CMPUT 201 (Fall 2017)
Midterm Examination: Version 1
October 23, 2017

Department of Computing Science
University of Alberta

Instructor: G. Lin

Time: 50 Minutes

Your name (last, first): _____

Your student ID (last 4 digits): __ __ __ __

- Read these instructions and wait for the signal to start.
- **Do NOT detach** any page from the staple, 4 physical pages in total.
- There are 4 problems; 12 (+1 bonus) marks in total.
- Use space below/beside the questions to write your solutions legibly.
- No electronic devices, no calculators, no conversations.
- Closed book; one letter-size paper with hand-written notes allowed.
- In general, no questions will be answered during the exam; if unsure, state your best assumptions clearly and proceed.
- When the time (50 minutes) is up, please pass your papers to the middle aisle.

Do NOT write on this page, for instructor's use only.

total marks	problem	your marks
3	1	
3	2	
3+1	3	
3	4	
13		

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Problem 1 (3 marks total; 1 mark per question)

Consider the following C program that reads in two integers and two floating point numbers. Assume it has been compiled using:

```
ghlin@innisfree:~/CMPUT201_17F>gcc -Wall -std=c99 mq1.c -o demo

ghlin@innisfree:~/CMPUT201_17F>cat -n mq1.c
     1  #include <stdio.h>
     2
     3  int main(void) {
     4
     5          int i = 5, j = 6;
     6          float x = 7, y = 8;
     7
     8          printf("Enter values for i, x, j, y: ");
     9          printf("scanf() reads in %d values: ", scanf("%d %f %d %f", &i, &x, &j, &y));
    10          printf("i = %d,  x = %f, j = %d, y = %f\n", i, x, j, y);
    11
    12          return 0;
    13  }
    14  /* end of main */
```

Fill in the following missing values from running the program:

1. ```
   ghlin@innisfree:~/CMPUT201_17F>./demo
   Enter values for i, x, j, y: +1+2+3+4
   scanf() reads in ______ values: i = ______,  x = ______, j = ______, y = ______
   ```

2. ```
   ghlin@innisfree:~/CMPUT201_17F>./demo
   Enter values for i, x, j, y: .1.2.3.4
   scanf() reads in ______ values: i = ______,  x = ______, j = ______, y = ______
   ```

3. ```
   ghlin@innisfree:~/CMPUT201_17F>./demo
   Enter values for i, x, j, y: 1e2e3e4
   scanf() reads in ______ values: i = ______,  x = ______, j = ______, y = ______
   ```
   ```

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Problem 2 (3 marks total; 1 mark per question)

In C99 standard, a floating point number (type `float`) is stored in 4 bytes: the first bit is the *sign*, the next 8 bits are the *exponent*, and the rest 23 bits are *fraction*.

1. Write the decimal number 37.3125 in binary system:

   _____._____

2. Fill in the machine format (i.e. how this number is stored in the memory) in the following 32-bit storage:

3. What is the floating point number in decimal system with its machine format shown in the following:

   _____._____

0	0	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

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Problem 3 (3+1 marks total; 2 marks for correctness, 1 mark for satisfying requirements; 1 bonus mark for least memory and least comparisons)

Write a C program that finds the second largest of the four integers entered by the user. Requirements:

1. Must have the following appearance (assuming the user enters correctly four integers):

```
Enter four integers: 21 43 1 35
The second largest: 35
```

2. At most 50 lines of code. *[Each line contains at most one statement.]*

3. Inside your code, you should use ≤ 4 `int`-type scalar variables, and you should try to use the least possible; similarly, you should use ≤ 12 comparison operations, and you should try to use the least number of comparison operations.

   [Each element of an array is considered as a scalar variable.]

   What is the total number of bytes of memory you request in your code?

   ☐

   What is the maximum number of comparison operations your program performs?

   ☐

   Compose your code below and continue on to the back:

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Problem 4 (3 marks total; 1 mark per question)

Consider the following C program that reads in two positive integers called "white" and "black". Assume it has been successfully compiled using "`gcc -Wall -std=c99`".

```
ghlin@innisfree:~/CMPUT201_17F>cat -n mq4.c
     1  #include <stdio.h>
     2  #include <stdlib.h>
     3  #include <time.h>
     4
     5  int main() {
     6          int white, black;
     7          int i, j;
     8
     9          printf("Enter two positive integers for white and black: ");
    10          scanf("%d%d", &white, &black);
    11          printf("white = %d, black = %d\n", white, black);
    12          srand((unsigned) time(NULL)); /* seed the random number generator */
    13          while (white + black > 1) {
    14                  i = rand() % (white + black);
    15                  j = rand() % (white + black - 1);
    16                  if (i < white) j++;
    17
    18                  if (i < white && j < white) {
    19                          white -= 2;
    20                          black += 1;
    21                  }
    22                  else
    23                          black -= 1;
    24          }
    25          printf("white = %d, black = %d\n", white, black);
    26
    27          return 0;
    28  }
```

1. Will the `while`-loop be infinite? _____

2. State one-line reason to support your answer in the above:

3. Suppose your program terminates at user input "`99 101`". Fill in the missing values from the last `printf()`":

   `white = ____, black = ____`