

## 1. Parse Tree and Leftmost Derivation

$$A = B * (C * (A + B))$$

Statement  $\rightarrow$  Assignment

Assignment  $\rightarrow$  Identifier = Expression

Identifier = Expression  $\rightarrow$  Identifier = Term

Identifier = Term  $\rightarrow$  Identifier = Term \* Factor

Identifier = Term \* Factor  $\rightarrow$  Identifier = Term \* (Expression)

Identifier = Term \* (Expression)  $\rightarrow$  Identifier = Term \* (Term)

Identifier = Term \* (Term)  $\rightarrow$  Identifier = Term \* (Term \* Factor)

Identifier = Term \* (Term \* Factor)  $\rightarrow$  Identifier = Term \* (Term \* (Expression))

Identifier = Term \* (Term \* (Expression))  $\rightarrow$  Identifier = Term \* (Term \* (Expression + Term))

Identifier = Term \* (Term \* (Expression + Term))  $\rightarrow$  Identifier = Term \* (Term \* (Term + Term))

Identifier = Term \* (Term \* (Term + Term))  $\rightarrow$  Identifier = Factor \* (Factor \* (Factor + Factor))

Identifier = Factor \* (Factor \* (Factor + Factor))  $\rightarrow$  Identifier = Identifier \* (Identifier \* (Identifier + Identifier))

Identifier = Identifier \* (Identifier \* (Identifier + Identifier))  $\rightarrow A = B * (C * (A + B))$

## 2. Scope Concepts

- a. Static scoping results

$$u = 180$$

add(v)	<u>Global</u> $u = 69 + 42 + 69 = 180$ $v = 69$ $w = 17$ $z = 69$
bar(add)	<u>Global</u> $u = 42$ $v = 69$ $w = 17$  <u>Local</u> $u = 17$
foo(u, 13)	<u>Global</u> $u = 42$ $v = 69$ $w = 17$  <u>Local</u>

	v = 17
main	<u>Global</u> u = 42 v = 69 w = 17

b. Dynamic Scoping with Deep Binding

u = 126

add()	<u>Non-local</u> v = 42 x = 42 w = 13  Local z = 42 u = 42+42+42 = 126
bar()	<u>Non-local</u> v = 42 x = 42 w = 13  <u>Local</u> u = 13
foo(u, 13)	<u>Local</u> v = 42 x = 42 w = 13
main	<u>Global</u> u = 42 v = 69 w = 17

c. Dynamic Scoping with Shallow Binding

u = 92

fun(v)	<u>Non-local</u> u = 13
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	<u>Global</u> u = 42+13+42 = 97
bar()	<u>Non-local</u> x= 42 v = 42 w = 13  <u>Local</u> u = 13
foo(u, 13)	<u>Local</u> x= 42 v = 42 w = 13
main	<u>Global</u> u = 42 v = 69 w = 17