

IMPROVISATION/STORYTELLING INSPIRED BY GEOMETRIC SHAPES. THE STORY OF KITE AND DART

Author: Gerhard Lock (gerhard.lock@tlu.ee)

Title: Improvisation/storytelling inspired by geometric shapes. The story of Kite and Dart

Age: 7.–9. class

Duration: 2x 45 min

Subjects: Geometry/Mathematics, Art, Music, Dance, Literature, Multimedia, Science, Chemistry

Description: Through sources of inspiration, students learn about geometric shapes called kites and darts. These are the Penrose tilings, or quasi-crystal structures that do not repeat regularly, discovered by the British mathematician Roger Penrose. Students look for similar structures in nature, where long and short elements alternate and form interesting patterns. Students transfer these structures 1) directly to art, music and movement/dance (structural elements overlap and complement each other) by creating short improvisations, 2) through a narrative (create a story, theater exercise, video, etc.) using kite and dart as characters (e.g. based on their translations from English to Estonian or on a fantasy level), 3) on a playful level: create an analog or digital game using kite and dart as characters. The duration of the results is 1–3 min, because longer creative results should be polished more, and in a large class you won't be able to listen/watch them all. Abstract thinking inspired by shapes and forms is important, as well as creative implementation, reviving shapes and images through intuition, improvisation and emotions. According to the field/competence of the teacher, the teacher can be an advisor, e.g. a music teacher in creating music notation (Musescore), a math teacher in generating geometric shapes (Geogebra). However, there is no need to use software, ideas can be implemented even without digital technology.

The idea of audiovisual implementation of kite and dart patterns was born during the TLU BFM integrated teaching and learning of creative subjects post schooling project (2020/2021). Its base are the following central concepts developed during the project: rhythm, composition, narrative, concept.

Learning goals:

Using geometric structures consisting of short and long elements that complement each other (form pairs), students learn to find these structures and transfer them directly or by analogy to other areas:

1. at the structural level: creating art, music and movement/dance improvisations (separately or interwoven);
2. at the level of a narrative: creating a story, a theater exercise, a video, as well as an improvisation of art, music, dance, the protagonists of which are kites and darts (literally or with fantasy meanings);
3. on a playful level: create an analog or digital game using kites and darts as characters.

Tools:

Paper, pencils, voice, Orff instruments, found sound objects, own instrument, computers/tablets for Geogebra, Musescore

Virtual/digital environments:

Geometry Freeware:

<https://www.geogebra.org/m/nhgapsdy>

Music notation (freeware):

<https://musescore.org/en>

A synthesizer (as a physical or virtual instrument) to create music

Various other programs:

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- shared piano (or other instrument): <https://musiclab.chromeexperiments.com/Shared-Piano/>

- a drawing environment that interprets drawing into music:
<https://musiclab.chromeexperiments.com/Kandinsky/>

(main source: <https://musiclab.chromeexperiments.com/Experiments>)

- Coagula Light (needs download): allows color (red, yellow, green) visuals to be converted into sound (pitch/frequency, event durations, stereo pan) <https://www.abc.se/~re/Coagula/Coagula.html>

- Pixelsynth (browser based): allows you to turn grayscale visuals into sound (pitch/frequency, different modes/density of sounds, event durations) <https://ojack.xyz/PIXELSYNTH/>

All programs are free software and allow either drawing directly in the software or inserting image files: coagula requires drawing on a black background for better performance, pixelsynth changes colors to grayscale by itself.

See the separate document Appendix 1 for ways to transfer Penrose quasi-crystals structurally and realize them as musical material.

For inspiration:

Table 1. Word play with words „kite“ and „dart“

<p><i>kite</i> <i>black kite</i> • Milvus migrans <i>fly a kite</i> <i>flying kite</i> <i>high as a kite</i> <i>kite</i> <i>kite board</i> <i>red kite</i> <i>Give a lark to catch a kite.</i></p>	<p><i>dart</i> <i>dart ahead</i> <i>dart gun</i> <i>dart thrower</i> <i>dart to and fro</i> <i>egg and dart</i></p>
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Penrose kite and dart quasi-crystal examples:

<http://www.quadibloc.com/math/pen01.htm> (John Savard)

<https://www.geogebra.org/m/nhgapzdy>

<https://mathworld.wolfram.com/PenroseTiles.html> (see more literature and examples there, too)

<http://emasab.github.io/penrose/>

https://www.projectrhea.org/rhea/index.php/MA271Fall2020Walther_Topic27_Rules_for_Generating_Penrose_Tilings

