COMP603: MIDTERM I

NAME: _____

Complete within 120 minutes. Read each question carefully. Write legibly and check your work. No calculators, phones, or laptops are allowed. Good luck!

1. Short Definitions

Correctly define 8 of the following terms for full credit. Correctly define all for extra credit.

(1) String _____

(2) Language _____

(3) Compiler _____

(4) Interpreter _____

(5) Bootstrapping _____

_____

(6) Visitor _____

(7) Nondeterminism _____

(8) Ambiguity _____

(9) First set _____

_____

(10) Follow set _____

_____

2. Lists

Complete 3 of the following lists for full credit. Complete all for extra credit.

(1) Compiler phases, in order. Briefly describe what each phase does.

(a) _____

(b) _____

(c) _____

(d) _____

(e) _____

(2) Primitive regular expressions. Briefly describe what each regular expression matches.

(a) _____

(b) _____

(c) _____

(d) _____

(e) _____

(f) _____

(3) Finite automaton elements. Describe each.

(a) _____

(b) _____

(c) _____

(d) _____

(e) _____

(4) For a grammar to be LL(1),[1] it must be:

(a) _____

(b) _____

(c) _____

(d) _____

3. Fill in the blank

Complete the following statements for full credit.

(1) A pushdown automaton is a finite automaton with _____

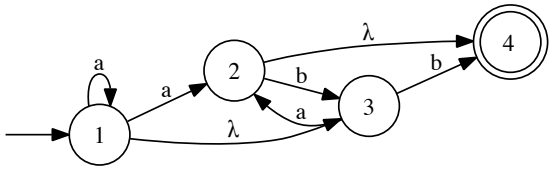
(2) A Turing machine is a finite automation with _____

(3) It is _____ possible to define an NFA which cannot be converted into a DFA.

[1] Left-right, Leftmost derivation, 1 token lookahead

4. Regular languages

Refer to the Figure below. Answer 3 of the following questions. Answer all for extra credit.



(1) What is the initial state of the DFA using subset construction?

(2) Draw the equivalent DFA using subset construction.

(3) Write the equivalent regular expression.

(4) IPv4 addresses are written as four integers, separated by dots (e.g., `173.203.204.223`). Each integer ranges from 0 to 255. Write a regular expression to match precisely these addresses.

5. Context-free languages

Refer to the context-free grammar below. S is the start symbol. Answer 4 of the following questions. Answer all for extra credit.

$$
\begin{array}{ll}
S \to T & T \to \mathbf{x} \\
S \to S + T & T \to \mathbf{y} \\
S \to S - T & T \to \mathbf{z} \\
S \to S * T & T \to (S) \\
S \to S/T &
\end{array}
$$

(1) Is the grammar above ambiguous? Why or why not?

(2) Explain why the grammar above is not LL(1).

(3) What is $First(T)$?

(4) What is $Follow(S)$?

(5) Perform a leftmost derivation of the following string: $\mathbf{x} * (\mathbf{y} + \mathbf{z})$

6. Extra credit

Complete any of the following for extra credit.

(1) List all possible *Sentences* that can be matched by the grammar below.

$$Sentence \rightarrow NounPhrase\ VerbPhrase$$
$$NounPhrase \rightarrow Article\ Noun$$
$$VerbPhrase \rightarrow Verb\ NounPhrase$$
$$Article \rightarrow \textbf{the}$$
$$Noun \rightarrow \textbf{boy}$$
$$Noun \rightarrow \textbf{ball}$$
$$Verb \rightarrow \textbf{kicked}$$

(2) Rewrite the grammar on the previous page to be LL(1).