

# CMPT 383

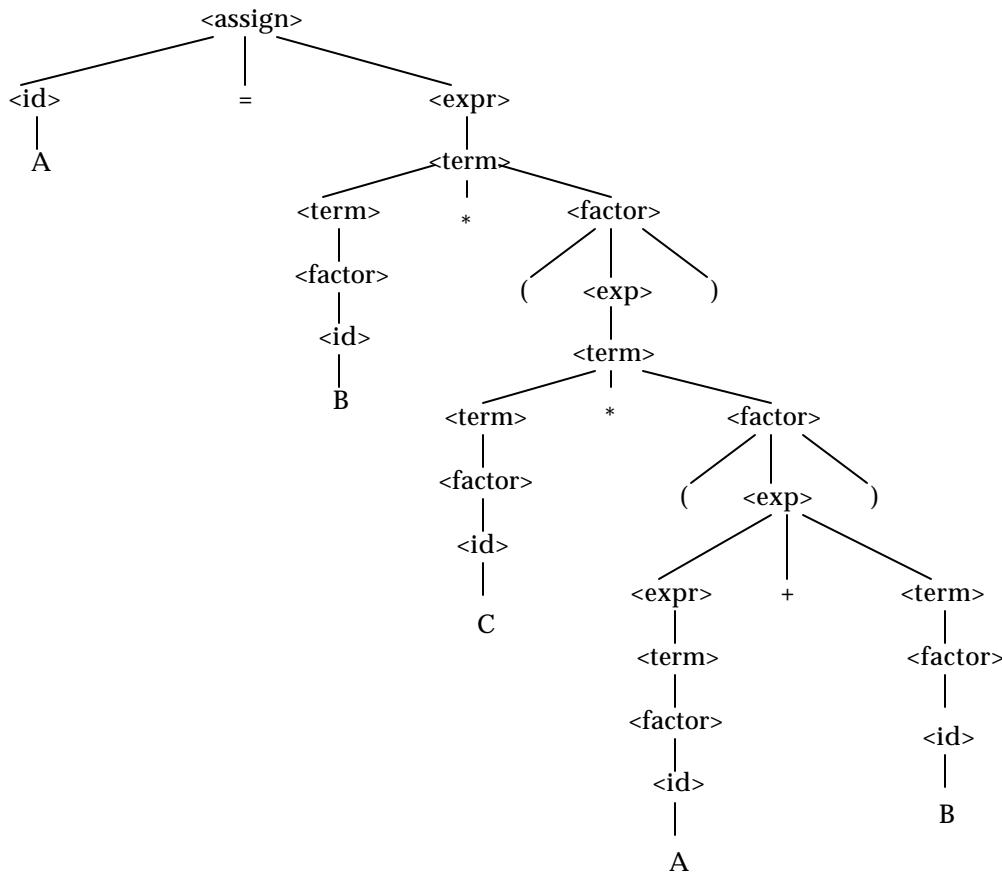
## Quiz #3

### September 29, 2005

- 1) Using grammar 1, show the parse tree, the abstract syntax tree and the leftmost derivation for