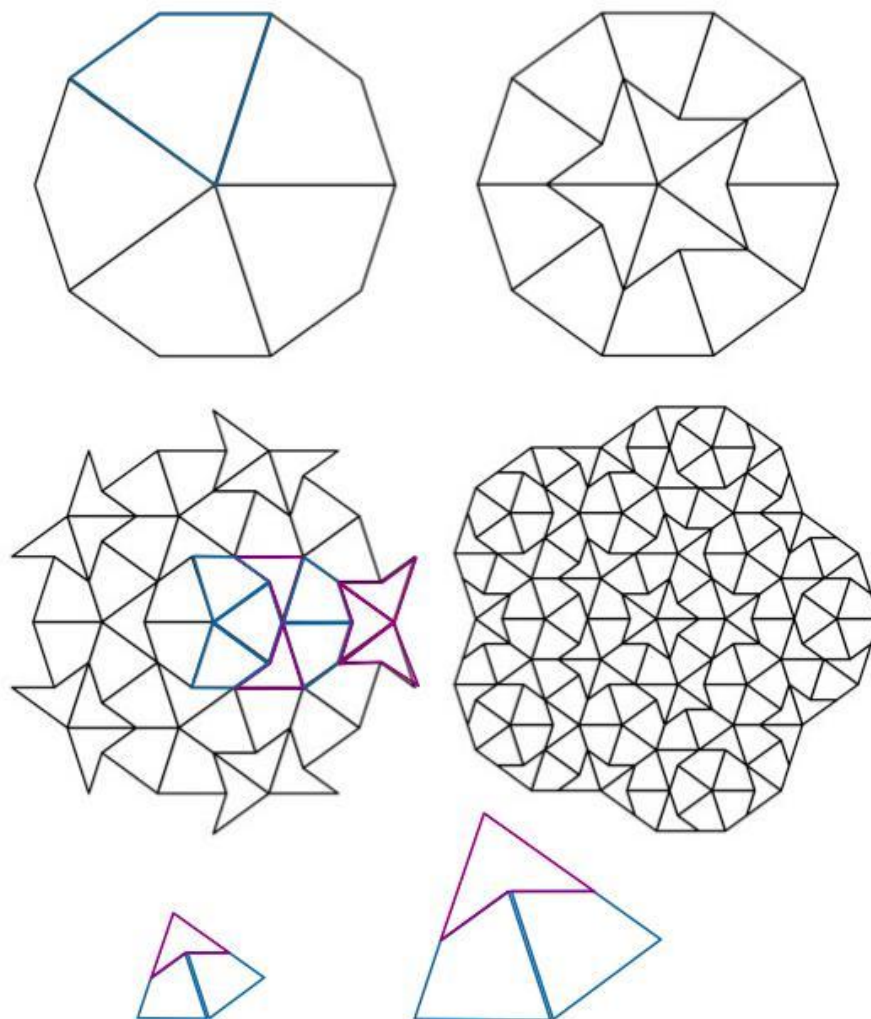
Read more about Penrose tilings:

<https://www.britannica.com/biography/Roger-Penrose>

https://en.wikipedia.org/wiki/Penrose_tiling

https://www.mathpuzzle.com/MAA/50-Melbourne,%20City%20of%20Math/mathgames_09_05_06.html

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Example 1. John Savard's shapes – colored separation by Gerhard Lock: kite – blue, dart – purple.
<http://www.quadibloc.com/math/pen01.htm>

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Example 2. A stone in the shape of a kite found on Tabasalu beach. Natural stone, red color (unknown artist). Photo by Gerhard Lock.

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Example 3. The structure of Penrose quasicrystals (kite and dart) applied as pedestrian smoothing in Helsinki (at Stockmann). Photo author: Juhani Nuorvala.

Actionplan:

First lesson (45 min)

15 min: the teacher introduces kite and dart shapes and sources of inspiration

10 min: the teacher explains the (homework) task for which to apply these shapes and in which areas

20 min: students choose one of the above learning outcomes, start generating ideas either alone or in a small group, choose the means of implementation (e.g. paper and pencils, voice, Orff instruments, found sound objects, their own instrument or virtual/digital environments/software).

According to the field/competence of the teacher, the teacher can be an advisor, e.g. a music teacher in creating music notation (Muscore), a math teacher in generating geometric shapes (Geogebra).

The teacher advises the students to what extent their ideas can be realized in a short time.

Homework: find structures similar to Penrose quasi-crystals in the environment (urban, nature) and the Internet; find/take instruments or found objects to make music; develop the ideas started in class according to the chosen learning outcome; prepare to present/perform in the second lesson.

Second lesson (45 min)

15 min: students/small groups present their ideas according to the chosen learning outcome – duration: 1 minute speed presentation (elevator speech format). The teacher advises the students to what extent their ideas can be realized in a short time.

5 min: Students/small groups make final decisions and prepare to present

25 min: students/small groups present their results – duration: 1–3 min. Evaluation/feedback is done briefly after each performance.

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Assessment/Feedback:

Since the results are creative outcomes, they can only be evaluated on a pass-or-fail level. Peer assessment of students can be implemented. The brevity, improvisational nature of the results and thus the incomplete level of their formalization must be taken into account. Supposedly the students create primal, spontaneous, unfinished, unrefined exercises that cannot be assessed with higher-level creative evaluation criteria. Aspects of students' creative thinking can be assessed: 1) interesting/fascinating/convincing/surprising, 2) variety of solutions/tools, 3) degree of integration of tools from several fields (absent, i.e. the result is created in only one field, to a small extent created only in two fields, to a large extent i.e. tools from several areas are connected), 4) students' self-awareness regarding their creation in the light of sources of inspiration – to what extent they keep to the latter or how much they have consciously retreated from them, 5) the abundance of fantasy in the creation.

