CSC-363 Lecture 01A
Course Introduction

Colin McKinney

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Course Overview

This course explores principles and practices used for designing and implementing compilers and interpreters. Students will build a compiler for a programming language designed for the course. The major stages of compilation will be studied in-depth – lexical analysis, syntax analysis, semantic analysis, and code generation. Additional topics such as advanced parsing techniques and specific compiler-construction tools may be covered at the instructor's discretion.

- Syllabus on Canvas: read it!
- Lecture MWF 0800-0850, Studio Thursdays 0800-0915.
- Plan for Studio is to be as interactive as possible, with tangible product due at end of each session
- Problem Sets every week or so; midterm exam during Studio, Final Exam
- Lots of programming. We'll build **two** compilers.

Motivating Example 1: Social Media

$$6 \div 2(1+2) =$$

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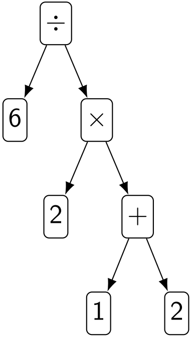
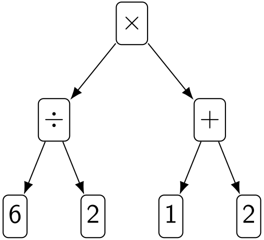
Incorrect parse (yields 1)



$6 \div \big(2(1+2)\big) = 6 \div 6 = \mathbf{1}$

Correct parse (yields 9)



$\big(6 \div 2\big)(1+2) = 3 \cdot 3 = \mathbf{9}$

Motivating Example 2: Natural Language

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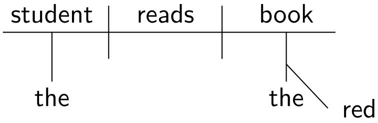
Reed–Kellogg



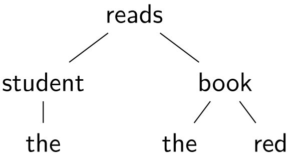
student | reads | book

the

the

red

Syntax Tree



reads

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book

the

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red

Motivating Example 2: Natural Language

New problem: let's translate the sentence into French. Can we do a direct word-for-word translation?

- The: *le* or *la*
- student: *étudiant*
- (he/she/it) reads: *lit*
- red: *rouge*
- book: *livre*

- *Le étudiant lit le rouge livre.*
- *Le étudiant lit la rouge livre.*
- *L'étudiant lit la livre rouge.*

From Sentences to Programs

We've seen two forms of translation both today and in CSC-241:

- C to assembly: arithmetic example
- English to French

The *idea* is mostly the same. We first need to decipher the underlying structure in a systematic way, to produce a tree. We then need to use this tree to do the translation.

- Creating the tree is primarily about structure, not meaning. Our sentence might as well have been "The borogove reads the mimsy tove".
- When doing the translation, we needed to understand the structure and meaning, along with the rules of the target language.

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Enter Admiral Grace Hopper.

Admiral Grace Hopper

- Mathematician who taught at Vassar College. Joined the Navy in WW2.
- Worked on Harvard Mark 1 computer during the war.
- After the war, worked on the UNIVAC (first commercial computer).
- "...I decided data processors ought to be able to write their programs in English, and the computers would translate them into machine code."
- This is the same idea we used today, made explicit and systematic.

Looking Forward: Our Central Goal

- Taking human-written programs seriously as *structured objects*
- Making implicit structure explicit
- Eliminating ambiguity
- Systematically translating structure and meaning into machine-executable form

By the end of this course:

- You will understand how computers *read*.
- GCC will no longer be a magic box.