

Ziffers - Numbered Notation for Algorithmic Composition

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ABSTRACT

Ziffers is an algorithmic number based musical notation system offering a terse syntax for the improvisation and composition of complex melodies and rhythms. Ziffers gradually evolved from empirical experiments aiming at closing the gap between several number-based notational practices spanning from numerical and staff notation to pitch class set and post-tonal theories. Ziffers places a special emphasis on providing support for live algorithmic and generative composition, embedding a toolset of algorithmic processes directly in its syntax model. The system also tries to accommodate these fixed media types of notation to the liveness experienced when using live coding environments. Ziffers has been influenced by TidalCycles (McLean and Geraint, 2010) and Ixi Lang (Magnusson 2011), two popular live coding libraries designed around the use of a custom domain specific language, called mininotation, allowing the live manipulation and transformation of musical patterns. In this article, we propose an environment agnostic presentation of the Ziffers musical notation system. As a proof of concept, this article also introduces two implementations running in different environments: Sonic Pi (Aaron, 2016), a live coding platform designed for education and music performance and Muscore, a general purpose scorewriter and score playback software. In doing so, we are hoping to highlight the versatility of our approach, which seems to allow the use of a unified syntax for different contexts of execution and interpretation.

1 INTRODUCTION: ZIFFERS, QUICKLY EDITABLE NUMBER BASED NOTATION

Ziffers — named and inspired by the older *Ziffersystem* (Warkentin 2022) — proposes a system focused on the conciseness and expressiveness of musical notation. Ziffers is designed to enable generation and transformation of musical patterns (McCormack et al. 1996; McLean 2020) in minimal amounts of time and typing. To do so, Ziffers uses a text-based syntax for representing various short-hand symbolic notations used in music theory and concepts in programming languages. The need for concise and succinct notation in the context of live coding performance is a well-known constraint (Roberts and Wakefield 2018) that gave rise to many practices and techniques aiming to reduce frictions in the conversational feedback loop between the musician and its programming interface (REFERENCE). Domain specific languages (DSLs) and the use of terse mini notations have become an important design pattern in the conception of live coding interfaces (Hoogland 2019; ADD OTHER), and can also be noted to be a key concept in the larger realm of exploratory or conversational open-ended programming where reactivity and fast decision-making is of prime importance to achieve a creative state of flow (Nash 2015; Kery and Myers 2017).

Ziffers is designed as a terse and platform independent syntax capable of embedding algorithmic and generative processes at the notational level. Basic notation tokens denoting pitch, rhythm or expression marks form the base notation, enriched by a set of generative operators and tokens denoting algorithmic transformations of that first layer of notation. Implementation of the Ziffers system is specific to each targeted platform, in conformity with the notation described in this article and the documentation for the prototype implementation. The first prototype of Ziffers has been created in 2018 (Alonen 2018) as an inline parser for Sonic Pi. It was thought as an attempt to speed up the process of writing melodic lines on-the-fly, taking advantage of the large number of predefined methods and compositional helpers offered by Sonic Pi’s rich internal library. Its design aimed at resolving the dissociation between pitch and rhythm imposed by Sonic Pi data structure and imperative-oriented programming model. After a few years of evolutionary prototyping, Ziffers 2.0 was released in 2022 (Alonen 2022), including a new parser aiming at extending Ziffers capabilities with new operators, nested structures and better support for stochastic and aleatoric composition.

2 METHOD: DESIGNING BY DRAWING FROM MUSIC NOTATION HISTORY

The Ziffers music notation project initially started as an experiment to confront historical numeric pitch-based music notation practices with the kairoic notations (Cocker 2013) typically found in live coding and algorithmic music performance systems (Blackwell et al. 2022). Therefore, the system has been designed iteratively in conversation with the diverse and complex historical legacy of said practices. Documents pertaining to the systems of numeric pitch notation in common practice can be traced back as early as the European baroque up to the contemporan era through examples as varied as the American Nashville system, the Chinese Jianpu simplified notation (Kaminski 2022; MNMA 2022) or the theoretical pitch-class set numbering of musical structures and chords used in post-tonal music theory (Forte 1973).