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Appendix I

Author: Gerhard Lock

STEAM study material 12.11.2022

Title/Theme: Improvisation/storytelling inspired by geometric shapes. The story of Kite and Dart

Target group: 7–9 class

Time: 2x 45 min

Subjects/areas: Geometry/Mathematics, Art, Music, Dance, Literature, Multimedia, Science, Chemistry

Interlacing options graphically and sonically

Ways to structurally and materialize Penrose quasi-crystals as musical material.

Software used:

1) for drawing shapes: OpenOffice/LibreOffice Draw (freeware)

<https://www.libreoffice.org/discover/libreoffice-vs-openoffice/>

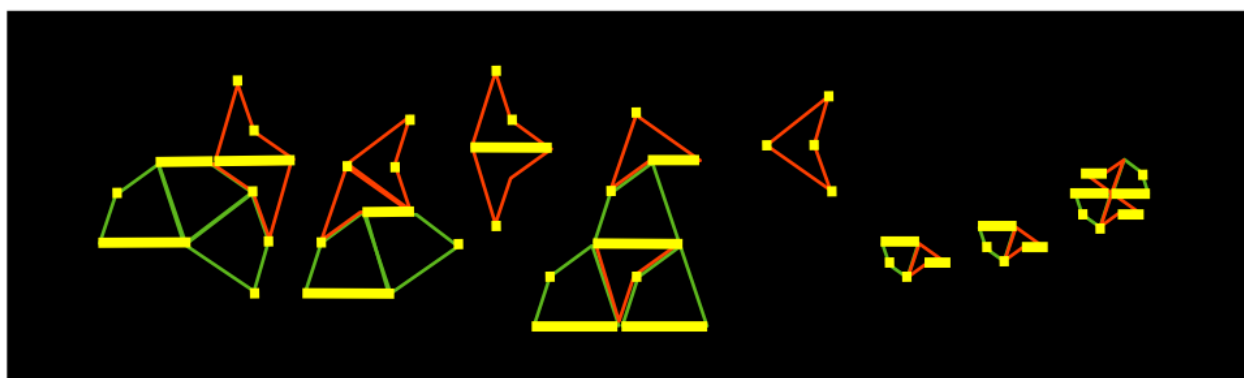
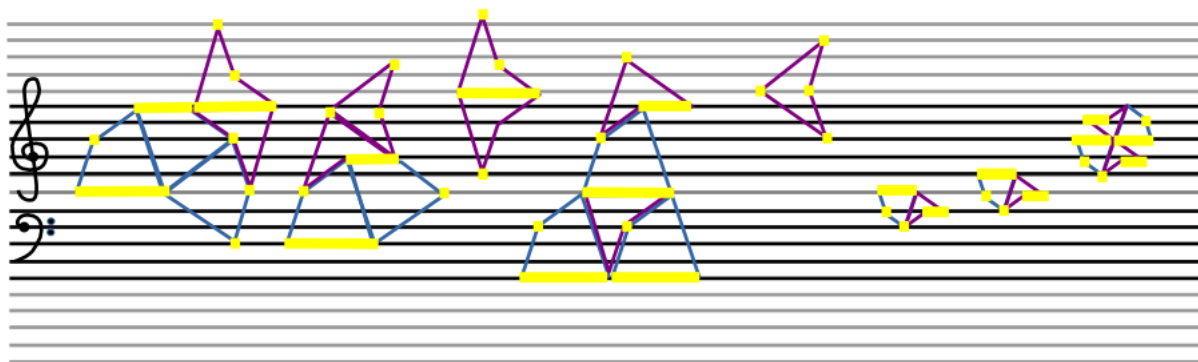
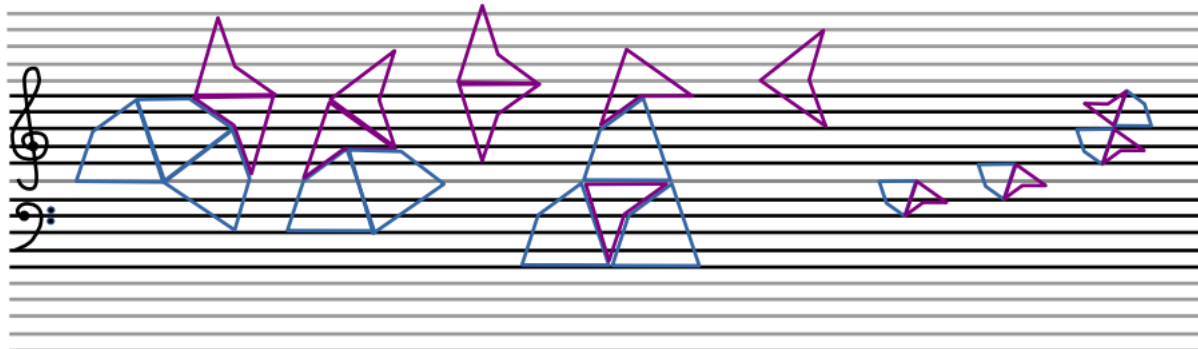
2) for music notation: Musescore (freeware)

