## Lab 06 – Assembly Language for Procedures

Students work in pairs with a triple if there is an odd number attending the lab session.

Learning objectives:

1. Explore the implementation of procedure calls at the machine level by a combination of hardware support (Branch-with-Link LEGv8 instruction) and software conventions for passing arguments and returning results.
2. Gain experience using simulation in zyBook.
3. Gain experience using Compiler Explorer at [godbolt.org](http://godbolt.org/).

Required equipment: Ability to login to a browser on a lab computer and to access our zyBook and godbolt.org.

Due at the end of this lab session.

1. A report of your findings uploaded to Gradescope.

## Grading

To earn 20 points, show your final Lab Notebook file to your TA, then save to PDF, and upload to Gradescope.

## Instructions

Open a text document to contain your observations during this lab. Use a document editing application from which you can save a PDF file for upload by the end of lab to Gradescope.

First, Title the document “CS250 Fall 2025 Lab 05 Lab Notebook by”.

Next, enter all team member names and Purdue career account usernames, one student per line.

Task 1: Perform Participation Activity 2.8.1 within our zyBook. Next, copy/paste the left column code into your Lab Notebook. Comment the lines of code for which the next line of code is not the default next line. Now, copy the right column and again comment only those lines of code for which the control flow is not the default next line of code.

Task 2: Copy/paste the C code of the procedure

long long int leaf\_example (long long int g, long long int h, long long int i, long long int j)

in Example 2.8.1 in your zyBook into the left half screen (replacing the square() function) of the Compiler Explorer project available at <http://godbolt.org/> . The minus sign for the subtract operation does not seem to copy to the correct ASCII character in the Compiler Explorer, leading to a compiler error. Select the minus sign and retype it using the minus (hyphen) character from your keyboard. The compilation error should clear. Compiler Explorer by default starts with C++ and Intel/AMD X86 assembly languages. Change the left half screen to the C language and the right half screen to the *armv8a clang (trunk)* compiler for the remainder of the tasks in this lab. Note: compiler choices are ordered by architecture name alphabetically and within an architecture by increasing datapath width. Note: the ARM compilers will output ARM assembly language which has some differences from LEGv8 assembly.

Examine the Compiler Explorer display closely, there is much information displayed. Feel free to discuss with students outside your team (forming a meta-team) if you wish. See if you can discover answers and record them in your lab notebook to the following questions (feel free to copy/paste from this instructions document into your lab notebook.

1. What do the colors of the backgrounds in the left and right half screens mean?
2. Which labels in the C program show up in the assembly language?
3. What other parts of the C program are shown to be related to line(s) of the assembly language? (How many of these graphical linkages can you find?)
4. What happens when you add the comp0iler flag -O for optimize?
5. What additional information is displayed when you select Output, Compile to Binary Object?
6. Do you disagree with some portion of the response provided when for the right half screen you select + Add new… and choose Claude Explain?

Task 3: Repeat Task 2 but copy/paste the zyBook code for Example 2.8.2, *long long int fact (long long n)*.

Task 4: Repeat Task 2 but copy/paste the zyBook code in the Elaboration, near the chapter end, for function *long long int sum (long long int n, long long int acc)* .

Show your TA your Lab Notebook file when you have completed Tasks 1 through 4. Make sure your lab attendance was recorded.

Save your Lab 05 Notebook file as a PDF and upload to the CS250 site in Gradescope. Do not bother to tell Gradescope about number of pages in your PDF.