

Composer's program notes for  
*Three Steganographic Études*

Noam D. Elkies, Op. 56

1. Allegro (*à la* J.S. Bach and C.M. v. Weber)
2. Andante (*à la* Chopin)
3. Deciso (*à la* Schumann)

The first of the three *Steganographic Études* was written in 2005 as a mnemonic for the first 244 decimal digits of  $\pi$ . Every fourth note of the right-hand figuration encodes a digit, with middle C, D, E for 1, 2, 3, etc.:

**Allegro**

3 . 1 4 1 5 9 2 6 5 ...

The remaining two études were written for *Bridges 2010*, and extend the encoding to the 768 digits, a number chosen for a reason that should be clear at the end of the piece. Each étude is in a different key, and poses different musical and technical challenges; still, the basic encoding scheme is similar, up an octave in the second étude, and in both octaves for the third:

**Andante espressivo**

... 2 0 1 9 0 9 1 4 5 6 4 8 ...

**Deciso**

... 9 6 2 7 4 9 5 6 ...

For more detailed remarks on the composition of the first étude, and on the connection of such pieces with human memory, steganography, and the entropy of music, see <http://www.math.harvard.edu/~elkies/stego.html>.