CS 536

Midterm Exam

Thursday, March 20, 1997

12:30 — 2:15

1221 CSST

Instructions
Answer question #1 and any three others. (If you answer more, only the first four will count.) Point values are as indicated. Please try to make your answers neat and coherent. Remember, if we can't read it, it's wrong. Partial credit will be given, so try to put something down for each question (a blank answer always gets 0 points!).

1. (1 point)
   In what year were the 1996 Olympic Games held?

2. (33 points)
   Many languages, including C and C++, have an include directive. In C and C++ it is of the form

```
#include filename
```

This command directs the compiler (and in particular the scanner) to read the contents of the named file as if it had been placed at the point where the include appeared. Note that nested includes are allowed (an included file may itself contain `#include` directives).

Explain how you would implement the `#include` directive in your CSX scanner.

What would happen if some file named `f` directly or indirectly included itself? How would you catch this error?

3. Write Lex regular expression definitions that match the following strings

(a) (11 points)
The four characters: `"\n"`

(b) (11 points)
Any odd number of backslash characters (e.g., \ or \\\ or \\\\\, etc.).

(c) (11 points)
A CSX multi-line comment, delimited by `{` and `}`, that is allowed to contain *no more* than two new-line characters. That is, the comment may appear entirely on one line, or it may span two or three lines, but no more than three lines.

4. (33 points)
Let AB be the operator that selects strings that contain both an A and a B somewhere within them from a set of strings. For example, AB({ABC, AA, BXXXA, BBB, BYAXAB}) = {ABC, BXXXA, BYAXAB}.

Let R be any regular expression (my choice). Show that AB(R) is a regular set.

5. (33 points)

Let $S = \{ [^i\,]^j \mid i \neq j \}$. S is the set of all *unbalanced* brackets; that is, a number of left brackets followed by a *different number* of right brackets.
Is S a regular set? If it is, give a regular expression or finite automaton that defines it. If S isn't a regular set, explain carefully why.

6. (a) (16 points)
Assume we have a deterministic finite automaton, D, with states s_1 and s_2. State s_1 has transitions out of it for n distinct characters. s_2 has transitions out of it for m distinct characters, where $m \neq n$.
Show that if D is optimized to remove unnecessary states, s_1 and s_2 can never be merged together.

(b) (17 points)
Let F be any deterministic finite automation (my choice). Explain how to test whether F accepts all possible strings (that is, no string at all is rejected).