1)

INPUT 1:

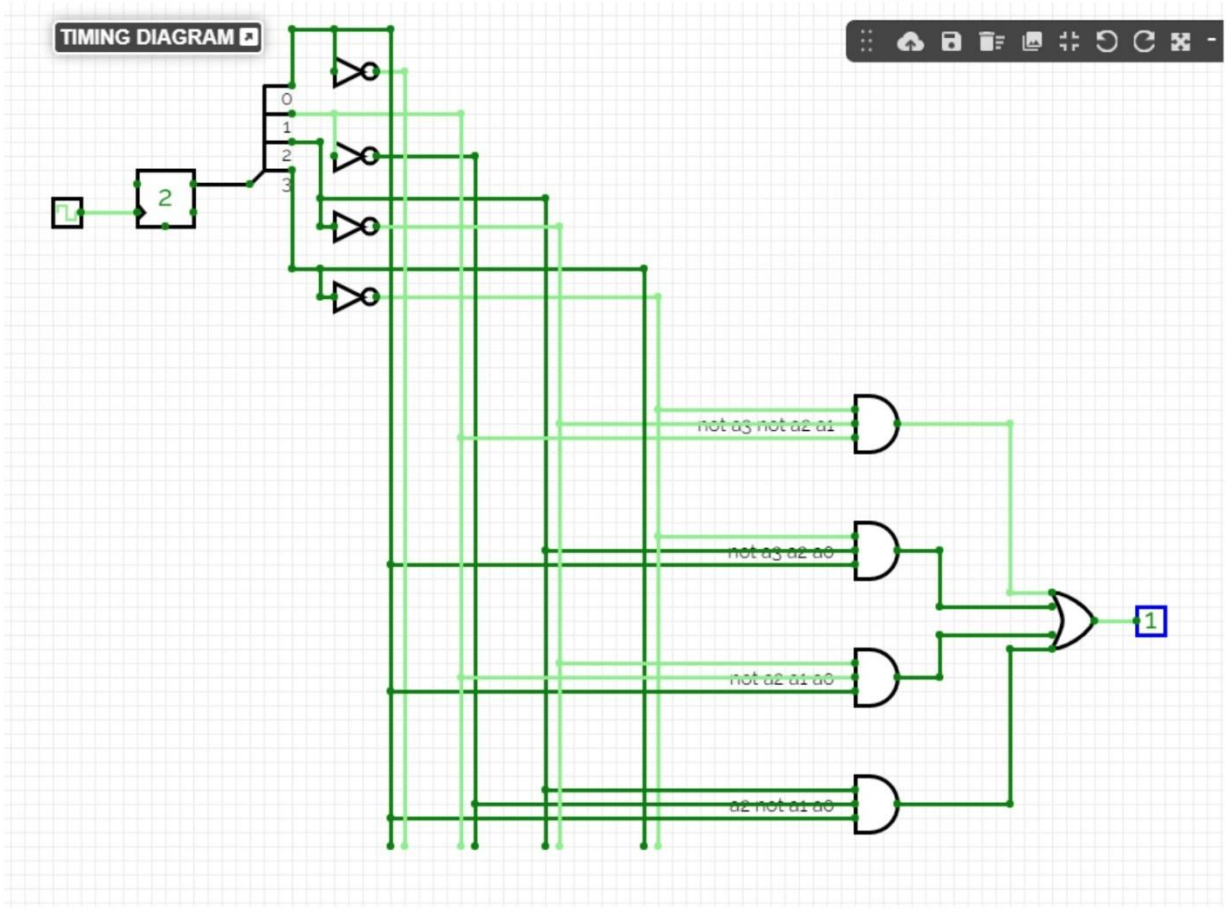



```
(%i7)  prime, a0 = true, a1 = false, a2 = false, a3 = false;

(%o7)  false
```

As evaluated by the circuit above, 1 is not a prime (not greater than 1)

INPUT 2:

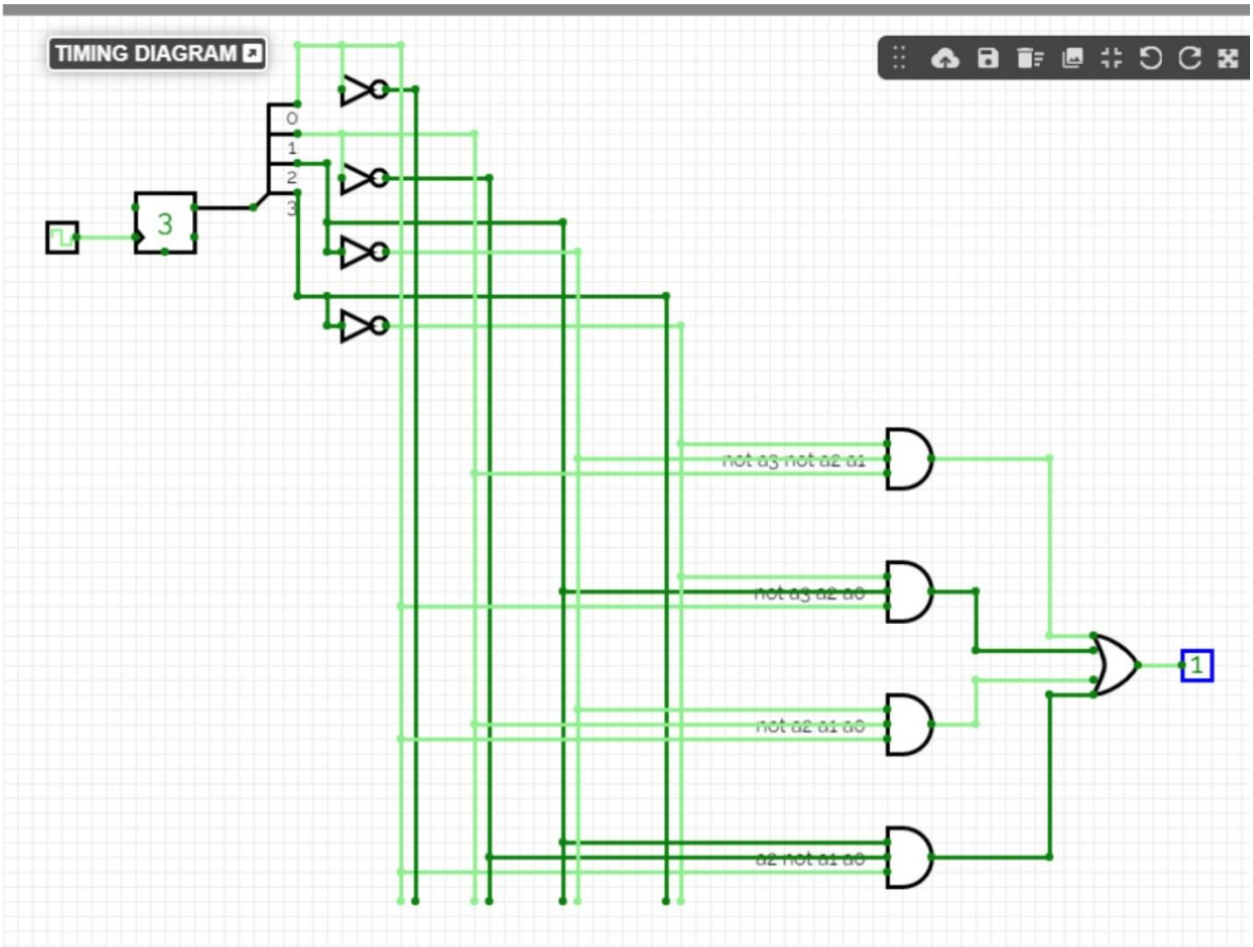



```
(%i8)  prime, a0 = false, a1 = true, a2 = false, a3 = false;

(%o8)  true
```

As evaluated by the circuit above, 2 is a prime number.

INPUT 3:

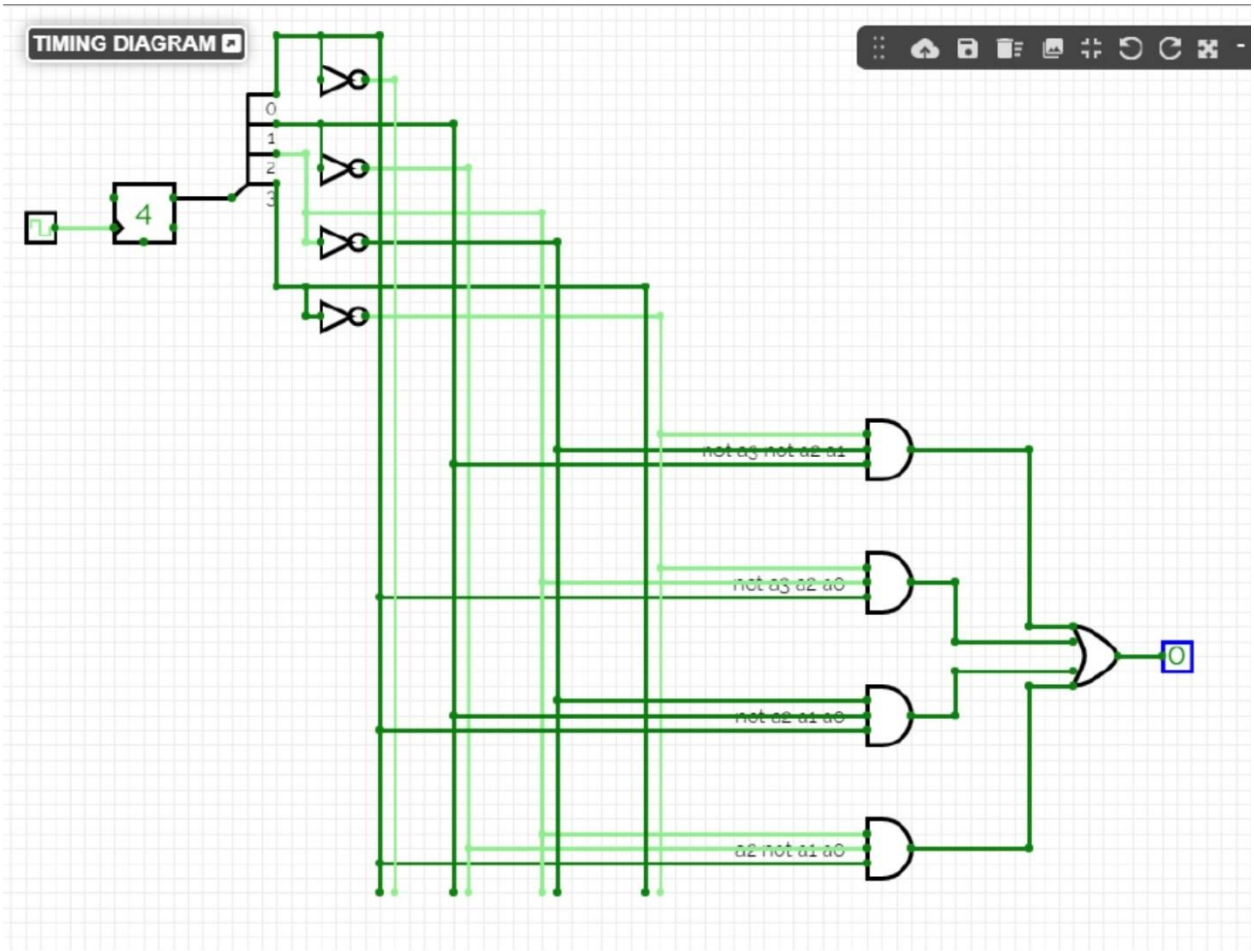



```
(%i9)  prime, a0 = true, a1 = true, a2 = false, a3 = false;

(%o9)  true
```

As evaluated by the circuit above, 3 is a prime number.

INPUT 4:

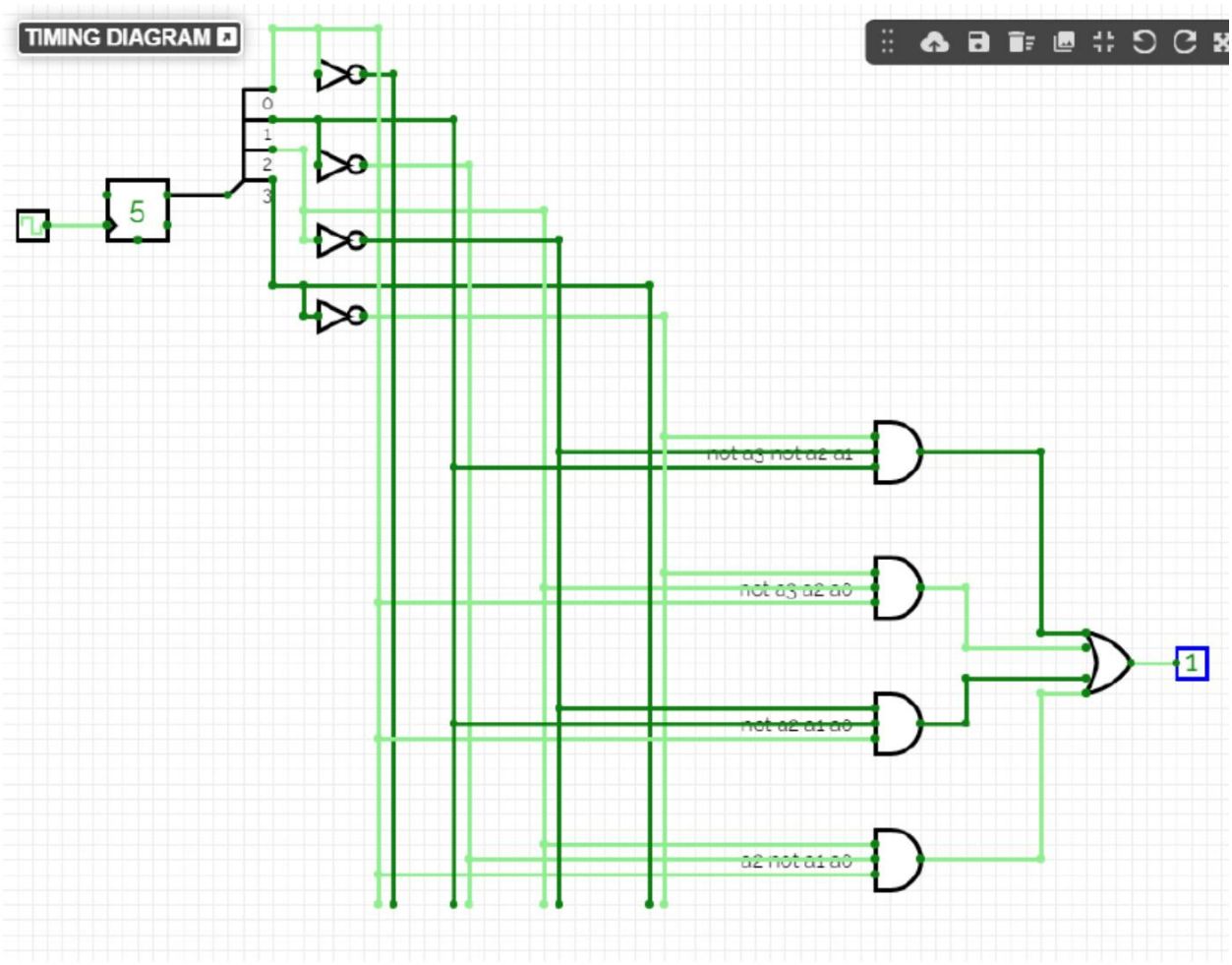



```
(%i10) prime, a0 = false, a1 = false, a2 = true, a3 = false;

(%o10)  false
```