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

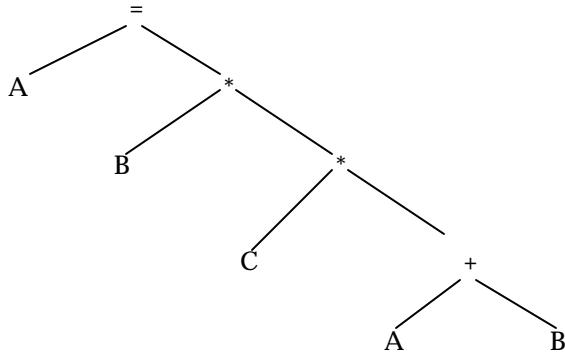
#### **Parse Tree (3 marks)**



#### **Leftmost Derivation (2 marks)**

$$\begin{aligned}
 <\text{assign}> &\Rightarrow <\text{id}> = <\text{expr}> \Rightarrow A = <\text{expr}> \Rightarrow A = <\text{term}> \Rightarrow A = <\text{term}> * <\text{factor}> \\
 &\Rightarrow A = <\text{factor}> * <\text{factor}> \Rightarrow A = <\text{id}> * <\text{factor}> \Rightarrow A = B^* <\text{factor}> \\
 &\Rightarrow A = B^* (<\text{expr}>) \Rightarrow A = B^* (<\text{term}>) \Rightarrow A = B^* (<\text{term}> * <\text{factor}>) \\
 &\Rightarrow A = B^* (<\text{factor}> * <\text{factor}>) \Rightarrow A = B^* (<\text{id}> * <\text{factor}>) \\
 &\Rightarrow A = B^* (C^* <\text{factor}>) \Rightarrow A = B^* (C^* (<\text{expr}>)) \\
 &\Rightarrow A = B^* (C^* (<\text{expr}> + <\text{term}>)) \Rightarrow A = B^* (C^* (<\text{term}> + <\text{term}>)) \\
 &\Rightarrow A = B^* (C^* (<\text{factor}> + <\text{term}>)) \Rightarrow A = B^* (C^* (<\text{id}> + <\text{term}>)) \\
 &\Rightarrow A = B^* (C^* (A + <\text{term}>)) \Rightarrow A = B^* (C^* (A + <\text{factor}>)) \\
 &\Rightarrow A = B^* (C^* (A + <\text{id}>)) \Rightarrow A = B^* (C^* (A + B))
 \end{aligned}$$

### Abstract Syntax Tree (2 marks)



### Grammar 1

```

<assign> ::= <id> = <expr>
<id>     ::= A | B | C
<expr>   ::= <expr> + <term> | <term>
<term>   ::= <term> * <factor> | <factor>
<factor> ::= (<expr>) | <id>
  
```

- 2) Describe, in English, the language defined by grammar 2. **(2 marks)**  
 Grammar 2 produces strings formed by one or more letter *a* followed by one or more letter *b* followed by one or more letter *c*

### Grammar 2

```

<S> ::= <A> <B> <C>
<A> ::= a <A> | a
<B> ::= b <B> | b
<C> ::= c <C> | c
  
```

- 3) Which of the following sentences are in the language generated by grammar 3? **(3 marks)**

a) abcd

Yes.

$\langle S \rangle \Rightarrow a \langle S \rangle c \langle B \rangle \Rightarrow a b c \langle B \rangle \Rightarrow a b c d$

b) acccbd

No.

$\langle S \rangle \Rightarrow a \langle S \rangle c \langle B \rangle \Rightarrow a \langle A \rangle c \langle B \rangle \Rightarrow a c \langle A \rangle c \langle B \rangle \Rightarrow a c c c \langle B \rangle$

No derivation of *bd* from *B*

c) acccbcc

No.

$\langle S \rangle \Rightarrow a \langle S \rangle c \langle B \rangle \Rightarrow a \langle A \rangle c \langle B \rangle \Rightarrow a c \langle A \rangle c \langle B \rangle \Rightarrow a c c c \langle B \rangle$

No derivation of *bcc* from *B*

d) acd

No.

$\langle S \rangle \Rightarrow a \langle S \rangle c \langle B \rangle$

Every string that begins with  $a$  must have at least 4 characters.

- e) accc

Yes.

$\langle S \rangle \Rightarrow a \langle S \rangle c \langle B \rangle \Rightarrow a \langle A \rangle c \langle B \rangle \Rightarrow a c c \langle B \rangle \Rightarrow a c c \langle A \rangle \Rightarrow a c c c$

**Grammar 3**

$\langle S \rangle ::= a \langle S \rangle c \langle B \rangle \mid \langle A \rangle \mid b$

$\langle A \rangle ::= c \langle A \rangle \mid c$

$\langle B \rangle ::= d \mid \langle A \rangle$

- 4) Convert the following EBNF to BNF:

- a)  $\langle S \rangle ::= \langle A \rangle \{ b \langle A \rangle \}$  (**2 marks**)

$\langle S \rangle ::= \langle A \rangle \langle B \rangle \mid \langle A \rangle$

$\langle B \rangle ::= b \langle A \rangle \langle B \rangle \mid b \langle A \rangle$

- b)  $\langle A \rangle ::= a [b] \langle A \rangle$  (**1 mark**)

$\langle A \rangle ::= a b \langle A \rangle \mid a \langle A \rangle$