# Homework #1

**Assigned**: 14/03/2023

**Due**: 21/03/2023

1. (**25 pts**) Consider three different processors P1, P2 and P3 executing the same instruction set. Clock rates and CPIs of the processors are given below.

|  |  |  |
| --- | --- | --- |
| Processor | Clock Rate | CPI |
| P1 | 2.0 GHz | 1.0 |
| P2 | 2.5 GHz | 1.25 |
| P3 | 3.0 GHz | 2.5 |

* 1. (**5 pts**) Compute MIPS rates of the processors.
  2. (**5 pts**) The programs C1, C2 and C3 are executed in P1, P2 and P3, respectively. All executions take 5 seconds. Find the number of instructions for each program.
  3. (**15 pts**) The modification to reduce the execution time by 20%, leads to an increase of 20% in the CPI. What should be the new clock rates of the processors to achieve the targeted performance.

1. (**30 pts**) Consider two processors (P1 and P2) are the different implementations of the same ISA. The clock rates of the processors are 2.5 GHz and 3 GHz, respectively. The instructions are divided into three classes according to their CPIs, which are given below.

|  |  |  |
| --- | --- | --- |
|  | P1 | P2 |
| Class A | 1 | 2 |
| Class B | 1.5 | 2 |
| Class C | 3 | 2 |

Given a program with a dynamic instruction count of 106 instructions divided into classes as follows: 40% class A, 35% class B and 25% class D.

* 1. (**10 pts**) What is the global CPI for each implementation?
  2. (**10 pts**) Find the clock cycles required in both cases.
  3. (**10 pts**) Find the execution time in both cases.

1. (**30 pts**) Consider a given benchmark has an instruction count of 2.1 x 1012 and a reference time of 8000s. The execution of the benchmark takes 900 s on a processor with the cycle time of 0.25 ns.
   1. (**10 pts**) Find the CPI of the processor.
   2. (**5 pts**) Find the SPECratio of the processor.
   3. (**15 pts**) Suppose that a new version of the processor with the clock rate of 4.5 GHz is developed. A couple of new instructions have been added to new design and the number of instructions has been reduced by 15%. The SPECratio for the new version is 12. Find the execution time and CPI of the new processor.