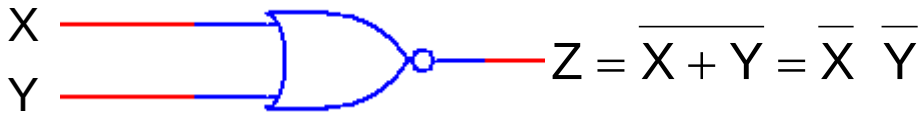
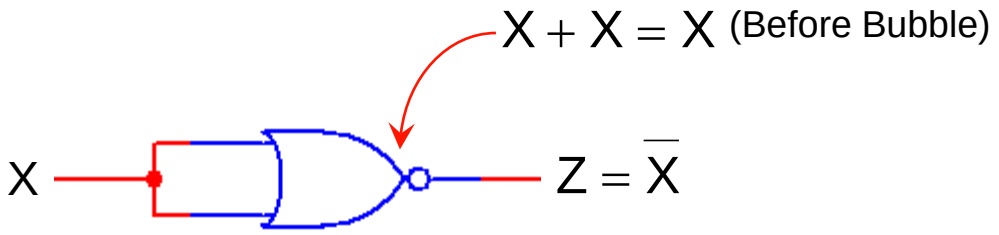
Universal Gate – NOR

NOR Gate



X	Y	Z
0	0	1
0	1	0
1	0	0
1	1	0

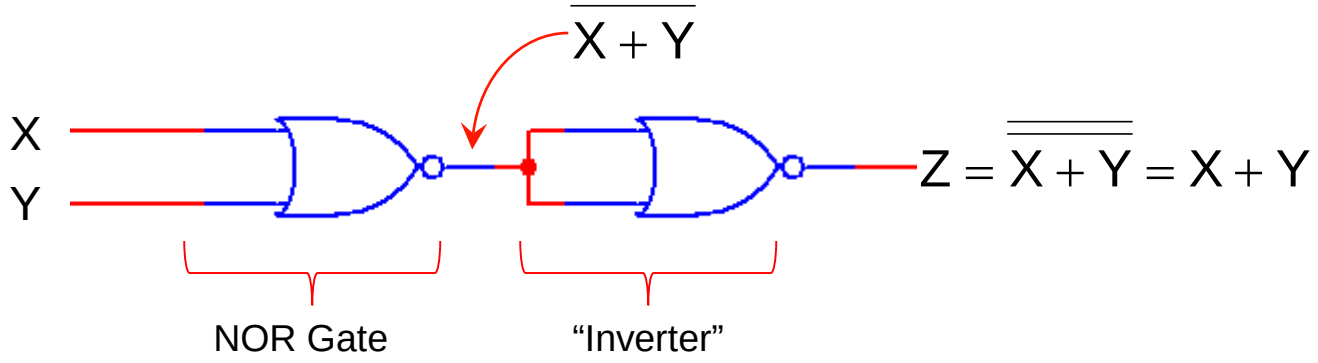
NOR Gate as an Inverter Gate



X	Z
0	1
1	0

Equivalent to Inverter

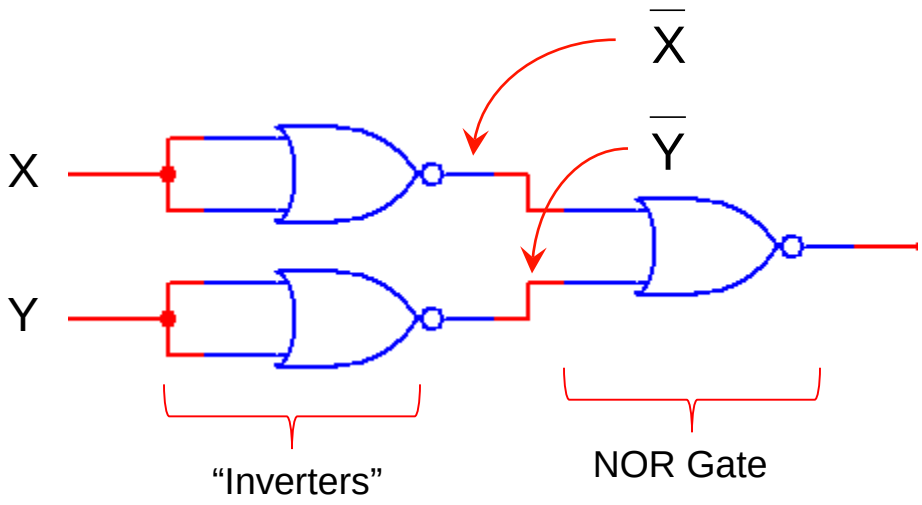
NOR Gate as an OR Gate



X	Y	Z
0	0	0
0	1	1
1	0	1
1	1	1

Equivalent to OR Gate

NOR Gate as an AND Gate



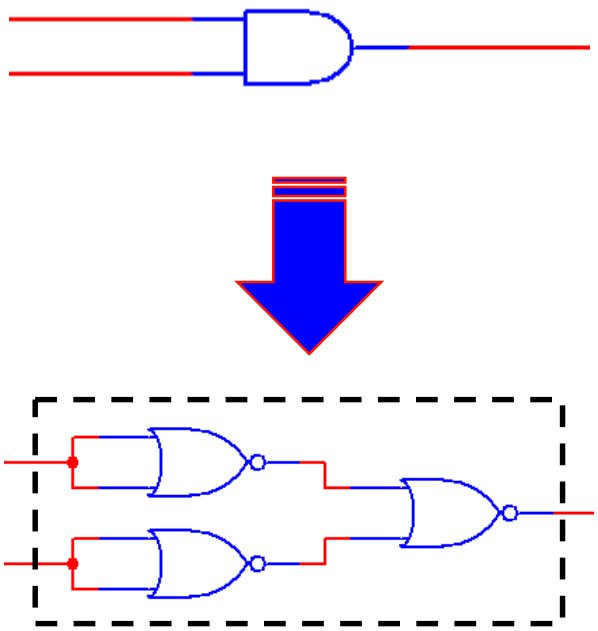
$$Z = \overline{\overline{X} + \overline{Y}} = \overline{\overline{X}}\,\overline{\overline{Y}} = X\,Y$$

