

UNIVERSITY OF MIAMI

*AN INTRODUCTION TO MODELING COMPOSITION
THROUGH ABJAD'S MODEL OF MUSIC NOTATION*

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An Introduction to Modeling Composition through Abjad's Model of Music Notation

ABSTRACT

In my recent music, I have begun to make extensive use of the Abjad API for Formalized Score Control in the Python programming language to produce music notation that is illustrated via the Lilypond engraving engine. In the research that led to this paper, I sought to find avenues for computationally modeling the act of composition with Abjad's model of music notation. In order to be best equipped to compose scores with these tools, the user should have a basic understanding of Python and Lilypond. The first chapter of this paper outlines various fundamentals in these environments. The second chapter discusses the underlying methodology behind the use of Abjad as a tool for both music composition and music engraving. After grasping the basic functionality within Abjad's notational model, it became clear to me that further software could be written to increase the efficiency of the use of Abjad, as well as to model my own idiosyncratic compositional workflow. The third and final chapters consists of appendices of my own tools, written in Python, along with source code and scores of music I have composed with the concurrent use of Python, Abjad, and Lilypond as a demonstration of my own compositional process and the power that these programming paradigms afford the composer. The tools I have written are a work in progress and my future research will consist of improvements to their functionality and to the order of operations of my compositional process in order to compose with the least redundant code possible.

THIS THESIS IS DEDICATED TO ALL COMPOSERS LOOKING TO FORMALIZE THEIR MUSIC WITHOUT
THE PAIN OF ARTHRITIS.

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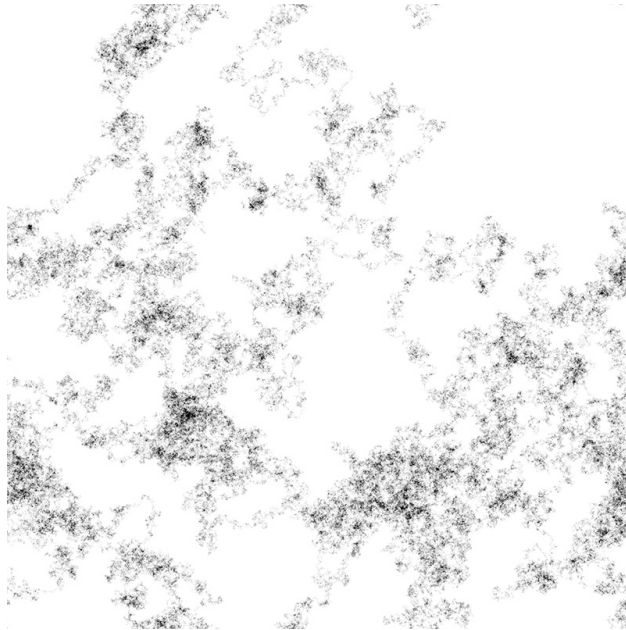


Figure 0.0.1: A 2-dimensional random walk of 100 iterations by Paul Bourke.

The artist-conceptor will have to be knowledgeable and inventive in such varied domains as mathematics, logic, physics, chemistry, biology, genetics, paleontology (for the evolution of forms), the human sciences and history; in short, a sort of universality, but one based upon, guided by and oriented toward forms and architectures.

(1985, Arts/Sciences: Alloys p.3)

Iannis Xenakis

1

Some Prerequisite Knowledge of Lilypond and Python

IN MY EXPERIENCE composing scores with the help of computational systems, I have found that the Abjad Application Programming Interface¹ for formalized score control provides the greatest power and flexibility. Abjad is significant because of the freedom with which it provides composers with the ability to manipulate their musical material and the ability to control not only the musical elements of a score, but also other graphic features as well. Every score that is created with Abjad is engraved by the Lilypond music notation engine.² Because of this interdependence, the composer should become familiar with Lilypond's model of music notation as well as elements of Lilypond's syntax. Since Abjad is an API in the Python programming language,³ it is essential that the composer be familiar with writing Python code. In this chapter, some basic concerns about Lilypond and Python will be discussed, while information directly related to the Abjad API follows in chapter two.

¹<http://abjad.mbrsi.org/>

²<http://lilypond.org/>

³<https://www.python.org/>

1.1 LILYPOND

1.1.1 COMPARISON WITH OTHER SOFTWARE

MOST MODERN COMPOSERS will be familiar with the plethora of options available for digital music engraving. The purpose of this paper is not to delve into the history of modern engraving practices, but it is important to note that, by far, the most popular engraving software available for the consumer market today are Finale⁴ and Sibelius,⁵ with a few new robust programs like Dorico⁶ beginning to appear. These systems, packed with many features, are suitable for the majority of composers' needs. They allow composers to be able to engrave pitches and rhythms in traditional Western notation and provide a number of formatting options that expand upon these traditions, allowing the user to create professional-quality documents, but it is not insignificant to note that many composers find the musical model of these programs to be overly restrictive upon musical creativity. As an example, with most of the common engraving software, users often must click through several menus to engrave a tuplet other than a triplet, especially if that tuplet does not contain successive rhythms of the same duration. Programs such as Dorico and the most recent versions of Finale have supplemented some of these issues through keyboard shortcuts⁷ and opened a clearer accessibility to the engraving of insected tuplets, but otherwise it is clear: these programs are tailored to a specific set of engraving requirements. This software is made for people engraving fairly traditional music like transcriptions, orchestrations, film scores, and so on, which do not typically make extensive use of this kind of notation.

While the programs are flexible and can be used for other means, I decided that what I require from a musical score is significantly restricted by the software. It becomes tedious to write music with many tuplets or other graphical oddities. While some composers have written their own engraving programs, like NoteAbility Pro,⁸ which can handle a number of contemporary techniques with ease, other

⁴<https://www.finalemusic.com/>

⁵<https://www.avid.com/sibelius>

⁶<https://www.dorico.com/>

⁷Most notation software also allows the user to define their own keyboard shortcuts.

⁸<http://debussy.music.ubc.ca/NoteAbility/>

composers have resorted to simply composing in graphic editors and drawing-oriented software, which brings the act of engraving much closer to the act of handwriting a piece; but even with these paradigm shifts, few notation engines show any friendliness to structural formalization. Finale and Sibelius have features that allow the user to program certain procedures,⁹ but these are limited. Programs like Patch Work (and its kin Patch Work Graphic Language¹⁰) and OpenMusic¹¹ were created in order to supplement this limitation. These programs allow the composer to manipulate data to represent musical elements which are then engraved within the program in the case of PWGL. In the case of OpenMusic, the elements are exported as MusicXML,¹² to be engraved by another software; but the complex MusicXML files produced by these programs are not always stable and often produce fallacious results or completely fail to convert.¹³ The combination of Abjad and Lilypond surmounts many of these concerns. Abjad simply writes text files of Lilypond code, which removes the concern of file transfer errors, and Lilypond represents each element of a score, music, text, or graphic, in a syntax that is simple and consistent across a number of engraving complexities allowing the composer to engrave almost anything as part of the score.¹⁴

1.1.2 LILYPOND'S MODEL OF MUSICAL RHYTHM

Another important aspect of Lilypond is its modelling of rhythmic content. Lilypond makes a distinction, unlike other notation engines, between written and prolated durations. In programs like OpenMusic, a set of triplet eighth notes would be written as durations of $\frac{1}{3}, \frac{1}{3}, \frac{1}{3}$,¹⁵ but in Lilypond they would be written as $\frac{1}{8}, \frac{1}{8}, \frac{1}{8}$ prolated by a duration of $\frac{3}{2}$. This means that traditional rhythmic notation like whole notes through

⁹I have mostly seen plugins related to layout spacing and harmonic analysis, but it is my understanding that there are more capabilities available.

¹⁰<http://www2.siba.fi/PWGL/>

¹¹<http://repmus.ircam.fr/openmusic/home>

¹²<https://www.musicxml.com/>

¹³Incidentally, my first serious attempt to learn Abjad stems exactly from the fact that neither Finale 2012 nor Dorico 1 could convert MusicXML files I had created in OpenMusic 6.12. OMLily was the salvation of this music, but engraving features of the score other than pitch and rhythm proved tedious.

¹⁴This is possible because Lilypond inherently has no GUI and writing text files is the intended user interaction with the program. It is also possible because Lilypond is open source. Abjad could potentially be reworked to engrave music with a different engine, but Lilypond was and still is the most feasible option.

¹⁵Often, composers use OpenMusic's RTM syntax which is comprised of LISP-like nested lists like the following, which does not model rhythm in the way described in this paragraph: $(1 (3 (2 (1 2 -1 1)) 3))$

sixty-fourth notes and beyond are written as usual, but are prolated by a surrounding tuplet bracket with a given duration. Abjad follows, as much as possible, the same conventions as Lilypond’s notational model.

1.1.3 CONTEXT CONCATENATION

Lilypond also has a feature referred to as “Context Concatenation.” A context in Lilypond can be thought of as a staff with various features and formats associated with it. When given a name, a context is able to be appended to another context with the same name, as long as the files share the same score structure.¹⁶

This allows the composer to write various sections of a piece in isolation and to stitch them together into a final document as a secondary process. Users should note a similarity between Lilypond syntax and \LaTeX ¹⁷ syntax, both of which share conceptual similarities with HTML¹⁸ code. The following is a simple example of Lilypond syntax containing an unusual tuplet:¹⁹

```

1 \version "2.19.82"
2 \language "english"
3 \score {
4   \new Staff
5   { \times 2/9{
6     c'8
7     cs'8
8     d'4.
9     ef'8
10    \times 3/2 {
11      e'8
12      f'8    }
13    }
14    fs'8
15    g'8
16    af'4
17    a'4  }
18 }

```

Code Example 1.1: Lilypond syntax

¹⁶i.e. instrumentation as well as other invisible contexts

¹⁷<https://www.latex-project.org/>

¹⁸<https://www.w3.org/html/>

¹⁹Note that it should be clear from this example that it is no more difficult to engrave this unusual tuplet than a regular triplet of straight eighth notes.

1.2 PYTHON

IN PYTHON, there are a number of data types. Some of the important data types to address when discussing Abjad are integers, floating-point decimals, booleans, variables, strings, lists, tuples, and dictionaries. Each of these data types have specific features and behave in characteristic ways. Both integers and floating-point decimals, often called floats, are numbers. Integers can be used to signify numeric value in whole numbers while floats offer a more refined gradation of values. Variables are names that are assigned to other values or processes. With variables, users are able to refer to elements throughout a file without rewriting the information many times by hand.

1.2.1 LISTS

1.2.1.1 SLICING

An important process to comprehend when composing with Abjad is that of list manipulation.²⁰ There are many processes that can be performed on and with lists. The concept of slicing will be discussed first. Readers vaguely familiar with Python may recognize the format $[x : y]$ when referring to slicing a list. In Python, the programmer can refer to items within a list via their indices. The index is the location within a list where an item exists. These indices begin at zero. An example set of indices is $[0, 1, 2, 3, 4, 5]$,²¹ but the Python slices $[x : y]$ do not refer to items, even though indices do refer to items. The indicators within a slice actually refer to the spaces between items. It is possible to test this principle as follows:²²

```
1 >>> letters = ['a', 'b', 'c', 'd', 'e', 'f']
2 >>> print(letters[2])
```

Code Example 1.2: Printing an item of a list through indexing

Which results in:

²⁰In fact, most of the work composers do when using Abjad involves storing and manipulating data in lists and dictionaries. Most elements of the score end up in a list at some point.

²¹It is also possible to use a negative index. The first element of a list is still index 0, but the final element of the list is -1.

²²This explanation comes from an email sent by Trevor Bača to the Abjad mailing list.

```
1 c
```

Code Example 1.3: Printing an item of a list through indexing: RESULT

but:

```
1 >>> letters = ['a', 'b', 'c', 'd', 'e', 'f']
2 >>> print(letters[0:2])
```

Code Example 1.4: Printing items of a list through slicing

results in:

```
1 a
2 b
```

Code Example 1.5: Printing items of a list through slicing: RESULT

The following example presents a logical pitfall:

```
1 >>> letters = ['a', 'b', 'c', 'd', 'e', 'f']
2 >>> letters[-1:1] = 'xyz'
3 >>> print(letters)
```

Code Example 1.6: Inserting elements into a list through slicing

Which will result in:

```
1 ['a', 'b', 'c', 'd', 'e', 'x', 'y', 'z', 'f']
```

Code Example 1.7: Inserting elements into a list through slicing: RESULT

It is demonstrated here that, in fact, this slicing refers to the continuous space between -1 and 1. The direction proceeds from right to left because the slice was begun with a negative number.

1.2.1.2 LIST COMPREHENSIONS

Another of the many actions that are able to be performed on lists is that of list comprehension. List comprehensions allow the programmer to quickly create lists whose contents follow simple parameters. Consider the built-in Python function `range()`, which allows the user to increment integers up until the user-input point. If Python were asked to print each item within `range(5)`, then 0, 1, 2, 3, and 4 would be written to the terminal. A list comprehension could be written as follows:

```

1 >>> foo = [x for x in range(5)]
2 >>> print(foo)

```

Code Example 1.8: Creating a list with a list comprehension

Which will result in:

```

1 [0, 1, 2, 3, 4]

```

Code Example 1.9: Creating a list with a list comprehension: RESULT

It is also possible to act upon the elements within this list:

```

1 >>> bar = [x*3 for x in range(5)]
2 >>> print(bar)

```

Code Example 1.10: Acting upon elements in a list comprehension

Which will result in:

```

1 [0, 3, 6, 9, 12]

```

Code Example 1.11: Acting upon elements in a list comprehension: RESULT

This process can be substituted by a “for loop,” which is useful for more complicated functions, but can be overly verbose for processes better handled by list comprehensions:

```

1 >>> increments = range(5)
2 >>> spam = []
3 >>> for x in increments:
4 ...     spam.append(x*3)
5 >>> print(spam)

```

Code Example 1.12: Rewriting a list comprehension as a “for loop”

In this example, the built-in function *append()* is used. It is important to make a distinction between *append()* and *extend()*. This can be illustrated as follows:

```

1 >>> list_1 = [0, 1, 2, 3]
2 >>> list_2 = [4, 5, 6, 7]
3 >>> list_1.append(list_2)
4 >>> print(list_1)

```

Code Example 1.13: Appending elements to a list

Which results in:

```

1 [0, 1, 2, 3, [4, 5, 6, 7]]

```

Code Example 1.14: Appending elements to a list: RESULT

but:

```
1 >>> list_1 = [0, 1, 2, 3]
2 >>> list_2 = [4, 5, 6, 7]
3 >>> list_1.extend(list_2)
4 >>> print(list_1)
```

Code Example 1.15: Extending a list with elements

results in:

```
1 [0, 1, 2, 3, 4, 5, 6, 7]
```

Code Example 1.16: Extending a list with elements: RESULT

1.2.2 DICTIONARIES

A dictionary is much like a list, but in the case of a dictionary, elements of the list are referred to by keys:

```
1 musician = {'name': 'Greg', 'instrument': 'cello', 'age': 24}
2 print(musician['instrument'])
```

Code Example 1.17: Printing elements from a dictionary

resulting in:

```
1 cello
```

Code Example 1.18: Printing elements from a dictionary: RESULT

Is is not possible to refer to elements in the dictionary from the right side of the key. The following example produces an error:

```
1 musician = {'name': 'Greg', 'instrument': 'cello', 'age': 24}
2 print(musician['cello'])
```

Code Example 1.19: Printing elements from a dictionary: ERROR

To make this kind of cross-definition work, the user must add the keys in reverse as follows:

```
1 musician = {'name': 'Greg', 'instrument': 'cello', 'age': 24, 'Greg': 'name', 'cello': 'instrument', 24: 'age'}
2 print(musician['cello'])
```

Code Example 1.20: Printing elements from a dictionary: CORRECTION

1.2.2.1 DICTIONARY COMPREHENSIONS

Dictionary comprehensions are also possible and follow the same structure as list comprehensions:

```
1 keys = ['Name', 'Instrument', 'Age']
2 definitions = ['Greg', 'Cello', 24]
3 musician = {key:definition for key, definition in zip(keys, definitions)}
4 print(musician)
```

Code Example 1.21: Making a dictionary comprehension

resulting in:

```
1 {'Name': 'Greg', 'Instrument': 'Cello', 'Age': 24}
```

Code Example 1.22: Making a dictionary comprehension: RESULT

1.2.3 MODELLING OBJECTS

One of the most attractive features of Abjad is that the system allows for the formalization of structures to control the placement and distribution of dynamics, articulations, and in fact, every visual element of the score. This is because Abjad attempts to model music notation rather than musical phenomenology. It treats all elements in a musical score as an object. An object in programming has various attributes and potential modes of behavior. An example of object modelling can be seen in the creation of animals. A first step is to create a general template on which the animals are based.

```
1 >>> class Animal:
2 ...     def __init__(self):
```

Code Example 1.23: Creating an empty class in python

Attributes can be added to the basic animal in the `__init__` section.

```
1 >>> class Animal:
2 ...     def __init__(self, name, color, pattern):
```

Code Example 1.24: Adding attributes to classes

In order to retrieve the information that is placed in these attributes, the user must add the following below the `__init__` section:

```

1 >>> class Animal:
2 ...     def __init__(self, name, color, pattern):
3 ...         self.name = name
4 ...         self.color = color
5 ...         self.pattern = pattern

```

Code Example 1.25: Defining attributes in classes

Now that an Animal object has been created, the programmer can begin to create individual animal types. One could create many animal objects to represent the menagerie, but a possible intermediate step would be to create a sub-class of the Animal. For instance, one could create a cat based on the general animal by doing the following:

```

1 >>> class Cat(Animal):

```

Code Example 1.26: Creating a subclass

This cat has all of the same attributes that the general animal has. It is also possible to write functions to be included only in a specific sub-class:

```

1 >>> class Cat(Animal):
2 ...     def speak(self):
3 ...         print('Purr...')

```

Code Example 1.27: Adding methods to a subclass

Likewise, other animals can be created in the same fashion:

```

1 >>> class Dog(Animal):
2 ...     def speak(self):
3 ...         print('Woof...')
4 >>> class Giraffe(Animal):
5 ...     def speak(self):
6 ...         print('...giraffe sounds?')

```

Code Example 1.28: Creating more subclasses

Once the programmer has created objects to model different types of animals, specific animals with names, colors, and coat patterns can be defined by creating an instance of the animal objects.

```

1 >>> huckle = Cat('huckle', 'orange', 'tabby')
2 >>> ginger = Dog('ginger', 'tan', 'fluffy')
3 >>> spooks = Cat('spooks', 'grey', 'tabby')
4 >>> geoffrey = Giraffe('geoffrey', 'brown and yellow', 'spotted')

```

Code Example 1.29: Instantiating objects with attribute values

These object instances can be queried for certain information:

```
1 >>> print('Huckle is ' + huckle.color)
2 >>> print('Spooks is a ' + spooks.pattern)
3 >>> print('The dog's name is ' + ginger.name)
4 >>> print('Geoffrey is ' + geoffrey.color)
5 >>> huckle.speak()
6 >>> spooks.speak()
7 >>> ginger.speak()
8 >>> geoffrey.speak()
```

Code Example 1.30: Interacting with objects

Which results in the following output at the terminal:

```
1 Huckle is orange
2 Spooks is a tabby
3 The dog's name is ginger
4 Geoffrey is brown and yellow
5 Purr...
6 Purr...
7 Woof!
8 ...giraffe sounds?
```

Code Example 1.31: Interacting with objects: RESULT

Working with Python quickly becomes very complex, depending on the needs of the programmer, but much can be accomplished with an understanding of Python's data types, lists, dictionaries, and object modelling. In the following chapter, concepts in Lilypond and Python pertaining specifically to Abjad will be introduced in the context of my own use of the software for my compositional process.

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One of the most significant areas of investigation in live instrumental music - that pertaining to the degree of approximation attained in any given realization of a particular type of musical text - offers itself most directly for transference into the computer studio, by reason of the obviously significant extent to which the concept of efficiency (in both human and computer terms) is (at least in real time) self-contradictory.
(1998, *Composer-Computer-Active Form* par.3)

Brian Ferneyhough

2

My Compositional Practice With Abjad, Lilypond, and Python

2.1 METHODOLOGY

IN THE PRECEDING CHAPTER, I presented some of the strengths and potential weaknesses of Abjad and Lilypond when compared with similar programming paradigms, as well as some potential logical pitfalls when working with these programs. In my recent compositional practice, I have begun to amalgamate a workflow out of the ecosystem of Python, Abjad, and Lilypond, by learning from and embracing the idiosyncrasies of each. The use of these tools in tandem is advantageous for my work due to the flexibility of Lilypond's notational algorithm and Abjad's clarification of Lilypond's model of music notation through Python's object-oriented nature, as well as Python's vast logical and mathematical abilities. Not only are Abjad and Lilypond both full of diverse features, but due to their open source nature, the source code for each is accessible to the user for further modification. Occasionally, I have found the need to tweak Abjad's source code in order for it to perform functions that I desire, but more often than this, the composer will find the need to build tools to simplify the process of engraving.

In my work, I often desire a structural rigor, where rhythms, pitches, and orchestration, among other

parameters are balanced together by a plan or logic that gives meaning to potential musical realities. A rigorous structure tends to fall apart when constructed by hand because humans are prone to err, while computers, conversely, do not make mistakes unless they are taught a false procedure. The computer does not have the ability to produce a logical fallacy unless the error is programmed into its underlying functionality. Because of this, working with the Python programming language allows for a consistency in formal rigor that might be otherwise unattainable by intuition or hand-written calculations and graphs. It also allows for the potential modeling of complex systems and algorithmic music, where human intuition is placed in a more subordinate role to formal design.

Lilypond's ability to draw lines and shapes, and its less restrictive model of notation than other software, allow the composer to have greater graphic freedom than other notation software. Another notable feature of Lilypond is its lack of a GUI,²³ allowing the program more memory power when calculating spacing to avoid collisions, which results in greater visual clarity upon the first engraving of a piece. Also, since it allows the user to include functions in the Scheme programming language,²⁴ the user is able to affect other features like proportional spacing across an entire score instead of manually clicking and dragging note heads as one would do while using Finale or Sibelius. Lilypond has the ability to manage all visual aspects of a score and can also be used to export image files in the *pdf* and *png* formats, along with *midi* files. Finally, a great feature of Lilypond is its context concatenation ability. As mentioned in the previous chapter, this allows multiple, separate Lilypond files to be combined with one another to stitch together separate segments of a full composition into one document.

An advantage to the Abjad composition paradigm is its ability to manage polyphony. Other programming paradigms like PWGL or OM are a little more restrictive in this regard. Often, in PWGL and OM, using a procedure in one instrument as well as the next requires the user to instantiate a function multiple times and to alter the settings of the function in order for the music to seem continuous.²⁵ This duplication of processes that were carried out in other voices clutters up the workspace with redundant

²³ Graphic User Interface

²⁴ <https://www.scheme.com/>

²⁵ This issue would be solved with generators, but functions in OpenMusic don't naturally behave in this way. Admittedly, I do not know LISP very well and never wrote my own LISP functions in OM.

information. In Abjad, the two concepts of copying and continuing are very distinct,²⁶ allowing the composer to specifically use either technique as needed. Since Abjad is an API,²⁷ in Python, it becomes very easy to cross-reference the same material-generating functions across different voices and at different points in time within the score. This comes from the fact that the music composed with Abjad is written as a text file, allowing composers to create and manipulate any object or function they choose; whereas programs like PWGL and OM are slightly restricted by their GUI. Though there are ways for composers to write their own functions in these programs, they are more difficult to manipulate and it is not entirely obvious to a beginner that it is even possible to do so. Because Abjad has no GUI, it inherently invites the composer to write the source code as part of the act of composition.

Though one could theoretically compose an entire score and only compile the Python file once the score is finalized, Abjad allows for an iterative workflow of composing, compiling, critiquing, and correcting in a cycle that lasts until the composer is satisfied with the composition. The speed of modern computation as opposed to hand written calculation and engraving makes this workflow reasonable.

In Abjad, elements of a score are modeled as Python objects. Some objects, like a note or a rest for instance, have a duration attribute, but a note has an attribute that a rest does not: pitch. All elements of the score are objects with properties and attributes, therefore the entire score is manipulable via Abjad and, by extension, various formal means. This is a feature that is not present in OM and is difficult to achieve in PWGL, as OM does not display articulations or dynamics within the score viewing windows and PWGL's interface is difficult to read.²⁸ This is, in part, because these programs have different foci and goals. OM is typically used like a calculator for composers to generate options for materials with which to compose and PWGL, while able to export data to other notation engines, is equipped with its own ENP,²⁹ with which music is rendered. Both OM and PWGL are based on CLOS,³⁰ but I believe that the legibility of Python scripts as well as the large number of Python programmers makes it a much better candidate

²⁶This distinction, as mentioned earlier, comes from whether or not the programmer retrieves data from a generator or another reservoir.

²⁷Application Programming Interface

²⁸Although many composers have had success with PWGL, its user interface has always seemed too cluttered to me and I have not explored it as thoroughly as I have OpenMusic.

²⁹Expressive Notation Package

³⁰Common LISP Object System

for the user-end of the system allowing for easy transference of knowledge from one user to another. The objects of notational elements are capable of being manipulated, therefore they can be created, connected, and appended to one another throughout the composition process to create a score through composer-written procedures and functions as well as through built-in tools. In the end, the greatest strength of this ecosystem is its flexibility.

In this chapter, I will discuss the compositional advantages of working with these programs such as how to automate potentially tedious tasks, the benefits of an iterative compositional workflow, and the possibilities for composing with algorithms or models. I will also explain some of my own solutions to composing with Abjad, like my *MusicMaker* and *AttachmentHandlers* classes as well as times when I have edited the Abjad source code.

2.1.1 THE USEFULNESS OF ABJAD FOR ME AS A COMPOSER

In my recent music, it is typical for me to focus significantly on formal uniformity and continuous, alternating procedures. These procedures might be in relation to the rhythmic, harmonic, textural, or dynamic material. I have also become very interested in a pseudo-tablature style of notation that features these iterative, procedural factors. It became apparent to me that I could leverage the programming concepts of loops and functions to write music very quickly. With this methodology I have written various programs that organize and produce musical material based on my predetermined structures, allowing me to compose material and generate the product of these procedures quickly. In the course of working in this manner, I have begun to appreciate the necessity of externalizing various tools in order to clean up my composition files. These tools, as well as my general compositional templates, could also easily be used by other composers, but they are tailored explicitly to my own compositional needs. Not only do my tools written in Python help me stay consistent with my formal designs, they also allow me to compose music that is specifically organized to my own tendencies and logic, rather than copying another composer's tools and workflow. Although I have benefited greatly from the programs I have written, they are a work in progress and may not necessarily have universal functionality.³¹

³¹ All code examples in this paper are written in Python 3, Abjad 3.1, and Lilypond 2.19.82.

2.1.2 AUTOMATING POTENTIALLY TEDIOUS TASKS

2.1.2.1 CREATING NOTES

There are two options for creating and viewing notes with Abjad. One could open up the terminal, or command line, and activate a Python session in order to write the code or alternatively, it is possible to write code in a text file saved with the *.py* suffix and call Python to compile it once the file is completed. The former method is better for quick testing of loops and materials, while the second method is much more sustainable for the process of composing a score, because it allows the programmer to save progress as well as multiple versions of the code along the way. Regardless of which method is chosen, the code is written in the same way. The first step is always to import the Abjad API into the python session or file so that all of Abjad's tools and properties are available. There are several ways of doing this, but the key to clarity is to be consistent. Throughout this chapter I will use this format:

```
1 >>> import abjad
```

Code Example 2.1: Import statement format

This tells Python to instantiate tools through the Abjad namespace. Doing this requires that all Abjad objects be prefixed with *abjad.* followed by whatever object or tool is being used. Thus, a note object will look like this:

```
1 >>> abjad.Note()
```

Code Example 2.2: Format for object instantiation

This note can be given a variable name with which the user is able to refer to the note throughout the file and *abjad.show()* can be used to quickly produce a *pdf* file of this note:

```
1 >>> import abjad
2 >>> note = abjad.Note()
3 >>> abjad.show(note)
```

Code Example 2.3: Showing an *abjad.Note()* object

This Abjad code will produce a Lilypond file containing the following text:

```
1 \version "2.19.82"  %! LilyPondFile
2 \language "english" %! LilyPondFile
3
```

```

4 \header { %! LilyPondFile
5     tagline = ##f
6 } %! LilyPondFile
7
8 \layout {}
9
10 \paper {}
11
12 \score { %! LilyPondFile
13     {
14         c'4
15     }
16 } %! LilyPondFile

```

Code Example 2.4: Showing an instance of an *abjad.Note()* object: RESULT

and will produce the image in a pdf file seen in figure 2.1.1:



Figure 2.1.1: A default note.

Notice that the note object has various default values associated with it. The note is rendered with a pitch value of middle c and a duration value of one quarter note. Easily enough, these values are manipulable! Instead, the following could have been written:³²

```

1 >>> import abjad
2 >>> note = abjad.Note(11, abjad.Duration(1, 8))
3 >>> abjad.show(note)

```

Code Example 2.5: Altering default values in an instance *abjad.Note()* object

from which the image in figure 2.1.2 and the following Lilypond code would be received:

```

1 \score { %! LilyPondFile
2     {
3         b'8
4     }
5 } %! LilyPondFile

```

Code Example 2.6: Altering default values in an instance *abjad.Note()* object: RESULT



Figure 2.1.2: A note with the user-input duration value of (1, 8) and pitch value of 11.

The following are a few strategies for making many notes in a row in order to create a piece. First, a staff and notes should be created. Then, the staff will be filled with notes and finally, the staff will be shown.

Here is one way this can be done:

```

1 >>> import abjad
2 >>> note_1 = abjad.Note(0, abjad.Duration(1, 4))
3 >>> note_2 = abjad.Note(1, abjad.Duration(1, 4))
4 >>> note_3 = abjad.Note(2, abjad.Duration(1, 2))
5 >>> notes = [note_1, note_2, note_3]
6 >>> staff = abjad.Staff(notes)
7 >>> abjad.show(staff)

```

Code Example 2.7: Populating a staff with notes

from which the user would receive figure 2.1.3 and the following Lilypond code:

```

1 \score { %! LilyPondFile
2   \new Staff
3   {
4     c'4
5     cs'4
6     d'2
7   }
8 } %! LilyPondFile

```

Code Example 2.8: Populating a staff with notes: RESULT



Figure 2.1.3: A staff with notes of varying pitch and duration.

As one might begin to suspect, this process of note creation can get quite tedious. Here is one possible

³²http://abjad.mbrsi.org/appendices/pitch_conventions.html

alternative approach to writing code with Abjad which is more economical for a longer piece:

```

1 >>> import abjad
2 >>> numerators = [1, 1, 1, 1, 1, 1, 1, 3, 1, 1, 1, 1, ]
3 >>> denominators = [4, 4, 2, 8, 8, 4, 16, 16, 16, 16, 16, ]
4 >>> durations = [abjad.Duration(y, z) for y, z in zip(numerators, denominators
5 )]
6 >>> pitches = [0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11]
7 >>> notes = [abjad.Note(x, y) for x, y in zip(pitches, durations)]
8 >>> note_staff = abjad.Staff(notes)
9 >>> abjad.show(note_staff)

```

Code Example 2.9: Faster note creation

Here, the use of `zip()` can be seen as well as a list comprehension. With `zip()` the programmer creates a list of numerators and denominators organized as tuples to represent fractions:

```

1 [(1, 4), (1, 4), (1, 2), (1, 8), (1, 8), (1, 4), (1, 16), (3, 16), (1, 16),
2  (1, 16), (1, 16), (1, 16),]

```

Code Example 2.10: Tuple zip: RESULT

and with this list comprehension a list of duration objects based on those fractions is returned:

```

1 >>> [abjad.Duration(y, z) for y, z in zip(numerators, denominators)]

```

Code Example 2.11: Duration list comprehension

resulting in:

```

1 [abjad.Duration((1, 4)), abjad.Duration((1, 4)), abjad.Duration((1, 2)), abjad.
2  .Duration((1, 8)), abjad.Duration((1, 8)), abjad.Duration((1, 4)), abjad.
3  .Duration((1, 16)), abjad.Duration((3, 16)), abjad.Duration((1, 16)), abjad.
4  .Duration((1, 16)), abjad.Duration((1, 16)), abjad.Duration((1, 16)),]

```

Code Example 2.12: Duration list comprehension: RESULT

Again, two lists are zipped together, these being the list of pitches and the list of durations:

```

1 [(0, abjad.Duration((1, 4))), (1, abjad.Duration((1, 4))), (2, abjad.Duration
2  ((1, 2))), (3, abjad.Duration((1, 8))), (4, abjad.Duration((1, 8))), (5,
3  abjad.Duration((1, 4))), (6, abjad.Duration((1, 16))), (7, abjad.Duration
4  ((3, 16))), (8, abjad.Duration((1, 16))), (9, abjad.Duration((1, 16))),
5  (10, abjad.Duration((1, 16))), (11, abjad.Duration((1, 16))),]

```

Code Example 2.13: Pitch and duration zip: RESULT

and a note object is created for every pitch and duration in this list with a list comprehension:

```

1 [abjad.Note(0, abjad.Duration((1, 4))), abjad.Note(1, abjad.Duration((1, 4))),
   abjad.Note(2, abjad.Duration((1, 2))), abjad.Note(3, abjad.Duration((1,
   8))), abjad.Note(4, abjad.Duration((1, 8))), abjad.Note(5, abjad.Duration
   ((1, 4))), abjad.Note(6, abjad.Duration((1, 16))), abjad.Note(7, abjad.
   Duration((3, 16))), abjad.Note(8, abjad.Duration((1, 16))), abjad.Note(9,
   abjad.Duration((1, 16))), abjad.Note(10, abjad.Duration((1, 16))), abjad.
   Note(11, abjad.Duration((1, 16))),]

```

Code Example 2.14: Note object list comprehension: RESULT

this list of notes is placed inside of a staff and the staff is shown.

```

1 >>> note_staff = abjad.Staff(notes)
2 >>> abjad.show(note_staff)

```

Code Example 2.15: Showing the staff

From this process, figure 2.1.4 along with the following Lilypond output are produced:

```

1 \score { %! LilyPondFile
2   \new Staff
3   {
4     c'4
5     cs'4
6     d'2
7     ef'8
8     e'8
9     f'4
10    fs'16
11    g'8.
12    af'16
13    a'16
14    bf'16
15    b'16
16  }
17 } %! LilyPondFile

```

Code Example 2.16: Showing the staff: RESULT



Figure 2.1.4: A staff with many notes.

If this kind of process is extrapolated, one can begin to create loops³³ to handle tasks of every shape and size. Because this process can be arduous at times, Abjad is equipped with a number of tools out of the

³³a “loop,” or “for loop” is the name of a kind of function structure.

box to assist in processes like note creation such as *abjad.LeafMaker()*, *abjad.NoteMaker()*, *abjad.MeasureMaker()*, and *abjad.SegmentMaker()*. While these features are useful and are at the heart of many other tools like the Abjad-ext package *rmakers*, it is important to realize that it is not necessary to rely on these built-in functions to be able to write music with Abjad.

2.1.2.2 DYNAMICS, ARTICULATIONS, AND HAIRPINS

Just like the creation of note objects, one can also simplify and formalize the attachment of dynamics:

```

1 >>> import abjad
2 >>> dynamic_staff = abjad.Staff()
3 >>> dynamic_staff.extend(r"{'c'4 cs'4 d'2}")
4 >>> piano = abjad.Dynamic('p')
5 >>> mezzo_forte = abjad.Dynamic('mf')
6 >>> forte = abjad.Dynamic('f')
7 >>> abjad.attach(piano, dynamic_staff[0])
8 >>> abjad.attach(mezzo_forte, dynamic_staff[1])
9 >>> abjad.attach(forte, dynamic_staff[2])
10 >>> abjad.show(dynamic_staff)

```

Code Example 2.17: Attaching dynamics

resulting in figure 2.1.6 and the following Lilypond code:

```

1 \score { %! LilyPondFile
2   \new Staff
3   {
4     c'4
5     \p
6     cs'4
7     \mf
8     d'2
9     \f
10  }
11 } %! LilyPondFile

```

Code Example 2.18: Attaching dynamics: RESULT

Simplifying this further by making use of a loop to attach the dynamics to each leaf³⁴ in the staff, dynamic objects can be created and attached at once:

```

1 >>> import abjad
2 >>> new_staff = abjad.Staff()

```

³⁴http://abjad.mbrsi.org/core_concepts/lcsi.html

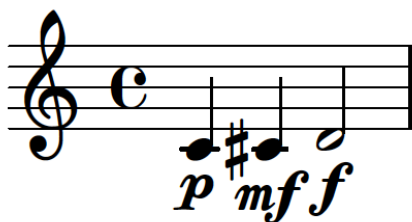


Figure 2.1.5: Notes with dynamics.

```

3 >>> new_staff.extend(r"c'4 cs'4 d'2 ef'8 e'8 f'4 fs'16 g'8. af'16 a'16 bf'16 b
   '16")
4 >>> dynamics = ['niente', 'pppp', 'ppp', 'pp', 'p', 'mp', 'mf', 'f', 'ff', '
   fff', 'ffff', 'sfz', ]
5 >>> leaves = abjad.select(new_staff).leaves()
6 >>> for leaf, dynamic in zip(leaves, dynamics):
7 ...     abjad.attach(abjad.Dynamic(dynamic), leaf)
8 >>> abjad.show(new_staff)

```

Code Example 2.19: Attaching more dynamics

resulting in the Lilypond code and figure: 2.1.6:

```

1 \score { %! LilyPondFile
2   \new Staff
3   {
4     c'4
5     _ #(make-dynamic-script (markup #:whiteout #:normal-text #:italic "
   niente"))
6     cs'4
7     \pppp
8     d'2
9     \ppp
10    ef'8
11    \pp
12    e'8
13    \p
14    f'4
15    \mp
16    fs'16
17    \mf
18    g'8.
19    \f
20    af'16
21    \ff
22    a'16
23    \fff
24    bf'16
25    \ffff
26    b'16
27    \sfz
28  }

```

```
29 } %! LilyPondFile
```

Code Example 2.20: Attaching more dynamics: RESULT

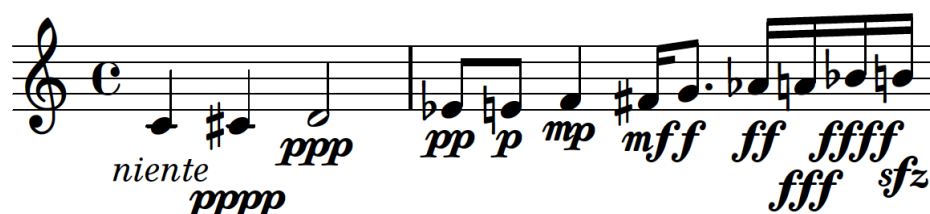


Figure 2.1.6: More notes with dynamics.

It can be seen that dynamics behave in the same way as other attachable objects. This is also true of articulations and hairpins. In the following example, articulations and hairpins are attached to leaves as well, featuring a possible way to imbue some behavioral qualities into the attachment of these elements.

```
1 >>> import abjad
2 >>> music_staff = abjad.Staff()
3 >>> music_staff.extend(r"c'4 cs'4 d'2 r4 ds'2. e'8 f'8 fs'8 g'8 gs'8 r4. a'1")
4 >>> for run in abjad.select(music_staff).runs():
5 ...     if len(run) > 3:
6 ...         leaves = abjad.select(run).leaves()
7 ...         abjad.attach(abjad.Dynamic('mf'), run[0])
8 ...         for leaf in leaves:
9 ...             abjad.attach(abjad.Articulation('tenuto'), leaf)
10 ...     elif len(run) == 3:
11 ...         abjad.attach(abjad.Dynamic('f'), run[0])
12 ...         abjad.attach(abjad.StartHairpin('>'), run[0])
13 ...         abjad.attach(abjad.Dynamic('mp'), run[-1])
14 ...     elif len(run) == 1:
15 ...         abjad.attach(abjad.Dynamic('ppp'), run[0])
16 >>> abjad.show(music_staff)
```

Code Example 2.21: Attaching dynamics through an algorithm

resulting in the Lilypond code and figure 2.1.7:

```
1 \score { %! LilyPondFile
2   \new Staff
3   {
4     c'4
5     \f
6     \>
7     cs'4
8     d'2
9     \mp
```

```

10         r4
11         e'2
12         \mf
13         - \tenuto
14         f'8
15         - \tenuto
16         g'8
17         - \tenuto
18         a''8
19         - \tenuto
20         b''8
21         - \tenuto
22         c''8
23         - \tenuto
24         r4
25         c''2.
26         \ppp
27     }
28 } %! LilyPondFile

```

Code Example 2.22: Attaching dynamics through an algorithm: RESULT



Figure 2.1.7: Notes with algorithmic dynamics.

This loop analyzes the length of each run in the staff and chooses what dynamics and articulations to attach based on the result. This is an extremely powerful method for attaching indicators throughout a score. Next, I will introduce a procedure to handle the *abjad.BowContactPoint()* object, which produces a more complex Lilypond result and graphic.³⁵

2.1.2.3 USING `ABJAD.BOWCONTACTPOINT()`

The `abjad.BowContactPoint()` object and an accompanying factory function,

`abjad.bow_contact spanner()`, are tools that are able to annotate a staff of notes with fractions intended to

³⁵For clean and legible notation, users will want to edit the Lilypond context in which this notation occurs to remove clefs and staff lines. An example of this can be seen in the following section on *Stylesheets*. In order to avoid confusion, examples featuring the *abjad.BowContactPoint* too are engraved with the default staff context.

represent points along the length of a bow.³⁶ Native in these tools is the ability to calculate whether one fraction is greater or lesser than its surrounding fractions and attach an “up-bow” or “down-bow” marking as needed. Because of this feature, I created a file in Abjad 2.2.1 which I called *abjad.StringContactSpanner* which eliminated the bow markings in order for it to be used universally for any potential parameter. This file was adapted by Trevor Bača into Abjad 3.1’s *abjad.BowContactPoint()* which features an optional keyword to include or exclude these bowings. Here is a possible way to use these tools:

```

1 >>> import abjad
2 >>> bow_staff = abjad.Staff()
3 >>> bow_staff.extend(r"c'4 c'4 c'4 c'4")
4 >>> indicator_1 = abjad.BowContactPoint((3, 3))
5 >>> indicator_2 = abjad.BowContactPoint((2, 3))
6 >>> indicator_3 = abjad.BowContactPoint((1, 3))
7 >>> indicator_4 = abjad.BowContactPoint((0, 3))
8 >>> abjad.attach(indicator_1, bow_staff[0])
9 >>> abjad.attach(indicator_2, bow_staff[1])
10 >>> abjad.attach(indicator_3, bow_staff[2])
11 >>> abjad.attach(indicator_4, bow_staff[3])
12 >>> abjad.bow_contact_spanner(bow_staff, omit_bow_changes=True)
13 >>> abjad.show(bow_staff)

```

Code Example 2.23: Bow tablature

resulting in the Lilypond code:

```

1 \score { %! LilyPondFile
2   \new Staff
3   {
4     \tweak Y-offset #2.0
5     \tweak stencil #ly:text-interface::print
6     \tweak text \markup {
7       \center-align
8       \vcenter
9       \fraction
10      1
11      1
12    }
13    c'4
14    \glissando
15    \tweak Y-offset #0.6666666666666666
16    \tweak stencil #ly:text-interface::print
17    \tweak text \markup {
18      \center-align
19      \vcenter
20      \fraction
21      2

```

³⁶It makes no difference what pitches are in the staff because the note heads are removed by the tool.


```

22           3
23       }
24   c '4
25   \glissando
26   \tweak Y-offset #-0.6666666666666666
27   \tweak stencil #ly:text-interface::print
28   \tweak text \markup {
29       \center-align
30       \vcenter
31       \fraction
32           1
33           3
34   }
35   c '4
36   \glissando
37   \tweak Y-offset #-2.0
38   \tweak stencil #ly:text-interface::print
39   \tweak text \markup {
40       \center-align
41       \vcenter
42       \fraction
43           0
44           1
45   }
46   c '4
47   }
48 } %! LilyPondFile

```

Code Example 2.24: Bow tablature: RESULT

and figure 2.1.8:



Figure 2.1.8: Bow tablature.

