CS250 Midterm 1 Review

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September 18, 2022

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1 Why Computer Architecture

1.1 Definitions

- *Computer* is a machine that can be programmed to **carry out computation automatically**
- *Architecture* is a **conceiving, planning, and designing structures**
  - CA has purpose only when given SW

- *Software* is a **description of a computation** expressed in a programming language, any data, and documentation
  - Purpose 1: Definining an DS & A
  - Purpose 2: Executing
- *Interpreter* **executes software**
  - Directly executes instructions expressed in a PL
  - **Does NOT rely on "Turtles all the way down"** (interpreter for interpreter for interpreter...) approach
- *Compiling* is the process of **traslating** programs written in one **HLL** (High-level language) into a **LLL** that **has a machine interpreter**

1.2 C Compiling Process

// TODO

```
source_code -> preprocessor -> preprocessed source code -> compiler -> assembly code ->
```

- Preprocessed Source Code: Does not contain **comments, macros, includes**, etc
- Assembly Code: **Machine specific**

1.3 Mechanical Computers

- Antikythera Mechanism (200B.C): Count Olumpics days
- Charles Babbage (1849)

1.3.1 Disadvantages

- Parts are small, require individual assembly
- Part shape and size determine computational function
- Parts cause waer and accuracy degrades over time
- Algorithm are slow

1.4 Vacuum Tube Computers

- Colossus

1.4.1 Disadvantages

- About the same volume as mechanical computer
- Uses a lot of electrical energy
- Vacuum tubes burn out

1.5 Transistor

- First one built at AT&T Bell Labs
- Used to use germanium crystal, now use silicon
- Futures are graphene or single layer of carbon

1.6 Two Architectures

1.6.1 Harvard Architecture

Separate memories for instructions and data

1.6.2 Von Neumann Architecture

Single memory for instruction and data

2 Representation

2.1 Electrical Representation of Bits

- **V (max) voltage V -** Δ is recognizes as 1
- **0 to 0** $+ \delta$ is recognizes as 0
- **Rising edge** and **falling edge** are ignored

2.2 Bit String

- **Bus: Collection of k wires carrying k-bits**
- **k-bits** on **k-wires**
- k-bits can represent up to 2^k **values**
- *Bit strings are only meaningful when it is paried with a representation*

3 Regular Representations

3.1 Unsigned integer, base 2, weighted positional

Regular binary number that we think of normally.

`001011` $= 0 \times 2^5 + 0 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0 = 11$

3.2 Sign Magnitude

UIB2WP but the MSB is the sign. MSP = left most bit.

`101011` $= -1(0 \times 2^4 + 1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0) = -11$

3.2.1 Disadvantages of sign magnitude

- There are two zeros (0000 = +0, 1000 = -1)
- Less number can be represented (duh)

3.3 Two's Complement