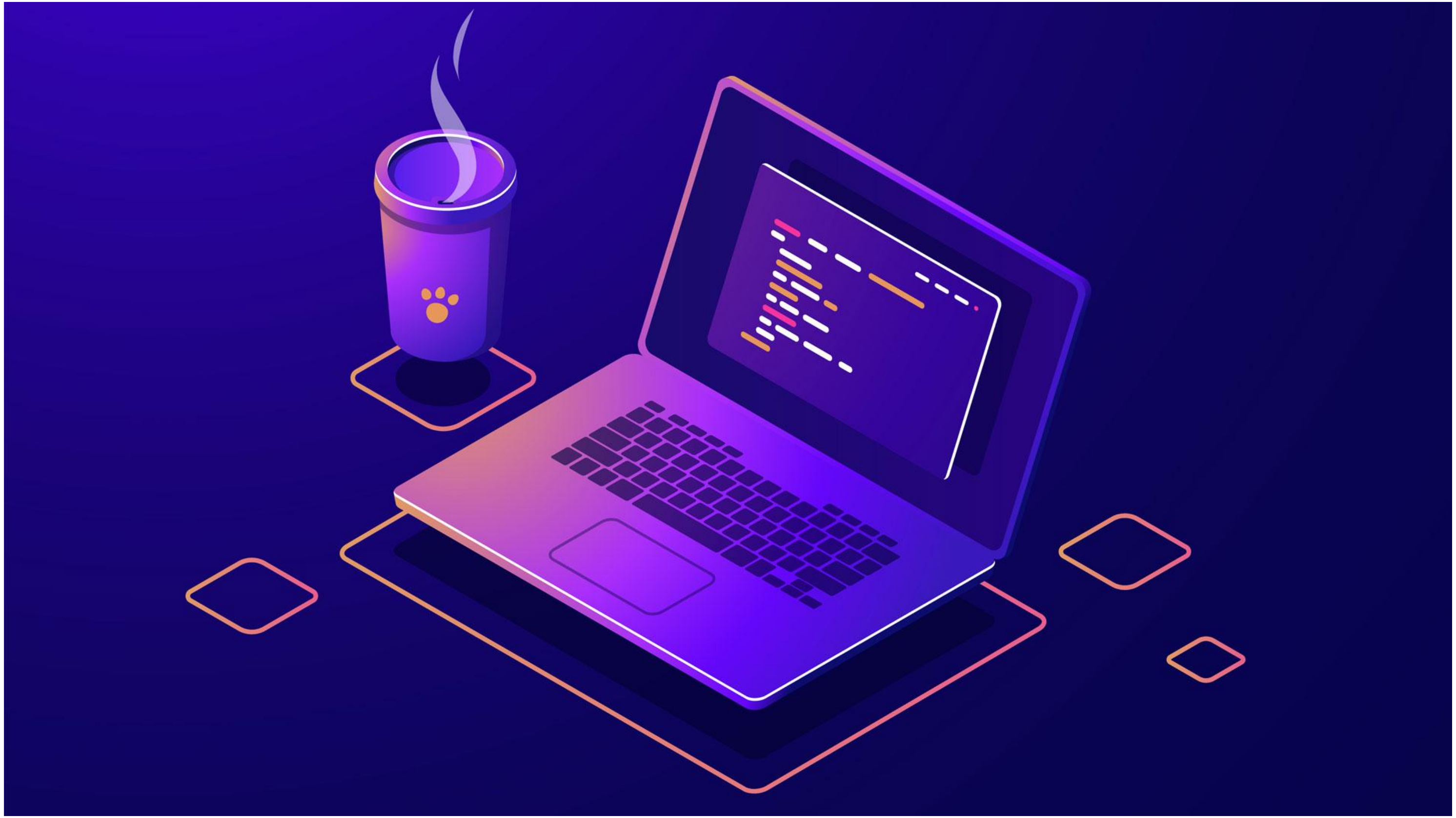
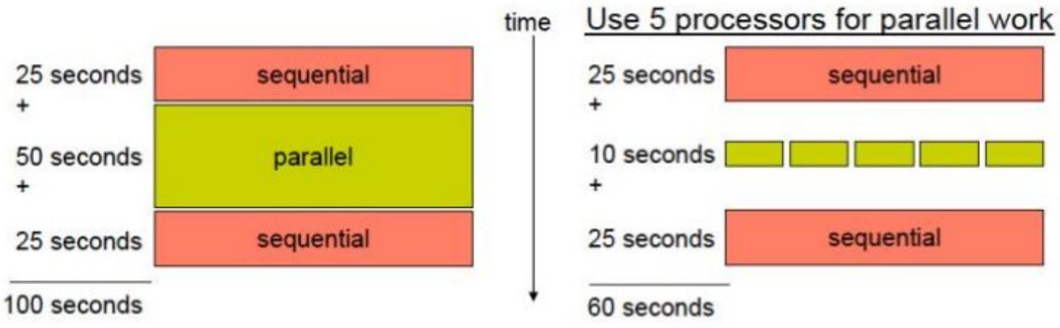
Amdahl's Law