In the resultant Lilypond code are several, lengthy *\tweak* commands. Composing a score in Lilypond where an instrument has two staves, one of which is a bowing tablature that uses notation similar to what is produced by the *abjad.BowContactPoint()* tool would be even more tedious to write than the note creation process above, making this tool quite useful for speeding up the engraving process. The following examples are a few alternative methods that achieve this kind of notation in a similar manner of reduction as in the note creation examples:

```

1 >>> import abjad
2 >>> new_bow_staff = abjad.Staff()
3 >>> new_bow_staff.extend(r"c'4 c'4 c'2 c'8 c'8 c'4 c'16 c'8. c'16 c'16 c'16 c'16")
4 >>> indicator_1 = abjad.BowContactPoint((3, 3))
5 >>> indicator_2 = abjad.BowContactPoint((2, 3))
6 >>> indicator_3 = abjad.BowContactPoint((1, 3))
7 >>> indicator_4 = abjad.BowContactPoint((0, 3))
8 >>> indicator_5 = abjad.BowContactPoint((2, 3))
9 >>> indicator_6 = abjad.BowContactPoint((1, 3))
10 >>> indicator_7 = abjad.BowContactPoint((3, 3))
11 >>> indicator_8 = abjad.BowContactPoint((0, 3))
12 >>> indicator_9 = abjad.BowContactPoint((1, 3))
13 >>> indicator_10 = abjad.BowContactPoint((2, 3))
14 >>> indicator_11 = abjad.BowContactPoint((3, 3))
15 >>> indicator_12 = abjad.BowContactPoint((0, 3))
16 >>> indicators = [indicator_1, indicator_2, indicator_3, indicator_4,
17 ...             indicator_5,
18 ...             indicator_6, indicator_7, indicator_8, indicator_9, indicator_10,
19 ...             indicator_11, indicator_12, ]
20 >>> leaves = abjad.select(new_bow_staff).leaves()
21 >>> for leaf, indicator in zip(leaves, indicators):
22 ...     abjad.attach(indicator, leaf)
>>> abjad.bow_contact_spanner(new_bow_staff, omit_bow_changes=True)

```

Code Example 2.25: Extended bow tablature

resulting in the Lilypond code:

```

1 \score { %! LilyPondFile
2   \new Staff
3   {
4     \tweak Y-offset #2.0
5     \tweak stencil #ly:text-interface::print
6     \tweak text \markup {
7       \center-align
8       \vcenter
9       \fraction
10        1
11        1
12     }
13     c'4
14     \glissando
15     \tweak Y-offset #0.6666666666666666
16     \tweak stencil #ly:text-interface::print
17     \tweak text \markup {
18       \center-align
19       \vcenter
20       \fraction
21        2
22        3
23     }
24     c'4
25     \glissando

```

```

26 \tweak Y-offset #-0.6666666666666666
27 \tweak stencil #ly:text-interface::print
28 \tweak text \markup {
29   \center-align
30     \vcenter
31       \fraction
32         1
33         3
34   }
35 c'2
36 \glissando
37 \tweak Y-offset #-2.0
38 \tweak stencil #ly:text-interface::print
39 \tweak text \markup {
40   \center-align
41     \vcenter
42       \fraction
43         0
44         1
45   }
46 c'8
47 \glissando
48 \tweak Y-offset #0.6666666666666666
49 \tweak stencil #ly:text-interface::print
50 \tweak text \markup {
51   \center-align
52     \vcenter
53       \fraction
54         2
55         3
56   }
57 c'8
58 \glissando
59 \tweak Y-offset #-0.6666666666666666
60 \tweak stencil #ly:text-interface::print
61 \tweak text \markup {
62   \center-align
63     \vcenter
64       \fraction
65         1
66         3
67   }
68 c'4
69 \glissando
70 \tweak Y-offset #2.0
71 \tweak stencil #ly:text-interface::print
72 \tweak text \markup {
73   \center-align
74     \vcenter
75       \fraction
76         1
77         1
78   }
79 c'16

```

```

80 \glissando
81 \tweak Y-offset #-2.0
82 \tweak stencil #ly:text-interface::print
83 \tweak text \markup {
84   \center-align
85   \vcenter
86   \fraction
87     0
88     1
89 }
90 c'8.
91 \glissando
92 \tweak Y-offset #-0.6666666666666666
93 \tweak stencil #ly:text-interface::print
94 \tweak text \markup {
95   \center-align
96   \vcenter
97   \fraction
98     1
99     3
100 }
101 c'16
102 \glissando
103 \tweak Y-offset #0.6666666666666666
104 \tweak stencil #ly:text-interface::print
105 \tweak text \markup {
106   \center-align
107   \vcenter
108   \fraction
109     2
110     3
111 }
112 c'16
113 \glissando
114 \tweak Y-offset #2.0
115 \tweak stencil #ly:text-interface::print
116 \tweak text \markup {
117   \center-align
118   \vcenter
119   \fraction
120     1
121     1
122 }
123 c'16
124 \glissando
125 \tweak Y-offset #-2.0
126 \tweak stencil #ly:text-interface::print
127 \tweak text \markup {
128   \center-align
129   \vcenter
130   \fraction
131     0
132     1
133 }

```

```

134 c'16
135 }
136 } %! LilyPondFile

```

Code Example 2.26: Extended bow tablature: RESULT

and figure 2.1.9:

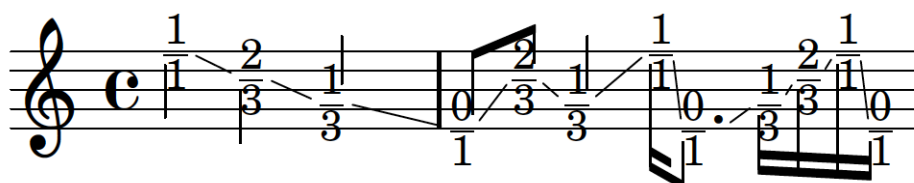


Figure 2.1.9: Extended bow tablature.

This example is very similar to the previous example, except for the fact that the process of attaching indicators to leaves has been streamlined. Here is another possibility:

```

1 >>> import abjad
2 >>> new_bow_staff = abjad.Staff()
3 >>> new_bow_staff.extend(r"c'4 c'4 c'4 c'4 c'4 c'4 c'4 c'4 c'4 c'4 c'4 c'4")
4 >>> numerators = [3, 2, 1, 0, 1, 2, 3, 2, 1, 3, 0, 1, ]
5 >>> indicators = [(abjad.BowContactPoint((numerator, 3))) for numerator in
6     numerators]
7 >>> leaves = abjad.select(new_bow_staff).leaves()
8 >>> for leaf, indicator in zip(leaves, indicators):
9     ...     abjad.attach(indicator, leaf)
10 >>> abjad.bow_contact_spanner(new_bow_staff, omit_bow_changes=True)
11 >>> abjad.show(new_bow_staff)

```

Code Example 2.27: Very long bow tablature

resulting in the Lilypond code and figure 2.1.10:

```

1 \score { %! LilyPondFile
2   \new Staff
3   {
4     \tweak Y-offset #2.0
5     \tweak stencil #ly:text-interface::print
6     \tweak text \markup {
7       \center-align
8       \vcenter
9       \fraction
10      1
11      1
12    }
13   c'4

```

```

14 \glissando
15 \tweak Y-offset #0.6666666666666666
16 \tweak stencil #ly:text-interface::print
17 \tweak text \markup {
18   \center-align
19     \vcenter
20       \fraction
21         2
22         3
23   }
24 c'4
25 \glissando
26 \tweak Y-offset #-0.6666666666666666
27 \tweak stencil #ly:text-interface::print
28 \tweak text \markup {
29   \center-align
30     \vcenter
31       \fraction
32         1
33         3
34   }
35 c'4
36 \glissando
37 \tweak Y-offset #-2.0
38 \tweak stencil #ly:text-interface::print
39 \tweak text \markup {
40   \center-align
41     \vcenter
42       \fraction
43         0
44         1
45   }
46 c'4
47 \glissando
48 \tweak Y-offset #-0.6666666666666666
49 \tweak stencil #ly:text-interface::print
50 \tweak text \markup {
51   \center-align
52     \vcenter
53       \fraction
54         1
55         3
56   }
57 c'4
58 \glissando
59 \tweak Y-offset #0.6666666666666666
60 \tweak stencil #ly:text-interface::print
61 \tweak text \markup {
62   \center-align
63     \vcenter
64       \fraction
65         2
66         3
67   }

```

```

68 c'4
69 \glissando
70 \tweak Y-offset #2.0
71 \tweak stencil #ly:text-interface::print
72 \tweak text \markup {
73     \center-align
74     \vcenter
75     \fraction
76         1
77         1
78 }
79 c'4
80 \glissando
81 \tweak Y-offset #0.6666666666666666
82 \tweak stencil #ly:text-interface::print
83 \tweak text \markup {
84     \center-align
85     \vcenter
86     \fraction
87         2
88         3
89 }
90 c'4
91 \glissando
92 \tweak Y-offset #-0.6666666666666666
93 \tweak stencil #ly:text-interface::print
94 \tweak text \markup {
95     \center-align
96     \vcenter
97     \fraction
98         1
99         3
100 }
101 c'4
102 \glissando
103 \tweak Y-offset #2.0
104 \tweak stencil #ly:text-interface::print
105 \tweak text \markup {
106     \center-align
107     \vcenter
108     \fraction
109         1
110         1
111 }
112 c'4
113 \glissando
114 \tweak Y-offset #-2.0
115 \tweak stencil #ly:text-interface::print
116 \tweak text \markup {
117     \center-align
118     \vcenter
119     \fraction
120         0
121         1

```



```

2 \new Staff
3 {
4     \tweak Y-offset #2.0
5     \tweak stencil #ly:text-interface::print
6     \tweak text \markup {
7         \center-align
8         \vcenter
9         \fraction
10            1
11            1
12     }
13     c'8
14     \glissando
15     \tweak Y-offset #0.6666666666666666
16     \tweak stencil #ly:text-interface::print
17     \tweak text \markup {
18         \center-align
19         \vcenter
20         \fraction
21            2
22            3
23     }
24     c'8
25     \glissando
26     \tweak Y-offset #-0.6666666666666666
27     \tweak stencil #ly:text-interface::print
28     \tweak text \markup {
29         \center-align
30         \vcenter
31         \fraction
32            1
33            3
34     }
35     c'8
36     \glissando
37     \tweak Y-offset #0.6666666666666666
38     \tweak stencil #ly:text-interface::print
39     \tweak text \markup {
40         \center-align
41         \vcenter
42         \fraction
43            2
44            3
45     }
46     c'8
47     \glissando
48     \tweak Y-offset #-0.6666666666666666
49     \tweak stencil #ly:text-interface::print
50     \tweak text \markup {
51         \center-align
52         \vcenter
53         \fraction
54            1
55            3

```

```

56     }
57     c'8
58     \glissando
59     \tweak Y-offset #-2.0
60     \tweak stencil #ly:text-interface::print
61     \tweak text \markup {
62         \center-align
63         \vcenter
64         \fraction
65             0
66             1
67     }
68     c'8
69     \glissando
70     \tweak Y-offset #2.0
71     \tweak stencil #ly:text-interface::print
72     \tweak text \markup {
73         \center-align
74         \vcenter
75         \fraction
76             1
77             1
78     }
79     c'8
80     \glissando
81     \tweak Y-offset #0.6666666666666666
82     \tweak stencil #ly:text-interface::print
83     \tweak text \markup {
84         \center-align
85         \vcenter
86         \fraction
87             2
88             3
89     }
90     c'8
91     \glissando
92     \tweak Y-offset #-2.0
93     \tweak stencil #ly:text-interface::print
94     \tweak text \markup {
95         \center-align
96         \vcenter
97         \fraction
98             0
99             1
100    }
101    c'8
102    \glissando
103    \tweak Y-offset #2.0
104    \tweak stencil #ly:text-interface::print
105    \tweak text \markup {
106        \center-align
107        \vcenter
108        \fraction
109            1

```

```

110             1
111         }
112     c'8
113     \glissando
114     \tweak Y-offset #-0.6666666666666666
115     \tweak stencil #ly:text-interface::print
116     \tweak text \markup {
117         \center-align
118         \vcenter
119         \fraction
120             1
121             3
122     }
123     c'8
124     \glissando
125     \tweak Y-offset #-2.0
126     \tweak stencil #ly:text-interface::print
127     \tweak text \markup {
128         \center-align
129         \vcenter
130         \fraction
131             0
132             1
133     }
134     c'8
135     \glissando
136     \tweak Y-offset #-2.0
137     \tweak stencil #ly:text-interface::print
138     \tweak text \markup {
139         \center-align
140         \vcenter
141         \fraction
142             0
143             1
144     }
145     c'8
146     \glissando
147     \tweak Y-offset #2.0
148     \tweak stencil #ly:text-interface::print
149     \tweak text \markup {
150         \center-align
151         \vcenter
152         \fraction
153             1
154             1
155     }
156     c'8
157     \glissando
158     \tweak Y-offset #0.6666666666666666
159     \tweak stencil #ly:text-interface::print
160     \tweak text \markup {
161         \center-align
162         \vcenter
163         \fraction

```

```

164             2
165             3
166         }
167     c'8
168     \glissando
169     \tweak Y-offset #2.0
170     \tweak stencil #ly:text-interface::print
171     \tweak text \markup {
172         \center-align
173         \vcenter
174         \fraction
175             1
176             1
177     }
178     c'8
179     \glissando
180     \tweak Y-offset #0.6666666666666666
181     \tweak stencil #ly:text-interface::print
182     \tweak text \markup {
183         \center-align
184         \vcenter
185         \fraction
186             2
187             3
188     }
189     c'8
190     \glissando
191     \tweak Y-offset #-0.6666666666666666
192     \tweak stencil #ly:text-interface::print
193     \tweak text \markup {
194         \center-align
195         \vcenter
196         \fraction
197             1
198             3
199     }
200     c'8
201     \glissando
202     \tweak Y-offset #-0.6666666666666666
203     \tweak stencil #ly:text-interface::print
204     \tweak text \markup {
205         \center-align
206         \vcenter
207         \fraction
208             1
209             3
210     }
211     c'8
212     \glissando
213     \tweak Y-offset #-2.0
214     \tweak stencil #ly:text-interface::print
215     \tweak text \markup {
216         \center-align
217         \vcenter

```

```

218         \fraction
219             0
220             1
221     }
222     c'8
223     \glissando
224     \tweak Y-offset #2.0
225     \tweak stencil #ly:text-interface::print
226     \tweak text \markup {
227         \center-align
228         \vcenter
229         \fraction
230             1
231             1
232     }
233     c'8
234     \glissando
235     \tweak Y-offset #0.6666666666666666
236     \tweak stencil #ly:text-interface::print
237     \tweak text \markup {
238         \center-align
239         \vcenter
240         \fraction
241             2
242             3
243     }
244     c'8
245     \glissando
246     \tweak Y-offset #-0.6666666666666666
247     \tweak stencil #ly:text-interface::print
248     \tweak text \markup {
249         \center-align
250         \vcenter
251         \fraction
252             1
253             3
254     }
255     c'8
256     \glissando
257     \tweak Y-offset #-2.0
258     \tweak stencil #ly:text-interface::print
259     \tweak text \markup {
260         \center-align
261         \vcenter
262         \fraction
263             0
264             1
265     }
266     c'8
267 }
268 } %! LilyPondFile

```

Code Example 2.30: Extremely long bow tablature: RESULT


```

9
10 \header {
11   tagline = ##f
12   breakbefore = ##t
13   title = \markup \override #'(
14     font-name . "Didot"
15     ) \fontsize #15 \bold \center-column {
16     "Cthar"
17   }
18   subtitle = \markup \override #'(
19     font-name . "Didot"
20     ) \fontsize #4 \center-column {
21     "for two cellos"
22   }
23   arranger = \markup \override #'(
24     font-name . "Didot"
25     ) \fontsize #2.5 {
26     "Gregory Rowland Evans"
27   }
28 }
29
30 bowtab = {
31   \override Staff.Clef.stencil = #ly:text-interface::print
32   \override Staff.Clef.text = \markup { \general-align #Y #0.03
33     \epsfile #Y #10 #"bow_position_tablature.eps"
34   }
35 }
36
37 \layout {
38   \accidentalStyle forget
39   indent = #5
40   ragged-right = ##t
41   \context {
42     \name TimeSignatureContext
43     \type Engraver_group
44     \numericTimeSignature
45     \consists Axis_group_engraver
46     \consists Bar_number_engraver
47     \consists Time_signature_engraver
48     \consists Mark_engraver
49     \consists Metronome_mark_engraver
50     \override BarNumber.Y-extent = #'(0 . 0)
51     \override BarNumber.Y-offset = 0
52     \override BarNumber.extra-offset = #'(-4 . 0)
53     \% \override BarNumber.font-name = "Didot"
54     \override BarNumber.stencil = #(
55       make-stencil-boxer 0.1 0.7 ly:text-interface::print
56     )
57     \override BarNumber.font-size = 1
58     \override BarNumber.padding = 4
59     \override MetronomeMark.X-extent = #'(0 . 0)
60     \override MetronomeMark.Y-extent = #'(0 . 0)
61     \override MetronomeMark.break-align-symbols = #'(left-edge)
62     \override MetronomeMark.extra-offset = #'(0 . 4)

```

```

63 \override MetronomeMark.font-size = 10
64 \override RehearsalMark.stencil = #(
65     make-stencil-circler 0.1 0.7 ly:text-interface::print
66 )
67 \override RehearsalMark.X-extent = #'(0 . 0)
68 \override RehearsalMark.X-offset = 6
69 \override RehearsalMark.Y-offset = -2.25
70 \override RehearsalMark.break-align-symbols = #'(time-signature)
71 \override RehearsalMark.break-visibility = #end-of-line-invisible
72 \override RehearsalMark.font-name = "Didot"
73 \override RehearsalMark.font-size = 8
74 \override RehearsalMark.outside-staff-priority = 500
75 \override RehearsalMark.self-alignment-X = #center
76     \override TimeSignature.X-extent = #'(0 . 0)
77     \override TimeSignature.X-offset = #ly:self-alignment-interface::x-
aligned-on-self
78     \override TimeSignature.Y-extent = #'(0 . 0)
79 \override TimeSignature.Y-offset = 3
80     \override TimeSignature.break-align-symbol = ##f
81     \override TimeSignature.break-visibility = #end-of-line-invisible
82     \override TimeSignature.font-size = #7
83     \override TimeSignature.self-alignment-X = #center
84     \override VerticalAxisGroup.default-staff-staff-spacing = #'(
85         (basic-distance . 0)
86         (minimum-distance . 10)
87         (padding . 6)
88         (stretchability . 0)
89     )
90 }
91 \context {
92     \Score
93     \remove Bar_number_engraver
94     \remove Mark_engraver
95     \accepts TimeSignatureContext
96     \accepts LipStaff
97     \override BarLine.bar-extent = #'(-2 . 2)
98     \override Beam.breakable = ##t
99     \override Beam.concaveness = #10000
100    \override Glissando.breakable = ##t
101    \override MetronomeMark.font-size = 5
102        \override SpacingSpanner.strict-grace-spacing = ##t
103        \override SpacingSpanner.strict-note-spacing = ##t
104        \override SpacingSpanner.uniform-stretching = ##t
105        \override StaffGrouper.staff-staff-spacing = #'(
106            (basic-distance . 0)
107            (minimum-distance . 6)
108            (padding . 2)
109        )
110        \override TupletBracket.bracket-visibility = ##t
111        \override TupletBracket.minimum-length = #3
112        \override TupletBracket.padding = #2
113        \override TupletBracket.springs-and-rods = #ly:spanner::set-spacing-
rods
114        \override TupletNumber.text = #tuplet-number::calc-fraction-text

```



```

115 \override TextSpanner.Y-offset = 1
116 proportionalNotationDuration = #(ly:make-moment 1 50)
117 autoBeaming = ##f
118 tupletFullLength = ##t
119 }
120 \context {
121   \Voice
122   \remove Forbid_line_break_engraver
123 }
124 \context {
125   \Staff
126   \remove Time_signature_engraver
127 }
128 \context {
129   \Staff
130   \name BowStaff
131   \type Engraver_group
132   \alias Staff
133   \bowtab
134   \override Beam.stencil = ##f
135   \override Dots.stencil = ##f
136   \override Flag.stencil = ##f
137   \override Glissando.bound-details.left.padding = #0.5
138   \override Glissando.bound-details.right.padding = #0.5
139   \override Glissando.thickness = #2
140   \override NoteHead.Y-offset = #-5
141   \override NoteHead.extra-offset = #'(0.05 . 0)
142   \override NoteHead.stencil = ##f
143   \override Rest.transparent = ##t
144   \override Script.staff-padding = #2
145   \override StaffSymbol.transparent = ##t
146   \override Stem.direction = #down
147   \override Stem.stencil = ##f
148   \override TimeSignature.stencil = ##f
149   \override Tie.stencil = ##f
150   \override TupletBracket.stencil = ##f
151   \override TupletNumber.stencil = ##f
152   %\RemoveEmptyStaves
153 }
154
155 \context {
156   \Staff
157   \name BeamStaff
158   \type Engraver_group
159   \alias Staff
160   \override Beam.direction = #down
161   \override Beam.positions = #'(5 . 5)
162   \override Clef.stencil = ##f
163   \override Dots.staff-position = #-2
164   \override Flag.Y-offset = #2.93
165   \override NoteHead.no-ledgers = ##t
166   \override NoteHead.stencil = ##f
167   \override Rest.transparent = ##t
168   \override Script.staff-padding = #3

```

```

169     \override StaffSymbol.transparent = ##t
170     \override Stem.direction = #down
171     \override Stem.length = #0.5
172     \override Stem.stem-begin-position = #15.975
173     \override TimeSignature.stencil = ##f
174     \override Tie.stencil = ##f
175     \override TupletBracket.positions = #'(3 . 3)
176   }
177
178   \context {
179     \RhythmicStaff
180     \remove Time_signature_engraver
181   }
182   \context {
183     \StaffGroup
184     \accepts BowStaff
185     \accepts BeamStaff
186   }
187 }
188
189 \paper {
190
191   top-margin = 1.5\cm
192   bottom-margin = 1.5\cm
193
194   %top-margin = .90\in
195   oddHeaderMarkup = \markup ""
196   evenHeaderMarkup = \markup ""
197   oddFooterMarkup = \markup \fill-line {
198     ""
199     \concat {
200       "Cthar ~"
201       \fontsize #2
202       \fromproperty #'page:page-number-string "~ Evans"
203     }
204     ""
205   }
206   evenFooterMarkup = \markup \fill-line {
207     ""
208     \concat { "Cthar ~" \fontsize #2
209       \fromproperty #'page:page-number-string "~ Evans"
210     } ""
211   }
212 }

```

Code Example 2.31: Cthar stylesheet

In this score, I defined a few new contexts in order to manage the specific visual properties I desired for a staff indicating bow motion with the *abjad.BowContactPoint()* tool. Aside from these properties, the composer is also able to edit graphic elements such as the width and spacing of beams, the thickness of stems, or the shape of flags. In this stylesheet, the clef symbol in the bowing staves is replaced with an *eps*

image of a bow to help indicate what the tablature represents.

These are just a few examples of ways in which Abjad and Lilypond allow for the simplification of processes that, by hand, could be extremely tedious over the course of a lengthy composition. The principles involved in these examples extend to every facet of both composing and engraving. Now that the power that Python can give composers has been described, next I will show how creating these loops and functions can have further ramifications in the process of composing.

2.1.2.5 COMPOSING WITH MODELS AND ALGORITHMS

Composing with Abjad and Python allows the composer to work with models and algorithms. The following is an example where pitches are generated by a random walk which can be seen as a one-dimensional model of Brownian motion.³⁸ Much of my recent music features a similar procedure as the following:

```

1 >>> import abjad
2 >>> from random import seed
3 >>> from random import random
4 >>> seed(3)
5 >>> random_walk = []
6 >>> random_walk.append(-1 if random() < 0.5 else 1)
7 >>> for i in range(1, 64):
8 ...     movement = -1 if random() < 0.5 else 1
9 ...     value = random_walk[i-1] + movement
10 ...    random_walk.append(value)
11 >>> notes = [abjad.Note(x / 2.0, (1, 8)) for x in random_walk]
12 >>> staff = abjad.Staff(notes)
13 >>> abjad.show(staff)

```

Code Example 2.32: Random walk

In this code, the user must first create an empty list. Based on a string of randomly generated numbers, a new list of pitches is created, notated by numbers moving in a step of plus or minus 0.5 that are turned into note objects. They are next placed in a staff. It results in this Lilypond code and figure 2.1.12:

```

1 \score { %! LilyPondFile
2     \new Staff
3     {
4         bqs8
5         c'8

```

³⁸Brownian motion is a model used to describe the rapid and random motion of particles in a fluid.

```
6      bqs8
7      c '8
8      cqs '8
9      c '8
10     bqs8
11     c '8
12     bqs8
13     b8
14     bqs8
15     b8
16     bqs8
17     b8
18     bqs8
19     b8
20     bqs8
21     c '8
22     cqs '8
23     cs '8
24     dqf '8
25     cs '8
26     dqf '8
27     d '8
28     dqf '8
29     cs '8
30     dqf '8
31     cs '8
32     dqf '8
33     d '8
34     dqs '8
35     ef '8
36     dqs '8
37     ef '8
38     dqs '8
39     ef '8
40     eqf '8
41     ef '8
42     dqs '8
43     d '8
44     dqs '8
45     d '8
46     dqs '8
47     d '8
48     dqs '8
49     d '8
50     dqf '8
51     d '8
52     dqs '8
53     ef '8
54     eqf '8
55     e '8
56     eqs '8
57     f '8
58     fqs '8
59     f '8
```

```

60     fqs '8
61     fs '8
62     gqf '8
63     g '8
64     gqs '8
65     g '8
66     gqs '8
67     af '8
68 }
69 } %! LilyPondFile

```

Code Example 2.33: Random walk: RESULT



Figure 2.1.12: A mapping of a random walk.

It is also possible to model more traditional compositional algorithms.³⁹ This code is more complex than what we have seen before.⁴⁰ This code creates a three-voice canon based on the melody input by the user. The melody is transposed and the rhythms are scaled to a different tempo. Voices with phrases that end before the slowest voice completes its phrase are repeated until the bottom voice has finished.

Because of how the rhythms are scaled, it is important to use *abjad.mutate().rewrite_meter()* to ensure that all rhythms remain in the appropriate measure:

```

1 >>> import abjad
2 >>> def generate_scaled_staff(scale_factor, staff):
3 ...     staff_pitches = []
4 ...     for logical_tie in abjad.iterate(staff).logical_ties():
5 ...         first_leaf = logical_tie[0]
6 ...         staff_pitches.append(first_leaf.written_pitch)
7 ...     staff_durations = [

```

³⁹Admittedly, mensuration canons do not present an extremely complex algorithm, but it meets my definition of algorithm.

⁴⁰This code is adapted from code written by Jeffrey Treviño and presented as a part of the 2018 Abjad summer workshop at CCRMA⁴¹ at Stanford University.

```

8 ... chain.written_duration*scale_factor for chain in abjad.iterate(staff).
   logical_ties()
9 ... ]
10 ...     scaled_staff = abjad.Staff()
11 ...     maker = abjad.NoteMaker()
12 ...     selections = maker(staff_pitches, staff_durations)
13 ...     scaled_staff.extend(selections)
14 ...     return scaled_staff
15
16 >>> def partition_value(value):
17 ...     if x >= 16:
18 ...         divisions, remainder = divmod(value, 8)
19 ...         parts = [8] * divisions
20 ...         if remainder:
21 ...             parts.append(remainder)
22 ...     return parts
23
24 >>> def process_maxima(durations):
25 ...     output_durations = []
26 ...     for duration in durations:
27 ...         if duration[0] >= 16:
28 ...             numerators = partition_value(duration[0])
29 ...             duration = [(numerator, 1) for numerator in numerators]
30 ...             output_durations.append(duration)
31
32 >>> def scale_and_chop_staff(voice_number, staff, time_signature):
33 ...     scale_factor = 2 ** voice_number
34 ...     scaled_staff = generate_scaled_staff(scale_factor, staff)
35 ...     abjad.mutate(scaled_staff).transpose(voice_number * -7)
36 ...     abjad.mutate(scaled_staff[:]).split([time_signature], cyclic=True)
37 ...     return scaled_staff
38
39 >>> def duplicate_music(num_copies, staff):
40 ...     out_staff = abjad.Staff()
41 ...     for x in range(num_copies):
42 ...         out_staff.extend(abjad.mutate(staff).copy())
43 ...     return out_staff
44
45 >>> def make_scaled_staves(melody_staff, time_signature):
46 ...     scaled_staves = []
47 ...     for voice_number in range(3):
48 ...         scaled_staff = scale_and_chop_staff(voice_number, melody_staff,
   time_signature)
49 ...         scaled_staves.append(scaled_staff)
50 ...     return scaled_staves
51
52 >>> def duplicate_score(scaled_staves):
53 ...     score = abjad.Score()
54 ...     for scaled_staff, duplicate_index in zip(scaled_staves, reversed(range
   (3))):
55 ...         scale_factor = 2**duplicate_index
56 ...         staff = duplicate_music(scale_factor, scaled_staff)
57 ...         score.append(staff)
58 ...     return score

```

```

59
60 >>> def format_score(score, key_signature, time_signature):
61 ...     for staff in score:
62 ...         key_sig = abjad.KeySignature(key_signature.tonic, key_signature.
        mode)
63 ...         abjad.attach(key_sig, staff[0])
64 ...         time_sig = abjad.TimeSignature(time_signature)
65 ...         abjad.attach(time_sig, staff[0])
66 ...         abjad.attach(abjad.Clef('varC'), score[1][0])
67 ...         abjad.attach(abjad.Clef('bass'), score[2][0])
68
69 >>> def make_canon(melody_staff, key_signature, time_signature):
70 ...     scaled_staves = make_scaled_staves(melody_staff, time_signature)
71 ...     score = duplicate_score(scaled_staves)
72 ...     format_score(score, key_signature, time_signature)
73 ...     return score
74
75 >>> def rewrite_meter(score):
76 ...     meter = abjad.Meter()
77 ...     for staff in score:
78 ...         for shard in abjad.mutate(staff[:]).split([abjad.Duration(4, 4)],
        cyclic=True):
79 ...             abjad.mutate(shard).rewrite_meter(meter)
80
81 >>> melody_staff = abjad.Staff("c'4 cs'8 d' ds' e' f'4 fs' g' gs'8 a' b' c'")
82 >>> score = make_canon(
83 ... melody_staff, abjad.KeySignature('c', 'major'), abjad.TimeSignature((4,4))
84 ... )
85 >>> rewrite_meter(score)
86 >>> abjad.show(score)

```

Code Example 2.34: Mensuration canon

resulting in the Lilypond code and figure 2.1.13:

```

1 \score { %! LilyPondFile
2   \new Score
3     <<
4       \new Staff
5         {
6           \key c \major
7           \time 4/4
8           c'4
9           cs'8
10          d'8
11          ds'8
12          e'8
13          f'4
14          fs'4
15          g'4
16          gs'8
17          a'8
18          b'8
19          c'8

```

```

20      c'4
21      cs'8
22      d'8
23      ds'8
24      e'8
25      f'4
26      fs'4
27      g'4
28      gs'8
29      a'8
30      b'8
31      c''8
32      c'4
33      cs'8
34      d'8
35      ds'8
36      e'8
37      f'4
38      fs'4
39      g'4
40      gs'8
41      a'8
42      b'8
43      c''8
44      c'4
45      cs'8
46      d'8
47      ds'8
48      e'8
49      f'4
50      fs'4
51      g'4
52      gs'8
53      a'8
54      b'8
55      c''8
56  }
57  \new Staff
58  {
59      \key c \major
60      \time 4/4
61      \clef "varC"
62      f2
63      fs4
64      g4
65      gs4
66      a4
67      bf2
68      b2
69      c'2
70      cs'4
71      d'4
72      e'4
73      f'4

```



```

74         f2
75         fs4
76         g4
77         gs4
78         a4
79         bf2
80         b2
81         c '2
82         cs '4
83         d '4
84         e '4
85         f '4
86     }
87     \new Staff
88     {
89         \key c \major
90         \time 4/4
91         \clef "bass"
92         bf,1
93         b,2
94         c2
95         cs2
96         d2
97         ef1
98         e1
99         f1
100        fs2
101        g2
102        a2
103        bf2
104    }
105    >>
106 } %! LilyPondFile

```

Code Example 2.35: Mensuration canon: RESULT

Using Abjad and Python, composers are able to write music full of intricate relationships with precise formal consistency, but a comfortable formalism in score control is not necessarily algorithmic utopia. Though these logical procedures are available and entirely possible, they are optional. The process of composing with Abjad should not be misperceived as a purely algorithmic system for music composition. Certainly, formalizing elements in a score allows for a great amount of consistency and control, but composers have every ability to make decisions and sculpt the music at will if they so desire.⁴² Abjad and

⁴² Composing with the workflow of Python, Abjad, and Lilypond does present some difficulty in composing idiomatically for instruments. Piano music, in particular, presents a great challenge, a challenge that I have yet to surmount. If one is not careful, it is possible to compose music completely unplayable by a human performer.



Figure 2.1.13: A mensuration canon.

Lilypond do not dictate what kind of music is able to be composed. It is still the duty of the composer to constrain their musical practices to those they consciously wish to deploy.

2.1.3 THE NEED TO BUILD TOOLS FOR A MORE PERSONALIZED APPROACH TO MUSIC-MAKING

2.1.3.1 BUILDING TOOLS

Why do I feel that it is important to write my own compositional tools? This is because each composer has a unique imagination and ideal. I feel greater satisfaction when I do not compose with the same methodology as another musician. I prefer a musical culture where each composer has a unique voice, because without it the beautiful diversity of new music would vanish. Abjad provides a framework for formalized score control but is not restrictive about the practices used to compose.⁴³ The fact that Abjad provides separate packages of tools for composition, as well as other functions, reveals that it is intended to be used by a variety of users with a variety of backgrounds. There are a handful of official extensions to Abjad under the title of abjad-ext.

⁴³As I have previously written, even composing in notation programs such as Finale or Sibelius has restrictions and makes certain procedures difficult or impossible.

2.1.3.2 ABJAD-EXT

Abjad-ext consists of a number of packages that are not necessary for full functionality of the API. The packages include `abjad-ext-tonality`,⁴⁴ a tonal analysis extension, `abjad-ext-book`,⁴⁵ an extension for rendering Abjad code in L^AT_EX, `abjad-ext-ipython`,⁴⁶ an extension for rendering Abjad code in IPython and Jupyter notebooks, `abjad-ext-nauert`,⁴⁷ an extension of quantization tools based on Paul Nauert's Q-Grids, `abjad-ext-cli`,⁴⁸ a Command Line Interface extension, and `abjad-ext-rmakers`,⁴⁹ a rhythm maker tool extension. Each of these packages extend the functionality of Abjad, but I have only seriously used Trevor Bača's `rmakers` package. These packages exist outside of the main Abjad source in order to emphasize their optionality.⁵⁰

2.1.3.3 RMAKERS

⁵¹

The `rmakers` consist of a set of tools for generating rhythmic material in certain characteristic ways. Contained in the `rmakers` package are a basic *RhythmMaker* class, *AccelerandoRhythmMaker*, *EvenDivisionRhythmMaker*, *IncisedRhythmMaker*, *NoteRhythmMaker*, *TaleaRhythmMaker*, and *TupletRhythmMaker*. An extended description of these tools and their functionality can be found in Josiah Oberholtzer's 2015 dissertation *A Computational Model of Music Composition*. (Oberholtzer, 2015, pp. 118–128) I am quite fond of these tools and, even though I intend to write my own rhythm-generating functions in the near future, they are the primary source of rhythmic composition in my recent music.

⁴⁴<https://github.com/Abjad/abjad-ext-tonality>

⁴⁵<https://github.com/Abjad/abjad-ext-book>

⁴⁶<https://github.com/Abjad/abjad-ext-ipython>

⁴⁷<https://github.com/Abjad/abjad-ext-nauert>

⁴⁸<https://github.com/Abjad/abjad-ext-cli>

⁴⁹<https://github.com/Abjad/abjad-ext-rmakers>

⁵⁰The `rmakers`, previously called `RhythmMakerTools`, were once a part of the main Abjad source, but were externalized because their author felt they were more of a reflection of his own compositional practices than being a universal tool set.

⁵¹make a subsubsubsection

2.1.4 OTHER PACKAGES

Along with the official abjad-ext packages are other packages by composers who make use of Abjad, including Consort,⁵² a package written by Josiah Wolf Oberholtzer and described in detail in his dissertation, mtools⁵³ by Ivan Alexander Moscotta, and calliope⁵⁴ by Randall West. All of these packages present unique and innovative tools for music composition and have encouraged me to find my own way of composing with Abjad. As of the writing of this paper, I have only written one external tool set for composing, but they are used extensively in my scores, these are MusicMaker and the accompanying AttachmentHandler classes.

2.1.5 MUSICMAKER

MusicMaker is a python class of mine which is the result of my attempt to combine material consistency of many kinds. MusicMaker takes the input of an rmaker and an optional set of AttachmentHandler objects. This tool was written because, although the rmakers are capable of generating rhythmic material, they do not handle pitch in any way. One could compose the entire rhythmic framework of a piece and add pitches after the fact. I found myself using many different rmakers throughout the course of a piece and I found that I was working very hard to unify rhythmic gestures by giving them unique harmonic fields and dynamic trajectories. This process became quite difficult and required a trial-and-error process or a tedious amount of pre-compositional calculation by hand outside of the computer program. My solution was to create a tool that could handle many different rmakers, pitch fields, and attachment characteristics at once, leaving the composer to define distinct and alternating characters and processes with which to compose. When MusicMaker is given an rmaker and a list of pitches inside of the accompanying PitchHandler object, it automatically adds those pitches to the rhythms cyclically. When the list of pitches runs out, it repeats endlessly to ensure that there is always pitch material when the MusicMaker is called. Because MusicMaker generates music based on the rhythms and pitches that were input by the user each time that it is called within the python file, it allows the composer to instantiate

⁵²<https://github.com/josiah-wolf-oberholtzer/consort>

⁵³<https://github.com/ivanalexandermoscotta/mtools>

⁵⁴<https://github.com/mirroredcho/calliope/tree/new-base>

multiple MusicMakers with unique rhythmic, harmonic, and dynamic qualities with other attachments.

Much of my recent music is composed from alternating fragments of processes begun with MusicMaker.

As I write more music, I find that there are more features that I wish to add to MusicMaker and the

AttachmentHandler objects. As such, their code is still under revision. The following is the current source code for MusicMaker:

```

1 import abjad
2 from evans.AttachmentHandlers.GlissandoHandler import GlissandoHandler
3 from evans.AttachmentHandlers.NoteheadHandler import NoteheadHandler
4 from evans.AttachmentHandlers.PitchHandler import PitchHandler
5 from evans.AttachmentHandlers.ArticulationHandler import ArticulationHandler
6 from evans.AttachmentHandlers.DynamicHandler import DynamicHandler
7 from evans.AttachmentHandlers.TextSpanHandler import TextSpanHandler
8 from evans.AttachmentHandlers.ClefHandler import ClefHandler
9 from evans.AttachmentHandlers.SlurHandler import SlurHandler
10 from evans.AttachmentHandlers.TrillHandler import TrillHandler
11
12 class MusicMaker:
13     def __init__(
14         self,
15         rmaker,
16         glissando_handler=None,
17         notehead_handler=None,
18         pitch_handler=None,
19         articulation_handler=None,
20         dynamic_handler=None,
21         text_span_handler=None,
22         clef_handler=None,
23         slur_handler=None,
24         trill_handler=None,
25         continuous=False,
26         state=None,
27     ):
28         self.glissando_handler = glissando_handler
29         self.notehead_handler = notehead_handler
30         self.pitch_handler = pitch_handler
31         self.articulation_handler = articulation_handler
32         self.dynamic_handler = dynamic_handler
33         self.text_span_handler = text_span_handler
34         self.clef_handler = clef_handler
35         self.slur_handler = slur_handler
36         self.trill_handler = trill_handler
37         self.continuous = continuous
38         self.rmaker = rmaker
39         self.state = self.rmaker.state
40         self._count = 0
41
42     def __call__(self, durations):
43         return self._make_music(durations)
44 
```

```

45 def _make_basic_rhythm(self, durations):
46     if self.continuous == True:
47         state = self.state
48         selections = self.rmaker(durations, previous_state=self.rmaker.
state)
49         self.state = self.rmaker.state
50     else:
51         selections = self.rmaker(durations, )
52     return selections
53
54 def _make_music(self, durations):
55     selections = self._make_basic_rhythm(durations)
56     if self.pitch_handler == None:
57         start_command = abjad.LilyPondLiteral(
58             r'\stopStaff \once \override Staff.StaffSymbol.line-count = #1
\startStaff',
59             format_slot='before',
60             )
61         stop_command = abjad.LilyPondLiteral(
62             r'\stopStaff \startStaff',
63             format_slot='after',
64             )
65         literal = abjad.LilyPondLiteral(r'\once \override Staff.Clef.
transparent = ##t', 'before')
66         c_clef = abjad.LilyPondLiteral(r'\clef alto', 'before')
67         abjad.attach(literal, selections[0][0])
68         abjad.attach(c_clef, selections[0][0])
69         abjad.attach(start_command, selections[0][0])
70         abjad.attach(stop_command, selections[0][-1])
71     if self.pitch_handler != None:
72         selections = self.pitch_handler(selections)
73     if self.clef_handler != None:
74         selections = self.clef_handler(selections)
75     if self.glissando_handler != None:
76         selections = self.glissando_handler(selections)
77     if self.notehead_handler != None:
78         selections = self.notehead_handler(selections)
79     if self.articulation_handler != None:
80         selections = self.articulation_handler(selections)
81     if self.dynamic_handler != None:
82         selections = self.dynamic_handler(selections)
83     if self.text_span_handler != None:
84         selections = self.text_span_handler(selections)
85     if self.slur_handler != None:
86         selections = self.slur_handler(selections)
87     if self.trill_handler != None:
88         selections = self.trill_handler(selections)
89     return selections

```

Code Example 2.36: MusicMaker source

MusicMaker is made to be called with timespans⁵⁵ and can be used as follows:

⁵⁵Timespans are also described in great detail in Josiah Oberholtzer's dissertation. (Oberholtzer, 2015, pp. 78–118)

```

1 >>> import abjad
2 >>> import itertools
3 >>> import abjadext.rmakers
4 >>> from evans.AttachmentHandlers.MusicMaker import MusicMaker
5 >>> from evans.AttachmentHandlers.PitchHandler import PitchHandler
6
7 >>> time_signatures = [
8 ...     abjad.TimeSignature(pair) for pair in [
9 ...         (4, 4), (5, 4),
10 ...     ]
11 ... ]
12
13 >>> bounds = abjad.mathtools.cumulative_sums([_.duration for _ in
14     time_signatures])
15
16 >>> rmaker_one = abjadext.rmakers.TaleaRhythmMaker(
17 ...     talea=abjadext.rmakers.Talea(
18 ...         counts=[1, 2, 3, 4],
19 ...         denominator=16,
20 ...     ),
21 ...     beam_specifier=abjadext.rmakers.BeamSpecifier(
22 ...         beam_divisions_together=True,
23 ...         beam_rests=False,
24 ...     ),
25 ...     extra_counts_per_division=[0, 1,],
26 ...     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
27 ...         trivialize=True,
28 ...         extract_trivial=True,
29 ...         rewrite_rest_filled=True,
30 ...     ),
31 ...     rewrite_sustained=True,
32 ... )
33
34 >>> rmaker_two = abjadext.rmakers.EvenDivisionRhythmMaker(
35 ...     denominators=[8, 16,],
36 ...     extra_counts_per_division=[0,],
37 ...     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
38 ...         trivialize=True,
39 ...         extract_trivial=True,
40 ...         rewrite_rest_filled=True,
41 ...     ),
42 ... )
43
44 >>> musicmaker_one = MusicMaker(
45 ...     rmaker=rmaker_one,
46 ...     pitches=[0, 1, 2, 3, 4],
47 ...     continuous=True,
48 ... )
49
50 >>> musicmaker_two = MusicMaker(
51 ...     rmaker=rmaker_two,
52 ...     pitch_handler=PitchHandler(pitch_list=[4, 3, 2, 1, 0]),
53 ...     continuous=True,
54 ... )
55
56 >>> silence_maker = abjadext.rmakers.NoteRhythmMaker(

```

```

54 ...     division_masks=[
55 ...         abjadext.rmakers.SilenceMask(
56 ...             pattern=abjad.index([0], 1),
57 ...         ),
58 ...     ],
59 ... )
60
61 >>> class MusicSpecifier:
62 ...     def __init__(self, music_maker, voice_name):
63 ...         self.music_maker = music_maker
64 ...         self.voice_name = voice_name
65
66 >>> voice_1_timespan_list = abjad.TimespanList([
67 ...     abjad.AnnotatedTimespan(
68 ...         start_offset=start_offset,
69 ...         stop_offset=stop_offset,
70 ...         annotation=MusicSpecifier(
71 ...             music_maker=music_maker,
72 ...             voice_name='Voice 1',
73 ...         ),
74 ...     )
75 >>>     for start_offset, stop_offset, music_maker in [
76 ...         [(0, 4), (2, 4), musicmaker_one],
77 ...         [(2, 4), (3, 4), musicmaker_one],
78 ...         [(3, 4), (4, 4), musicmaker_one],
79 ...         [(6, 4), (8, 4), musicmaker_two],
80 ...         [(8, 4), (9, 4), silence_maker],
81 ...     ]
82 ... ])
83
84 >>> all_timespan_lists = {
85 ...     'Voice 1': voice_1_timespan_list,
86 ... }
87
88 >>> global_timespan = abjad.Timespan(
89 ...     start_offset=0,
90 ...     stop_offset=max(_.stop_offset for _ in all_timespan_lists.values())
91 ... )
92
93 >>> for voice_name, timespan_list in all_timespan_lists.items():
94 ...     silences = abjad.TimespanList([global_timespan])
95 ...     silences.extend(timespan_list)
96 ...     silences.sort()
97 ...     silences.compute_logical_xor()
98 ...     for silence_timespan in silences:
99 ...         timespan_list.append(
100 ...             abjad.AnnotatedTimespan(
101 ...                 start_offset=silence_timespan.start_offset,
102 ...                 stop_offset=silence_timespan.stop_offset,
103 ...                 annotation=MusicSpecifier(
104 ...                     music_maker=None,
105 ...                     voice_name=voice_name,
106 ...                 ),
107 ...             )

```



```

108 ...         )
109 ...         timespan_list.sort()
110
111 >>> for voice_name, timespan_list in all_timespan_lists.items():
112 ...     shards = timespan_list.split_at_offsets(bounds)
113 ...     split_timespan_list = abjad.TimespanList()
114 ...     for shard in shards:
115 ...         split_timespan_list.extend(shard)
116 ...     split_timespan_list.sort()
117 ...     all_timespan_lists[voice_name] = timespan_list
118
119 >>> score = abjad.Score([
120 ...     abjad.Staff(lilypond_type='TimeSignatureContext', name='Global Context
121 ...     '),
122 ...     abjad.Staff([abjad.Voice(name='Voice 1')], name='Staff 1',
123 ...     lilypond_type='Staff'),
124 ... ],
125 ... )
126
127 >>> for time_signature in time_signatures:
128 ...     skip = abjad.Skip(1, multiplier=(time_signature))
129 ...     abjad.attach(time_signature, skip)
130 ...     score['Global Context'].append(skip)
131
132 >>> def make_container(music_maker, durations):
133 ...     selections = music_maker(durations)
134 ...     container = abjad.Container([])
135 ...     container.extend(selections)
136 ...     return container
137
138 >>> def key_function(timespan):
139 ...     return timespan.annotation.music_maker or silence_maker
140
141 >>> for voice_name, timespan_list in all_timespan_lists.items():
142 ...     for music_maker, grouper in itertools.groupby(
143 ...         timespan_list,
144 ...         key=key_function,
145 ...     ):
146 ...         durations = [timespan.duration for timespan in grouper]
147 ...         container = make_container(music_maker, durations)
148 ...         voice = score[voice_name]
149 ...         voice.append(container)
150
151 >>> for voice in abjad.iterate(score['Voice 1']).components(abjad.Voice):
152 ...     for i, shard in enumerate(abjad.mutate(voice[:]).split(
153 ...         time_signatures)):
154 ...         time_signature = time_signatures[i]
155 ...         abjad.mutate(shard).rewrite_meter(time_signature)
156
157 >>> for voice in abjad.select(score).components(abjad.Voice):
158 ...     for run in abjad.select(voice).runs():
159 ...         specifier = abjadext.rmakers.BeamSpecifier(
160 ...             beam_each_division=False,
161 ...         )

```

```

159 ...         specifier(run)
160 ...         abjad.beam(voice[:], beam_lone_notes=False, beam_rests=False,)
161
162 >>> abjad.show(score)

```

Code Example 2.37: Using MusicMaker with PitchHandler

With the assistance of a stylesheet for formatting, results in the following Lilypond code and figure

2.1.14:

```

1 \score { %! LilyPondFile
2   \new Score
3     <<
4       \context TimeSignatureContext = "Global Context"
5       {
6         \time 4/4
7         s1 * 1
8         \time 5/4
9         s1 * 5/4
10      }
11     \context Staff = "Staff 1"
12     {
13       \context Voice = "Voice 1"
14       {
15         {
16           c'16
17           [
18             cs'16
19             ~
20             cs'16
21             d'16
22             ~
23             d'8
24             ef'8
25             ~
26             \times 4/5 {
27               ef'8
28               e'16
29               c'8
30             }
31             cs'8.
32             d'16
33             ]
34           }
35         {
36           r2
37         }
38         {
39           e'8
40           [
41             ef'8
42             d'8
43             cs'8

```

```

44         ]
45     }
46     {
47         r4
48     }
49 }
50 }
51 >>
52 } %! LilyPondFile

```

Code Example 2.38: Using MusicMaker with PitchHandler: RESULT



Figure 2.1.14: Notation from MusicMaker with two rmakers and PitchHandlers.

