CS 254 PROGRAMMING ASSIGNMENT #3

Horner's Method

Write a SPIM basic assembly language program that evaluates the polynomial:

$$5x^4 - 2x^3 + 12x^2 - 3x + 10$$

Do this with integer math. Designate register **$16** to play the role of **x** and initialized it using an **addiu** instruction. Do this at the start of the program so changing values of **x** is easy. Remember that **addiu** can load a register with a sign-extended positive or negative integer. Use register **$23** to accumulate the result. When the program is finished, **$23** should hold the result.

Assume that the values calculated while evaluating the polynomial are small enough so that they all fit into 32 bits.

Evaluate the polynomial by using **Horner's Method**. (This is required.) This is a way of building up values until the final value is reached. Use register **$23** as the accumulator. The accumulator holds the value at each step. Use other registers to help build up the value at each step.

First, put the coefficient of the highest order term into the accumulator:

5

Next, multiply that value by x (use the **mult** instruction):

5x

Subtract the coefficient of the next term :

5x - 2

Next, multiply that sum by x:

$5x^2 - 2x$

Add the coefficient of the next term:

$5x^2 - 2x + 12$

Next, multiply that sum by x:

$5x^3 - 2x^2 + 12x$

Subtract the coefficient of the next term:

$5x^3 - 2x^2 + 12x - 3$

Multiply that sum by x:

$5x^4 - 2x^3 + 12x^2 - 3x$

Finally, add in the last term, and you are done. Ensure that the correct result sits in **$23**.

$5x^4 - 2x^3 + 12x^2 - 3x + 10$

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Evaluating the polynomial in this way reduces the number of steps (and the amount of code). Multiplication is performed four times in the above. If individual terms were separately evaluated and then added together, ten multiplications would be needed.

To save time and reduce bugs, write and debug each step before moving on to the next. When you reach the final step you should have a working, debugged program.

Using Horner's method is required for this assignment.

Verify that the program works by using several initial values for x. Use x = 1 or x = -1 to start, since this makes debugging easy. Then try some other values.

I will grade your program by running it, and I will edit x to plug in some of my own values. Of course, your program will also be graded on how sensibly it is coded and how nice it looks.

```
## CS 254 Program 3
##
## Compute 5x^4 - 2x^3 + 12x^2 - 3x + 10 using Horner's Method
##
## Programmer:
## Date:
```

Following this, include a register use table. Set SPIM options to the following.

ON Bare machine
ON Enable Delayed Branches
ON Enable Mapped I/O

OFF Load Exception Handler

OFF Accept Pseudo Instructions
ON Enable Delayed Loads

Set these options as specified or SPIM will start up with options you don't want. You *may* have to set the options, close SPIM, and then restart it for the options to have an effect. Use only those instructions that have been discussed in the notes through chapter 14.

Turn in: Your source code file, nicely commented and formatted to professional standards. Be sure that the columns for mnemonics, operands and comments are vertically aligned. Remove all tabs from the source file.

Nearly every line of code will have a comment to its right that explains what it does in terms of the problem.

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