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2-29-16
CSCI 330
Assignment #4

2. Write EBNF description for the following:
a) A Java class definition header statement
class <class_name> [implements <interface>][extends <class_name>] abstract|final|public

b) A java method call statement
<method_name>({<param>});

c) A C switch statement

```
switch ( <var> ){
        {case <value>: {<body>;}
        [default: {<body>}]
}
```

d) A C union definition

```
union [union_tag]
        { {<type> <id>}
        } <union_name>;
```

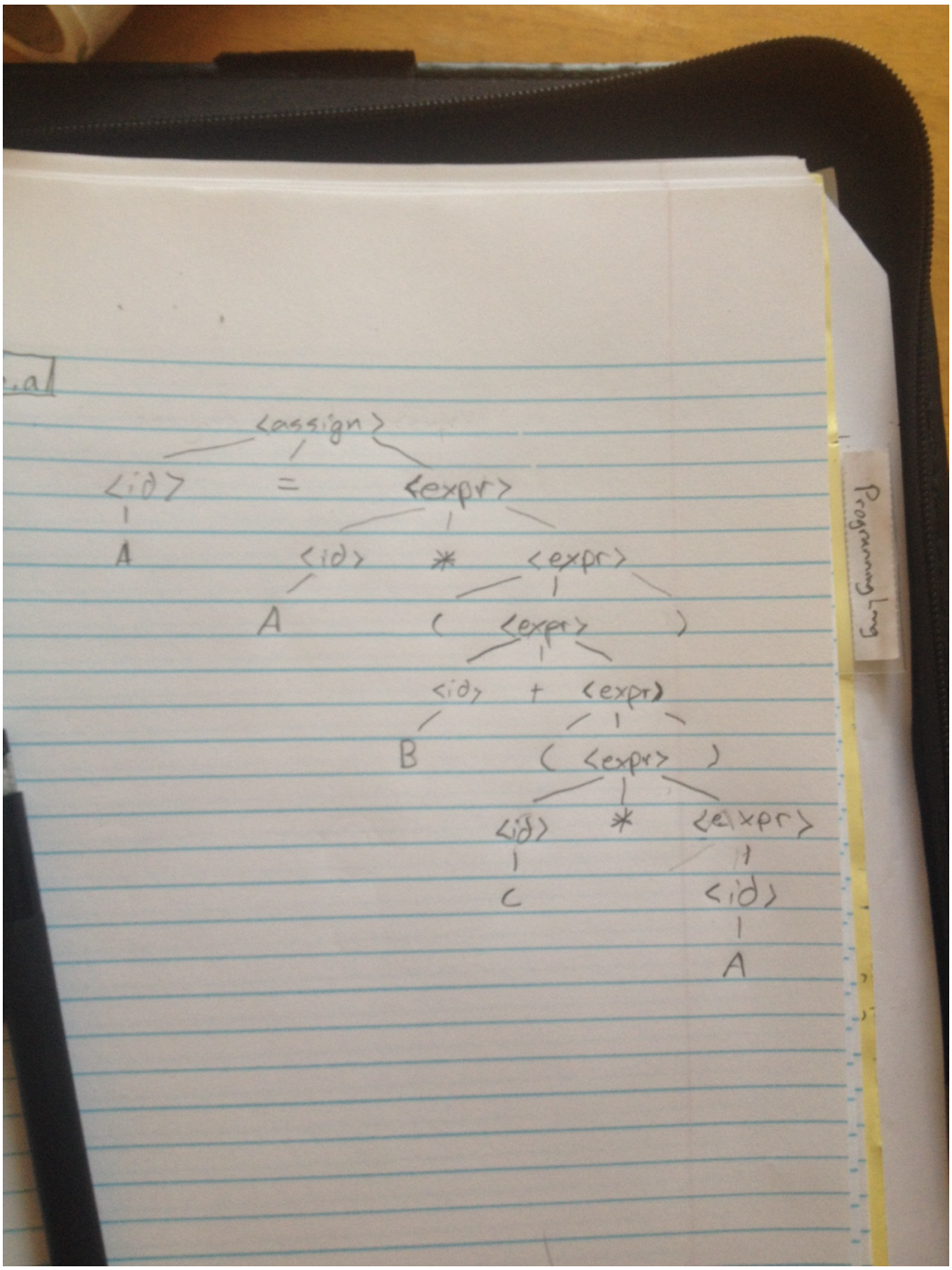
e) C float literal

<number>e|E<exponent>[l|L|f|F]

6.a. Using grammar definition in Example 3.2, show a parse tree and a leftmost derivation for: A = A * (B + (C * A))

