Turing Completeness

A mini-lecture series

CSE498 Collaborative Design (W) - Secure and Efficient C++ Software Development

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Turing completeness

- For a programming language to be Turing complete:
  - It must be able to do everything that a Turing machine can do

Turing Machines

- An infinitely long tape

- A Read/Write Head that can store 0 or 1 on any part of that tape

- If your program can do that, it is a Turing Machine

- It is powerful enough to compute anything that can be computed

Turing complete conditions

- 1) Conditional Branching
  - If-then-else statements
- 2) Ability to go to a different part of the tape
- 3) Must be able to have arbitrary amount of memory

Turing Equivalence

- Turing equivalence is a system that is exactly as powerful as a Turing machine

- Given two computers P and Q
  - P can simulate Q
  - Q can simulate P

I Made a Working Computer with just Redstone!

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Turing completeness

- Most programming languages are turing complete
- BASIC
- PASCAL
- C++
- Python
- Minecraft
- Magic the gathering

Magic: The Gathering Is Turing Complete

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Implications

- For any type of program written in a given language, you can write an equivalent program in a different language.

- So why do we care what type of language we write a program in?

Person of the Day
Alan Turing

- Father of theoretical computer science
- Concepts of algorithms
- Help with War efforts on German Ciphers during WWII

References

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