2.1.6 ATTACHMENTHANDLERS

Along with MusicMaker, I have written a number of AttachmentHandler tools to control many other musical features. The current list of functioning tools consists of ArticulationHandler, ClefHandler, DynamicHandler, GlissandoHandler, NoteheadHandler, PitchHandler, SlurHandler, and TrillHandler. As the names imply, each of these tools contain processes for the application of various graphical elements within a score. They can be called alongside MusicMaker to create far more complex musical gestures and to handle a number of engraving issues that would typically be surmounted by hand outside of the python file. The source code for these tools is included in the appendix to this paper. With the exception of TrillHandler, each of the AttachmentHandler tools is able to be used both within MusicMaker and elsewhere in a file. TrillHandler can be used as follows:

```

1 >>> import abjad
2 >>> from TrillHandler import TrillHandler
3 >>> trill_handler = TrillHandler()
4 >>> staff = abjad.Staff(
5 ...     r'<a b>1 ~ <a b>4 \times 2/3 { a8 a8 <a b>8 } a4 a \times 2/3 { b8 a b
6 ...     }'
7 ... )

```

```

7 >>> score = abjad.Score([staff])
8 >>> trill_handler(score)
9 >>> abjad.show(score)

```

Code Example 2.39: Using TrillHandler

It results in the following:

```

1 \version "2.19.82"  %! LilyPondFile
2 \language "english" %! LilyPondFile
3
4 \header { %! LilyPondFile
5     tagline = ##f
6 } %! LilyPondFile
7
8 \layout {}
9
10 \paper {}
11
12 \score { %! LilyPondFile
13     \new Score
14     <<
15         \new Staff
16         {
17             \pitchedTrill
18             a1
19             ~
20             \startTrillSpan b
21             a4
22             \times 2/3 {
23                 a8
24                 \stopTrillSpan
25                 a8
26                 \pitchedTrill
27                 a8
28                 \startTrillSpan b
29             }
30             a4
31             \stopTrillSpan
32             a4
33             \times 2/3 {
34                 b8
35                 a8
36                 b8
37             }
38         }
39     >>
40 } %! LilyPondFile

```

Code Example 2.40: Using TrillHandler: RESULT

and figure 2.1.15:



Figure 2.1.15: Trills.

The following example is a few bars for four voices exhibiting the functionality of each of the AttachmentHandlers.

```

1 >>> import abjad
2 >>> import itertools
3 >>> import os
4 >>> import pathlib
5 >>> import time
6 >>> import abjadext.rmakers
7 >>> from MusicMaker import MusicMaker
8 >>> from ArticulationHandler import ArticulationHandler
9 >>> from ClefHandler import ClefHandler
10 >>> from DynamicHandler import DynamicHandler
11 >>> from GlissandoHandler import GlissandoHandler
12 >>> from NoteheadHandler import NoteheadHandler
13 >>> from PitchHandler import PitchHandler
14 >>> from SlurHandler import SlurHandler
15 >>> from TextSpanHandler import TextSpanHandler
16
17 >>> print('Interpreting file ...')
18
19 >>> time_signatures = [
20 ...     abjad.TimeSignature(pair) for pair in [
21 ...         (4, 4),
22 ...     ]
23 ... ]
24
25 >>> bounds = abjad.mathtools.cumulative_sums([_.duration for _ in
26 ...     time_signatures])
27
28 >>> rmaker = abjadext.rmakers.TaleaRhythmMaker(
29 ...     talea=abjadext.rmakers.Talea(
30 ...         counts=[2, 1, 5, 1, 3, 3, 1, 2, ],
31 ...         denominator=16,
32 ...     ),
33 ...     beam_specifier=abjadext.rmakers.BeamSpecifier(
34 ...         beam_divisions_together=True,
35 ...         beam_rests=False,
36 ...     ),
37 ...     extra_counts_per_division=[0, 0, 1, 0, -1],
38 ...     burnish_specifier=abjadext.rmakers.BurnishSpecifier(
39 ...         left_classes=[abjad.Note, abjad.Rest],
40 ...         left_counts=[1, 0, 1],
41 ...     ),

```

```

41 ...     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
42 ...         trivialize=True,
43 ...         extract_trivial=True,
44 ...         rewrite_rest_filled=True,
45 ...     ),
46 ... )
47
48 >>> articulation_handler = ArticulationHandler(
49 ...     articulation_list=['tenuto', 'staccato', 'portato', ],
50 ...     continuous=True,
51 ... )
52
53 >>> clef_handler = ClefHandler(
54 ...     clef='bass',
55 ...     add_ottavas=True,
56 ...     # ottava_shelf=5,
57 ... )
58
59 >>> dynamic_handler = DynamicHandler(
60 ...     starting_dynamic='f',
61 ...     hairpin='>',
62 ...     ending_dynamic='p',
63 ...     continuous=True,
64 ... )
65
66 >>> glissando_handler = GlissandoHandler(
67 ...     line_style='dotted-line',
68 ... )
69
70 >>> notehead_handler = NoteheadHandler(
71 ...     notehead_list=['cross', 'harmonic-mixed',
72 ...                     'diamond', 'triangle', 'slash', 'default', ],
73 ...     continuous=True,
74 ... )
75
76 >>> pitch_handler = PitchHandler(
77 ...     pitch_list=[0, 2, 1, [3, 10], 4, 8, [7, 9], 6],
78 ...     continuous=True,
79 ... )
80
81 >>> slur_handler = SlurHandler(
82 ...     slurs='runs',
83 ... )
84
85 >>> text_span_handler = TextSpanHandler(
86 ...     position_list_one=['0/7', '5/7', '7/7', ],
87 ...     position_list_two=['two', 'three', 'one', ],
88 ...     position_list_three=['three', 'one', 'two', ],
89 ...     start_style_one='solid-line-with-arrow',
90 ...     start_style_two='dashed-line-with-arrow',
91 ...     stop_style_one='solid-line-with-hook',
92 ...     stop_style_two='dashed-line-with-hook',
93 ...     stop_style_three='solid-line-with-hook',
94 ...     apply_list_one_to='edges',

```

```

95 ...     apply_list_two_to='ties',
96 ...     apply_list_three_to='left_only',
97 ...     continuous=True,
98 ... )
99
100 >>> music_maker = MusicMaker(
101 ...     rmaker=rmaker,
102 ...     articulation_handler=articulation_handler,
103 ...     clef_handler=clef_handler,
104 ...     dynamic_handler=dynamic_handler,
105 ...     glissando_handler=glissando_handler,
106 ...     notehead_handler=notehead_handler,
107 ...     pitch_handler=pitch_handler,
108 ...     slur_handler=slur_handler,
109 ...     # text_span_handler=text_span_handler,
110 ...     continuous=True,
111 ... )
112
113 >>> silence_maker = abjadext.rmakers.NoteRhythmMaker(
114 ...     division_masks=[
115 ...         abjadext.rmakers.SilenceMask(
116 ...             pattern=abjad.index([0], 1),
117 ...         ),
118 ...     ],
119 ... )
120
121 >>> class MusicSpecifier:
122
123 ...     def __init__(self, rhythm_maker, voice_name):
124 ...         self.rhythm_maker = rhythm_maker
125 ...         self.voice_name = voice_name
126
127 >>> print('Collecting timespans and rmakers ...')
128
129 >>> voice_1_timespan_list = abjad.TimespanList([
130 ...     abjad.AnnotatedTimespan(
131 ...         start_offset=start_offset,
132 ...         stop_offset=stop_offset,
133 ...         annotation=MusicSpecifier(
134 ...             rhythm_maker=rhythm_maker,
135 ...             voice_name='Voice 1',
136 ...         ),
137 ...     )
138 ...     for start_offset, stop_offset, rhythm_maker in [
139 ...         [(0, 8), (4, 8), music_maker],
140 ...         [(5, 8), (7, 8), music_maker],
141 ...         [(7, 8), (8, 8), silence_maker],
142 ...     ]
143 ... ])
144
145 >>> voice_2_timespan_list = abjad.TimespanList([
146 ...     abjad.AnnotatedTimespan(
147 ...         start_offset=start_offset,
148 ...         stop_offset=stop_offset,

```

```

149 ...     annotation=MusicSpecifier(
150 ...         rhythm_maker=rhythm_maker,
151 ...         voice_name='Voice 2',
152 ...     ),
153 ... )
154 ... for start_offset, stop_offset, rhythm_maker in [
155 ...     [(0, 8), (4, 8), music_maker],
156 ...     [(5, 8), (7, 8), music_maker],
157 ...     [(7, 8), (8, 8), silence_maker],
158 ... ]
159 ... ])
160
161 >>> voice_3_timespan_list = abjad.TimespanList([
162 ...     abjad.AnnotatedTimespan(
163 ...         start_offset=start_offset,
164 ...         stop_offset=stop_offset,
165 ...         annotation=MusicSpecifier(
166 ...             rhythm_maker=rhythm_maker,
167 ...             voice_name='Voice 3',
168 ...         ),
169 ...     )
170 ...     for start_offset, stop_offset, rhythm_maker in [
171 ...         [(0, 8), (4, 8), music_maker],
172 ...         [(5, 8), (7, 8), music_maker],
173 ...         [(7, 8), (8, 8), silence_maker],
174 ...     ]
175 ... ])
176
177 >>> voice_4_timespan_list = abjad.TimespanList([
178 ...     abjad.AnnotatedTimespan(
179 ...         start_offset=start_offset,
180 ...         stop_offset=stop_offset,
181 ...         annotation=MusicSpecifier(
182 ...             rhythm_maker=rhythm_maker,
183 ...             voice_name='Voice 4',
184 ...         ),
185 ...     )
186 ...     for start_offset, stop_offset, rhythm_maker in [
187 ...         [(0, 8), (4, 8), music_maker],
188 ...         [(5, 8), (7, 8), music_maker],
189 ...         [(7, 8), (8, 8), silence_maker],
190 ...     ]
191 ... ])
192
193 >>> all_timespan_lists = {
194 ...     'Voice 1': voice_1_timespan_list,
195 ...     'Voice 2': voice_2_timespan_list,
196 ...     'Voice 3': voice_3_timespan_list,
197 ...     'Voice 4': voice_4_timespan_list,
198 ... }
199
200 >>> global_timespan = abjad.Timespan(
201 ...     start_offset=0,
202 ...     stop_offset=max(_.stop_offset for _ in all_timespan_lists.values())

```



```

203 ... )
204
205 >>> for voice_name, timespan_list in all_timespan_lists.items():
206 ...     silences = abjad.TimespanList([global_timespan])
207 ...     silences.extend(timespan_list)
208 ...     silences.sort()
209 ...     silences.compute_logical_xor()
210 ...     for silence_timespan in silences:
211 ...         timespan_list.append(
212 ...             abjad.AnnotatedTimespan(
213 ...                 start_offset=silence_timespan.start_offset,
214 ...                 stop_offset=silence_timespan.stop_offset,
215 ...                 annotation=MusicSpecifier(
216 ...                     rhythm_maker=None,
217 ...                     voice_name=voice_name,
218 ...                 ),
219 ...             )
220 ...         )
221 ...     timespan_list.sort()
222
223 >>> for voice_name, timespan_list in all_timespan_lists.items():
224 ...     shards = timespan_list.split_at_offsets(bounds)
225 ...     split_timespan_list = abjad.TimespanList()
226 ...     for shard in shards:
227 ...         split_timespan_list.extend(shard)
228 ...     split_timespan_list.sort()
229 ...     all_timespan_lists[voice_name] = timespan_list
230
231 >>> score = abjad.Score([
232 ...     abjad.Staff(lilypond_type='TimeSignatureContext', name='Global Context
233 ...     '),
234 ...     abjad.StaffGroup(
235 ...         [
236 ...             abjad.Staff(
237 ...                 [abjad.Voice(name='Voice 1')], name='Staff 1', lilypond_type='Staff',
238 ...             ),
239 ...             abjad.Staff(
240 ...                 [abjad.Voice(name='Voice 2')], name='Staff 2', lilypond_type='Staff',
241 ...             ),
242 ...             abjad.Staff(
243 ...                 [abjad.Voice(name='Voice 3')], name='Staff 3', lilypond_type='Staff',
244 ...             ),
245 ...             abjad.Staff(
246 ...                 [abjad.Voice(name='Voice 4')], name='Staff 4', lilypond_type='Staff',
247 ...             ),
248 ...             ],
249 ...         name='Staff Group',
250 ...     ])
251
252
253 >>> for time_signature in time_signatures:
254 ...     skip = abjad.Skip(1, multiplier=(time_signature))
255 ...     abjad.attach(time_signature, skip)

```

```

256 ...     score['Global Context'].append(skip)
257
258 >>> print('Making containers ...')
259
260 >>> def make_container(rhythm_maker, durations):
261 ...     selections = rhythm_maker(durations)
262 ...     container = abjad.Container([])
263 ...     container.extend(selections)
264 ...     return container
265
266 >>> def key_function(timespan):
267 ...     return timespan.annotation.rhythm_maker or silence_maker
268
269 >>> for voice_name, timespan_list in all_timespan_lists.items():
270 ...     for rhythm_maker, grouper in itertools.groupby(
271 ...         timespan_list,
272 ...         key=key_function,
273 ...     ):
274 ...         durations = [timespan.duration for timespan in grouper]
275 ...         container = make_container(rhythm_maker, durations)
276 ...         voice = score[voice_name]
277 ...         voice.append(container)
278
279 >>> print('Beaming runs ...')
280 >>> for voice in abjad.select(score['Staff Group']).components(abjad.Voice):
281 ...     for run in abjad.select(voice).runs():
282 ...         specifier = abjadext.rmakers.BeamSpecifier(
283 ...             beam_each_division=False,
284 ...             )
285 ...         specifier(run)
286 ...         abjad.beam(voice[:], beam_lone_notes=False, beam_rests=False,)
287
288 >>> print('Stopping Hairpins and Text Spans...')
289
290 >>> for staff in abjad.iterate(score['Staff Group']).components(abjad.Staff):
291 ...     for run in abjad.select(staff).runs():
292 ...         last_leaf = run[-1]
293 ...         next_leaf = abjad.inspect(last_leaf).leaf(1)
294 ...         abjad.attach(abjad.StopHairpin(), next_leaf)
295
296 >>> print('Adding attachments ...')
297 >>> bar_line = abjad.BarLine('||')
298 >>> metro = abjad.MetronomeMark((1, 4), 108)
299 >>> markup = abjad.Markup(r'\bold { A }')
300 >>> mark = abjad.RehearsalMark(markup=markup)
301
302 >>> def cyc(lst):
303 ...     count = 0
304 ...     while True:
305 ...         yield lst[count%len(lst)]
306 ...         count += 1
307
308 >>> instruments = cyc([
309 ...     abjad.Violin(),

```

```

310 ...     abjad.Violin(),
311 ...     abjad.Viola(),
312 ...     abjad.Cello(),
313 ... ])
314
315 >>> clefs = cyc([
316 ...     abjad.Clef('treble'),
317 ...     abjad.Clef('treble'),
318 ...     abjad.Clef('varC'),
319 ...     abjad.Clef('bass'),
320 ... ])
321
322 >>> abbreviations = cyc([
323 ...     abjad.MarginMarkup(markup=abjad.Markup('vln. I'),),
324 ...     abjad.MarginMarkup(markup=abjad.Markup('vln. II'),),
325 ...     abjad.MarginMarkup(markup=abjad.Markup('vla.'),),
326 ...     abjad.MarginMarkup(markup=abjad.Markup('vc.'),),
327 ... ])
328
329 >>> names = cyc([
330 ...     abjad.StartMarkup(markup=abjad.Markup('Violin I'),),
331 ...     abjad.StartMarkup(markup=abjad.Markup('Violin II'),),
332 ...     abjad.StartMarkup(markup=abjad.Markup('Viola'),),
333 ...     abjad.StartMarkup(markup=abjad.Markup('Violoncello'),),
334 ... ])
335
336 >>> for staff in abjad.iterate(score['Staff Group']).components(abjad.Staff):
337 ...     leaf1 = abjad.select(staff).leaves()[0]
338 ...     abjad.attach(next(instruments), leaf1)
339 ...     abjad.attach(next(abbreviations), leaf1)
340 ...     abjad.attach(next(names), leaf1)
341
342 >>> for staff in abjad.select(score['Staff Group']).components(abjad.Staff)
343 [0]:
344 ...     leaf1 = abjad.select(staff).leaves()[0]
345 ...     last_leaf = abjad.select(staff).leaves()[-1]
346 ...     abjad.attach(metro, leaf1)
347 ...     abjad.attach(bar_line, last_leaf)
348
349 >>> for staff in abjad.iterate(score['Global Context']).components(abjad.Staff
350 ):
351 ...     leaf1 = abjad.select(staff).leaves()[0]
352 ...     abjad.attach(mark, leaf1)
353
354 >>> for staff in abjad.iterate(score['Staff Group']).components(abjad.Staff):
355 ...     abjad.Instrument.transpose_from_sounding_pitch(staff)
356
357 >>> score_file = abjad.LilyPondFile.new(
358 ...     score,
359 ...     includes=['first_stylesheets.ily',
360 ...                 '/Users/evansdsg2/abjad/docs/source/_stylesheets/abjad.ily'
361 ...             ],
362 ... )

```

```

362 >>> abjad.SegmentMaker.comment_measure_numbers(score)
363
364 >>> abjad.show(score_file)

```

Code Example 2.41: Demonstration of AttachmentHandlers

It results in the following lilypond code:

```

1 \version "2.19.82"  %! LilyPondFile
2 \language "english" %! LilyPondFile
3
4 \include "first_stylesheet.ily" %!
   LilyPondFile
5 \include "/Users/evansdsg2/abjad/docs/source/_stylesheets/abjad.ily" %!
   LilyPondFile
6
7 \header { %! LilyPondFile
8     tagline = ##f
9 } %! LilyPondFile
10
11 \layout {}
12
13 \paper {}
14
15 \score { %! LilyPondFile
16     \new Score
17     <<
18         \context TimeSignatureContext = "Global Context"
19         {
20             % [Global Context measure 1] %! COMMENT_MEASURE_NUMBERS
21             \time 4/4
22             \mark \markup {
23                 \bold
24                 {
25                     A
26                 }
27             }
28             s1 * 1
29         }
30         \context StaffGroup = "Staff Group"
31         <<
32             \context Staff = "Staff 1"
33             \with
34             {
35                 \consists Horizontal_bracket_engraver
36             }
37             {
38                 \context Voice = "Voice 1"
39                 {
40                     {
41                         % [Voice 1 measure 1] %! COMMENT_MEASURE_NUMBERS
42                         \set Staff.shortInstrumentName =
43                         \markup { "vln. I" }
44                         \set Staff.instrumentName =

```

```

45 \markup { "Violin I" }
46 \tempo 4=108
47 \once \override Staff.NoteHead.style = #'cross
48 \clef "bass"
49 c'8
50 \f
51 - \tenuto
52 \>
53 - \tweak style #'dotted-line
54 \glissando
55 (
56 [
57 \once \override Staff.NoteHead.style = #'harmonic-
mixed
58 d'16
59 - \staccato
60 - \tweak style #'dotted-line
61 \glissando
62 ]
63 \once \override Staff.NoteHead.style = #'diamond
64 cs'4
65 ~
66 - \tweak style #'dotted-line
67 \glissando
68 \once \override Staff.NoteHead.style = #'diamond
69 cs'16
70 \p
71 - \tweak stencil #constante-hairpin
72 \<
73 )
74 }
75 {
76 r8
77 \!
78 }
79 {
80 \once \override Staff.NoteHead.style = #'triangle
81 \clef "bass"
82 cs'16
83 \f
84 - \portato
85 \>
86 - \tweak style #'dotted-line
87 \glissando
88 (
89 [
90 \ottava 1
91 \once \override Staff.NoteHead.style = #'slash
92 <ef' bf'>8.
93 \p
94 - \tenuto
95 - \tweak stencil #constante-hairpin
96 \<
97 )

```

```

98         ]
99         \ottava 0
100     }
101     {
102         r8
103         \!
104         \bar "||"
105     }
106 }
107
108 \context Staff = "Staff 2"
109 \with
110 {
111     \consists Horizontal_bracket_engraver
112 }
113 {
114     \context Voice = "Voice 2"
115     {
116         {
117             \times 8/9 {
118                 % [Voice 2 measure 1] %! COMMENT_MEASURE_NUMBERS
119                 \set Staff.shortInstrumentName =
120                 \markup { "vln. II" }
121                 \set Staff.instrumentName =
122                 \markup { "Violin II" }
123                 \ottava 1
124                 \once \override Staff.NoteHead.style = #'default
125                 \clef "bass"
126                 <ef' bf'>8.
127                 \f
128                 - \staccato
129                 \>
130                 - \tweak style #'dotted-line
131                 \glissando
132                 (
133                 [
134                     \ottava 0
135                     \ottava 1
136                     \once \override Staff.NoteHead.style = #'cross
137                     e'16
138                     - \portato
139                     - \tweak style #'dotted-line
140                     \glissando
141                     \ottava 0
142                     \ottava 1
143                     \once \override Staff.NoteHead.style = #'harmonic-
mixed
144                     af'8
145                     - \tenuto
146                     - \tweak style #'dotted-line
147                     \glissando
148                     \ottava 0
149                     \ottava 1
150                     \ottava 1

```

```

151         \once \override Staff.NoteHead.style = #'diamond
152         <g' a'>8
153         - \staccato
154         - \tweak style #'dotted-line
155         \glissando
156         \ottava 0
157         \ottava 0
158         \ottava 1
159         \once \override Staff.NoteHead.style = #'triangle
160         fs'16
161         \p
162         - \portato
163         - \tweak stencil #constante-hairpin
164         \<
165         )
166         ]
167         \ottava 0
168     }
169 }
170 {
171     r8
172     \!
173 }
174 {
175     \ottava 1
176     \once \override Staff.NoteHead.style = #'slash
177     \clef "bass"
178     fs'4
179     \f
180     - \tenuto
181     - \tweak stencil #constante-hairpin
182     \<
183     )
184     (
185     \ottava 0
186     }
187     {
188         r8
189         \!
190     }
191 }
192 }
193 \context Staff = "Staff 3"
194 \with
195 {
196     \consists Horizontal_bracket_engraver
197 }
198 {
199     \context Voice = "Voice 3"
200     {
201         {
202             \tweak text #tuplet-number::calc-fraction-text
203             \times 8/7 {
204                 % [Voice 3 measure 1] %! COMMENT_MEASURE_NUMBERS

```

```

205         \set Staff.shortInstrumentName =
206         \markup { vla. }
207         \set Staff.instrumentName =
208         \markup { Viola }
209         \ottava 1
210         \once \override Staff.NoteHead.style = #'default
211         \clef "bass"
212         fs'16
213         \f
214         - \staccato
215         \>
216         - \tweak style #'dotted-line
217         \glissando
218         (
219         [
220         \ottava 0
221         \once \override Staff.NoteHead.style = #'cross
222         c'16
223         - \portato
224         - \tweak style #'dotted-line
225         \glissando
226         \once \override Staff.NoteHead.style = #'harmonic-
mixed
227         d'8.
228         - \tenuto
229         - \tweak style #'dotted-line
230         \glissando
231         \once \override Staff.NoteHead.style = #'diamond
232         cs'8
233         \p
234         - \staccato
235         - \tweak stencil #constante-hairpin
236         \<
237         )
238         ]
239     }
240 }
241 {
242     r8
243     \!
244 }
245 {
246     \once \override Staff.NoteHead.style = #'triangle
247     \clef "bass"
248     cs'16
249     \f
250     - \portato
251     \>
252     - \tweak style #'dotted-line
253     \glissando
254     (
255     [
256     \ottava 1
257     \once \override Staff.NoteHead.style = #'slash

```



```

258         <ef' bf'>16
259         - \tenuto
260         - \tweak style #'dotted-line
261         \glissando
262         \ottava 0
263         \ottava 1
264         \once \override Staff.NoteHead.style = #'default
265         e'8
266         \p
267         - \staccato
268         - \tweak stencil #constante-hairpin
269         \<
270         )
271         ]
272         \ottava 0
273     }
274     {
275         r8
276         \!
277     }
278 }
279
280 \context Staff = "Staff 4"
281 \with
282 {
283     \consists Horizontal_bracket_engraver
284 }
285 {
286     \context Voice = "Voice 4"
287     {
288         {
289             % [Voice 4 measure 1] %! COMMENT_MEASURE_NUMBERS
290             \set Staff.shortInstrumentName =
291             \markup { vc. }
292             \set Staff.instrumentName =
293             \markup { Violoncello }
294             \ottava 1
295             \once \override Staff.NoteHead.style = #'cross
296             \clef "bass"
297             e'8
298             \f
299             - \portato
300             \>
301             - \tweak style #'dotted-line
302             \glissando
303             (
304             [
305             \ottava 0
306             \ottava 1
307             \once \override Staff.NoteHead.style = #'harmonic-
mixed
308             af'16
309             - \tenuto
310             - \tweak style #'dotted-line

```

```

311      \glissando
312    ]
313    \ottava 0
314    \ottava 1
315    \ottava 1
316    \once \override Staff.NoteHead.style = #'diamond
317    <g' a'>4
318    ~
319    - \tweak style #'dotted-line
320    \glissando
321    \once \override Staff.NoteHead.style = #'diamond
322    <g' a'>16
323    \p
324    - \tweak stencil #constante-hairpin
325    \<
326    )
327    \ottava 0
328    \ottava 0
329  }
330  {
331    r8
332    \!
333  }
334  {
335    \times 4/5 {
336      \ottava 1
337      \ottava 1
338      \once \override Staff.NoteHead.style = #'triangle
339      \clef "bass"
340      <g' a'>16
341      \f
342      - \staccato
343      \>
344      - \tweak style #'dotted-line
345      \glissando
346      (
347      [
348      \ottava 0
349      \ottava 0
350      \ottava 1
351      \once \override Staff.NoteHead.style = #'slash
352      fs'8.
353      - \portato
354      - \tweak style #'dotted-line
355      \glissando
356      \ottava 0
357      \once \override Staff.NoteHead.style = #'default
358      c'16
359      \p
360      - \tenuto
361      - \tweak stencil #constante-hairpin
362      \<
363      )
364      ]

```

```

365 }
366 }
367 {
368   r8
369   \!
370 }
371 }
372 }
373 >>
374 >>
375 } %! LilyPondFile

```

Code Example 2.42: Demonstration of AttachmentHandlers: RESULT

and figure 2.1.16:

The musical score is for four voices: Violin I, Violin II, Viola, and Violoncello. It is in 4/4 time with a tempo of 108. The key signature has one sharp (F#). The score consists of four measures. The first measure is marked with a forte (f) dynamic and a slur. The second measure is marked with a piano (p) dynamic and a slur. The third measure is marked with a forte (f) dynamic and a slur. The fourth measure is marked with a piano (p) dynamic and a slur. The score is written in bass clef for all instruments.

Figure 2.1.16: Four voice demonstration of AttachmentHandlers.

2.2 EDITING SOURCE CODE

While I have written my own tools for composition with Abjad, I have also occasionally found it necessary to edit Abjad's source code in order to include features that I desire, which is possible because Abjad is open source.

2.2.1 CLEF.PY

Recently I edited the *Clef.py* file in the Abjad source. I did this in order to include Abjad representations of clefs that were present in the most recent update of Lilypond. The clefs in question were *varC* and *tenorvarC*, both of which are alternative “c” clefs. I wanted to add these clefs for a logical reason as well as a personal reason. The first reason is that, as much as possible, Abjad should have a representation of all of Lilypond’s features. If a composer knows that Lilypond is capable of producing a certain graphic object,⁵⁶ it can be very frustrating to find no way to use it in Abjad. The second reason is that these clefs more closely represent my own handwriting of c clefs than the traditional c clef.

2.2.2 ARTICULATION.PY

Just as with *Clef.py* I also recently edited the *Articulation.py* file. I did this at the same time and for the same reason as editing the clef file. I added Abjad representations of “halfopen,” which is a circle with a diagonal slash and “snappizzicato,” which is the common notation for a snap or “Bartok” pizzicato.

2.2.3 MICROTONAL EXPANSION IN ABJAD 2.2.1

In the summer of 2018, I undertook, with help from Ivan Moscotta, a much larger revision of Abjad’s source code. These edits were specifically centered around Abjad’s representation of pitch. At the time, the most recent version of Abjad was Abjad 2.2.1. Also during this summer, I attended the CCRMA Abjad workshop and I was able to discuss some of these changes with the primary maintainers of the system: Trevor Bača and Josiah Oberholtzer. We came to the conclusion that much of Abjad’s representation of microtones should be reassessed and should be open enough for composers to be able to define their own accidentals and scales. Because of this decision, the changes that I made to Abjad 2.2.1’s code are not available for users in the main branch of Abjad 3.1, but will hopefully be given new birth in a future release.⁵⁷

⁵⁶These are often called grobs in Lilypond-lingo.

⁵⁷However, these changes are available in my greg/dev branch of Abjad.

2.2.3.1 PROCESS

I decided to undertake this major revision because I wanted to compose with microtones smaller than Lilypond's and Abjad's smallest interval, which is the quarter tone. In Lilypond's font, Emmantaler, are two different kinds of quarter tones. Quarter tones written in Stein-Ellis notation and quarter tones written as traditional accidentals with an attached arrow either up or down to represent the microtonal alteration. I decided to use these arrow-based quarter tones to represent eighth tones.⁵⁸ In fact, there is a file buried deep within Lilypond called *Microtonal.ily* that does just this. The file must be included at the header of the Lilypond file in order to make use of the user-defined microtones. I tried to find a way to do this and had a little success, although with great difficulty. I began to wonder if it was possible to extend this to further divisions of the octave. I began to edit the default font in Lilypond to be able to represent different kinds of accidentals as well as making some slight changes to the default accidentals for my own graphic preference, generally keeping to the Stein-Zimmerman notation for quarter tones⁵⁹ and the Ferneyhough notation for all other microtonal alterations.⁶⁰ This became cumbersome and inconsistent and I looked for an alternative. Fortuitously, I found the Ekmelily system.⁶¹ This extension of Lilypond, written by Thomas Richter, does something similar to *Microtonal.ily*, but it also comes with an extensive font extension to allow for many kinds of microtonal representations and the ability to create user-defined scales with accidental grobs chosen by the user. This was my solution for graphically representing my new microtones. The following image in figure 2.2.1 is a representation of my own user-defined scale:

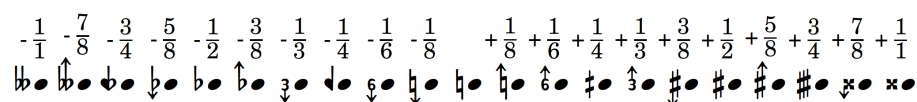


Figure 2.2.1: ekmelicStyle evans scale.

⁵⁸This decision is informed, in part, by my familiarity with OpenMusic's accidentals.

⁵⁹<https://w3c.github.io/smufi/gitbook/tables/extended-stein-zimmermann-accidentals.html>

⁶⁰<https://w3c.github.io/smufi/gitbook/tables/other-accidentals.html>

⁶¹<http://www.ekmelic-music.org/en/extra/ekmelily.htm>

2.2.3.2 FILE SYSTEMS AND ALTERATIONS

There were a few files in Abjad that needed to be changed in order to interface with Ekmelily via Abjad. These files were *Accidental.py*, *NumberedPitchClass.py*, *PitchClass.py*, and *language_pitch_names.py*. I also edited the *language_pitch_names.ly* file in Lilypond. In these files I defined the name, division size, and abbreviation of each new accidental and linked these abbreviations to my user-defined scale in Ekmelily. Making sure to always include Ekmelily and my own scale at the beginning of each Lilypond file, I was able to compose music in abjad with eighth tones, third tones, and sixth tones. All of the code alterations for this functionality is available at <https://github.com/GregoryREvans/Abjad-Microtones>.

The following image in figure 2.2.2 is a random walk generated with a pitch depth of eighth tones from my development branch of Abjad:



Figure 2.2.2: An eighth tone random walk.

2.3 CONCLUSION

In this chapter, I have described my methodology for composing in Abjad and the tools that I have written to assist in my compositional process. In the next chapter I will present the source code and scores of recent music that I have written with Abjad, all of which is available at <https://github.com/GregoryREvans>. Since the composition of these pieces, I have begun to experiment with a new organizational principle for my music. I now think of each piece as being similar to a piece of software which can make use of a number of data sets housed externally from the segment files of the composition. I now foresee a composition that is highly externalized. This will allow for greater fluidity when calling variables, functions, and lists throughout the composition process and will potentially

contribute to a greater sense of continuity throughout a piece while simplifying and reducing the amount of code written. The first piece that I am beginning to compose in this manner can be found at <https://github.com/GregoryREvans/onkos>. Because the pieces included in this appendix were written before this paradigm shift, the source code has a tendency to be overly long and at times redundant.

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I realized that one of the fundamental questions in music is its ability to make variations but preserving certain peculiarities, making it stable. We see variations; what is kept is the harmonic structure while music follows its own path. We also find constant structures, dilations and scale reductions in the music of the past [...]. Certain types of topologies are therefore obviously established.

(2017, *Metamodels in Compositional Practices* p.85)

Francisco Guerrero



Appendix of Source Code

CONTAINED IN THIS APPENDIX is the source code of my AttachmentHandlers as well as three of my compositions: “Cthar,” “Tianshu,” and “Four Ages of Sand.” The compilation of these materials and the scores in appendix B constitute the fruits of my recent research into computer assisted composition and engraving.

A.1 ATTACHMENTHANDLERS

A.1.1 ARTICULATIONHANDLER

```
1 import abjad
2
3 class ArticulationHandler:
4
5     def __init__(
6         self,
7         articulation_list=None,
8         continuous=False,
9     ):
10         def cyc(lst):
11             if self.continuous == False:
12                 self._count = 0
13                 while True:
14                     yield lst[self._count % len(lst)]
15                     self._count += 1
16         self.articulation_list = articulation_list
17         self.continuous = continuous
18         self._cyc_articulations = cyc(articulation_list)
19         self._count = 0
20
```

```

21 def __call__(self, selections):
22     return self.add_articulations(selections)
23
24 def add_articulations(self, selections):
25     ties = abjad.select(selections).logical_ties(pitched=True)
26     for tie in ties:
27         if len(tie) == 1:
28             if self.articulation_list != None:
29                 articulation = self._cyc_articulations
30                 abjad.attach(abjad.Aarticulation(next(articulation)), tie
[0])
31     return selections

```

Code Example A.1: ArticulationHandler

A.1.2 CLEFHANDLER

```

1 import abjad
2
3 class ClefHandler:
4
5     def __init__(
6         self,
7         clef=None,
8         ottava_shelf=None,
9         add_ottavas=False,
10    ):
11        self.clef = clef
12        self.ottava_shelf = ottava_shelf
13        self.add_ottavas = add_ottavas
14
15    def __call__(self, selections):
16        return self.add_clef(selections)
17
18    def add_clef(self, selections):
19        for run in abjad.select(selections).runs():
20            ties = abjad.select(run).logical_ties(pitched=True)
21            if self.clef != None:
22                abjad.attach(abjad.Clef(self.clef), ties[0][0])
23            if self.add_ottavas == True:
24                self._add_ottavas(selections)
25        return selections
26
27    def _add_ottavas(self, selections):
28        if self.clef == 'treble':
29            if self.ottava_shelf != None:
30                shelf = self.ottava_shelf
31                for tie in abjad.select(selections).logical_ties():
32                    for pitch in abjad.inspect(tie[0]).pitches():
33                        if pitch > shelf:
34                            abjad.ottava(tie)
35            else:
36                shelf = 36

```

```

37         for tie in abjad.select(selections).logical_ties(pitched=True)
38     :
39         for pitch in abjad.inspect(tie[0]).pitches():
40             if pitch > shelf:
41                 abjad.ottava(tie)
42     if self.clef == 'alto':
43         if self.ottava_shelf != None:
44             shelf = self.ottava_shelf
45         for tie in abjad.select(selections).logical_ties(pitched=True)
46     :
47         for pitch in abjad.inspect(tie).pitches():
48             if pitch > shelf:
49                 abjad.ottava(tie)
50     else:
51         shelf = 13
52         for tie in abjad.select(selections).logical_ties(pitched=True)
53     :
54         for pitch in abjad.inspect(tie[0]).pitches():
55             if pitch > shelf:
56                 abjad.ottava(tie)
57     if self.clef == 'varC':
58         if self.ottava_shelf != None:
59             shelf = self.ottava_shelf
60         for tie in abjad.select(selections).logical_ties(pitched=True)
61     :
62         for pitch in abjad.inspect(tie[0]).pitches():
63             if pitch > shelf:
64                 abjad.ottava(tie)
65     else:
66         shelf = 13
67         for tie in abjad.select(selections).logical_ties(pitched=True)
68     :
69         for pitch in abjad.inspect(tie[0]).pitches():
70             if pitch > shelf:
71                 abjad.ottava(tie)
72     if self.clef == 'tenor':
73         if self.ottava_shelf != None:
74             shelf = self.ottava_shelf
75         for tie in abjad.select(selections).logical_ties(pitched=True)
76     :
77         for pitch in abjad.inspect(tie[0]).pitches():
78             if pitch > shelf:
79                 abjad.ottava(tie)
80     else:
81         shelf = 10
82         for tie in abjad.select(selections).logical_ties(pitched=True)
83     :
84         for pitch in abjad.inspect(tie[0]).pitches():
85             if pitch > shelf:
86                 abjad.ottava(tie)
87     if self.clef == 'tenorvarC':
88         if self.ottava_shelf != None:
89             shelf = self.ottava_shelf
90         for tie in abjad.select(selections).logical_ties(pitched=True)

```

```

:
84         for pitch in abjad.inspect(tie[0]).pitches():
85             if pitch > shelf:
86                 abjad.ottava(tie)
87     else:
88         shelf = 10
89         for tie in abjad.select(selections).logical_ties(pitched=True)
:
90         for pitch in abjad.inspect(tie[0]).pitches():
91             if pitch > shelf:
92                 abjad.ottava(tie)
93     if self.clef == 'bass':
94         if self.ottava_shelf != None:
95             shelf = self.ottava_shelf
96         for tie in abjad.select(selections).logical_ties(pitched=True)
:
97         for pitch in abjad.inspect(tie[0]).pitches():
98             if pitch > shelf:
99                 abjad.ottava(tie)
100     else:
101         shelf = 3
102         for tie in abjad.select(selections).logical_ties(pitched=True)
:
103         for pitch in abjad.inspect(tie[0]).pitches():
104             if pitch > shelf:
105                 abjad.ottava(tie)
106     return(selections)

```

Code Example A.2: ClefHandler

A.1.3 DYNAMICHANDLER

```

1 import abjad
2
3 class DynamicHandler:
4
5     def __init__(
6         self,
7         starting_dynamic=None,
8         ending_dynamic=None,
9         hairpin=None,
10        continuous=False,
11    ):
12        def cyc(lst):
13            if self.continuous == False:
14                self._count = 0
15            while True:
16                yield lst[self._count % len(lst)]
17                self._count += 1
18        self.starting_dynamic = starting_dynamic
19        self.ending_dynamic = ending_dynamic
20        self.hairpin = hairpin
21        self.continuous = continuous

```

```

22     self._cyc_dynamics = cyc([starting_dynamic, ending_dynamic])
23     self._count = 0
24
25     def __call__(self, selections):
26         return self.add_dynamics(selections)
27
28     def add_dynamics(self, selections):
29         runs = abjad.select(selections).runs()
30         ties = abjad.select(selections).logical_ties(pitched=True)
31         for run in runs:
32             if len(run) > 1:
33                 leaves = abjad.select(run).leaves()
34                 if self.starting_dynamic != None:
35                     abjad.attach(abjad.Dynamic(self.starting_dynamic), leaves
[0])
36                 if self.hairpin != None:
37                     abjad.attach(abjad.StartHairpin(self.hairpin), leaves[0])
38                 if self.ending_dynamic != None:
39                     abjad.attach(abjad.Dynamic(self.ending_dynamic), leaves
[-1])
40                 abjad.attach(abjad.StartHairpin('--'), leaves[-1])
41             else:
42                 leaves = abjad.select(run).leaves()
43                 dynamic = next(self._cyc_dynamics)
44                 if self.starting_dynamic != None:
45                     if self.ending_dynamic != None:
46                         abjad.attach(abjad.Dynamic(dynamic), leaves[0])
47                     else:
48                         abjad.attach(abjad.Dynamic(self.starting_dynamic),
leaves[0])
49                 if self.starting_dynamic == None:
50                     if self.ending_dynamic != None:
51                         abjad.attach(abjad.Dynamic(self.ending_dynamic),
leaves[0])
52                 abjad.attach(abjad.StartHairpin('--'), leaves[0])
53         return selections

```

Code Example A.3: DynamicHandler

A.1.4 GLISSANDOHANDLER

```

1 import abjad
2
3 class GlissandoHandler:
4
5     def __init__(
6         self,
7         glissando_style=None,
8         line_style=None,
9     ):
10         self.glissando_style = glissando_style
11         self.line_style = line_style
12

```

```

13 def __call__(self, selections):
14     return self.add_glissando(selections)
15
16 def add_glissando(self, selections):
17     runs = abjad.select(selections).runs()
18     if self.glissando_style == 'hide_middle_note_heads':
19         if self.line_style != None:
20             for run in runs:
21                 if len(run) > 1:
22                     abjad.glissando(run[:], abjad.tweak(self.line_style).
style, hide_middle_note_heads=True, )
23         else:
24             for run in runs:
25                 if len(run) > 1:
26                     abjad.glissando(run[:], hide_middle_note_heads=True, )
27     elif self.glissando_style == 'hide_middle_stems':
28         if self.line_style != None:
29             for run in runs:
30                 if len(run) > 1:
31                     abjad.glissando(run[:], abjad.tweak(self.line_style).
style, hide_middle_note_heads=True, hide_middle_stems=True, )
32         else:
33             for run in runs:
34                 if len(run) > 1:
35                     abjad.glissando(run[:], hide_middle_note_heads=True,
hide_middle_stems=True, )
36         else:
37             if self.line_style != None:
38                 for run in runs:
39                     if len(run) > 1:
40                         abjad.glissando(run[:], abjad.tweak(self.line_style).
style, allow_repeats=True, allow_ties=True, )
41             else:
42                 for run in runs:
43                     if len(run) > 1:
44                         abjad.glissando(run[:], allow_repeats=True, allow_ties
=True, )
45     return selections

```

Code Example A.4: GlissandoHandler

A.1.5 NOTEHEADHANDLER

```

1 import abjad
2
3 class NoteheadHandler:
4
5     def __init__(
6         self,
7         notehead_list=None,
8         continuous=False,
9     ):
10     def cyc(lst):

