CS 20 Laboratory 4: Introduction to Integrated Circuits and Logic Gates

1. IC Basics
2. Provide the truth tables for the 74LS32 setup. Attach a picture of the setup and include the Logisim file (cs20lab4\_1a.circ) of the circuit.

|  |  |  |
| --- | --- | --- |
| **Inputs** | | **Output** |
| **1** | **2** | **3** |
| 0 | 0 | 0 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 1 |

Diagram, schematic

Description automatically generated

1. Provide the truth tables for the 74LS00 setup. Attach a picture of the setup and include the Logisim file (cs20lab4\_1b.circ) of the circuit.

|  |  |  |
| --- | --- | --- |
| **Inputs** | | **Output** |
| **1** | **2** | **3** |
| 0 | 0 | 1 |
| 0 | 1 | 1 |
| 1 | 0 | 1 |
| 1 | 1 | 0 |

Diagram, schematic

Description automatically generated

1. What logic gate is implemented in the 74LS32 IC?

The logic gate implemented in 74LS32 IC is an **OR gate**.

1. What logic gate is implemented in the 74LS00 IC?

The logic gate implemented in 74LS00 IC is a **NAND gate**.

1. Integrating multiple ICs
2. Provide the truth table for the whole setup. Attach a picture of the initial setup and include the Logisim file (cs20lab4\_2.circ) of the circuit.

|  |  |  |  |
| --- | --- | --- | --- |
| **Inputs** | | | **Output** |
| **A** | **B** | **C** |
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 |

Diagram

Description automatically generated

1. What is the equivalent Boolean expression for the network of ICs in Logisim?

Using SOP of K-maps,

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| a | bc | | | | |  |
|  | 00 | 01 | 11 | 10 |  |
| 0 | 0 | 1 | 1 | 0 |  |
| 1 | 0 | 1 | 1 | 1 | AB |
|  |  |  | C | |  |  |

Hence, the Boolean expression is **C+AB**.

1. Boolean expressions using ICs
2. Provide a sketch/diagram of the network of logic gates for the whole setup. In addition, include the Logisim file (cs20lab4\_3.circ) of the circuit.

Diagram

Description automatically generated

1. Provide the truth table for the expression. Attach pictures as proof for each combination of inputs (16 in total, 0.25pts each). The inputs have to be visible and labelled.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Inputs** | | | | **Output** |
| **A** | **B** | **C** | **D** |
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 | 0 |
| 0 | 0 | 1 | 0 | 0 |
| 0 | 0 | 1 | 1 | 0 |
| 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 0 | 1 | 0 |
| 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 1 |
| 1 | 0 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 | 1 |
| 1 | 0 | 1 | 1 | 0 |
| 1 | 1 | 0 | 0 | 1 |
| 1 | 1 | 0 | 1 | 1 |
| 1 | 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 | 1 |

1. A = 0 C = 0 Output = 0

B = 0 D = 0

Diagram

Description automatically generated

1. A = 0 C = 0 Output = 0

B = 0 D = 1

Diagram

Description automatically generated

1. A = 0 C = 1 Output = 0

B = 0 D = 0

Diagram

Description automatically generated

1. A = 0 C = 1 Output = 0

B = 0 D = 1

Diagram

Description automatically generated

1. A = 0 C = 0 Output = 1

B = 1 D = 0

Diagram

Description automatically generated

1. A = 0 C = 0 Output = 0

B = 1 D = 1

Diagram

Description automatically generated

1. A = 0 C = 1 Output = 1

B = 1 D = 0

Diagram

Description automatically generated

1. A = 0 C = 1 Output = 0

B = 1 D = 1

Diagram

Description automatically generated

1. A = 1 C = 0 Output = 1

B = 0 D = 0

Diagram

Description automatically generated

1. A = 1 C = 0 Output = 1

B = 0 D = 1

Diagram

Description automatically generated

1. A = 1 C = 1 Output = 1

B = 0 D = 0

Diagram

Description automatically generated

1. A = 1 C = 1 Output = 0

B = 0 D = 1

Diagram

Description automatically generated

1. A = 1 C = 0 Output = 1

B = 1 D = 0

Diagram

Description automatically generated

1. A = 1 C = 0 Output = 1

B = 1 D = 1

Diagram

Description automatically generated

1. A = 1 C = 1 Output = 1

B = 1 D = 0

Diagram

Description automatically generated

1. A = 1 C = 1 Output = 1

B = 1 D = 1

Diagram

Description automatically generated