Fill in the Blank [5 marks]

Question	The word that should go into the blank
In class, we discussed four types of memory. _____ is the slowest type of memory.	Hard Drive
The _____ translates assembly language to machine code.	Assembler
Snap is an example of a _____ type of programming language.	High Level We also accepted Visual as an answer.
Computers store information about colour by representing each colour as _____ hexadecimal digits.	6 (2 for R, 2 for B, 2 for G) This question could have been interpreted to mean how many hexadecimal digits are required to represent one of red, green or blue so we also accepted 2 as an answer.
In CPSC 100, students form project groups with other students in their lab section. Carmen is trying to assign a project TA to each group. To help figure out an algorithm to do this, she decides to only look at the project groups from one lab section instead of looking at all the project groups. This is an example of _____.	Decomposition

Short Answer [10 marks]

1. [2 marks] Each midterm exam has an exam number (found at the top right corner of your exam). Arden has randomly grabbed ten exams from the box. Specifically, she is looking at a pile of exams with numbers: 100, 480, 232, 123, 533, 355, 182, 234, 142, and 800. She remembers that she needs to double check exam #533 to see if the cover page was filled out by the student. Without doing anything else to the pile, should she use a linear search or binary search method to find exam #533? Why? Provide a 1 to 3 sentence explanation in the box below.

   Arden should use a linear search. Using binary search would require that the pile is sorted in either ascending or descending order.

2. If you were asked to rank ice cream flavours from best to worst:
   a. [0.5 marks] Is an example of an ambiguous or unambiguous task? Circle your answer.

      Ambiguous Unambiguous

   b. [1.5 marks] Why?

   There is no clear definition of what “best” is. Everyone has different preferences for what flavour they like best so there is no clear way of ranking the flavours.

3. [2 marks] Name two differences in the way snow looked between Beauty and the Beast and Monsters Inc.

Difference 1:

(There could have been many different answers to this but we required the answer to be specific)

Snow was 2D in Beauty and the Beast and 3D in Monsters Inc

Difference 2:

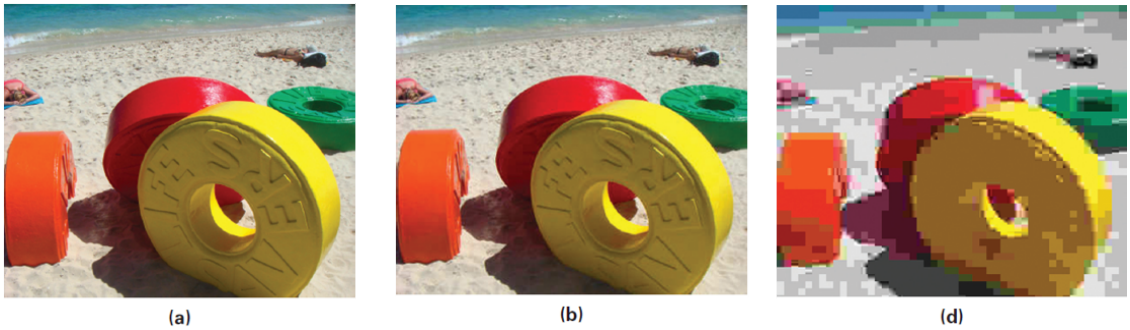
(There could have been many different answers to this but we required the answer to be specific)

Snow could not interact with the characters in Beauty and the Beast (think of when the snow fell on Belle and the way it interacted with her clothes) as opposed to how the snow could stay on Scully's fur in Monsters Inc.

4. [1 mark] Why do images get blurrier the more we use lossy compression on it?

Lossy compression involves a loss of data. One mechanism for compressing an image in a lossy way is to modify an area with similar colours to be the same colour (similar to what jpgs do).

Example:



(a) Original

(b) 10:1 compression

(d) 25:1 compression

5. [2 marks] Recall the quicksort algorithm discussed in the CS Field Guide Chapter 2. In the worst case possible, would quicksort or selection sort have fewer comparisons when sorting six cards from smallest to largest? Why?

