Compiler Design

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Fall Semester 1401-1402

Writing Assignment III	Deadline 1401/10/25

1   Bottom-Up Parsing

According to the following grammar, answer the next questions (a-c).

$$S' \to S$$
$$S \to AC$$
$$C \to e|\varepsilon$$
$$A \to aBCd|BQ$$
$$B \to bB|\varepsilon$$
$$Q \to q|\varepsilon$$

a. Simplify the grammar as much as possible. (5pts)

b. Draw the SLR(1) transition diagram and parsing table for the grammar. (5pts)
    Note that the $S' \to S$ production has already been added. Then, show the sequence of the stack, input, and action configurations that occur during an SLR(1) parsing of string: "a b b d e $".

c. Draw the LR(1) transition diagram for the grammar. (5pts)

d. Prove or disprove that all -free LL(1) grammars are LR(0). (5pts)

e. Is it possible to construct a single grammar that contains the SLR(3) properties but not the SLR(2) properties? If yes, construct it. (5pts)

f. Which of the following pairs of items can coexist in an LR item set? (5pts)

    (a) $A \to P \bullet Q$ and $B \to Q\,P \bullet$
    (b) $A \to P \bullet Q$ and $B \to P\,Q \bullet$
    (c) $A \to \bullet\, x$ and $B \to x \bullet$

(d) A → P • Q and B → P • Q

(e) A → P • Q and A → • Q

2 Intermediate Code Generation

a. The code of the C routine corresponds to the flow graph shown in Figure 1. The weights for static profiling have been marked by the letters a to q. Set up the traffic flow equations for this flow graph under the following assumptions. At an if-node, 70% of the traffic goes to the then-part and 30% goes to the else-part; a loop body is (re)entered 9 out of 10 times; in a switch statement, all cases get the same traffic, except the default case, which gets half. (15pts)
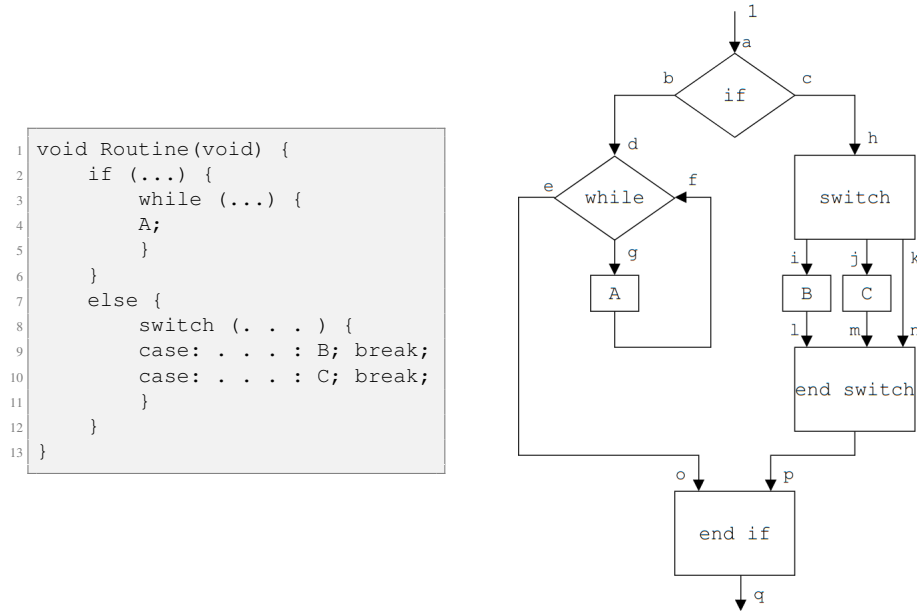
```
1  void Routine(void) {
2      if (...) {
3          while (...) {
4              A;
5          }
6      }
7      else {
8          switch (. . . ) {
9          case: . . . : B; break;
10         case: . . . : C; break;
11         }
12     }
13 }
```


Figure 1: Routine pseudocode and Flow graph for static profiling

b. The following conditional statement, where *be* represents a logical expression or variable and *A*, *B*, *C*, and *D* are simple variables, is assumed. (15pts)

```
1  if be1 then if be2 then A:=B
2              else if be3 then A:=C
3                   else A:=D
```

How many jump commands are unconditional, and how many are conditional in the code-generated machine language for the above command?

3 Semantic Analysis

a. Consider the following program fragment (30pts)

```
...
while (a) {
    if (b)
        break;
    else if (c)
        a = update(a);
        continue;
    else return;
    print(a,b,c)
}
...
```

Note that no matter which leg of the if is executed, the print statement cannot be reached. This is quite possibly an error and certainly deserves a warning message. Explain how the *isReachable* and *terminatesNormally* values set during reach-ability analysis can be used to conclude that the above print statement is unreachable.

b. For each of the following items, indicate whether it belongs to a non-terminal or to a production rule of a non-terminal. (10pts)
• inherited attribute;
• synthesized attribute;
• attribute evaluation rule;
• dependency graph;
• visiting routine;
• node in an AST;
• child pointer in an AST.

Required Document

Please upload a zip or a pdf file in Quera(https://quera.org/course/11991/).

General Rules

Submissions with more than 48 hours delay will not be graded.

Deadline

Tuesday 23:59. 1401/10/25.

Contact Information

Ask your questions in Quera(https://quera.org/course/11991/)

Good Luck