<https://musescore.org/en>

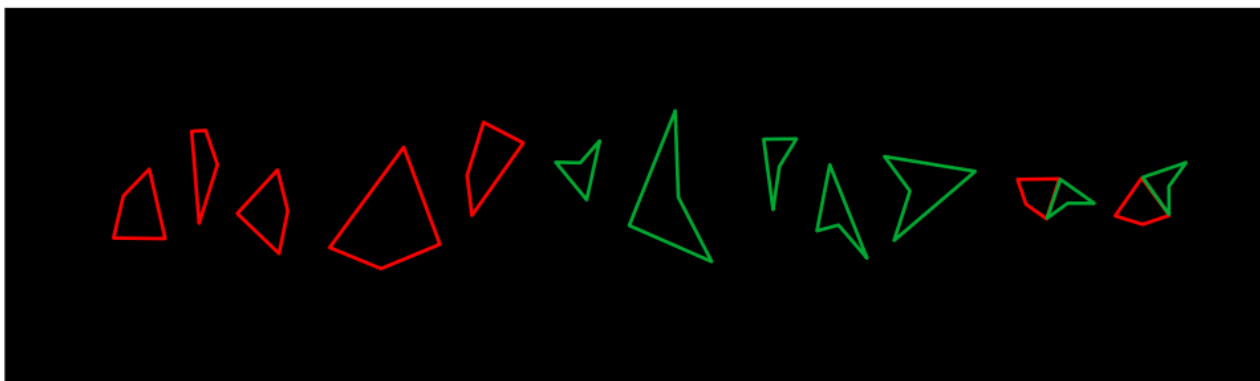
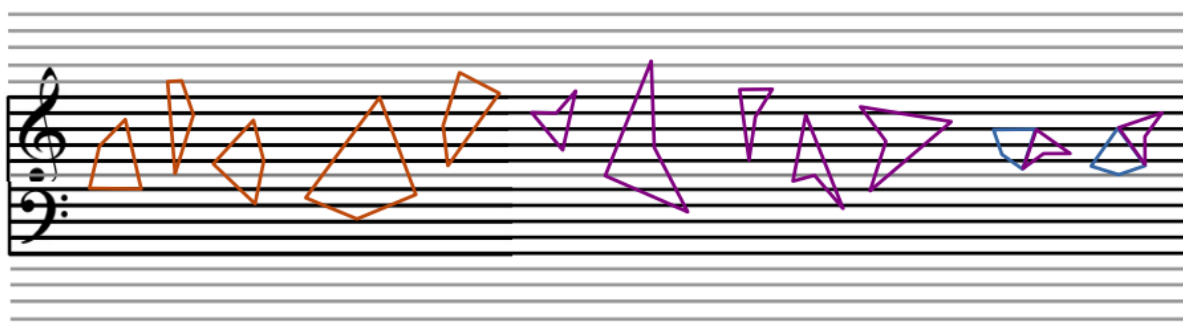
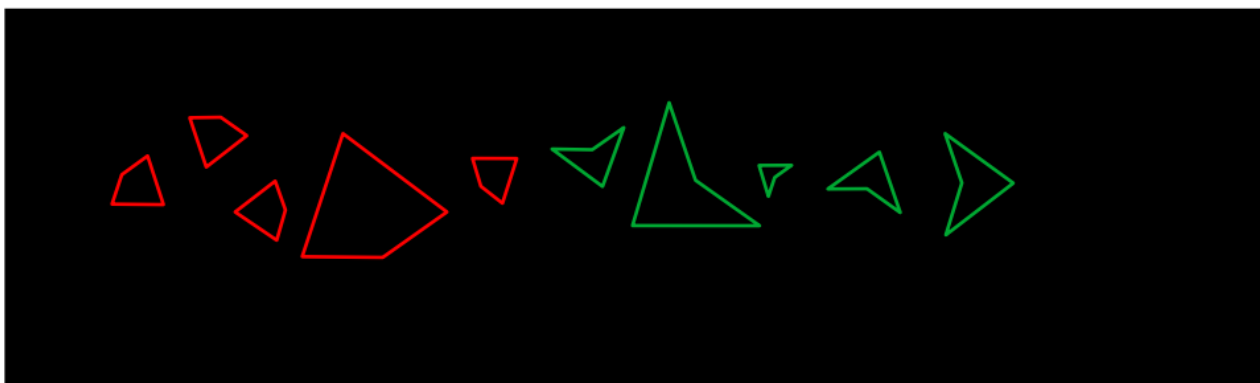
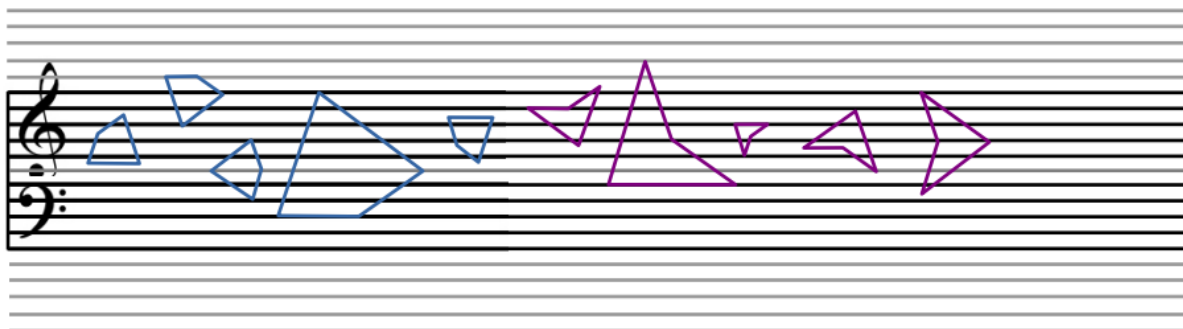
Penrose Tilings - Artistic Use and MATIK

Music: Mapping to sheet music and Coagula light av synth below

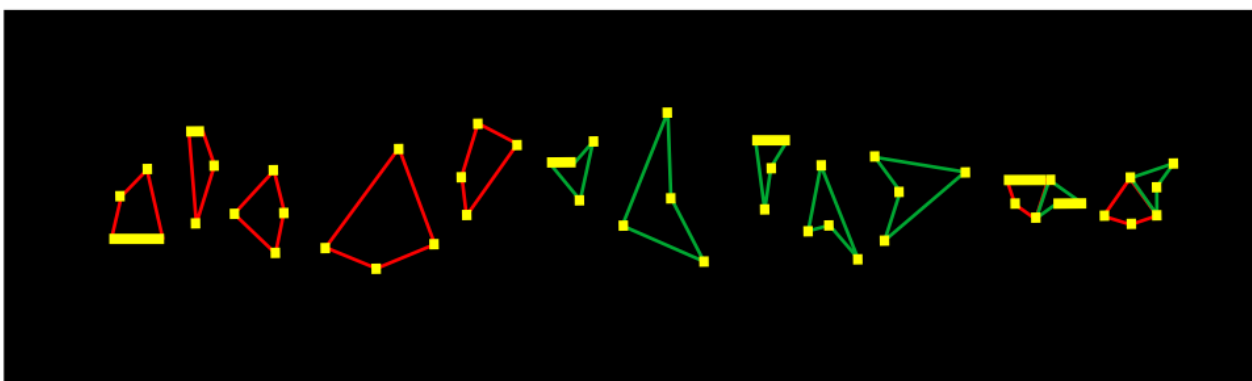
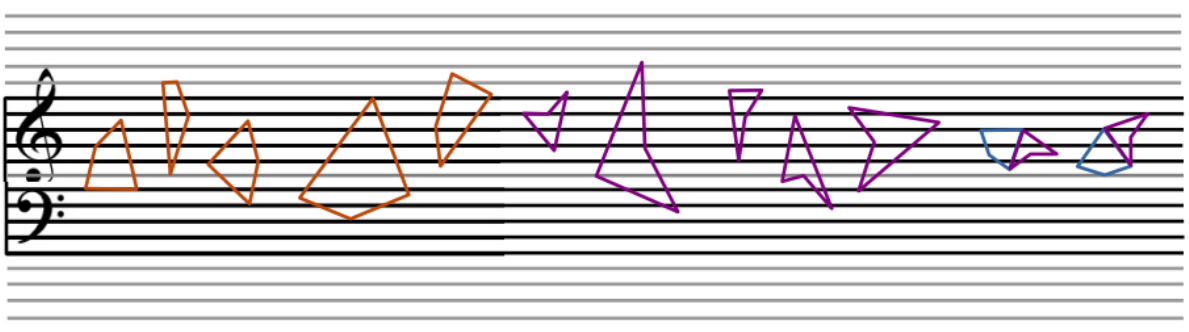
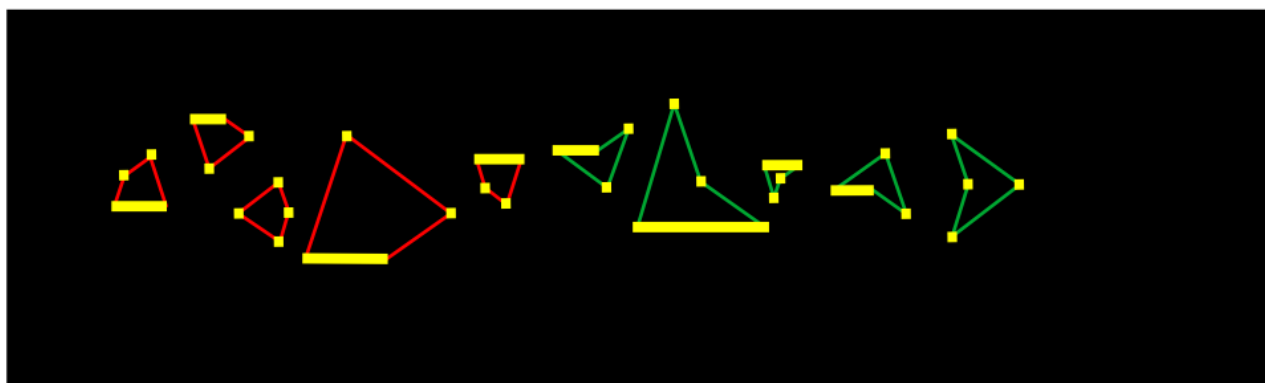
