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| **2016-2017** | **American Computer Science League** Intermediate Shorts Solutions | **All-Star Contest** |

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| 1. Boolean Algebra   =  =  =  =  =  = | A. |
| 1. Bit-String Flicking     X=abcde  LHS = (LCIRC-3 (RSHIFT-1 abcde) OR 11010  AND NOT (RCIRC-2 10001))  = (LCIRC-3 0abcd OR 11010 AND NOT 01100)  = cd0ab OR (11010 AND 10011)  = cd0ab OR 10010 = 1d01b  RHS = ((LSHIFT-2 10101) XOR 01110)  = 10100 XOR 01110 = 11010  LHS = RHS → 1d01b = 11010 → a = \*, b = 0, c = \*, d = 1, e = \* | D. \*0\*1\* |
| 1. Recursive Functions   (5, 6) = (5 + 1, 6 − 4) − 5 = (6, 2) − 5 = -3 − 5 = -8  (6, 2) = (6 − 2, 2 + 3) + 5 = (4, 5) + 5 = -8 + 5 = -3  (4, 5) = (4 + 1, 5 − 4) − 5 = (5, 1) − 5 = -3 − 5 = -8  (5, 1) = (5 − 2, 1 + 3) + 5 = (3, 4) + 5 = -8 + 5 = -3  (3, 4) = (3 + 1, 4 − 4) − 5 = (4, 0) − 5 = -3 − 5 = -8  (4, 0) = (4 − 2, 0 + 3) + 5 = (2, 3) + 5 = -8 + 5 = -3  (2, 3) = (2 + 1, 3 − 4) − 5 = (3, -1) − 5 = -3 − 5 = -8  (3, -1) = 3 \* (-1) = -3  Now substitute backwards. | C. -8 |
| 1. Digital Electronics   The circuit translates to:  =  =  =  =  =  =  This is TRUE for . Therefore (1,\*, 0) makes it TRUE. | C. 2 |
| 1. Prefix-Infix-Postfix   A=5, B=12, C=8, and D=20  / − ^ \ \* C − − D A B A \ ^ % + A C − D B 2 7 1 − B % B A  = / − ^ \ \* C − (− 20 5) B A \ ^ % (+ 5 8) ( − 20 12) 2 7 1 − B % B A  = / − ^ \ \* C (− 15 12) A \ ^ (% 13 8) 2 7 1 − B (% 12 5)  = / − ^ \ (\* 8 3) A \ (^ 5 2) 7 1 (− 12 2)  = / − ^ (\ 24 5) (\ 25 7) 1 10  = / − (^ 4 3) 1 10  = / (− 64 1) 10  = / 63 10  = 6.3 | B. 6.3 |
| 1. Computer Number Systems   The ticket numbers 116 to AA16 represent the digital numbers 1 to  170 and the binary from 12 to 101010102. There are 15 tickets that  contain the string 10101 when written in binary. They are:  1516=21=101012 2A16=42=1010102 2B16=43=1010112  3516=53=1101012 5416=84=10101002 5516=85=10101012  5616=86=10101102 5716=87=10101112 6A16=106=11010102  6B16=107=11010112 7516=117=11101012 9516=149=100101012  A816=168=101010002 A916=169=101010012 AA16=170=101010102 | B. 15 |
| 1. What Does This Program Do?  |  |  |  |  |  | | --- | --- | --- | --- | --- | | 17 | 31 | -15 | -1 | 13 | | 29 | -7 | -3 | 11 | 15 | | -9 | -5 | 9 | 23 | 27 | | 3 | 7 | 21 | 25 | -11 | | 5 | 19 | 33 | -13 | 1 |   This program creates a 5 x 5 magic square starting with -15 and adding 2 each time ending with 33. The output is the sum of the entries on the two main diagonals which is 45 + 45 = 90. | E. None of the above |
| 1. Data Structures   The binary search tree for The resulting tree with the root  LOSANGELESCA is: node deleted is: | B. E, O |
| 1. Graph Theory   The cycles from A in the original directed graph are: AGA, AGFA,  ABFA, ABFGA, ABEFA, and ABEFGA. There are 6.  The cycles from A in the altered directed graph are: AGA, ABCEFA,  ABEFA, and ABFA. There are 4 of them. That is 2 fewer. | C. 2 fewer |
| 1. LISP   (CAR (CDR (CDR (CDR (REVERSE (CONS (CAR X) (CDR Y)))))))  = (CAR (CDR (CDR (CDR (REVERSE (CONS  (CAR ‘((a (b)) c (d e f))) (CDR ‘((a b) (c) (d e) f))))))))  = (CAR (CDR (CDR (CDR (REVERSE (CONS ‘(a (b)) ‘((c) (d e) f)))))))  = (CAR (CDR (CDR (CDR (REVERSE ‘((a (b)) (c) (d e) f))))))  = (CAR (CDR (CDR (CDR ‘(f (d e) (c) (a (b)))))))  = (CAR (CDR (CDR ‘((d e) (c) (a (b))))))  = (CAR (CDR ‘((c) (a (b)))))  = (CAR ‘((a (b))))  = (a (b)) | B. (a (b)) |
| 1. FSAs and Regular Expressions   [A-A] - must start with A - none eliminated  [A-Z]\* - second character might be a letter - none eliminated  [1-9] [0-9]\* - number(s) must not start with 0 - iv eliminated  [A-Z] [A-M]\* [H-Z]\* - 1 or more letters - v eliminated  {@}  (A/C/S/L)\* (U/C) - character before “.” must be U or C - ii & iii eliminated  {.}  (A/C/S/U)\*-only these may follow “.” - viii eliminated | D. i, vi, vii |
| 1. Assembly Language   This program finds the largest and smallest data and subtracts  them to find the range. 90 − 25 = 65 | D. 65 |