X	Y	Z
0	0	0
0	1	0
1	0	0
1	1	1

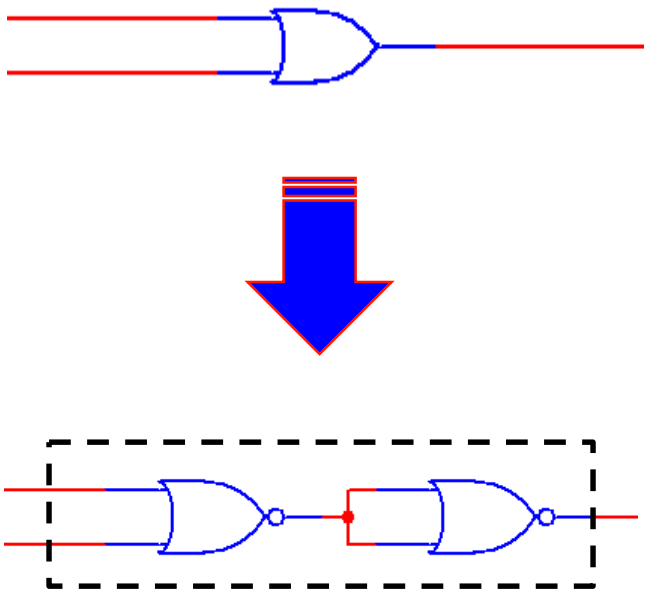
Equivalent to AND Gate

NOR Gate Equivalent of AOI Gates

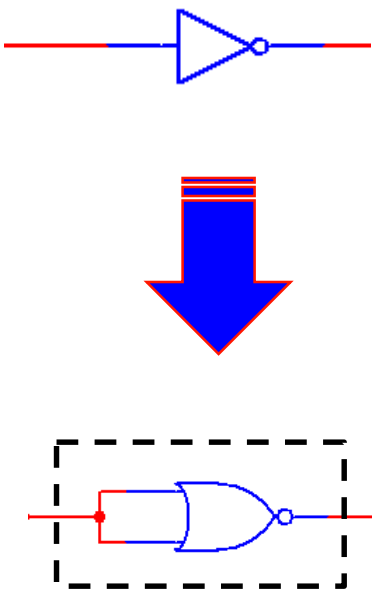
AND



OR



INVERTER



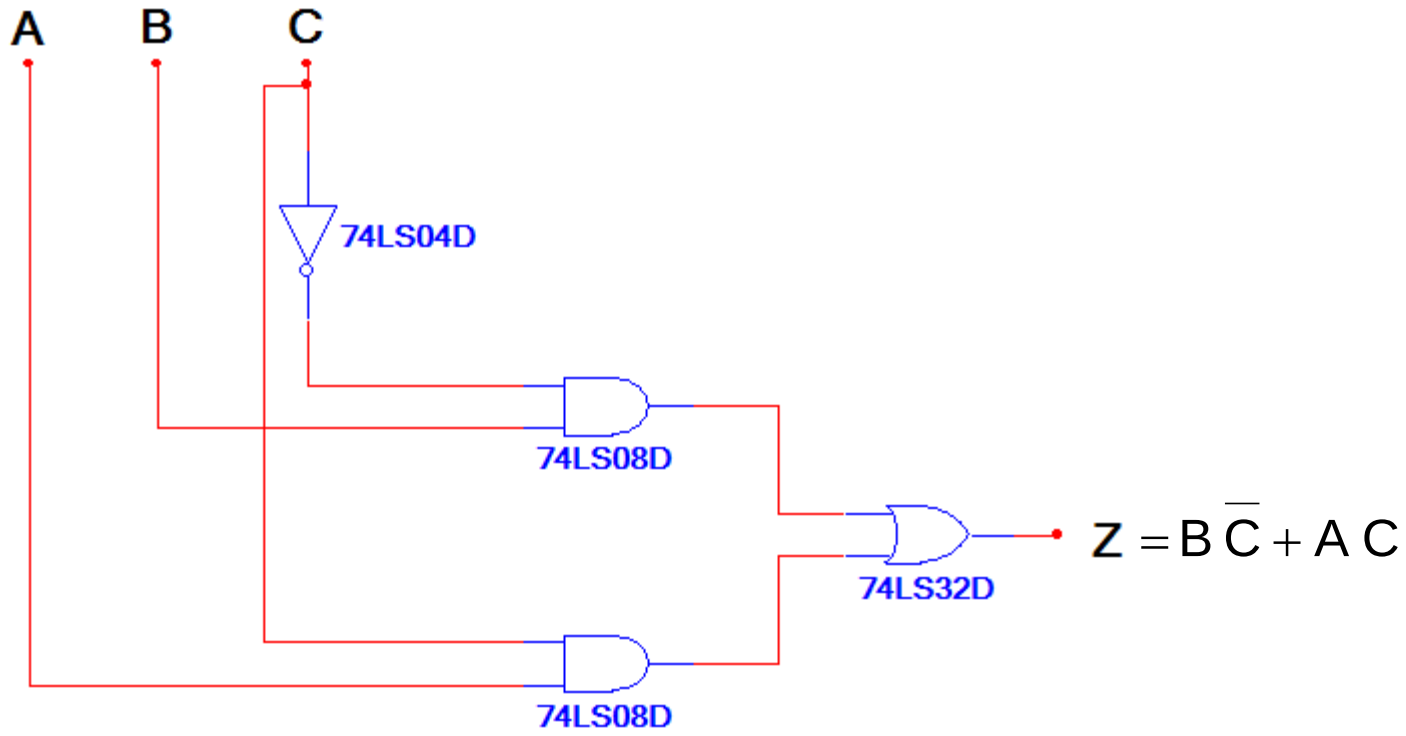
Process for NOR Implementation

1. If starting from a logic expression, implement the design with AOI logic.
2. In the AOI implementation, identify and replace every AND,OR, and INVERTER gate with its NOR equivalent.
3. Redraw the circuit.
4. Identify and eliminate any double inversions. (i.e. back-to-back inverters)
5. Redraw the final circuit.

NOR Implementation

Example:

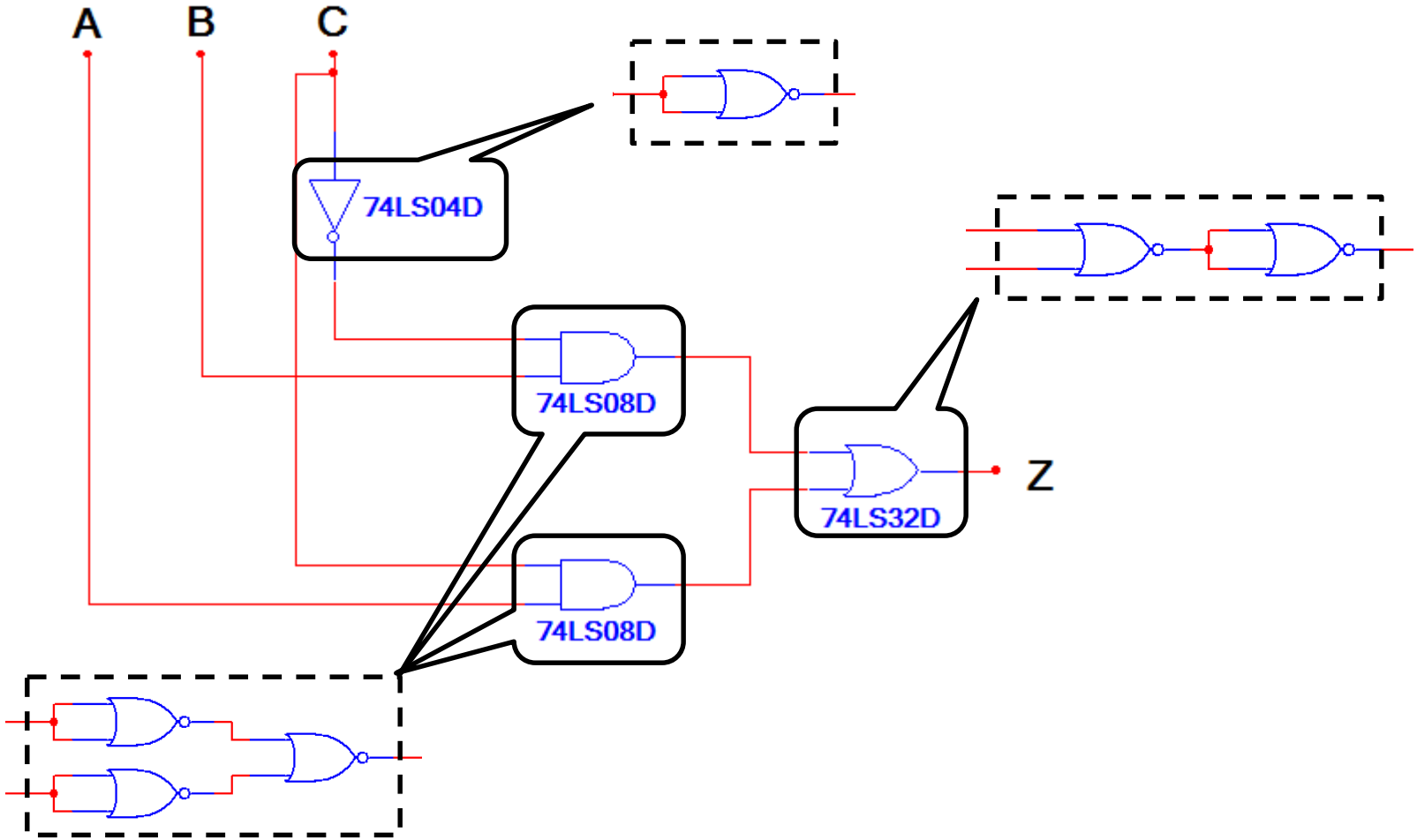
Design a NOR Logic Circuit that is equivalent to the AOI circuit shown below.



