CSC196: Great Ideas in Computing

Tutorial 1

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Introduction

- Introduction
- Write names on a piece of paper
- Marks for participation

Assignment0

- 2% of 20% participation
- Deadline: September 20th (Tuesday)
- No right or wrong answers, so don't forget to submit using Markus
  - Login with UTORid

Possible discussion topics for this course

- Von Neumann Architecture
  - Other architectures: Parallel/Quantum
- Turing machine, mathematical description of computable function
- Advances in computing hardware, Moore's law
- The internet
- Fortran, one of the first source level languages
- First compiler, Grace hopper
  - Why do we need it? Cost of Machine vs Cost of developer?

Possible discussion topics for this course (contd.)

- Search engines, what they do well and what they don't
  - Authenticity is a problem
  - Possible to artificially inflate the rank of an article
  - Search Engine Optimization (SEO)
- P vs NP
- Cryptography
- Deep neural networks
- Human Computer Interaction
- Information theory, Claude Shannon

Possible discussion topics for this course (contd.)

- Social networks
- Open Source license
- Relational Databases
- Linear programming
- Distributed systems
  - Consensus
  - Mutual exclusion
- Differential privacy
- Algorithm design

General guidelines

- Answers should be not more than one page or 250 words
- Make sure to use legible font and size

Q1

- Why have you taken this course
- What you believe might be the differences in High school vs University education system
- Ever taken any CS course?
  - Done any CS related projects?
  - Read any articles or blog posts
- Top 3 interests, this will drive the course (important)
- Any great ideas not mentioned in the slides/class that you can think of (bonus marks)

Q2

- Find a web article or photo/print of a newspaper/magazine article
  - Related to the a particular topic in CS and discuss its importance
- How do you think this topic will evolve in future
  - Discuss both short term (10 years) and long term (50 years)
  - Outcomes
    - Will it die
    - Will it gain more acceptance in the society
    - Will it transform into or give birth to a new topic

FAQs

- What application: Any word processing application
- What format: Use legible font (Recommended Times New Roman with font size 14) and size, use paragrpah for subquestions, keep answer under 1 page (250 words) per question
- Whether to take notes: I will share notes, but I encourage you to take notes
  - There might be some disucssion points missing in my notes
  - Slides will also be shared

Von Neumann Architecture

- Components
  - Memory
  - Input/Output
  - ALU
  - Controller
  - Data bus (optional)

Memory

- Array of words * bits/bytes
- Each word or byte (optional) is addressable
- You can store program and data here, why do you need to store program and data separately?

Why did we adopt binary system and not octal or decimal system?

- Due to ease of detecting just one voltage vs none
- Harder to detect and process ten different voltages
- Sometimes simple solutions are the best

Introduction to binary system

- Can also present negative numbers while sacrificing the upper bit for sign, this will reduce range by one number
- Why digitization
  - Floating point number representation
    - Approximate, has limits min/max values as well as granularity limit
- Deterministic machines can model stochastic processes using psuedo random number generator.
  - PRNG seed

Floating point numbers

- Used to approximately represent real numbers
  - Note limited granualrity and limits on min/max values
- Note decimal point can float around, hence the name
- Will consider Unsgined 16 bit floating point number
  - There are other variants such as 32 bit floating point
  - Signed/Unsigned

Floating point numbers (Sign)

- Sign bit (Assume Unsigned for now, that means only positive real numbers)
  - We don't care about this for Unsigned

Floating point numbers (Exponent)

- Exponent bits (7)
- Calculate value of binary representation (a)
- Bias (b) = 2^(n-1) - 1 (n is the number of bits for exponent)
  - This is half of the range of n bit binary number
- Exponent value (e) = a - b
- Example
  - 010 111 1 = 1 + 2 + 4 + 32 = 39
  - b = 2^(6) - 1 = 32 - 1 = 31
  - e = 39 - 31 = 8

Floating point numbers (Mantissa)

- Mantissa bits (a.k.a significant bits) (9)
- Mantissa (m) = 1 + f
- Fractional part (f): Use powers starting from -1 from the leftmost bit (highest value bit)
- Example
  - 111 000 000 = 2^-1 + 2^-2 + 2^-3 = 0.875
  - m = 1 + 0.875 = 1.875

Floating point numbers (Actual value)

- Actual value
  - Value (v) = m * 2^e
  - Example
    - 100 111 1 111 000 000 = 1.875 * 2^8
- Reference: https://www.geeksforgeeks.org/introduction-of-floating-point-representation/

Next tutorial on 21st Sept 2022