```

```

11         if self.continuous == False:
12             self._count = 0
13         while True:
14             yield lst[self._count % len(lst)]
15             self._count += 1
16     self.notehead_list = notehead_list
17     self.continuous = continuous
18     self._cyc_noteheads = cyc(notehead_list)
19     self._count = 0
20
21     def __call__(self, selections):
22         return self.add_noteheads(selections)
23
24     def add_noteheads(self, selections):
25         if self.notehead_list != None:
26             head = self._cyc_noteheads
27             for tie in abjad.select(selections).logical_ties(pitched=True):
28                 head_name = next(head)
29                 string = str(r"""\once \override Staff.NoteHead.style = #'""")
30                 full_string = string + head_name
31                 style = abjad.LilyPondLiteral(full_string, format_slot='before
',)
32                 for leaf in abjad.select(tie).leaves(pitched=True):
33                     abjad.attach(style, leaf)
34         return selections

```

Code Example A.5: NoteheadHandler

A.1.6 PITCHHANDLER

```

1 import abjad
2
3 class PitchHandler:
4
5     def __init__(
6         self,
7         pitch_list=None,
8         continuous=False,
9     ):
10         def cyc(lst):
11             if self.continuous == False:
12                 self._count = 0
13             while True:
14                 yield lst[self._count % len(lst)]
15                 self._count += 1
16         self.pitch_list = pitch_list
17         self.continuous = continuous
18         self._cyc_pitches = cyc(pitch_list)
19         self._count = 0
20
21     def __call__(self, selections):
22         return self._apply_pitches(selections, self.pitch_list)
23

```

```

24 def _collect_pitches_durations_leaves(self, logical_ties, pitches):
25     def cyc(lst):
26         if self.continuous == False:
27             self._count = 0
28         while True:
29             yield lst[self._count % len(lst)]
30             self._count += 1
31     cyc_pitches = cyc(pitches)
32     pitches, durations, leaves = [], [], []
33     for tie in logical_ties:
34         if isinstance(tie[0], abjad.Note):
35             pitch = next(cyc_pitches)
36             for leaf in tie:
37                 pitches.append(pitch)
38                 durations.append(leaf.written_duration)
39                 leaves.append(leaf)
40         else:
41             for leaf in tie:
42                 pitches.append(None)
43                 durations.append(leaf.written_duration)
44                 leaves.append(leaf)
45     return pitches, durations, leaves
46
47 def _apply_pitches(self, selections, pitches):
48     leaf_maker = abjad.LeafMaker()
49     container = abjad.Container(selections)
50     old_ties = [tie for tie in abjad.iterate(
51         container).logical_ties()]
52     pitches, durations, old_leaves = self.
53     _collect_pitches_durations_leaves(
54         old_ties, pitches)
55     new_leaves = [leaf for leaf in leaf_maker(pitches, durations)]
56     for old_leaf, new_leaf in zip(old_leaves, new_leaves):
57         indicators = abjad.inspect(old_leaf).indicators()
58         for indicator in indicators:
59             abjad.attach(indicator, new_leaf)
60         parent = abjad.inspect(old_leaf).parentage().parent
61         parent[parent.index(old_leaf)] = new_leaf
62     return [container[:]]

```

Code Example A.6: PitchHandler

A.1.7 SLURHANDLER

```

1 import abjad
2
3 class SlurHandler:
4
5     def __init__(
6         self,
7         slurs=None,
8     ):
9         self.slurs = slurs

```



```

10
11     def __call__(self, selections):
12         return self.add_slurs(selections)
13
14     def add_slurs(self, selections):
15         if self.slurs == 'selections':
16             abjad.slur(selections[:])
17         elif self.slurs == 'runs':
18             for run in abjad.select(selections).runs():
19                 abjad.slur(run[:])
20         else:
21             pass
22         return selections

```

Code Example A.7: SlurHandler

A.1.8 TRILLHANDLER

```

1 import abjad
2
3 class TrillHandler:
4
5     def __call__(self, selections):
6         return self._apply_trills(selections)
7
8     def _apply_trills(self, selections):
9         container = abjad.Container()
10        container.append(selections)
11
12        for tie in abjad.iterate(container).logical_ties(pitched=True):
13            if all(isinstance(leaf, abjad.Chord) for leaf in abjad.iterate(tie)
14                .leaves()):
15                old_chord = tie[0]
16                base_pitch = old_chord.written_pitches[0]
17                trill_pitch = old_chord.written_pitches[-1]
18                interval_ = abjad.NamedInterval().from_pitch_carriers(
19                    base_pitch, trill_pitch)
20                new_leaf = abjad.Note(base_pitch, old_chord.written_duration)
21
22                trill_start = abjad.LilyPondLiteral(r'\pitchedTrill',
23                    format_slot='before')
24                trill_literal = abjad.LilyPondLiteral(f'\startTrillSpan {
25                    trill_pitch}', format_slot='after')
26                trill_stop = abjad.LilyPondLiteral(r'\stopTrillSpan',
27                    format_slot='after')
28                abjad.attach(trill_start, new_leaf)
29                abjad.attach(trill_literal, new_leaf)
30                last_leaf = tie[-1]
31                next_leaf = abjad.inspect(last_leaf).leaf(1)
32                if next_leaf != None:
33                    abjad.attach(trill_stop, next_leaf)
34
35                indicators = abjad.inspect(old_chord).indicators()

```

```

31         for indicator in indicators:
32             abjad.attach(indicator, new_leaf)
33
34         parent = abjad.inspect(old_chord).parentage().parent
35         parent[parent.index(old_chord)] = new_leaf
36
37         tail = abjad.select(tie).leaves()[1:]
38         for leaf in tail:
39             new_tail = abjad.Note(base_pitch, leaf.written_duration)
40             parent = abjad.inspect(leaf).parentage().parent
41             parent[parent.index(leaf)] = new_tail
42             indicators = abjad.inspect(leaf).indicators()
43             for indicator in indicators:
44                 abjad.attach(indicator, new_tail)
45
46         return container[:]

```

Code Example A.8: TrillHandler

A.2 CTHAR (FOR TWO CELLOS) SOURCE CODE

A.2.1 SEGMENT

A.2.1.1 SEGMENT_I

```

1  import abjad
2  import itertools
3  import os
4  import pathlib
5  import time
6  import abjadext.rmakers
7  from MusicMaker import MusicMaker
8  from AttachmentHandler import AttachmentHandler
9  from random import random
10 from random import seed
11
12 print('Interpreting file ...')
13
14 time_signatures = [
15     abjad.TimeSignature(pair) for pair in [
16         (4, 4), (5, 4), (3, 4), (3, 4), (5, 4), (3, 4),
17         (4, 4), (4, 4), (5, 4), (4, 4), (4, 4), (4, 4),
18         (3, 4), (5, 4), (4, 4), (4, 4), (4, 4), (4, 4),
19         (4, 4), (5, 4), (3, 4), (4, 4), (3, 4), (3, 4),
20         (5, 4), (4, 4), (3, 4), (4, 4), (4, 4), (5, 4),
21         (3, 4), (5, 4), (5, 4), (4, 4), (3, 4), (3, 4),
22         (4, 4), (4, 4), (4, 4), (4, 4), (5, 4), (4, 4),
23         (5, 4), (4, 4), (4, 4), (5, 4), (5, 4),
24     ]
25 ]

```

```

26
27 bounds = abjad.mathtools.cumulative_sums([_.duration for _ in time_signatures
    ])
28
29 def reduceMod7(rw):
30     return [(x % 8) for x in rw]
31
32 def reduceMod9(rw):
33     return [(x % 10) for x in rw]
34
35 def reduceMod17(rw):
36     return [(x % 18) for x in rw]
37
38 def reduceMod21(rw):
39     return [(x % 22) for x in rw]
40
41 def reduceMod47(rw):
42     return [(x % 48) for x in rw]
43
44 def cyc(lst):
45     count = 0
46     while True:
47         yield lst[count%len(lst)]
48         count += 1
49
50 def grouper(lst1, lst2):
51     def cyc(lst):
52         c = 0
53         while True:
54             yield lst[c%len(lst)]
55             c += 1
56     lst1 = cyc(lst1)
57     return [next(lst1) if i == 1 else [next(lst1) for _ in range(i)] for i in
    lst2]
58
59 seed(1)
60 cello_random_walk_one = []
61 cello_random_walk_one.append(-1 if random() < 0.5 else 1)
62 for i in range(1, 1000):
63     movement = -1 if random() < 0.5 else 1
64     value = cello_random_walk_one[i-1] + movement
65     cello_random_walk_one.append(value)
66 cello_random_walk_one = [abs(x) for x in cello_random_walk_one]
67 cello_chord_one = [-12, -11.5, -11, -10.5, -10, -9.5, -9, -8.5, -8, -7.5, -7,
    -6.5, -6, -5.5, -5, -4.5, -4, -3.5, -3, -2.5, -2, -1.5, -1, -0.5, 0, -0.5,
    -1, -1.5, -2, -2.5, -3, -3.5, -4, -4.5, -5, -5.5, -6, -6.5, -7, -7.5, -8,
    -8.5, -9, -9.5, -10, -10.5, -11, -11.5, ]
68 cello_notes_one = [cello_chord_one[x] for x in reduceMod47(
    cello_random_walk_one)]
69
70 seed(2)
71 cello_random_walk_two = []
72 cello_random_walk_two.append(-1 if random() < 0.5 else 1)
73 for i in range(1, 1000):

```

```

74     movement = -1 if random() < 0.5 else 1
75     value = cello_random_walk_two[i-1] + movement
76     cello_random_walk_two.append(value)
77 cello_random_walk_two = [abs(x) for x in cello_random_walk_two]
78 cello_chord_two = [-24, -11, -20, -6, -12, -6, 0, -11, -6, 4, 0, 6, 0, -11,
79                    -6, -24, -8, 0, ]
80 cello_notes_two_walk = [cello_chord_two[x] for x in reduceMod17(
81                          cello_random_walk_two)]
82
83 seed(3)
84 cello_random_walk_three = []
85 cello_random_walk_three.append(-1 if random() < 0.5 else 1)
86 for i in range(1, 1000):
87     movement = -1 if random() < 0.5 else 1
88     value = cello_random_walk_three[i-1] + movement
89     cello_random_walk_three.append(value)
90 cello_random_walk_three = [abs(x) for x in cello_random_walk_three]
91 cello_chord_three = [-24, -20, -15, -14, -4, 5, 11, 19, 26, 37, 39, 42, 39,
92                     37, 26, 19, 11, 5, -4, -14, -15, -20, ]
93 cello_notes_three = [cello_chord_three[x] for x in reduceMod21(
94                       cello_random_walk_three)]
95
96 seed(4)
97 cello_random_walk_four = []
98 cello_random_walk_four.append(-1 if random() < 0.5 else 1)
99 for i in range(1, 2000):
100     movement = -1 if random() < 0.5 else 1
101     value = cello_random_walk_four[i-1] + movement
102     cello_random_walk_four.append(value)
103 cello_random_walk_four = [abs(x) for x in cello_random_walk_four]
104 cello_chord_four = [-17, -8, -13, -5, 5, -5, -13, -8, ]
105 map_2 = [2, 1, 2, 1, 2, 2, 1, 2, 1, 2, 1, 1, 1, 2, 1, 2, 1, ]
106 cello_notes_four_walk = [cello_chord_four[x] for x in reduceMod7(
107                           cello_random_walk_four)]
108 cello_notes_four = grouper(cello_notes_four_walk, map_2)
109
110 rmaker_one = abjadext.rmakers.TaleaRhythmMaker(
111     talea=abjadext.rmakers.Talea(
112         counts=[7, 4, 6, 3, 5, 3, 5, 3, 6, 4],
113         denominator=32,
114     ),
115     beam_specifier=abjadext.rmakers.BeamSpecifier(
116         beam_divisions_together=True,
117         beam_rests=False,
118     ),
119     extra_counts_per_division=[0, 1, 0, -1],
120     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
121         trivialize=True,
122         extract_trivial=True,
123         rewrite_rest_filled=True,
124     ),
125 )

```

```

123
124 rmaker_two = abjadext.rmakers.TaleaRhythmMaker(
125     talea=abjadext.rmakers.Talea(
126         counts=[1, 1, 1, 2, 1, 3, 1, 2, 3],
127         denominator=16,
128     ),
129     beam_specifier=abjadext.rmakers.BeamSpecifier(
130         beam_divisions_together=True,
131         beam_rests=False,
132     ),
133     extra_counts_per_division=[1, 0, -1, 0, 1],
134     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
135         trivialize=True,
136         extract_trivial=True,
137         rewrite_rest_filled=True,
138     ),
139 )
140
141 rmaker_three = abjadext.rmakers.EvenDivisionRhythmMaker(
142     denominators=[8, 8, 16, 8, 8, 16],
143     extra_counts_per_division=[0, 1, 0, 0, -1, 0, 1, -1],
144     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
145         trivialize=True,
146         extract_trivial=True,
147         rewrite_rest_filled=True,
148     ),
149 )
150
151 attachment_handler_one = AttachmentHandler(
152     starting_dynamic='p',
153     ending_dynamic='mp',
154     hairpin_indicator='--',
155     articulation='accent',
156 )
157
158 attachment_handler_two = AttachmentHandler(
159     starting_dynamic='fff',
160     ending_dynamic='mf',
161     hairpin_indicator='>',
162     articulation='tenuto',
163 )
164
165 attachment_handler_three = AttachmentHandler(
166     starting_dynamic='mp',
167     ending_dynamic='ff',
168     hairpin_indicator='<|',
169     articulation='',
170 )
171
172 #####cello#####
173 cellomusicmaker_one = MusicMaker(
174     rmaker=rmaker_one,
175     pitches=cello_notes_one,
176     continuous=True,

```

```

177     attachment_handler=attachment_handler_one,
178 )
179 cellomusicmaker_two = MusicMaker(
180     rmaker=rmaker_two,
181     pitches=cello_notes_two,
182     continuous=True,
183     attachment_handler=attachment_handler_two,
184 )
185 cellomusicmaker_three = MusicMaker(
186     rmaker=rmaker_three,
187     pitches=cello_notes_three,
188     continuous=True,
189     attachment_handler=attachment_handler_three,
190 )
191 cellomusicmaker_four = MusicMaker(
192     rmaker=rmaker_two,
193     pitches=cello_notes_four,
194     continuous=True,
195     attachment_handler=attachment_handler_three,
196 )
197
198 silence_maker = abjadext.rmakers.NoteRhythmMaker(
199     division_masks=[
200         abjadext.rmakers.SilenceMask(
201             pattern=abjad.index([0], 1),
202         ),
203     ],
204 )
205
206 bowmaker = MusicMaker(
207     pitches=[33, ],
208     rmaker=rmaker_two,
209     continuous=True,
210 )
211
212 class MusicSpecifier:
213
214     def __init__(self, music_maker, voice_name):
215         self.music_maker = music_maker
216         self.voice_name = voice_name
217
218 print('Collecting timespans and rmakers ...')
219 ###group one###
220 voice_1_timespan_list = abjad.TimespanList([
221     abjad.AnnotatedTimespan(
222         start_offset=start_offset,
223         stop_offset=stop_offset,
224         annotation=MusicSpecifier(
225             music_maker=music_maker,
226             voice_name='Voice 1',
227         ),
228     )
229     for start_offset, stop_offset, music_maker in [
230         [(0, 4), (4, 4), bowmaker],

```

```

231     [(4, 4), (7, 4), bowmaker],
232     [(12, 4), (15, 4), bowmaker],
233     [(15, 4), (17, 4), bowmaker],
234     [(17, 4), (20, 4), bowmaker],
235     [(23, 4), (25, 4), bowmaker],
236     [(25, 4), (27, 4), bowmaker],
237     [(27, 4), (30, 4), bowmaker],
238     [(32, 4), (36, 4), bowmaker],
239     [(43, 4), (44, 4), bowmaker],
240     [(44, 4), (48, 4), bowmaker],
241     [(48, 4), (51, 4), bowmaker],
242     [(52, 4), (56, 4), bowmaker],
243     [(56, 4), (58, 4), bowmaker],
244     [(62, 4), (64, 4), bowmaker],
245     [(68, 4), (72, 4), bowmaker],
246     [(72, 4), (76, 4), bowmaker],
247     [(76, 4), (78, 4), bowmaker],
248     [(78, 4), (81, 4), bowmaker],
249     [(82, 4), (84, 4), bowmaker],
250     [(84, 4), (87, 4), bowmaker],
251     [(88, 4), (91, 4), bowmaker],
252     [(91, 4), (93, 4), bowmaker],
253     [(94, 4), (99, 4), bowmaker],
254     [(100, 4), (103, 4), bowmaker],
255     [(103, 4), (105, 4), bowmaker],
256     [(106, 4), (110, 4), bowmaker],
257     [(110, 4), (111, 4), bowmaker],
258     [(112, 4), (114, 4), bowmaker],
259     [(114, 4), (119, 4), bowmaker],
260     [(122, 4), (126, 4), bowmaker],
261     [(128, 4), (131, 4), bowmaker],
262     [(132, 4), (134, 4), bowmaker],
263     [(139, 4), (140, 4), bowmaker],
264     [(144, 4), (146, 4), bowmaker],
265     [(146, 4), (149, 4), bowmaker],
266     [(150, 4), (153, 4), bowmaker],
267     [(157, 4), (158, 4), bowmaker],
268     [(158, 4), (162, 4), bowmaker],
269     [(165, 4), (167, 4), bowmaker],
270     [(167, 4), (169, 4), bowmaker],
271     [(174, 4), (176, 4), bowmaker],
272     [(176, 4), (177, 4), bowmaker],
273     [(181, 4), (185, 4), bowmaker],
274     [(185, 4), (186, 4), bowmaker],
275
276 ]
277 ])
278
279 voice_2_timespan_list = abjad.TimespanList([
280     abjad.AnnotatedTimespan(
281         start_offset=start_offset,
282         stop_offset=stop_offset,
283         annotation=MusicSpecifier(
284             music_maker=music_maker,

```

```

285         voice_name='Voice 2',
286     ),
287 )
288     for start_offset, stop_offset, music_maker in [
289         [(0, 4), (4, 4), cellomusicmaker_two],
290         [(4, 4), (7, 4), cellomusicmaker_one],
291         [(12, 4), (15, 4), cellomusicmaker_two],
292         [(15, 4), (17, 4), cellomusicmaker_one],
293         [(17, 4), (20, 4), cellomusicmaker_two],
294         [(23, 4), (25, 4), cellomusicmaker_two],
295         [(25, 4), (27, 4), cellomusicmaker_one],
296         [(27, 4), (30, 4), cellomusicmaker_two],
297         [(32, 4), (36, 4), cellomusicmaker_three],
298         [(43, 4), (44, 4), cellomusicmaker_two],
299         [(44, 4), (48, 4), cellomusicmaker_two],
300         [(48, 4), (51, 4), cellomusicmaker_one],
301         [(52, 4), (56, 4), cellomusicmaker_one],
302         [(56, 4), (58, 4), cellomusicmaker_two],
303         [(62, 4), (64, 4), cellomusicmaker_two],
304         [(68, 4), (72, 4), cellomusicmaker_three],
305         [(72, 4), (76, 4), cellomusicmaker_two],
306         [(76, 4), (78, 4), cellomusicmaker_three],
307         [(78, 4), (81, 4), cellomusicmaker_two],
308         [(82, 4), (84, 4), cellomusicmaker_two],
309         [(84, 4), (87, 4), cellomusicmaker_four],#
310         [(88, 4), (91, 4), cellomusicmaker_four],
311         [(91, 4), (93, 4), cellomusicmaker_one],
312         [(94, 4), (99, 4), cellomusicmaker_three],
313         [(100, 4), (103, 4), cellomusicmaker_one],
314         [(103, 4), (105, 4), cellomusicmaker_one],
315         [(106, 4), (110, 4), cellomusicmaker_four],
316         [(110, 4), (111, 4), cellomusicmaker_four],
317         [(112, 4), (114, 4), cellomusicmaker_three],
318         [(114, 4), (119, 4), cellomusicmaker_three],
319         [(122, 4), (126, 4), cellomusicmaker_one],
320         [(128, 4), (131, 4), cellomusicmaker_three],
321         [(132, 4), (134, 4), cellomusicmaker_four],
322         [(139, 4), (140, 4), cellomusicmaker_four],
323         [(144, 4), (146, 4), cellomusicmaker_four],
324         [(146, 4), (149, 4), cellomusicmaker_four],
325         [(150, 4), (153, 4), cellomusicmaker_four],#
326         [(157, 4), (158, 4), cellomusicmaker_two],
327         [(158, 4), (162, 4), cellomusicmaker_three],
328         [(165, 4), (167, 4), cellomusicmaker_two],
329         [(167, 4), (169, 4), cellomusicmaker_two],
330         [(174, 4), (176, 4), cellomusicmaker_three],
331         [(176, 4), (177, 4), cellomusicmaker_one],
332         [(181, 4), (185, 4), cellomusicmaker_two],
333         [(185, 4), (186, 4), cellomusicmaker_three],
334     ]
335 ])
336
337 ###group two###
338 voice_3_timespan_list = abjad.TimespanList([

```



```

339 abjad.AnnotatedTimespan(
340     start_offset=start_offset,
341     stop_offset=stop_offset,
342     annotation=MusicSpecifier(
343         music_maker=music_maker,
344         voice_name='Voice 3',
345     ),
346 )
347 for start_offset, stop_offset, music_maker in [
348     [(0, 4), (3, 4), bowmaker],
349     [(3, 4), (4, 4), bowmaker],
350     [(4, 4), (5, 4), bowmaker],
351     [(8, 4), (9, 4), bowmaker],
352     [(9, 4), (12, 4), bowmaker],
353     [(12, 4), (15, 4), bowmaker],
354     [(20, 4), (23, 4), bowmaker],
355     [(25, 4), (27, 4), bowmaker],
356     [(27, 4), (29, 4), bowmaker],
357     [(34, 4), (36, 4), bowmaker],
358     [(36, 4), (40, 4), bowmaker],
359     [(40, 4), (43, 4), bowmaker],
360     [(48, 4), (51, 4), bowmaker],
361     [(52, 4), (56, 4), bowmaker],
362     [(58, 4), (60, 4), bowmaker],
363     [(60, 4), (64, 4), bowmaker],
364     [(64, 4), (66, 4), bowmaker],
365     [(72, 4), (76, 4), bowmaker],
366     [(76, 4), (79, 4), bowmaker],
367     [(79, 4), (81, 4), bowmaker],
368     [(81, 4), (82, 4), bowmaker],
369     [(83, 4), (84, 4), bowmaker],
370     [(84, 4), (88, 4), bowmaker],
371     [(88, 4), (89, 4), bowmaker],
372     [(90, 4), (91, 4), bowmaker],
373     [(91, 4), (94, 4), bowmaker],
374     [(94, 4), (96, 4), bowmaker],
375     [(97, 4), (99, 4), bowmaker],
376     [(99, 4), (103, 4), bowmaker],
377     [(104, 4), (106, 4), bowmaker],
378     [(106, 4), (110, 4), bowmaker],
379     [(111, 4), (114, 4), bowmaker],
380     [(115, 4), (117, 4), bowmaker],
381     [(119, 4), (122, 4), bowmaker],
382     [(125, 4), (127, 4), bowmaker],
383     [(127, 4), (129, 4), bowmaker],
384     [(133, 4), (136, 4), bowmaker],
385     [(136, 4), (138, 4), bowmaker],
386     [(143, 4), (146, 4), bowmaker],
387     [(146, 4), (150, 4), bowmaker],
388     [(150, 4), (154, 4), bowmaker],
389     [(154, 4), (155, 4), bowmaker],
390     [(157, 4), (158, 4), bowmaker],
391     [(158, 4), (160, 4), bowmaker],
392     [(164, 4), (167, 4), bowmaker],

```

```

393     [(167, 4), (169, 4), bowmaker],
394     [(171, 4), (172, 4), bowmaker],
395     [(172, 4), (174, 4), bowmaker],
396     [(178, 4), (180, 4), bowmaker],
397     [(180, 4), (183, 4), bowmaker],
398     [(185, 4), (189, 4), bowmaker],
399
400 ]
401 ])
402
403 voice_4_timespan_list = abjad.TimespanList([
404     abjad.AnnotatedTimespan(
405         start_offset=start_offset,
406         stop_offset=stop_offset,
407         annotation=MusicSpecifier(
408             music_maker=music_maker,
409             voice_name='Voice 4',
410         ),
411     )
412     for start_offset, stop_offset, music_maker in [
413         [(0, 4), (3, 4), cellomusicmaker_one],
414         [(3, 4), (4, 4), cellomusicmaker_two],
415         [(4, 4), (5, 4), cellomusicmaker_one],
416         [(8, 4), (9, 4), cellomusicmaker_one],
417         [(9, 4), (12, 4), cellomusicmaker_three],
418         [(12, 4), (15, 4), cellomusicmaker_one],
419         [(20, 4), (23, 4), cellomusicmaker_two],
420         [(25, 4), (27, 4), cellomusicmaker_one],
421         [(27, 4), (29, 4), cellomusicmaker_one],
422         [(34, 4), (36, 4), cellomusicmaker_two],
423         [(36, 4), (40, 4), cellomusicmaker_one],
424         [(40, 4), (43, 4), cellomusicmaker_two],
425         [(48, 4), (51, 4), cellomusicmaker_two],
426         [(52, 4), (56, 4), cellomusicmaker_two],
427         [(58, 4), (60, 4), cellomusicmaker_one],
428         [(60, 4), (64, 4), cellomusicmaker_one],
429         [(64, 4), (66, 4), cellomusicmaker_three],
430         [(72, 4), (76, 4), cellomusicmaker_two],
431         [(76, 4), (79, 4), cellomusicmaker_one],
432         [(79, 4), (81, 4), cellomusicmaker_one],
433         [(81, 4), (82, 4), cellomusicmaker_three],
434         [(83, 4), (84, 4), cellomusicmaker_two],
435         [(84, 4), (88, 4), cellomusicmaker_two],
436         [(88, 4), (89, 4), cellomusicmaker_one],
437         [(90, 4), (91, 4), cellomusicmaker_one],
438         [(91, 4), (94, 4), cellomusicmaker_three],
439         [(94, 4), (96, 4), cellomusicmaker_two],
440         [(97, 4), (99, 4), cellomusicmaker_two],
441         [(99, 4), (103, 4), cellomusicmaker_one],
442         [(104, 4), (106, 4), cellomusicmaker_one],
443         [(106, 4), (110, 4), cellomusicmaker_three],
444         [(111, 4), (114, 4), cellomusicmaker_two],
445         [(115, 4), (117, 4), cellomusicmaker_four],#
446         [(119, 4), (122, 4), cellomusicmaker_four],

```

```

447     [(125, 4), (127, 4), cellomusicmaker_four],
448     [(127, 4), (129, 4), cellomusicmaker_four],
449     [(133, 4), (136, 4), cellomusicmaker_four],
450     [(136, 4), (138, 4), cellomusicmaker_four],
451     [(143, 4), (146, 4), cellomusicmaker_four],
452     [(146, 4), (150, 4), cellomusicmaker_four],
453     [(150, 4), (154, 4), cellomusicmaker_four],#
454     [(154, 4), (155, 4), cellomusicmaker_one],
455     [(157, 4), (158, 4), cellomusicmaker_three],
456     [(158, 4), (160, 4), cellomusicmaker_three],
457     [(164, 4), (167, 4), cellomusicmaker_two],
458     [(167, 4), (169, 4), cellomusicmaker_two],
459     [(171, 4), (172, 4), cellomusicmaker_three],
460     [(172, 4), (174, 4), cellomusicmaker_one],
461     [(178, 4), (180, 4), cellomusicmaker_one],
462     [(180, 4), (183, 4), cellomusicmaker_two],
463     [(185, 4), (189, 4), cellomusicmaker_two],
464     [(189, 4), (190, 4), silence_maker],
465 ]
466 ])
467
468 all_timespan_lists = {
469     'Voice 1': voice_1_timespan_list,
470     'Voice 2': voice_2_timespan_list,
471     'Voice 3': voice_3_timespan_list,
472     'Voice 4': voice_4_timespan_list,
473 }
474
475 global_timespan = abjad.Timespan(
476     start_offset=0,
477     stop_offset=max(_.stop_offset for _ in all_timespan_lists.values())
478 )
479
480 for voice_name, timespan_list in all_timespan_lists.items():
481     silences = abjad.TimespanList([global_timespan])
482     silences.extend(timespan_list)
483     silences.sort()
484     silences.compute_logical_xor()
485     for silence_timespan in silences:
486         timespan_list.append(
487             abjad.AnnotatedTimespan(
488                 start_offset=silence_timespan.start_offset,
489                 stop_offset=silence_timespan.stop_offset,
490                 annotation=MusicSpecifier(
491                     music_maker=None,
492                     voice_name=voice_name,
493                 ),
494             )
495         )
496     timespan_list.sort()
497
498 for voice_name, timespan_list in all_timespan_lists.items():
499     shards = timespan_list.split_at_offsets(bounds)
500     split_timespan_list = abjad.TimespanList()

```

```

501     for shard in shards:
502         split_timespan_list.extend(shard)
503     split_timespan_list.sort()
504     all_timespan_lists[voice_name] = timespan_list
505
506 score = abjad.Score([
507     abjad.Staff(lilypond_type='TimeSignatureContext', name='Global Context'),
508     abjad.StaffGroup(
509         [
510             abjad.Staff([abjad.Voice(name='Voice 1')], name='Staff 1',
511             lilypond_type='BowStaff',),
512             abjad.Staff([abjad.Voice(name='Voice 5')], name='Staff 5',
513             lilypond_type='BeamStaff',),
514             abjad.Staff([abjad.Voice(name='Voice 2')], name='Staff 2',
515             lilypond_type='Staff',),
516         ],
517         name='Staff Group 1',
518     ),
519     abjad.StaffGroup(
520         [
521             abjad.Staff([abjad.Voice(name='Voice 3')], name='Staff 3',
522             lilypond_type='BowStaff',),
523             abjad.Staff([abjad.Voice(name='Voice 6')], name='Staff 6',
524             lilypond_type='BeamStaff',),
525             abjad.Staff([abjad.Voice(name='Voice 4')], name='Staff 4',
526             lilypond_type='Staff',),
527         ],
528         name='Staff Group 2',
529     )
530 ],
531 )
532
533 for time_signature in time_signatures:
534     skip = abjad.Skip(1, multiplier=(time_signature))
535     abjad.attach(time_signature, skip)
536     score['Global Context'].append(skip)
537
538 print('Making containers ...')
539
540 def make_container(music_maker, durations):
541     selections = music_maker(durations)
542     container = abjad.Container([])
543     container.extend(selections)
544     return container
545
546 def key_function(timespan):
547     return timespan.annotation.music_maker or silence_maker
548
549 for voice_name, timespan_list in all_timespan_lists.items():
550     for music_maker, grouper in itertools.groupby(
551         timespan_list,
552         key=key_function,
553     ):
554         durations = [timespan.duration for timespan in grouper]

```

```

549         container = make_container(music_maker, durations)
550         voice = score[voice_name]
551         voice.append(container)
552
553     print('Adding Beam Staff ...')
554     voice_1_copy = abjad.mutate(score['Voice 1']).copy()
555     score['Voice 5'].extend([voice_1_copy[:]])
556
557     voice_3_copy = abjad.mutate(score['Voice 3']).copy()
558     score['Voice 6'].extend([voice_3_copy[:]])
559
560     print('Splitting and rewriting ...')
561
562     for voice in abjad.iterate(score['Staff Group 1']).components(abjad.Voice):
563         for i, shard in enumerate(abjad.mutate(voice[:]).split(time_signatures)):
564             time_signature = time_signatures[i]
565             abjad.mutate(shard).rewrite_meter(time_signature)
566
567     for voice in abjad.iterate(score['Staff Group 2']).components(abjad.Voice):
568         for i, shard in enumerate(abjad.mutate(voice[:]).split(time_signatures)):
569             time_signature = time_signatures[i]
570             abjad.mutate(shard).rewrite_meter(time_signature)
571
572     print('Beaming runs ...')
573
574     for voice in abjad.select(score).components(abjad.Voice):
575         for run in abjad.select(voice).runs():
576             if 1 < len(run):
577                 specifier = abjadext.rmakers.BeamSpecifier(
578                     beam_each_division=True,
579                 )
580                 specifier(abjad.select(run))
581                 abjad.attach(abjad.StartBeam(), run[0])
582                 abjad.attach(abjad.StopBeam(), run[-1])
583
584     print('Stopping Hairpins ...')
585     for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
586         for rest in abjad.iterate(staff).components(abjad.Rest):
587             previous_leaf = abjad.inspect(rest).leaf(-1)
588             if isinstance(previous_leaf, abjad.Note):
589                 abjad.attach(abjad.StopHairpin(), rest)
590             elif isinstance(previous_leaf, abjad.Chord):
591                 abjad.attach(abjad.StopHairpin(), rest)
592             elif isinstance(previous_leaf, abjad.Rest):
593                 pass
594
595     for staff in abjad.iterate(score['Staff Group 2']).components(abjad.Staff):
596         for rest in abjad.iterate(staff).components(abjad.Rest):
597             previous_leaf = abjad.inspect(rest).leaf(-1)
598             if isinstance(previous_leaf, abjad.Note):
599                 abjad.attach(abjad.StopHairpin(), rest)
600             elif isinstance(previous_leaf, abjad.Chord):
601                 abjad.attach(abjad.StopHairpin(), rest)
602             elif isinstance(previous_leaf, abjad.Rest):

```

```

603         pass
604
605
606 print('Adding attachments ...')
607 bar_line = abjad.BarLine('|.|')
608 section_bar_line = abjad.BarLine('||')
609 metro = abjad.MetronomeMark((1, 8), 60)
610 markup1 = abjad.Markup(r'\bold { A }')
611 markup2 = abjad.Markup(r'\bold { B }')
612 markup3 = abjad.Markup(r'\bold { C }')
613 markup4 = abjad.Markup(r'\bold { D }')
614 markup5 = abjad.Markup(r'\bold { E }')
615 markup6 = abjad.Markup(r'\bold { F }')
616 mark1 = abjad.RehearsalMark(markup=markup1)
617 mark2 = abjad.RehearsalMark(markup=markup2)
618 mark3 = abjad.RehearsalMark(markup=markup3)
619 mark4 = abjad.RehearsalMark(markup=markup4)
620 mark5 = abjad.RehearsalMark(markup=markup5)
621 mark6 = abjad.RehearsalMark(markup=markup6)
622
623 def _apply_numerators_and_tech(staff, nums, tech):
624     numerators = cyc(nums)
625     techs = cyc(tech)
626     for logical_tie in abjad.select(staff).logical_ties(pitched=True):
627         tech = next(techs)
628         numerator = next(numerators)
629         bcp = abjad.BowContactPoint((numerator, 5))
630         technis = abjad.BowMotionTechnique(tech)
631         for note in logical_tie:
632             abjad.attach(bcp, note)
633             abjad.attach(technis, note)
634     for run in abjad.select(staff).runs():
635         abjad.bow_contact_spanner(run, omit_bow_changes=False)
636
637 for voice in abjad.select(score['Voice 1']).components(abjad.Voice):
638     seed(4)
639     nums_random_walk = []
640     nums_random_walk.append(-1 if random() < 0.5 else 1)
641     for i in range(1, 1000):
642         movement = -1 if random() < 0.5 else 1
643         value = nums_random_walk[i-1] + movement
644         nums_random_walk.append(value)
645     nums_random_walk = [abs(x) for x in nums_random_walk]
646     nums_chord = [0, 5, 3, 1, 4, 2, 5, 4, 3, 2]
647     num_list = [nums_chord[x] for x in reduceMod9(nums_random_walk)]
648     tech_list = ['ordinario', 'ordinario', 'ordinario', 'ordinario', 'circular',
649                 'circular', 'ordinario', 'ordinario', 'ordinario', 'jete', 'ordinario',
650                 'ordinario', 'ordinario', 'ordinario', 'ordinario', 'jete', 'jete', 'jete', 'jete',]
649     _apply_numerators_and_tech(staff=voice, nums=num_list, tech=tech_list)
650
651 for voice in abjad.select(score['Voice 3']).components(abjad.Voice):
652     seed(5)
653     nums_random_walk = []

```

```

654     nums_random_walk.append(-1 if random() < 0.5 else 1)
655     for i in range(1, 1000):
656         movement = -1 if random() < 0.5 else 1
657         value = nums_random_walk[i-1] + movement
658         nums_random_walk.append(value)
659     nums_random_walk = [abs(x) for x in nums_random_walk]
660     nums_chord = [0, 1, 2, 3, 4, 5, 4, 3, 2, 1]
661     num_list = [nums_chord[x] for x in reduceMod9(nums_random_walk)]
662     tech_list = ['ordinario', 'ordinario', 'ordinario', 'ordinario', 'circular',
663                 'circular', 'ordinario', 'ordinario', 'ordinario', 'jete', 'ordinario',
664                 'ordinario', 'ordinario', 'ordinario', 'ordinario', 'jete', 'jete', 'jete', 'jete',]
665     _apply_numerators_and_tech(staff=voice, nums=num_list, tech=tech_list)
666
667 def _apply_position_and_span(staff, poses):
668     positions = cyc(poses)
669     for run in abjad.select(staff).runs():
670         span = abjad.StartTextSpan(
671             left_text=abjad.Markup(next(positions)).upright(),
672             right_text=abjad.Markup(next(positions)).upright(),
673             style='dashed-line-with-arrow',
674         )
675         abjad.attach(span, run[0])
676         abjad.attach(abjad.StopTextSpan(), run[-1])
677         abjad.override(staff).text_spanner.staff_padding = 0
678
679 for voice in abjad.select(score['Voice 5']).components(abjad.Voice):
680     pos_list_1 = ['st.', 'ord.', 'sp.', 'msp.', 'ord.',]
681     _apply_position_and_span(staff=voice, poses=pos_list_1)
682
683 for voice in abjad.select(score['Voice 6']).components(abjad.Voice):
684     pos_list_2 = ['sp.', 'msp.', 'ord.', 'st.', 'ord.',]
685     _apply_position_and_span(staff=voice, poses=pos_list_2)
686
687 for voice in abjad.select(score['Voice 1']).components(abjad.Voice):
688     for run in abjad.select(voice).runs():
689         specifier = abjadext.rmakers.BeamSpecifier(
690             beam_each_division=False,
691         )
692         specifier(run)
693
694 for voice in abjad.select(score['Voice 3']).components(abjad.Voice):
695     for run in abjad.select(voice).runs():
696         specifier = abjadext.rmakers.BeamSpecifier(
697             beam_each_division=False,
698         )
699         specifier(run)
700
701 instruments1 = cyc([
702     abjad.Cello(),
703 ])
704
705 instruments2 = cyc([
706     abjad.Cello(),

```

```

705 ])
706
707 clefs1 = cyc([
708     abjad.Clef('percussion'),
709     abjad.Clef('percussion'),
710     abjad.Clef('bass'),
711 ])
712
713 clefs2 = cyc([
714     abjad.Clef('percussion'),
715     abjad.Clef('percussion'),
716     abjad.Clef('bass'),
717 ])
718
719 abbreviations1 = cyc([
720     abjad.MarginMarkup(markup=abjad.Markup('B.H.'),),
721     abjad.MarginMarkup(markup=abjad.Markup('vc.I'),),
722     abjad.MarginMarkup(markup=abjad.Markup('L.H.'),),
723 ])
724
725 abbreviations2 = cyc([
726     abjad.MarginMarkup(markup=abjad.Markup('B.H.'),),
727     abjad.MarginMarkup(markup=abjad.Markup('vc.II'),),
728     abjad.MarginMarkup(markup=abjad.Markup('L.H.'),),
729 ])
730
731 names1 = cyc([
732     abjad.StartMarkup(markup=abjad.Markup('Bow Hand'),),
733     abjad.StartMarkup(markup=abjad.Markup('Violoncello I'),),
734     abjad.StartMarkup(markup=abjad.Markup('Left Hand'),),
735 ])
736
737 names2 = cyc([
738     abjad.StartMarkup(markup=abjad.Markup('Bow Hand'),),
739     abjad.StartMarkup(markup=abjad.Markup('Violoncello II'),),
740     abjad.StartMarkup(markup=abjad.Markup('Left Hand'),),
741 ])
742
743 for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
744     leaf1 = abjad.select(staff).leaves()[0]
745     abjad.attach(next(instruments1), leaf1)
746     abjad.attach(next(abbreviations1), leaf1)
747     abjad.attach(next(names1), leaf1)
748     abjad.attach(next(clefs1), leaf1)
749
750 for staff in abjad.iterate(score['Staff Group 2']).components(abjad.Staff):
751     leaf1 = abjad.select(staff).leaves()[0]
752     abjad.attach(next(instruments2), leaf1)
753     abjad.attach(next(abbreviations2), leaf1)
754     abjad.attach(next(names2), leaf1)
755     abjad.attach(next(clefs2), leaf1)
756
757 for staff in abjad.select(score['Staff Group 1']).components(abjad.Staff)[0]:
758     leaf1 = abjad.select(staff).leaves()[0]

```



```

759     last_leaf = abjad.select(staff).leaves()[-1]
760     abjad.attach(metro, leaf1)
761     abjad.attach(bar_line, last_leaf)
762
763     for staff in abjad.select(score['Staff Group 2']).components(abjad.Staff):
764         leaf1 = abjad.select(staff).leaves()[0]
765         last_leaf = abjad.select(staff).leaves()[-1]
766         abjad.attach(metro, leaf1)
767         abjad.attach(bar_line, last_leaf)
768
769     for staff in abjad.iterate(score['Global Context']).components(abjad.Staff):
770         leaf1_start = abjad.select(staff).leaves()[7]
771         leaf1 = abjad.select(staff).leaves()[8]
772         abjad.attach(mark1, leaf1)
773         abjad.attach(section_bar_line, leaf1_start)
774
775     for staff in abjad.iterate(score['Global Context']).components(abjad.Staff):
776         leaf2_start = abjad.select(staff).leaves()[15]
777         leaf2 = abjad.select(staff).leaves()[16]
778         abjad.attach(mark2, leaf2)
779         abjad.attach(section_bar_line, leaf2_start)
780
781     for staff in abjad.iterate(score['Global Context']).components(abjad.Staff):
782         leaf3_start = abjad.select(staff).leaves()[23]
783         leaf3 = abjad.select(staff).leaves()[24]
784         abjad.attach(mark3, leaf3)
785         abjad.attach(section_bar_line, leaf3_start)
786
787     for staff in abjad.iterate(score['Global Context']).components(abjad.Staff):
788         leaf4_start = abjad.select(staff).leaves()[31]
789         leaf4 = abjad.select(staff).leaves()[32]
790         abjad.attach(mark4, leaf4)
791         abjad.attach(section_bar_line, leaf4_start)
792
793     for staff in abjad.iterate(score['Global Context']).components(abjad.Staff):
794         leaf5_start = abjad.select(staff).leaves()[38]
795         leaf5 = abjad.select(staff).leaves()[39]
796         abjad.attach(mark5, leaf5)
797         abjad.attach(section_bar_line, leaf5_start)
798
799     score_file = abjad.LilyPondFile.new(
800         score,
801         includes=['first_stylesheet.ily', '/Users/evansdsg2/abjad/docs/source/
_stylesheet/abjad.ily'],
802     )
803
804     abjad.SegmentMaker.comment_measure_numbers(score)
805     #####
806
807     directory = '/Users/evansdsg2/Scores/cthar/cthar/Segments/Segment_I'
808     pdf_path = f'{directory}/Segment_I.pdf'
809     path = pathlib.Path('Segment_I.pdf')
810     if path.exists():
811         print(f'Removing {pdf_path} ...')

