Prof. Dr. B. Eckhardt
Fachbereich Physik

June 26, 2018
Philipps Universität Marburg

Computational Physics II

To be turned in by: July 11, 2018

10.1. Sun spot activities

Sun spots have been observed and counted since 1749. Data up to 2016 is available at `https://solarscience.msfc.nasa.gov/greenwch/SN_m_tot_V2.0.txt` Prepare the data, take a rectangular or linear window function and compute the location of the two most prominent peaks (outside zero).
How does removal of the mean number of sunspots affect the Fourier transform?

10.2. Fourier transforms and derivatives

Let $\hat{f}_k$ denote the discrete Fourier transform of f_n,

$$\hat{f}_k = \sum_n f_n e^{ink/N} \tag{1}$$

that is computed by the subroutine `sci.fft`. Given $\hat{f}_k$, the inverse can be computed using `sci.ifft` (the result has to be multiplied by N to fully recover the original time series).
Verify that you can compute the Fourier transform and its inverse, and recover the signal you started out with.
The derivative of f in time becomes multiplication by the frequency, i.e. if $g(t) = f'(t)$, then $\hat{g} = (-i\omega)\hat{f}$.
Implement this rule and verify that you can compute $f'(t)$ and $f''(t)$ correctly.