

Lecture 7

Introduction to Formal Languages

CS 241: Foundations of Sequential Programs
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Motivation

- ▶ precision of specification and recognition
- ▶ importance of this: every assignment from this point forward
- ▶ benefits of theory:

Terminology

- ▶ rooted in set theory
 - ▶ alphabet: a finite set of symbols
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- ▶ word (aka string, sentence): finite sequence of symbols from the alphabet

Uses of Formal Languages: Specification

Uses of Formal Languages: Recognition

WLP

Let's try to formally specify WLP.

- ▶ alphabet:

- ▶ word:

- ▶ language:

Language Classes

- ▶ a set of languages may share common characteristics
- ▶ Chomsky Hierarchy

Uses of Formal Languages: Organization of Compilation

- ▶ lexical analysis
- ▶ syntactic analysis
- ▶ context-sensitive analysis (semantic) analysis
- ▶ synthesis (code generation)

Which language level?

Let $\Sigma = \{\text{ASCII characters}\} - \{\text{CR}\}$.

- ▶ $L_1 = \{\$0, \$1, \$2, \dots, \$31\}$
- ▶ $L_2 = \text{valid labels in MIPS}$
- ▶ $L_3 = \text{valid load word (lw) offsets}$
- ▶ $L_4 = \text{valid line of AL for A3P3}$
- ▶ $L_5 = \text{valid line of AL for A3P4}$

Regular Languages

- ▶ Defining regular languages: two approaches

- ▶ We will see that these are equivalent

Specifying Regular Languages

Basic building blocks

1. finite languages
2. union
3. concatenation
4. repetition

Union

- ▶ Definition:

- ▶ Examples:

Concatenation

- ▶ Definition:

- ▶ Examples:

Repetition

- ▶ Definition:

- ▶ Alternate Definition:

- ▶ Examples: