Monash University
Faculty of Information Technology

程序代写代做 CS编程辅导

FIT2014 Theory of Computation

Lecture 15

Parsing

WeChat: cstutorcs

Assignment Project Exam Help

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https://tutorcs.com

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Overview

- Concepts and definitions
- Examples
- Shift-reduce parser
- Lex & Yacc

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Parsing

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Suppose you have a Context Free Grammar, and a string of letters.

Parsing: determining whether

- is a word in the language,

  and if it is,
- finding a parse tree, or a derivation, for it.

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Parser: a program that does this.

- Two main types:
  - Top-down parsers
  - Bottom-up parsers
    - reduce the string to the Start symbol
    - repeatedly apply production rules in reverse

a^*ba^*b

$$
\begin{aligned}
S &\longrightarrow BB \\
B &\longrightarrow \mathtt{a}B \\
B &\longrightarrow \mathtt{b}
\end{aligned}
$$

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Input string: aabab

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Plus-Times-A

1. $S \longrightarrow E$
2. $E \longrightarrow E + E$
3. $E \longrightarrow E * E$
4. $E \longrightarrow \texttt{i}$

This grammar is *ambiguous*.

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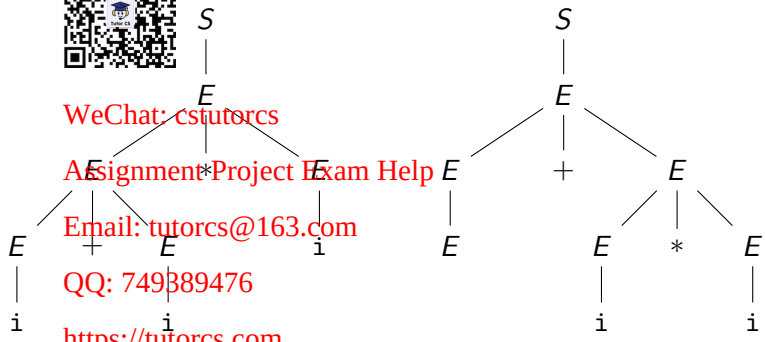
Input string: $\texttt{i} + \texttt{i} * \texttt{i}$



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Two parse trees

Plus-Times-B

$$
\begin{array}{lcl}
S & \longrightarrow & E \\
E & \longrightarrow & T + E \\
E & \longrightarrow & T \\
T & \longrightarrow & F * T \\
T & \longrightarrow & F \\
F & \longrightarrow & \texttt{i}
\end{array}
$$

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Input string: `i + i * i`

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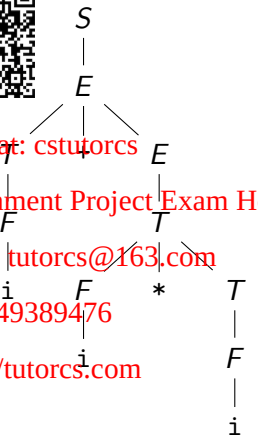

LR Parser

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- bottom-up parser
- scans input **L**eft to Right
- constructs a **R**ightmost derivation in reverse
- implemented using a Deterministic Pushdown Automaton (DPDA)
- Not all CFGs have such a parser: DCFL $\neq$ CFL.
- We'll look at one type of LR parser: **shift-reduce parser**

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Shift-reduce Parser

This is a particular type of LR Parser.

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It has:

- a **stack**: terminals and non-terminals processed so far.
  - Initially: empty.
- a **buffer**: the rest of the input string (yet to be processed).
  - Initially: contains the entire input string.

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Repeatedly . . .

- **Shift** input letters onto the **stack**, OR
- When a string of top-most **stack** symbols equal the right-hand side of a production rule:
  - **Reduce** that string, i.e., use production rule in reverse

. . . until **Stack** only has Start symbol, and **buffer** is empty.

a^*ba^*b

Input: abb

1. $S \rightarrow BB$
2. $B \rightarrow aB$
3. $B \rightarrow b$

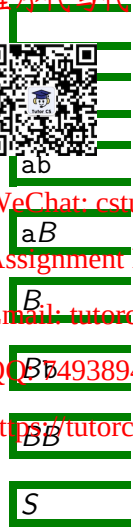

abb		shift
bb		shift
ab	b	reduce, (3)
aB	b	reduce, (2)
B	b	shift
BB		reduce, (3)
S		reduce, (1)
		ACCEPT

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Plus-Times-A

1. $S \longrightarrow E$
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3. $E \longrightarrow E * E$
4. $E \longrightarrow \texttt{i}$

Input: i+i*i

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	i+i*i	shift
	+i*i	reduce, (4)
	+i*i	shift
E+	i*i	shift
E+i	*i	reduce, (4)
E+E	*i	