NOR Implementation

Solution – Step 2

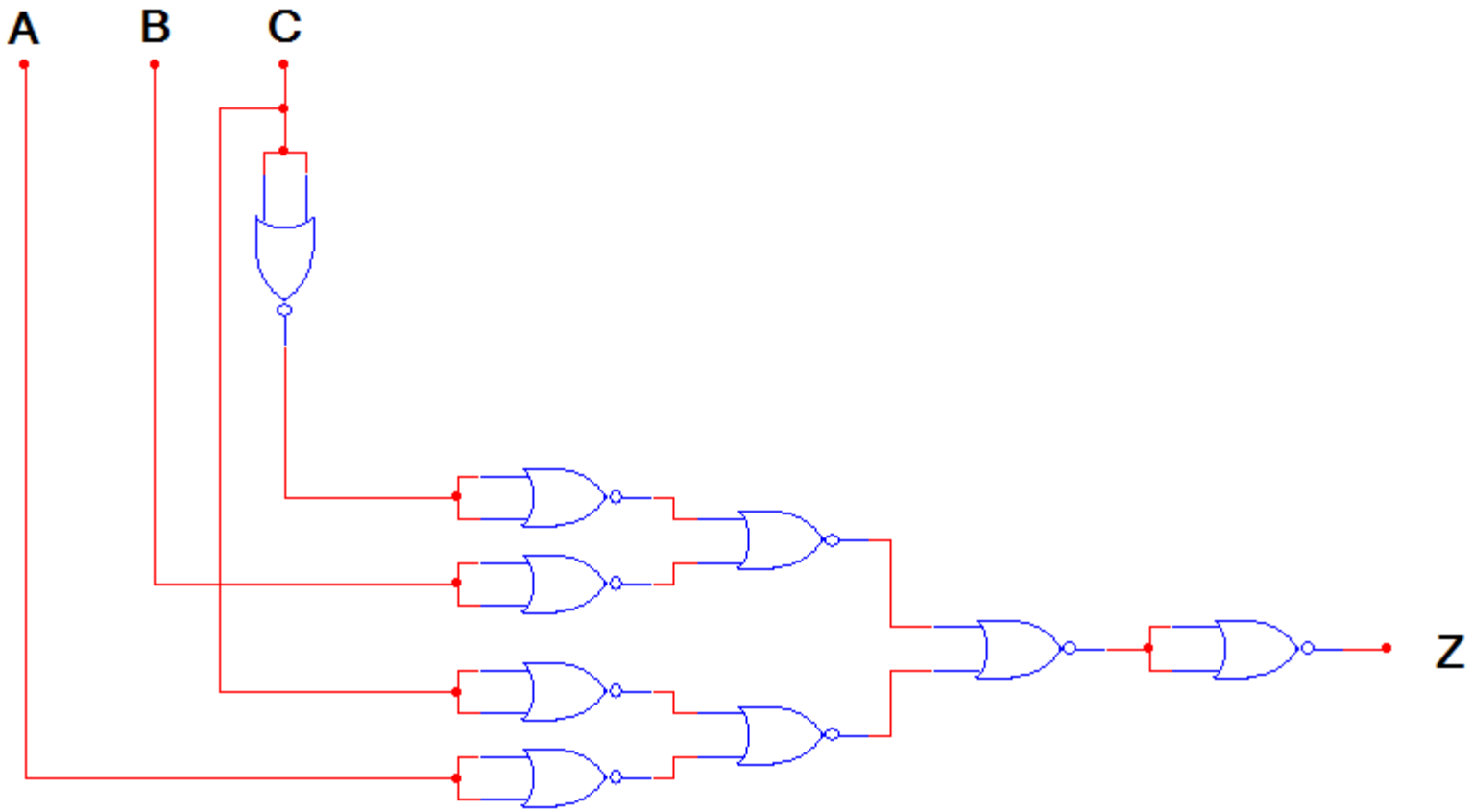
Identify and replace every AND,OR, and INVERTER gate with its NAND equivalent.