Numerical systems for score, harmonic or melodic writing – less commonly encountered than their staff-based counterparts – have historically most often served as compositional tools for polyphonic contrapuntal notation (Davantès 1560), early theoretical endeavours in algorithmic composition (Kircher 1650) or in pedagogy and teaching (Rousseau 1781). Finding a new breath during the late nineteenth-century through the Galin-Paris-Chevré notation (Dauphin 2012), the practice spread to Asia where it is widely used, known and practiced, sometimes concurrently with standard staff notation. Some specialized applications of numbered notation can also be found in the toolset of contemporary ethnomusicologists and ethnomathematicians that often take advantage of the versatility of symbolic cipher notation to devise notation systems capable of formalizing musical systems or previously non-written musical practices (Chemillier 2002).

Conclusion

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References

- 10 Alonen, Miika. 2018. *Ziffers: Numbered notation for algorithmic composition* (version 0.1). <https://github.com/amiika/ziffers/commit/c12516d2b1604836925cbe829e488e033578405c>.
- . 2022. *Ziffers: Numbered notation for algorithmic composition* (version 2.0). <https://github.com/amiika/ziffers>.
- Blackwell, Alan F, Emma Cocker, Geoff Cox, Alex McLean, and Thor Magnusson. 2022. *Live Coding: A User's Manual*. MIT Press.
- Chemillier, Marc. 2002. "Ethnomusicology, Ethnomathematics. The Logic Underlying Orally Transmitted Artistic Practices." In *Mathematics and Music*, 161–83. Springer.
- Cocker, Emma. 2013. "Live Notation:—Reflections on a Kairotic Practice." *Performance Research* 18 (5): 69–76.
- Dauphin, Claude. 2012. "Le Devenir Du Système de Notation Musicale de Jean-Jacques Rousseau." *Rousseau En Musique, Orages*, no. 11: 79–98.
- Davantès, Pierre. 1560. "Pseaumes de David, Nouvelle Et Facile Methode Pour Chanter Chacun Couplet Des Pseaumes Sans Recour Au Premier." 1560. <https://gallica.bnf.fr/ark:/12148/bpt6k3135388/f23.item>.
- Forte, Allen. 1973. *The Structure of Atonal Music*. Vol. 304. Yale University Press.
- Kaminski, Joseph S. 2022. "Jianpu Simplified Notation and the Transnational in Musical Repertoires of New York's Chinatown." In *Material Cultures of Music Notation*, 110–23. Routledge.
- Kery, Mary Beth, and Brad A Myers. 2017. "Exploring Exploratory Programming." In *2017 IEEE Symposium on Visual Languages and Human-Centric Computing (VL/HCC)*, 25–29. IEEE.
- Kircher, Athanasius. 1650. "Musurgia Universalis Sive Ars Magna Consoni Et Dissoni." 1650. https://archive.org/details/bub_gb_97xCAAACAAJ/mode/2up.
- McCormack, Jon et al. 1996. "Grammar Based Music Composition." *Complex Systems* 96: 321–36.
- McLean, Alex. 2020. "Algorithmic Pattern." In *Proceedings of the 20th Conference on New Interfaces for Musical Expression*. Birmingham, UK.
- MNMA. 2022. "The Music Notation Project." 2022. <https://musicnotation.org/tutorials/numerical-notation-systems/>.

Nash, Chris. 2015. "The Cognitive Dimensions of Music Notations."

Roberts, Charlie, and Graham Wakefield. 2018. "Tensions and Techniques in Live Coding Performance."

Rousseau, Jean-Jacques. 1781. *Projet Concernant de Nouveaux Signes Pour La Musique*. éditeur non identifié.

Warkentin, Emily Grace. 2022. "The Story of the Ziffersystem and the Russian Mennonites: Counting Blessings."