~~Solution~~

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CPU Time $= \frac{\text{Instruction count}}{\text{clock rate}}$ $f_u = 1.05 f_o$

Unoptimized Instructions $I_{LS,u} = 0.30L$

optimized version $= \frac{2}{3} \times 0.30 = 0.20 L_u$

Other 70% $= 0.70 L_u$

Total Instruction $= 0.20 L_u + 0.70 L_u = 0.90 L_u$

∴ The optimized version executes 90% as many instructions as the unoptimized version.

Execution Times

CPU time $= \frac{I_u}{f_u} \frac{C_o}{f_o} = \frac{0.90 L_u}{f_u}$ but $f_u = 1.05 f_o$

Speed time $= \frac{1}{1.05} \times \frac{1}{0.90} = \frac{1}{0.945} = 1.058$

The optimized version is 5.8% faster than the unoptimized version. The optimized version is faster.

The clock period increases by 5%

New clock period $T' = 1.05T$

$$\frac{\text{New instruction count}}{\text{Old instruction count}} = \frac{1}{1.05} = 0.952$$

Total instruction count reduced to 95.2% of the original

Instruction Type	Percentage
ALU	50%
loads	26%
stores	10%
Branches	14%

Let x be fraction of loads eliminated

$$10x - 26x$$

$$100 - 26x = 95.2$$

$$26x = 4.8$$

$$x = 4.8/26 \approx (0.185) \times 100$$

18.5% of the loads have to be eliminated

∴ At least 18.5% of loads must be ~~eliminated~~ eliminated

∴ A load followed by multiple uses of the loaded register cannot be replaced.