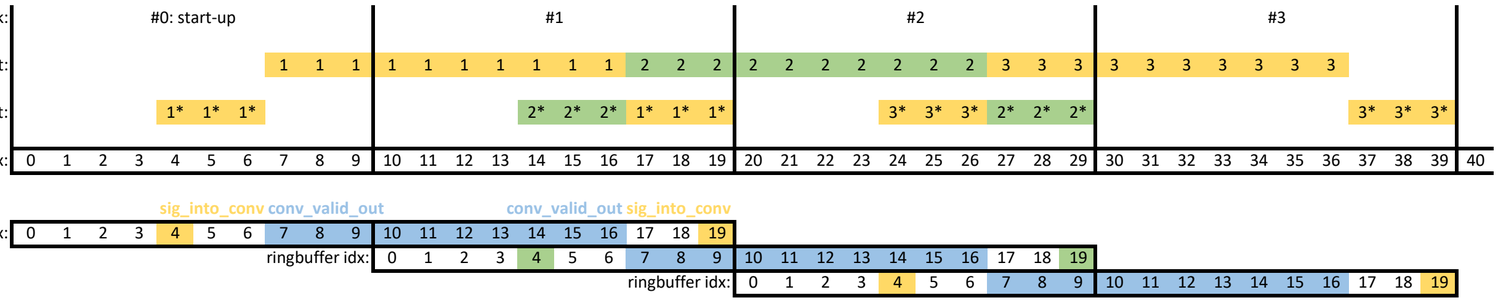
filter output `conv_valid_out` = convolve(ringbuffer signal in, filter tap array, mode='valid') Dennis van Gils, 24-05-2021
`rb` stands for ring buffer

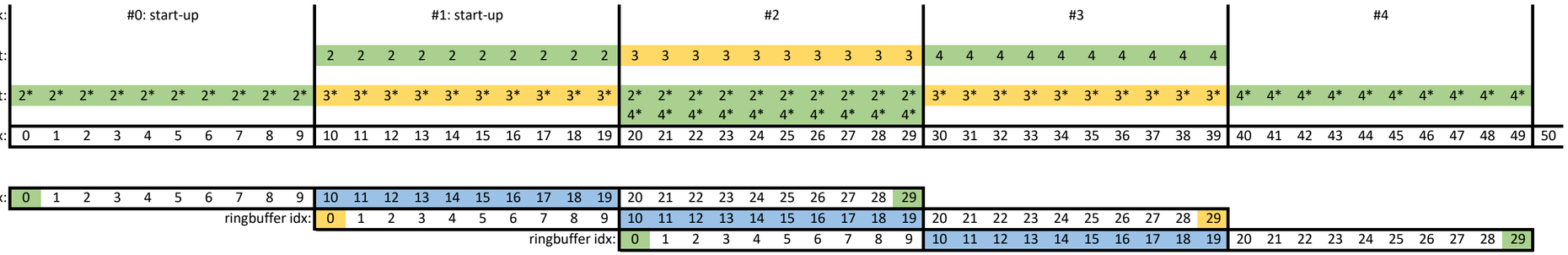
Test scenario 1:
Perform convolve every incoming block, ring buffer is 2x BLOCK_SIZE
Not optimal

BLOCK_SIZE	10	samples	
N_blocks	2	int	
rb_capacity	20	samples	
N_taps	7	samples	== must be odd number
N_sig_into_conv	16	samples	
offset_sig_into_conv	4	samples	
N_conv_valid_out	10	samples	== BLOCK_SIZE
offset_conv_valid_out	3	samples	
idx_rb_valid_start	7	samples	



Test scenario 2:
Perform convolve every incoming block, ring buffer is 3x BLOCK_SIZE
Maximized N_taps given BLOCK_SIZE and N_blocks

BLOCK_SIZE	10	samples	
N_blocks	3	int	
rb_capacity	30	samples	
N_taps	21	samples	== must be odd number
N_sig_into_conv	30	samples	
offset_sig_into_conv	0	samples	
N_conv_valid_out	10	samples	== BLOCK_SIZE
offset_conv_valid_out	10	samples	
idx_rb_valid_start	10	samples	



Optimal scenario:
Perform convolve every incoming block, maximize N_taps given BLOCK_SIZE and N_blocks

Fs	20000	Hz	
BLOCK_SIZE	2000	samples	
N_blocks	21	int	
rb_capacity	42000	samples	= BLOCK_SIZE * N_blocks
N_taps	40001	samples	= BLOCK_SIZE * (N_blocks - 1) + 1 == max that fits using rb_capacity

Fred Harris' approximation — Multirate Signal Processing for Communication Systems, Fredric J. Harris, 2004, page 216, equation (8.16)

f_pass	49	Hz	
f_stop	50	Hz	
filter attenuation	44.00	dB	= N_taps * 22 * ((f_stop - f_pass) / Fs)

N_sig_into_conv	42000	samples	= BLOCK_SIZE + N_taps - 1 == rb_capacity by optimal design
offset_sig_into_conv	0	samples	= rb_capacity - N_sig_into_conv == 0 by optimal design
N_conv_valid_out	2000	samples	= rb_capacity - N_taps + 1 == BLOCK_SIZE by optimal design
offset_conv_valid_out	20000	samples	= INT((N_taps - 1) / 2)
idx_rb_valid_start	20000	samples	= offset_conv_valid_out + offset_sig_into_conv == offset_conv_valid_out by optimal design
T_valid_start	1.00	s	= idx_rb_valid_start / Fs
T_settle_filter	2.00	s	= (N_blocks - 1) * BLOCK_SIZE / Fs

i.e. Starting index within the input-signal ring buffer aligning to the time stamps of the computed valid filter output
i.e. Wallclock time when the filter starts outputting when being fed with incoming realtime data. Here, the term `settle` is not to be confused with the filter theoretical response time to an impulse. Note that the filter output lies in the past, namely at T_valid_start