1 - Binary and logic

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This lesson provides its participants with an introduction to circuits and binary. Understanding binary and circuits are at the soul of computers, therefore it is essential they are discussed in order to be comfortable with computers. By implementing logic gates using breadboards, participants will learn how basic circuits are constructed using hands-on learning activities. Understanding circuitry will lay the ground work for introducing more complicated concepts like processors in later lessons.

Overview

Lesson Objectives

By the end of the lesson, students will be able to:

- Explain the function of the power supply unit in the computer.
- Build basic logic gates out of transistors, both theoretically and physically on a breadboard.
- Draw the logic gate diagram corresponding to a circuit on a breadboard.
- Name a few basic Haskell types and use an interactive Haskell prompt like GHCi.

Materials

To run this lesson, the following are needed:

- lesson slides;
  `https://www.computing-workshop.com/pdf/1-slides.pdf`
- logic gate review worksheet;
  `https://www.computing-workshop.com/pdf/1-ws-gate-review.pdf`
- circuit diagrams and boolean logic worksheet;
  `https://www.computing-workshop.com/pdf/1-ws-circuit.pdf`
- breadboard reverse engineering worksheet;
  `https://www.computing-workshop.com/pdf/1-ws-bb-reverse-engineering.pdf`
- one breadboard for each group and enough of the following electronic components: NPN transistors, 100 Ω resistors, 9 V batteries, 5 V power regulators, jumper wires of various lengths or ribbon cables, and assorted LEDs.

Instructional Sequence

5 mins. Facilitators welcome the group and present lesson agenda.

20 mins. Using the slides, facilitators will present the power supply unit, binary numbers, and logic gates (AND, OR, NOT, XOR).

10 mins. Students will complete the "Logic gate review" worksheet. In this worksheet, students write out the truth tables for the four basic logic gates: AND, OR, XOR, and NOT.

15 mins. Students will complete the "Circuit diagrams and boolean logic" worksheet. Each group will receive two copies of the worksheet and the worksheet is to be completed in pairs.

30 mins. Students will complete the "Breadboard reverse engineering worksheet". This is a collaborative activity in which each group is assigned a logical circuit to implement physically using transistors and integrated circuits.

10 mins. The rest of the class will introduce Haskell and programming languages. To tie in pre-existing knowledge of hardware, students will understand compilation to be moving down the latter of abstraction. Participants are now prepared to complete the `www.tryhaskell.org` by the next session.

Homework

Students should build an intuitive understanding of Haskell syntax and types by completing `www.tryhaskell.org` up to but not including lesson 4 (on pattern matching).