Example 5-1: Consider a 3-point running average system expressed in the sliding window form of (**??**)

$$y[n] = \sum_{\ell=n-2}^{n} \tfrac{1}{3} x[\ell]$$

with input

$$x[n] = \begin{cases} 1 & 0 \le n \le 10 \\ 0 & \text{otherwise} \end{cases}$$

as plotted in Fig. **??**(a). We refer to this $x[n]$ as a "pulse input" because it is nonzero and constant over a short interval of length 11. The shaded regions in Fig. **??**(a) highlight the three samples of $x[\ell]$ involved in the computation of the output at $n = 0$, $n = 6$, and $n = 14$. These specific cases illustrate how the causal *sliding window* interval of length three scans across the input sequence moving sample-by-sample to produce the output signal. Note the three highlighted samples of the output in Fig. **??**(b) which correspond to the three positions of the averaging interval in Fig. **??**(a). Finally, note that the output is zero when $n < 0$ and $n > 12$ because for these values of n, the averaging interval includes only zero values of the input. Also note that the output for $n = 0, 1, 2$ follows a straight line from 0 to 1 because the averaging interval includes an additional unit sample as it moves to the right over the interval $0 \le n \le 2$. A similar taper occurs at the end of the pulse interval as the averaging interval includes fewer nonzero samples as it moves to the right. The output is constant and equal to one in the interval $2 \le n \le 10$, where the averaging interval includes three samples of $x[n]$ where $x[n] = 1$.

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