Computer Science Contest #1415-03 Key

October 25, 2014

1)	A		21)	B
2)	D		22)	B
3)	A		23)	A
4)	B		24)	A
5)	D		25)	D
6)	B		26)	B
7)	B		27)	B
8)	C		28)	E
9)	D		29)	E
10)	D		30)	E
11)	B		31)	B
12)	E		32)	A
13)	C		33)	A
14)	D		34)	C
15)	D		35)	B
16)	A		36)	A
17)	E		37)	A
18)	E		38)	E
19)	C		39)	6
20)	E		40)	68

Note to Graders:

- All provided code segments are intended to be syntactically correct, unless otherwise stated (e.g. error is an answer). **Ignore any typographical errors.**
- Any necessary Standard Java 2 Packages are assumed to have been imported as needed.
- Assume any undefined (undeclared) variables have been defined as used.

Explanations:

1. $11101101_2 + 11101101_2 = 237_{10} + 52_{10} = 289_{10} = 441_8 = 121_{16} = 100100001_2$

2. $8 / 9 + 7 \% 10 = 7$

3. The values 5 and 4 are numerically added since that operation came before the concatenation with the string, but the values 2 and 3 were simply attached to the string since they were after the concatenation.

4. The string "ChopinNocturnes" does indeed contain the string "pin", and the location of the string "hop" is at position 1 due to zero indexing.

5. Since p is true, !p (not p) is false, making the first expression false. The second expression is true since both parts are true.

6. The absolute value (distance from zero) of -45 is 45.

7. $9 + 4.5 = 13.5$

8. Since the actual value of PI extends beyond 3.14 with the Math.PI constant (3.14159265...and so on through 15 places), 3.14 is slightly less in value.

9. The loop starts at zero and ends at 22, with stars output each time except for when x is 22, which causes the loop to stop. There are 22 values from 0 to 21, inclusive, thus that many stars output.

10. The output is this: `09030-60200`. There are seven non-positive values in this array...the six zeroes that were assigned by default, and the -6 assigned in the code.

11. In addition to the main heading, there must be a "throws IOException" or "throws FileNotFoundException" line tacked onto the end of it. Also, a Scanner object, f in this case (or whatever you choose to call it) is defined in two parts...new Scanner and new File, with the name of the data file in quotes as the parameter for File.

12. The output value pairs are: 2 1, 7 4, 20 12, and 54 33. 12 is the 3rd value of m.

13. The multiplicative operators (`*` `/` `%`) are third in the Java Order of Precedence chart, the shift operators (`<<` `>>` `>>>`) are fifth, and the ternary operators (`?` `:`) are next to last, thirteenth in order.

14. Float is a member of the primitive decimal family along with double.

15. subList works for ArrayLists just like substring does for Strings.
    [4, 2, 7, 5, -7, 0, 3, 9] shows the initial values in the list
    [-7, 0, 2, 3, 4, 5, 7, 9] shows the sorted list
    [2, 3, 4, 5] shows the sublist from position 2 up to but not including position 6

16.

A B $\overline{A}$ $\overline{A}B$ $A + \overline{A}B$

A	B	$\overline{A}$	$\overline{A}B$	$A + \overline{A}B$
0	0	1	0	0
0	1	1	1	1
1	0	0	0	1
1	1	0	0	1

The truth table above shows three true results in the final column.

$A + \overline{A}B$ also simplifies to A+B using the "disappearing opposite" rule. The A+B truth table result matches the one shown.

17. Here are the contents of the entire grid after the code segment executes.
    ```
    0  0  0  0  0  0  0
    0  2  4  6  8  10 12
    0  6  12 18 24 30 36
    0  14 28 42 56 70 84
    ```

18. 112 in 8-bit binary is 01110000. Applying the rule mentioned in the problem gives you 10010000, which is the binary equivalent of -112.

19. The outside x loop termination values are 1, 2, 4, 8, 16, 32, and 64. The inside loop goes from 1 to each of those values, adding a star to the string each time. The length of the string is simply the sum of all of those termination values, which is 127.

20. The resulting tree has five nodes (N, E, W, C, and O) with two children each: the root node N has E and W, E has C and H, W has S and Y, C has A and E, and O has O and R.

21. The cosine of a 60 degree angle is 0.5 (adjacent over hypotenuse)

22. This code segment sorts the array into ascending order from position 3 up to but not including position 8. So from the original array, 3 5 4 **7 6 3 1 2** 0 8 9 5, only those elements are sorted, resulting in 3 5 4 **1 2 3 6 7** 0 8 9 5.

