CDA 3101: Spring 2019
Homework 1

Total Points: 50
Due: Thursday 02/28/2019, in class (by 4:50 PM)

Submissions are due by the beginning of class on the specified due date. Handwritten or typed solutions are acceptable. If you do write your solutions by hand, please write clearly. If the TA's cannot read your answer, they cannot give you the points.

Late submissions will be accepted with a 10% penalty by 4:50 PM on Friday, 03/01/2019. Late submissions should be turned in in my mailbox or under my door.

You must show how you arrived at the answer and circle your final answer where applicable!

1   Problem 1 - 20 points

The following table shows the number of instructions for a program.

Arithmetic/Logic	Load	Store	Branch	Jump	Total
560	150	75	85	30	900

(a). Assuming that arithmetic and logic instructions take 1 cycle, load and store take 6 cycles each, and branches and jumps 3 cycles each, what is the execution time of this program in a 3.1 GHz processor?

(b). What is the CPI for the program?

(c). If the number of load instructions can be reduced by one third, what is the speedup and the new CPI?

(d). If the number of jump instructions is doubled, is the resulting reduction in speed and the new CPI?

2   Problem 2 - 20 points

Consider three different processors P1, P2, and P3 executing the **same instruction set** with the clock rates and CPIs given in the following table.

Processor	Clock Rate	CPI
P1	1.8 GHz	1.5
P2	2.3 GHz	2.3
P3	3.1 GHz	2.8

(a). Which processor has the highest performance (as defined in class)?

(b). If the processors each execute a program in 15 seconds, find the number of instructions and the number of cycles for each processor.

(c). We are trying to reduce the current time of 15s by 30% but this leads to an increase of 25% in the CPI. For each processor, what clock rate should we have to achieve this time reduction?

(d). Using the results above, explain why it is inappropriate to compare the performance of each processor using the Clock Rate as a lone metric. What are the three key factors that affect performance?

3 Problem 3 - 10 points

For each of the following actions, indicate the translation phase during which the action takes place (preprocessing, compiling, assembling, linking, or loading).

(a). Creating `program.exe` from `main.o` and `myClass.o`

(b). Allocating space for an executable called `test.exe` in memory.

(c). Updating the symbol table entry for scanf (patching external reference).

(d). Including the contents of `#include<ctype.h>`

(e). Placing the symbolic name `malloc` in the symbol table and `call malloc` in the relocation table.

(f). Detecting the semantic error `dblptr = num`, where `num` in an `int` and `dblptr` is a pointer to a `double` array.

(g). Expanding `#define pi 3.14` in the program text.

(h). Translating `i -= 3` to `addi $t0, $t0, -3`.

(i). Detecting the syntax error in `a + 10 = x;`.

(j). Translating `addi $t0, $t0, 5` to 00100001000010000000000000000101