```

```

812     path.unlink()
813 time_1 = time.time()
814 print(f'Persisting {pdf_path} ...')
815 result = abjad.persist(score_file).as_pdf(pdf_path)
816 print(result[0])
817 print(result[1])
818 print(result[2])
819 success = result[3]
820 if success is False:
821     print('LilyPond failed!')
822 time_2 = time.time()
823 total_time = time_2 - time_1
824 print(f'Total time: {total_time} seconds')
825 if path.exists():
826     print(f'Opening {pdf_path} ...')
827     os.system(f'open {pdf_path}')

```

Code Example A.9: Cthar Segment_1

A.2.2 STYLESHEET

```

1 Cthar Stylesheet.
2 % 2018-07-17 19:54
3
4 \version "2.19.82"
5 \language "english"
6 #(set-default-paper-size "letterlandscape")
7 #(set-global-staff-size 10)
8 \include "ekmel.ily"
9 \ekmelicStyle evans
10
11 \header {
12     tagline = ##f
13     breakbefore = ##t
14     title = \markup \override #'(
15         font-name . "Didot"
16         ) \fontsize #15 \bold \center-column {
17         "Cthar"
18     }
19     subtitle = \markup \override #'(
20         font-name . "Didot"

```

```

21         ) \fontsize #4 \center-column {
22             "for two cellos"
23         }
24     arranger = \markup \override #'(
25         font-name . "Didot"
26     ) \fontsize #2.5 {
27         "Gregory Rowland Evans"
28     }
29 }
30
31 bowtab = {
32     \override Staff.Clef.stencil = #ly:text-interface::print
33     \override Staff.Clef.text = \markup { \general-align #Y #0.03
34         \epsfile #Y #10 #"bow_position_tablature.eps"
35     }
36 }
37
38 \layout {
39     \accidentalStyle forget
40     %\accidentalStyle modern
41     %\accidentalStyle modern-cautionary
42     %\accidentalStyle neo-modern
43     %\accidentalStyle dodecaphonic
44     indent = #5
45     %ragged-last = ##t
46     ragged-right = ##t
47     %left-margin = #15
48     \context {
49         \name TimeSignatureContext
50         \type Engraver_group
51         \numericTimeSignature
52         \consists Axis_group_engraver
53         \consists Bar_number_engraver

```

```

54     \consists Time_signature_engraver
55     \consists Mark_engraver
56     \consists Metronome_mark_engraver
57     \override BarNumber.Y-extent = #'(0 . 0)
58     \override BarNumber.Y-offset = 0
59     \override BarNumber.extra-offset = #'(-4 . 0)
60     %\override BarNumber.font-name = "Didot"
61     \override BarNumber.stencil = #(
62         make-stencil-boxer 0.1 0.7 ly:text-interface::print
63     )
64     \override BarNumber.font-size = 1
65     \override BarNumber.padding = 4
66     \override MetronomeMark.X-extent = #'(0 . 0)
67     \override MetronomeMark.Y-extent = #'(0 . 0)
68     \override MetronomeMark.break-align-symbols = #'(left-edge)
69     \override MetronomeMark.extra-offset = #'(0 . 4)
70     \override MetronomeMark.font-size = 10
71     \override RehearsalMark.stencil = #(
72         make-stencil-circler 0.1 0.7 ly:text-interface::print
73     )
74     \override RehearsalMark.X-extent = #'(0 . 0)
75     \override RehearsalMark.X-offset = 6
76     \override RehearsalMark.Y-offset = -2.25
77     \override RehearsalMark.break-align-symbols = #'(time-signature)
78     \override RehearsalMark.break-visibility = #end-of-line-invisible
79     \override RehearsalMark.font-name = "Didot"
80     \override RehearsalMark.font-size = 8
81     \override RehearsalMark.outside-staff-priority = 500
82     \override RehearsalMark.self-alignment-X = #center
83     \override TimeSignature.X-extent = #'(0 . 0)
84     \override TimeSignature.X-offset = #ly:self-alignment-interface::x-
aligned-on-self
85     \override TimeSignature.Y-extent = #'(0 . 0)

```

```

86 \override TimeSignature.Y-offset = 3
87 \override TimeSignature.break-align-symbol = ##f
88 \override TimeSignature.break-visibility = #end-of-line-invisible
89 \override TimeSignature.font-size = #7
90 \override TimeSignature.self-alignment-X = #center
91 \override VerticalAxisGroup.default-staff-staff-spacing = #'(
92 (basic-distance . 0) (minimum-distance . 10) (padding . 6) (stretchability
93 . 0)
94 )
95 }
96 \context {
97 \Score
98 \remove Bar_number_engraver
99 \remove Mark_engraver
100 \accepts TimeSignatureContext
101 \accepts LipStaff
102 \override BarLine.bar-extent = #'(-2 . 2)
103 \override Beam.breakable = ##t
104 \override Beam.concaveness = #10000
105 \override Glissando.breakable = ##t
106 \override MetronomeMark.font-size = 5
107 \override SpacingSpanner.strict-grace-spacing = ##t
108 \override SpacingSpanner.strict-note-spacing = ##t
109 \override SpacingSpanner.uniform-stretching = ##t
110 \override StaffGrouper.staff-staff-spacing = #'(
111 (basic-distance . 0) (minimum-distance . 6) (padding . 2)
112 )
113 \override TupletBracket.bracket-visibility = ##t
114 \override TupletBracket.minimum-length = #3
115 \override TupletBracket.padding = #2
116 \override TupletBracket.springs-and-rods = #ly:spanner::set-spacing-
rods
\override TupletNumber.text = #tuplet-number::calc-fraction-text

```

```

117 \override TextSpanner.Y-offset = 1
118 proportionalNotationDuration = #(ly:make-moment 1 50)
119 autoBeaming = ##f
120 tupletFullLength = ##t
121 }
122 \context {
123   \Voice
124   \remove Forbid_line_break_engraver
125 }
126 \context {
127   \Staff
128   \remove Time_signature_engraver
129 }
130 \context {
131   \Staff
132   \name BowStaff
133   \type Engraver_group
134   \alias Staff
135   \bowtab
136   \override Beam.stencil = ##f
137   \override Dots.stencil = ##f
138   \override Flag.stencil = ##f
139   \override Glissando.bound-details.left.padding = #0.5
140   \override Glissando.bound-details.right.padding = #0.5
141   \override Glissando.thickness = #2
142   \override NoteHead.Y-offset = #-5
143   \override NoteHead.extra-offset = #'(0.05 . 0)
144   \override NoteHead.stencil = ##f
145   \override Rest.transparent = ##t
146   \override Script.staff-padding = #2
147   \override StaffSymbol.transparent = ##t
148   \override Stem.direction = #down
149   \override Stem.stencil = ##f

```

```

150     \override TimeSignature.stencil = ##f
151 \override Tie.stencil = ##f
152     \override TupletBracket.stencil = ##f
153     \override TupletNumber.stencil = ##f
154     %\RemoveEmptyStaves
155 }
156
157 \context {
158     \Staff
159     \name BeamStaff
160     \type Engraver_group
161     \alias Staff
162     \override Beam.direction = #down
163     \override Beam.positions = #'(5 . 5)
164     \override Clef.stencil = ##f
165     \override Dots.staff-position = #-2
166     \override Flag.Y-offset = #2.93
167     \override NoteHead.no-ledgers = ##t
168     \override NoteHead.stencil = ##f
169 \override Rest.transparent = ##t
170     \override Script.staff-padding = #3
171     \override StaffSymbol.transparent = ##t
172     \override Stem.direction = #down
173     \override Stem.length = #0.5
174     \override Stem.stem-begin-position = #15.975
175     \override TimeSignature.stencil = ##f
176 \override Tie.stencil = ##f
177     \override TupletBracket.positions = #'(3 . 3)
178     %\RemoveEmptyStaves
179 }
180
181 \context {
182     \RhythmicStaff

```

```

183     \remove Time_signature_engraver
184 }
185     \context {
186         \StaffGroup
187         \accepts BowStaff
188         \accepts BeamStaff
189     }
190 }
191
192 \paper {
193
194     top-margin = 1.5\cm
195     bottom-margin = 1.5\cm
196
197     %top-margin = .90\in
198     oddHeaderMarkup = \markup ""
199     evenHeaderMarkup = \markup ""
200     oddFooterMarkup = \markup \fill-line {
201         ""
202         \concat {
203             "Cthar  ~"
204             \fontsize #2
205             \fromproperty #'page:page-number-string "~  Evans"
206         }
207         ""
208     }
209     evenFooterMarkup = \markup \fill-line {
210         ""
211         \concat { "Cthar  ~" \fontsize #2
212             \fromproperty #'page:page-number-string "~  Evans"
213         } ""
214     }

```



```
215 }
```

Code Example A.10: Cthar Stylesheet

A.3 TIANSHU (FOR 12 PLAYERS) SOURCE CODE

A.3.1 SEGMENTS

A.3.1.1 SEGMENT_I

```

1 import abjad
2 import itertools
3 import os
4 import pathlib
5 import time
6 import abjadext.rmakers
7 from MusicMaker import MusicMaker
8 from AttachmentHandler import AttachmentHandler
9 from random import random
10 from random import seed
11
12 print('Interpreting file ...')
13
14 time_signatures = [
15     abjad.TimeSignature(pair) for pair in [
16         (5, 4), (2, 4), (4, 4), (3, 4), (4, 4), (4, 4),
17         (4, 4), (4, 4), (5, 4), (5, 4), (3, 4), (3, 4),
18         (4, 4), (4, 4), (5, 4), (5, 4), (3, 4), (3, 4),
19         (2, 4), (3, 4), (4, 4), (3, 4), (4, 4), (3, 4),
20         (5, 4), (3, 4), (3, 4), (4, 4), (3, 4), (3, 4),
21         (4, 4), (5, 4), (4, 4), (3, 4), (5, 4), (5, 4),
22         (5, 4), (5, 4), (4, 4), (4, 4), (5, 4), (5, 4),
23         (4, 4), (4, 4), (3, 4), (4, 4), (4, 4), (3, 4),
24         (5, 4),
25     ]
26 ]
27
28 bounds = abjad.mathtools.cumulative_sums([_.duration for _ in time_signatures
29 ])
30
31 def reduceMod3(rw):
32     return [(x % 4) for x in rw]
33
34 def reduceMod5(rw):
35     return [(x % 6) for x in rw]
36
37 def reduceMod7(rw):
38     return [(x % 8) for x in rw]
```

```

39 def reduceMod9(rw):
40     return [(x % 10) for x in rw]
41
42 def reduceMod11(rw):
43     return [(x % 12) for x in rw]
44
45 def reduceMod13(rw):
46     return [(x % 14) for x in rw]
47
48 def reduceMod15(rw):
49     return [(x % 16) for x in rw]
50
51 seed(1)
52 flute_random_walk_one = []
53 flute_random_walk_one.append(-1 if random() < 0.5 else 1)
54 for i in range(1, 1000):
55     movement = -1 if random() < 0.5 else 1
56     value = flute_random_walk_one[i-1] + movement
57     flute_random_walk_one.append(value)
58 flute_random_walk_one = [abs(x) for x in flute_random_walk_one]
59 flute_chord_one = [8, 14, 23, 27, 28, 30, 37, 30, 28, 27, 23, 14, ]
60 flute_notes_one = [flute_chord_one[x] for x in reduceMod11(
    flute_random_walk_one)]
61
62 seed(2)
63 clarinet_random_walk_one = []
64 clarinet_random_walk_one.append(-1 if random() < 0.5 else 1)
65 for i in range(1, 1000):
66     movement = -1 if random() < 0.5 else 1
67     value = clarinet_random_walk_one[i-1] + movement
68     clarinet_random_walk_one.append(value)
69 clarinet_random_walk_one = [abs(x) for x in clarinet_random_walk_one]
70 clarinet_chord_one = [-3, 5, 8, 14, 23, 27, 23, 14, 8, 5, ]
71 clarinet_notes_one = [clarinet_chord_one[x] for x in reduceMod9(
    clarinet_random_walk_one)]
72
73 seed(3)
74 bassoon_random_walk_one = []
75 bassoon_random_walk_one.append(-1 if random() < 0.5 else 1)
76 for i in range(1, 1000):
77     movement = -1 if random() < 0.5 else 1
78     value = bassoon_random_walk_one[i-1] + movement
79     bassoon_random_walk_one.append(value)
80 bassoon_random_walk_one = [abs(x) for x in bassoon_random_walk_one]
81 bassoon_chord_one = [-24, -14, -3, 5, 8, 5, -3, -14, ]
82 bassoon_notes_one = [bassoon_chord_one[x] for x in reduceMod7(
    bassoon_random_walk_one)]
83
84 seed(4)
85 horn_random_walk_one = []
86 horn_random_walk_one.append(-1 if random() < 0.5 else 1)
87 for i in range(1, 1000):
88     movement = -1 if random() < 0.5 else 1
89     value = horn_random_walk_one[i-1] + movement

```

```

90     horn_random_walk_one.append(value)
91 horn_random_walk_one = [abs(x) for x in horn_random_walk_one]
92 horn_chord_one = [-24, -14, -3, 5, 8, 5, -3, -14, ]
93 horn_notes_one = [horn_chord_one[x] for x in reduceMod7(horn_random_walk_one)]
94
95 seed(5)
96 trumpet_random_walk_one = []
97 trumpet_random_walk_one.append(-1 if random() < 0.5 else 1)
98 for i in range(1, 1000):
99     movement = -1 if random() < 0.5 else 1
100    value = trumpet_random_walk_one[i-1] + movement
101    trumpet_random_walk_one.append(value)
102 trumpet_random_walk_one = [abs(x) for x in trumpet_random_walk_one]
103 trumpet_chord_one = [-3, 5, 8, 14, 23, 14, 8, 5, ]
104 trumpet_notes_one = [trumpet_chord_one[x] for x in reduceMod7(
    trumpet_random_walk_one)]
105
106 seed(6)
107 trombone_random_walk_one = []
108 trombone_random_walk_one.append(-1 if random() < 0.5 else 1)
109 for i in range(1, 1000):
110    movement = -1 if random() < 0.5 else 1
111    value = trombone_random_walk_one[i-1] + movement
112    trombone_random_walk_one.append(value)
113 trombone_random_walk_one = [abs(x) for x in trombone_random_walk_one]
114 trombone_chord_one = [-14, -3, 5, -3, ]
115 trombone_notes_one = [trombone_chord_one[x] for x in reduceMod3(
    trombone_random_walk_one)]
116
117 seed(7)
118 tuba_random_walk_one = []
119 tuba_random_walk_one.append(-1 if random() < 0.5 else 1)
120 for i in range(1, 1000):
121    movement = -1 if random() < 0.5 else 1
122    value = tuba_random_walk_one[i-1] + movement
123    tuba_random_walk_one.append(value)
124 tuba_random_walk_one = [abs(x) for x in tuba_random_walk_one]
125 tuba_chord_one = [-29, -24, -14, -3, 5, -3, -14, -24, ]
126 tuba_notes_one = [tuba_chord_one[x] for x in reduceMod7(tuba_random_walk_one)]
127
128 seed(8)
129 violin1_random_walk_one = []
130 violin1_random_walk_one.append(-1 if random() < 0.5 else 1)
131 for i in range(1, 1000):
132    movement = -1 if random() < 0.5 else 1
133    value = violin1_random_walk_one[i-1] + movement
134    violin1_random_walk_one.append(value)
135 violin1_random_walk_one = [abs(x) for x in violin1_random_walk_one]
136 violin1_chord_one = [-3, 5, 8, 14, 23, 27, 28, 30, 37, 30, 28, 27, 23, 14, 8,
    5, ]
137 violin1_notes_one = [violin1_chord_one[x] for x in reduceMod15(
    violin1_random_walk_one)]
138
139 seed(9)

```

```

140 violin2_random_walk_one = []
141 violin2_random_walk_one.append(-1 if random() < 0.5 else 1)
142 for i in range(1, 1000):
143     movement = -1 if random() < 0.5 else 1
144     value = violin2_random_walk_one[i-1] + movement
145     violin2_random_walk_one.append(value)
146 violin2_random_walk_one = [abs(x) for x in violin2_random_walk_one]
147 violin2_chord_one = [-3, 5, 8, 14, 23, 27, 28, 27, 23, 14, 8, 5, ]
148 violin2_notes_one = [violin2_chord_one[x] for x in reduceMod11(
    violin2_random_walk_one)]
149
150 seed(10)
151 viola_random_walk_one = []
152 viola_random_walk_one.append(-1 if random() < 0.5 else 1)
153 for i in range(1, 1000):
154     movement = -1 if random() < 0.5 else 1
155     value = viola_random_walk_one[i-1] + movement
156     viola_random_walk_one.append(value)
157 viola_random_walk_one = [abs(x) for x in viola_random_walk_one]
158 viola_chord_one = [-3, 5, 8, 14, 23, 27, 28, 27, 23, 14, 8, 5, ]
159 viola_notes_one = [viola_chord_one[x] for x in reduceMod11(
    viola_random_walk_one)]
160
161 seed(11)
162 cello_random_walk_one = []
163 cello_random_walk_one.append(-1 if random() < 0.5 else 1)
164 for i in range(1, 1000):
165     movement = -1 if random() < 0.5 else 1
166     value = cello_random_walk_one[i-1] + movement
167     cello_random_walk_one.append(value)
168 cello_random_walk_one = [abs(x) for x in cello_random_walk_one]
169 cello_chord_one = [-24, -14, -3, 5, 8, 14, 8, 5, -3, -14]
170 cello_notes_one = [cello_chord_one[x] for x in reduceMod9(
    cello_random_walk_one)]
171
172 seed(12)
173 bass_random_walk_one = []
174 bass_random_walk_one.append(-1 if random() < 0.5 else 1)
175 for i in range(1, 1000):
176     movement = -1 if random() < 0.5 else 1
177     value = bass_random_walk_one[i-1] + movement
178     bass_random_walk_one.append(value)
179 bass_random_walk_one = [abs(x) for x in bass_random_walk_one]
180 bass_chord_one = [-29, -24, -14, -3, -14, -24, ]
181 bass_notes_one = [bass_chord_one[x] for x in reduceMod5(bass_random_walk_one)]
182
183 flute_scale = [30, 23, 5, 23, ]
184 clarinet_scale = [23, 5, ]
185 bassoon_scale = [-24, ]
186 horn_scale = [5, ]
187 trumpet_scale = [23, ]
188 trombone_scale = [5, ]
189 tuba_scale = [-24, ]
190 violin1_scale = [30, 29.5, 29, 28.5, 28, 27.5, 27, 26.5, 26, 25.5, 25, 24.5,

```

```

    24, 23.5, 23, 22.5, 22, 21.5, 21, 20.5, 20, 19.5, 19, 19.5, 20, 20.5, 21,
    21.5, 22, 22.5, 23, 23.5, 24, 24.5, 25, 25.5, 26, 26.5, 27, 27.5, 28,
    28.5, 29, 29.5, ]
191 violin2_scale = [19, 18.5, 18, 17.5, 17, 16.5, 16, 15.5, 15, 14.5, 14, 13.5,
    13, 12.5, 12, 11.5, 11, 10.5, 10, 9.5, 9, 8.5, 8, 8.5, 9, 9.5, 10, 10.5,
    11, 11.5, 12, 12.5, 13, 13.5, 14, 14.5, 15, 15.5, 16, 16.5, 17, 17.5, 18,
    18.5, ]
192 viola_scale = [8, 7.5, 7, 6.5, 6, 5.5, 5, 4.5, 4, 3.5, 3, 2.5, 2, 1.5, 1, 0.5,
    0, -0.5, -1, -1.5, -2, -2.5, -3, -2.5, -2, -1.5, -1, -0.5, 0, 0.5, 1,
    1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 5.5, 6, 6.5, 7, 7.5, ]
193 cello_scale = [-3, -3.5, -4, -4.5, -5, -5.5, -6, -6.5, -7, -7.5, -8, -8.5, -9,
    -9.5, -10, -10.5, -11, -11.5, -12, -12.5, -13, -13.5, -14, -13.5, -13,
    -12.5, -12, -11.5, -11, -10.5, -10, -9.5, -9, -8.5, -8, -7.5, -7, -6.5,
    -6, -5.5, -5, -4.5, -4, -3.5, ]
194 bass_scale = [-14, -14.5, -15, -15.5, -16, -16.5, -17, -17.5, -18, -18.5, -19,
    -19.5, -20, -20.5, -21, -21.5, -22, -22.5, -23, -23.5, -24, -24.5, -25,
    -24.5, -24, -23.5, -23, -22.5, -22, -21.5, -21, -20.5, -20, -19.5, -19,
    -18.5, -18, -17.5, -17, -16.5, -16, -15.5, -15, -14.5, ]

195
196 seed(1)
197 flute_random_walk_two = []
198 flute_random_walk_two.append(-1 if random() < 0.5 else 1)
199 for i in range(1, 1000):
200     movement = -1 if random() < 0.5 else 1
201     value = flute_random_walk_two[i-1] + movement
202     flute_random_walk_two.append(value)
203 flute_random_walk_two = [abs(x) for x in flute_random_walk_two]
204 flute_chord_two = [10, 16, 23, 25, 26, 25, 23, 16, ]
205 flute_notes_two = [flute_chord_two[x] for x in reduceMod7(
    flute_random_walk_two)]

206
207 seed(2)
208 clarinet_random_walk_two = []
209 clarinet_random_walk_two.append(-1 if random() < 0.5 else 1)
210 for i in range(1, 1000):
211     movement = -1 if random() < 0.5 else 1
212     value = clarinet_random_walk_two[i-1] + movement
213     clarinet_random_walk_two.append(value)
214 clarinet_random_walk_two = [abs(x) for x in clarinet_random_walk_two]
215 clarinet_chord_two = [-5, 5, 10, 16, 23, 25, 26, 25, 23, 16, 10, 5, ]
216 clarinet_notes_two = [clarinet_chord_two[x] for x in reduceMod11(
    clarinet_random_walk_two)]

217
218 seed(3)
219 bassoon_random_walk_two = []
220 bassoon_random_walk_two.append(-1 if random() < 0.5 else 1)
221 for i in range(1, 1000):
222     movement = -1 if random() < 0.5 else 1
223     value = bassoon_random_walk_two[i-1] + movement
224     bassoon_random_walk_two.append(value)
225 bassoon_random_walk_two = [abs(x) for x in bassoon_random_walk_two]
226 bassoon_chord_two = [-24, -16, -5, 5, -5, -16, ]
227 bassoon_notes_two = [bassoon_chord_two[x] for x in reduceMod5(
    bassoon_random_walk_two)]

```

```

228
229 seed(4)
230 horn_random_walk_two = []
231 horn_random_walk_two.append(-1 if random() < 0.5 else 1)
232 for i in range(1, 1000):
233     movement = -1 if random() < 0.5 else 1
234     value = horn_random_walk_two[i-1] + movement
235     horn_random_walk_two.append(value)
236 horn_random_walk_two = [abs(x) for x in horn_random_walk_two]
237 horn_chord_two = [-16, -5, 5, 10, 5, -5, ]
238 horn_notes_two = [horn_chord_two[x] for x in reduceMod5(horn_random_walk_two)]
239
240 seed(5)
241 trumpet_random_walk_two = []
242 trumpet_random_walk_two.append(-1 if random() < 0.5 else 1)
243 for i in range(1, 1000):
244     movement = -1 if random() < 0.5 else 1
245     value = trumpet_random_walk_two[i-1] + movement
246     trumpet_random_walk_two.append(value)
247 trumpet_random_walk_two = [abs(x) for x in trumpet_random_walk_two]
248 trumpet_chord_two = [-5, 5, 10, 16, 23, 16, 10, 5, ]
249 trumpet_notes_two = [trumpet_chord_two[x] for x in reduceMod7(
    trumpet_random_walk_two)]
250
251 seed(6)
252 trombone_random_walk_two = []
253 trombone_random_walk_two.append(-1 if random() < 0.5 else 1)
254 for i in range(1, 1000):
255     movement = -1 if random() < 0.5 else 1
256     value = trombone_random_walk_two[i-1] + movement
257     trombone_random_walk_two.append(value)
258 trombone_random_walk_two = [abs(x) for x in trombone_random_walk_two]
259 trombone_chord_two = [-16, -5, 5, -5, ]
260 trombone_notes_two = [trombone_chord_two[x] for x in reduceMod3(
    trombone_random_walk_two)]
261
262 seed(7)
263 tuba_random_walk_two = []
264 tuba_random_walk_two.append(-1 if random() < 0.5 else 1)
265 for i in range(1, 1000):
266     movement = -1 if random() < 0.5 else 1
267     value = tuba_random_walk_two[i-1] + movement
268     tuba_random_walk_two.append(value)
269 tuba_random_walk_two = [abs(x) for x in tuba_random_walk_two]
270 tuba_chord_two = [-27, -24, -16, -5, -16, -24, ]
271 tuba_notes_two = [tuba_chord_two[x] for x in reduceMod5(tuba_random_walk_two)]
272
273 seed(8)
274 violin1_random_walk_two = []
275 violin1_random_walk_two.append(-1 if random() < 0.5 else 1)
276 for i in range(1, 1000):
277     movement = -1 if random() < 0.5 else 1
278     value = violin1_random_walk_two[i-1] + movement
279     violin1_random_walk_two.append(value)

```

```

280 violin1_random_walk_two = [abs(x) for x in violin1_random_walk_two]
281 violin1_chord_two = [-5, 5, 10, 16, 23, 25, 26, 30, 38, 30, 26, 25, 23, 16,
    10, 5, ]
282 violin1_notes_two = [violin1_chord_two[x] for x in reduceMod15(
    violin1_random_walk_two)]
283
284 seed(9)
285 violin2_random_walk_two = []
286 violin2_random_walk_two.append(-1 if random() < 0.5 else 1)
287 for i in range(1, 1000):
288     movement = -1 if random() < 0.5 else 1
289     value = violin2_random_walk_two[i-1] + movement
290     violin2_random_walk_two.append(value)
291 violin2_random_walk_two = [abs(x) for x in violin2_random_walk_two]
292 violin2_chord_two = [-5, 5, 10, 16, 23, 25, 26, 25, 23, 16, 10, 5, ]
293 violin2_notes_two = [violin2_chord_two[x] for x in reduceMod11(
    violin2_random_walk_two)]
294
295 seed(10)
296 viola_random_walk_two = []
297 viola_random_walk_two.append(-1 if random() < 0.5 else 1)
298 for i in range(1, 1000):
299     movement = -1 if random() < 0.5 else 1
300     value = viola_random_walk_two[i-1] + movement
301     viola_random_walk_two.append(value)
302 viola_random_walk_two = [abs(x) for x in viola_random_walk_two]
303 viola_chord_two = [-5, 5, 10, 16, 23, 16, 10, 5, ]
304 viola_notes_two = [viola_chord_two[x] for x in reduceMod7(
    viola_random_walk_two)]
305
306 seed(11)
307 cello_random_walk_two = []
308 cello_random_walk_two.append(-1 if random() < 0.5 else 1)
309 for i in range(1, 1000):
310     movement = -1 if random() < 0.5 else 1
311     value = cello_random_walk_two[i-1] + movement
312     cello_random_walk_two.append(value)
313 cello_random_walk_two = [abs(x) for x in cello_random_walk_two]
314 cello_chord_two = [-24, -16, -5, 5, 10, 16, 23, 16, 10, 5, -5, -16]
315 cello_notes_two = [cello_chord_two[x] for x in reduceMod11(
    cello_random_walk_two)]
316
317 seed(12)
318 bass_random_walk_two = []
319 bass_random_walk_two.append(-1 if random() < 0.5 else 1)
320 for i in range(1, 1000):
321     movement = -1 if random() < 0.5 else 1
322     value = bass_random_walk_two[i-1] + movement
323     bass_random_walk_two.append(value)
324 bass_random_walk_two = [abs(x) for x in bass_random_walk_two]
325 bass_chord_two = [-27, -24, -16, -5, -16, -24, ]
326 bass_notes_two = [bass_chord_two[x] for x in reduceMod5(bass_random_walk_two)]
327
328 rmaker_one = abjadext.rmakers.NoteRhythmMaker()

```

```

329
330 rmaker_two = abjadext.rmakers.EvenDivisionRhythmMaker(
331     denominators=[16, 16, 8, 16, 4, 16, 8],
332     extra_counts_per_division=[0, 1, 0, 0, -1, 0, 1, -1],
333     burnish_specifier=abjadext.rmakers.BurnishSpecifier(
334         left_classes=[abjad.Rest],
335         left_counts=[1],
336         right_classes=[abjad.Rest],
337         right_counts=[1],
338         outer_divisions_only=True,
339     ),
340     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
341         trivialize=True,
342         extract_trivial=True,
343         rewrite_rest_filled=True,
344     ),
345 )
346
347 rmaker_three = abjadext.rmakers.TaleaRhythmMaker(
348     talea=abjadext.rmakers.Talea(
349         counts=[1, 1, 1, 2, 1, 3, 1, 4, 5],
350         denominator=16,
351     ),
352     beam_specifier=abjadext.rmakers.BeamSpecifier(
353         beam_divisions_together=True,
354         beam_rests=False,
355     ),
356     extra_counts_per_division=[0, 1, 0, -1],
357     burnish_specifier=abjadext.rmakers.BurnishSpecifier(
358         left_classes=[abjad.Note, abjad.Rest],
359         left_counts=[1, 0, 1],
360     ),
361     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
362         trivialize=True,
363         extract_trivial=True,
364         rewrite_rest_filled=True,
365     ),
366 )
367
368 attachment_handler_one = AttachmentHandler(
369     starting_dynamic='p',
370     ending_dynamic='mp',
371     hairpin_indicator='--',
372     articulation='accent',
373 )
374
375 attachment_handler_two = AttachmentHandler(
376     starting_dynamic='fff',
377     ending_dynamic='mf',
378     hairpin_indicator='>',
379     articulation='tenuto',
380 )
381
382 attachment_handler_three = AttachmentHandler(

```



```

383     starting_dynamic='mp',
384     ending_dynamic='ff',
385     hairpin_indicator='<|',
386     articulation='',
387 )
388
389 #####oboe#####
390 flutemusicmaker_one = MusicMaker(
391     rmaker=rmaker_one,
392     pitches=flute_scale,
393     continuous=True,
394     attachment_handler=attachment_handler_one,
395 )
396 flutemusicmaker_two = MusicMaker(
397     rmaker=rmaker_two,
398     pitches=flute_notes_two,
399     continuous=True,
400     attachment_handler=attachment_handler_two,
401 )
402 flutemusicmaker_three = MusicMaker(
403     rmaker=rmaker_three,
404     pitches=flute_notes_one,
405     continuous=True,
406     attachment_handler=attachment_handler_three,
407 )
408 #####violin1#####
409 violin1musicmaker_one = MusicMaker(
410     rmaker=rmaker_one,
411     pitches=violin1_scale,
412     continuous=True,
413     attachment_handler=attachment_handler_one,
414 )
415 violin1musicmaker_two = MusicMaker(
416     rmaker=rmaker_two,
417     pitches=violin1_notes_two,
418     continuous=True,
419     attachment_handler=attachment_handler_two,
420 )
421 violin1musicmaker_three = MusicMaker(
422     rmaker=rmaker_three,
423     pitches=violin1_notes_one,
424     continuous=True,
425     attachment_handler=attachment_handler_three,
426 )
427 #####trumpet#####
428 trumpetmusicmaker_one = MusicMaker(
429     rmaker=rmaker_one,
430     pitches=trumpet_scale,
431     continuous=True,
432     attachment_handler=attachment_handler_one,
433 )
434 trumpetmusicmaker_two = MusicMaker(
435     rmaker=rmaker_two,
436     pitches=trumpet_notes_two,

```

```

437     continuous=True,
438     attachment_handler=attachment_handler_two,
439 )
440 trumpetmusicmaker_three = MusicMaker(
441     rmaker=rmaker_three,
442     pitches=trumpet_notes_one,
443     continuous=True,
444     attachment_handler=attachment_handler_three,
445 )
446 #####clarinet#####
447 clarinetmusicmaker_one = MusicMaker(
448     rmaker=rmaker_one,
449     pitches=clarinet_scale,
450     continuous=True,
451     attachment_handler=attachment_handler_one,
452 )
453 clarinetmusicmaker_two = MusicMaker(
454     rmaker=rmaker_two,
455     pitches=clarinet_notes_two,
456     continuous=True,
457     attachment_handler=attachment_handler_two,
458 )
459 clarinetmusicmaker_three = MusicMaker(
460     rmaker=rmaker_three,
461     pitches=clarinet_notes_one,
462     continuous=True,
463     attachment_handler=attachment_handler_three,
464 )
465 #####violin2#####
466 violin2musicmaker_one = MusicMaker(
467     rmaker=rmaker_one,
468     pitches=violin2_scale,
469     continuous=True,
470     attachment_handler=attachment_handler_one,
471 )
472 violin2musicmaker_two = MusicMaker(
473     rmaker=rmaker_two,
474     pitches=violin2_notes_two,
475     continuous=True,
476     attachment_handler=attachment_handler_two,
477 )
478 violin2musicmaker_three = MusicMaker(
479     rmaker=rmaker_three,
480     pitches=violin2_notes_one,
481     continuous=True,
482     attachment_handler=attachment_handler_three,
483 )
484 #####viola#####
485 violamusicmaker_one = MusicMaker(
486     rmaker=rmaker_one,
487     pitches=viola_scale,
488     continuous=True,
489     attachment_handler=attachment_handler_one,
490 )

```

```

491 violamusicmaker_two = MusicMaker(
492     rmaker=rmaker_two,
493     pitches=viola_notes_two,
494     continuous=True,
495     attachment_handler=attachment_handler_two,
496 )
497 violamusicmaker_three = MusicMaker(
498     rmaker=rmaker_three,
499     pitches=viola_notes_one,
500     continuous=True,
501     attachment_handler=attachment_handler_three,
502 )
503 #####bassoon#####
504 bassoonmusicmaker_one = MusicMaker(
505     rmaker=rmaker_one,
506     pitches=bassoon_scale,
507     continuous=True,
508     attachment_handler=attachment_handler_one,
509 )
510 bassoonmusicmaker_two = MusicMaker(
511     rmaker=rmaker_two,
512     pitches=bassoon_notes_two,
513     continuous=True,
514     attachment_handler=attachment_handler_two,
515 )
516 bassoonmusicmaker_three = MusicMaker(
517     rmaker=rmaker_three,
518     pitches=bassoon_notes_one,
519     continuous=True,
520     attachment_handler=attachment_handler_three,
521 )
522 #####trombone#####
523 trombonemusicmaker_one = MusicMaker(
524     rmaker=rmaker_one,
525     pitches=trombone_scale,
526     continuous=True,
527     attachment_handler=attachment_handler_one,
528 )
529 trombonemusicmaker_two = MusicMaker(
530     rmaker=rmaker_two,
531     pitches=trombone_notes_two,
532     continuous=True,
533     attachment_handler=attachment_handler_two,
534 )
535 trombonemusicmaker_three = MusicMaker(
536     rmaker=rmaker_three,
537     pitches=trombone_notes_one,
538     continuous=True,
539     attachment_handler=attachment_handler_three,
540 )
541 #####cello#####
542 cellomusicmaker_one = MusicMaker(
543     rmaker=rmaker_one,
544     pitches=cello_scale,

```

```

545     continuous=True,
546     attachment_handler=attachment_handler_one,
547 )
548 cellomusicmaker_two = MusicMaker(
549     rmaker=rmaker_two,
550     pitches=cello_notes_two,
551     continuous=True,
552     attachment_handler=attachment_handler_two,
553 )
554 cellomusicmaker_three = MusicMaker(
555     rmaker=rmaker_three,
556     pitches=cello_notes_one,
557     continuous=True,
558     attachment_handler=attachment_handler_three,
559 )
560 #####horn#####
561 hornmusicmaker_one = MusicMaker(
562     rmaker=rmaker_one,
563     pitches=horn_scale,
564     continuous=True,
565     attachment_handler=attachment_handler_one,
566 )
567 hornmusicmaker_two = MusicMaker(
568     rmaker=rmaker_two,
569     pitches=horn_notes_two,
570     continuous=True,
571     attachment_handler=attachment_handler_two,
572 )
573 hornmusicmaker_three = MusicMaker(
574     rmaker=rmaker_three,
575     pitches=horn_notes_one,
576     continuous=True,
577     attachment_handler=attachment_handler_three,
578 )
579 #####tuba#####
580 tubamusicmaker_one = MusicMaker(
581     rmaker=rmaker_one,
582     pitches=tuba_scale,
583     continuous=True,
584     attachment_handler=attachment_handler_one,
585 )
586 tubamusicmaker_two = MusicMaker(
587     rmaker=rmaker_two,
588     pitches=tuba_notes_two,
589     continuous=True,
590     attachment_handler=attachment_handler_two,
591 )
592 tubamusicmaker_three = MusicMaker(
593     rmaker=rmaker_three,
594     pitches=tuba_notes_one,
595     continuous=True,
596     attachment_handler=attachment_handler_three,
597 )
598 #####bass#####

```

```

599 bassmusicmaker_one = MusicMaker(
600     rmaker=rmaker_one,
601     pitches=bass_scale,
602     continuous=True,
603     attachment_handler=attachment_handler_one,
604 )
605 bassmusicmaker_two = MusicMaker(
606     rmaker=rmaker_two,
607     pitches=bass_notes_two,
608     continuous=True,
609     attachment_handler=attachment_handler_two,
610 )
611 bassmusicmaker_three = MusicMaker(
612     rmaker=rmaker_three,
613     pitches=bass_notes_one,
614     continuous=True,
615     attachment_handler=attachment_handler_three,
616 )
617
618 silence_maker = abjadext.rmakers.NoteRhythmMaker(
619     division_masks=[
620         abjadext.rmakers.SilenceMask(
621             pattern=abjad.index([0], 1),
622         ),
623     ],
624 )
625
626 class MusicSpecifier:
627
628     def __init__(self, music_maker, voice_name):
629         self.music_maker = music_maker
630         self.voice_name = voice_name
631
632 print('Collecting timespans and rmakers ...')
633 ###group one###
634 voice_1_timespan_list = abjad.TimespanList([
635     abjad.AnnotatedTimespan(
636         start_offset=start_offset,
637         stop_offset=stop_offset,
638         annotation=MusicSpecifier(
639             music_maker=music_maker,
640             voice_name='Voice 1',
641         ),
642     )
643     for start_offset, stop_offset, music_maker in [
644         [(9, 4), (10, 4), flutemusicmaker_one],
645         [(15, 4), (18, 4), flutemusicmaker_two],
646         [(22, 4), (25, 4), flutemusicmaker_three],
647         [(27, 4), (30, 4), flutemusicmaker_one],
648         [(30, 4), (32, 4), flutemusicmaker_one],
649         [(35, 4), (39, 4), flutemusicmaker_two],
650         [(42, 4), (43, 4), flutemusicmaker_three],
651         [(43, 4), (44, 4), flutemusicmaker_three],
652         [(45, 4), (46, 4), flutemusicmaker_one],

```

```

653     [(46, 4), (50, 4), flutemusicmaker_one],
654     [(54, 4), (57, 4), flutemusicmaker_two],
655     [(59, 4), (60, 4), flutemusicmaker_three],
656     [(65, 4), (67, 4), flutemusicmaker_one],
657     [(67, 4), (69, 4), flutemusicmaker_one],
658     [(70, 4), (72, 4), flutemusicmaker_two],
659     [(72, 4), (75, 4), flutemusicmaker_two],
660     [(76, 4), (78, 4), flutemusicmaker_three],
661     [(81, 4), (82, 4), flutemusicmaker_one],
662     [(82, 4), (85, 4), flutemusicmaker_one],
663     [(90, 4), (91, 4), flutemusicmaker_two],
664     [(93, 4), (94, 4), flutemusicmaker_three],
665     [(94, 4), (96, 4), flutemusicmaker_three],
666     [(100, 4), (104, 4), flutemusicmaker_one],
667     [(104, 4), (105, 4), flutemusicmaker_one],
668     [(106, 4), (107, 4), flutemusicmaker_two],
669     [(107, 4), (108, 4), flutemusicmaker_two],
670     [(111, 4), (114, 4), flutemusicmaker_one],
671     [(114, 4), (115, 4), flutemusicmaker_one],
672     [(116, 4), (119, 4), flutemusicmaker_one],
673     [(119, 4), (120, 4), flutemusicmaker_one],
674     [(121, 4), (123, 4), flutemusicmaker_one],
675     [(123, 4), (125, 4), flutemusicmaker_one],
676     [(126, 4), (131, 4), flutemusicmaker_two],
677     [(131, 4), (133, 4), flutemusicmaker_two],
678     [(136, 4), (141, 4), flutemusicmaker_two],
679     [(148, 4), (150, 4), flutemusicmaker_two],
680     [(150, 4), (153, 4), flutemusicmaker_three],
681     [(155, 4), (159, 4), flutemusicmaker_three],
682     [(162, 4), (164, 4), flutemusicmaker_three],
683     [(168, 4), (171, 4), flutemusicmaker_three],
684     [(173, 4), (175, 4), flutemusicmaker_three],
685     [(175, 4), (177, 4), flutemusicmaker_three],
686     [(180, 4), (182, 4), flutemusicmaker_three],
687     [(186, 4), (190, 4), flutemusicmaker_three],
688     [(190, 4), (191, 4), silence_maker],
689 ]
690 ])
691
692 voice_5_timespan_list = abjad.TimespanList([
693     abjad.AnnotatedTimespan(
694         start_offset=start_offset,
695         stop_offset=stop_offset,
696         annotation=MusicSpecifier(
697             music_maker=music_maker,
698             voice_name='Voice 5',
699         ),
700     )
701     for start_offset, stop_offset, music_maker in [
702         [(9, 4), (10, 4), trumpetmusicmaker_one],
703         [(14, 4), (18, 4), trumpetmusicmaker_two],
704         [(23, 4), (25, 4), trumpetmusicmaker_three],
705         [(27, 4), (30, 4), trumpetmusicmaker_one],
706         [(30, 4), (32, 4), trumpetmusicmaker_one],

```

```

707     [(35, 4), (39, 4), trumpetmusicmaker_two],
708     [(42, 4), (43, 4), trumpetmusicmaker_three],
709     [(43, 4), (44, 4), trumpetmusicmaker_three],
710     [(45, 4), (46, 4), trumpetmusicmaker_one],
711     [(46, 4), (50, 4), trumpetmusicmaker_one],
712     [(54, 4), (57, 4), trumpetmusicmaker_two],
713     [(59, 4), (60, 4), trumpetmusicmaker_three],
714     [(65, 4), (67, 4), trumpetmusicmaker_one],
715     [(67, 4), (69, 4), trumpetmusicmaker_one],
716     [(70, 4), (72, 4), trumpetmusicmaker_two],
717     [(72, 4), (75, 4), trumpetmusicmaker_two],
718     [(76, 4), (78, 4), trumpetmusicmaker_three],
719     [(81, 4), (82, 4), trumpetmusicmaker_one],
720     [(82, 4), (85, 4), trumpetmusicmaker_one],
721     [(90, 4), (91, 4), trumpetmusicmaker_two],
722     [(93, 4), (94, 4), trumpetmusicmaker_three],
723     [(94, 4), (96, 4), trumpetmusicmaker_three],
724     [(100, 4), (104, 4), trumpetmusicmaker_one],
725     [(104, 4), (105, 4), trumpetmusicmaker_one],
726     [(106, 4), (107, 4), trumpetmusicmaker_two],
727     [(107, 4), (108, 4), trumpetmusicmaker_two],
728     [(111, 4), (114, 4), trumpetmusicmaker_one],
729     [(114, 4), (115, 4), trumpetmusicmaker_one],
730     [(116, 4), (119, 4), trumpetmusicmaker_one],
731     [(119, 4), (120, 4), trumpetmusicmaker_one],
732     [(121, 4), (123, 4), trumpetmusicmaker_one],
733     [(123, 4), (125, 4), trumpetmusicmaker_one],
734     [(126, 4), (131, 4), trumpetmusicmaker_two],
735     [(131, 4), (133, 4), trumpetmusicmaker_two],
736     [(136, 4), (141, 4), trumpetmusicmaker_two],
737     [(148, 4), (150, 4), trumpetmusicmaker_two],
738     [(150, 4), (154, 4), trumpetmusicmaker_three],
739     [(157, 4), (159, 4), trumpetmusicmaker_three],
740     [(163, 4), (164, 4), trumpetmusicmaker_three],
741     [(164, 4), (166, 4), trumpetmusicmaker_three],
742     [(168, 4), (172, 4), trumpetmusicmaker_three],
743     [(175, 4), (177, 4), trumpetmusicmaker_three],
744     [(181, 4), (183, 4), trumpetmusicmaker_three],
745     [(183, 4), (184, 4), trumpetmusicmaker_three],
746     [(186, 4), (190, 4), trumpetmusicmaker_three],
747 ]
748 ])
749
750 voice_8_timespan_list = abjad.TimespanList([
751     abjad.AnnotatedTimespan(
752         start_offset=start_offset,
753         stop_offset=stop_offset,
754         annotation=MusicSpecifier(
755             music_maker=music_maker,
756             voice_name='Voice 8',
757         ),
758     )
759     for start_offset, stop_offset, music_maker in [
760         [(9, 4), (10, 4), violin1musicmaker_one],

```

```

761     [(14, 4), (18, 4), violin1musicmaker_two],
762     [(22, 4), (25, 4), violin1musicmaker_three],
763     [(27, 4), (30, 4), violin1musicmaker_one],
764     [(35, 4), (39, 4), violin1musicmaker_two],
765     [(42, 4), (43, 4), violin1musicmaker_three],
766     [(43, 4), (44, 4), violin1musicmaker_three],
767     [(45, 4), (46, 4), violin1musicmaker_one],
768     [(46, 4), (50, 4), violin1musicmaker_one],
769     [(54, 4), (57, 4), violin1musicmaker_two],
770     [(59, 4), (60, 4), violin1musicmaker_three],
771     [(65, 4), (67, 4), violin1musicmaker_one],
772     [(67, 4), (69, 4), violin1musicmaker_one],
773     [(70, 4), (72, 4), violin1musicmaker_two],
774     [(72, 4), (75, 4), violin1musicmaker_two],
775     [(76, 4), (78, 4), violin1musicmaker_three],
776     [(81, 4), (82, 4), violin1musicmaker_one],
777     [(82, 4), (85, 4), violin1musicmaker_one],
778     [(90, 4), (91, 4), violin1musicmaker_two],
779     [(93, 4), (94, 4), violin1musicmaker_three],
780     [(94, 4), (96, 4), violin1musicmaker_three],
781     [(100, 4), (104, 4), violin1musicmaker_one],
782     [(104, 4), (105, 4), violin1musicmaker_one],
783     [(106, 4), (107, 4), violin1musicmaker_two],
784     [(107, 4), (108, 4), violin1musicmaker_two],
785     [(111, 4), (114, 4), violin1musicmaker_one],
786     [(114, 4), (115, 4), violin1musicmaker_one],
787     [(116, 4), (119, 4), violin1musicmaker_one],
788     [(119, 4), (120, 4), violin1musicmaker_one],
789     [(121, 4), (123, 4), violin1musicmaker_one],
790     [(123, 4), (125, 4), violin1musicmaker_one],
791     [(126, 4), (131, 4), violin1musicmaker_two],
792     [(131, 4), (133, 4), violin1musicmaker_two],
793     [(136, 4), (141, 4), violin1musicmaker_two],
794     [(148, 4), (150, 4), violin1musicmaker_two],
795     [(150, 4), (152, 4), violin1musicmaker_three],
796     [(156, 4), (159, 4), violin1musicmaker_three],
797     [(161, 4), (164, 4), violin1musicmaker_three],
798     [(164, 4), (165, 4), violin1musicmaker_three],
799     [(168, 4), (170, 4), violin1musicmaker_three],
800     [(174, 4), (175, 4), violin1musicmaker_three],
801     [(175, 4), (177, 4), violin1musicmaker_three],
802     [(179, 4), (183, 4), violin1musicmaker_three],
803     [(186, 4), (190, 4), violin1musicmaker_three],
804 ]
805 ])
806
807 ###group two###
808 voice_2_timespan_list = abjad.TimespanList([
809     abjad.AnnotatedTimespan(
810         start_offset=start_offset,
811         stop_offset=stop_offset,
812         annotation=MusicSpecifier(
813             music_maker=music_maker,
814             voice_name='Voice 2',

