* MFB and Sallen-Key are both filter topologies that are strict to implement a filter.
* Butterworth is the transfer function that defines the filter, many different topologies can result
* Resistance is the real part of impedance. Resistance does not involve phase.
* Reactance is the imaginary part of impedance, reactance is phase.
* Current in capacitor = C\*dv/dt, Voltage in inductor = L\*di/dt
* Impedance of inductor = jwL, Impedance of capacitor = 1/jwc…. In the ideal case, they both only contribute reactive impedance. Think about them in the AC and DC cases and how much the OPPOSE current flow… this makes it easy to calculate the impedance of the devices.
* In small signal analysis we short capacitors and open inductors. Additionally, in DC analysis we do the opposite.
* Nyquist frequency (or folding frequency) is the axis of symmetry for aliased signals (the middle)
* Visual effect of aliasing with an FM signal  
  Graphical user interface

  Description automatically generated
* Harmonics can cause aliasing. A lowpass anti-aliasing filter works by filtering out all higher frequency components of a signal that are not wanted.
* Cutoff frequency of a lowpass RC filter is 1/2piRC… this is where the vector sum of the resistance and the impedance of the capacitor is equal to the resistance of the resistor.
* Gain and accuracy of cascaded filters decline
* OP AMPS ALLOW US TO PLACE A VIRUAL POINT OF REFERENCE!
* Q is the quality factor of a filter and is higher when the filter is more selective. Q is the ratio of the resonant frequency to the bandwidth
* Q apparently determines the peakiness of the filter at the cutoff frequency but also manipulates the gain. Setting Q to 0.707 gives a maximally flat curve. Zeta is the inverse of Q and is named “damping factor”
* Usually when cascading filters you want to increase the resistance by a factor of 10 and decrease the capacitance by a factor of 10
* Frequency response of a butterworth filter:  
  Diagram

  Description automatically generated
* Standardized Butterworth Filter Polynomials  
  Table

  Description automatically generated
* Higher order filters are just cascaded single and double order filters
* Most filters (if not all) are constructed by cascading 2 pole filters and then adding a single pole to the beginning of the filter.
* The 2nd and 1st order filters that we have been talking about are LTI (sallen key), therefore, the transfer functions can be cascaded with multiplication!
* Gain bandwidth product is the frequency at which an opamp’s gain goes to 1
* Slew rate is the maximum rate of change of an opamp’s output
* Rail to Rail devices can be tricky…. Make sure they are right!
* ANY signal into an op amp can only swing as far as the op amp allows. You really want a dual supply op amp…. Not a single supply unless you want to rectify
* Always try to get your quality factor to be 0.707…. this makes it maximum smoothness. Q at 0.707 is where the resistance equals the reactance in the circuit and makes maximal smoothness.
* Cutoff frequency is where the capacitive reactance and the resistor are equal in an RC circuit. After this point the rolloff is 20dB/dec

How do you normally go about designing a filter?

How do you do filter compensation?

Is there any disadvantage to creating a super high impedance input on every filter?

* ADC muxing is going to be hard
* RMS square root is decimated… use average of squares.