Exercise and Solution on Amdahl's Law

1. What is the overall speedup if you make 10% of a program 90 times faster?
2. What is the overall speedup if you make 90% of a program 10 times faster

- Amdahl's law

$$OverallSpeedup = \frac{1}{(1-f)+\frac{f}{s}}$$

- What is the overall speedup if you make 10% of a program 90 times faster?

$$\frac{1}{(1-0.1)+\frac{0.1}{90}} \approx \frac{1}{0.9011} \approx 1.11$$

- What is the overall speedup if you make 90% of a program 10 times faster

$$\frac{1}{(1-0.9)+\frac{0.9}{10}} = \frac{1}{0.19} \approx 5.26$$

3. We are considering an enhancement to the processor of a web server. The new CPU is 20 times faster on search queries than the old processor. The old processor is busy with search queries 70% of the time, what is the speedup gained by integrating the enhanced CPU?

$$Speedup = \frac{1}{(1-Fraction_{enhanced})\frac{Fraction_{enhanced}}{Speedup_{enhanced}}}$$

$Fraction_{enhanced}$ = 70 % = 0.70
$Speedup_{enhanced}$ = 20

$$Speedup = \frac{1}{(1-0.70)+\frac{0.70}{20}} = \frac{1}{0.335} = 2.985$$

4. We are considering an enhancement to the processor of a server. The new CPU 10X faster. I/O bound server, so 60% time waiting for I/O.

- New CPU 10X faster
- I/O bound server, so 60% time waiting for I/O

$$\text{Speedup}_{\text{overall}} = \frac{1}{(1-\text{Fraction}_{\text{enhanced}})+\frac{\text{Fraction}_{\text{enhanced}}}{\text{Speedup}_{\text{enhanced}}}}$$

$$= \frac{1}{(1-0.4)+\frac{0.4}{10}} = \frac{1}{0.64} = 1.56$$