Problem 1: Multiple Choice- Circle the correct choice(s) [4 marks]

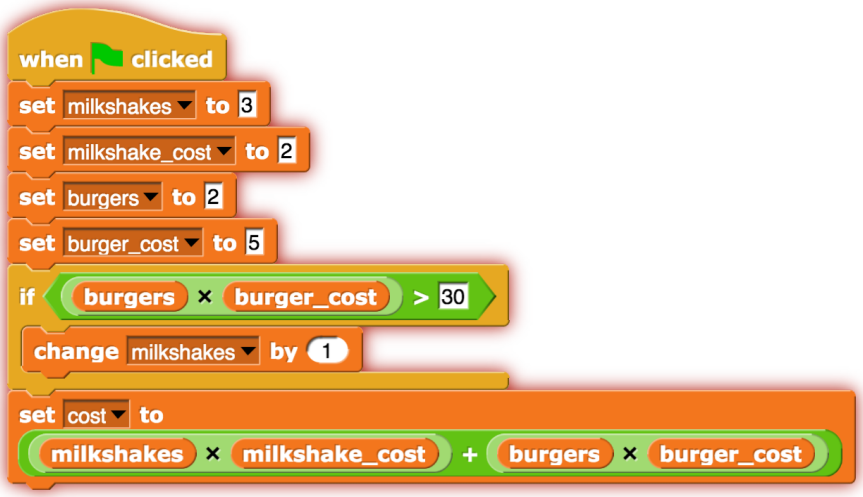
1. [1 mark] Which of the following answers has the terms from the "Memory Hierarchy" in order from Lowest to Highest Capacity.
    a. Disc Storage, Physical Ram, Level 2 & Level 1 Cache, CPU Registers
    b. CPU Registers, Physical Ram, Disc Storage, Level 2 & Level 1 Cache
    c. Physical Ram, Disc Storage, CPU Registers, Level 1 & Level 2 Cache
    d. Physical Ram, CPU Registers, Level 2 & Level 1 Cache, Disc Storage
    e. CPU Registers, Level 1 & Level 2 Cache, Physical Ram, Disc Storage

2. [1 mark] Which sort(s) require the most space?
    a. Selection Sort
    b. Insertion Sort
    c. Simple Sort
    d. They all required the same amount of space
    e. You can't tell—it depends on what kind of cards you are given to work with

3. [1 mark] What is an algorithm? Pick the best answer (i.e., pick **one** answer).
    a. A series of steps written to solve a specific problem with specific inputs
    b. A series of steps written to solve a specific problem with non-specific inputs
    c. A way to sort things
    d. A class exercise we keep doing

4. [1 mark] Operating system is a type of:
    a. Software
    b. Hardware

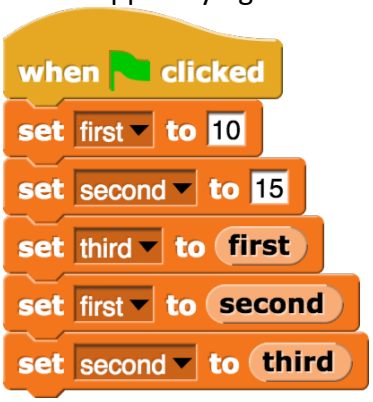
Problem 2: Snap! Snap! Snap! [9 marks]



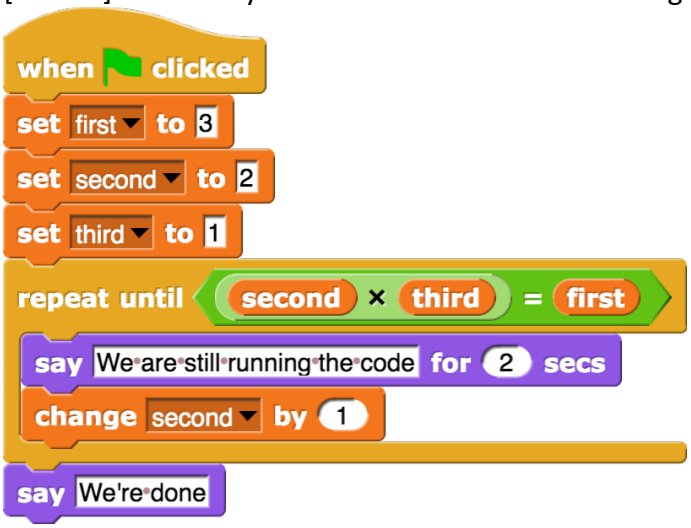
1. [1 mark] How many variables are in this code snippet?

2. [2 marks] What are the final values for each of the variables in the code snippet above?

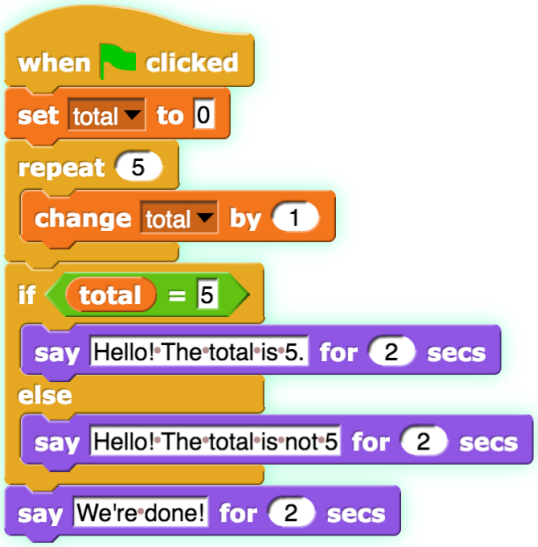
3. [2 marks] Use one to three sentences to describe the purpose of the code snippet. We are NOT looking for a line by line description of what this code is doing. What is this code snippet trying to achieve as a whole?



