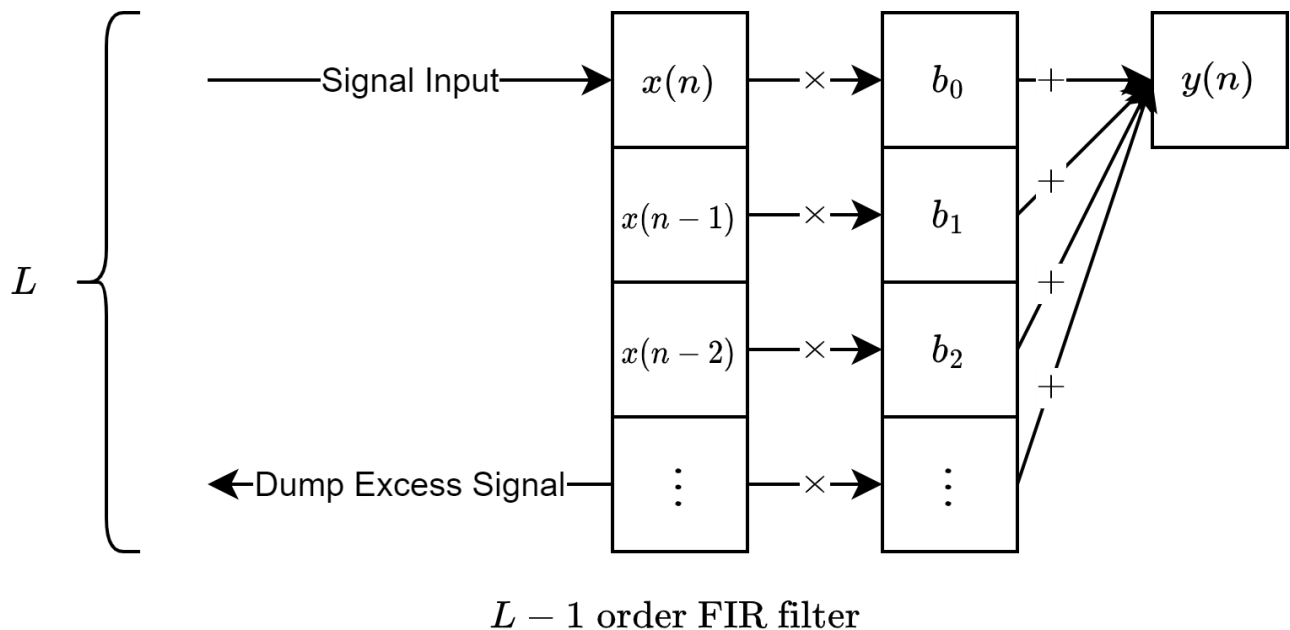


Q1 Filter order and filter length of FIR filter.

Let's assume a FIR system with I/O equation of

$y(n) = b_0x(n) + b_1x(n-1) + \dots + b_mx(n-m)$, which is equal to $y(n) = \sum_{k=0}^m b_kx(n-k)$. This filter has the order of m , and length of $m+1$.

Q2 Visualize signal-flow diagram of FIR filter in different style.



Q3 How to derive the unique equation of MA filter.

MA filter is a specific type of FIR filter, which uses the same coefficient for all elements and weighted at the end. This can be represented with

$$y(n) = \frac{1}{L} \left[x(n) + x(n-1) + \dots + x(n-L+1) \right], \text{ or } y(n) = \frac{1}{L} \sum_{k=0}^{L-1} x(n-k).$$

What is special about this filter is that all coefficients are exactly the same, since all coefficients are 1 in this case. This makes it meaning less to add all elements up in every cycle and results in another equation as $y(n) = y(n-1) + \frac{1}{L} \left[x(n) + x(n-L) \right]$, which add up the newest element and remove the oldest element instead of adding everything up.

Q4 What is the complexity of MA filter.

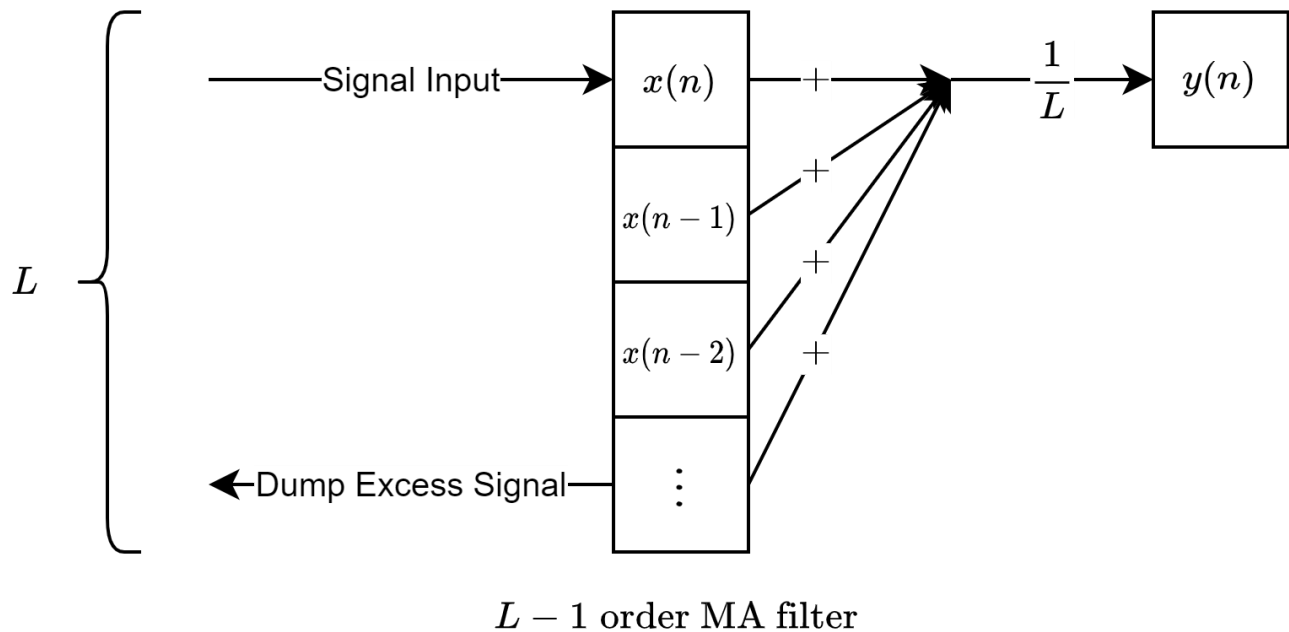
Let's assume 1 machine cycle is needed to add(subtract) up two numbers, and 20 machine cycles are needed to divide.

