

1. An optimization speeds up ALU operations on a certain computer by a factor of 2.3. ALU operations account for 30% of execution time before the optimization. By how much is the computer's overall execution time speed up by this optimization?

$$\text{speedup} = \frac{1}{(1-0.3) + \frac{0.3}{2.3}} = \boxed{1.2}$$

2. If a cache system has a hit time of 1 cycle to load an instruction, and 1 extra cycle if the instruction has a load or store that hits the cache a miss penalty of 100 cycles, and a miss rate for instruction fetch of 1%, and for data load or store 5%, and if 20% of instructions include a data load/store, what is the average memory access time?

$$\text{fetch} \frac{(0.01) + (0.05) \cdot 0.05}{1 + 0.20} = \frac{0.05}{1.2} \text{ miss/instruction}$$

average
memory
access
time

$$\begin{aligned} & (1/1.20) \times (1 + 0.5 \times 100) \\ & + (0.20/1.20) \times (1 + 1 + 0.5 \times 100) \end{aligned}$$

$$= \boxed{51.16 \text{ cycles}}$$