4. [1 mark] How many times does “We are still running the code” appear on screen?



5. [2 marks] Which words will appear on the stage when this code snippet is run?



6. [1 mark] What will the arrow sprite look like on the stage after the following code snippet is run?

The rectangle below represents the stage you see when you run Snap!. Draw what the stage would look like after the code snippet is run. The sprite will start in the middle of the stage (think back to how the sprite looked when you first started Snap! in the lab).

Problem 3: Algorithms [17 marks]

1. [4 marks] Albert has invented a new language called Gatadebasldf. He has given some translations below that demonstrate how this language works.

English	Gatadebasldf
Almond	Dnomlay
Apple	Elppay
Beet	Teebay
Carrot	Torracay

Write an algorithm that will translate English to Gatadebasldf.

2. [3 marks] Mona and Anna are secret agents and are trying to pass messages to each other through leaving notes in a box. Note that this box is magical and cannot be stolen by enemy agents (the box will run away and go back to Mona and Anna).

To avoid having their message tampered with, Mona and Anna have come up with a great message passing algorithm by using one box and two locks (Mona and Anna only know the combination to their own lock).

Write down an algorithm that Mona and Anna can use to exchange messages.

3. Clarissa is sorting 200 midterms by numerical order. The exams have numbers ranging from 100 to 300. Unfortunately, as she was carrying the exams, she dropped them down the stairs. After gathering the exams back up in the box, she needs to figure out how to resort them quickly.

   Here are two algorithms that she can potentially use to resort the exams. It does not matter if the exams are sorted from largest exam ID to smallest or vice versa.

   Assumptions for this question:
   - You have access to a genie that gives you as many boxes as you need
   - Each box can hold as much or as little as you need it to
   - You have a magical table that stretches to become as long as you need it to be

   Algorithm 1:
   1. Take each exam and put it in a box based on the leftmost number of the exam ID.
   2. Take each box from step 1 and sort the exams into another box based on the number to the right of what you used in step 1.
   3. Repeat step 2 until there is only one exam in a box.
   4. Put the exams back in order by going through each box.

   Algorithm 2:
   1. Put each exam in a box and lay them all beside each other.
   2. Starting from the first box on your table (let's call it box A), compare the exam ID with the exam in the box next to it (let's call it box B).
      a. If the exam ID in box A belongs after the exam ID in box B, swap the exams.

         For example, if the exam ID in box A is 510 and the exam ID in box B is 500 and we wanted to sort from the smallest ID to the largest, we would want to put exam 500 in box A and exam 510 in box B.
   3. Shift your focus over to the next box and compare that with the box next to it. Box B now becomes box A and the box next to box B (what was box C in step 2) becomes box B.
   4. When there are no more boxes left to compare, go back to the first box and repeat steps 2-3.
   5. Repeat steps 2-4 until you no longer need to swap exams when going through the line of boxes.
   6. Put the exams back in order by going through each box.

a. [2 marks] Which algorithm requires the use of more boxes? Justify your answer with 2-3 sentences. Anything longer than that will not be graded.

b. [2 marks] Which algorithm will take more comparisons to sort? Justify your answer with 2-3 sentences. Anything longer than that will not be graded.

c. [2 marks] Which is the worst possible order for the exams to be in when it comes to the number of comparisons needed for algorithm 1? Why?

d. [2 marks] Which is the worst possible order for the exams to be in when it comes to the number of comparisons needed for algorithm 2? Why?

e. [2 marks] Which algorithm would you recommend to Clarissa? Why?

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Problem 4: Algorithms and Bias [6 marks]

1. Algorithms are increasingly used to recommend jobs to people. For example, websites like LinkedIn will collect data about you and based on that data, it will present jobs that it thinks would be suitable.

    a. [2 marks] List a decision that could be made that would be the result of conscious bias and say why.

    b. [2 marks] List a decision that could be made that would be the result of unconscious bias and say why.

2. [2 marks] Consider an algorithm that decides what ads to show someone as they are browsing the web. Using terms discussed in class and in the readings, state why the programmers may want to consider sensitive information in their algorithm.

Problem 5: Internet [11 marks]

1. [4 marks] Neatly label the parts that make up the following URL.

   http://phdcomics.com/comics/archive.php

2. [1 mark] What information does the "/comics/archive.php" portion of the URL tell us?

3. [1 mark] When we simulated the Internet in class (the activity where we all wore party hats), how did we ensure that a message can be reconstructed by the person receiving the message (partner B)?

4. [4 marks] Draw the hierarchy for the following URLs.
   http://www.google.com
   http://cbc.ca
   http://cs.ubc.ca
   http://www.cs.ubc.ca
   http://www.ugrad.cs.ubc.ca

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