

Name: \_\_\_\_\_

1. (1 pt.)

- **Read all material carefully.**
- *If in doubt whether something is allowed, ask, don't assume.*
- You may refer to your books, papers, and notes during this test.
- E-books may be used *subject to the restrictions* noted in class.
- Computers are not permitted, except when used strictly as e-books.
- Network access of any kind (cell, voice, text, data, ...) is not permitted.
- Write, and draw, carefully. Ambiguous or cryptic answers receive zero credit.
- Use class and textbook conventions for notation, algorithmic options, etc.

Write your name in the space provided above.

WAIT UNTIL INSTRUCTED TO CONTINUE TO REMAINING QUESTIONS.
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**Do not write on this page below this point.**

Q	Full Score
1	1
2	9
3	10
4	10
total	40

2. (9 pts.) Consider the following context-free grammar.

$$S \rightarrow A B S \mid B A \mid \epsilon$$

$$A \rightarrow a \mid a A$$

$$B \rightarrow b \mid B b b$$

For each of the following *sentences*, state clearly whether the sentence is *valid* (belongs to the language of the grammar). If it does then provide a leftmost derivation for it; else explain (as precisely as possible) why it does not. Ignore all whitespace.

(a) b a a

(b) a b b b a a b

[additional space for earlier material]

3. (10 pts.) For each sentence of Question 2 that is not valid, make as small a change as possible to yield a valid sentence. Write each sentence from that question, possibly modified as above, here. Then provide a parse tree for each.

[additional space for earlier material]

4. (10 pts.) Repeat Question 3 but provide abstract syntax trees (ASTs) instead of parse trees.