NOR Implementation

Solution – Step 3

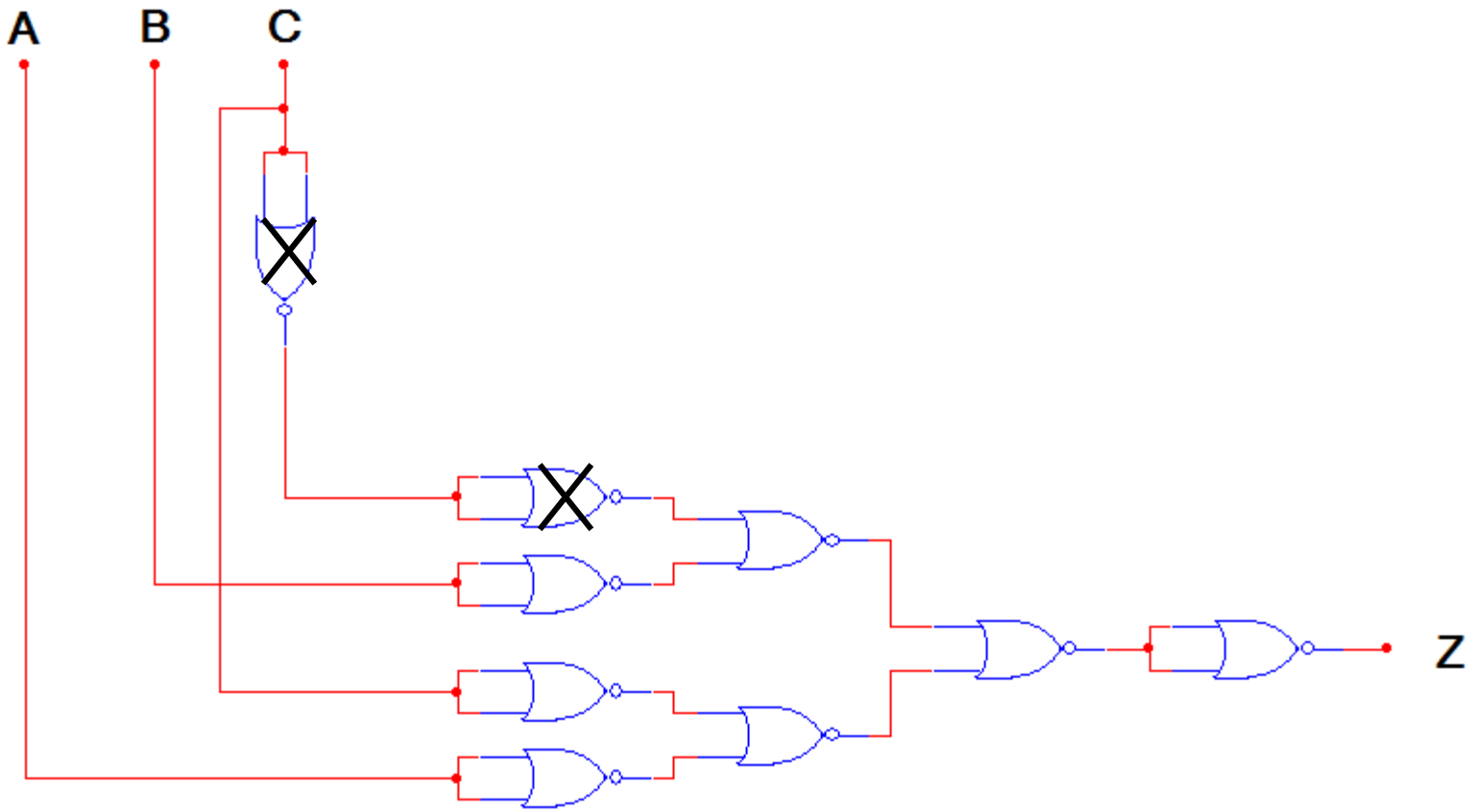
Redraw Circuit.



NOR Implementation

