Overlap and Add Method:

Overlap and add method is based on the linearity of the convolution: $y[n] = \left(x_1[n] + x_2[n] + x_3[n]\right) * h[n]$

$$y[n] = x_1[n] * h[n] + x_2[n] * h[n] + x_3[n] * h[n].$$

Let $x[n]$ be a long signal (or it may be streaming): The signal $x[n]$ can be expressed as

$$x[n] = x_1[n] + x_2[n] + x_3[n]$$

where $x_1[n]$ ~~is zero~~ $= x[n]\,w[n] = [x[0], x[1], \dots, x[L-1]]$

$$x_2[n] = x[n]\,w[n-L] = [x[L], x[L+1], \dots, x[2L-1]]$$

and

$$x_3[n] = x[n]\,w[n-2L] = [x[2L], x[2L+1], \dots, x[3L-1]]$$

Notice that $w[n]$ is a window of length L:

$$w[n] = \begin{cases} 1, & n = 0, 1, \dots, L-1 \\ 0, & \text{otherwise.} \end{cases}$$

The convolutions

$y_i[n] = x_i[n] * h[n]$, $i = 1, 2, \dots$

have a length of $L+M-1$; $h[n]$ has a length of M.

We can use $N \geq L+M-1$ length FFT to compute $y[n]$ by computing $y_i[n]$, $i = 1, 2, \dots$

$$y[n] = y_1[n] + y_2[n] + y_3[n] + \cdots \qquad (*)$$

Therefore, the input signal $x[n]$ is divided into windows of length L. After using N-point DFT's we obtain $y_1[n], y_2[n], \dots$

Since the starting points of $y_1[n]$ is 0, $y_2[n]$ is L, $y_2[n]$ is $2L$, the method is called "overlap and add" method.