As evaluated by the circuit above, 4 is not a prime (divisible by 4)

INPUT 5:

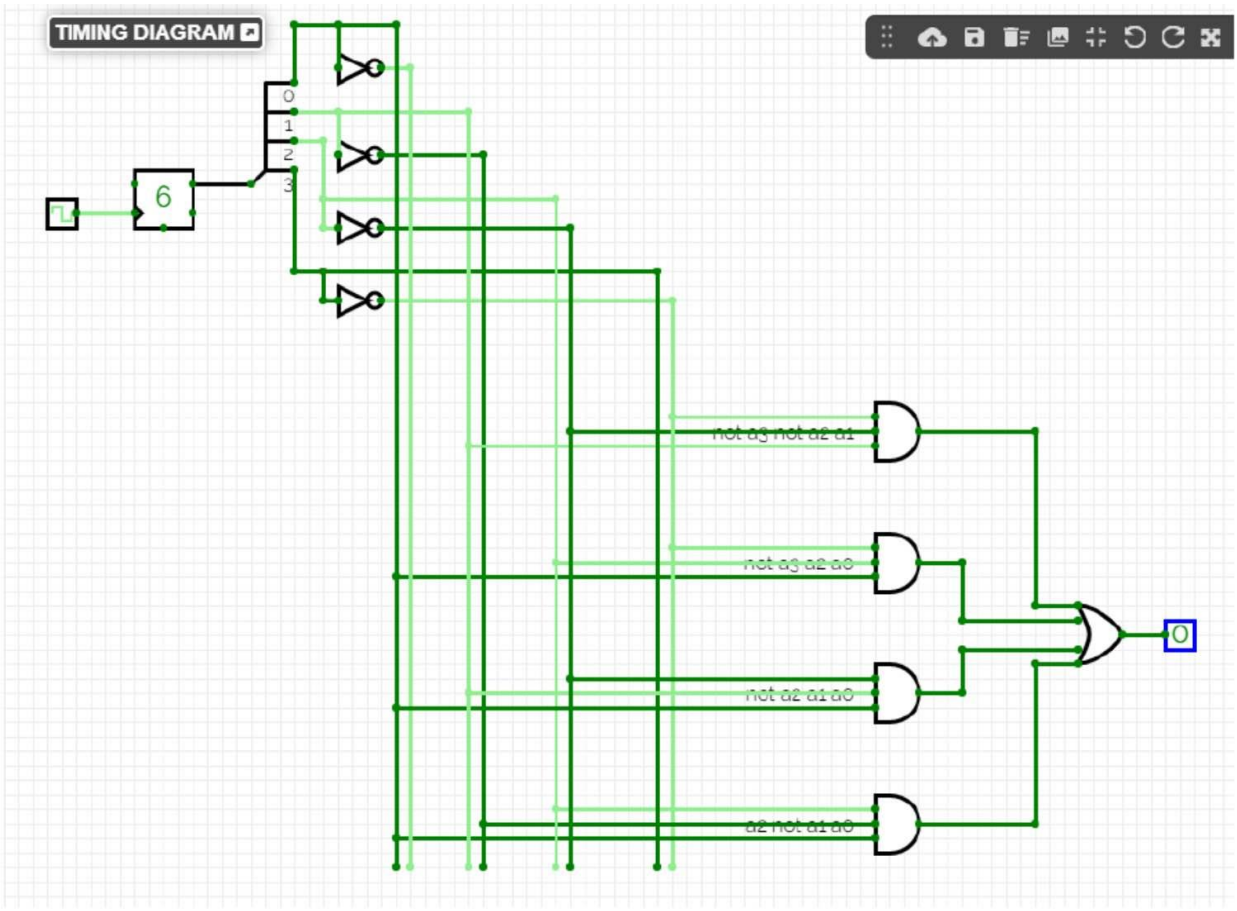



```
(%i11) prime, a0 = true, a1 = false, a2 = true, a3 = false;

(%o11)  true
```

As evaluated by the circuit above, 5 is a prime.

INPUT 6:

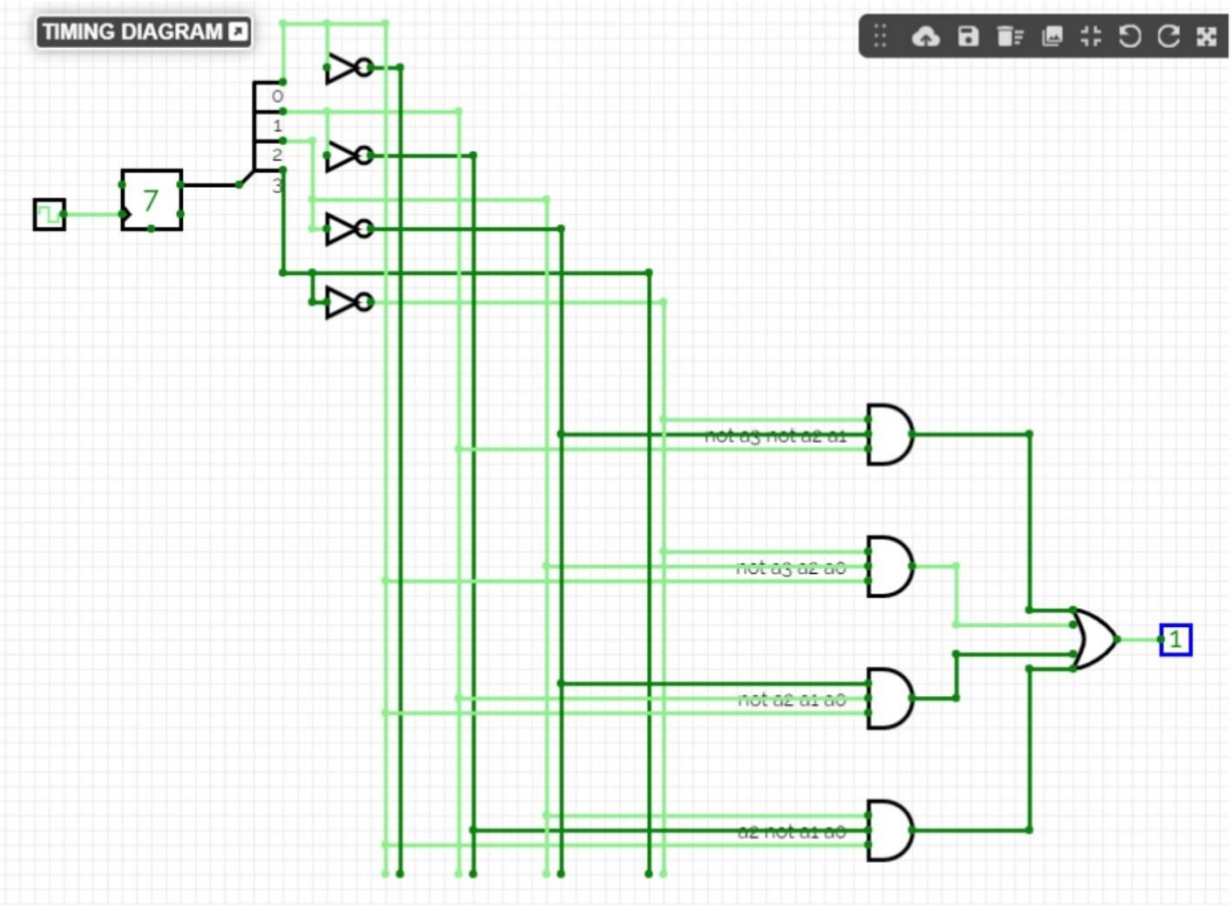



```
(%i12) prime, a0 = false, a1 = true, a2 = true, a3 = false;

(%o12)  false
```

As evaluated by the circuit above, 6 is not a prime (divisible by 2,3)

INPUT 7:

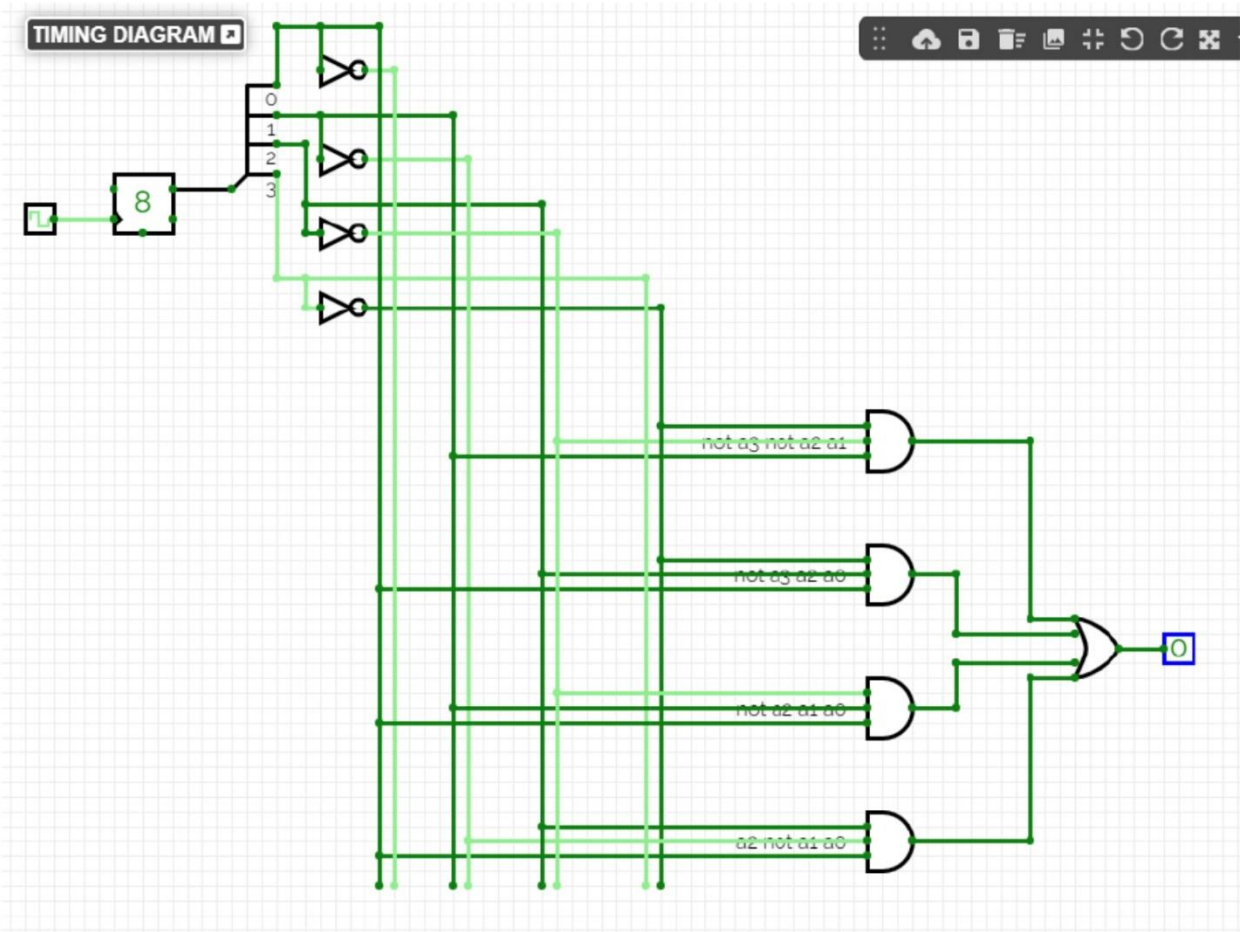



```
(%i13) prime, a0 = true, a1 = true, a2 = true, a3 = false;

(%o13)  true
```

As evaluated by the circuit above, 7 is a prime.

