Problem 1. Consider the vector space of square summable sequences $\ell^2(\mathbf{N})$.

1. Conjecture a definition of an inner product for this vector space. Please make it clear how this inner product is computed.

2. Prove your conjectured inner product actually is an inner product.

3. Using your inner product please compute the norm of the harmonic sequence. Please also give an example of two sequences in $\ell^2(\mathbf{N})$ that are orthogonal.