

Computer Science 320: Midterm Examination

March 15, 2001

You have 1.5 hours to answer the following six questions. This midterm is closed book/closed notes. For partial credit, show all work. Put your name on every page. Write out and sign the Honor Code pledge before turning in the test.

“I pledge my honor that I have not violated the Honor Code during this examination.”

Problem 1: (20%)

Build a *Deterministic Finite Automaton* (DFA) that recognizes the following regular expression:

$$(abc \mid c^*)a$$

You will receive 4 extra credit points for a correct *minimal* DFA.

Problem 2: (15%)

Derive a context free grammar for the regular expression in Problem 1.

Problem 3: (15%)

Prove that the following grammar is ambiguous:

$$\begin{array}{ll} S \rightarrow \text{IF ID THEN } S \text{ ELSE } S & S \rightarrow \text{IF ID THEN } S \\ S \rightarrow \text{ID} & \end{array}$$

Problem 4: (20%)

Is the following grammar in LR(1)? Prove your answer in an organized manner.

$$\begin{array}{ll} S' \rightarrow S \$ & A \rightarrow a b B \\ S \rightarrow A b & B \rightarrow a \\ S \rightarrow B & B \rightarrow b A \end{array}$$

Problem 5: (15%)

Is the Problem 4 grammar in LR(0)? Prove your answer in an organized manner.

Problem 6: (15%)

Consider the following Tiger program:

```
let
  function fact(n:int):int =
    let
      var result := 1
    in
      if n > 0 then result := n * fact(n - 1);
      result
    end
  in
    fact(2)
end
```

Clearly diagram the state of the stack at the point when *fact* has just been called with an argument of 0. Label each stack location and show its value.