

CS 301 Assignment 2

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1. Consider two different machines, with two different instruction sets, both of which have a clock rate of 200 MHz. The following measurements are recorded on the two machines running a given set of programs. Determine the effective CPI, MIPS rate, and execution time for each machine.

Table 1: Equations for Machines *A* and *B*

Machine <i>A</i>	Machine <i>B</i>
$CPI = \frac{\sum_{i=1}^n CPI_i \times I_i}{n}$	$CPI = \frac{\sum_{i=1}^n CPI_i \times I_i}{n}$
$CPI = \frac{8 \times 1 + 4 \times 3 + 2 \times 4 + 4 \times 3}{18}$	$CPI = \frac{10 \times 1 + 8 \times 2 + 2 \times 4 + 4 \times 3}{24}$
$CPI = \frac{40}{18} \approx 2.22$	$CPI = \frac{46}{24} \approx 1.92$
$MIPS = \frac{f \times 10^6}{CPI \times 10^6}$	$MIPS = \frac{f \times 10^6}{CPI \times 10^6}$
$MIPS = \frac{200 \times 10^6}{2.22 \times 10^6}$	$MIPS = \frac{200 \times 10^6}{1.92 \times 10^6}$
$T = CPI \times \frac{1}{f} \times I_c$	$T = CPI \times \frac{1}{f} \times I_c$
$T = 2.22 \times \frac{1}{200 \times 10^6} \times 18,000,000$	$T = 1.92 \times \frac{1}{200 \times 10^6} \times 24,000,000$
$T = 0.1998$	

2. Consider the following code:

```
for (i = 0; i < 20; i++)  
    for (j = 0; j < 10; j++)  
        a[i] = a[i] * j
```

(a) Give one example of the spatial locality in the code.

An example of spatial locality in this code can be seen in the array *a*. The data in *a* is stored linearly and accessed sequentially.

(b) Give one example of the temporal locality in the code.

An example of temporal locality in this code can be seen in the line that modifies *a*. This line of code is repetitively accessed in the for loops, lending temporal locality to the instruction and the data accessed in the array *a*

3. What do you mean by CPI, average CPI, and MIPS? Derive the formula for MIPS, in terms of clock frequency and average CPI.