Lecture 13

Semantics Analysis

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Take aways from the last class

- LR(1) parse table

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- LALR Parse Table

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- Parser Generator

Semantic Analysis

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whether a function has return or not.

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can we say the same for semantic analysis??

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  - `string x; int y;`
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  - An identifier may refer to different variables in different parts of the program
  - An identifier may be usable in one part of the program but not another

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- Methods in a class are not multiply defined

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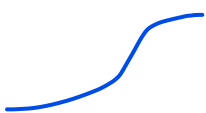
  - Do analysis along with parsing
  - Use code for attribute value computation



we want to do everything in parallel => Lexical, Syntax and Semantic Analyzer works in parallel.

Attribute Grammar Framework

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  - Translation schemes (or syntax directed translations)
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SDDs are used for specifications while SDT are used for implementation purposes.

- Conceptually both:
  - Parse input token stream
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- It may store information in symbol table

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- The synthesized attribute of Node `N` can be defined using inherited attributes of Node `N`
- Inherited attribute of Node `N` can not be defined using attribute of child of Node `N`
- Terminal can have only synthesized attributes (calculated from lexical phase). No SDD rules for computing attributes of terminal

Example

- Consider a grammar for signed binary numbers
  $Number \rightarrow sign \quad list$
  $sign \rightarrow +|-$
  $list \rightarrow list \quad bit|bit$
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Symbol	Attribute
number	value
sign	negative
list	position, value
bit	position, value

Attribute Rules

Production	Attribute Rule

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number → sign list	*list.position* ← 0
	`if sign.negative`
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sign $\rightarrow$ +	sign.negative $\leftarrow$ false

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bit $\rightarrow$ 0	bit.value $\leftarrow$ 0

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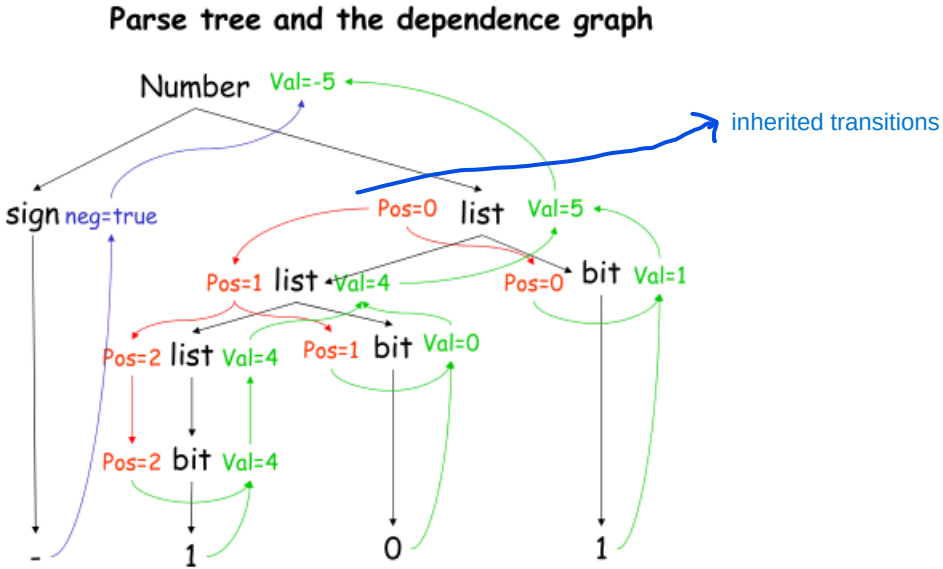
list → bit	bit.position ← list.position list.value ← bit.value
$list_0 \rightarrow list_1\, bit$	$list_1.position \leftarrow list_0.position + 1$ $bit.position \leftarrow list_0.position$ $list_0.value \leftarrow list_1.value + bit.value$
bit → 0	bit.value ← 0
bit → 1	bit.value ← $2^{bit.position}$

position is an inherited attribute

value, negative, are synthesized attribute.


Parse tree and the dependence graph
Number
Val=-5
inherited transitions
sign
neg=true
Pos=0
list
Val=5
Pos=1
list
Val=4
Pos=0
bit
Val=1
Pos=2
list
Val=4
Pos=1
bit
Val=0
Pos=2
bit
Val=4
-
1
0
1