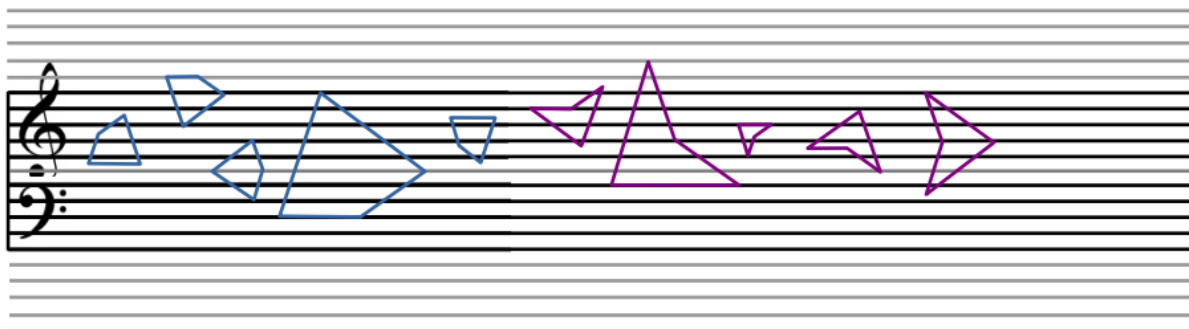
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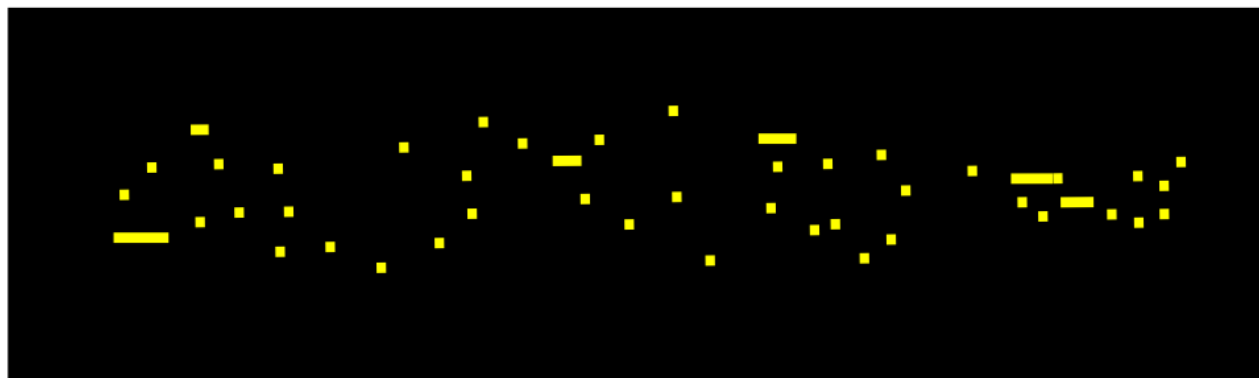
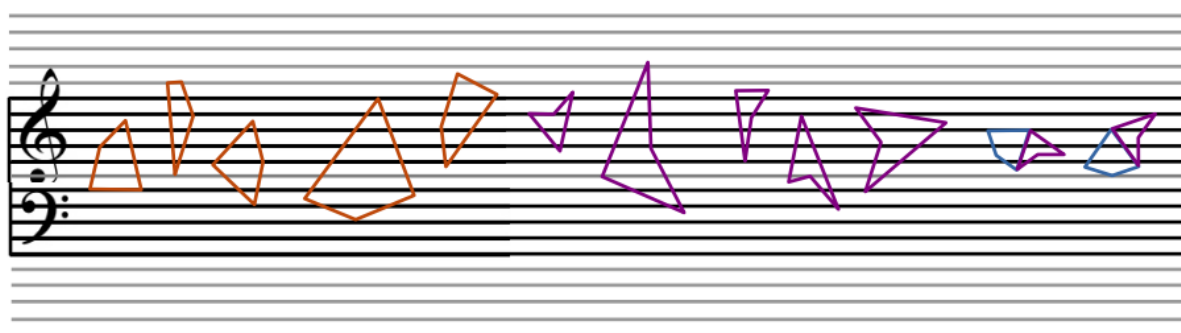
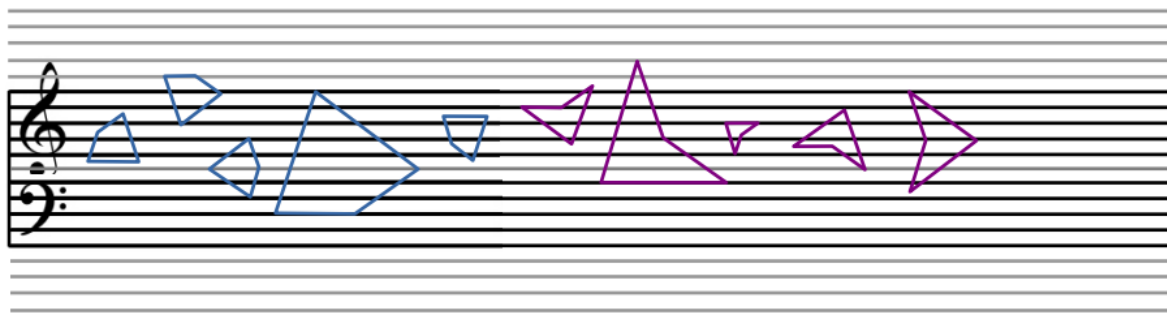