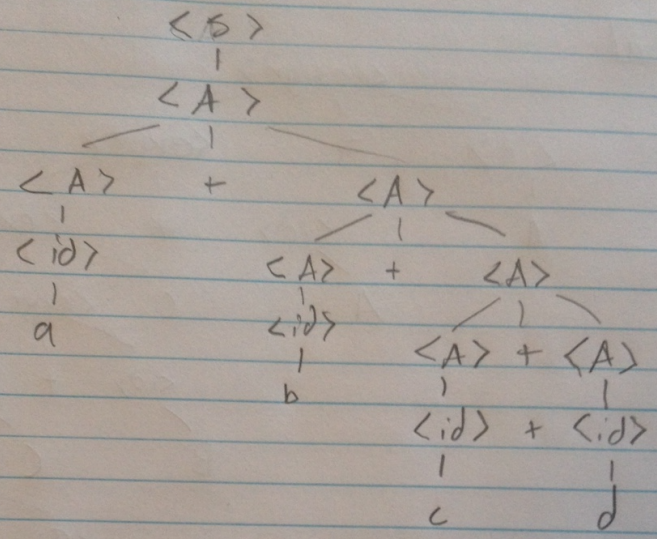
<assign> -> <id> = <expr>

- ➔ A = <expr>
- ➔ A = <id> * <expr>
- ➔ A = A * <expr>
- ➔ A = A * (<expr>)
- ➔ A = A * (<id> + <expr>)
- ➔ A = A * (B + <expr>)
- ➔ A = A * (B + (<expr>))
- ➔ A = A * (B + (<id> * <expr>))
- ➔ A = A * (B + (C * <expr>))
- ➔ A = A * (B + (C * <id>))
- ➔ A = A * (B + (C * A))

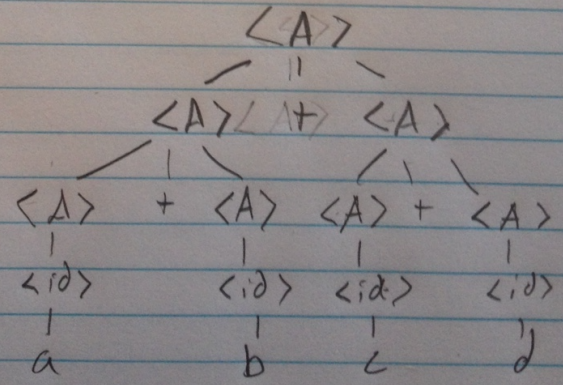


8. Prove that the following grammar is ambiguous:
<S> <A>
<A> <A> + <A> | <id>
<id> a | b | c We can find that this grammar is ambiguous with two individual parses of the string “a + b + c + d ”

Parse 1



Parse 2:



10. Describe, in English, the language defined by the following grammar:
<S> -> <A> <B> <C>
<A> -> a <A> | a
<B> -> b <B> | b
<C> -> c <C> | c

Any string over the alphabet {a,b,c} in which there are one or more a's followed by one or more b's followed by one or more c's.

13. Write a grammar for the language consisting of a string that have n copies of the letter a followed by the same number of copies of the letter b, where n>0. For example, the strings ab, aaaabbbb, and aaaaaaaabbbbbbbb are in the language but a, abb, ba, and aaabb are not.

<S> -> aSb
<S> -> *e* (empty string)

18. What is the difference between an intrinsic attribute and a nonintrinsic synthesized attribute?

An intrinsic attribute is an inherent characteristic of a terminal symbol in the grammar where it's value is the value of that symbol. A non-intrinsic synthesized attribute's value depends on it's child values.

Write an attribute grammar whose BNF basis in that Example 3.6 in section 3.4.5 but whose language rules are as follows: Data types cannot be mixed in expressions, but assignment statements need not have the same type on both sides of the assignment operator.
We only need to modify the 2nd rule:
2. Syntax Rule: <expr> - > <var>[2] + <var>[3]
Predicate Rule: <var>[2].actual_type == <var>[3].actual_type
Semantic Rule: <expr>.actual_type <- <var>[2].actual_type

21. Using the virtual machine instructions given in Section 3.5.1.1, give an operational sematic definition of:
c. C++ if-then-else statement

```
if (var relop var == true) {
        expr1;
} else {
        expr2;
}
```

e. C switch statement

```
switch (ident) {
        if ident == var1
                body;
        if ident == var2
                body;
        …

}
```

