# CMPE-250 Assembly and Embedded Programming

## Laboratory Exercise 2

## Basic Arithmetic Operations

By submitting this report, I attest that its contents are wholly my individual writing about this exercise and that they reflect the submitted code. I further acknowledge that permitted collaboration for this exercise consists only of discussions of concepts with course staff and fellow students. Other than code provided by the instructor for this exercise, all code was developed by me.

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Andrei Tumbar
09-14-20

Lab Section: 5
Instructor: Melton
TA: Tianran Cui
Anthony Bacchetta

Lecture Section: 1
Lecture Instructor: Melton

## Results

Screen captures were taken for two different input sets. The variable memory is divided into 4-byte signed decimal values. The first two values are `P` and `Q`. The next three are `F`, `G`, and `Result` respectively.

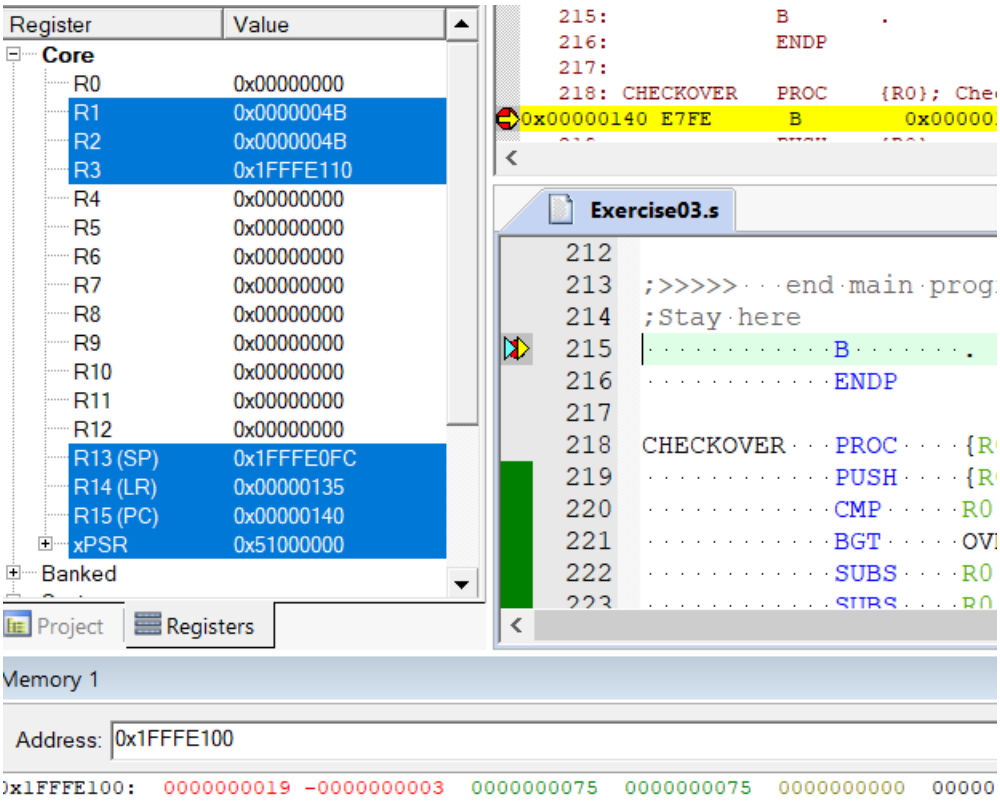


Figure 1: Debugger results after program execution with first input set.

Figure 1 shows the register values and memory contents after execution with the first input set where $P = 19_{10}$ and $Q = -3_{10}$

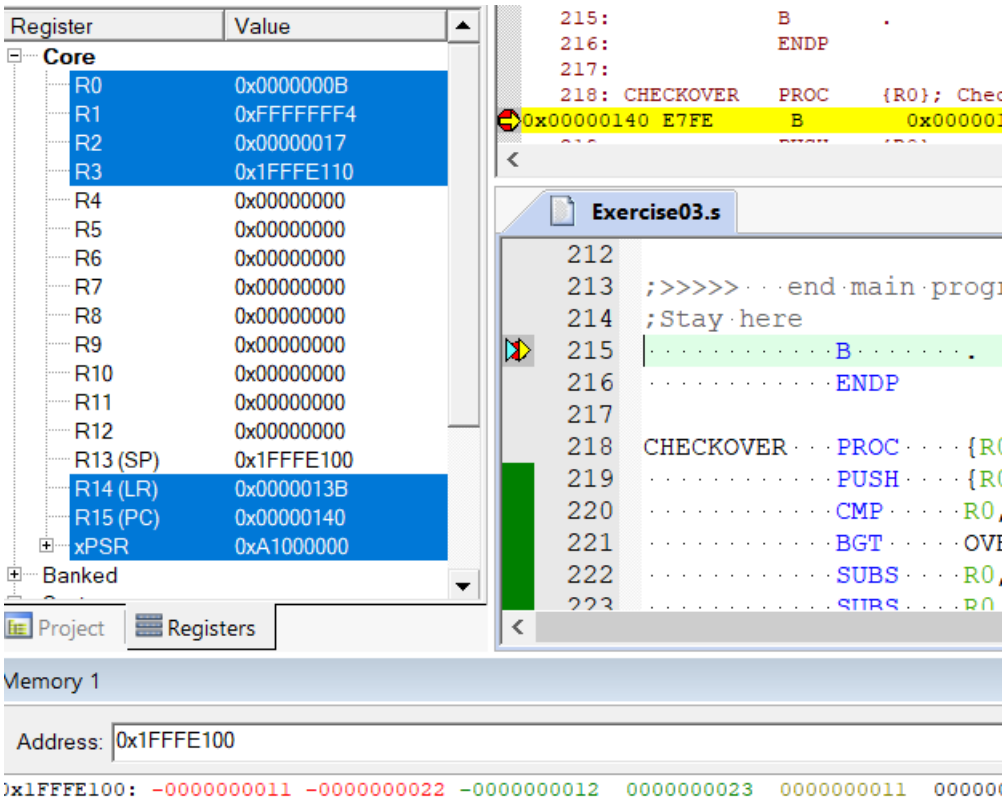


Figure 2: Debugger results after program execution with second input set.

Figure 2 shows the register values as well as memory contents after the second input set where $P = -11_{10}$ and $Q = -22_{10}$.

According to prelab calculations, in the first input set `F` and `G` should both be $75_{10}$ which would case `Result` to overflow. Figure 1 shows the `Result` variable with a value of 10 and `F` and `G` both have $75_{10}$ indicating that the results were correct.

Similarly, for the second input set, prelab calculations revealed $F = -12_{10}$, $G = 23_{10}$, and $Result = 11_{10}$. This is corroborated by the results shown in Figure 2.

## Question

In theory you could reduce the overflow of the calculations if the overflow occurs in one of the intermediate steps. For example in the expression $G = 3P - 2Q + 12$, $G$ would overflow if $3P$ was out of range of $[-128, 127]$ even the final result could still be within that range. To reduce this overflow, the order of operations can be changed like so:

$$G = P + 2 \cdot (P - Q) + 12 \tag{1}$$

This alternate equation would stop overflow in intermediate steps but would obviously not avoid it if the result were to overflow.