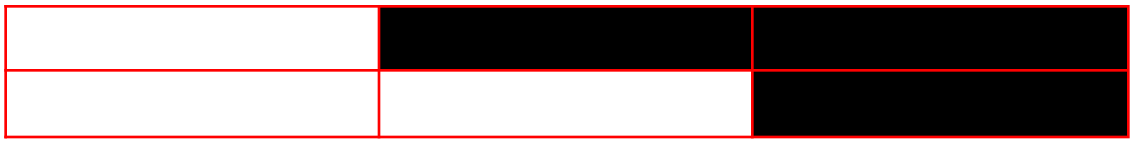
In the worst case, both selection sort and quicksort require the same number of comparisons. On average, quicksort would take fewer comparisons so quicksort is the better choice.

With six cards, selection sort will require 15 comparisons (5 + 4 + 3 + 2 + 1).

The number of comparisons required by quicksort will vary depending on which card is chosen as the pivot. If you are very unlucky and choose the biggest/smallest card as the pivot each time, the number of comparisons required is also 15. On average, it will require fewer than 15 comparisons.

6. [1 mark] Draw the image shown by the following bitmap image representation (the representation given follows the conventions described in lecture).
FFFFFF is white, 000000 is black.

2x3
FFFFFF 000000 000000 FFFFFF FFFFFF 000000



Algorithms [10 marks]

1. [6 marks] Given a bitmap image, write an algorithm that would create a new type of compressed data representation for it that describes the image by columns. Assume you have a table that tells you the hexadecimal representation of a particular colour.

   For example, given the bitmap image below (the colours listed in the box are meant to represent what colour that pixel is), your algorithm should produce:

White	White	Black
Black	Black	Black
White	Black	White

   (number of columns) x (number of rows)
   A description of the colours in each column starting from the leftmost column and moving from top to bottom.

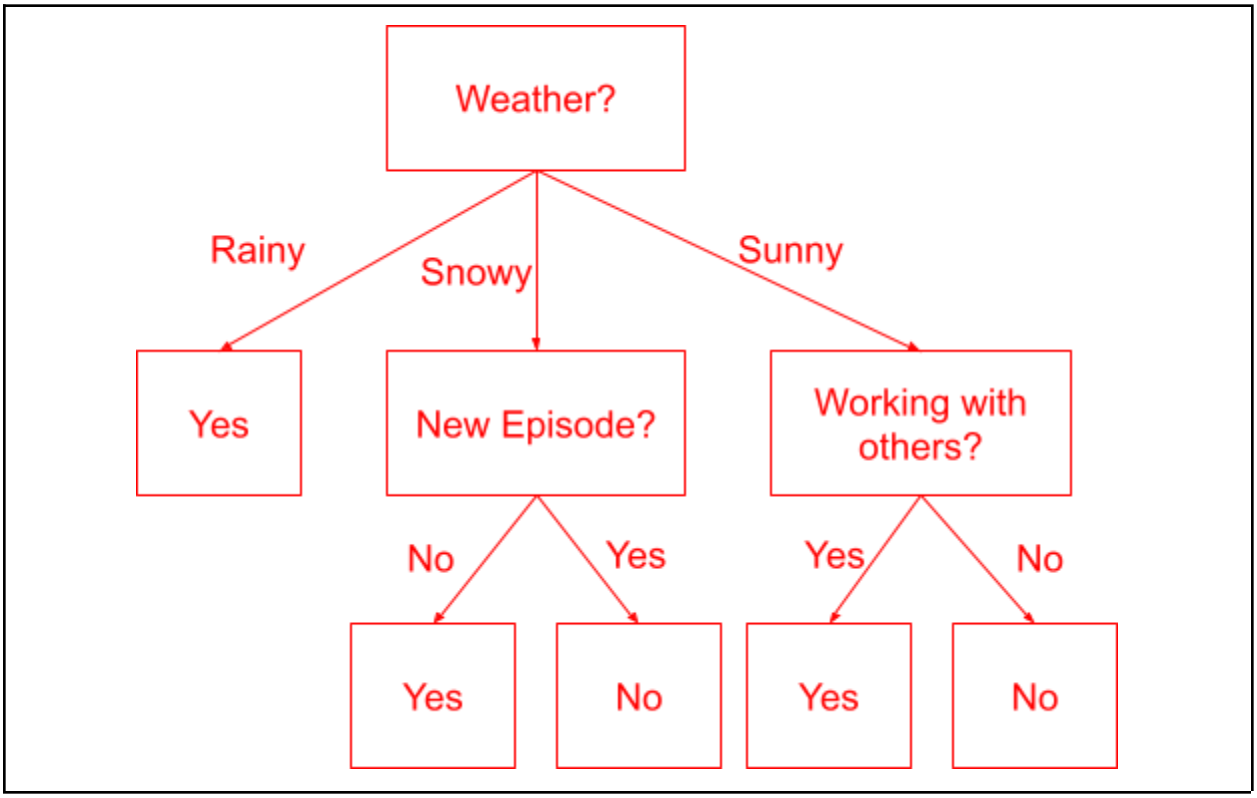
   The image to the left would produce a representation like this:
   3x3
   FFFFFF 1 000000 1 FFFFFF 2 000000 4 FFFFFF 1