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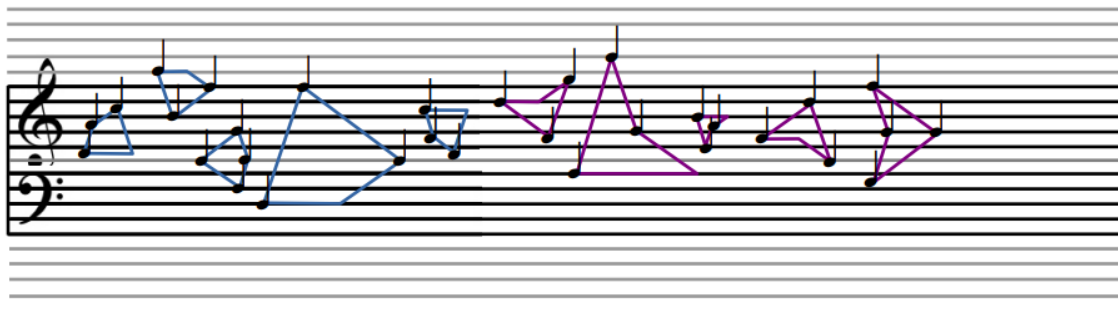
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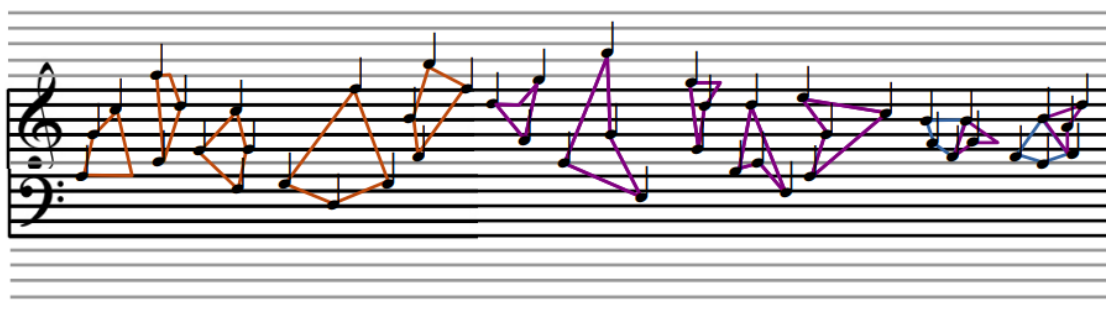


