5118014 Programming Language Theory

Ch 1. What Is Programming Language

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What is a Programming Language?

- examples
  - C, Java, Python, C++, …

- language

- programming

What is Programming

- construct a composition of instructions to solve a certain kind of problems when a specific problem is given as input data
  - instruction
  - instruction composition

- is programming specific to a computing machine, or something universal?
  - Turing machine
  - λ-calculus

Programming is for Computing, not for Computer

이광근, *SNU 4190.310 Programming Languages Lecture Notes,* page 12

What is Language

- a language is a set of strings chosen from Σ^*, all strings of alphabet Σ
  - alphabet is a finite set of symbols
  - L is a language over Σ if $L \subseteq \Sigma^*$
    - The set of strings of 0's and 1's with an equal number of each is a language of $\{0, 1\}$: $\{\epsilon, 01, 10, 0011, 0101, 1001, \ldots\}$
    - The set of binary numbers each of which represents a prime number is a language of $\{0, 1\}$: $\{10, 11, 101, 111, 1011, \ldots\}$
  - a sentence (alphabet string) is finite, yet the size of a language may be infinite

- a language is a mapping from sentences to another set

Let's Think About Language

- why is alphabet finite?

- why is a sentence (string) form of a sequence?

- why does a language contain an infinite number of strings?

- how is it possible to define an infinite set as a finite form?

- how is it possible to relate a word to what it represents?

- how to associate a sentence with what it represents?

Syntax and Semantics

- a syntax defines which sentences are in a language
    - a syntax is represented as a set of construction rules

- a semantics defines how each sentence of a language is mapped to an element of the target domain
    - a semantics is represented a set of rules associated with the syntax rules

- to which set, a programming language maps its sentences?

Coming Back to Original Question: What is PL?

- a language for human developers to compose a program which can be translated into machine instructions

- why do we write programs in programming languages rather than machine languages?

More Aspects of Programming Languages

- standard libraries

- ecosystem
  - third-party library
  - tools
  - documentation and specification

Programming Language Theory

- the principles of various programming languages

  - real-world programming languages share mostly the same foundation, while their appearances are varying

- people who know the key principles can easily catch-up real-world programming languages