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Note that any work that you do on this page will NOT be graded.

General Instructions – The exam has twelve questions. Read each question carefully and answer in the space provided. For some questions, the answers MUST be written within the given box.

1. [4 points] Rank the following places where memory is stored in a computer from fastest (1) to slowest (4). Write your answer in the boxes provided:

Cache [ ] 2

Hard drive [ ] 4

RAM [ ] 3

Registers [ ] 1

2. a. [1 point] Define an algorithm.

An *algorithm* is a precise, systematic method for producing a specified result.

b. [1 point] Define computational thinking

Computational thinking is the thought processes involved in formulating problems and their solutions so that the solutions are in a form that can be effectively carried out by an information-processing agent"

3. [4 points] As a member of a voter suppression organization that verifies fair elections in Canada, you have been charged with visiting a polling station and reporting on any questionable behavior that you observe. Nothing seems to be happening and so you get out your phone to monitor the election on Twitter. Two minutes later, you notice a person stuffing a ballot box with ballots. You take a picture of the person in question and immediately try to send the image to your boss. Unfortunately, the file is too big to be attached to an email, so you need to compress it. Explain the benefits and limitations of using either of the types of compression discussed in class.

Lossy compression will make for a smaller file, but will lose information. Lossless compression will retain all information but will not be as small.

4. [3 points] Consider the task of deciding which person/people in a class is the tallest. In the appropriate space below, please write (a) whether the task is ambiguous or unambiguous. Then (b) state why.

a. [1 point] Ambiguous or unambiguous? (please write your answer below)

unambiguous

b. [2 points] Why?

There is a clear definition of what a person's height is, so deciding who is the taller requires no interpreting the question. Even in the case of if two people have the same height, the question is specified to allow multiple people be returned

5. [6 points] Consider the three sorting algorithms (insertion sort, selection sort, and simple sort) that we discussed in class. Assume that you were using one of them to sort books that had been on a library shelf for a long time. These books are have been in heavy circulation and are now largely sorted backwards order. Note that the description of the sorts is listed at the end of the exam.

a. [3 points] Which of the algorithms that we covered is the best algorithm to use? Why?

Selection sort. Insertion sort performs many fewer comparisons than any of the others if things are close to in the correct order, in contrast, if things are heavily out of order, it takes up a lot more time. Both take up the minimal amount of space.

b. [3 points] Which of the algorithms that we covered is the worst algorithm to use? Why?

Simple sort. It both requires many more comparisons and much more space than the other algorithms

6. [4 points] Number conversions

Please convert the following numbers. Show your work

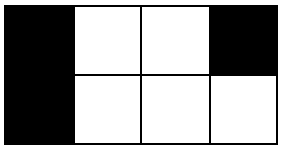
a. [2 points] Convert decimal 110 to binary

0b1101110 No need to start with the leading 0b

b. [2 points] Convert 0x1a0 to decimal

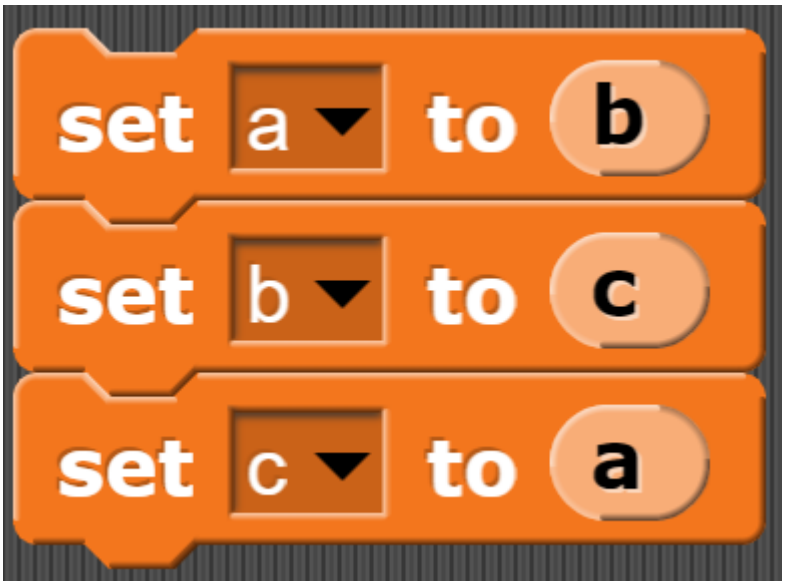
The answer is 416

7. [3 points] Write out the non-compressed representation for the bitmap image. For all colours, where applicable, please write the representation in hex. The darker color is black, while the lighter one is white.



2 x 4 000000 FFFFFF FFFFFF 000000 000000 FFFFFF FFFFFF FFFFFF	

8. [3 points] At a high level, what does this program do? (i.e., do not state what each step does, explain what the overall effect is. For example, you are looking for a description like “it sets all of the variables to the value of the lowest variable” Note that this is ***not*** the correct answer.)