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Plus-Times-A

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Input: `i+i*i`

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	`i+i*i`	shift
	`+i*i`	reduce, (4)
	`+i*i`	shift
$E+$	`i*i`	shift
$E+\texttt{i}$	`*i`	reduce, (4)
$E+E$	`*i`	shift
$E+E*$	`i`	shift
$E+E*\texttt{i}$		reduce, (4)
$E+E*E$		reduce, (3)
$E+E$		reduce, (2)
E		reduce, (1)
S		ACCEPT

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Plus-Times-A

1. $S \longrightarrow E$
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4. $E \longrightarrow \texttt{i}$

Input: `i+i*i`

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	`i+i*i`	shift
	`+i*i`	reduce, (4)
	`+i*i`	shift
	`i*i`	shift
E`+i`	`*i`	reduce, (4)
E`+`E	`*i`	

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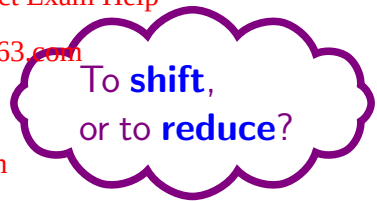

Plus-Times-A

1. $S \longrightarrow E$
2. $E \longrightarrow E + E$
3. $E \longrightarrow E * E$
4. $E \longrightarrow \texttt{i}$

Input: `i+i*i`

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	i+i*i	shift
	+i*i	reduce, (4)
	+i*i	shift
	i*i	shift
E+i	*i	reduce, (4)
E+E	*i	**reduce, (2)**
E	*i	shift
E*	i	shift
E*i		reduce, (4)
E*E		reduce, (3)
E		reduce, (1)
S		ACCEPT

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⟶ **shift-reduce conflict**

Also:

reduce-reduce conflict: letters on top of stack correspond to $>$ one production rule.

Unix/Linux tools

Yacc

- **Y**et **A**nother **C**ompiler-**C**ompiler
- a parser-generator
- Input: a Context-Free Grammar
- Output: parser, in file `y.tab.c`
- Typically used with a lexical analyser, e.g., Lex.

Lex

- **Lex**ical Analyser
- Input: regular expression for each token ...
- Output: lexical analyser, in file `lex.yy.c`

Both are widely available in Unix/Linux

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Lex: lexical analysis

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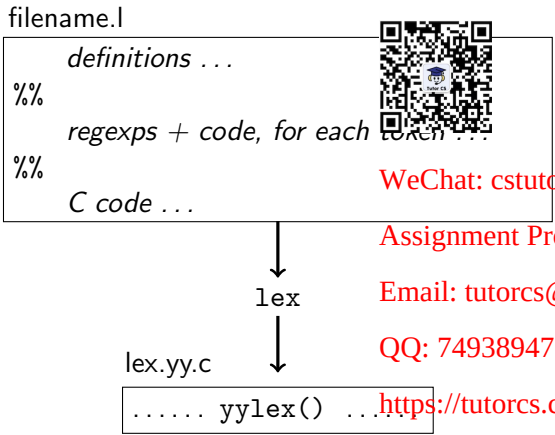

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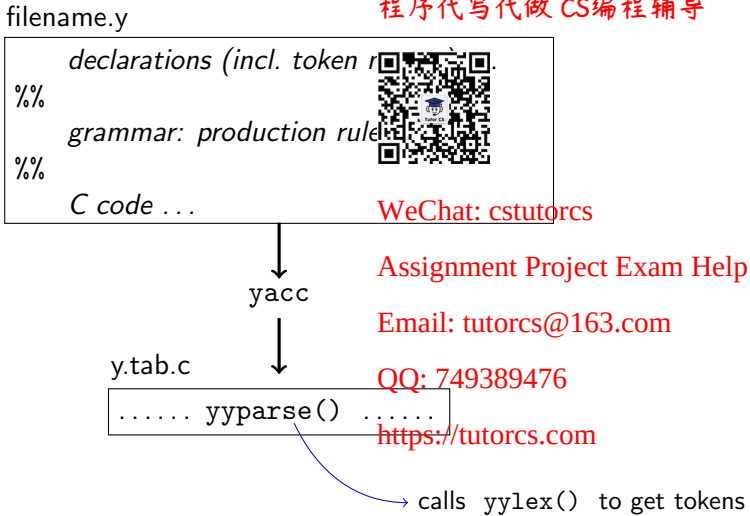
Yacc: parser generation



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Lex & Yacc

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- Compile `y.tab.c` and `l` using, say, `cc`.
- yields an executable parser.
- It can evaluate as it parses.
- See Assignment 2.

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Conflict resolution in Yacc:

- Shift-reduce: shift
- Reduce-reduce: use the rule listed first.

Revision

程序代写代做 CS编程辅导

- Construct a parse tree for given string and grammar.
- Understand how a Shift-reduce Parser works.
- Start using Lex and Yacc.

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