COMP

Compilers Comprehensive, November 2, 2000

This is a 60 minute open book exam (but do not use computers). All answers should be written in the blue book (not on the exam). Clear, organized answers to essay questions is important.

1. (10 points) In your blue book, indicate whether each language is LL(1), LR(1), both, or neither.

   (a) $S \rightarrow aSa|aSb|c$

   (b) $S \rightarrow Sa|bS|c$

   (c) $S \rightarrow aSa|bS|c$

   (d) $S \rightarrow aSa|bSb|\epsilon$

   (e) $S \rightarrow Sa|b|c$

2. (20 points)

   The following YACC grammar parses simple Polish expressions (e.g., `*+12+34`, which is equal to 21).

   Show what actions need to be added to print the equivalent reverse Polish expressions (e.g., `12+34+*`). Assume that the lexical analyzer returns the numerical value of the number described by `NUM`

```
%token NUM

%%

S       :       R
        ;

R       :       NUM  { printf("%d ", $1); }
        |       '+' R R
        |       '*' R R
        ;
```

   Now add actions to print Polish expressions, given reverse Polish:

```
S       :       R
        ;

R       :       NUM
        |       R R '+'
        |       R R '*'
        ;
```

3. (20 points) Describe some well-known compiler optimizations that could be usefully applied to the following code, and why they would improve the code. Be specific about what parts of the code would be improved and why. The most basic optimizations will count most heavily in grading this question.

```
struct s {
  int f1;
  double f2;
};

struct s A[100];

extern f(struct s *);

int main(void)
{
  int i;
  for (i=1; i<100; i++) {
    A[i].f1 = A[i-1].f1 - 1;
  }

  return f(A);
}
```

4. (10 points) This question asks for practical reasons to prefer one way of writing parser over another.

   (a) Give three good reasons to write a recursive descent parser by hand, even though highly efficient automatic parser generators are freely available.

   (b) Give three good reasons to use an LALR parser generator such as YACC instead of writing a recursive descent parser by hand.