INPUT 8:

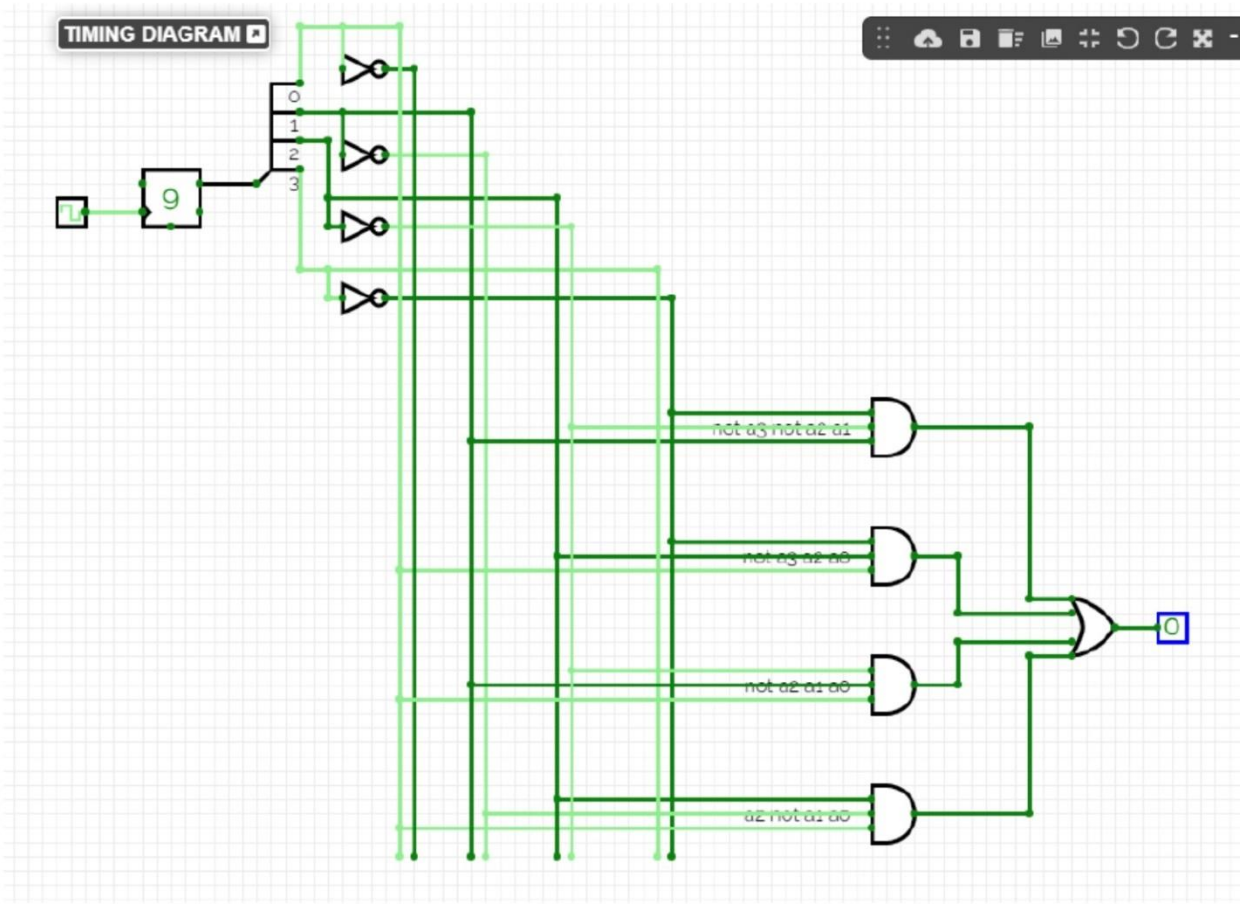



```
(%i14) prime, a0 = false, a1 = false, a2 = false, a3 = true;

(%o14)  false
```

As evaluated by the circuit above, 8 is not a prime (divisible by 4,2).

INPUT 9:

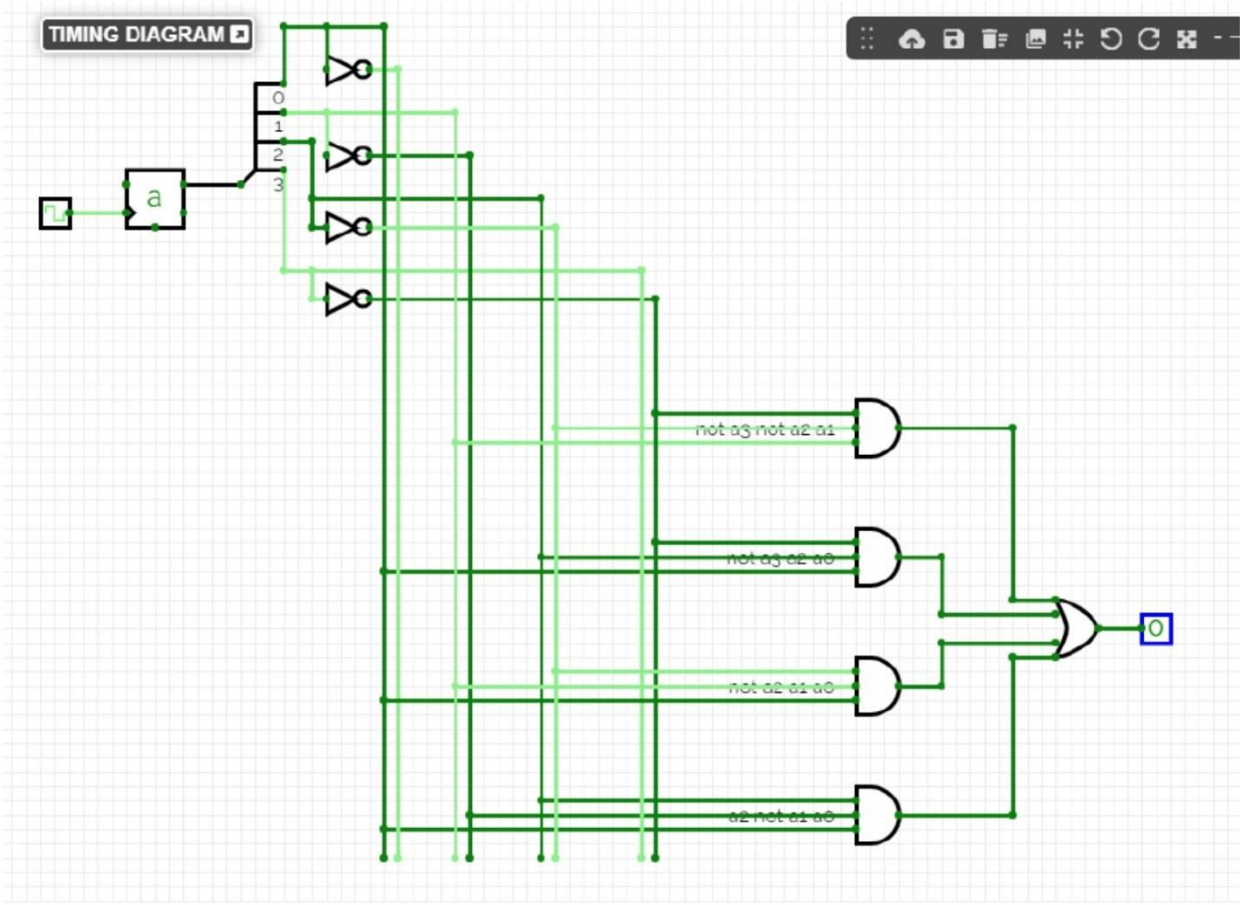



```
(%i16) prime, a0 = true, a1 = false, a2 = false, a3 = true;

(%o16) false
```

As evaluated by the circuit above, 9 is not a prime.