The code swaps the values in the variables b and c

9. [9 points] Consider a simplified version of the Hexadecimal digits chart on the last page. The top of that chart is reproduced here.

Binary Representation	Hexadecimal representation
0000	0
0001	1
0010	2
…	…

Write an algorithm that takes in an initial chart like the above and creates a new chart that has the hexadecimal representation before the binary representation. E.g., the start of the output should look like:

Hexadecimal Representation	Binary Representation
0	0000
1	0001
2	0010
…	…

Make sure that your algorithm works for any number of numbers (i.e., don't assume that it stops at 0XF)

Your algorithm should specify both the numbers and the **basic** formatting.

State any assumptions that you make. As a starting point, do not worry about font size, and assume the things that you need to write will fit inside the space provided. Do not worry about specifying the exact spacing.

A solution. There are many others.

1. Write the words "Hexadecimal Representation"

2. Leave some space

3. Write the words "Binary Representation"

4. Set the variable ROW to be 1

5. While there are still more rows

    6. Set the variable BINARY to be the first number on the row that we're on in the original table

    7. Set the variable HEX to be the second number of the row that we're on in the original table

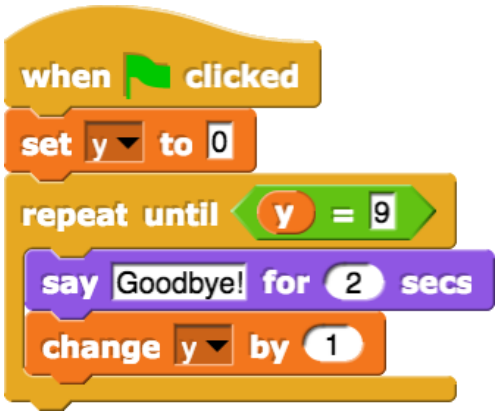
    8. On a new line, write the value of HEX

    9. Write some space

    10. Write the value of BINARY

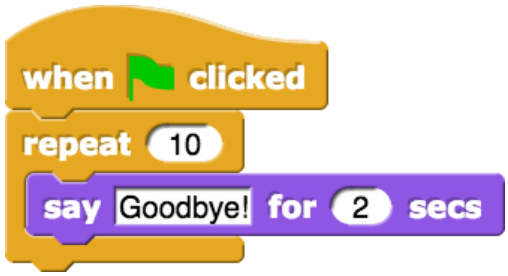
    11. Increase ROW by 1

10. [2 points] Consider the code:



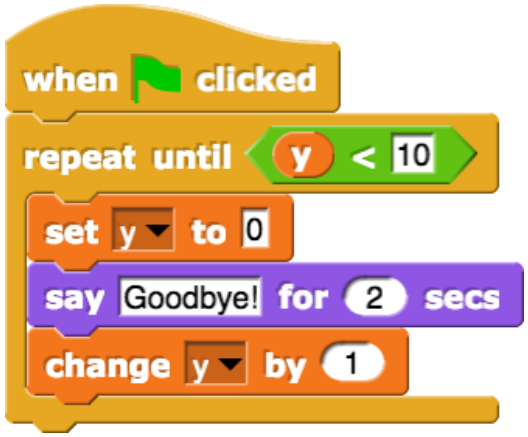
Which of the following have the same outcome as the code above? Write the letter(s) here:

A:



Answer: C. Note, this is a practice problem.

B:



C:

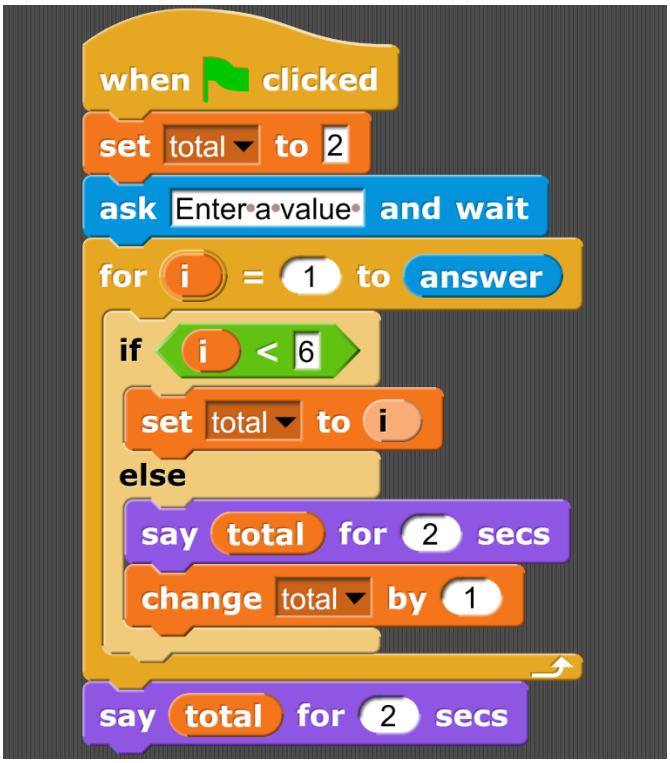
11. [5 points] What is displayed to the screen when this block is run and the user inputs the value 9?

