

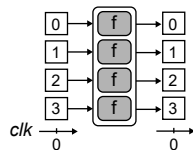
1D Convolution in

Standard, Data-Parallel Language

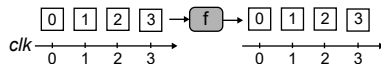
```
conv_math x =
  map (\y -> div (tuple y 3)) (reduce add x)

conv1d input =
  let shift_once = shift input
  let shift_twice = shift shift_once
  let window_tuple = map2 tuple_append
    (map2 tuple shift_once shift_twice) input
  let window = map tuple_to_seq
    (partition N 1 window_tuple)
  let result = map conv_math window
  unpartition result
```

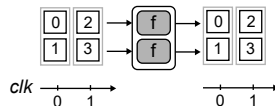
Different Schedules for 1D Convolution's map in Space-Time Language



$\text{map_s } f :: \text{SSeq } 4 \ t \rightarrow \text{SSeq } 4 \ t'$
 $\text{throughput}(\text{map_s } f) = 4 \text{ elt}/\text{clk}$
 $\text{area}(\text{map_s } f) = 4 \times \text{area}(f)$



$\text{map_t } f :: \text{TSeq } 4 \ 0 \ t \rightarrow \text{TSeq } 4 \ 0 \ t'$
 $\text{throughput}(\text{map_t } f) = 1 \text{ elt}/\text{clk}$
 $\text{area}(\text{map_t } f) = \text{area}(f)$



$\text{map_t } (\text{map_s } f)$
 $:: \text{TSeq } 2 \ 0 \ (\text{SSeq } 2 \ t) \rightarrow \text{TSeq } 2 \ 0 \ (\text{SSeq } 2 \ t')$
 $\text{throughput}(\text{map_t } (\text{map_s } f)) = 2 \text{ elt}/\text{clk}$
 $\text{area}(\text{map_t } (\text{map_s } f)) = 2 \times \text{area}(f)$

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in Space-Time Language