

CS-3160
Concepts of Programming Languages
Spring 2015

EXAM #1
(Chapters 1 - 6)

KEY

Name: _____

SCORES

MC: _____/75 PROB #1: _____/15 PROB #2: _____/10

TOTAL: _____/100

Multiple Choice Responses

Each multiple choice question in the separate packet is worth 3 points. There is no partial credit in this section. Choose the **BEST** answer of those given. Please indicate your answer by **DARKENING** the response that you have chosen **in the space provided below**. Make your selection obvious. Don't forget to mark your answers on this sheet. Only answers indicated below will be graded.

- | | | | | |
|---------------------------------------------|-----------------------------------------------|------------------------------------------------|------------------------------------------------|----------------------------------------------|
| 1. a b c <input checked="" type="radio"/> e | 6. <input checked="" type="radio"/> b c d e | 11. a b c <input checked="" type="radio"/> e | 16. a b c d <input checked="" type="radio"/> e | 21. a b c <input checked="" type="radio"/> e |
| 2. a <input checked="" type="radio"/> c d e | 7. a <input checked="" type="radio"/> c d e | 12. a b <input checked="" type="radio"/> d e | 17. <input checked="" type="radio"/> b c d e | 22. a b <input checked="" type="radio"/> d e |
| 3. a b <input checked="" type="radio"/> d e | 8. a b c d <input checked="" type="radio"/> e | 13. a b <input checked="" type="radio"/> d e | 18. a <input checked="" type="radio"/> c d e | 23. <input checked="" type="radio"/> b c d e |
| 4. a <input checked="" type="radio"/> c d e | 9. a b c <input checked="" type="radio"/> e | 14. a <input checked="" type="radio"/> c d e | 19. <input checked="" type="radio"/> b c d e | 24. <input checked="" type="radio"/> b c d e |
| 5. <input checked="" type="radio"/> b c d e | 10. a b <input checked="" type="radio"/> d e | 15. a b c d <input checked="" type="radio"/> e | 20. a <input checked="" type="radio"/> c d e | 25. a b <input checked="" type="radio"/> d e |

Problem #1 (15 pts)

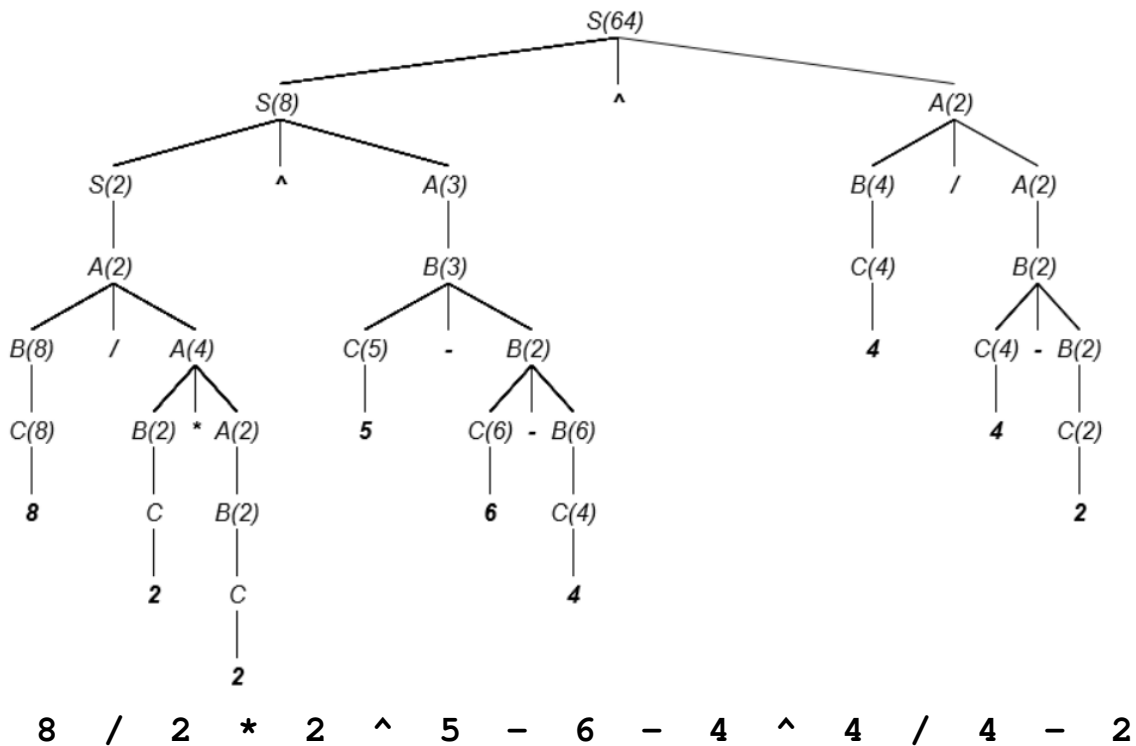
Consider the following grammar:

- $S \rightarrow (A \mid S \wedge A)$
 $A \rightarrow (B \mid B (* \mid /) A)$
 $B \rightarrow (C \mid C (+ \mid -) B)$
 $C \rightarrow \text{one of } \{0, 1, 2, 3, 4, 5, 6, 7, 8, 9\}$

The operator semantics are the usual ones and are given in the table below. Circle the appropriate precedence (1 is highest) and associativity.

operator	name	example	Precedence	Associativity
+	addition	$6 + 2 = 8$	1 2 3 4 5	L R
-	subtraction	$6 - 2 = 4$	1 2 3 4 5	L R
*	multiplication	$6 * 2 = 12$	1 2 3 4 5	L R
/	division	$6 / 2 = 3$	1 2 3 4 5	L R
^	exponentiation	$6 \wedge 2 = 36$	1 2 3 4 5	L R

Draw the parse tree, starting from S , for the following expression:



What is the value of this expression? 64

Problem #2 (10 pts)

A grammar consists of three binary operators and single-digit integer literals. The precedence and associativity are shown in the following table.

operator	Precedence	Associativity
#	1	R
@	2	L
\$	3	R

Develop a set of productions (BNF or EBNF) that reflects this grammar.

<dollar> -> (<at> | <at>\$<dollar>)

<at> -> (<hash> | <at>@<hash>)

<hash> -> (<int> | <int>#<hash>)

<int> -> one of {0,1,2,3,4,5,6,7,8,9}