```



```

815     ),
816 )
817 for start_offset, stop_offset, music_maker in [
818     [(2, 4), (5, 4), clarinetmusicmaker_one],
819     [(10, 4), (11, 4), clarinetmusicmaker_two],
820     [(11, 4), (13, 4), clarinetmusicmaker_two],
821     [(16, 4), (18, 4), clarinetmusicmaker_three],
822     [(21, 4), (22, 4), clarinetmusicmaker_one],
823     [(22, 4), (25, 4), clarinetmusicmaker_one],
824     [(35, 4), (40, 4), clarinetmusicmaker_one],
825     [(44, 4), (46, 4), clarinetmusicmaker_two],
826     [(46, 4), (47, 4), clarinetmusicmaker_two],
827     [(49, 4), (50, 4), clarinetmusicmaker_three],
828     [(55, 4), (59, 4), clarinetmusicmaker_one],
829     [(62, 4), (64, 4), clarinetmusicmaker_two],
830     [(65, 4), (67, 4), clarinetmusicmaker_three],
831     [(67, 4), (70, 4), clarinetmusicmaker_three],
832     [(70, 4), (71, 4), clarinetmusicmaker_three],
833     [(73, 4), (75, 4), clarinetmusicmaker_two],
834     [(75, 4), (76, 4), clarinetmusicmaker_two],
835     [(80, 4), (82, 4), clarinetmusicmaker_one],
836     [(82, 4), (85, 4), clarinetmusicmaker_one],
837     [(86, 4), (88, 4), clarinetmusicmaker_two],
838     [(91, 4), (94, 4), clarinetmusicmaker_three],
839     [(94, 4), (95, 4), clarinetmusicmaker_three],
840     [(100, 4), (101, 4), clarinetmusicmaker_two],
841     [(103, 4), (104, 4), clarinetmusicmaker_one],
842     [(104, 4), (106, 4), clarinetmusicmaker_one],
843     [(110, 4), (114, 4), clarinetmusicmaker_one],
844     [(115, 4), (119, 4), clarinetmusicmaker_one],
845     [(120, 4), (123, 4), clarinetmusicmaker_one],
846     [(123, 4), (124, 4), clarinetmusicmaker_one],
847     [(125, 4), (126, 4), clarinetmusicmaker_two],
848     [(129, 4), (131, 4), clarinetmusicmaker_two],
849     [(131, 4), (134, 4), clarinetmusicmaker_two],
850     [(141, 4), (144, 4), clarinetmusicmaker_two],
851     [(149, 4), (150, 4), clarinetmusicmaker_two],
852     [(155, 4), (159, 4), clarinetmusicmaker_three],
853     [(162, 4), (164, 4), clarinetmusicmaker_three],
854     [(165, 4), (168, 4), clarinetmusicmaker_three],
855     [(168, 4), (170, 4), clarinetmusicmaker_three],
856     [(174, 4), (175, 4), clarinetmusicmaker_three],
857     [(175, 4), (177, 4), clarinetmusicmaker_three],
858     [(179, 4), (180, 4), clarinetmusicmaker_three],
859     [(185, 4), (186, 4), clarinetmusicmaker_three],
860     [(186, 4), (190, 4), clarinetmusicmaker_three],
861 ]
862 ])
863
864 voice_9_timespan_list = abjad.TimespanList([
865     abjad.AnnotatedTimespan(
866         start_offset=start_offset,
867         stop_offset=stop_offset,
868         annotation=MusicSpecifier(

```

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869         music_maker=music_maker,
870         voice_name='Voice 9',
871     ),
872 )
873 for start_offset, stop_offset, music_maker in [
874     [(2, 4), (5, 4), violin2musicmaker_one],
875     [(9, 4), (11, 4), violin2musicmaker_two],
876     [(11, 4), (13, 4), violin2musicmaker_two],
877     [(16, 4), (18, 4), violin2musicmaker_three],
878     [(21, 4), (22, 4), violin2musicmaker_one],
879     [(22, 4), (23, 4), violin2musicmaker_one],
880     [(35, 4), (40, 4), violin2musicmaker_one],
881     [(44, 4), (46, 4), violin2musicmaker_two],
882     [(46, 4), (47, 4), violin2musicmaker_two],
883     [(49, 4), (50, 4), violin2musicmaker_three],
884     [(55, 4), (59, 4), violin2musicmaker_one],
885     [(62, 4), (64, 4), violin2musicmaker_two],
886     [(65, 4), (67, 4), violin2musicmaker_three],
887     [(67, 4), (70, 4), violin2musicmaker_three],
888     [(70, 4), (71, 4), violin2musicmaker_three],
889     [(73, 4), (75, 4), violin2musicmaker_two],
890     [(75, 4), (76, 4), violin2musicmaker_two],
891     [(80, 4), (82, 4), violin2musicmaker_one],
892     [(82, 4), (85, 4), violin2musicmaker_one],
893     [(86, 4), (88, 4), violin2musicmaker_two],
894     [(91, 4), (94, 4), violin2musicmaker_three],
895     [(94, 4), (95, 4), violin2musicmaker_three],
896     [(100, 4), (101, 4), violin2musicmaker_two],
897     [(103, 4), (104, 4), violin2musicmaker_one],
898     [(104, 4), (106, 4), violin2musicmaker_one],
899     [(110, 4), (114, 4), violin2musicmaker_one],
900     [(115, 4), (119, 4), violin2musicmaker_one],
901     [(120, 4), (123, 4), violin2musicmaker_one],
902     [(123, 4), (124, 4), violin2musicmaker_one],
903     [(125, 4), (126, 4), violin2musicmaker_two],
904     [(129, 4), (131, 4), violin2musicmaker_two],
905     [(131, 4), (134, 4), violin2musicmaker_two],
906     [(141, 4), (144, 4), violin2musicmaker_two],
907     [(149, 4), (150, 4), violin2musicmaker_two],
908     [(154, 4), (157, 4), violin2musicmaker_three],
909     [(159, 4), (160, 4), violin2musicmaker_three],
910     [(165, 4), (168, 4), violin2musicmaker_three],
911     [(168, 4), (169, 4), violin2musicmaker_three],
912     [(172, 4), (174, 4), violin2musicmaker_three],
913     [(175, 4), (179, 4), violin2musicmaker_three],
914     [(179, 4), (180, 4), violin2musicmaker_three],
915     [(184, 4), (186, 4), violin2musicmaker_three],
916     [(186, 4), (190, 4), violin2musicmaker_three],
917 ]
918 ])
919
920 voice_10_timespan_list = abjad.TimespanList([
921     abjad.AnnotatedTimespan(
922         start_offset=start_offset,

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```

923     stop_offset=stop_offset,
924     annotation=MusicSpecifier(
925         music_maker=music_maker,
926         voice_name='Voice 10',
927     ),
928 )
929 for start_offset, stop_offset, music_maker in [
930     [(2, 4), (5, 4), violamusicmaker_one],
931     [(9, 4), (11, 4), violamusicmaker_two],
932     [(11, 4), (13, 4), violamusicmaker_two],
933     [(17, 4), (18, 4), violamusicmaker_three],
934     [(21, 4), (22, 4), violamusicmaker_one],
935     [(22, 4), (25, 4), violamusicmaker_one],
936     [(29, 4), (30, 4), violamusicmaker_two],
937     [(30, 4), (32, 4), violamusicmaker_two],
938     [(35, 4), (40, 4), violamusicmaker_one],
939     [(44, 4), (46, 4), violamusicmaker_two],
940     [(46, 4), (47, 4), violamusicmaker_two],
941     [(49, 4), (50, 4), violamusicmaker_three],
942     [(55, 4), (59, 4), violamusicmaker_one],
943     [(62, 4), (64, 4), violamusicmaker_two],
944     [(65, 4), (67, 4), violamusicmaker_three],
945     [(67, 4), (70, 4), violamusicmaker_three],
946     [(70, 4), (71, 4), violamusicmaker_three],
947     [(73, 4), (75, 4), violamusicmaker_two],
948     [(75, 4), (76, 4), violamusicmaker_two],
949     [(80, 4), (82, 4), violamusicmaker_one],
950     [(82, 4), (85, 4), violamusicmaker_one],
951     [(86, 4), (88, 4), violamusicmaker_two],
952     [(91, 4), (94, 4), violamusicmaker_three],
953     [(94, 4), (95, 4), violamusicmaker_three],
954     [(100, 4), (101, 4), violamusicmaker_two],
955     [(103, 4), (104, 4), violamusicmaker_one],
956     [(104, 4), (106, 4), violamusicmaker_one],
957     [(110, 4), (114, 4), violamusicmaker_one],
958     [(115, 4), (119, 4), violamusicmaker_one],
959     [(120, 4), (123, 4), violamusicmaker_one],
960     [(123, 4), (124, 4), violamusicmaker_one],
961     [(125, 4), (126, 4), violamusicmaker_two],
962     [(129, 4), (131, 4), violamusicmaker_two],
963     [(131, 4), (134, 4), violamusicmaker_two],
964     [(141, 4), (144, 4), violamusicmaker_two],
965     [(149, 4), (150, 4), violamusicmaker_two],
966     [(153, 4), (154, 4), violamusicmaker_three],
967     [(154, 4), (155, 4), violamusicmaker_three],
968     [(156, 4), (159, 4), violamusicmaker_three],
969     [(159, 4), (161, 4), violamusicmaker_three],
970     [(165, 4), (168, 4), violamusicmaker_three],
971     [(170, 4), (171, 4), violamusicmaker_three],
972     [(176, 4), (179, 4), violamusicmaker_three],
973     [(179, 4), (180, 4), violamusicmaker_three],
974     [(183, 4), (185, 4), violamusicmaker_three],
975     [(186, 4), (190, 4), violamusicmaker_three],
976 ]

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977 ])
978
979 ###group three###
980 voice_3_timespan_list = abjad.TimespanList([
981     abjad.AnnotatedTimespan(
982         start_offset=start_offset,
983         stop_offset=stop_offset,
984         annotation=MusicSpecifier(
985             music_maker=music_maker,
986             voice_name='Voice 3',
987         ),
988     )
989     for start_offset, stop_offset, music_maker in [
990         [(7, 4), (11, 4), bassoonmusicmaker_one],
991         [(15, 4), (16, 4), bassoonmusicmaker_two],
992         [(19, 4), (22, 4), bassoonmusicmaker_three],
993         [(22, 4), (23, 4), bassoonmusicmaker_three],
994         [(27, 4), (30, 4), bassoonmusicmaker_one],
995         [(32, 4), (35, 4), bassoonmusicmaker_two],
996         [(35, 4), (36, 4), bassoonmusicmaker_three],
997         [(37, 4), (40, 4), bassoonmusicmaker_two],
998         [(40, 4), (42, 4), bassoonmusicmaker_two],
999         [(46, 4), (49, 4), bassoonmusicmaker_one],
1000        [(51, 4), (52, 4), bassoonmusicmaker_three],
1001        [(57, 4), (59, 4), bassoonmusicmaker_two],
1002        [(59, 4), (61, 4), bassoonmusicmaker_two],
1003        [(64, 4), (66, 4), bassoonmusicmaker_one],
1004        [(67, 4), (70, 4), bassoonmusicmaker_three],
1005        [(70, 4), (72, 4), bassoonmusicmaker_one],
1006        [(72, 4), (73, 4), bassoonmusicmaker_one],
1007        [(77, 4), (79, 4), bassoonmusicmaker_two],
1008        [(79, 4), (82, 4), bassoonmusicmaker_two],
1009        [(83, 4), (85, 4), bassoonmusicmaker_three],
1010        [(88, 4), (89, 4), bassoonmusicmaker_two],
1011        [(89, 4), (92, 4), bassoonmusicmaker_two],
1012        [(97, 4), (98, 4), bassoonmusicmaker_one],
1013        [(100, 4), (103, 4), bassoonmusicmaker_two],
1014        [(107, 4), (110, 4), bassoonmusicmaker_three],
1015        [(110, 4), (112, 4), bassoonmusicmaker_one],
1016        [(113, 4), (114, 4), bassoonmusicmaker_one],
1017        [(114, 4), (117, 4), bassoonmusicmaker_one],
1018        [(118, 4), (119, 4), bassoonmusicmaker_one],
1019        [(119, 4), (122, 4), bassoonmusicmaker_one],
1020        [(123, 4), (125, 4), bassoonmusicmaker_one],
1021        [(126, 4), (131, 4), bassoonmusicmaker_two],
1022        [(138, 4), (141, 4), bassoonmusicmaker_two],
1023        [(146, 4), (150, 4), bassoonmusicmaker_two],
1024        [(150, 4), (154, 4), bassoonmusicmaker_three],
1025        [(154, 4), (155, 4), bassoonmusicmaker_three],
1026        [(159, 4), (162, 4), bassoonmusicmaker_three],
1027        [(164, 4), (165, 4), bassoonmusicmaker_three],
1028        [(170, 4), (172, 4), bassoonmusicmaker_three],
1029        [(172, 4), (174, 4), bassoonmusicmaker_three],
1030        [(177, 4), (179, 4), bassoonmusicmaker_three],

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1031         [(180, 4), (183, 4), bassoonmusicmaker_three],
1032         [(183, 4), (185, 4), bassoonmusicmaker_three],
1033         [(186, 4), (190, 4), bassoonmusicmaker_three],
1034     ]
1035 ])
1036
1037 voice_6_timespan_list = abjad.TimespanList([
1038     abjad.AnnotatedTimespan(
1039         start_offset=start_offset,
1040         stop_offset=stop_offset,
1041         annotation=MusicSpecifier(
1042             music_maker=music_maker,
1043             voice_name='Voice 6',
1044         ),
1045     )
1046     for start_offset, stop_offset, music_maker in [
1047         [(7, 4), (11, 4), trombonemusicmaker_one],
1048         [(14, 4), (16, 4), trombonemusicmaker_two],
1049         [(19, 4), (22, 4), trombonemusicmaker_three],
1050         [(22, 4), (23, 4), trombonemusicmaker_three],
1051         [(27, 4), (29, 4), trombonemusicmaker_one],
1052         [(35, 4), (36, 4), trombonemusicmaker_three],
1053         [(37, 4), (40, 4), trombonemusicmaker_two],
1054         [(40, 4), (42, 4), trombonemusicmaker_two],
1055         [(46, 4), (49, 4), trombonemusicmaker_one],
1056         [(51, 4), (52, 4), trombonemusicmaker_three],
1057         [(57, 4), (59, 4), trombonemusicmaker_two],
1058         [(59, 4), (61, 4), trombonemusicmaker_two],
1059         [(64, 4), (66, 4), trombonemusicmaker_one],
1060         [(67, 4), (70, 4), trombonemusicmaker_three],
1061         [(70, 4), (72, 4), trombonemusicmaker_one],
1062         [(72, 4), (73, 4), trombonemusicmaker_one],
1063         [(77, 4), (79, 4), trombonemusicmaker_two],
1064         [(79, 4), (82, 4), trombonemusicmaker_two],
1065         [(83, 4), (85, 4), trombonemusicmaker_three],
1066         [(88, 4), (89, 4), trombonemusicmaker_two],
1067         [(89, 4), (92, 4), trombonemusicmaker_two],
1068         [(97, 4), (98, 4), trombonemusicmaker_one],
1069         [(100, 4), (103, 4), trombonemusicmaker_two],
1070         [(107, 4), (110, 4), trombonemusicmaker_three],
1071         [(110, 4), (112, 4), trombonemusicmaker_one],
1072         [(113, 4), (114, 4), trombonemusicmaker_one],
1073         [(114, 4), (117, 4), trombonemusicmaker_one],
1074         [(118, 4), (119, 4), trombonemusicmaker_one],
1075         [(119, 4), (122, 4), trombonemusicmaker_one],
1076         [(123, 4), (125, 4), trombonemusicmaker_one],
1077         [(126, 4), (131, 4), trombonemusicmaker_two],
1078         [(138, 4), (141, 4), trombonemusicmaker_two],
1079         [(146, 4), (150, 4), trombonemusicmaker_two],
1080         [(150, 4), (154, 4), trombonemusicmaker_three],
1081         [(157, 4), (159, 4), trombonemusicmaker_three],
1082         [(160, 4), (164, 4), trombonemusicmaker_three],
1083         [(164, 4), (165, 4), trombonemusicmaker_three],
1084         [(169, 4), (172, 4), trombonemusicmaker_three],

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1085         [(174, 4), (175, 4), trombonemusicmaker_three],
1086         [(180, 4), (183, 4), trombonemusicmaker_three],
1087         [(183, 4), (184, 4), trombonemusicmaker_three],
1088         [(186, 4), (190, 4), trombonemusicmaker_three],
1089     ]
1090 ])
1091
1092 voice_11_timespan_list = abjad.TimespanList([
1093     abjad.AnnotatedTimespan(
1094         start_offset=start_offset,
1095         stop_offset=stop_offset,
1096         annotation=MusicSpecifier(
1097             music_maker=music_maker,
1098             voice_name='Voice 11',
1099         ),
1100     )
1101     for start_offset, stop_offset, music_maker in [
1102         [(7, 4), (11, 4), cellomusicmaker_one],
1103         [(14, 4), (16, 4), cellomusicmaker_two],
1104         [(21, 4), (22, 4), cellomusicmaker_three],
1105         [(22, 4), (23, 4), cellomusicmaker_three],
1106         [(27, 4), (30, 4), cellomusicmaker_one],
1107         [(35, 4), (36, 4), cellomusicmaker_three],
1108         [(37, 4), (40, 4), cellomusicmaker_two],
1109         [(40, 4), (42, 4), cellomusicmaker_two],
1110         [(46, 4), (49, 4), cellomusicmaker_one],
1111         [(51, 4), (52, 4), cellomusicmaker_three],
1112         [(57, 4), (59, 4), cellomusicmaker_two],
1113         [(59, 4), (61, 4), cellomusicmaker_two],
1114         [(64, 4), (66, 4), cellomusicmaker_one],
1115         [(67, 4), (70, 4), cellomusicmaker_three],
1116         [(70, 4), (72, 4), cellomusicmaker_one],
1117         [(72, 4), (73, 4), cellomusicmaker_one],
1118         [(77, 4), (79, 4), cellomusicmaker_two],
1119         [(79, 4), (82, 4), cellomusicmaker_two],
1120         [(83, 4), (85, 4), cellomusicmaker_three],
1121         [(88, 4), (89, 4), cellomusicmaker_two],
1122         [(89, 4), (92, 4), cellomusicmaker_two],
1123         [(97, 4), (98, 4), cellomusicmaker_one],
1124         [(100, 4), (103, 4), cellomusicmaker_two],
1125         [(107, 4), (110, 4), cellomusicmaker_three],
1126         [(110, 4), (112, 4), cellomusicmaker_one],
1127         [(113, 4), (114, 4), cellomusicmaker_one],
1128         [(114, 4), (117, 4), cellomusicmaker_one],
1129         [(118, 4), (119, 4), cellomusicmaker_one],
1130         [(119, 4), (122, 4), cellomusicmaker_one],
1131         [(123, 4), (125, 4), cellomusicmaker_one],
1132         [(126, 4), (131, 4), cellomusicmaker_two],
1133         [(138, 4), (141, 4), cellomusicmaker_two],
1134         [(146, 4), (150, 4), cellomusicmaker_two],
1135         [(150, 4), (153, 4), cellomusicmaker_three],
1136         [(155, 4), (156, 4), cellomusicmaker_three],
1137         [(161, 4), (164, 4), cellomusicmaker_three],
1138         [(164, 4), (165, 4), cellomusicmaker_three],

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1139     [(168, 4), (170, 4), cellomusicmaker_three],
1140     [(171, 4), (172, 4), cellomusicmaker_three],
1141     [(172, 4), (175, 4), cellomusicmaker_three],
1142     [(175, 4), (176, 4), cellomusicmaker_three],
1143     [(180, 4), (183, 4), cellomusicmaker_three],
1144     [(185, 4), (186, 4), cellomusicmaker_three],
1145     [(186, 4), (190, 4), cellomusicmaker_three],
1146 ]
1147 ])
1148
1149 ###group four###
1150 voice_4_timespan_list = abjad.TimespanList([
1151     abjad.AnnotatedTimespan(
1152         start_offset=start_offset,
1153         stop_offset=stop_offset,
1154         annotation=MusicSpecifier(
1155             music_maker=music_maker,
1156             voice_name='Voice 4',
1157         ),
1158     )
1159     for start_offset, stop_offset, music_maker in [
1160         [(0, 4), (5, 4), hornmusicmaker_one],
1161         [(8, 4), (10, 4), hornmusicmaker_two],
1162         [(14, 4), (18, 4), hornmusicmaker_three],
1163         [(21, 4), (22, 4), hornmusicmaker_one],
1164         [(22, 4), (23, 4), hornmusicmaker_one],
1165         [(38, 4), (40, 4), hornmusicmaker_two],
1166         [(41, 4), (43, 4), hornmusicmaker_one],
1167         [(43, 4), (46, 4), hornmusicmaker_one],
1168         [(50, 4), (53, 4), hornmusicmaker_three],
1169         [(55, 4), (56, 4), hornmusicmaker_two],
1170         [(61, 4), (64, 4), hornmusicmaker_one],
1171         [(64, 4), (65, 4), hornmusicmaker_one],
1172         [(68, 4), (70, 4), hornmusicmaker_three],
1173         [(70, 4), (72, 4), hornmusicmaker_two],
1174         [(72, 4), (74, 4), hornmusicmaker_two],
1175         [(79, 4), (80, 4), hornmusicmaker_three],
1176         [(82, 4), (85, 4), hornmusicmaker_two],
1177         [(89, 4), (94, 4), hornmusicmaker_one],
1178         [(95, 4), (97, 4), hornmusicmaker_two],
1179         [(100, 4), (104, 4), hornmusicmaker_three],
1180         [(109, 4), (110, 4), hornmusicmaker_two],
1181         [(110, 4), (111, 4), hornmusicmaker_one],
1182         [(112, 4), (114, 4), hornmusicmaker_one],
1183         [(114, 4), (116, 4), hornmusicmaker_one],
1184         [(117, 4), (119, 4), hornmusicmaker_one],
1185         [(119, 4), (121, 4), hornmusicmaker_one],
1186         [(122, 4), (123, 4), hornmusicmaker_one],
1187         [(123, 4), (125, 4), hornmusicmaker_one],
1188         [(133, 4), (136, 4), hornmusicmaker_two],
1189         [(142, 4), (146, 4), hornmusicmaker_two],
1190         [(146, 4), (150, 4), hornmusicmaker_two],
1191         [(153, 4), (154, 4), hornmusicmaker_three],
1192         [(154, 4), (155, 4), hornmusicmaker_three],

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1193     [(159, 4), (162, 4), hornmusicmaker_three],
1194     [(164, 4), (168, 4), hornmusicmaker_three],
1195     [(171, 4), (172, 4), hornmusicmaker_three],
1196     [(172, 4), (173, 4), hornmusicmaker_three],
1197     [(177, 4), (179, 4), hornmusicmaker_three],
1198     [(179, 4), (180, 4), hornmusicmaker_three],
1199     [(182, 4), (183, 4), hornmusicmaker_three],
1200     [(183, 4), (186, 4), hornmusicmaker_three],
1201     [(186, 4), (190, 4), hornmusicmaker_three],
1202 ]
1203 ])
1204
1205 voice_7_timespan_list = abjad.TimespanList([
1206     abjad.AnnotatedTimespan(
1207         start_offset=start_offset,
1208         stop_offset=stop_offset,
1209         annotation=MusicSpecifier(
1210             music_maker=music_maker,
1211             voice_name='Voice 7',
1212         ),
1213     )
1214     for start_offset, stop_offset, music_maker in [
1215         [(0, 4), (5, 4), tubamusicmaker_one],
1216         [(8, 4), (10, 4), tubamusicmaker_two],
1217         [(14, 4), (18, 4), tubamusicmaker_three],
1218         [(21, 4), (22, 4), tubamusicmaker_one],
1219         [(22, 4), (23, 4), tubamusicmaker_one],
1220         [(26, 4), (30, 4), tubamusicmaker_two],
1221         [(38, 4), (40, 4), tubamusicmaker_two],
1222         [(41, 4), (43, 4), tubamusicmaker_one],
1223         [(43, 4), (46, 4), tubamusicmaker_one],
1224         [(50, 4), (53, 4), tubamusicmaker_three],
1225         [(55, 4), (56, 4), tubamusicmaker_two],
1226         [(61, 4), (64, 4), tubamusicmaker_one],
1227         [(64, 4), (65, 4), tubamusicmaker_one],
1228         [(68, 4), (70, 4), tubamusicmaker_three],
1229         [(70, 4), (72, 4), tubamusicmaker_two],
1230         [(72, 4), (74, 4), tubamusicmaker_two],
1231         [(79, 4), (80, 4), tubamusicmaker_three],
1232         [(82, 4), (85, 4), tubamusicmaker_two],
1233         [(89, 4), (94, 4), tubamusicmaker_one],
1234         [(95, 4), (97, 4), tubamusicmaker_two],
1235         [(100, 4), (104, 4), tubamusicmaker_three],
1236         [(109, 4), (110, 4), tubamusicmaker_two],
1237         [(110, 4), (111, 4), tubamusicmaker_one],
1238         [(112, 4), (114, 4), tubamusicmaker_one],
1239         [(114, 4), (116, 4), tubamusicmaker_one],
1240         [(117, 4), (119, 4), tubamusicmaker_one],
1241         [(119, 4), (121, 4), tubamusicmaker_one],
1242         [(122, 4), (123, 4), tubamusicmaker_one],
1243         [(123, 4), (125, 4), tubamusicmaker_one],
1244         [(133, 4), (136, 4), tubamusicmaker_two],
1245         [(142, 4), (146, 4), tubamusicmaker_two],
1246         [(146, 4), (150, 4), tubamusicmaker_two],

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1247         [(154, 4), (157, 4), tubamusicmaker_three],
1248         [(159, 4), (163, 4), tubamusicmaker_three],
1249         [(166, 4), (168, 4), tubamusicmaker_three],
1250         [(172, 4), (175, 4), tubamusicmaker_three],
1251         [(177, 4), (179, 4), tubamusicmaker_three],
1252         [(179, 4), (181, 4), tubamusicmaker_three],
1253         [(184, 4), (186, 4), tubamusicmaker_three],
1254         [(186, 4), (190, 4), tubamusicmaker_three],
1255     ]
1256 ])
1257
1258 voice_12_timespan_list = abjad.TimespanList([
1259     abjad.AnnotatedTimespan(
1260         start_offset=start_offset,
1261         stop_offset=stop_offset,
1262         annotation=MusicSpecifier(
1263             music_maker=music_maker,
1264             voice_name='Voice 12',
1265         ),
1266     )
1267     for start_offset, stop_offset, music_maker in [
1268         [(0, 4), (5, 4), bassmusicmaker_one],
1269         [(8, 4), (10, 4), bassmusicmaker_two],
1270         [(14, 4), (18, 4), bassmusicmaker_three],
1271         [(21, 4), (22, 4), bassmusicmaker_one],
1272         [(22, 4), (23, 4), bassmusicmaker_one],
1273         [(38, 4), (40, 4), bassmusicmaker_two],
1274         [(41, 4), (43, 4), bassmusicmaker_one],
1275         [(43, 4), (46, 4), bassmusicmaker_one],
1276         [(50, 4), (53, 4), bassmusicmaker_three],
1277         [(55, 4), (56, 4), bassmusicmaker_two],
1278         [(61, 4), (64, 4), bassmusicmaker_one],
1279         [(64, 4), (65, 4), bassmusicmaker_one],
1280         [(68, 4), (70, 4), bassmusicmaker_three],
1281         [(70, 4), (72, 4), bassmusicmaker_two],
1282         [(72, 4), (74, 4), bassmusicmaker_two],
1283         [(79, 4), (80, 4), bassmusicmaker_three],
1284         [(82, 4), (85, 4), bassmusicmaker_two],
1285         [(89, 4), (94, 4), bassmusicmaker_one],
1286         [(95, 4), (97, 4), bassmusicmaker_two],
1287         [(100, 4), (104, 4), bassmusicmaker_three],
1288         [(109, 4), (110, 4), bassmusicmaker_two],
1289         [(110, 4), (111, 4), bassmusicmaker_one],
1290         [(112, 4), (114, 4), bassmusicmaker_one],
1291         [(114, 4), (116, 4), bassmusicmaker_one],
1292         [(117, 4), (119, 4), bassmusicmaker_one],
1293         [(119, 4), (121, 4), bassmusicmaker_one],
1294         [(122, 4), (123, 4), bassmusicmaker_one],
1295         [(123, 4), (125, 4), bassmusicmaker_one],
1296         [(133, 4), (136, 4), bassmusicmaker_two],
1297         [(142, 4), (146, 4), bassmusicmaker_two],
1298         [(146, 4), (150, 4), bassmusicmaker_two],
1299         [(152, 4), (154, 4), bassmusicmaker_three],
1300         [(154, 4), (156, 4), bassmusicmaker_three],

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1301         [(159, 4), (161, 4), bassmusicmaker_three],
1302         [(165, 4), (168, 4), bassmusicmaker_three],
1303         [(170, 4), (172, 4), bassmusicmaker_three],
1304         [(172, 4), (174, 4), bassmusicmaker_three],
1305         [(177, 4), (179, 4), bassmusicmaker_three],
1306         [(183, 4), (186, 4), bassmusicmaker_three],
1307         [(186, 4), (190, 4), bassmusicmaker_three],
1308     ]
1309 ])
1310
1311 all_timespan_lists = {
1312     'Voice 1': voice_1_timespan_list,
1313     'Voice 2': voice_2_timespan_list,
1314     'Voice 3': voice_3_timespan_list,
1315     'Voice 4': voice_4_timespan_list,
1316     'Voice 5': voice_5_timespan_list,
1317     'Voice 6': voice_6_timespan_list,
1318     'Voice 7': voice_7_timespan_list,
1319     'Voice 8': voice_8_timespan_list,
1320     'Voice 9': voice_9_timespan_list,
1321     'Voice 10': voice_10_timespan_list,
1322     'Voice 11': voice_11_timespan_list,
1323     'Voice 12': voice_12_timespan_list,
1324 }
1325
1326 global_timespan = abjad.Timespan(
1327     start_offset=0,
1328     stop_offset=max(_.stop_offset for _ in all_timespan_lists.values())
1329 )
1330
1331 for voice_name, timespan_list in all_timespan_lists.items():
1332     silences = abjad.TimespanList([global_timespan])
1333     silences.extend(timespan_list)
1334     silences.sort()
1335     silences.compute_logical_xor()
1336     for silence_timespan in silences:
1337         timespan_list.append(
1338             abjad.AnnotatedTimespan(
1339                 start_offset=silence_timespan.start_offset,
1340                 stop_offset=silence_timespan.stop_offset,
1341                 annotation=MusicSpecifier(
1342                     music_maker=None,
1343                     voice_name=voice_name,
1344                 ),
1345             )
1346         )
1347     timespan_list.sort()
1348
1349 for voice_name, timespan_list in all_timespan_lists.items():
1350     shards = timespan_list.split_at_offsets(bounds)
1351     split_timespan_list = abjad.TimespanList()
1352     for shard in shards:
1353         split_timespan_list.extend(shard)
1354     split_timespan_list.sort()

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```

1355     all_timespan_lists[voice_name] = timespan_list
1356
1357 score = abjad.Score([
1358     abjad.Staff(lilypond_type='TimeSignatureContext', name='Global Context 1')
1359     ,
1360     abjad.StaffGroup(
1361         [
1362             abjad.Staff([abjad.Voice(name='Voice 1')], name='Staff 1',
1363             lilypond_type='Staff'),
1364             abjad.Staff([abjad.Voice(name='Voice 2')], name='Staff 2',
1365             lilypond_type='Staff'),
1366             abjad.Staff([abjad.Voice(name='Voice 3')], name='Staff 3',
1367             lilypond_type='Staff'),
1368         ],
1369         name='Staff Group 1',
1370     ),
1371     abjad.Staff(lilypond_type='TimeSignatureContext', name='Global Context 2')
1372     ,
1373     abjad.StaffGroup(
1374         [
1375             abjad.Staff([abjad.Voice(name='Voice 4')], name='Staff 4',
1376             lilypond_type='Staff'),
1377             abjad.Staff([abjad.Voice(name='Voice 5')], name='Staff 5',
1378             lilypond_type='Staff'),
1379             abjad.Staff([abjad.Voice(name='Voice 6')], name='Staff 6',
1380             lilypond_type='Staff'),
1381             abjad.Staff([abjad.Voice(name='Voice 7')], name='Staff 7',
1382             lilypond_type='Staff'),
1383         ],
1384         name='Staff Group 2',
1385     ),
1386     abjad.Staff(lilypond_type='TimeSignatureContext', name='Global Context 3')
1387     ,
1388     abjad.StaffGroup(
1389         [
1390             abjad.Staff([abjad.Voice(name='Voice 8')], name='Staff 8',
1391             lilypond_type='Staff'),
1392             abjad.Staff([abjad.Voice(name='Voice 9')], name='Staff 9',
1393             lilypond_type='Staff'),
1394             abjad.Staff([abjad.Voice(name='Voice 10')], name='Staff 10',
1395             lilypond_type='Staff'),
1396             abjad.Staff([abjad.Voice(name='Voice 11')], name='Staff 11',
1397             lilypond_type='Staff'),
1398             abjad.Staff([abjad.Voice(name='Voice 12')], name='Staff 12',
1399             lilypond_type='Staff'),
1400         ],
1401         name='Staff Group 3',
1402     )
1403 ],
1404 )
1405
1406 for time_signature in time_signatures:
1407     skip = abjad.Skip(1, multiplier=(time_signature))
1408     abjad.attach(time_signature, skip)

```

```

1394     score['Global Context 1'].append(skip)
1395
1396     for time_signature in time_signatures:
1397         skip = abjad.Skip(1, multiplier=(time_signature))
1398         abjad.attach(time_signature, skip)
1399         score['Global Context 2'].append(skip)
1400
1401     for time_signature in time_signatures:
1402         skip = abjad.Skip(1, multiplier=(time_signature))
1403         abjad.attach(time_signature, skip)
1404         score['Global Context 3'].append(skip)
1405
1406     print('Making containers ...')
1407
1408     def make_container(music_maker, durations):
1409         selections = music_maker(durations)
1410         container = abjad.Container([])
1411         container.extend(selections)
1412         return container
1413
1414     def key_function(timespan):
1415         return timespan.annotation.music_maker or silence_maker
1416
1417     for voice_name, timespan_list in all_timespan_lists.items():
1418         for music_maker, grouper in itertools.groupby(
1419             timespan_list,
1420             key=key_function,
1421         ):
1422             durations = [timespan.duration for timespan in grouper]
1423             container = make_container(music_maker, durations)
1424             voice = score[voice_name]
1425             voice.append(container)
1426
1427     print('Splitting and rewriting ...')
1428
1429     for voice in abjad.iterate(score['Staff Group 1']).components(abjad.Voice):
1430         for i, shard in enumerate(abjad.mutate(voice[:]).split(time_signatures)):
1431             time_signature = time_signatures[i]
1432             abjad.mutate(shard).rewrite_meter(time_signature)
1433
1434     for voice in abjad.iterate(score['Staff Group 2']).components(abjad.Voice):
1435         for i, shard in enumerate(abjad.mutate(voice[:]).split(time_signatures)):
1436             time_signature = time_signatures[i]
1437             abjad.mutate(shard).rewrite_meter(time_signature)
1438
1439     for voice in abjad.iterate(score['Staff Group 3']).components(abjad.Voice):
1440         for i, shard in enumerate(abjad.mutate(voice[:]).split(time_signatures)):
1441             time_signature = time_signatures[i]
1442             abjad.mutate(shard).rewrite_meter(time_signature)
1443
1444     print('Beaming runs ...')
1445
1446     for voice in abjad.select(score).components(abjad.Voice):
1447         for run in abjad.select(voice).runs():

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1448     if 1 < len(run):
1449         specifier = abjadext.rmakers.BeamSpecifier(
1450             beam_each_division=False,
1451             )
1452         specifier(run)
1453         abjad.attach(abjad.StartBeam(), run[0])
1454         abjad.attach(abjad.StopBeam(), run[-1])
1455     for leaf in run:
1456         if abjad.Duration(1, 4) <= leaf.written_duration:
1457             continue
1458         previous_leaf = abjad.inspect(leaf).leaf(-1)
1459         next_leaf = abjad.inspect(leaf).leaf(1)
1460         if (isinstance(next_leaf, (abjad.Chord, abjad.Note)) and
1461             abjad.Duration(1, 4) <= next_leaf.written_duration):
1462             left = previous_leaf.written_duration.flag_count
1463             right = leaf.written_duration.flag_count
1464             beam_count = abjad.BeamCount(
1465                 left=left,
1466                 right=right,
1467             )
1468             abjad.attach(beam_count, leaf)
1469             continue
1470         if (isinstance(previous_leaf, (abjad.Chord, abjad.Note)) and
1471             abjad.Duration(1, 4) <= previous_leaf.written_duration):
1472             left = leaf.written_duration.flag_count
1473             right = next_leaf.written_duration.flag_count
1474             beam_count = abjad.BeamCount(
1475                 left=left,
1476                 right=right,
1477             )
1478             abjad.attach(beam_count, leaf)
1479
1480     print('Beautifying score ...')
1481     for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
1482         for selection in abjad.select(staff).components(abjad.Rest).
1483             group_by_contiguity():
1484                 start_command = abjad.LilyPondLiteral(
1485                     r'\stopStaff \once \override Staff.StaffSymbol.line-count = #1 \
1486                     startStaff',
1487                     format_slot='before',
1488                 )
1489                 stop_command = abjad.LilyPondLiteral(
1490                     r'\stopStaff \startStaff',
1491                     format_slot='after',
1492                 )
1493                 abjad.attach(start_command, selection[0])
1494                 abjad.attach(stop_command, selection[-1])
1495
1496     for staff in abjad.iterate(score['Staff Group 2']).components(abjad.Staff):
1497         for selection in abjad.select(staff).components(abjad.Rest).
1498             group_by_contiguity():
1499                 start_command = abjad.LilyPondLiteral(
1500                     r'\stopStaff \once \override Staff.StaffSymbol.line-count = #1 \
1501                     startStaff',

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1498         format_slot='before',
1499     )
1500     stop_command = abjad.LilyPondLiteral(
1501         r'\stopStaff \startStaff',
1502         format_slot='after',
1503     )
1504     abjad.attach(start_command, selection[0])
1505     abjad.attach(stop_command, selection[-1])
1506
1507 for staff in abjad.iterate(score['Staff Group 3']).components(abjad.Staff):
1508     for selection in abjad.select(staff).components(abjad.Rest).
1509     group_by_contiguity():
1510         start_command = abjad.LilyPondLiteral(
1511             r'\stopStaff \once \override Staff.StaffSymbol.line-count = #1 \
1512             startStaff',
1513             format_slot='before',
1514         )
1515         stop_command = abjad.LilyPondLiteral(
1516             r'\stopStaff \startStaff',
1517             format_slot='after',
1518         )
1519         abjad.attach(start_command, selection[0])
1520         abjad.attach(stop_command, selection[-1])
1521
1522 print('Stopping Hairpins ...')
1523 for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
1524     for rest in abjad.iterate(staff).components(abjad.Rest):
1525         previous_leaf = abjad.inspect(rest).leaf(-1)
1526         if isinstance(previous_leaf, abjad.Note):
1527             abjad.attach(abjad.StopHairpin(), rest)
1528         elif isinstance(previous_leaf, abjad.Chord):
1529             abjad.attach(abjad.StopHairpin(), rest)
1530         elif isinstance(previous_leaf, abjad.Rest):
1531             pass
1532
1533 for staff in abjad.iterate(score['Staff Group 2']).components(abjad.Staff):
1534     for rest in abjad.iterate(staff).components(abjad.Rest):
1535         previous_leaf = abjad.inspect(rest).leaf(-1)
1536         if isinstance(previous_leaf, abjad.Note):
1537             abjad.attach(abjad.StopHairpin(), rest)
1538         elif isinstance(previous_leaf, abjad.Chord):
1539             abjad.attach(abjad.StopHairpin(), rest)
1540         elif isinstance(previous_leaf, abjad.Rest):
1541             pass
1542
1543 for staff in abjad.iterate(score['Staff Group 3']).components(abjad.Staff):
1544     for rest in abjad.iterate(staff).components(abjad.Rest):
1545         previous_leaf = abjad.inspect(rest).leaf(-1)
1546         if isinstance(previous_leaf, abjad.Note):
1547             abjad.attach(abjad.StopHairpin(), rest)
1548         elif isinstance(previous_leaf, abjad.Chord):
1549             abjad.attach(abjad.StopHairpin(), rest)
1550         elif isinstance(previous_leaf, abjad.Rest):
1551             pass

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1550
1551 print('Adding pitch material ...')
1552 def cyc(lst):
1553     count = 0
1554     while True:
1555         yield lst[count%len(lst)]
1556         count += 1
1557
1558 print('Adding attachments ...')
1559 bar_line = abjad.BarLine('||')
1560 metro = abjad.MetronomeMark((1, 4), 108)
1561 markup1 = abjad.Markup(r'\bold { A }')
1562 markup2 = abjad.Markup(r'\bold { B }')
1563 markup3 = abjad.Markup(r'\bold { C }')
1564 markup4 = abjad.Markup(r'\bold { D }')
1565 markup5 = abjad.Markup(r'\bold { E }')
1566 markup6 = abjad.Markup(r'\bold { F }')
1567 mark1 = abjad.RehearsalMark(markup=markup1)
1568 mark2 = abjad.RehearsalMark(markup=markup2)
1569 mark3 = abjad.RehearsalMark(markup=markup3)
1570 mark4 = abjad.RehearsalMark(markup=markup4)
1571 mark5 = abjad.RehearsalMark(markup=markup5)
1572 mark6 = abjad.RehearsalMark(markup=markup6)
1573
1574 instruments1 = cyc([
1575     abjad.Flute(),
1576     abjad.ClarinetInBFlat(),
1577     abjad.Bassoon(),
1578 ])
1579
1580 instruments2 = cyc([
1581     abjad.FrenchHorn(),
1582     abjad.Trumpet(),
1583     abjad.TenorTrombone(),
1584     abjad.Tuba(),
1585 ])
1586
1587 instruments3 = cyc([
1588     abjad.Violin(),
1589     abjad.Violin(),
1590     abjad.Viola(),
1591     abjad.Cello(),
1592     abjad.Contrabass(),
1593 ])
1594
1595 clefs1 = cyc([
1596     abjad.Clef('treble'),
1597     abjad.Clef('treble'),
1598     abjad.Clef('bass'),
1599 ])
1600
1601 clefs2 = cyc([
1602     abjad.Clef('bass'),
1603     abjad.Clef('treble'),

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1604     abjad.Clef('bass'),
1605     abjad.Clef('bass'),
1606 ])
1607
1608 clefs3 = cyc([
1609     abjad.Clef('treble'),
1610     abjad.Clef('treble'),
1611     abjad.Clef('alto'),
1612     abjad.Clef('bass'),
1613     abjad.Clef('bass'),
1614 ])
1615
1616 abbreviations1 = cyc([
1617     abjad.MarginMarkup(markup=abjad.Markup('fl.'),),
1618     abjad.MarginMarkup(markup=abjad.Markup('cl.'),),
1619     abjad.MarginMarkup(markup=abjad.Markup('bssn.'),),
1620 ])
1621
1622 abbreviations2 = cyc([
1623     abjad.MarginMarkup(markup=abjad.Markup('hr.'),),
1624     abjad.MarginMarkup(markup=abjad.Markup('trp.'),),
1625     abjad.MarginMarkup(markup=abjad.Markup('trmb.'),),
1626     abjad.MarginMarkup(markup=abjad.Markup('tb.'),),
1627 ])
1628
1629 abbreviations3 = cyc([
1630     abjad.MarginMarkup(markup=abjad.Markup('vln.I'),),
1631     abjad.MarginMarkup(markup=abjad.Markup('vln.II'),),
1632     abjad.MarginMarkup(markup=abjad.Markup('vla.'),),
1633     abjad.MarginMarkup(markup=abjad.Markup('vc.'),),
1634     abjad.MarginMarkup(markup=abjad.Markup('cb.'),),
1635 ])
1636
1637 names1 = cyc([
1638     abjad.StartMarkup(markup=abjad.Markup('Flute'),),
1639     abjad.StartMarkup(markup=abjad.Markup('Clarinet'),),
1640     abjad.StartMarkup(markup=abjad.Markup('Bassoon'),),
1641 ])
1642
1643 names2 = cyc([
1644     abjad.StartMarkup(markup=abjad.Markup('Horn'),),
1645     abjad.StartMarkup(markup=abjad.Markup('Trumpet'),),
1646     abjad.StartMarkup(markup=abjad.Markup('Trombone'),),
1647     abjad.StartMarkup(markup=abjad.Markup('Tuba'),),
1648 ])
1649
1650 names3 = cyc([
1651     abjad.StartMarkup(markup=abjad.Markup('Violin I'),),
1652     abjad.StartMarkup(markup=abjad.Markup('Violin II'),),
1653     abjad.StartMarkup(markup=abjad.Markup('Viola'),),
1654     abjad.StartMarkup(markup=abjad.Markup('Violoncello'),),
1655     abjad.StartMarkup(markup=abjad.Markup('Contrabass'),),
1656 ])
1657

