

CS214 Computer Organization HW#2

Problem 1.

Consider two different implementations P1 and P2 of the same instruction set architecture. The instructions can be divided into four classes according to their CPI (class A, B, C, and D). P1 with a clock rate of 2.5 GHz and CPIs of 1, 2, 3, and 3, and P2 with a clock rate of 3 GHz and CPIs of 2, 2, 2, and 2 for four classes respectively.

Given a program with a dynamic instruction count of $1.0E6$ instructions divided into classes as follows: 10% class A, 20% class B, 50% class C, and 20% class D, which implementation is faster?

1. What is the global CPI for each implementation?
2. Find the clock cycles required in both cases.

Problem 2.

The results of the SPEC CPU2006 bzip2 benchmark running on an AMD Barcelona has an instruction count of $2.389E12$, an execution time of 750 s, and a reference time of 9650 s.

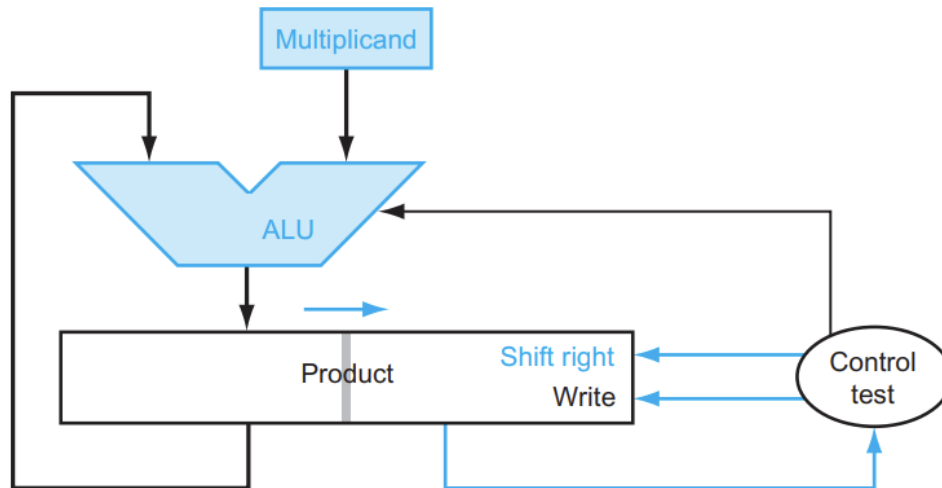
1. Find the CPI if the clock cycle time is 0.333 ns.
2. Find the SPECratio.
3. Find the new CPU time if the number of instructions of the benchmark is increased by 10% without affecting the CPI.
4. Find the new CPU time if the number of instructions of the benchmark is increased by 10% and the CPI is increased by 5%.
5. Find the new SPECratio for this change.
6. Suppose that we are developing a new version of the AMD Barcelona processor with a 4 GHz clock rate. We have added some additional instructions to the instruction set in such a way that the number of instructions has been reduced by 15%. The execution time is reduced to 700 s and the new SPECratio is 13.7. Find the new CPI.

Problem 3.

1. Assume 23 and 112 are signed 8-bit decimal integers stored in two's complement format. Calculate $23 + 112$ using saturating arithmetic. The result should be written in decimal. Show the steps for calculation.
2. Assume 23 and 112 are signed 8-bit decimal integers stored in two's complement format. Calculate $23 - 112$ using saturating arithmetic. The result should be written in decimal. Show the steps for calculation.
3. Assume 23 and 112 are unsigned 8-bit integers. Calculate $23 + 112$ using saturating arithmetic. The result should be written in decimal. Show the steps for calculation.

Problem 4.

Calculate the product of the hexadecimal unsigned 8-bit integers 62 and 13 using the hardware described below. You should show the contents of each register on each step. Use a table to show the detailed process.

**Problem 5.**

Calculate 52 divided by 21 using the hardware described below. You should show the contents of each register on each step. Assume both inputs are unsigned 6-bit integers. Use a table to show the detailed process.

