# Binary Instrumentation with PIN/Valgrind

Definition: You studied MIPS ISA during the computer organization lecture. Now, it is time to do some experiments with X86 ISA, which is the instruction set in your computers. For this task, you will use PIN Binary Instrumentation Tool:

* + <https://software.intel.com/en-us/articles/pin-a-dynamic-binary-instrumentation-tool>

PIN allows you to collect runtime information about any application compiled and running on an X86 computer. In this homework, you will instrument simple matrix multiplication application. You can directly download the application from the following link: <https://people.sc.fsu.edu/~jburkardt/c_src/matmul/matmul.html>

**Task1:** Count the total number of instructions in the application. Also answer if this number is for macroinstructions or microinstructions.

**Task2:**

In the ISAs, there are three classes of machine instructions:

- Memory Instructions (ie. Loads and Stores)

- Branch Instructions (ie. Jumps, Branches etc.)

- Arithmetic and Logic Instructions (ie. Add, Sub, Mul, Div, Shift, And, Or etc.)

Count the number of instructions in each class in the matrix multiplication application.

**Task3:** Here is the list of registers and their purposes in X86:

The purposes of each register are as follows:

RAX: Accumulator

RBX: Base index (for use with arrays)

RCX: Counter (for use with loops and strings)

RDX: Extend the precision of the accumulator

RSI: Source index for string operations.

RDI: Destination index for string operations.

RSP: Stack pointer for top address of the stack.

RBP: Stack base pointer for holding the address of the current stack frame.

R8-R15: general purposed registers

Calculate the frequency of usage of each register as a destination register in your application.

**Submission:**

Write your instrumentation code for each task into the same instrumentation file as a .c or .cpp file. Also write a report to explain your code and also put your results for the matrix multiplication application to the report. Submit your code and your report on Canvas for this homework.