CS254 Computer Organization and Assembly Language	October 13, 2016
Homework 6	

There are three programming questions for you to do. Please submit four `.s` or `.asm` files. In the settings for SPIM, as usual use a bare machine with no exception handler, and also choose "Enable Delayed Loads" and "Enable Delayed Branches". This simulates a more realistic machine with a pipelined architecture.

1. (3 points) Evaluate the expression:

   $$27xy + 16x - 12y + 55$$

   Use symbolic addresses **x**, **y**, and **answer** in the data section. Assume that the values are small enough so that all results fit into 32 bits. Since load delays are turned on in SPIM be careful what instructions are placed in the load delay slot. The result of the evaluation should be stored into the memory location with label "**answer**".

   You can verify the correctness of your program by trying different values for x and y in the data section. When you hand in your solutions, you only need to leave one value for each of x and y.

2. (3 points) Evaluate the polynomial:

   $$15x^3 - 9x^2 + 10x + 24$$

   Get the value for x from symbolic addresses **x**. Store the result at symbolic address **poly**. Assume that the values are small enough so that all results fit into 32 bits. Since load delays are turned on in SPIM be careful what instructions are placed in the load delay slot.

   Evaluate the polynomial by using **Horner's Method**. This is a way of building up values until the final value is reached. First, pick a register, say $7, to act as an accumulator. The accumulator will hold the value at each step. Use other registers to help build up the value at each step.

   - First, put the coefficient of the first term into the accumulator: 15
   - Next, multiply that value by x: $15x$
   - Add the coefficient of the next term: $15x - 9$
   - Next, multiply that sum by x: $15x^2 - 9x$
   - Add the coefficient of the next term: $15x^2 - 9x + 10$
   - Next, multiply that sum by x: $15x^3 - 9x^2 + 10x$
   - Finally, add the coefficient of the last term: $15x^3 - 9x^2 + 10x + 24$

   Evaluating the polynomial in this way reduces the number of steps (and the amount of code).

3. (4 points) Evaluate the following polynomial using Horner's method:

   $$ax^3 + bx^2 + cx + d$$

Now the values for the coefficients a, b, c, d as well as for x come from the .data section of memory:

```
    .data
x: .word 1
a: .word -7
b: .word 15
c: .word -32
d: .word 25
```

Load a base register with the address of the first byte of the .data section. Calculate (by hand) the displacement needed for each of the values in memory and use it with a `lw` instruction to get values from memory. You also should store the result of the evaluation at symbolic address **poly**.