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```

1658 for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
1659     leaf1 = abjad.select(staff).leaves()[0]
1660     abjad.attach(next(instruments1), leaf1)
1661     abjad.attach(next(abbreviations1), leaf1)
1662     abjad.attach(next(names1), leaf1)
1663     abjad.attach(next(clefs1), leaf1)
1664
1665 for staff in abjad.iterate(score['Staff Group 2']).components(abjad.Staff):
1666     leaf1 = abjad.select(staff).leaves()[0]
1667     abjad.attach(next(instruments2), leaf1)
1668     abjad.attach(next(abbreviations2), leaf1)
1669     abjad.attach(next(names2), leaf1)
1670     abjad.attach(next(clefs2), leaf1)
1671
1672 for staff in abjad.iterate(score['Staff Group 3']).components(abjad.Staff):
1673     leaf1 = abjad.select(staff).leaves()[0]
1674     abjad.attach(next(instruments3), leaf1)
1675     abjad.attach(next(abbreviations3), leaf1)
1676     abjad.attach(next(names3), leaf1)
1677     abjad.attach(next(clefs3), leaf1)
1678
1679 for staff in abjad.select(score['Staff Group 1']).components(abjad.Staff)[0]:
1680     leaf1 = abjad.select(staff).leaves()[0]
1681     last_leaf = abjad.select(staff).leaves()[-1]
1682     abjad.attach(metro, leaf1)
1683     abjad.attach(bar_line, last_leaf)
1684
1685 for staff in abjad.select(score['Staff Group 2']).components(abjad.Staff)[0]:
1686     leaf1 = abjad.select(staff).leaves()[0]
1687     last_leaf = abjad.select(staff).leaves()[-1]
1688     abjad.attach(metro, leaf1)
1689     abjad.attach(bar_line, last_leaf)
1690
1691 for staff in abjad.select(score['Staff Group 3']).components(abjad.Staff)[0]:
1692     leaf1 = abjad.select(staff).leaves()[0]
1693     last_leaf = abjad.select(staff).leaves()[-1]
1694     abjad.attach(metro, leaf1)
1695     abjad.attach(bar_line, last_leaf)
1696
1697 for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1698     leaf1 = abjad.select(staff).leaves()[7]
1699     abjad.attach(mark1, leaf1)
1700
1701 for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1702     leaf1 = abjad.select(staff).leaves()[7]
1703     abjad.attach(mark1, leaf1)
1704
1705 for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1706     leaf1 = abjad.select(staff).leaves()[7]
1707     abjad.attach(mark1, leaf1)
1708
1709 for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1710     leaf2 = abjad.select(staff).leaves()[16]
1711     abjad.attach(mark2, leaf2)

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1712
1713 for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1714     leaf2 = abjad.select(staff).leaves()[16]
1715     abjad.attach(mark2, leaf2)
1716
1717 for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1718     leaf2 = abjad.select(staff).leaves()[16]
1719     abjad.attach(mark2, leaf2)
1720
1721 for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1722     leaf3 = abjad.select(staff).leaves()[22]
1723     abjad.attach(mark3, leaf3)
1724
1725 for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1726     leaf3 = abjad.select(staff).leaves()[22]
1727     abjad.attach(mark3, leaf3)
1728
1729 for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1730     leaf3 = abjad.select(staff).leaves()[22]
1731     abjad.attach(mark3, leaf3)
1732
1733 for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1734     leaf4 = abjad.select(staff).leaves()[29]
1735     abjad.attach(mark4, leaf4)
1736
1737 for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1738     leaf4 = abjad.select(staff).leaves()[29]
1739     abjad.attach(mark4, leaf4)
1740
1741 for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1742     leaf4 = abjad.select(staff).leaves()[29]
1743     abjad.attach(mark4, leaf4)
1744
1745 for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1746     leaf5 = abjad.select(staff).leaves()[34]
1747     abjad.attach(mark5, leaf5)
1748
1749 for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1750     leaf5 = abjad.select(staff).leaves()[34]
1751     abjad.attach(mark5, leaf5)
1752
1753 for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1754     leaf5 = abjad.select(staff).leaves()[34]
1755     abjad.attach(mark5, leaf5)
1756
1757 for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1758     leaf6 = abjad.select(staff).leaves()[39]
1759     abjad.attach(mark6, leaf6)
1760
1761 for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1762     leaf6 = abjad.select(staff).leaves()[39]
1763     abjad.attach(mark6, leaf6)
1764
1765 for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):

```

```

1766     leaf6 = abjad.select(staff).leaves()[39]
1767     abjad.attach(mark6, leaf6)
1768
1769 for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
1770     abjad.Instrument.transpose_from_sounding_pitch(staff)
1771
1772 for staff in abjad.iterate(score['Staff Group 2']).components(abjad.Staff):
1773     abjad.Instrument.transpose_from_sounding_pitch(staff)
1774
1775 for staff in abjad.iterate(score['Staff Group 3']).components(abjad.Staff):
1776     abjad.Instrument.transpose_from_sounding_pitch(staff)
1777
1778 score_file = abjad.LilyPondFile.new(
1779     score,
1780     includes=['first_stylesheet.ily', '/Users/evansdsg2/abjad/docs/source/
1781             _stylesheets/abjad.ily'],
1782 )
1783
1784 abjad.SegmentMaker.comment_measure_numbers(score)
1785 #####
1786
1787 directory = '/Users/evansdsg2/Scores//tianshu/tianshu/Segments/Segment_I'
1788 pdf_path = f'{directory}/Segment_I.pdf'
1789 path = pathlib.Path('Segment_I.pdf')
1790 if path.exists():
1791     print(f'Removing {pdf_path} ...')
1792     path.unlink()
1793
1794 time_1 = time.time()
1795 print(f'Persisting {pdf_path} ...')
1796 result = abjad.persist(score_file).as_pdf(pdf_path)
1797 print(result[0])
1798 print(result[1])
1799 print(result[2])
1800 success = result[3]
1801 if success is False:
1802     print('LilyPond failed!')
1803
1804 time_2 = time.time()
1805 total_time = time_2 - time_1
1806 print(f'Total time: {total_time} seconds')
1807
1808 if path.exists():
1809     print(f'Opening {pdf_path} ...')
1810     os.system(f'open {pdf_path}')

```

Code Example A.11: Tianshu Segment_I

A.3.1.2 SEGMENT_II

```

1 import abjad
2 import itertools
3 import os
4 import pathlib
5 import time
6 import abjadext.rmakers

```

```

7 from MusicMaker import MusicMaker
8 from AttachmentHandler import AttachmentHandler
9 from random import random
10 from random import seed
11
12 print('Interpreting file ...')
13
14 time_signatures = [
15     abjad.TimeSignature(pair) for pair in [
16         (5, 4), (2, 4), (4, 4), (3, 4), (4, 4), (4, 4),
17         (4, 4), (4, 4), (5, 4), (5, 4), (3, 4), (3, 4),
18         (4, 4), (4, 4), (5, 4), (5, 4), (3, 4), (3, 4),
19         (2, 4), (3, 4), (4, 4), (3, 4), (4, 4), (3, 4),
20         (5, 4), (3, 4), (3, 4), (4, 4), (3, 4), (3, 4),
21         (4, 4), (5, 4), (4, 4), (3, 4), (5, 4), (5, 4),
22         (5, 4), (5, 4), (4, 4), (4, 4), (5, 4), (5, 4),
23         (4, 4), (4, 4), (3, 4), (4, 4), (4, 4), (3, 4),
24         (5, 4),
25     ]
26 ]
27
28 bounds = abjad.mathtools.cumulative_sums([_.duration for _ in time_signatures
29 ])
30
31 def reduceMod5(rw):
32     return [(x % 6) for x in rw]
33
34 def reduceMod6(rw):
35     return [(x % 7) for x in rw]
36
37 def reduceMod7(rw):
38     return [(x % 8) for x in rw]
39
40 def reduceMod9(rw):
41     return [(x % 10) for x in rw]
42
43 def reduceMod11(rw):
44     return [(x % 12) for x in rw]
45
46 def reduceMod15(rw):
47     return [(x % 16) for x in rw]
48
49 seed(1)
50 flute_random_walk_one = []
51 flute_random_walk_one.append(-1 if random() < 0.5 else 1)
52 for i in range(1, 1000):
53     movement = -1 if random() < 0.5 else 1
54     value = flute_random_walk_one[i-1] + movement
55     flute_random_walk_one.append(value)
56 flute_random_walk_one = [abs(x) for x in flute_random_walk_one]
57 flute_chord_one = [0, 10, 16, 18, 25, 26, 25, 18, 16, 10 ]
58 flute_notes_one = [flute_chord_one[x] for x in reduceMod9(
    flute_random_walk_one)]

```

```

59 seed(2)
60 clarinet_random_walk_one = []
61 clarinet_random_walk_one.append(-1 if random() < 0.5 else 1)
62 for i in range(1, 1000):
63     movement = -1 if random() < 0.5 else 1
64     value = clarinet_random_walk_one[i-1] + movement
65     clarinet_random_walk_one.append(value)
66 clarinet_random_walk_one = [abs(x) for x in clarinet_random_walk_one]
67 clarinet_chord_one = [-5, 0, 10, 16, 18, 25, 18, 16, 10, 0 ]
68 clarinet_notes_one = [clarinet_chord_one[x] for x in reduceMod9(
    clarinet_random_walk_one)]
69
70 seed(3)
71 bassoon_random_walk_one = []
72 bassoon_random_walk_one.append(-1 if random() < 0.5 else 1)
73 for i in range(1, 1000):
74     movement = -1 if random() < 0.5 else 1
75     value = bassoon_random_walk_one[i-1] + movement
76     bassoon_random_walk_one.append(value)
77 bassoon_random_walk_one = [abs(x) for x in bassoon_random_walk_one]
78 bassoon_chord_one = [-19, -16, -5, 0, 10, 0, -5, -16 ]
79 bassoon_notes_one = [bassoon_chord_one[x] for x in reduceMod7(
    bassoon_random_walk_one)]
80
81 seed(4)
82 horn_random_walk_one = []
83 horn_random_walk_one.append(-1 if random() < 0.5 else 1)
84 for i in range(1, 1000):
85     movement = -1 if random() < 0.5 else 1
86     value = horn_random_walk_one[i-1] + movement
87     horn_random_walk_one.append(value)
88 horn_random_walk_one = [abs(x) for x in horn_random_walk_one]
89 horn_chord_one = [-19, -16, -5, 0, -5, -16 ]
90 horn_notes_one = [horn_chord_one[x] for x in reduceMod5(horn_random_walk_one)]
91
92 seed(5)
93 trumpet_random_walk_one = []
94 trumpet_random_walk_one.append(-1 if random() < 0.5 else 1)
95 for i in range(1, 1000):
96     movement = -1 if random() < 0.5 else 1
97     value = trumpet_random_walk_one[i-1] + movement
98     trumpet_random_walk_one.append(value)
99 trumpet_random_walk_one = [abs(x) for x in trumpet_random_walk_one]
100 trumpet_chord_one = [-5, 0, 10, 16, 18, 16, 10, 0 ]
101 trumpet_notes_one = [trumpet_chord_one[x] for x in reduceMod7(
    trumpet_random_walk_one)]
102
103 seed(6)
104 trombone_random_walk_one = []
105 trombone_random_walk_one.append(-1 if random() < 0.5 else 1)
106 for i in range(1, 1000):
107     movement = -1 if random() < 0.5 else 1
108     value = trombone_random_walk_one[i-1] + movement
109     trombone_random_walk_one.append(value)

```

```

110 trombone_random_walk_one = [abs(x) for x in trombone_random_walk_one]
111 trombone_chord_one = [-19, -16, -5, 0, -5, -16 ]
112 trombone_notes_one = [trombone_chord_one[x] for x in reduceMod5(
    trombone_random_walk_one)]
113
114 seed(7)
115 tuba_random_walk_one = []
116 tuba_random_walk_one.append(-1 if random() < 0.5 else 1)
117 for i in range(1, 1000):
118     movement = -1 if random() < 0.5 else 1
119     value = tuba_random_walk_one[i-1] + movement
120     tuba_random_walk_one.append(value)
121 tuba_random_walk_one = [abs(x) for x in tuba_random_walk_one]
122 tuba_chord_one = [-27, -19, -16, -5, -16, -19 ]
123 tuba_notes_one = [tuba_chord_one[x] for x in reduceMod5(tuba_random_walk_one)]
124
125 seed(8)
126 violin1_random_walk_one = []
127 violin1_random_walk_one.append(-1 if random() < 0.5 else 1)
128 for i in range(1, 1000):
129     movement = -1 if random() < 0.5 else 1
130     value = violin1_random_walk_one[i-1] + movement
131     violin1_random_walk_one.append(value)
132 violin1_random_walk_one = [abs(x) for x in violin1_random_walk_one]
133 violin1_chord_one = [-5, 0, 10, 16, 18, 25, 26, 34, 38, 34, 26, 25, 18, 16,
    10, 0 ]
134 violin1_notes_one = [violin1_chord_one[x] for x in reduceMod15(
    violin1_random_walk_one)]
135
136 seed(9)
137 violin2_random_walk_one = []
138 violin2_random_walk_one.append(-1 if random() < 0.5 else 1)
139 for i in range(1, 1000):
140     movement = -1 if random() < 0.5 else 1
141     value = violin2_random_walk_one[i-1] + movement
142     violin2_random_walk_one.append(value)
143 violin2_random_walk_one = [abs(x) for x in violin2_random_walk_one]
144 violin2_chord_one = [-5, 0, 10, 16, 18, 25, 26, 25, 18, 16, 10, 0 ]
145 violin2_notes_one = [violin2_chord_one[x] for x in reduceMod11(
    violin2_random_walk_one)]
146
147 seed(10)
148 viola_random_walk_one = []
149 viola_random_walk_one.append(-1 if random() < 0.5 else 1)
150 for i in range(1, 1000):
151     movement = -1 if random() < 0.5 else 1
152     value = viola_random_walk_one[i-1] + movement
153     viola_random_walk_one.append(value)
154 viola_random_walk_one = [abs(x) for x in viola_random_walk_one]
155 viola_chord_one = [-5, 0, 10, 16, 18, 16, 10, 0 ]
156 viola_notes_one = [viola_chord_one[x] for x in reduceMod7(
    viola_random_walk_one)]
157
158 seed(11)

```

```

159 cello_random_walk_one = []
160 cello_random_walk_one.append(-1 if random() < 0.5 else 1)
161 for i in range(1, 1000):
162     movement = -1 if random() < 0.5 else 1
163     value = cello_random_walk_one[i-1] + movement
164     cello_random_walk_one.append(value)
165 cello_random_walk_one = [abs(x) for x in cello_random_walk_one]
166 cello_chord_one = [-19, -16, -5, 0, 10, 16, 18, 16, 10, 0, -5, -16 ]
167 cello_notes_one = [cello_chord_one[x] for x in reduceMod11(
    cello_random_walk_one)]
168
169 seed(12)
170 bass_random_walk_one = []
171 bass_random_walk_one.append(-1 if random() < 0.5 else 1)
172 for i in range(1, 1000):
173     movement = -1 if random() < 0.5 else 1
174     value = bass_random_walk_one[i-1] + movement
175     bass_random_walk_one.append(value)
176 bass_random_walk_one = [abs(x) for x in bass_random_walk_one]
177 bass_chord_one = [-27, -19, -16, -5, 0, -5, -19 ]
178 bass_notes_one = [bass_chord_one[x] for x in reduceMod6(bass_random_walk_one)]
179
180 flute_scale = [18 ]
181 clarinet_scale = [0 ]
182 bassoon_scale = [-19 ]
183 horn_scale = [-19 ]
184 trumpet_scale = [18 ]
185 trombone_scale = [-0 ]
186 tuba_scale = [-19 ]
187 violin1_scale = [30, 29.5, 29, 28.5, 28, 27.5, 27, 26.5, 26, 25.5, 25, 24.5,
    24, 23.5, 23, 22.5, 22, 21.5, 21, 20.5, 20, 19.5, 19, 19.5, 20, 20.5, 21,
    21.5, 22, 22.5, 23, 23.5, 24, 24.5, 25, 25.5, 26, 26.5, 27, 27.5, 28,
    28.5, 29, 29.5, ]
188 violin2_scale = [19, 18.5, 18, 17.5, 17, 16.5, 16, 15.5, 15, 14.5, 14, 13.5,
    13, 12.5, 12, 11.5, 11, 10.5, 10, 9.5, 9, 8.5, 8, 8.5, 9, 9.5, 10, 10.5,
    11, 11.5, 12, 12.5, 13, 13.5, 14, 14.5, 15, 15.5, 16, 16.5, 17, 17.5, 18,
    18.5, ]
189 viola_scale = [8, 7.5, 7, 6.5, 6, 5.5, 5, 4.5, 4, 3.5, 3, 2.5, 2, 1.5, 1, 0.5,
    0, -0.5, -1, -1.5, -2, -2.5, -3, -2.5, -2, -1.5, -1, -0.5, 0, 0.5, 1,
    1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 5.5, 6, 6.5, 7, 7.5, ]
190 cello_scale = [-3, -3.5, -4, -4.5, -5, -5.5, -6, -6.5, -7, -7.5, -8, -8.5, -9,
    -9.5, -10, -10.5, -11, -11.5, -12, -12.5, -13, -13.5, -14, -13.5, -13,
    -12.5, -12, -11.5, -11, -10.5, -10, -9.5, -9, -8.5, -8, -7.5, -7, -6.5,
    -6, -5.5, -5, -4.5, -4, -3.5, ]
191 bass_scale = [-14, -14.5, -15, -15.5, -16, -16.5, -17, -17.5, -18, -18.5, -19,
    -19.5, -20, -20.5, -21, -21.5, -22, -22.5, -23, -23.5, -24, -24.5, -25,
    -24.5, -24, -23.5, -23, -22.5, -22, -21.5, -21, -20.5, -20, -19.5, -19,
    -18.5, -18, -17.5, -17, -16.5, -16, -15.5, -15, -14.5, ]
192
193 seed(1)
194 flute_random_walk_two = []
195 flute_random_walk_two.append(-1 if random() < 0.5 else 1)
196 for i in range(1, 1000):
197     movement = -1 if random() < 0.5 else 1

```

```

198     value = flute_random_walk_two[i-1] + movement
199     flute_random_walk_two.append(value)
200 flute_random_walk_two = [abs(x) for x in flute_random_walk_two]
201 flute_chord_two = [0, 8, 14, 18, 27, 28, 27, 18, 14, 8 ]
202 flute_notes_two = [flute_chord_two[x] for x in reduceMod9(
    flute_random_walk_two)]
203
204 seed(2)
205 clarinet_random_walk_two = []
206 clarinet_random_walk_two.append(-1 if random() < 0.5 else 1)
207 for i in range(1, 1000):
208     movement = -1 if random() < 0.5 else 1
209     value = clarinet_random_walk_two[i-1] + movement
210     clarinet_random_walk_two.append(value)
211 clarinet_random_walk_two = [abs(x) for x in clarinet_random_walk_two]
212 clarinet_chord_two = [-3, 0, 8, 14, 18, 14, 8, 0 ]
213 clarinet_notes_two = [clarinet_chord_two[x] for x in reduceMod7(
    clarinet_random_walk_two)]
214
215 seed(3)
216 bassoon_random_walk_two = []
217 bassoon_random_walk_two.append(-1 if random() < 0.5 else 1)
218 for i in range(1, 1000):
219     movement = -1 if random() < 0.5 else 1
220     value = bassoon_random_walk_two[i-1] + movement
221     bassoon_random_walk_two.append(value)
222 bassoon_random_walk_two = [abs(x) for x in bassoon_random_walk_two]
223 bassoon_chord_two = [-19, -14, -3, 0, 8, 0, -3, -14 ]
224 bassoon_notes_two = [bassoon_chord_two[x] for x in reduceMod7(
    bassoon_random_walk_two)]
225
226 seed(4)
227 horn_random_walk_two = []
228 horn_random_walk_two.append(-1 if random() < 0.5 else 1)
229 for i in range(1, 1000):
230     movement = -1 if random() < 0.5 else 1
231     value = horn_random_walk_two[i-1] + movement
232     horn_random_walk_two.append(value)
233 horn_random_walk_two = [abs(x) for x in horn_random_walk_two]
234 horn_chord_two = [-19, -14, -3, 0, 8, 0, -3, -14 ]
235 horn_notes_two = [horn_chord_two[x] for x in reduceMod7(horn_random_walk_two)]
236
237 seed(5)
238 trumpet_random_walk_two = []
239 trumpet_random_walk_two.append(-1 if random() < 0.5 else 1)
240 for i in range(1, 1000):
241     movement = -1 if random() < 0.5 else 1
242     value = trumpet_random_walk_two[i-1] + movement
243     trumpet_random_walk_two.append(value)
244 trumpet_random_walk_two = [abs(x) for x in trumpet_random_walk_two]
245 trumpet_chord_two = [-3, 0, 8, 14, 18, 14, 8, 0 ]
246 trumpet_notes_two = [trumpet_chord_two[x] for x in reduceMod7(
    trumpet_random_walk_two)]
247

```



```

248 seed(6)
249 trombone_random_walk_two = []
250 trombone_random_walk_two.append(-1 if random() < 0.5 else 1)
251 for i in range(1, 1000):
252     movement = -1 if random() < 0.5 else 1
253     value = trombone_random_walk_two[i-1] + movement
254     trombone_random_walk_two.append(value)
255 trombone_random_walk_two = [abs(x) for x in trombone_random_walk_two]
256 trombone_chord_two = [-19, -14, -3, 0, -3, -14 ]
257 trombone_notes_two = [trombone_chord_two[x] for x in reduceMod5(
    trombone_random_walk_two)]
258
259 seed(7)
260 tuba_random_walk_two = []
261 tuba_random_walk_two.append(-1 if random() < 0.5 else 1)
262 for i in range(1, 1000):
263     movement = -1 if random() < 0.5 else 1
264     value = tuba_random_walk_two[i-1] + movement
265     tuba_random_walk_two.append(value)
266 tuba_random_walk_two = [abs(x) for x in tuba_random_walk_two]
267 tuba_chord_two = [-29, -19, -14, -3, -14, -19 ]
268 tuba_notes_two = [tuba_chord_two[x] for x in reduceMod5(tuba_random_walk_two)]
269
270 seed(8)
271 violin1_random_walk_two = []
272 violin1_random_walk_two.append(-1 if random() < 0.5 else 1)
273 for i in range(1, 1000):
274     movement = -1 if random() < 0.5 else 1
275     value = violin1_random_walk_two[i-1] + movement
276     violin1_random_walk_two.append(value)
277 violin1_random_walk_two = [abs(x) for x in violin1_random_walk_two]
278 violin1_chord_two = [36, 35, 28, 27, 18, 14, 8, 0, -3, 0, 8, 14, 18, 27, 28,
    35 ]
279 violin1_notes_two = [violin1_chord_two[x] for x in reduceMod15(
    violin1_random_walk_two)]
280
281 seed(9)
282 violin2_random_walk_two = []
283 violin2_random_walk_two.append(-1 if random() < 0.5 else 1)
284 for i in range(1, 1000):
285     movement = -1 if random() < 0.5 else 1
286     value = violin2_random_walk_two[i-1] + movement
287     violin2_random_walk_two.append(value)
288 violin2_random_walk_two = [abs(x) for x in violin2_random_walk_two]
289 violin2_chord_two = [-3, 0, 8, 14, 18, 27, 18, 14, 8, 0 ]
290 violin2_notes_two = [violin2_chord_two[x] for x in reduceMod9(
    violin2_random_walk_two)]
291
292 seed(10)
293 viola_random_walk_two = []
294 viola_random_walk_two.append(-1 if random() < 0.5 else 1)
295 for i in range(1, 1000):
296     movement = -1 if random() < 0.5 else 1
297     value = viola_random_walk_two[i-1] + movement

```

```

298     viola_random_walk_two.append(value)
299 viola_random_walk_two = [abs(x) for x in viola_random_walk_two]
300 viola_chord_two = [-3, 0, 8, 14, 18, 14, 8, 0 ]
301 viola_notes_two = [viola_chord_two[x] for x in reduceMod7(
    viola_random_walk_two)]
302
303 seed(11)
304 cello_random_walk_two = []
305 cello_random_walk_two.append(-1 if random() < 0.5 else 1)
306 for i in range(1, 1000):
307     movement = -1 if random() < 0.5 else 1
308     value = cello_random_walk_two[i-1] + movement
309     cello_random_walk_two.append(value)
310 cello_random_walk_two = [abs(x) for x in cello_random_walk_two]
311 cello_chord_two = [-19, -14, -3, 0, 8, 14, 18, 14, 8, 0, -3, -14 ]
312 cello_notes_two = [cello_chord_two[x] for x in reduceMod11(
    cello_random_walk_two)]
313
314 seed(12)
315 bass_random_walk_two = []
316 bass_random_walk_two.append(-1 if random() < 0.5 else 1)
317 for i in range(1, 1000):
318     movement = -1 if random() < 0.5 else 1
319     value = bass_random_walk_two[i-1] + movement
320     bass_random_walk_two.append(value)
321 bass_random_walk_two = [abs(x) for x in bass_random_walk_two]
322 bass_chord_two = [-29, -19, -14, -3, 0, -3, -14, -19 ]
323 bass_notes_two = [bass_chord_two[x] for x in reduceMod7(bass_random_walk_two)]
324
325 rmaker_one = abjadext.rmakers.EvenDivisionRhythmMaker(
326     denominators=[16, 16, 8, 16, 4, 16, 8],
327     extra_counts_per_division=[1, 1, 0, -1, 0, 1, -1, 0],
328     burnish_specifier=abjadext.rmakers.BurnishSpecifier(
329         left_classes=[abjad.Rest],
330         left_counts=[2],
331         right_classes=[abjad.Rest],
332         right_counts=[1],
333         outer_divisions_only=True,
334     ),
335     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
336         trivialize=True,
337         extract_trivial=True,
338         rewrite_rest_filled=True,
339     ),
340 )
341
342 rmaker_two = abjadext.rmakers.IncisedRhythmMaker(
343     incise_specifier=abjadext.rmakers.InciseSpecifier(
344         prefix_talea=[-1],
345         prefix_counts=[0, 1],
346         suffix_talea=[-1],
347         suffix_counts=[1],
348         talea_denominator=16,
349     ),

```

```

350     )
351
352     rmaker_three = abjadext.rmakers.TupletRhythmMaker(
353         tuplet_ratios=[(1, 3, 2)],
354         tuplet_specifier=abjadext.rmakers.TupletSpecifier(
355             trivialize=True,
356             extract_trivial=True,
357             rewrite_rest_filled=True,
358         ),
359     )
360
361     attachment_handler_one = AttachmentHandler(
362         starting_dynamic='mf',
363         ending_dynamic='p',
364         hairpin_indicator='>',
365         articulation='tenuto',
366     )
367
368     attachment_handler_two = AttachmentHandler(
369         starting_dynamic='mp',
370         ending_dynamic='mf',
371         hairpin_indicator='<',
372         articulation='',
373     )
374
375     attachment_handler_three = AttachmentHandler(
376         starting_dynamic='pp',
377         ending_dynamic='ff',
378         hairpin_indicator='<',
379         articulation='',
380     )
381
382     #####oboe#####
383     flutemusicmaker_one = MusicMaker(
384         rmaker=rmaker_one,
385         pitches=flute_scale,
386         continuous=True,
387         attachment_handler=attachment_handler_one,
388     )
389     flutemusicmaker_two = MusicMaker(
390         rmaker=rmaker_two,
391         pitches=flute_notes_two,
392         continuous=True,
393         attachment_handler=attachment_handler_two,
394     )
395     flutemusicmaker_three = MusicMaker(
396         rmaker=rmaker_three,
397         pitches=flute_notes_one,
398         continuous=True,
399         attachment_handler=attachment_handler_three,
400     )
401     #####violin1#####
402     violin1musicmaker_one = MusicMaker(
403         rmaker=rmaker_one,

```

```

404     pitches=violin1_scale,
405     continuous=True,
406     attachment_handler=attachment_handler_one,
407 )
408 violin1musicmaker_two = MusicMaker(
409     rmaker=rmaker_two,
410     pitches=violin1_notes_two,
411     continuous=True,
412     attachment_handler=attachment_handler_two,
413 )
414 violin1musicmaker_three = MusicMaker(
415     rmaker=rmaker_three,
416     pitches=violin1_notes_one,
417     continuous=True,
418     attachment_handler=attachment_handler_three,
419 )
420 #####trumpet#####
421 trumpetmusicmaker_one = MusicMaker(
422     rmaker=rmaker_one,
423     pitches=trumpet_scale,
424     continuous=True,
425     attachment_handler=attachment_handler_one,
426 )
427 trumpetmusicmaker_two = MusicMaker(
428     rmaker=rmaker_two,
429     pitches=trumpet_notes_two,
430     continuous=True,
431     attachment_handler=attachment_handler_two,
432 )
433 trumpetmusicmaker_three = MusicMaker(
434     rmaker=rmaker_three,
435     pitches=trumpet_notes_one,
436     continuous=True,
437     attachment_handler=attachment_handler_three,
438 )
439 #####clarinet#####
440 clarinetmusicmaker_one = MusicMaker(
441     rmaker=rmaker_one,
442     pitches=clarinet_scale,
443     continuous=True,
444     attachment_handler=attachment_handler_one,
445 )
446 clarinetmusicmaker_two = MusicMaker(
447     rmaker=rmaker_two,
448     pitches=clarinet_notes_two,
449     continuous=True,
450     attachment_handler=attachment_handler_two,
451 )
452 clarinetmusicmaker_three = MusicMaker(
453     rmaker=rmaker_three,
454     pitches=clarinet_notes_one,
455     continuous=True,
456     attachment_handler=attachment_handler_three,
457 )

```

```

458 #####violin2#####
459 violin2musicmaker_one = MusicMaker(
460     rmaker=rmaker_one,
461     pitches=violin2_scale,
462     continuous=True,
463     attachment_handler=attachment_handler_one,
464 )
465 violin2musicmaker_two = MusicMaker(
466     rmaker=rmaker_two,
467     pitches=violin2_notes_two,
468     continuous=True,
469     attachment_handler=attachment_handler_two,
470 )
471 violin2musicmaker_three = MusicMaker(
472     rmaker=rmaker_three,
473     pitches=violin2_notes_one,
474     continuous=True,
475     attachment_handler=attachment_handler_three,
476 )
477 #####viola#####
478 violamusicmaker_one = MusicMaker(
479     rmaker=rmaker_one,
480     pitches=viola_scale,
481     continuous=True,
482     attachment_handler=attachment_handler_one,
483 )
484 violamusicmaker_two = MusicMaker(
485     rmaker=rmaker_two,
486     pitches=viola_notes_two,
487     continuous=True,
488     attachment_handler=attachment_handler_two,
489 )
490 violamusicmaker_three = MusicMaker(
491     rmaker=rmaker_three,
492     pitches=viola_notes_one,
493     continuous=True,
494     attachment_handler=attachment_handler_three,
495 )
496 #####bassoon#####
497 bassoonmusicmaker_one = MusicMaker(
498     rmaker=rmaker_one,
499     pitches=bassoon_scale,
500     continuous=True,
501     attachment_handler=attachment_handler_one,
502 )
503 bassoonmusicmaker_two = MusicMaker(
504     rmaker=rmaker_two,
505     pitches=bassoon_notes_two,
506     continuous=True,
507     attachment_handler=attachment_handler_two,
508 )
509 bassoonmusicmaker_three = MusicMaker(
510     rmaker=rmaker_three,
511     pitches=bassoon_notes_one,

```

```

s12     continuous=True,
s13     attachment_handler=attachment_handler_three,
s14 )
s15 #####trombone#####
s16 trombonemusicmaker_one = MusicMaker(
s17     rmaker=rmaker_one,
s18     pitches=trombone_scale,
s19     continuous=True,
s20     attachment_handler=attachment_handler_one,
s21 )
s22 trombonemusicmaker_two = MusicMaker(
s23     rmaker=rmaker_two,
s24     pitches=trombone_notes_two,
s25     continuous=True,
s26     attachment_handler=attachment_handler_two,
s27 )
s28 trombonemusicmaker_three = MusicMaker(
s29     rmaker=rmaker_three,
s30     pitches=trombone_notes_one,
s31     continuous=True,
s32     attachment_handler=attachment_handler_three,
s33 )
s34 #####cello#####
s35 cellomusicmaker_one = MusicMaker(
s36     rmaker=rmaker_one,
s37     pitches=cello_scale,
s38     continuous=True,
s39     attachment_handler=attachment_handler_one,
s40 )
s41 cellomusicmaker_two = MusicMaker(
s42     rmaker=rmaker_two,
s43     pitches=cello_notes_two,
s44     continuous=True,
s45     attachment_handler=attachment_handler_two,
s46 )
s47 cellomusicmaker_three = MusicMaker(
s48     rmaker=rmaker_three,
s49     pitches=cello_notes_one,
s50     continuous=True,
s51     attachment_handler=attachment_handler_three,
s52 )
s53 #####horn#####
s54 hornmusicmaker_one = MusicMaker(
s55     rmaker=rmaker_one,
s56     pitches=horn_scale,
s57     continuous=True,
s58     attachment_handler=attachment_handler_one,
s59 )
s60 hornmusicmaker_two = MusicMaker(
s61     rmaker=rmaker_two,
s62     pitches=horn_notes_two,
s63     continuous=True,
s64     attachment_handler=attachment_handler_two,
s65 )

```

```

566 hornmusicmaker_three = MusicMaker(
567     rmaker=rmaker_three,
568     pitches=horn_notes_one,
569     continuous=True,
570     attachment_handler=attachment_handler_three,
571 )
572 #####tuba#####
573 tubamusicmaker_one = MusicMaker(
574     rmaker=rmaker_one,
575     pitches=tuba_scale,
576     continuous=True,
577     attachment_handler=attachment_handler_one,
578 )
579 tubamusicmaker_two = MusicMaker(
580     rmaker=rmaker_two,
581     pitches=tuba_notes_two,
582     continuous=True,
583     attachment_handler=attachment_handler_two,
584 )
585 tubamusicmaker_three = MusicMaker(
586     rmaker=rmaker_three,
587     pitches=tuba_notes_one,
588     continuous=True,
589     attachment_handler=attachment_handler_three,
590 )
591 #####bass#####
592 bassmusicmaker_one = MusicMaker(
593     rmaker=rmaker_one,
594     pitches=bass_scale,
595     continuous=True,
596     attachment_handler=attachment_handler_one,
597 )
598 bassmusicmaker_two = MusicMaker(
599     rmaker=rmaker_two,
600     pitches=bass_notes_two,
601     continuous=True,
602     attachment_handler=attachment_handler_two,
603 )
604 bassmusicmaker_three = MusicMaker(
605     rmaker=rmaker_three,
606     pitches=bass_notes_one,
607     continuous=True,
608     attachment_handler=attachment_handler_three,
609 )
610
611 silence_maker = abjadext.rmakers.NoteRhythmMaker(
612     division_masks=[
613         abjadext.rmakers.SilenceMask(
614             pattern=abjad.index([0], 1),
615         ),
616     ],
617 )
618
619 class MusicSpecifier:

```