Solution – Step 4

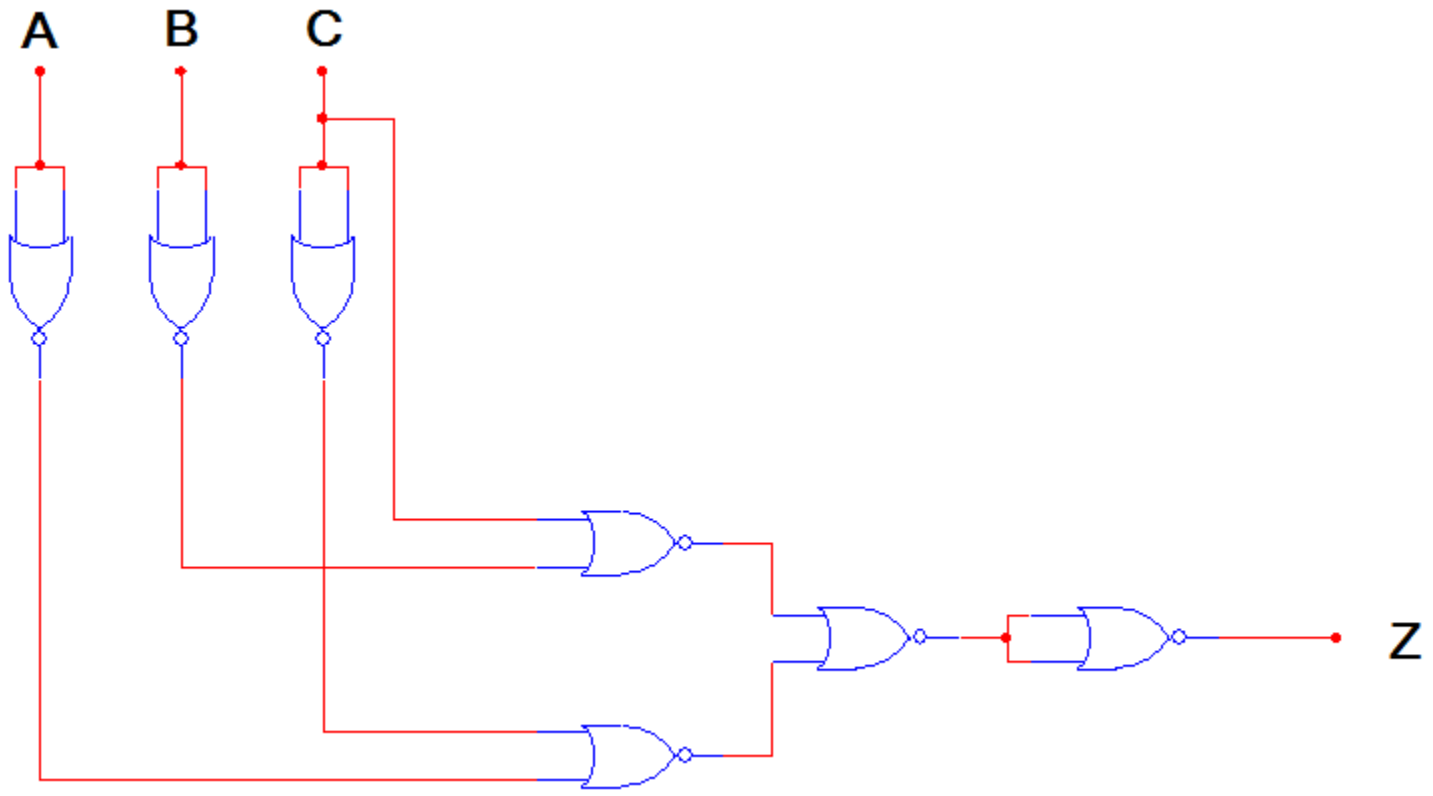
Identify and eliminate any double inversions.



