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CS 471

Chapter 3 Problem Set

4. (Page 181) Rewrite the BNF of Example 3.4 to add the ++ and -- unary operators of Java.

Answer:

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

11. (Page 182) Consider the following grammar:

```
<S> → <A> a <B> b
<A> → <A> b | b
<B> → b
```

Which of the following sentences are in the language generated by this grammar?

a. babb
b. bbbabb
c. bbaaaaabc
d. aaaaaa

Answers: a, b

```
Work: (a) <S> → <A> a <B> b
              → b a <B> b
              → b a b b

      (b) <S> → <A> a <B> b
              → <A> b a <B> b
              → <A> b b a <B> b
              → b b b a <B> b
              → b b b a b b
```

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21. (Page 183) Using the virtual machine instructions given in Section 3.5.1.1, give an operational semantic definition of the following:

a. Java do-while
b. Ada for
c. C++ if-then-else
d. C for
e. C switch

Answers:

a. Java do-while:

```
Pseudo: do {
            (expr1)
            }
            while (expr2)
```

Answer:

```
do {expr1}
Loop: if (expr2) == false, goto out
goto Loop
out: …
```

b. Ada for:

```
Pseudo:   for I in int range (first) to (last), loop
                      (state)
          end loop
```

Answer:

```
if (first) <= (last) goto line1
goto line2

line1:
for I in (first)…(last) loop
I = (first)
loop: if I < (last) goto out
          (state)
I = I + 1
goto loop

line2:
for I in (first)…(last) loop
I = (first)
loop: if I > (last) goto out
          (state)
I = I – 1
goto loop

out: …
```

c. C++ if-then-else:

```
Pseudo: if (expr1) {
          expr2
          } else (expr3)
```

Answer:

```
if (expr1) == true goto line1
goto line2

line1: (expr2)
line2: (expr3)
```

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d. C for:

```
Pseudo: for ((expr1); (expr2); (expr3)) {
                    (state)
            }
```

Answer:

```
    (expr1)
    loop: if (expr2) == false goto out
    (expr3)
    (state)
    goto loop

    out: …
```

e. C switch:

```
Pseudo: switch (condition) {
            case1:
                    statement1;
                    break;
            default:
                    statement2;
                    break;
            }
```

Answer:

```
r10 = (condition)
if (r10 = case1) goto line1
goto default

line1:
statement1
default:
statement2

out: …
```