

# Zero, Connected, Empty: An Essay after a Cantata

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**Abstract:** This brief essay attempts to explain some of the thinking behind the cantata *Zero, Connected, Empty*, composed by Ryoko Goguen, with words by Joseph Goguen.

The cantata *Zero, Connected, Empty* was written for the banquet of the 16th Workshop on Algebraic Development Techniques, a conference on theoretical computer science, which was held in a monastery (more properly, a nunnery) on the island of Frauenchiemsee, in a lake in the country about an hour by train from Munich; it was performed there on 25 September 2002. It has 87 measures and takes about 8 minutes to perform.

Artists, especially musicians, are often reluctant to “explain” their work, but this is an exception, because the piece was written for a very specific situation, and its creators are rather loquacious, though possibly obscure. The piece is a brief history of Western culture from the Enlightenment to the present, told in music and elliptical words, focusing on mathematics in a broad sense, or more precisely, on the philosophy of mathematics, in a sense that includes computer science. Its sections move from the eternal certainties and formal structures of the classical period, through the emotional and cultural aggression of romanticism, to contemporary confusions like postmodernism and computing. It is interesting to recall that in the medieval universities, music was taught in the mathematics faculty.

It is a cantata in the loose sense that modern composers use that term, rather than in the traditional sense associated with Bach. It is written for voice and piano, preferably the same musician. Though originally performed with an electric piano (which miraculously recovered from a last minute surgery at the banquet), it sounds much better on a concert grand, which allows the reverberations from the cluster chords to circulate and decay properly.

The initial 8 measure Mozart-like introduction is the first theme from the first movement of *Sonatina No. 1* for piano, by Ryoko. This leads into a 9 measure recitative-like vocal section, expressing the philosophy of the classical period, exemplified by thinkers like Newton and Leibniz. This is followed by an 8 measure romantic treatment of the second theme from the same *Sonatina*, and then by another vocal section, with words reflecting the spirit of the romantic period (which we take as lasting into the early 20th century), with its emphasis on conquering and colonizing nature, and foreign territories in general. The word “power” is meant in several senses, including those of physics, politics, electronics, and the military. This is followed by a 9 measure counting section, featuring the natural numbers from 1 to 12, accompanied by a variation on the first *Sonatina* theme, using Beethovenesque chords. The music in measures 46 to 71 moves into the

contemporary period, with more complex chords and rhythms, an accelerating tempo, and deconstructed quotations of familiar themes of Bach, Beethoven, and Mendelssohn, culminating in an explosive sequence of cluster chords.

The final vocal section in 12 measures mainly uses modern jazz chords. Its first phrase is a reference to the geography of Frauenchiemsee, but also, as the following phrases suggest, to the buddhist philosophy of emptiness (*sunyata* in Sanskrit, *mu* in Japanese), which according for example to the 13th century Zen master Dogen Zenji [1], says that nothing has a “soul” or self-essence or ideal form, because everything arises together through mutual causation, i.e. through connectedness. The number zero gets recruited here as a symbol for the manifestation of emptiness as form. This section concludes with a brief recapitulation of the second *Sonatina* theme underneath its last 2 measures. The final 4 measures of the piece are an echo of emptiness, or emptiness ringing your door bell. (Some more general aspects of the relation between music and *sunyata* will probably be discussed in [3].) An element of non-linear coherence enters through the repeated reappearance of melodic and harmonic fragments in transformed guises.

A clever person in the audience pointed out that the repeated phrase “zero, connected,” can be interpreted as a “generation constraint” (e.g. in the sense of [2], page 121) for the natural numbers; this shows how the audience can enrich an artist’s comprehension of a piece.

International copyright is secured through JASRAC, the Japanese equivalent of the American ASCAP, but there may not be a great demand from performers, because the piece requires an unusual vocal range, contemporary classical piano skills, and the ability to interpret with shades of contemporary free jazz, and even a bit of pop.

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## References

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2. Joseph Goguen and Rod Burstall. Institutions: Abstract model theory for specification and programming. *Journal of the Association for Computing Machinery*, 39(1):95–146, January 1992.
3. Joseph Goguen and Erik Myin, editors. *Art, Brain and Consciousness*. Imprint Academic, to appear 2004.