INPUT 10:

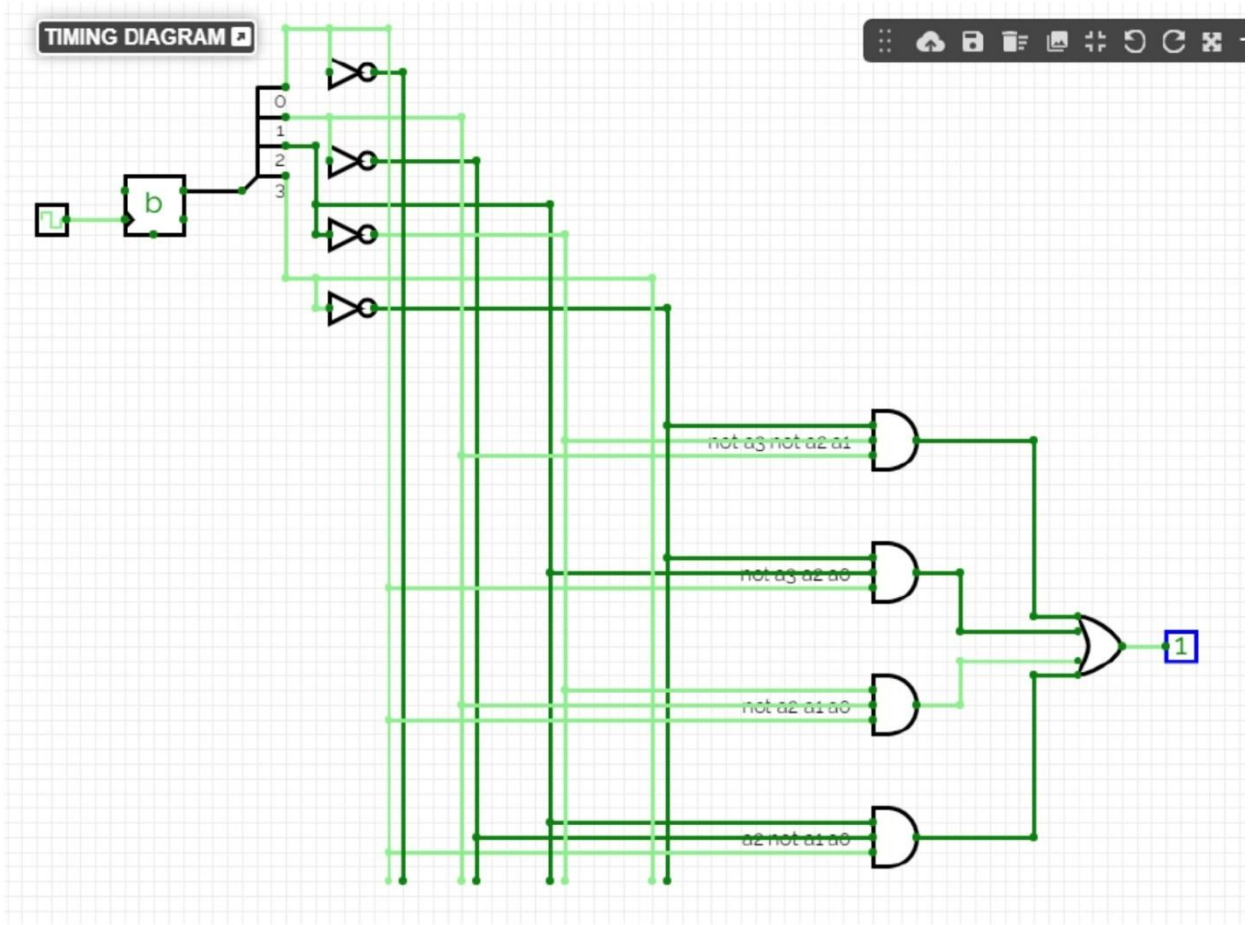



```
(%i17) prime, a0 = false, a1 = true, a2 = false, a3 = true;

(%o17)  false
```

As evaluated by the circuit above, a (10 in hexadecimal) is not a prime (divisible by 5,2).

INPUT 11:

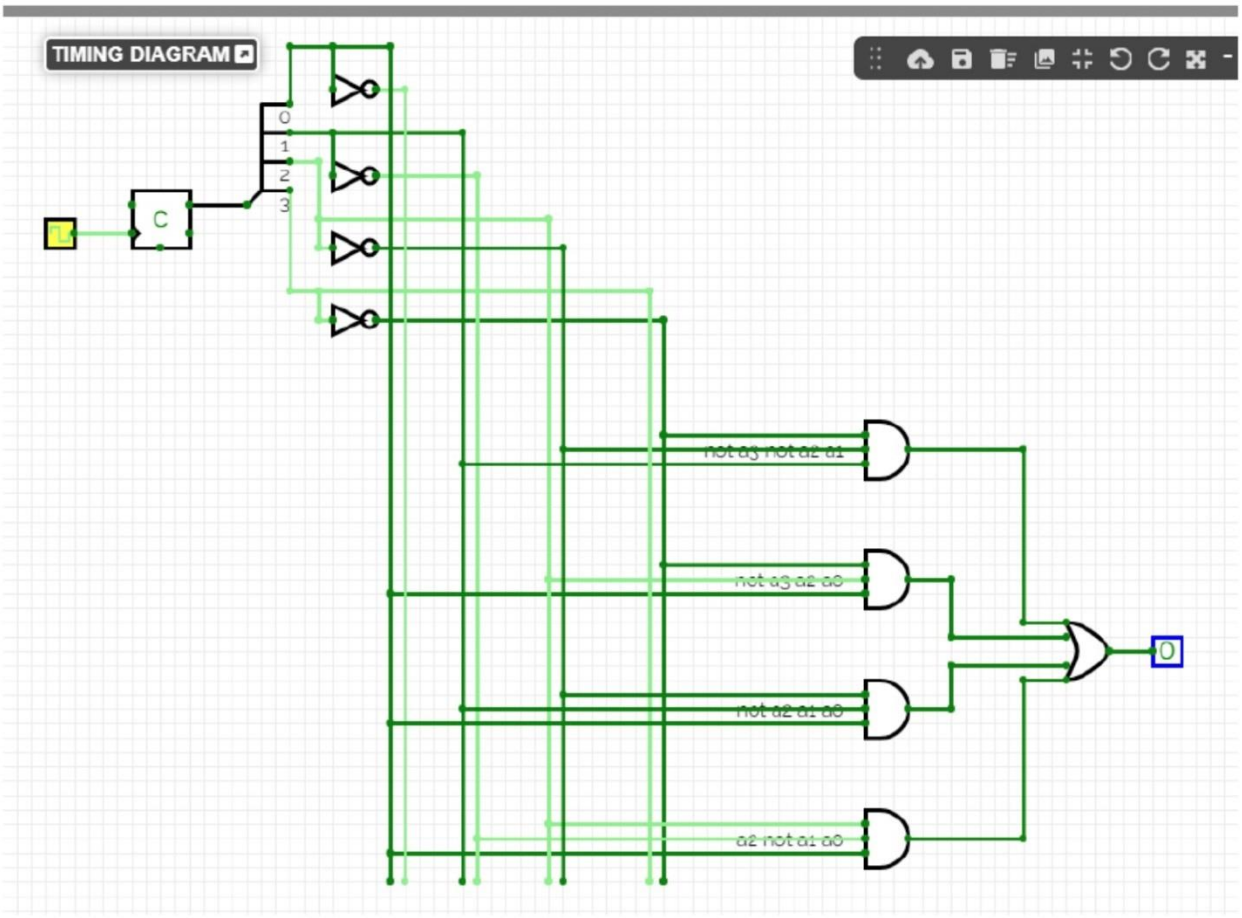



```
(%i18) prime, a0 = true, a1 = true, a2 = false, a3 = true;

(%o18) true
```

