

Wesleyan University, Fall 2022, COMP 211

Homework 1: Information Representation

Due by 11:59pm on September 14, 2022

1. WRITTEN PROBLEMS (15 POINTS)

PROBLEM 1. *This problem reviews the basics of binary.*

- (1) *What is the binary for the decimal numeral 255, using 8 bits?*
- (2) *What is the binary for the decimal numeral 127, using 8 bits?*
- (3) *What is the binary for the decimal numeral 126, using 8 bits?*
- (4) *What is the most significant bit in the binary numeral 10010000?*
- (5) *What is the least significant bit in the binary numeral 10010000?*
- (6) *What decimal numeral is represented by the binary numeral 10010000?*

Solution:

- (1) 11111111
- (2) 01111111
- (3) 01111110
- (4) 1 (or leftmost bit)
- (5) 0 (or rightmost bit)
- (6) 144

PROBLEM 2. *Consider the following sequence of bits (spaces have been inserted spaces for readability, but have no meaning).*

01101000 01101001 00100001 01100001 01101100 01101100 11110100 00100001

- (1) *Suppose each byte above is the ISO-88591 encoding of a character. Using the table of ISO-88591 characters at https://www.w3schools.com/charsets/ref_html_8859.asp what do the characters spell out?*
- (2) *Suppose the seventh byte is the 8-bit signed base-2 representation of the integer x . What is the signed base-10 representation of x ? Now suppose the seventh byte is the 8-bit unsigned base-2 representation of x . What is the signed base-10 representation of x ?*
- (3) *Suppose the seventh byte is the 8-bit twos-complement representation of the integer x . What is the signed base-10 representation of x . Explain your calculation.*

Solution:

- (1) The characters spell out `hi!allô!`. Note that there are no space characters in this sequence.
- (2) If the seventh byte is the 8-bit signed base-2 representation of the integer x , then the signed base-10 representation of x is $-(64+32+16+4) = -116$. If the seventh byte is the 8-bit unsigned base-2 representation of x , then the signed base-10 representation of x is $(128+64+32+16+4) = 244$.
- (3) Since the most significant bit of the seventh byte is 1, the seventh byte represents a negative number. To determine the absolute value of x , we can reverse the steps used to obtain a twos

```

/* A program to compute the sum of the integers from 1 to max where
 * max is an integer specified by the user.
 */

#include <stdio.h>

int main(void)
{
    int sum = 0; // Stores the sum of the integers
    int max = 0; // User-entered max integer to sum to
    int i = 1;

    printf("Enter the maximum integer to sum until: ");
    scanf(" %d", &max);

    // Compute sum of integers from 1 to max
    for (i = 1; i <= max; i++) {
        sum += i;
    }

    printf("Sum of integers from 1 to %d: %d\n", max, sum);
    return 0;
}

```

FIGURE 1. A program to compute the sum of integers from 1 to some maximum integer.

complement representation. First, subtract 1 to get 11110011. Then take the complement by flipping the bits to get 00001100. This represents $(8 + 4) = 12_{10}$, so the signed base-10 representation of x is -12.

2. CODING PROBLEMS (5 POINTS)

PROBLEM 3. *The purpose of this problem is to get you to type in a C program and to run it. You may not understand all of the details of what is happening in the program: do not worry about this, the goal is simply to start giving you some familiarity with the C programming language. You may wish to wait to do this problem until after the lab on Wednesday, September 8th which will give you some familiarity with working with directories, files, and the command-line terminal.*

Open a file, `hw1.c` and type in the program in Figure 1 by hand. Save the file. Now in a terminal, making sure you are in the same directory as the file, type `gcc hw1.c -o hw1`. This will compile the file `hw1.c` into the executable `hw1`. Make sure that after `-o` you put the name of the file you would like the executable to be stored in, not the name of the `.c` file, otherwise you will overwrite your `.c` file. Run this executable by typing `./hw1` in the terminal, again in the same directory as the `hw1` executable and the `hw1.c` file. Try your program out: what is the sum of the integers from 1 to 20? Play around with the program: add a line within the for loop to print out the values of i and sum at each iteration.

3. SUBMISSION

Upload your written work as `hw1.pdf`, and your code solution as `hw1.c`, to the Google Drive directory I have created for you named `comp211-f21-USERNAME/hw1/`. You should replace `USERNAME` with your Wesleyan username.

Do not forget that your written work must be submitted as a PDF! And make sure that at the top of each file you have put your name! Do not, however, change the names of the files.