CSE 141 Summer 2020 Assignment 1

PID: _____ Name:_____

1. Consider the matrix_init() function

```
#include <stdio.h>
#include <stdlib.h>

void matrix_init(int *a, int dimension)
{
  int i;
  for(i = 0; i < dimension; i++)
  {
      a[i]=0;
  }
  return;
}
```

and answer the following questions

A. Express this function using MIPS assembly language. You may assume that the address of a is passed through $a0 and dimension is passed through $a1. You may assume the compiler uses $t0 to store the value of i. Try to minimize the number of instructions.

B. According to your answer in (A), how many dynamic instructions will be executed if the value of dimension is 512?

C. Please compile the code into x86 assembly using gcc, without any optimization. Please paste the x86 assembly code you get.

D. Please compile the code into x86 assembly using gcc, with flag –O3. Please paste the x86 assembly code you get.

E. If dimension is 512, how many dynamic instructions will be executed with/without optimization?

2. Consider three different processors P1, P2, and P3 executing the same instruction set. P1 has a 3 GHz clock rate and a CPI of 1.5. P2 has a 2.5 GHz clock rate and a CPI of 1.0. P3 has a 4.0 GHz clock rate and has a CPI of 2.2.
   A. Which processor has the highest performance given the same binary?

   B. If the processors each execute a program in 10 seconds, find the number of cycles and the number of instructions of the program running on each processor.

C. We are trying to reduce the execution time by 30% but this leads to an increase of 20% in the CPI. What clock rate should we have to get this time reduction? (use the execution time in part. A)

3. Assume for arithmetic instructions, load/store instructions, and branch instructions, the CPIs are 1, 12, and 5 on a processor, respectively. Also assume that on a program requires the execution of 5 billions instructions, including 60% arithmetic instructions, 30% load/store instructions, and 10% branch instructions. Assume that the processor has a 2 GHz clock frequency.
   A. Find the average CPI when running this program

   B. Calculate the total execution time of the program