23. The sequential search returns a value of zero through the size of the list minus 1 when if first encounters the search key. If the key is not found, a value of -1 is returned. In this case, the 8 is found at position 7, the 5 at position 1, and the 7 not found at all, indicated by the -1.

24. The sequential search returns a value of zero through the size of the list minus 1 when if first encounters the search key. If the key is not found, a value of -1 is returned. In this case, the 8 is found at position 7, the 5 at position 1, and the 7 not found at all, indicated by the -1.

25. All of these patterns result in a true output. Study the Pattern class carefully and look up the parts of each pattern to see how each causes the statements to be true.

26. Here is how to do it: start with just the operands in their original order, 5 2 5 6 3.
    Then think about the order of operations. In this case, 2*5 goes first, so put the * in front of the 2 and 5, giving you 5 *** 2 5** 6 3. Next is the 6*3, so do the same, getting 5 *** 2 5 * 6** 3. Next comes subtraction, so put the minus in front of the 5 and *** 2 5**, resulting in - **5 * 2 5 * 6** 3. Finally comes the addition, which goes out in front of the whole thing ==> **+ - 5 * 2 5 * 6 3.**

27. When you have several assignment statements, the evaluation order is right to left, which means `i2 -= 3` becomes -5. Then `i1 *= -5` produces -15, which when added to 2.5 results in 12.5.

28. Recursion (a method calling itself), iteration (looping), branching (if, if else, switch), and input/output are typical processes found in a computer program.

29. This map keys the length of the word with the word itself, so the word "whose" would be a (5,"whose") mapping. However, since there are no duplicate mappings, the next word "woods" overwrites "whose" as the word mapped by the value 5. Therefore, any other length 5 string after that will overwrite the previous one. After the entire mapping process, there are 8 mappings left, and they are: {1=i, 2=up, 3=his, 4=snow, 5=woods, 6=though, 7=village, 8=stopping}. There are 8 mappings, which is the size of the list, and the last key, is mapped to the word "stopping".

30. The split pattern `"\\p{Upper}"` means split on any capital letter, wherever they occur in the string. This split causes an empty string at the front, with "inter", "pring", "ummer", and "all" after that.

31. The output of an object is controlled by the toString method, which is overridden in this class to show a sentence as shown in the correct choice indicated, "R rated 90 minute thriller", showing the values provided by the default constructor of the class.

32. Since there are three parameters in the call to the new Movie constructor, the compiler selects the matching constructor with three parameters, or #2. Inside the #2 constructor, the reference to **this(m,t)** indicates that the two-parameter constructor is to be used, which is #3. Finally, although the value 'M' is provided by #3, that value is then reassigned in constructor #2 after the call to this(m,t).

33. This one is tricky. Although the rating provided was 'G', the rating assigned was 'M' in constructor 2. The other two parameters were assigned as given.

34. This converts the base 10 value 45 to the equivalent base 6 value of 113. Converting back to base ten would be 1 X 36 + 1 X 6 + 3, or 36 + 6 + 3 = 45.

35. To simplify, break the NOT over the plus, discard the resulting double NOT over the AB, leave the NOT over the C, and change the OR to AND, making $AB\overline{C}$

36. When an even value is encountered, it is added to the queue, otherwise the odd value is added, and the front value of the queue is removed. Since there are three odd values in the list, the first three values added end up to be the ones removed.

37. The triangle with a circle at the point is a NOT signal for the A, which goes into an AND gate (bullet shaped) with B, and that signal goes into a NOT OR (arrow shaped with a circle at the point) with C as the other signal. The result is **NOT**(NOT A AND B **OR** C).

38. The four output values are 13(10+12/4), 10(9+8/7), 9(9+6/10), and 4(-6+-10/-1). The value 5 is not one of the outputs.

39. There are six different cycles in this graph: ABDFA, ABCFA, ABCEGFA, BCFDB, BCEGFDB, CEGFC

40. Here is the recursive trace for the elf box cookie problem.
    f(71) = 1 + f(35) + f(36) = 1 + 32 + 35 = 68
    f(35) = 1 + f(17) + f(18)= 1 + 14 + 17 = 32
    f(17) = 1 + f(8) + f(9) = 1 + 5 + 8 = 14
    f(8) = 1 + f(4) + f(4) = 1 + 2 + 2 = 5
    f(9) = 1 + f(4) + f(5) = 1 + 2 + 5 = 8
    f(5) = 1 + f(2) + f(3) = 1 + 2 + 2 = 5
    f(18) = 1 + f(9) + f(9) = 1 + 8 + 8 = 17
    f(36) = 1 + f(18) + f(18) = 1 + 17 + 17 = 35