Compilers [Spring 2023]
Test I

NAME: _____

Instructions:

1) This test is 7 pages in length.

2) You have 75 minutes to complete and turn in this test.

3) Short-answer and essay questions will be graded on how clearly you've communicated the necessary ideas. Respond in complete English sentences. Avoid using bullet points and enumerated lists. Respond at the level of detail discussed in class.

4) This test is closed books, notes, papers, friends, phones, neighbors, smartwatches, etc.

5) Use the backs of pages in this test packet for scratch work. If you write more than a final answer in the area next to a question, circle your final answer.

6) Write and sign the following: "I pledge my Honor that I have not cheated, and will not cheat, on this test."

_____

_____

Signed: _____

1. [10 points] Describe the format of *.l* and *.y* files. [*Short* essay]

2. [5 points]
a) In DJ, what are class members? [1 sentence]

b) As mentioned in class, what is notation for "there exists exactly one"?

3. [10 points]
Compare and contrast compilers, interpreters, and translators. [*Short* essay]

4. [25 points] a) Draw a minimum-state DFA recognizing strings over {x,y} that do not have xyx as a substring.

b) Write an RE for strings over {x,y} that do not have xyx as a substring. Keep the RE as simple as you can.

c) Draw a minimum-state DFA recognizing base-5 numbers that (i) do not have any leading 0s and (ii) have a remainder of 1 when divided by 3.

5. G is: `s -> x$  x -> ^x^ | ε | ~x~`

a) Show (i) an LALR parse table for G and (ii) an LALR parse trace of input ~^^~$ according to G. If you arrive at a point in the parse trace where the trace cannot continue, indicate the problem and stop the trace at that point. Hint: LALR DFAs can be created by merging states as you go, while defining the DFA, instead of afterward. [25 points]

G is: `s -> x$  x -> ^x^ | ε | ~x~`

b) Considering all the LR sets of grammars we discussed in class, prove which ones (if any) contain G. [10 points]

G is: `s -> x$  x -> ^x^ | ε | ~x~`

c) Considering all the LL sets of grammars we discussed in class, prove which ones (if any) contain G. [15 points]

Undergraduates stop here. The remaining problem is for graduate students.

6 . [15 points]

Recall that context-free languages are those that can be specified by a CFG and, equivalently, can be recognized by a pushdown automaton (i.e., "an NFA with a stack"). Write high-level explanations that context-free languages are closed under (a) union and (b) concatenation but are not closed under (c) intersection and (d) complement.

Hint: At some point you may wish to consider $L_1=\{0^a1^a2^b\}$ and $L_2=\{0^a1^b2^b\}$ where $a,b\geq 0$.