   The bitmap image can contain colours other than black and white.

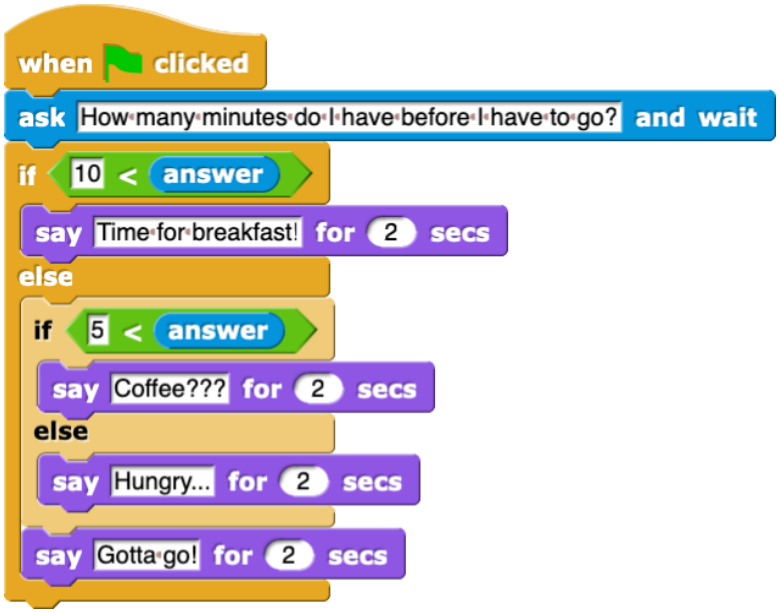
1. Count the number of columns.
2. Count the number of rows.
3. Write the number of columns and rows.
4. Create a space to store what colour you have seen last. Set this to be blank.
5. Create a space to store the number of (consecutive) pixels with the same colour as what is stored in step 4. Set this to 0.
6. Starting from the top of the leftmost column:
   a. Use the colour to hexadecimal representation table to determine the hexadecimal representation of the pixel/cell you are looking at.
   b. Compare the colour from step 6a to the colour stored in step 4.
      i. If the colour in the space from step 4 is blank, store the colour from step 6a into this space.
      ii. If the colour in the space from step 4 is the same as the colour from step 6a, increment the count variable from step 5 by 1.
      iii. If the colour in the space from step 4 is different from the colour in step 6a, write down the colour stored in step 4 and the number stored in step 5. Set the colour in step 4 to the colour in step 6a and the number in the space from step 5 to 1.
   c. Move down the column to the next pixel/cell. If there are no more cells below our current location, move to the top of the column to the right and go back to step 6a. If there are no more columns (i.e., you are at the bottom right hand corner of the image), write down the colour stored in step 4 and the number stored in step 5.

2. [4 marks] Karin is currently debating about whether she should continue to work on her current task. Using the process we discussed in class, create a decision tree that will help her make a decision.