22. Write denotational semantics mapping function for the following statements
c. Java Boolean expression

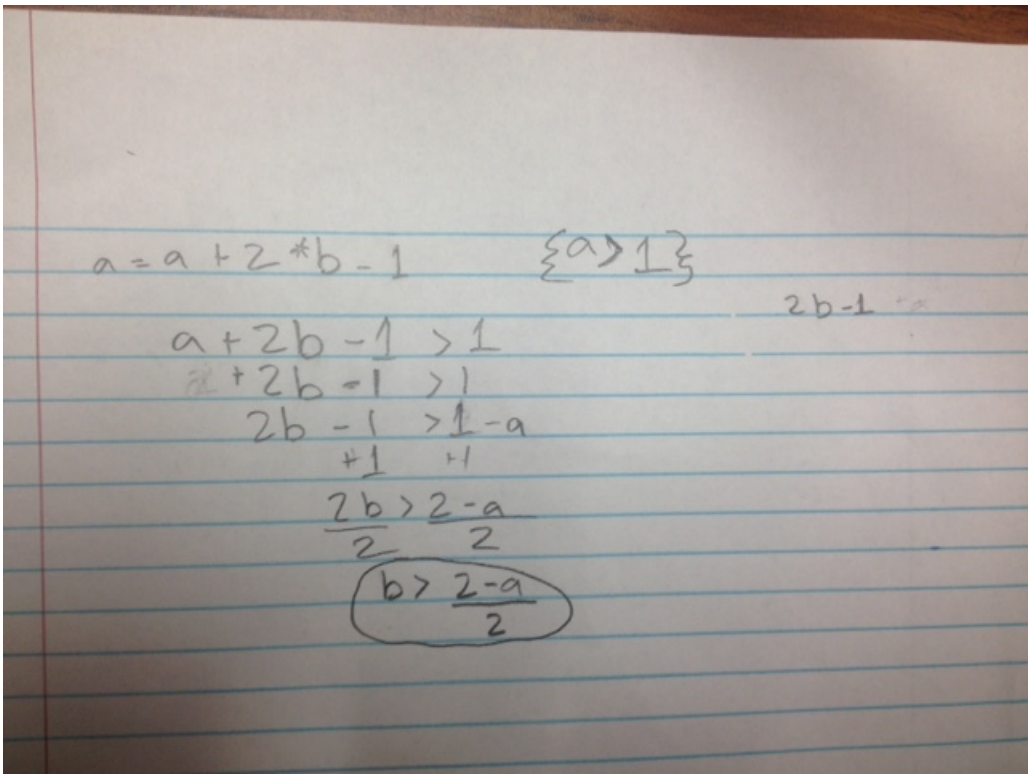
```
        If Mbool(B, s) == undefined
                Then error
        Else
                If Msl (L, s) == error
                        Then error
                Else if Mbool(B, s) == false
                        Then Msl(L,s)
                Else Msl(L',S)
```

d. java for

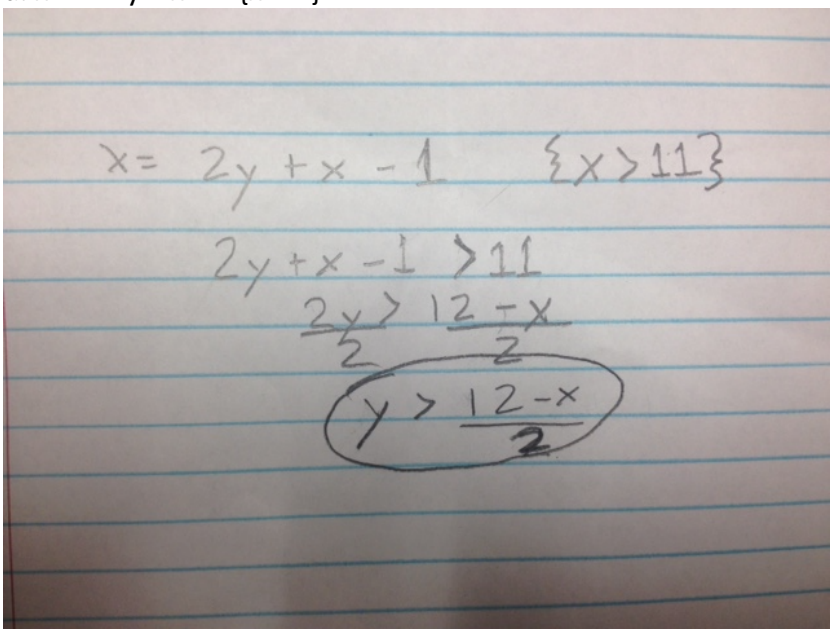
```
        Mr( for (<initial_expr>; <bool_expr>; <increment_expr>)) Δ
                If Mbool(B,s) == undefined
                        Then error
                Else
                        If Msl(L,s) == error
                                Then error
                        Else if Mbool(M,S) == false
                                Then Msl(L,s)
                                Else Mr( ( repeat L until B), Msl(L,s))
```

e. C switch

23. Compute the weakest precondition for each of the following assignment statements and postconditions:
c. a = a + 2 * b -1 {a > 1}



d. x = 2 * y + x – 1 {x>11}



24.b. Compute the weakest precondition for each of the following sequence of assignment statements and their postconditions:
a = 3 * (2 * b + a);
b = 2 * a – 1
{b>5}

$a = 3*(2b + a)$

$b = 2*a - 1$ $\quad \{b > 5\}$

$2a - 1 > 5$

$\{a > 3\}$

$3*(2b + a) > 3$

$6b + 3a > 3$

$-3a \quad -3a$

$6b > 3 - 3a$

$b > \frac{1 - a}{2}$ (6)

weakest