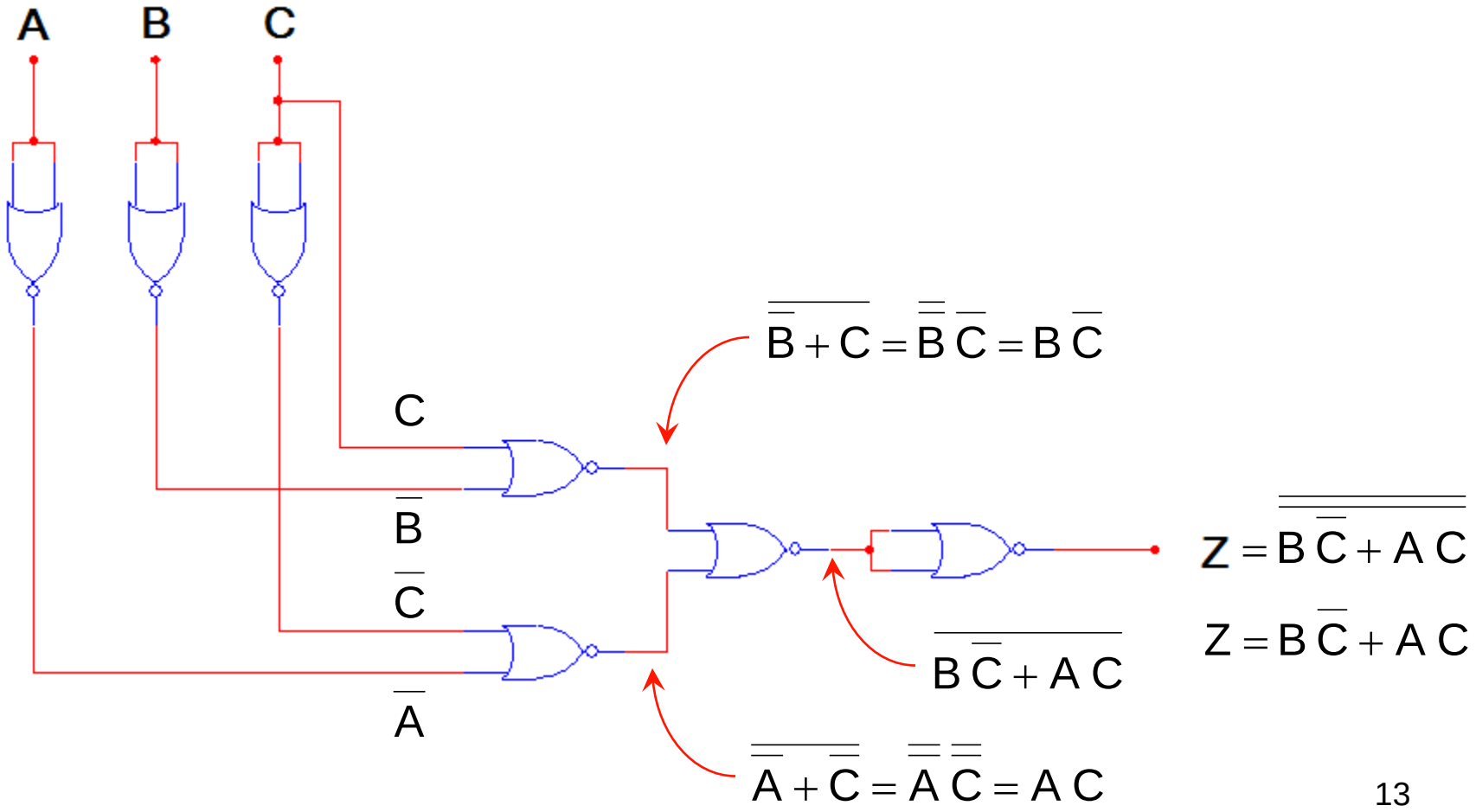
NOR Implementation

Solution – Step 5

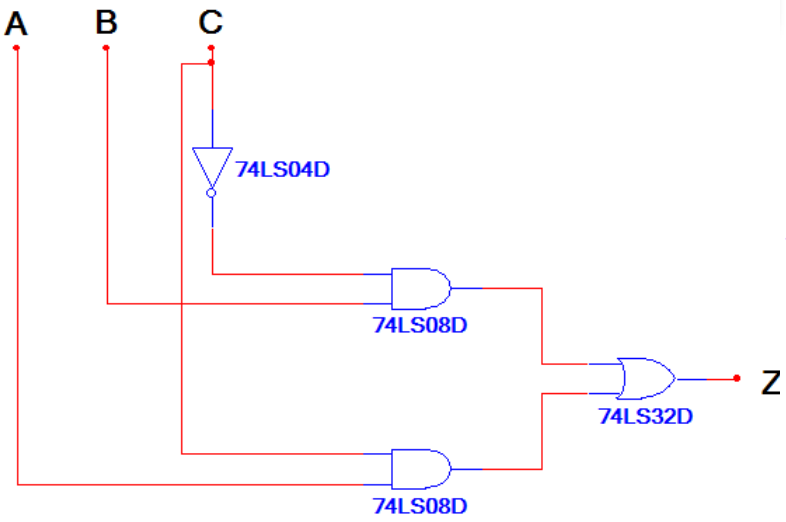
Redraw Circuit.

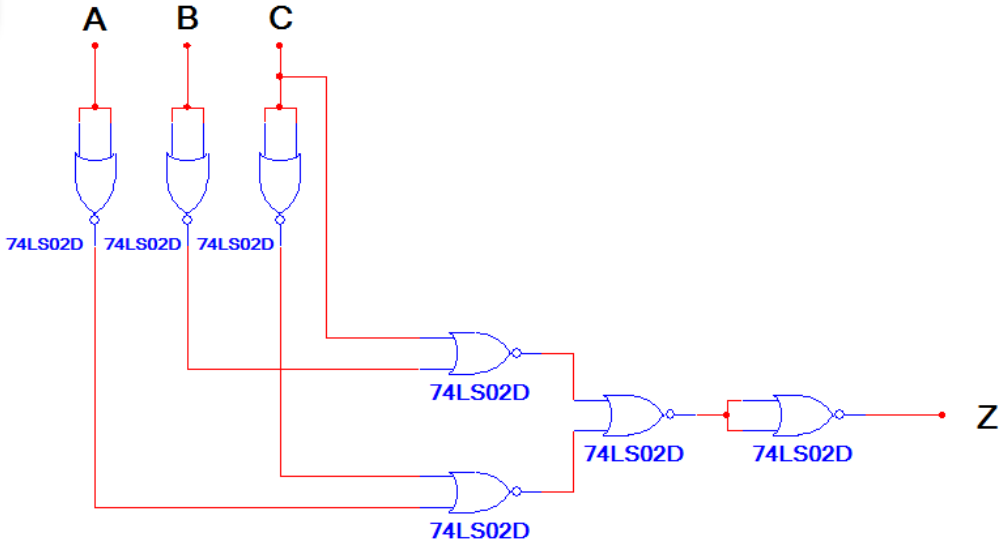


Proof of Equivalence



AOI vs NOR





IC Type	Gates	Gate / IC	# ICs
74LS04	1	6	1
74LS08	2	4	1
74LS32	1	4	1
Total Number of ICs →			3

IC Type	Gates	Gate / IC	# ICs
74LS02	7	4	2
Total Number of ICs →			2