Calculation of average waiting time W_{avg}

$$W_{avg} = \frac{1}{n}\left(\sum_{i=1}^{n} T_{wait}(P_i)\right)$$

where

$T_{wait}(P_i)$ is the time P_i sits in the ready queue during its current CPU burst.

Let

$T_{arrive}(P_i)$ – the time P_i arrived to the ready queue

$T_{depart}(P_i)$ – the time P_i completed its CPU burst

$T_{CPUburst}(P_i)$ – the length of CPU burst of P_i

$T_{around}(P_i)$ – the turnaround time of P_i

We have:

$T_{around}(P_i) = T_{depart}(P_i) - T_{arrive}(P_i)$

but also:

$T_{around}(P_i) = T_{CPUburst}(P_i) + T_{wait}(P_i)$

So

$T_{wait}(P_i) = T_{around}(P_i) - T_{CPUburst}(P_i) = T_{depart}(P_i) - T_{arrive}(P_i) - T_{CPUburst}(P_i)$

or

$T_{wait}(P_i) = T_{depart}(P_i) - T_{arrive}(P_i) - T_{CPUburst}(P_i)$

Hence

$\sum_{i=1}^{n} T_{wait}(P_i) = \sum_{i=1}^{n} T_{depart}(P_i) - \sum_{i=1}^{n} T_{arrive}(P_i) - \sum_{i=1}^{n} T_{CPUburst}(P_i)$

Let' a assume that CPU does not idle and T_n is the last process that completed its CPU burst. Then

$\sum_{i=1}^{n} T_{CPUburst}(P_i) = T_{depart}(P_n)$

So,

$\sum_{i=1}^{n} T_{wait}(P_i) = \sum_{i=1}^{n} T_{depart}(P_i) - \sum_{i=1}^{n} T_{arrive}(P_i) - T_{depart}(P_n)$

or

$\sum_{i=1}^{n} T_{wait}(P_i) = \sum_{i=1}^{n-1} T_{depart}(P_i) - \sum_{i=1}^{n} T_{arrive}(P_i)$

Therefore,

$$W_{avg} = \frac{1}{n}\left(\sum_{i=1}^{n-1} T_{depart}(P_i) - \sum_{i=1}^{n} T_{arrive}(P_i)\right)$$

In the case when all the processes arrived at the same time 0 to the ready queue, $\sum_{i=1}^{n} T_{arrive}(P_i) = 0$ and the above formula simplifies to

$$W_{avg} = \frac{1}{n}\left(\sum_{i=1}^{n-1} T_{depart}(P_i)\right)$$