For the original computation equation ($y(n) = \frac{1}{L} \sum_{k=0}^{L-1} x(n-k)$), the time it takes is $L \times 1 + 20 = L + 20$ machine cycles.

For the less computation expensive equation ($y(n) = y(n-1) + \frac{1}{L} [x(n) + x(n-L)]$), the time it takes is $1 + 20 + 1 = 22$ machine cycles.

The computation expenses difference grows as more elements or orders are needed in the filter.

Q5 Draw signal-flow diagrams of MA filter.



Q6 How to further reduce complexity of MA filter.

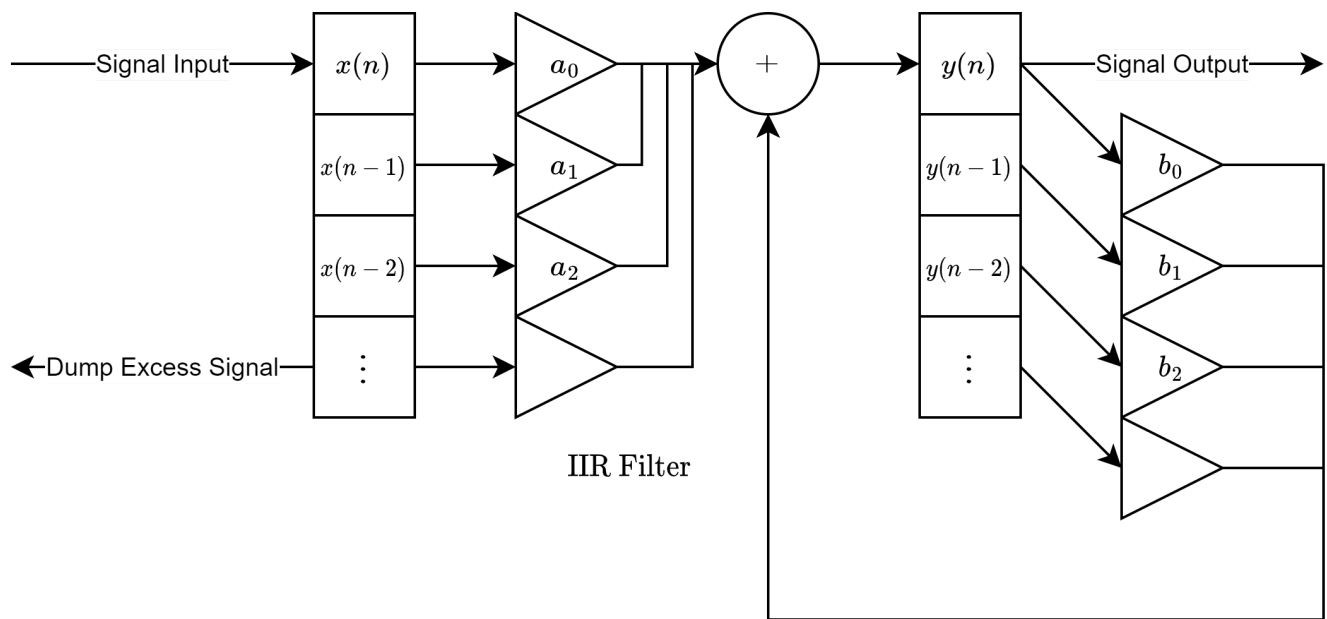
One way is to use multiplication instead of division with pre-calculated coefficient.

Q7 What is the order of IIR systems?

The order of IIR systems is based on the transfer function it correspond to, not with either the input or the feedback coefficients. The oder of the IIR system is equal to the highest power of the complex variable in the transferfunction.

IIR filters are often used when low computational complexity is a requirement, or when it is necessary to achieve very sharp frequency response cutoffs.

Q8 What is the signal-flow diagram of IIR systems?



Q9 Is an MA filter FIR or IIR?

A MA filter is a FIR filter because it does not require feedback signals from system output.

CYEE 10828241 Dachuan Chen