

CS344 Lab 1 – Integer Overflow/Underflow

Due: 9/2/09

Points: 10

Purpose

To understand how underflow and overflow can occur in FORTRAN.

Process

In this lab we will examine how underflow and underflow can occur. We will learn alternative techniques to display numbers and declaring integers.

The number of bytes allocated for an integer can be controlled by using the integer keyword followed by an * and then by an integer constant. The integer constant determines the size of the integer. In the following example, num1 is allocated 2 bytes, num2 is allocated 4 bytes, and num3 is allocated 8 bytes.

```
integer*2 num1
integer*4 num2
integer*8 num3
```

One variation of the PRINT statement uses a corresponding FORMAT statement to control how the variables of the PRINT statement are to be displayed. The number used after the PRINT keyword specifies the number of the FORMAT statement to use. The FORMAT statement consists of a set of parentheses which contain fields separated by commas. Each field has a specific meaning. In this example the variable, count, is displayed twice. The first time it is displayed in the I field and the second time in the Z field.

```
PRINT 10, count, count
10 format(1X,I12,Z10)
```

The X field causes one or more spaces to be displayed. The number preceding the X is the number of spaces to display. The I field is used to specify that an integer is to be displayed. Likewise the Z field it is used to display the number as a hexadecimal value. The numbers following these fields specify the width of the output fields. For a count value of 20 the results of the PRINT statement follows:

```
20          14
```

Step 1

Create a FORTRAN program that declares an integer that is allocated 4 bytes. Initialize this variable to 0.

Use an integer declaration to declare a 4 byte integer called MAX_INT and then use the parameter statement to assign it the largest positive integer value for a 4 byte integer (2147483647). Declare and assign a 4 byte integer, MIN_INT, to the smallest value possible (-2147483648).

Display these values with appropriate labels similar to the following:

```
COUNT:           0
MAX_INT:    2147483647
MIN_INT:   -2147483648
```

Step 2

Assign MAX_INT to the count and then display its value in decimal and hex. Increment the variable by one and then display its value in decimal and hex again. You will notice that overflow has occurred.

Step 3

Assign MIN_INT to count and then display its value in decimal and hex. Decrement the variable by one and then display its value in decimal and hex again. You will notice that underflow has occurred.

Questions

1. Did the FORTRAN program continue executing when overflow and/or underflow occurred?

What if any problems can you envision with this behavior?

What To Turn In

In a Word document, add a Lab 4 title and your name. Next, copy your program and paste it into the document. Highlight the code and display it using Courier font. Add a header indicating that your output follows and then insert your output highlighted and in Courier.

Next, copy and answer the question part of this lab to the document. The basic format will be as follows:

Lab 4 **Your name**

Code:

```
...  
    COUNT = MAX_INT  
    PRINT 20, ...  
...
```

Output:

```
COUNT:           0  
MAX_INT:  2147483647  
MIN_INT:  -2147483648  
...
```

Questions

1. Did the FORTRAN program continue executing when overflow and/or underflow occurred?

In my esteemed opinion ...

What if any problems can you envision with this behavior?

It is intuitively obvious to the casual observer that ...

Turn this document in.