# Cmpe344 Fall 2021 FF34 Experiment #2: Multiplication and Direct Address

In this experiment, you will write a MIPS program which finds the minimum number in a **word** array and saves **the multiplication** of **the minimum number** and **its index** to the memory location at 0x10010070. This array can be of any length and finishes with a special value “0” (it should **not** be considered as an element of the array). If the minimum value is repeated in the array, choose the index of the **first** one for the multiplication. The first item in the array has the index 0.

You have two constraints:

1. You should **not** use any extra memory location,
2. Input values **must** remain the same, though their order can be changed.

You can assume that the given array will be non-empty and that the result of the multiplication will be representable as a signed word; we will ensure these in our test cases.

An example array is given below:

5, 3, 7, -2, 9, 6, 0, 1, 4

Resulting value in the memory (in decimal view):

-6

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| **Please read the questions and the submission details on the following TWO pages!** |
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## Questions

### Question 1

Can you implement your program without using any registers? Explain why.

We cannot implement it since we stored all the values in the registers, otherwise how can we store them? In MIPS, some instructions can be executed only with registers. So we have to use them. Some instructions are just able to look the registers. So we must store the value we want to use to that registers before using the instruction.

### Question 2

Consider two different implementations P1 and P2, of the same instruction set that includes three different classes of instructions namely A, B, and C. P1 has a clock rate of 4.5GHz. P2 has a clock rate of 3GHz. The average number of cycles for each instruction class for P1 and P2 is as follows:

| Class | CPI on P1 | CPI on P2 |
| --- | --- | --- |
| A | 3 | 2 |
| B | 2 | 1 |
| C | 1 | 4 |

The number of instructions executed in a certain program is divided equally among the instruction classes except for class A, which occurs **twice** as often as each of the others. Fill in the table below.

| Average CPI on P1 | 2.25 |
| --- | --- |
| Average instruction execution time on P1 | 2 |
| Average CPI on P2 | 2.25 |
| Average instruction execution time on P2 | 1.3333 |
| Is P2 faster than P1? | YES |
| If P2 is faster than P1, how much faster? | 1.5 times |

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## Demo and Submission

**Make a demo** of your code to an assistant until 12:50, strict.

**Submit the following** to Moodle (for the online participants) or as directed by the assistants (for the on-site participants) until 12:50, strict:

1. **This document** with your answers filled in, with the file name

lab2\_<GROUPID>.docx

1. **Your source code** performing the described operations, with either one of the following file names

lab2\_<GROUPID>.asm  
lab2\_<GROUPID>.txt

E-mail submissions will **NOT** be accepted.