




Opycleid: A Python package for transformational music theory

Alexandre Popoff¹

1 N/A

DOI: [10.21105/joss.00956](https://doi.org/10.21105/joss.00956)

Software

- [Review](#) 
- [Repository](#) 
- [Archive](#) 

Submitted: 16 September 2018

Published: 16 September 2018

License

Authors of papers retain copyright and release the work under a Creative Commons Attribution 4.0 International License ([CC-BY](#)).

Summary

Transformational music theory (TMT) is a branch of mathematical music theory which uses modern mathematical structures (such as groups, monoids and categories) to study and characterize musical objects (such as tones, chords, durations, rhythms) and their relations. More precisely, transformational music theory has progressively shifted the music-theoretical and analytical process from an “object-oriented” point of view to one where the transformations between musical elements are emphasized. The field originated in the work of David Lewin (Lewin, 1987) (Lewin, 1982) who pioneered the use of groups and group actions (Fiore & Noll, 2011), and has later been extended to monoids (Noll, 2005), and category theory (Mazzola & Andreatta, 2006) (Popoff, Andreatta, & Ehresmann, 2015) (Popoff, Agon, Andreatta, & Ehresmann, 2016). It has proved useful in analysis, from late romantic music (Gollin & Rehding, 2010) (Cohn, 2012) to recent film music (F. Lehman & Lehman, 2018). The algebraic and combinatorial nature of musical transformation make them prone to easy computer implementations. However, general frameworks for creating and applying musical transformations (for example using category theory) are scarce if not non-existent, and are instead focused on specific and restrained areas for example, neo-Riemannian operations).

Opycleid is a Python package for transformational music theory, allowing the definition and application of musical transformations in the broadest way possible. The API for Opycleid was designed in order to take a very general approach to TMT by considering category actions in $\mathbb{R}\triangleleft$, i.e. faithful functors from a small category to the 2-category $\mathbb{R}\triangleleft$ of finite sets and relations between them. At the same time, Opycleid provides ready-to-use classes for the common groups and monoids encountered in TMT (such as the T/I group or the PRL group usually found in neo-Riemannian theory), allowing the analysis of chords with just a few Python lines of code.

Opycleid was designed to be used by both researchers and by students in music theory (see for example https://www.mathsstudents.leeds.ac.uk/fileadmin/user_upload/Current_Maths_UG_Students/2017_Dr_R_Sturman.pdf). The source code for Opycleid has been archived to Zenodo with the linked DOI: (TO BE COMPLETED)

References

- Cohn, R. (2012). *Audacious euphony: Chromatic harmony and the triad's second nature*. Oxford studies in music theory. Oxford University Press, USA. Retrieved from <https://books.google.fr/books?id=rZxZCMRiO9EC>
- Fiore, T. M., & Noll, T. (2011). Commuting groups and the topos of triads. In C. Agon, M. Andreatta, G. Assayag, E. Amiot, J. Bresson, & J. Mandereau (Eds.), *Mathematics*

and computation in music: *Third international conference, mcm 2011, paris, france, june 15-17, 2011. Proceedings* (pp. 69–83). Berlin, Heidelberg: Springer Berlin Heidelberg. doi:[10.1007/978-3-642-21590-2_6](https://doi.org/10.1007/978-3-642-21590-2_6)

Gollin, E., & Rehding, A. (2010). *The oxford handbook of neo-riemannian music theories*. Oxford handbooks. Oxford University Press. Retrieved from <https://books.google.fr/books?id=NZppAgAAQBAJ>

Lehman, F., & Lehman, A. (2018). *Hollywood harmony: Musical wonder and the sound of cinema*. Oxford music/media series. Oxford University Press. Retrieved from <https://books.google.fr/books?id=TfgsswEACAAJ>

Lewin, D. (1982). Transformational techniques in atonal and other music theories. *Perspectives of New Music*, 21(1-2), 312–381.

Lewin, D. (1987). *Generalized music intervals and transformations*. Yale University Press.

Mazzola, G., & Andreatta, M. (2006). From a categorical point of view: K-nets as limit denotators. *Perspectives of New Music*, 44(2), 88–113. Retrieved from <http://www.jstor.org/stable/25164629>

Noll, T. (2005). The topos of triads. In H. Fripertinger & L. Reich (Eds.), *Colloquium on mathematical music theory*, Grazer math. Ber. (Vol. 347, pp. 103–135).

Popoff, A., Agon, C., Andreatta, M., & Ehresmann, A. (2016). From k-nets to pk-nets: A categorical approach. *Perspectives of New Music*, 54(2), 5–63. Retrieved from <http://www.jstor.org/stable/10.7757/persnewmusi.54.2.0005>

Popoff, A., Andreatta, M., & Ehresmann, A. (2015). A categorical generalization of klumpenhower networks. In T. Collins, D. Meredith, & A. Volk (Eds.), *Mathematics and computation in music: 5th international conference, mcm 2015, london, uk, june 22-25, 2015, proceedings*, Lecture notes in computer science (Vol. 9110, pp. 303–314). Springer International Publishing. doi:[10.1007/978-3-319-20603-5_31](https://doi.org/10.1007/978-3-319-20603-5_31)