Make sure that you show all values that are output. E.g., if the algorithm says “a”, then “b”, then “c”, your answer should be

a

b

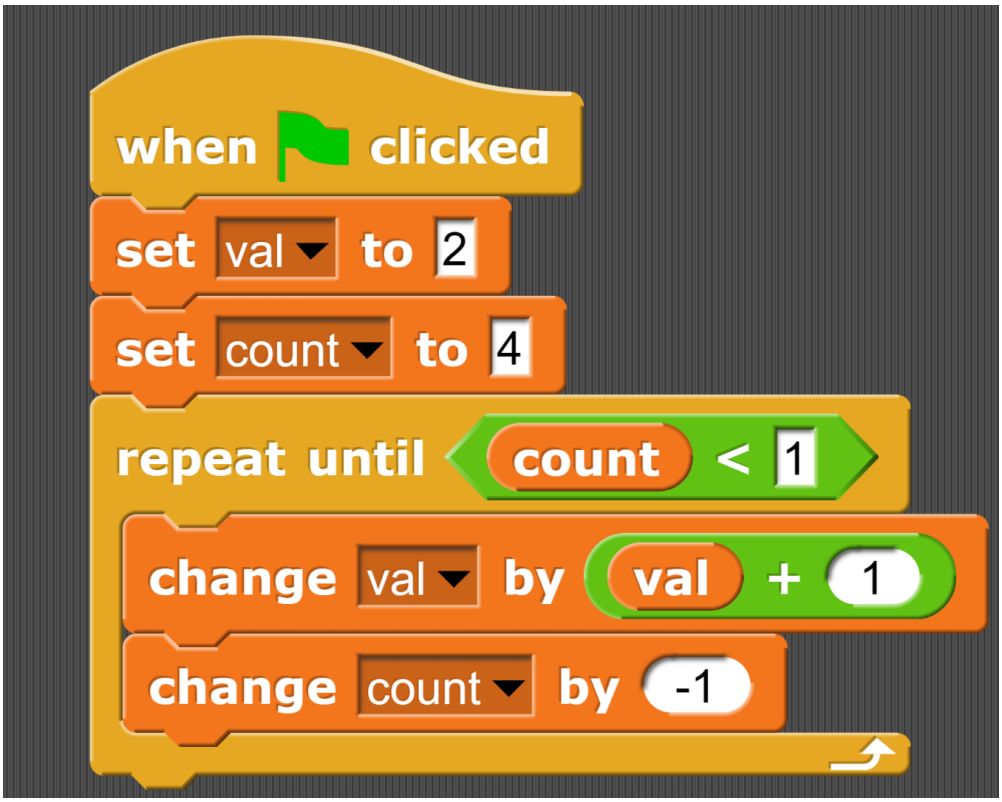
c



Record your answer (and only your answer) in the box

5
6

12. [5 points]



a [3 points] What is the value of the "val" variable after the block (shown above) has run?
Write your answer in the box below

47

b [2 points] What is the value of the "count" variable after the block (shown above) has run?
Write your answer in the box below

0

Use this sheet for work that you want graded. Make sure you clearly state which question(s) you are answering on this page.

Information you may find useful. This sheet will NOT be graded.

Powers of two

2 raised to the power of	
0	1
1	2
2	4
3	8
4	16
5	32
6	64
7	128
8	256
9	512

Hexadecimal digits

Binary Representation	Hexadecimal Representation
0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9
1010	A
1011	B
1100	C
1101	D
1110	E
1111	F

Information you may find useful. This sheet will NOT be graded.

Insertion sort:

1. Deal the unsorted cards
2. Put a divider after the first card
3. Repeat steps 4 through 6 until their is no card is to the right of the divider
    4. Select the first card to the right of the divider. This is the "new" card.
    5. Swap this card to the left until it arrives at the correct sorted position
    6. Advance the divider to the right one card
7. Stop

Selection sort:

1. Deal the unsorted cards
2. Put a divider at the left of the unsorted cards
3. Repeat steps 4 through 7 until one unsorted card remains
    4. Initially mark the first (leftmost) card
    5. For each card to the right of the second card:
       If the card is smaller than the marked card,
          move the marker to the current card
6. Swap the marked card with the first unsorted card (just to the right of the divider)
7. Advance the divider to the right one card
8. Stop

Simple sort:

1. Place the unsorted cards in the top row
2. Repeat steps 3 through 6 until no unsorted card remains
3. Initially mark the first (leftmost) card
4. Working right from the second card, compare the marked card to the current card.
   If the current card is smaller than the marked card,
          Move the marker to the current card
5. Move the marked card to the sorted hand
6. Put a "Max" (upside down) card in the empty unsorted slot
7. Stop

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