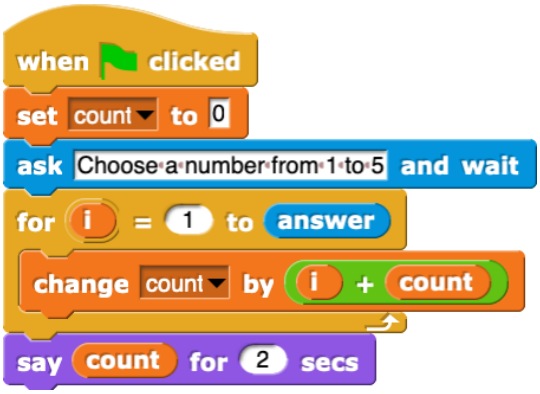
Is there a new episode of her favourite show?	Is she working with other people?	What is the weather like?	Do task?
Yes	No	Snowy	No
Yes	No	Rainy	Yes
No	No	Snowy	Yes
No	Yes	Sunny	Yes
Yes	Yes	Snowy	No
No	No	Sunny	No
Yes	Yes	Sunny	Yes
No	Yes	Rainy	Yes
Yes	Yes	Rainy	Yes



Trace Through the Code [10 marks]

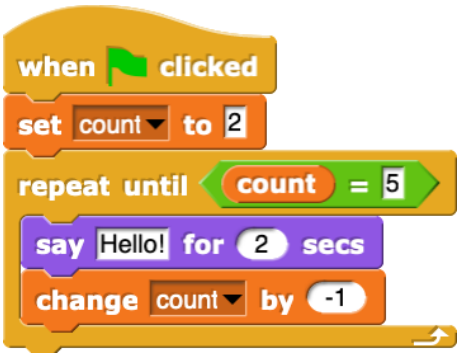


User Answers With...	Sprite Says
15	Time for breakfast!
8	Coffee??? Gotta go!



[2 marks] If user answers with 3, the sprite will say:

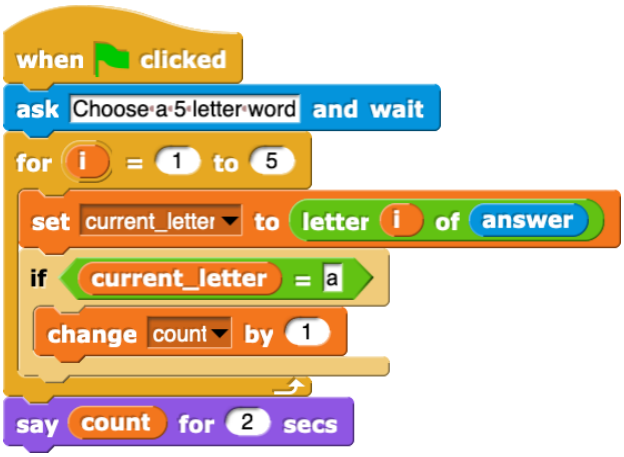
11



[2 marks] **Sprite Says**

Hello is repeated infinitely as count will never be equal to 5.

[2 marks] Using 1-2 sentences, describe what the following code snippet is doing. Note that answers that describe what the code is doing line by line will not be given any marks.



It counts the number of a's in a five letter word.

Number Conversions [6 marks]

For each of the following questions, you don't have to show your work but in the case where your answer is wrong, there is some possibility (although not guaranteed) of obtaining part marks based on your work. The conversion table exists on the last page of the exam.

Question	Answer
[1 mark] 0x342 to decimal. For this question, you can also show the mathematical equation you would use to calculate the answer. E.g., (2 x 6) + (2 x 3)	$(3 \times 16^2) + (4 \times 16^1) + (2 \times 16^0) = 834$ The brackets are not necessary but are shown to improve the clarity of the answer.
[1 mark] 0b1010110010 to hexadecimal	0x2B2
[2 marks] 238 to hexadecimal	0xEE
[2 marks] 197 to binary	0b11000101

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

Powers of 2

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

Powers of 16

16 raised to the power of	
0	1
1	16
2	256
3	4096

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