

## T5 Part 1: Filtering seismic data: Low-pass, high-pass, band pass. Instrument correction

For all programs to work properly, you need to download and execute them from the directory you created last time (the one in which the data directory is located).

### Exercise 1 (*Convolution*)

- a) Download `convolution.py` and run it (`run -i convolution.py`)
- b) Study implementation of time and frequency domain convolution.
- c) What is more efficient?
- d) Is there any trade off?

### Exercise 2 (*Effects of a Simple Boxcar Window*)

- a) Download `filter_bc.py` from the webpage to the working directory of last time
- b) Open a cmd window, change to your working directory of last time and start IPython by `ipython -pylab`
- c) Run `run -i filter_bc.py` (from your working directory of last time, within an IPython shell) give different cut-off frequencies
- d) Write down the effect you see.
- e) To which function is the filtered signal similar?
- f) What happens if you decrease the number of points `npts` of the input signal (line 46)
- g) Uncomment line 60, which will replace the spike by a random signal.
- h) Do you still see the effect?

### Exercise 3 (*Filtering with a Lowpass*)

- a) Download `filter_bw_lp.py` and run it (`run -i filter_bw_lp.py`)
- b) Write down the effect of different corners (`n` in the label)
- c) Try different lowpass frequencies. Therefore change `f0` in line 74.
- d) Replace lowpass by zero-phase lowpass (line 16).
- e) Zoom into the signals onset. What is the difference of the lowpass versus the zerophase lowpass?

#### Exercise 4 (*Filtering with a Highpass*)

- a) Download `filter_bw_hp.py` and run it (`run -i filter_bw_hp.py`)
- b) Write down the effect of different corners (`n` in the label)
- c) Try different highpass frequencies. Therefore change `f0` in line 69.

#### Exercise 5 (*Downsampling*)

- a) Download `downsampling.py` and run it (`run -i downsampling.py`)
- b) Write down what happens when we are just taking every second point (red lines). How is this effect called?
- c) How do you circumvent this problem by filtering (check the frequency representation).

#### Exercise 6 (*Bandpass Hokkaido Earthquake*)

- a) Download `filter_bw_bp.py` and run it (`run -i filter_bw_bp.py`)
- b) Write down what happens if you different frequencies are bandpassed?
- c) What is the difference to the spectrogram of T4?

#### Exercise 7 (*Filter the Artificial Seismograms of T3*)

- a) Replace `src` in `ac2d.m` (of T3) by a spike source `src` at `ist` and save the result in MATLAB  
`save seismogram seis`
- b) Download `bandpass_artificial_seismogram.py`
- c) Write down what you see?
- d) Thus is it possible to simulate/generate the seismogram with a spike as source time function and filter it afterwards?