DATA.ML.200 Pattern Recognition and Machine Learning

Homework 2: Detection theory

This homework prepares you for the next week exercises.

1. **pen&paper** *A sinusoid detector.*
   The signal $s[n]$ to be detected is a sinusoid

   $$s[n] = A\cos\left(2\pi f_0 n + \phi\right) \ , \tag{1}$$

   where $A = 1$, $f_0 = 0.1$ and $\phi = 0$. Write down the detection rule that uses the detection threshold γ to detect whether $s[n]$ is present in the measured signal $x[n]$ of $n = 0, 1, \ldots, N-1$.

2. **pen&paper** *A general frequency detector.*
   Let's assume the same signal $s[n]$ but use a general phase invariant frequency detector

   $$s_f[n] = \exp\left(-2\pi i f_0 n\right) \ , \tag{2}$$

   where i is the imaginary unit. Write down the detection rule for this detector as well.