Amdahl's Law

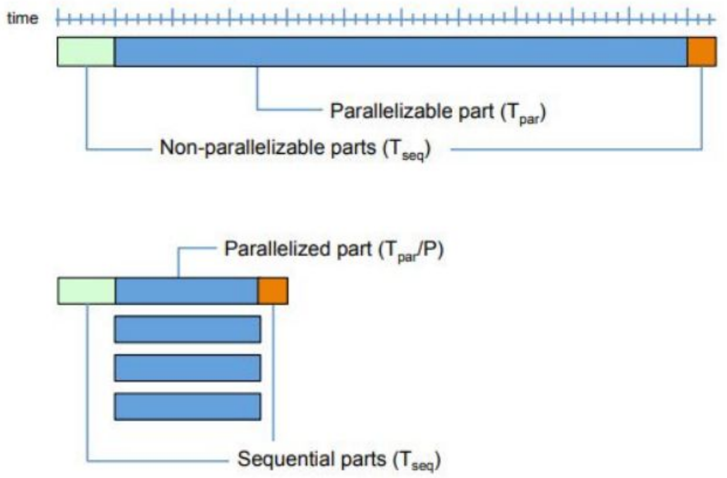
Performance improvement is limited by the fraction of time the program does not run in fully parallel mode



- Parallel part is 5 times faster: $Speedup_{parallel\_part} = 50/10 = 5$
- Parallel version is just 1.67 times faster: $S_p = 100/60 = 1.67$, $E_p = 1.67/5 = 0.33$

Amdahl's Law

Assume the following simplified case, where the parallel fraction φ is the fraction, of total execution time, the program can be parallelized



$$T_1 = T_{seq} + T_{par}$$
$$\varphi = T_{par}/T_1$$
$$T_{seq} = (1-\varphi) \times T_1$$
$$T_{par} = \varphi \times T_1$$

$$T_1 = (1-\varphi) \times T_1 + \varphi \times T_1$$

$$T_P = T_{seq} + T_{par}/P$$
$$T_P = (1-\varphi) \times T_1 + (\varphi \times T_1/P)$$

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Amdahl's Law

From where we can compute the speed–up S_P that can be achieved as

$$S_p = \frac{T_1}{T_p} = \frac{T_1}{(1-\varphi) \times T_1 + (\varphi \times T_1/P)}$$

$$S_p = \frac{1}{((1-\varphi) + \varphi/P)}$$

Two particular cases:

$$\varphi = 0 \rightarrow S_p = 1$$
$$\varphi = 1 \rightarrow S_p = P$$

Amdahl's Law

When $P \to \infty$ the expression of the speed–up becomes

$$S_{p \to \infty} = \frac{1}{(1 - \varphi)}$$

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