Kites

Musical notation for the 'Kites' section, measures 1 through 9. The melody is primarily composed of quarter and eighth notes, with a simple harmonic accompaniment.

Darts

Musical notation for the 'Darts' section, measures 10 through 20. This section features a more complex melody with some sixteenth notes and a richer harmonic texture.



Kites modified

Musical notation for the 'Kites modified' section, measures 1 through 9. This version of the 'Kites' section uses a different harmonic setting and includes some chords.

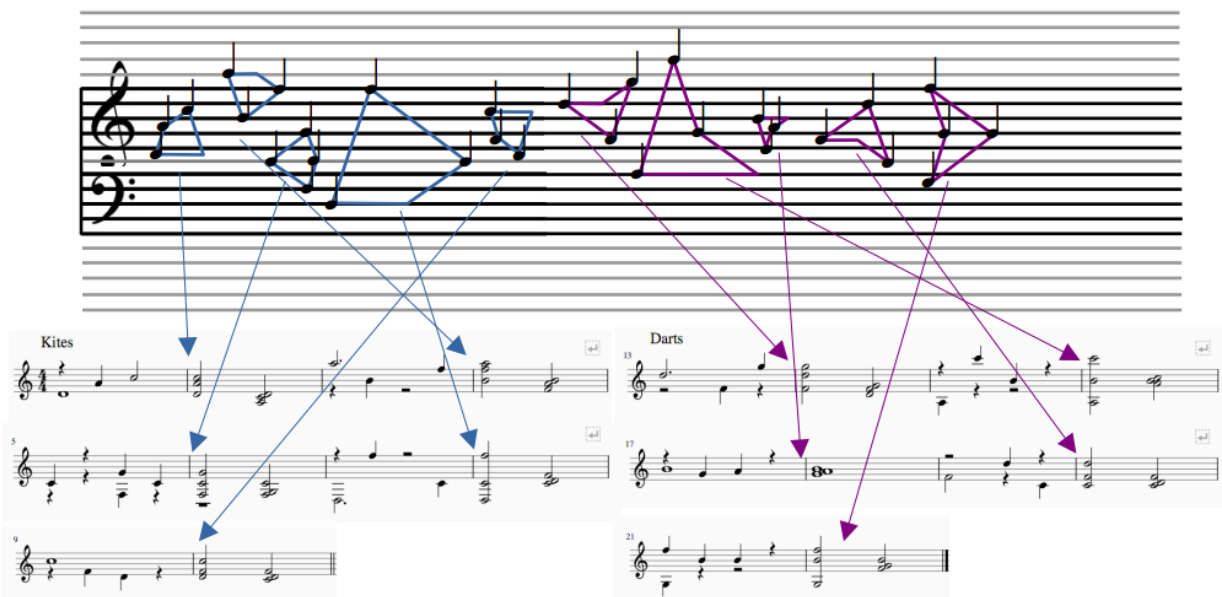
Darts modified

Musical notation for the 'Darts modified' section, measures 10 through 20. This version of the 'Darts' section features a more complex melody and a richer harmonic texture.

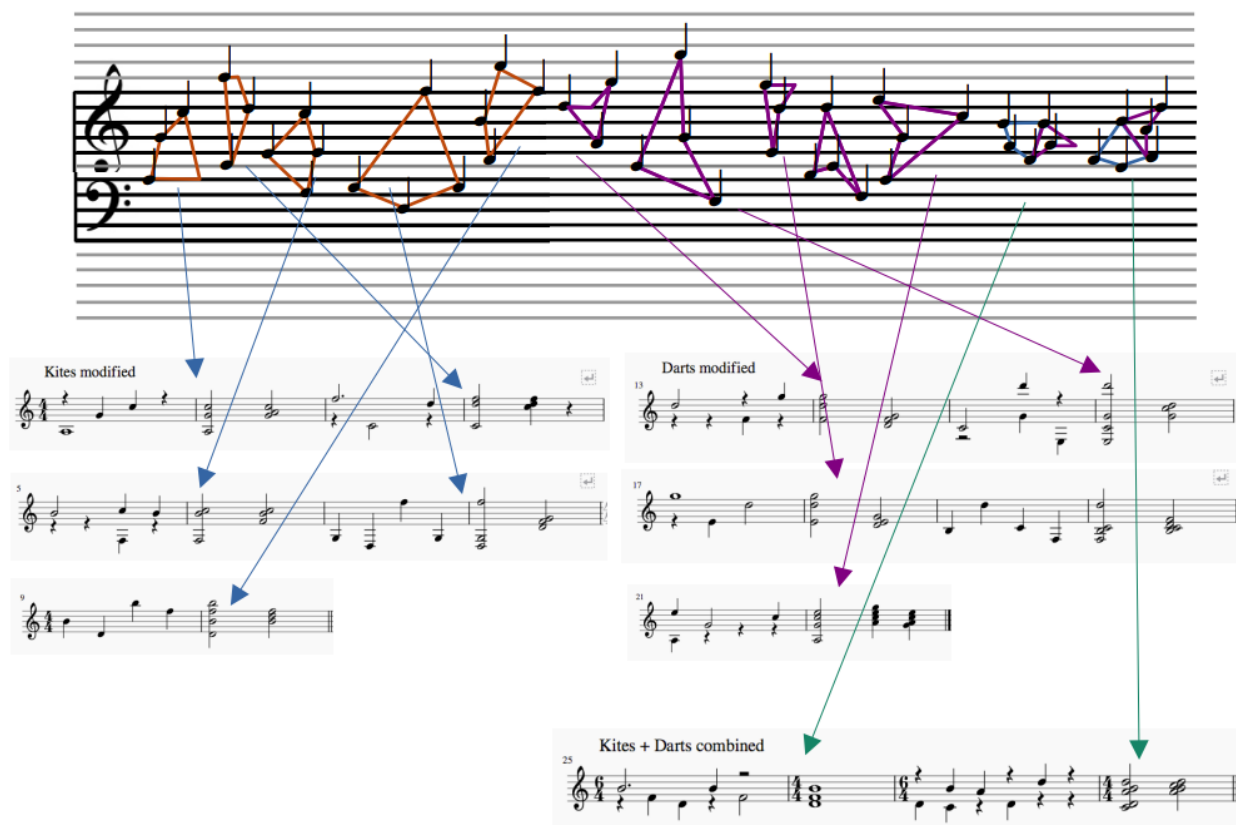
Kites + Darts combined

Musical notation for the 'Kites + Darts combined' section, measures 21 through 25. This section combines elements from both the 'Kites' and 'Darts' sections into a single piece.

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This section shows the original musical pieces. The 'Kites' piece (measures 1-9) features a melody with blue triangles overlaid, representing kite shapes. The 'Darts' piece (measures 13-21) features a melody with purple triangles overlaid, representing dart shapes. Arrows connect the shapes on the main staff to the corresponding notes in the individual piece staves below.



This section shows modified versions of the pieces and their combination. The 'Kites modified' piece (measures 1-9) uses orange triangles. The 'Darts modified' piece (measures 13-21) uses purple triangles. The 'Kites + Darts combined' piece (measures 25-33) integrates elements from both. Arrows connect the shapes on the main staff to the corresponding notes in the individual piece staves below.

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