As evaluated by the circuit above, b (11 in hexadecimal) is a prime.

INPUT 12:

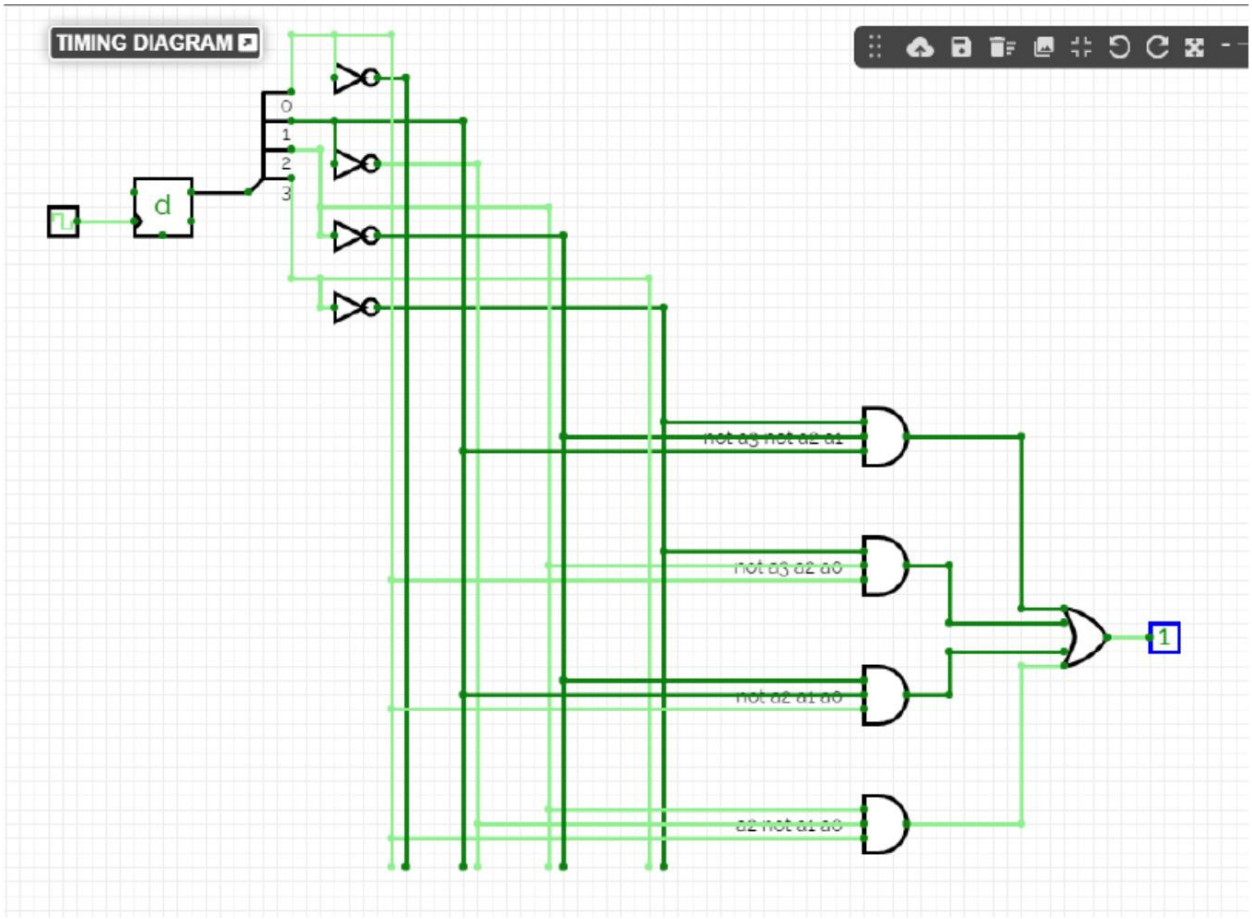



```
(%i19) prime, a0 = false, a1 = false, a2 = true, a3 = true;

(%o19)  false
```

As evaluated by the circuit above, c (12 in hexadecimal) is not a prime (divisible by 2,3,6,4)

INPUT 13:

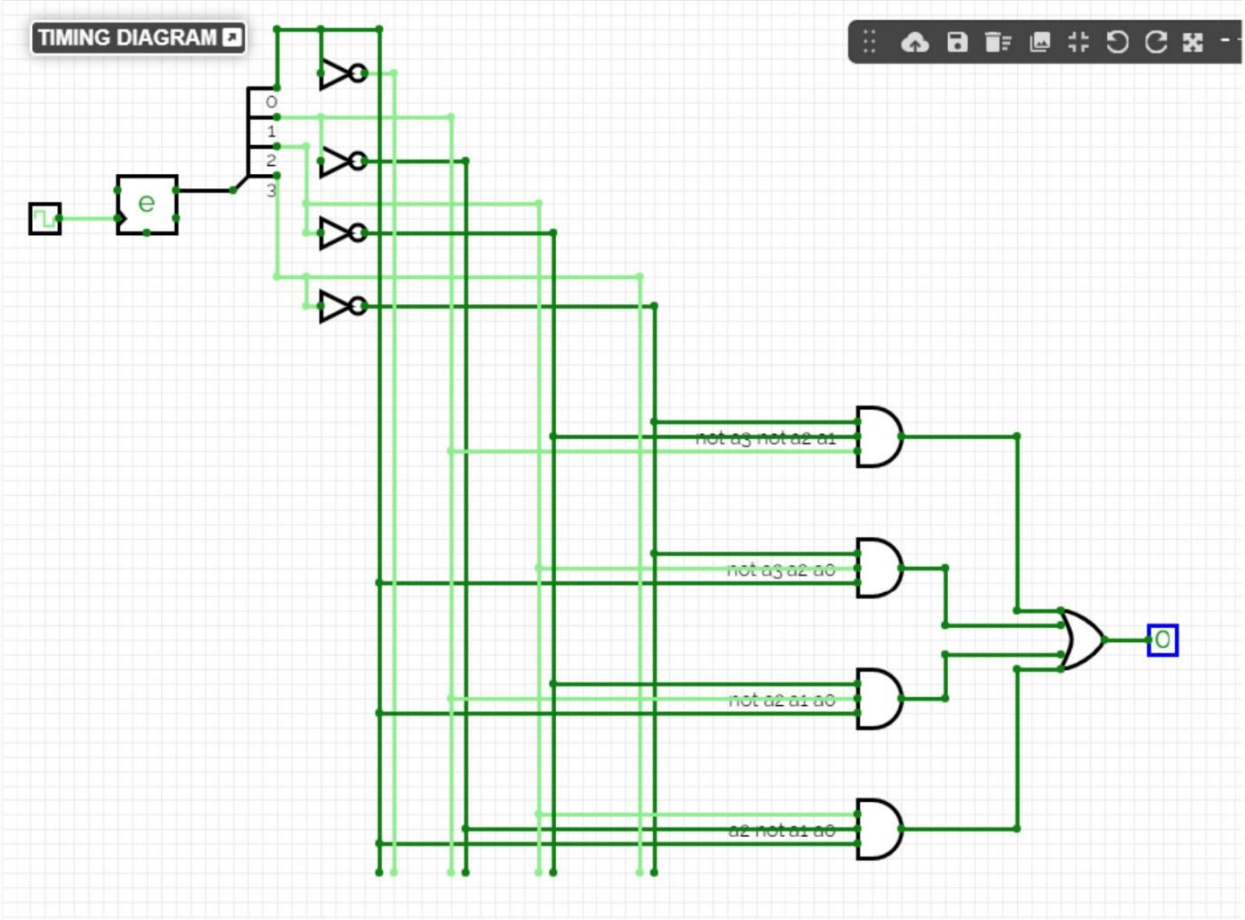



```
(%i20) prime, a0 = true, a1 = false, a2 = true, a3 = true;

(%o20)  true
```

As evaluated by the circuit above, d (13 in hexadecimal) is a prime

INPUT 14:

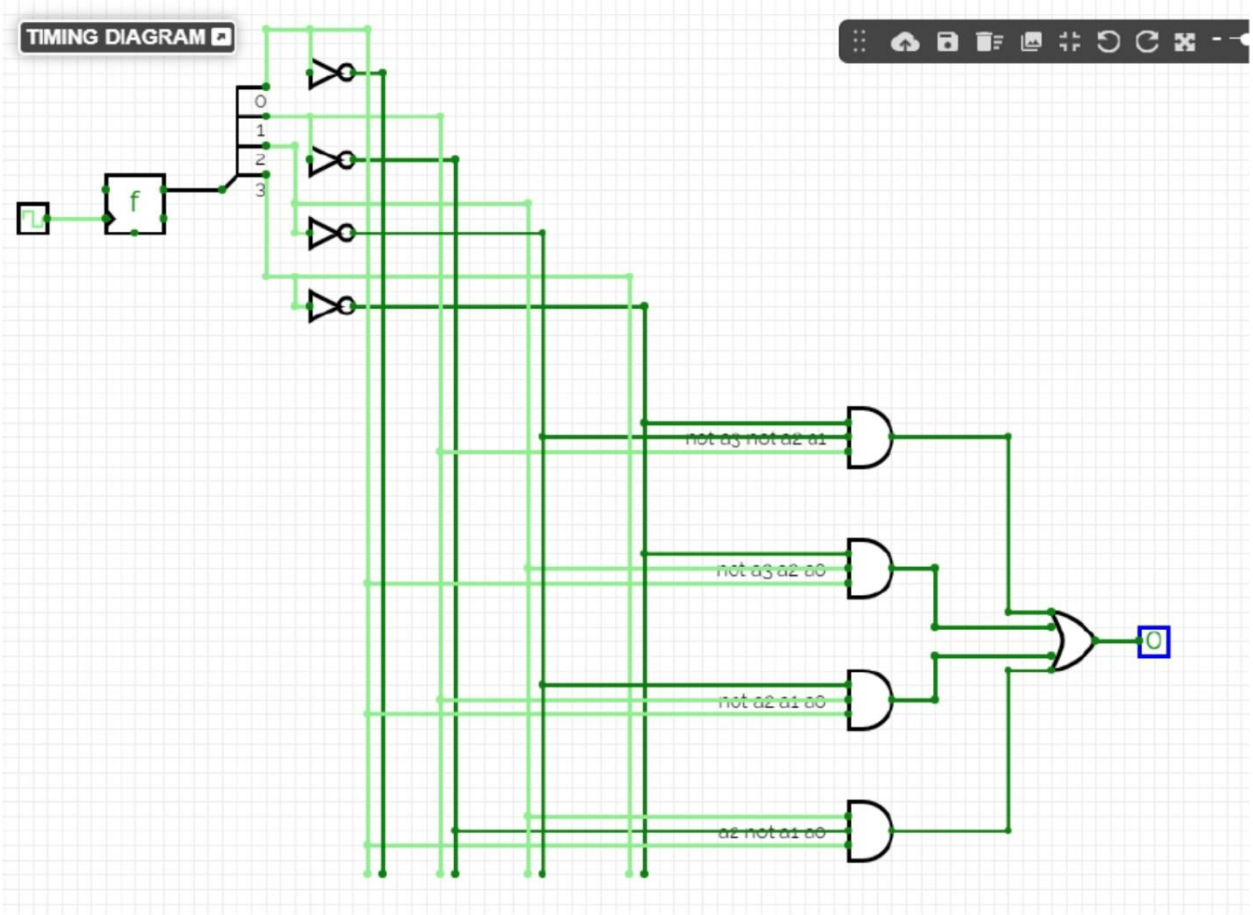



```
(%i21) prime, a0 = false, a1 = true, a2 = true, a3 = true;

(%o21)  false
```

As evaluated by the circuit above, e (14 in hexadecimal) is not a prime (divisible by 7,2)

INPUT 15:




```
(%i22) prime, a0 = true, a1 = true, a2 = true, a3 = true;

(%o22) false
```

As evaluated above, f (15 in hexadecimal) is not a prime (5,3).

Summary:

By looking at the circuits, we see that 2,3,5,7,11,13 are all prime numbers. This matches with the truth table made for lab 5 (attached below). Therefore, the circuit designed accurately models the prime number identifier for integers 0-15.

Number	Binary(a1/a2/a3/a4)	**Prime**/Composite/None
0	0000	N
1	0001	N
2	0010	**P**
3	0011	**P**
4	0100	C
5	0101	**P**
6	0110	C
7	0111	**P**
8	1000	C
9	1001	C
10	1010	C
11	1011	**P**
12	1100	C
13	1101	**P**
14	1110	C
15	1111	C