CS312 Notes

August 20, 2024

Contents

1 Theory Of Computation Introduction

The 3 componenets of problem solving

1. Unknowns
2. Data
3. Conditions

To solve a problem we need to find a way of determining the unknowns from given data such that conditions of the problem are satisfied.

The traditional areas of the theory of computation (TOC)

- Automata
  - Provide problem solving devices
- Computability
  - Provide framework that can characterize devices by their computing power

- Complexity
  - Provide framework to classify problems acording to time/space complexity of the toold used to solve them

1.1 Automata (Automaton)

- Abstration of computing devices
- How much memory can be used?
- What operations can be performed?

1.2 Computability

- Study different computing models and identify the most powerful ones
- Range of problems
- Problems can be undecidable or uncomputatble
  - The halting problem

1.3 Complexity

- Computing problems range from easy to hard; sorting is easier than scheduling
- Question
  - What makes some problems computationally hard or others easy?

1.4 Problem Abstration

Data

- Abstracted as a word in a given alphabet

Conditions

- Abstracted as a set of words called a language

Unknowns

- A boolean variable: true if a word is in the language or false other wise

1.4.1 Abstration of Data

- Σ: alphabet, a finite, nonempty set of symbols
- Σ^*: all words of a finite length built up using Σ
- Rules: (1) the empty word (ϵ) is in Σ^*; (2) if w $\in \Sigma^*$ and a $\in \Sigma$, then aw $\in \Sigma^*$, and (3) nothing else is in Σ^*

Example: If $\Sigma = \{0{,}1\}$, then $\Sigma^* = \{\epsilon{,}0{,}1{,}00{,}01{,}10{,}11{,}000{,}001{,}010{,}011{,}\ldots\}$.

1. Valid C

   ```
   int my_func() { return 1; };

   int main() {
       int var = my_func(1,2,3,4,5,6,7);
       for (;;) {}
       // You cannot just simply change the syntax of a for loop
       for(;) {}
   }
   ```

2. Invalid C++

   ```
   int my_func() { return 1; };

   int main() {
       int var = my_func(1,2,3,4,5,6,7);
       for (;;) {}
       // You cannot just simply change the syntax of a for loop
       for(;) {}
   }
   ```

1.4.2 ¬ ˆ V