1 Introduction

Digital circuits makeup the cornerstone of modern computational hardware. By representing binary digits (i.e. {0,1}) with voltage levels, digital circuits are able to process binary numbers electronically. *Logic gates* are the fundamental components within digital circuits so understanding their behavior is important. Therefore, the purpose of this experiment is to introduce you to gate behavior and logic interpretation as well as the basics of circuit wiring and troubleshooting. To do so, we will explore the function of several of the basic *logic gates* discussed in lecture.

2 Background

Background information necessary for the completion of this lab assignment will be presented in the next few subsections.

2.1 The 7400 Series of Logic Gates

Logic gates are constructed from transistors, which are analog switches. These transistors can be forced to operate in two modes, namely ”ON” or ”OFF.” In doing so, we can abstractly think of electronic signals within a digital circuit as being either HIGH or LOW (i.e. ’1’ or ’0’). A digital gate takes as input one or more digital signals and outputs a digital signal as a result of a boolean operation. Figure 1 depicts the standard logic gate symbols and their associated boolean operation.

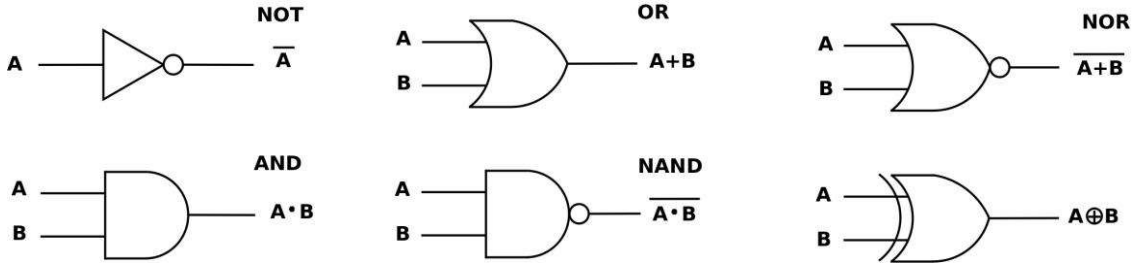

Figure 1: Logic Gates

The basic gates you will study in lecture are available in a series of Integrated Circuits (ICs) commonly referred to as the "7400" series. Within this series, there are various IC package types available; however, for bread-boarding digital circuits in the laboratory, we will use the Dual-Inline Package (DIP) type as shown 3

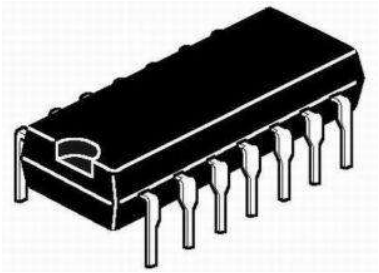

Figure 2: Dual-Inline Package

in Figure 2. As shown, the DIP features a black plastic package with pins on both sides, slightly resembling a flat caterpillar.

Figure 3 shows the DIP pinout diagrams for the NOT gates (left) and the AND gates (right). These pinout diagrams were taken from their respective datasheets and illustrate the function of each pin within a give IC package. Notice that the DIP on the left (7404) contains six NOT gates arranged in a counterclockwise fashion starting at the top-left of the IC. The DIP on the right (7408) contains four AND gates arranged in a similar fashion. Also note that the notch on the DIP designates the top of the IC package.

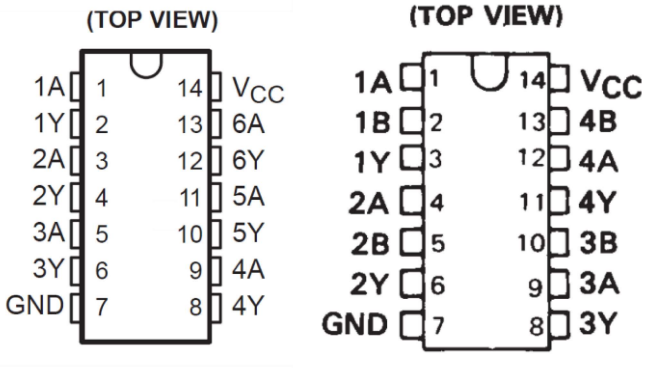

Figure 3: 7404 (NOT) & 7408 (AND) Pinout Diagrams

Tasks:

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1. Install and run Logisim
2. Verify each basic logic gate in Logisim and note the Truth Table.
3. Implement NOT gate using NAND Gate(s).
4. Implement AND gate using NAND Gate(s).
5. Implement OR gate using NAND Gate(s).