FIR FILTER SCALING

FIR Filter Example

- Use reduction technique and add all terms in a large tree for FIR structures which add delayed products into an output sum.
FIR Filter Example

• Remove zeroed terms

FIR Filter Example

• Add with a single carry-save adder structure similar to how multiplier partial-products are reduced
FIR Filter Example

- Complete addition with a carry-propagate adder

FIR Filter HW Reduction

- If we can scale coefficients all by the same amount
  - Frequency response unchanged
  - Overall gain change
  - May be possible to reduce filter’s complexity significantly
  - Must watch
    - Overflow
    - Quantization noise
FIR Filter Scaling

- If \( \text{coeffs} = [9\ 18\ 45\ 18\ 9] \)
  
  note that \( 0.889 \times \text{coeffs} = [8\ 16\ 40\ 16\ 8] \)

FIR Filter Scaling

- Often, scaling of a filter can be accommodated or reversed elsewhere in the signal path
FIR Output Range

- Worst-case inputs: maximum pos/neg samples
  - signs match coeff signs
  - signs opposite coeff signs
- Handling large peak-to-average ratios
  - Calculate full range output (more hardware)
  - Deal with large possible peaks
    - Saturate
    - Overflow (might be risky!)
    - Compression