

# Compilers [Spring 2022] 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.
- 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. [4 points] [Respond with 1 sentence for each]

a) What is a language?

b) What is a programming language?

2. [8 points]

a) In a flex-input (.l) file, where would the RE for identifiers normally be positioned? Why? [1-2 sentences]

b) In a flex-input (.l) file, where would the RE to catch errors normally be positioned? Why? [1-2 sentences]

3. [4 points]

a) What is an example pattern that cannot be written as an RE?

b) Explain the intuition for why your pattern cannot be written as a RE. [1 sentence]

4. [15 points]

Draw a minimum-state DFA recognizing the following RE.  $(10 \mid (10^*1)^*)^*$

5. Essay [20 points]

Compare and contrast the “phases of compilation” used by djc, javac (the standard Java compiler), sim-dism, the original non-JIT (non-Just In Time) Java Virtual Machine (VM), and a JIT Java VM.

6. [19 points]

Write high-level proofs that regular languages are closed under (a) complement, (b) union, (c) concatenation, and (d) intersection.

7. [30 points]

G is: 0  $S \rightarrow A\$$

1  $A \rightarrow AxB$

2  $A \rightarrow \epsilon$

3  $A \rightarrow y$

4  $B \rightarrow By$

5  $B \rightarrow \epsilon$

a) Draw an SLR parse table for G.

b) Using your SLR parse table from Part (a), complete the following parse trace. If you arrive at a point in the parse trace in which conflicting actions must be performed or a parse error is detected, indicate the problem and stop the trace at that point.

Stack	Input	Action
	xy\$	

c) Draw an LL(1) parse table for G.

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

8. [12 points]

Prove that all left-recursive grammars are outside of LL(1). For this problem you may not axiomatically assume that all left-recursive grammars are outside of LL(1). ☺