Chapter 4: Gates and Circuits

Computers and Electricity – Ch. 4.1

- voltage: measure of electromotive force
            (analogy: water pressure in a garden hose)
- voltage is variable: we are only interested in **off** (no voltage)
            or **on** (high voltage, 5V)
- voltage can fluctuate (brown outs): **off** (0V to 2V), **on** (2V to 5V)
- maximum voltage is 5V so you won't "fry" the delicate wires

- gate:
    - device that performs a basic operation on electrical signals
    - one or more input signals, produces <u>one</u> output signal
    - basic operations: not, and, or, xor, nand, nor

- circuits
    - combination of interacting gates designed to accomplish
        a specific logical function
    - e.g. perform arithmetic, store values

- notation for describing behaviour of gates and circuits:
    - boolean algebra
    - logic diagrams
    - truth tables

- boolean algebra:
    - (abstract/modern) algebra: system that consists of elements and
        operations performed on them
    - only two elements (true/false, yes/no, on/off)
    - operations: or, and, not

- logic diagrams:
    - a graphical representation of a circuit

- truth table:
    - a table showing all possible input values and
        the associated output values

Gates – Ch. 4.2

- tour of the six main types of gates
- why these six? can build everything we need from them
    - operations in boolean algebra: and, or, not
    - for convenience: xor, nand, nor
    - easier to physically build <u>nand</u> gate than an <u>and</u> gate
- details for the six gates: see Chapter 4.2

Constructing Gates – Ch. 4.3

- transistor:
    - a device that acts either as a wire or resistor, depending on voltage level
        of input signal
    - a switch, with no moving parts, controlled by another wire when on
        the switch is closed, otherwise open

- semiconductor:
    - material out of which this switch with no moving parts is constructed

- basic properties of electricity: see Chapter 4.3

Circuits – Ch. 4.4

- combinational circuits:
    - output solely determined by the input values
    - change an input value at any point in time and the output changes
        immediately

- circuit equivalence:
    - same output for each corresponding input-value combination
        for two circuits
    - useful to simplify circuits

- adder:
    - circuits to implement pencil-and-paper arithmetic

- multiplexor:
    - a circuit that uses several input control signals to determine which of
        several input data lines to route to its output