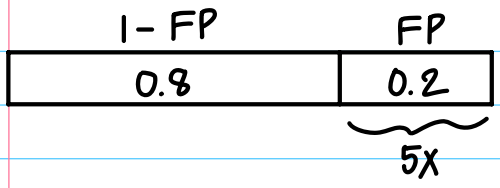
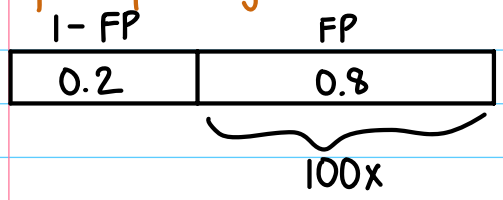
① If Floating point instructions are improved to run 5 times faster, while only 20% of actual instructions are FP, what is the overall speedup after this enhancement?



$$\text{Speedup}_{\text{overall}} = \frac{\text{ExTime}_{\text{old}}}{\text{ExTime}_{\text{new}}} = \frac{1}{1 - \text{Fraction}_{\text{enhanced}} + \frac{\text{Fraction}_{\text{enhanced}}}{\text{Speedup}_{\text{enhanced}}}}$$

$$= \frac{1}{1 - 0.2 + \frac{0.2}{5}} = 1.1905$$

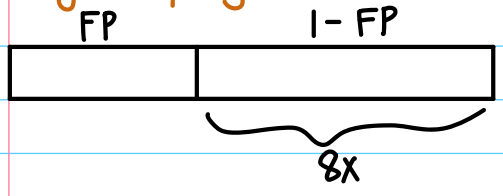
② A program spends 80% time doing computing jobs, and the other 20% time on disk accesses. If we use a 100 times faster CPU, how much speedup we gain?



$$\text{Speedup}_{\text{overall}} = \frac{\text{ExTime}_{\text{old}}}{\text{ExTime}_{\text{new}}} = \frac{1}{1 - \text{Fraction}_{\text{enhanced}} + \frac{\text{Fraction}_{\text{enhanced}}}{\text{Speedup}_{\text{enhanced}}}}$$

$$= \frac{1}{1 - 0.8 + \frac{0.8}{100}} = 4.8077$$

③ Suppose 8x speedup from 10 processors. What fraction at most of the original program can be sequential?



$$\text{Speedup}_{\text{overall}} = \frac{\text{ExTime}_{\text{old}}}{\text{ExTime}_{\text{new}}} = \frac{1}{\text{Fraction}_{\text{enhanced}} + \frac{1 - \text{Fraction}_{\text{enhanced}}}{\text{Speedup}_{\text{enhanced}}}}$$

$$= \frac{1}{F + \frac{1-F}{10}} = 8 \longrightarrow F + \frac{1-F}{10} = \frac{1}{8} \longrightarrow 40F + 4(1-F) = 5$$

$$40F + 4 - 4F = 5$$

$$36F = 1$$

$$F = \frac{1}{36}$$

∴ At most ~ 2.78% of original program can be sequential.