```

620
621     def __init__(self, music_maker, voice_name):
622         self.music_maker = music_maker
623         self.voice_name = voice_name
624
625     print('Collecting timespans and rmakers ...')
626     ###group one###
627     voice_1_timespan_list = abjad.TimespanList([
628         abjad.AnnotatedTimespan(
629             start_offset=start_offset,
630             stop_offset=stop_offset,
631             annotation=MusicSpecifier(
632                 music_maker=music_maker,
633                 voice_name='Voice 1',
634             ),
635         )
636     for start_offset, stop_offset, music_maker in [
637         [(9, 4), (10, 4), flutemusicmaker_one],
638         [(15, 4), (18, 4), flutemusicmaker_two],
639         [(22, 4), (25, 4), flutemusicmaker_three],
640         [(27, 4), (30, 4), flutemusicmaker_one],
641         [(30, 4), (32, 4), flutemusicmaker_one],
642         [(35, 4), (39, 4), flutemusicmaker_two],
643         [(42, 4), (43, 4), flutemusicmaker_three],
644         [(43, 4), (44, 4), flutemusicmaker_three],
645         [(45, 4), (46, 4), flutemusicmaker_one],
646         [(46, 4), (50, 4), flutemusicmaker_one],
647         [(54, 4), (57, 4), flutemusicmaker_two],
648         [(59, 4), (60, 4), flutemusicmaker_three],
649         [(65, 4), (67, 4), flutemusicmaker_one],
650         [(67, 4), (69, 4), flutemusicmaker_one],
651         [(70, 4), (72, 4), flutemusicmaker_two],
652         [(72, 4), (75, 4), flutemusicmaker_two],
653         [(76, 4), (78, 4), flutemusicmaker_three],
654         [(81, 4), (82, 4), flutemusicmaker_one],
655         [(82, 4), (85, 4), flutemusicmaker_one],
656         [(90, 4), (91, 4), flutemusicmaker_two],
657         [(93, 4), (94, 4), flutemusicmaker_three],
658         [(94, 4), (96, 4), flutemusicmaker_three],
659         [(100, 4), (104, 4), flutemusicmaker_one],
660         [(104, 4), (105, 4), flutemusicmaker_one],
661         [(106, 4), (107, 4), flutemusicmaker_two],
662         [(107, 4), (108, 4), flutemusicmaker_two],
663         [(111, 4), (114, 4), flutemusicmaker_one],
664         [(114, 4), (115, 4), flutemusicmaker_one],
665         [(116, 4), (119, 4), flutemusicmaker_one],
666         [(119, 4), (120, 4), flutemusicmaker_one],
667         [(121, 4), (123, 4), flutemusicmaker_one],
668         [(123, 4), (125, 4), flutemusicmaker_one],
669         [(126, 4), (131, 4), flutemusicmaker_two],
670         [(131, 4), (133, 4), flutemusicmaker_two],
671         [(136, 4), (141, 4), flutemusicmaker_two],
672         [(148, 4), (150, 4), flutemusicmaker_two],
673         [(150, 4), (153, 4), flutemusicmaker_three],

```



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674         [(155, 4), (159, 4), flutemusicmaker_three],
675         [(162, 4), (164, 4), flutemusicmaker_three],
676         [(168, 4), (171, 4), flutemusicmaker_three],
677         [(173, 4), (175, 4), flutemusicmaker_three],
678         [(175, 4), (177, 4), flutemusicmaker_three],
679         [(180, 4), (182, 4), flutemusicmaker_three],
680         [(186, 4), (190, 4), flutemusicmaker_three],
681         [(190, 4), (191, 4), silence_maker],
682     ]
683 ])
684
685 voice_5_timespan_list = abjad.TimespanList([
686     abjad.AnnotatedTimespan(
687         start_offset=start_offset,
688         stop_offset=stop_offset,
689         annotation=MusicSpecifier(
690             music_maker=music_maker,
691             voice_name='Voice 5',
692         ),
693     )
694     for start_offset, stop_offset, music_maker in [
695         [(9, 4), (10, 4), trumpetmusicmaker_one],
696         [(14, 4), (18, 4), trumpetmusicmaker_two],
697         [(23, 4), (25, 4), trumpetmusicmaker_three],
698         [(27, 4), (30, 4), trumpetmusicmaker_one],
699         [(30, 4), (32, 4), trumpetmusicmaker_one],
700         [(35, 4), (39, 4), trumpetmusicmaker_two],
701         [(42, 4), (43, 4), trumpetmusicmaker_three],
702         [(43, 4), (44, 4), trumpetmusicmaker_three],
703         [(45, 4), (46, 4), trumpetmusicmaker_one],
704         [(46, 4), (50, 4), trumpetmusicmaker_one],
705         [(54, 4), (57, 4), trumpetmusicmaker_two],
706         [(59, 4), (60, 4), trumpetmusicmaker_three],
707         [(65, 4), (67, 4), trumpetmusicmaker_one],
708         [(67, 4), (69, 4), trumpetmusicmaker_one],
709         [(70, 4), (72, 4), trumpetmusicmaker_two],
710         [(72, 4), (75, 4), trumpetmusicmaker_two],
711         [(76, 4), (78, 4), trumpetmusicmaker_three],
712         [(81, 4), (82, 4), trumpetmusicmaker_one],
713         [(82, 4), (85, 4), trumpetmusicmaker_one],
714         [(90, 4), (91, 4), trumpetmusicmaker_two],
715         [(93, 4), (94, 4), trumpetmusicmaker_three],
716         [(94, 4), (96, 4), trumpetmusicmaker_three],
717         [(100, 4), (104, 4), trumpetmusicmaker_one],
718         [(104, 4), (105, 4), trumpetmusicmaker_one],
719         [(106, 4), (107, 4), trumpetmusicmaker_two],
720         [(107, 4), (108, 4), trumpetmusicmaker_two],
721         [(111, 4), (114, 4), trumpetmusicmaker_one],
722         [(114, 4), (115, 4), trumpetmusicmaker_one],
723         [(116, 4), (119, 4), trumpetmusicmaker_one],
724         [(119, 4), (120, 4), trumpetmusicmaker_one],
725         [(121, 4), (123, 4), trumpetmusicmaker_one],
726         [(123, 4), (125, 4), trumpetmusicmaker_one],
727         [(126, 4), (131, 4), trumpetmusicmaker_two],

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728     [(131, 4), (133, 4), trumpetmusicmaker_two],
729     [(136, 4), (141, 4), trumpetmusicmaker_two],
730     [(148, 4), (150, 4), trumpetmusicmaker_two],
731     [(150, 4), (154, 4), trumpetmusicmaker_three],
732     [(157, 4), (159, 4), trumpetmusicmaker_three],
733     [(163, 4), (164, 4), trumpetmusicmaker_three],
734     [(164, 4), (166, 4), trumpetmusicmaker_three],
735     [(168, 4), (172, 4), trumpetmusicmaker_three],
736     [(175, 4), (177, 4), trumpetmusicmaker_three],
737     [(181, 4), (183, 4), trumpetmusicmaker_three],
738     [(183, 4), (184, 4), trumpetmusicmaker_three],
739     [(186, 4), (190, 4), trumpetmusicmaker_three],
740 ]
741 ])
742
743 voice_8_timespan_list = abjad.TimespanList([
744     abjad.AnnotatedTimespan(
745         start_offset=start_offset,
746         stop_offset=stop_offset,
747         annotation=MusicSpecifier(
748             music_maker=music_maker,
749             voice_name='Voice 8',
750         ),
751     )
752     for start_offset, stop_offset, music_maker in [
753         [(9, 4), (10, 4), violin1musicmaker_one],
754         [(14, 4), (18, 4), violin1musicmaker_two],
755         [(22, 4), (25, 4), violin1musicmaker_three],
756         [(27, 4), (30, 4), violin1musicmaker_one],
757         [(35, 4), (39, 4), violin1musicmaker_two],
758         [(42, 4), (43, 4), violin1musicmaker_three],
759         [(43, 4), (44, 4), violin1musicmaker_three],
760         [(45, 4), (46, 4), violin1musicmaker_one],
761         [(46, 4), (50, 4), violin1musicmaker_one],
762         [(54, 4), (57, 4), violin1musicmaker_two],
763         [(59, 4), (60, 4), violin1musicmaker_three],
764         [(65, 4), (67, 4), violin1musicmaker_one],
765         [(67, 4), (69, 4), violin1musicmaker_one],
766         [(70, 4), (72, 4), violin1musicmaker_two],
767         [(72, 4), (75, 4), violin1musicmaker_two],
768         [(76, 4), (78, 4), violin1musicmaker_three],
769         [(81, 4), (82, 4), violin1musicmaker_one],
770         [(82, 4), (85, 4), violin1musicmaker_one],
771         [(90, 4), (91, 4), violin1musicmaker_two],
772         [(93, 4), (94, 4), violin1musicmaker_three],
773         [(94, 4), (96, 4), violin1musicmaker_three],
774         [(100, 4), (104, 4), violin1musicmaker_one],
775         [(104, 4), (105, 4), violin1musicmaker_one],
776         [(106, 4), (107, 4), violin1musicmaker_two],
777         [(107, 4), (108, 4), violin1musicmaker_two],
778         [(111, 4), (114, 4), violin1musicmaker_one],
779         [(114, 4), (115, 4), violin1musicmaker_one],
780         [(116, 4), (119, 4), violin1musicmaker_one],
781         [(119, 4), (120, 4), violin1musicmaker_one],

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782     [(121, 4), (123, 4), violin1musicmaker_one],
783     [(123, 4), (125, 4), violin1musicmaker_one],
784     [(126, 4), (131, 4), violin1musicmaker_two],
785     [(131, 4), (133, 4), violin1musicmaker_two],
786     [(136, 4), (141, 4), violin1musicmaker_two],
787     [(148, 4), (150, 4), violin1musicmaker_two],
788     [(150, 4), (152, 4), violin1musicmaker_three],
789     [(156, 4), (159, 4), violin1musicmaker_three],
790     [(161, 4), (164, 4), violin1musicmaker_three],
791     [(164, 4), (165, 4), violin1musicmaker_three],
792     [(168, 4), (170, 4), violin1musicmaker_three],
793     [(174, 4), (175, 4), violin1musicmaker_three],
794     [(175, 4), (177, 4), violin1musicmaker_three],
795     [(179, 4), (183, 4), violin1musicmaker_three],
796     [(186, 4), (190, 4), violin1musicmaker_three],
797 ]
798 ])
799
800 ###group two###
801 voice_2_timespan_list = abjad.TimespanList([
802     abjad.AnnotatedTimespan(
803         start_offset=start_offset,
804         stop_offset=stop_offset,
805         annotation=MusicSpecifier(
806             music_maker=music_maker,
807             voice_name='Voice 2',
808         ),
809     )
810     for start_offset, stop_offset, music_maker in [
811         [(2, 4), (5, 4), clarinetmusicmaker_one],
812         [(10, 4), (11, 4), clarinetmusicmaker_two],
813         [(11, 4), (13, 4), clarinetmusicmaker_two],
814         [(16, 4), (18, 4), clarinetmusicmaker_three],
815         [(21, 4), (22, 4), clarinetmusicmaker_one],
816         [(22, 4), (25, 4), clarinetmusicmaker_one],
817         [(35, 4), (40, 4), clarinetmusicmaker_one],
818         [(44, 4), (46, 4), clarinetmusicmaker_two],
819         [(46, 4), (47, 4), clarinetmusicmaker_two],
820         [(49, 4), (50, 4), clarinetmusicmaker_three],
821         [(55, 4), (59, 4), clarinetmusicmaker_one],
822         [(62, 4), (64, 4), clarinetmusicmaker_two],
823         [(65, 4), (67, 4), clarinetmusicmaker_three],
824         [(67, 4), (70, 4), clarinetmusicmaker_three],
825         [(70, 4), (71, 4), clarinetmusicmaker_three],
826         [(73, 4), (75, 4), clarinetmusicmaker_two],
827         [(75, 4), (76, 4), clarinetmusicmaker_two],
828         [(80, 4), (82, 4), clarinetmusicmaker_one],
829         [(82, 4), (85, 4), clarinetmusicmaker_one],
830         [(86, 4), (88, 4), clarinetmusicmaker_two],
831         [(91, 4), (94, 4), clarinetmusicmaker_three],
832         [(94, 4), (95, 4), clarinetmusicmaker_three],
833         [(100, 4), (101, 4), clarinetmusicmaker_two],
834         [(103, 4), (104, 4), clarinetmusicmaker_one],
835         [(104, 4), (106, 4), clarinetmusicmaker_one],

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836         [(110, 4), (114, 4), clarinetmusicmaker_one],
837         [(115, 4), (119, 4), clarinetmusicmaker_one],
838         [(120, 4), (123, 4), clarinetmusicmaker_one],
839         [(123, 4), (124, 4), clarinetmusicmaker_one],
840         [(125, 4), (126, 4), clarinetmusicmaker_two],
841         [(129, 4), (131, 4), clarinetmusicmaker_two],
842         [(131, 4), (134, 4), clarinetmusicmaker_two],
843         [(141, 4), (144, 4), clarinetmusicmaker_two],
844         [(149, 4), (150, 4), clarinetmusicmaker_two],
845         [(155, 4), (159, 4), clarinetmusicmaker_three],
846         [(162, 4), (164, 4), clarinetmusicmaker_three],
847         [(165, 4), (168, 4), clarinetmusicmaker_three],
848         [(168, 4), (170, 4), clarinetmusicmaker_three],
849         [(174, 4), (175, 4), clarinetmusicmaker_three],
850         [(175, 4), (177, 4), clarinetmusicmaker_three],
851         [(179, 4), (180, 4), clarinetmusicmaker_three],
852         [(185, 4), (186, 4), clarinetmusicmaker_three],
853         [(186, 4), (190, 4), clarinetmusicmaker_three],
854     ]
855 ]])
856
857 voice_9_timespan_list = abjad.TimespanList([
858     abjad.AnnotatedTimespan(
859         start_offset=start_offset,
860         stop_offset=stop_offset,
861         annotation=MusicSpecifier(
862             music_maker=music_maker,
863             voice_name='Voice 9',
864         ),
865     )
866     for start_offset, stop_offset, music_maker in [
867         [(2, 4), (5, 4), violin2musicmaker_one],
868         [(9, 4), (11, 4), violin2musicmaker_two],
869         [(11, 4), (13, 4), violin2musicmaker_two],
870         [(16, 4), (18, 4), violin2musicmaker_three],
871         [(21, 4), (22, 4), violin2musicmaker_one],
872         [(22, 4), (23, 4), violin2musicmaker_one],
873         [(35, 4), (40, 4), violin2musicmaker_one],
874         [(44, 4), (46, 4), violin2musicmaker_two],
875         [(46, 4), (47, 4), violin2musicmaker_two],
876         [(49, 4), (50, 4), violin2musicmaker_three],
877         [(55, 4), (59, 4), violin2musicmaker_one],
878         [(62, 4), (64, 4), violin2musicmaker_two],
879         [(65, 4), (67, 4), violin2musicmaker_three],
880         [(67, 4), (70, 4), violin2musicmaker_three],
881         [(70, 4), (71, 4), violin2musicmaker_three],
882         [(73, 4), (75, 4), violin2musicmaker_two],
883         [(75, 4), (76, 4), violin2musicmaker_two],
884         [(80, 4), (82, 4), violin2musicmaker_one],
885         [(82, 4), (85, 4), violin2musicmaker_one],
886         [(86, 4), (88, 4), violin2musicmaker_two],
887         [(91, 4), (94, 4), violin2musicmaker_three],
888         [(94, 4), (95, 4), violin2musicmaker_three],
889         [(100, 4), (101, 4), violin2musicmaker_two],

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890     [(103, 4), (104, 4), violin2musicmaker_one],
891     [(104, 4), (106, 4), violin2musicmaker_one],
892     [(110, 4), (114, 4), violin2musicmaker_one],
893     [(115, 4), (119, 4), violin2musicmaker_one],
894     [(120, 4), (123, 4), violin2musicmaker_one],
895     [(123, 4), (124, 4), violin2musicmaker_one],
896     [(125, 4), (126, 4), violin2musicmaker_two],
897     [(129, 4), (131, 4), violin2musicmaker_two],
898     [(131, 4), (134, 4), violin2musicmaker_two],
899     [(141, 4), (144, 4), violin2musicmaker_two],
900     [(149, 4), (150, 4), violin2musicmaker_two],
901     [(154, 4), (157, 4), violin2musicmaker_three],
902     [(159, 4), (160, 4), violin2musicmaker_three],
903     [(165, 4), (168, 4), violin2musicmaker_three],
904     [(168, 4), (169, 4), violin2musicmaker_three],
905     [(172, 4), (174, 4), violin2musicmaker_three],
906     [(175, 4), (179, 4), violin2musicmaker_three],
907     [(179, 4), (180, 4), violin2musicmaker_three],
908     [(184, 4), (186, 4), violin2musicmaker_three],
909     [(186, 4), (190, 4), violin2musicmaker_three],
910 ]
911 ])
912
913 voice_10_timespan_list = abjad.TimespanList([
914     abjad.AnnotatedTimespan(
915         start_offset=start_offset,
916         stop_offset=stop_offset,
917         annotation=MusicSpecifier(
918             music_maker=music_maker,
919             voice_name='Voice 10',
920         ),
921     )
922     for start_offset, stop_offset, music_maker in [
923         [(2, 4), (5, 4), violamusicmaker_one],
924         [(9, 4), (11, 4), violamusicmaker_two],
925         [(11, 4), (13, 4), violamusicmaker_two],
926         [(17, 4), (18, 4), violamusicmaker_three],
927         [(21, 4), (22, 4), violamusicmaker_one],
928         [(22, 4), (25, 4), violamusicmaker_one],
929         [(29, 4), (30, 4), violamusicmaker_two],
930         [(30, 4), (32, 4), violamusicmaker_two],
931         [(35, 4), (40, 4), violamusicmaker_one],
932         [(44, 4), (46, 4), violamusicmaker_two],
933         [(46, 4), (47, 4), violamusicmaker_two],
934         [(49, 4), (50, 4), violamusicmaker_three],
935         [(55, 4), (59, 4), violamusicmaker_one],
936         [(62, 4), (64, 4), violamusicmaker_two],
937         [(65, 4), (67, 4), violamusicmaker_three],
938         [(67, 4), (70, 4), violamusicmaker_three],
939         [(70, 4), (71, 4), violamusicmaker_three],
940         [(73, 4), (75, 4), violamusicmaker_two],
941         [(75, 4), (76, 4), violamusicmaker_two],
942         [(80, 4), (82, 4), violamusicmaker_one],
943         [(82, 4), (85, 4), violamusicmaker_one],

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944     [(86, 4), (88, 4), violamusicmaker_two],
945     [(91, 4), (94, 4), violamusicmaker_three],
946     [(94, 4), (95, 4), violamusicmaker_three],
947     [(100, 4), (101, 4), violamusicmaker_two],
948     [(103, 4), (104, 4), violamusicmaker_one],
949     [(104, 4), (106, 4), violamusicmaker_one],
950     [(110, 4), (114, 4), violamusicmaker_one],
951     [(115, 4), (119, 4), violamusicmaker_one],
952     [(120, 4), (123, 4), violamusicmaker_one],
953     [(123, 4), (124, 4), violamusicmaker_one],
954     [(125, 4), (126, 4), violamusicmaker_two],
955     [(129, 4), (131, 4), violamusicmaker_two],
956     [(131, 4), (134, 4), violamusicmaker_two],
957     [(141, 4), (144, 4), violamusicmaker_two],
958     [(149, 4), (150, 4), violamusicmaker_two],
959     [(153, 4), (154, 4), violamusicmaker_three],
960     [(154, 4), (155, 4), violamusicmaker_three],
961     [(156, 4), (159, 4), violamusicmaker_three],
962     [(159, 4), (161, 4), violamusicmaker_three],
963     [(165, 4), (168, 4), violamusicmaker_three],
964     [(170, 4), (171, 4), violamusicmaker_three],
965     [(176, 4), (179, 4), violamusicmaker_three],
966     [(179, 4), (180, 4), violamusicmaker_three],
967     [(183, 4), (185, 4), violamusicmaker_three],
968     [(186, 4), (190, 4), violamusicmaker_three],
969 ]
970 ])
971
972 ###group three###
973 voice_3_timespan_list = abjad.TimespanList([
974     abjad.AnnotatedTimespan(
975         start_offset=start_offset,
976         stop_offset=stop_offset,
977         annotation=MusicSpecifier(
978             music_maker=music_maker,
979             voice_name='Voice 3',
980         ),
981     )
982     for start_offset, stop_offset, music_maker in [
983         [(7, 4), (11, 4), bassoonmusicmaker_one],
984         [(15, 4), (16, 4), bassoonmusicmaker_two],
985         [(19, 4), (22, 4), bassoonmusicmaker_three],
986         [(22, 4), (23, 4), bassoonmusicmaker_three],
987         [(27, 4), (30, 4), bassoonmusicmaker_one],
988         [(32, 4), (35, 4), bassoonmusicmaker_two],
989         [(35, 4), (36, 4), bassoonmusicmaker_three],
990         [(37, 4), (40, 4), bassoonmusicmaker_two],
991         [(40, 4), (42, 4), bassoonmusicmaker_two],
992         [(46, 4), (49, 4), bassoonmusicmaker_one],
993         [(51, 4), (52, 4), bassoonmusicmaker_three],
994         [(57, 4), (59, 4), bassoonmusicmaker_two],
995         [(59, 4), (61, 4), bassoonmusicmaker_two],
996         [(64, 4), (66, 4), bassoonmusicmaker_one],
997         [(67, 4), (70, 4), bassoonmusicmaker_three],

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998     [(70, 4), (72, 4), bassoonmusicmaker_one],
999     [(72, 4), (73, 4), bassoonmusicmaker_one],
1000    [(77, 4), (79, 4), bassoonmusicmaker_two],
1001    [(79, 4), (82, 4), bassoonmusicmaker_two],
1002    [(83, 4), (85, 4), bassoonmusicmaker_three],
1003    [(88, 4), (89, 4), bassoonmusicmaker_two],
1004    [(89, 4), (92, 4), bassoonmusicmaker_two],
1005    [(97, 4), (98, 4), bassoonmusicmaker_one],
1006    [(100, 4), (103, 4), bassoonmusicmaker_two],
1007    [(107, 4), (110, 4), bassoonmusicmaker_three],
1008    [(110, 4), (112, 4), bassoonmusicmaker_one],
1009    [(113, 4), (114, 4), bassoonmusicmaker_one],
1010    [(114, 4), (117, 4), bassoonmusicmaker_one],
1011    [(118, 4), (119, 4), bassoonmusicmaker_one],
1012    [(119, 4), (122, 4), bassoonmusicmaker_one],
1013    [(123, 4), (125, 4), bassoonmusicmaker_one],
1014    [(126, 4), (131, 4), bassoonmusicmaker_two],
1015    [(138, 4), (141, 4), bassoonmusicmaker_two],
1016    [(146, 4), (150, 4), bassoonmusicmaker_two],
1017    [(150, 4), (154, 4), bassoonmusicmaker_three],
1018    [(154, 4), (155, 4), bassoonmusicmaker_three],
1019    [(159, 4), (162, 4), bassoonmusicmaker_three],
1020    [(164, 4), (165, 4), bassoonmusicmaker_three],
1021    [(170, 4), (172, 4), bassoonmusicmaker_three],
1022    [(172, 4), (174, 4), bassoonmusicmaker_three],
1023    [(177, 4), (179, 4), bassoonmusicmaker_three],
1024    [(180, 4), (183, 4), bassoonmusicmaker_three],
1025    [(183, 4), (185, 4), bassoonmusicmaker_three],
1026    [(186, 4), (190, 4), bassoonmusicmaker_three],
1027 ]
1028 ])
1029
1030 voice_6_timespan_list = abjad.TimespanList([
1031     abjad.AnnotatedTimespan(
1032         start_offset=start_offset,
1033         stop_offset=stop_offset,
1034         annotation=MusicSpecifier(
1035             music_maker=music_maker,
1036             voice_name='Voice 6',
1037         ),
1038     )
1039     for start_offset, stop_offset, music_maker in [
1040         [(7, 4), (11, 4), trombonemusicmaker_one],
1041         [(14, 4), (16, 4), trombonemusicmaker_two],
1042         [(19, 4), (22, 4), trombonemusicmaker_three],
1043         [(22, 4), (23, 4), trombonemusicmaker_three],
1044         [(27, 4), (29, 4), trombonemusicmaker_one],
1045         [(35, 4), (36, 4), trombonemusicmaker_three],
1046         [(37, 4), (40, 4), trombonemusicmaker_two],
1047         [(40, 4), (42, 4), trombonemusicmaker_two],
1048         [(46, 4), (49, 4), trombonemusicmaker_one],
1049         [(51, 4), (52, 4), trombonemusicmaker_three],
1050         [(57, 4), (59, 4), trombonemusicmaker_two],
1051         [(59, 4), (61, 4), trombonemusicmaker_two],

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1052     [(64, 4), (66, 4), trombonemusicmaker_one],
1053     [(67, 4), (70, 4), trombonemusicmaker_three],
1054     [(70, 4), (72, 4), trombonemusicmaker_one],
1055     [(72, 4), (73, 4), trombonemusicmaker_one],
1056     [(77, 4), (79, 4), trombonemusicmaker_two],
1057     [(79, 4), (82, 4), trombonemusicmaker_two],
1058     [(83, 4), (85, 4), trombonemusicmaker_three],
1059     [(88, 4), (89, 4), trombonemusicmaker_two],
1060     [(89, 4), (92, 4), trombonemusicmaker_two],
1061     [(97, 4), (98, 4), trombonemusicmaker_one],
1062     [(100, 4), (103, 4), trombonemusicmaker_two],
1063     [(107, 4), (110, 4), trombonemusicmaker_three],
1064     [(110, 4), (112, 4), trombonemusicmaker_one],
1065     [(113, 4), (114, 4), trombonemusicmaker_one],
1066     [(114, 4), (117, 4), trombonemusicmaker_one],
1067     [(118, 4), (119, 4), trombonemusicmaker_one],
1068     [(119, 4), (122, 4), trombonemusicmaker_one],
1069     [(123, 4), (125, 4), trombonemusicmaker_one],
1070     [(126, 4), (131, 4), trombonemusicmaker_two],
1071     [(138, 4), (141, 4), trombonemusicmaker_two],
1072     [(146, 4), (150, 4), trombonemusicmaker_two],
1073     [(150, 4), (154, 4), trombonemusicmaker_three],
1074     [(157, 4), (159, 4), trombonemusicmaker_three],
1075     [(160, 4), (164, 4), trombonemusicmaker_three],
1076     [(164, 4), (165, 4), trombonemusicmaker_three],
1077     [(169, 4), (172, 4), trombonemusicmaker_three],
1078     [(174, 4), (175, 4), trombonemusicmaker_three],
1079     [(180, 4), (183, 4), trombonemusicmaker_three],
1080     [(183, 4), (184, 4), trombonemusicmaker_three],
1081     [(186, 4), (190, 4), trombonemusicmaker_three],
1082 ]
1083 ])
1084
1085 voice_11_timespan_list = abjad.TimespanList([
1086     abjad.AnnotatedTimespan(
1087         start_offset=start_offset,
1088         stop_offset=stop_offset,
1089         annotation=MusicSpecifier(
1090             music_maker=music_maker,
1091             voice_name='Voice 11',
1092         ),
1093     )
1094     for start_offset, stop_offset, music_maker in [
1095         [(7, 4), (11, 4), cellomusicmaker_one],
1096         [(14, 4), (16, 4), cellomusicmaker_two],
1097         [(21, 4), (22, 4), cellomusicmaker_three],
1098         [(22, 4), (23, 4), cellomusicmaker_three],
1099         [(27, 4), (30, 4), cellomusicmaker_one],
1100         [(35, 4), (36, 4), cellomusicmaker_three],
1101         [(37, 4), (40, 4), cellomusicmaker_two],
1102         [(40, 4), (42, 4), cellomusicmaker_two],
1103         [(46, 4), (49, 4), cellomusicmaker_one],
1104         [(51, 4), (52, 4), cellomusicmaker_three],
1105         [(57, 4), (59, 4), cellomusicmaker_two],

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1106 [(59, 4), (61, 4), cellomusicmaker_two],
1107 [(64, 4), (66, 4), cellomusicmaker_one],
1108 [(67, 4), (70, 4), cellomusicmaker_three],
1109 [(70, 4), (72, 4), cellomusicmaker_one],
1110 [(72, 4), (73, 4), cellomusicmaker_one],
1111 [(77, 4), (79, 4), cellomusicmaker_two],
1112 [(79, 4), (82, 4), cellomusicmaker_two],
1113 [(83, 4), (85, 4), cellomusicmaker_three],
1114 [(88, 4), (89, 4), cellomusicmaker_two],
1115 [(89, 4), (92, 4), cellomusicmaker_two],
1116 [(97, 4), (98, 4), cellomusicmaker_one],
1117 [(100, 4), (103, 4), cellomusicmaker_two],
1118 [(107, 4), (110, 4), cellomusicmaker_three],
1119 [(110, 4), (112, 4), cellomusicmaker_one],
1120 [(113, 4), (114, 4), cellomusicmaker_one],
1121 [(114, 4), (117, 4), cellomusicmaker_one],
1122 [(118, 4), (119, 4), cellomusicmaker_one],
1123 [(119, 4), (122, 4), cellomusicmaker_one],
1124 [(123, 4), (125, 4), cellomusicmaker_one],
1125 [(126, 4), (131, 4), cellomusicmaker_two],
1126 [(138, 4), (141, 4), cellomusicmaker_two],
1127 [(146, 4), (150, 4), cellomusicmaker_two],
1128 [(150, 4), (153, 4), cellomusicmaker_three],
1129 [(155, 4), (156, 4), cellomusicmaker_three],
1130 [(161, 4), (164, 4), cellomusicmaker_three],
1131 [(164, 4), (165, 4), cellomusicmaker_three],
1132 [(168, 4), (170, 4), cellomusicmaker_three],
1133 [(171, 4), (172, 4), cellomusicmaker_three],
1134 [(172, 4), (175, 4), cellomusicmaker_three],
1135 [(175, 4), (176, 4), cellomusicmaker_three],
1136 [(180, 4), (183, 4), cellomusicmaker_three],
1137 [(185, 4), (186, 4), cellomusicmaker_three],
1138 [(186, 4), (190, 4), cellomusicmaker_three],
1139 ]
1140 ])
1141
1142 ###group four###
1143 voice_4_timespan_list = abjad.TimespanList([
1144     abjad.AnnotatedTimespan(
1145         start_offset=start_offset,
1146         stop_offset=stop_offset,
1147         annotation=MusicSpecifier(
1148             music_maker=music_maker,
1149             voice_name='Voice 4',
1150         ),
1151     )
1152     for start_offset, stop_offset, music_maker in [
1153         [(0, 4), (5, 4), hornmusicmaker_one],
1154         [(8, 4), (10, 4), hornmusicmaker_two],
1155         [(14, 4), (18, 4), hornmusicmaker_three],
1156         [(21, 4), (22, 4), hornmusicmaker_one],
1157         [(22, 4), (23, 4), hornmusicmaker_one],
1158         [(38, 4), (40, 4), hornmusicmaker_two],
1159         [(41, 4), (43, 4), hornmusicmaker_one],

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1160     [(43, 4), (46, 4), hornmusicmaker_one],
1161     [(50, 4), (53, 4), hornmusicmaker_three],
1162     [(55, 4), (56, 4), hornmusicmaker_two],
1163     [(61, 4), (64, 4), hornmusicmaker_one],
1164     [(64, 4), (65, 4), hornmusicmaker_one],
1165     [(68, 4), (70, 4), hornmusicmaker_three],
1166     [(70, 4), (72, 4), hornmusicmaker_two],
1167     [(72, 4), (74, 4), hornmusicmaker_two],
1168     [(79, 4), (80, 4), hornmusicmaker_three],
1169     [(82, 4), (85, 4), hornmusicmaker_two],
1170     [(89, 4), (94, 4), hornmusicmaker_one],
1171     [(95, 4), (97, 4), hornmusicmaker_two],
1172     [(100, 4), (104, 4), hornmusicmaker_three],
1173     [(109, 4), (110, 4), hornmusicmaker_two],
1174     [(110, 4), (111, 4), hornmusicmaker_one],
1175     [(112, 4), (114, 4), hornmusicmaker_one],
1176     [(114, 4), (116, 4), hornmusicmaker_one],
1177     [(117, 4), (119, 4), hornmusicmaker_one],
1178     [(119, 4), (121, 4), hornmusicmaker_one],
1179     [(122, 4), (123, 4), hornmusicmaker_one],
1180     [(123, 4), (125, 4), hornmusicmaker_one],
1181     [(133, 4), (136, 4), hornmusicmaker_two],
1182     [(142, 4), (146, 4), hornmusicmaker_two],
1183     [(146, 4), (150, 4), hornmusicmaker_two],
1184     [(153, 4), (154, 4), hornmusicmaker_three],
1185     [(154, 4), (155, 4), hornmusicmaker_three],
1186     [(159, 4), (162, 4), hornmusicmaker_three],
1187     [(164, 4), (168, 4), hornmusicmaker_three],
1188     [(171, 4), (172, 4), hornmusicmaker_three],
1189     [(172, 4), (173, 4), hornmusicmaker_three],
1190     [(177, 4), (179, 4), hornmusicmaker_three],
1191     [(179, 4), (180, 4), hornmusicmaker_three],
1192     [(182, 4), (183, 4), hornmusicmaker_three],
1193     [(183, 4), (186, 4), hornmusicmaker_three],
1194     [(186, 4), (190, 4), hornmusicmaker_three],
1195 ]
1196 ])
1197
1198 voice_7_timespan_list = abjad.TimespanList([
1199     abjad.AnnotatedTimespan(
1200         start_offset=start_offset,
1201         stop_offset=stop_offset,
1202         annotation=MusicSpecifier(
1203             music_maker=music_maker,
1204             voice_name='Voice 7',
1205         ),
1206     )
1207     for start_offset, stop_offset, music_maker in [
1208         [(0, 4), (5, 4), tubamusicmaker_one],
1209         [(8, 4), (10, 4), tubamusicmaker_two],
1210         [(14, 4), (18, 4), tubamusicmaker_three],
1211         [(21, 4), (22, 4), tubamusicmaker_one],
1212         [(22, 4), (23, 4), tubamusicmaker_one],
1213         [(26, 4), (30, 4), tubamusicmaker_two],

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1214     [(38, 4), (40, 4), tubamusicmaker_two],
1215     [(41, 4), (43, 4), tubamusicmaker_one],
1216     [(43, 4), (46, 4), tubamusicmaker_one],
1217     [(50, 4), (53, 4), tubamusicmaker_three],
1218     [(55, 4), (56, 4), tubamusicmaker_two],
1219     [(61, 4), (64, 4), tubamusicmaker_one],
1220     [(64, 4), (65, 4), tubamusicmaker_one],
1221     [(68, 4), (70, 4), tubamusicmaker_three],
1222     [(70, 4), (72, 4), tubamusicmaker_two],
1223     [(72, 4), (74, 4), tubamusicmaker_two],
1224     [(79, 4), (80, 4), tubamusicmaker_three],
1225     [(82, 4), (85, 4), tubamusicmaker_two],
1226     [(89, 4), (94, 4), tubamusicmaker_one],
1227     [(95, 4), (97, 4), tubamusicmaker_two],
1228     [(100, 4), (104, 4), tubamusicmaker_three],
1229     [(109, 4), (110, 4), tubamusicmaker_two],
1230     [(110, 4), (111, 4), tubamusicmaker_one],
1231     [(112, 4), (114, 4), tubamusicmaker_one],
1232     [(114, 4), (116, 4), tubamusicmaker_one],
1233     [(117, 4), (119, 4), tubamusicmaker_one],
1234     [(119, 4), (121, 4), tubamusicmaker_one],
1235     [(122, 4), (123, 4), tubamusicmaker_one],
1236     [(123, 4), (125, 4), tubamusicmaker_one],
1237     [(133, 4), (136, 4), tubamusicmaker_two],
1238     [(142, 4), (146, 4), tubamusicmaker_two],
1239     [(146, 4), (150, 4), tubamusicmaker_two],
1240     [(154, 4), (157, 4), tubamusicmaker_three],
1241     [(159, 4), (163, 4), tubamusicmaker_three],
1242     [(166, 4), (168, 4), tubamusicmaker_three],
1243     [(172, 4), (175, 4), tubamusicmaker_three],
1244     [(177, 4), (179, 4), tubamusicmaker_three],
1245     [(179, 4), (181, 4), tubamusicmaker_three],
1246     [(184, 4), (186, 4), tubamusicmaker_three],
1247     [(186, 4), (190, 4), tubamusicmaker_three],
1248 ]
1249 ])
1250
1251 voice_12_timespan_list = abjad.TimespanList([
1252     abjad.AnnotatedTimespan(
1253         start_offset=start_offset,
1254         stop_offset=stop_offset,
1255         annotation=MusicSpecifier(
1256             music_maker=music_maker,
1257             voice_name='Voice 12',
1258         ),
1259     )
1260     for start_offset, stop_offset, music_maker in [
1261         [(0, 4), (5, 4), bassmusicmaker_one],
1262         [(8, 4), (10, 4), bassmusicmaker_two],
1263         [(14, 4), (18, 4), bassmusicmaker_three],
1264         [(21, 4), (22, 4), bassmusicmaker_one],
1265         [(22, 4), (23, 4), bassmusicmaker_one],
1266         [(38, 4), (40, 4), bassmusicmaker_two],
1267         [(41, 4), (43, 4), bassmusicmaker_one],

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1268     [(43, 4), (46, 4), bassmusicmaker_one],
1269     [(50, 4), (53, 4), bassmusicmaker_three],
1270     [(55, 4), (56, 4), bassmusicmaker_two],
1271     [(61, 4), (64, 4), bassmusicmaker_one],
1272     [(64, 4), (65, 4), bassmusicmaker_one],
1273     [(68, 4), (70, 4), bassmusicmaker_three],
1274     [(70, 4), (72, 4), bassmusicmaker_two],
1275     [(72, 4), (74, 4), bassmusicmaker_two],
1276     [(79, 4), (80, 4), bassmusicmaker_three],
1277     [(82, 4), (85, 4), bassmusicmaker_two],
1278     [(89, 4), (94, 4), bassmusicmaker_one],
1279     [(95, 4), (97, 4), bassmusicmaker_two],
1280     [(100, 4), (104, 4), bassmusicmaker_three],
1281     [(109, 4), (110, 4), bassmusicmaker_two],
1282     [(110, 4), (111, 4), bassmusicmaker_one],
1283     [(112, 4), (114, 4), bassmusicmaker_one],
1284     [(114, 4), (116, 4), bassmusicmaker_one],
1285     [(117, 4), (119, 4), bassmusicmaker_one],
1286     [(119, 4), (121, 4), bassmusicmaker_one],
1287     [(122, 4), (123, 4), bassmusicmaker_one],
1288     [(123, 4), (125, 4), bassmusicmaker_one],
1289     [(133, 4), (136, 4), bassmusicmaker_two],
1290     [(142, 4), (146, 4), bassmusicmaker_two],
1291     [(146, 4), (150, 4), bassmusicmaker_two],
1292     [(152, 4), (154, 4), bassmusicmaker_three],
1293     [(154, 4), (156, 4), bassmusicmaker_three],
1294     [(159, 4), (161, 4), bassmusicmaker_three],
1295     [(165, 4), (168, 4), bassmusicmaker_three],
1296     [(170, 4), (172, 4), bassmusicmaker_three],
1297     [(172, 4), (174, 4), bassmusicmaker_three],
1298     [(177, 4), (179, 4), bassmusicmaker_three],
1299     [(183, 4), (186, 4), bassmusicmaker_three],
1300     [(186, 4), (190, 4), bassmusicmaker_three],
1301 ]
1302 ])
1303
1304 all_timespan_lists = {
1305     'Voice 1': voice_1_timespan_list,
1306     'Voice 2': voice_2_timespan_list,
1307     'Voice 3': voice_3_timespan_list,
1308     'Voice 4': voice_4_timespan_list,
1309     'Voice 5': voice_5_timespan_list,
1310     'Voice 6': voice_6_timespan_list,
1311     'Voice 7': voice_7_timespan_list,
1312     'Voice 8': voice_8_timespan_list,
1313     'Voice 9': voice_9_timespan_list,
1314     'Voice 10': voice_10_timespan_list,
1315     'Voice 11': voice_11_timespan_list,
1316     'Voice 12': voice_12_timespan_list,
1317 }
1318
1319 global_timespan = abjad.Timespan(
1320     start_offset=0,
1321     stop_offset=max(_.stop_offset for _ in all_timespan_lists.values()))

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1322 )
1323
1324 for voice_name, timespan_list in all_timespan_lists.items():
1325     silences = abjad.TimespanList([global_timespan])
1326     silences.extend(timespan_list)
1327     silences.sort()
1328     silences.compute_logical_xor()
1329     for silence_timespan in silences:
1330         timespan_list.append(
1331             abjad.AnnotatedTimespan(
1332                 start_offset=silence_timespan.start_offset,
1333                 stop_offset=silence_timespan.stop_offset,
1334                 annotation=MusicSpecifier(
1335                     music_maker=None,
1336                     voice_name=voice_name,
1337                 ),
1338             )
1339         )
1340     timespan_list.sort()
1341
1342 for voice_name, timespan_list in all_timespan_lists.items():
1343     shards = timespan_list.split_at_offsets(bounds)
1344     split_timespan_list = abjad.TimespanList()
1345     for shard in shards:
1346         split_timespan_list.extend(shard)
1347     split_timespan_list.sort()
1348     all_timespan_lists[voice_name] = timespan_list
1349
1350 score = abjad.Score([
1351     abjad.Staff(lilypond_type='TimeSignatureContext', name='Global Context 1')
1352     ,
1353     abjad.StaffGroup(
1354         [
1355             abjad.Staff([abjad.Voice(name='Voice 1')], name='Staff 1',
1356             lilypond_type='Staff'),
1357             abjad.Staff([abjad.Voice(name='Voice 2')], name='Staff 2',
1358             lilypond_type='Staff'),
1359             abjad.Staff([abjad.Voice(name='Voice 3')], name='Staff 3',
1360             lilypond_type='Staff'),
1361         ],
1362         name='Staff Group 1',
1363     ),
1364     abjad.Staff(lilypond_type='TimeSignatureContext', name='Global Context 2')
1365     ,
1366     abjad.StaffGroup(
1367         [
1368             abjad.Staff([abjad.Voice(name='Voice 4')], name='Staff 4',
1369             lilypond_type='Staff'),
1370             abjad.Staff([abjad.Voice(name='Voice 5')], name='Staff 5',
1371             lilypond_type='Staff'),
1372             abjad.Staff([abjad.Voice(name='Voice 6')], name='Staff 6',
1373             lilypond_type='Staff'),
1374             abjad.Staff([abjad.Voice(name='Voice 7')], name='Staff 7',
1375             lilypond_type='Staff'),

```

```

1367     ],
1368     name='Staff Group 2',
1369 ),
1370 abjad.Staff(lilypond_type='TimeSignatureContext', name='Global Context 3')
1371 ,
1372 abjad.StaffGroup(
1373     [
1374         abjad.Staff([abjad.Voice(name='Voice 8')], name='Staff 8',
1375         lilypond_type='Staff'),
1376         abjad.Staff([abjad.Voice(name='Voice 9')], name='Staff 9',
1377         lilypond_type='Staff'),
1378         abjad.Staff([abjad.Voice(name='Voice 10')], name='Staff 10',
1379         lilypond_type='Staff'),
1380         abjad.Staff([abjad.Voice(name='Voice 11')], name='Staff 11',
1381         lilypond_type='Staff'),
1382         abjad.Staff([abjad.Voice(name='Voice 12')], name='Staff 12',
1383         lilypond_type='Staff'),
1384     ],
1385     name='Staff Group 3',
1386 )
1387 ],
1388 )
1389
1390 for time_signature in time_signatures:
1391     skip = abjad.Skip(1, multiplier=(time_signature))
1392     abjad.attach(time_signature, skip)
1393     score['Global Context 1'].append(skip)
1394
1395 for time_signature in time_signatures:
1396     skip = abjad.Skip(1, multiplier=(time_signature))
1397     abjad.attach(time_signature, skip)
1398     score['Global Context 2'].append(skip)
1399
1400 for time_signature in time_signatures:
1401     skip = abjad.Skip(1, multiplier=(time_signature))
1402     abjad.attach(time_signature, skip)
1403     score['Global Context 3'].append(skip)
1404
1405 print('Making containers ...')
1406
1407 def make_container(music_maker, durations):
1408     selections = music_maker(durations)
1409     container = abjad.Container([])
1410     container.extend(selections)
1411     return container
1412
1413 def key_function(timespan):
1414     return timespan.annotation.music_maker or silence_maker
1415
1416 for voice_name, timespan_list in all_timespan_lists.items():
1417     for music_maker, grouper in itertools.groupby(
1418         timespan_list,
1419         key=key_function,
1420     ):

```

```

1415     durations = [timespan.duration for timespan in grouper]
1416     container = make_container(music_maker, durations)
1417     voice = score[voice_name]
1418     voice.append(container)
1419
1420 print('Splitting and rewriting ...')
1421
1422 for voice in abjad.iterate(score['Staff Group 1']).components(abjad.Voice):
1423     for i, shard in enumerate(abjad.mutate(voice[:]).split(time_signatures)):
1424         time_signature = time_signatures[i]
1425         abjad.mutate(shard).rewrite_meter(time_signature)
1426
1427 for voice in abjad.iterate(score['Staff Group 2']).components(abjad.Voice):
1428     for i, shard in enumerate(abjad.mutate(voice[:]).split(time_signatures)):
1429         time_signature = time_signatures[i]
1430         abjad.mutate(shard).rewrite_meter(time_signature)
1431
1432 for voice in abjad.iterate(score['Staff Group 3']).components(abjad.Voice):
1433     for i, shard in enumerate(abjad.mutate(voice[:]).split(time_signatures)):
1434         time_signature = time_signatures[i]
1435         abjad.mutate(shard).rewrite_meter(time_signature)
1436
1437 print('Beaming runs ...')
1438
1439 for voice in abjad.select(score).components(abjad.Voice):
1440     for run in abjad.select(voice).runs():
1441         if 1 < len(run):
1442             specifier = abjadext.rmakers.BeamSpecifier(
1443                 beam_each_division=False,
1444             )
1445             specifier(run)
1446             abjad.attach(abjad.StartBeam(), run[0])
1447             abjad.attach(abjad.StopBeam(), run[-1])
1448             for leaf in run:
1449                 if abjad.Duration(1, 4) <= leaf.written_duration:
1450                     continue
1451                 previous_leaf = abjad.inspect(leaf).leaf(-1)
1452                 next_leaf = abjad.inspect(leaf).leaf(1)
1453                 if (isinstance(next_leaf, (abjad.Chord, abjad.Note)) and
1454                     abjad.Duration(1, 4) <= next_leaf.written_duration):
1455                     left = previous_leaf.written_duration.flag_count
1456                     right = leaf.written_duration.flag_count
1457                     beam_count = abjad.BeamCount(
1458                         left=left,
1459                         right=right,
1460                     )
1461                     abjad.attach(beam_count, leaf)
1462                     continue
1463                 if (isinstance(previous_leaf, (abjad.Chord, abjad.Note)) and
1464                     abjad.Duration(1, 4) <= previous_leaf.written_duration):
1465                     left = leaf.written_duration.flag_count
1466                     right = next_leaf.written_duration.flag_count
1467                     beam_count = abjad.BeamCount(
1468                         left=left,

```

```

1469         right=right,
1470     )
1471     abjad.attach(beam_count, leaf)
1472
1473     print('Beautifying score ...')
1474     for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
1475         for selection in abjad.select(staff).components(abjad.Rest):
1476             group_by_contiguity():
1477                 start_command = abjad.LilyPondLiteral(
1478                     r'\stopStaff \once \override Staff.StaffSymbol.line-count = #1 \
1479                     startStaff',
1480                     format_slot='before',
1481                 )
1482                 stop_command = abjad.LilyPondLiteral(
1483                     r'\stopStaff \startStaff',
1484                     format_slot='after',
1485                 )
1486                 abjad.attach(start_command, selection[0])
1487                 abjad.attach(stop_command, selection[-1])
1488
1489     for staff in abjad.iterate(score['Staff Group 2']).components(abjad.Staff):
1490         for selection in abjad.select(staff).components(abjad.Rest):
1491             group_by_contiguity():
1492                 start_command = abjad.LilyPondLiteral(
1493                     r'\stopStaff \once \override Staff.StaffSymbol.line-count = #1 \
1494                     startStaff',
1495                     format_slot='before',
1496                 )
1497                 stop_command = abjad.LilyPondLiteral(
1498                     r'\stopStaff \startStaff',
1499                     format_slot='after',
1500                 )
1501                 abjad.attach(start_command, selection[0])
1502                 abjad.attach(stop_command, selection[-1])
1503
1504     for staff in abjad.iterate(score['Staff Group 3']).components(abjad.Staff):
1505         for selection in abjad.select(staff).components(abjad.Rest):
1506             group_by_contiguity():
1507                 start_command = abjad.LilyPondLiteral(
1508                     r'\stopStaff \once \override Staff.StaffSymbol.line-count = #1 \
1509                     startStaff',
1510                     format_slot='before',
1511                 )
1512                 stop_command = abjad.LilyPondLiteral(
1513                     r'\stopStaff \startStaff',
1514                     format_slot='after',
1515                 )
1516                 abjad.attach(start_command, selection[0])
1517                 abjad.attach(stop_command, selection[-1])
1518
1519     print('Stopping Hairpins ...')
1520     for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
1521         for rest in abjad.iterate(staff).components(abjad.Rest):
1522             previous_leaf = abjad.inspect(rest).leaf(-1)

```



```

1517         if isinstance(previous_leaf, abjad.Note):
1518             abjad.attach(abjad.StopHairpin(), rest)
1519         elif isinstance(previous_leaf, abjad.Chord):
1520             abjad.attach(abjad.StopHairpin(), rest)
1521         elif isinstance(previous_leaf, abjad.Rest):
1522             pass
1523
1524     for staff in abjad.iterate(score['Staff Group 2']).components(abjad.Staff):
1525         for rest in abjad.iterate(staff).components(abjad.Rest):
1526             previous_leaf = abjad.inspect(rest).leaf(-1)
1527             if isinstance(previous_leaf, abjad.Note):
1528                 abjad.attach(abjad.StopHairpin(), rest)
1529             elif isinstance(previous_leaf, abjad.Chord):
1530                 abjad.attach(abjad.StopHairpin(), rest)
1531             elif isinstance(previous_leaf, abjad.Rest):
1532                 pass
1533
1534     for staff in abjad.iterate(score['Staff Group 3']).components(abjad.Staff):
1535         for rest in abjad.iterate(staff).components(abjad.Rest):
1536             previous_leaf = abjad.inspect(rest).leaf(-1)
1537             if isinstance(previous_leaf, abjad.Note):
1538                 abjad.attach(abjad.StopHairpin(), rest)
1539             elif isinstance(previous_leaf, abjad.Chord):
1540                 abjad.attach(abjad.StopHairpin(), rest)
1541             elif isinstance(previous_leaf, abjad.Rest):
1542                 pass
1543
1544     print('Adding pitch material ...')
1545     def cyc(lst):
1546         count = 0
1547         while True:
1548             yield lst[count%len(lst)]
1549             count += 1
1550
1551
1552     print('Adding attachments ...')
1553     bar_line = abjad.BarLine('||')
1554     metro = abjad.MetronomeMark((1, 4), 90)
1555     markup1 = abjad.Markup(r'\bold { G }')
1556     markup2 = abjad.Markup(r'\bold { H }')
1557     markup3 = abjad.Markup(r'\bold { I }')
1558     markup4 = abjad.Markup(r'\bold { J }')
1559     markup5 = abjad.Markup(r'\bold { K }')
1560     markup6 = abjad.Markup(r'\bold { L }')
1561     mark1 = abjad.RehearsalMark(markup=markup1)
1562     mark2 = abjad.RehearsalMark(markup=markup2)
1563     mark3 = abjad.RehearsalMark(markup=markup3)
1564     mark4 = abjad.RehearsalMark(markup=markup4)
1565     mark5 = abjad.RehearsalMark(markup=markup5)
1566     mark6 = abjad.RehearsalMark(markup=markup6)
1567
1568     instruments1 = cyc([
1569         abjad.Flute(),
1570         abjad.ClarinetInBFlat(),

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1571     abjad.Bassoon(),
1572 ])
1573
1574 instruments2 = cyc([
1575     abjad.FrenchHorn(),
1576     abjad.Trumpet(),
1577     abjad.TenorTrombone(),
1578     abjad.Tuba(),
1579 ])
1580
1581 instruments3 = cyc([
1582     abjad.Violin(),
1583     abjad.Violin(),
1584     abjad.Viola(),
1585     abjad.Cello(),
1586     abjad.Contrabass(),
1587 ])
1588
1589 clefs1 = cyc([
1590     abjad.Clef('treble'),
1591     abjad.Clef('treble'),
1592     abjad.Clef('bass'),
1593 ])
1594
1595 clefs2 = cyc([
1596     abjad.Clef('treble'),
1597     abjad.Clef('treble'),
1598     abjad.Clef('bass'),
1599     abjad.Clef('bass'),
1600 ])
1601
1602 clefs3 = cyc([
1603     abjad.Clef('treble'),
1604     abjad.Clef('treble'),
1605     abjad.Clef('alto'),
1606     abjad.Clef('bass'),
1607     abjad.Clef('bass'),
1608 ])
1609
1610 abbreviations1 = cyc([
1611     abjad.MarginMarkup(markup=abjad.Markup('fl.'),),
1612     abjad.MarginMarkup(markup=abjad.Markup('cl.'),),
1613     abjad.MarginMarkup(markup=abjad.Markup('bssn.'),),
1614 ])
1615
1616 abbreviations2 = cyc([
1617     abjad.MarginMarkup(markup=abjad.Markup('hr.'),),
1618     abjad.MarginMarkup(markup=abjad.Markup('trp.'),),
1619     abjad.MarginMarkup(markup=abjad.Markup('trmb.'),),
1620     abjad.MarginMarkup(markup=abjad.Markup('tb.'),),
1621 ])
1622
1623 abbreviations3 = cyc([
1624     abjad.MarginMarkup(markup=abjad.Markup('vln.I'),),

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1625     abjad.MarginMarkup(markup=abjad.Markup('vln.II'),),
1626     abjad.MarginMarkup(markup=abjad.Markup('vla.'),),
1627     abjad.MarginMarkup(markup=abjad.Markup('vc.'),),
1628     abjad.MarginMarkup(markup=abjad.Markup('cb.'),),
1629 ])
1630
1631 names1 = cyc([
1632     abjad.StartMarkup(markup=abjad.Markup('Flute'),),
1633     abjad.StartMarkup(markup=abjad.Markup('Clarinet'),),
1634     abjad.StartMarkup(markup=abjad.Markup('Bassoon'),),
1635 ])
1636
1637 names2 = cyc([
1638     abjad.StartMarkup(markup=abjad.Markup('Horn'),),
1639     abjad.StartMarkup(markup=abjad.Markup('Trumpet'),),
1640     abjad.StartMarkup(markup=abjad.Markup('Trombone'),),
1641     abjad.StartMarkup(markup=abjad.Markup('Tuba'),),
1642 ])
1643
1644 names3 = cyc([
1645     abjad.StartMarkup(markup=abjad.Markup('Violin I'),),
1646     abjad.StartMarkup(markup=abjad.Markup('Violin II'),),
1647     abjad.StartMarkup(markup=abjad.Markup('Viola'),),
1648     abjad.StartMarkup(markup=abjad.Markup('Violoncello'),),
1649     abjad.StartMarkup(markup=abjad.Markup('Contrabass'),),
1650 ])
1651
1652 for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
1653     leaf1 = abjad.select(staff).leaves()[0]
1654     abjad.attach(next(instruments1), leaf1)
1655     abjad.attach(next(abbreviations1), leaf1)
1656     abjad.attach(next(names1), leaf1)
1657     abjad.attach(next(clefs1), leaf1)
1658
1659 for staff in abjad.iterate(score['Staff Group 2']).components(abjad.Staff):
1660     leaf1 = abjad.select(staff).leaves()[0]
1661     abjad.attach(next(instruments2), leaf1)
1662     abjad.attach(next(abbreviations2), leaf1)
1663     abjad.attach(next(names2), leaf1)
1664     abjad.attach(next(clefs2), leaf1)
1665
1666 for staff in abjad.iterate(score['Staff Group 3']).components(abjad.Staff):
1667     leaf1 = abjad.select(staff).leaves()[0]
1668     abjad.attach(next(instruments3), leaf1)
1669     abjad.attach(next(abbreviations3), leaf1)
1670     abjad.attach(next(names3), leaf1)
1671     abjad.attach(next(clefs3), leaf1)
1672
1673 for staff in abjad.select(score['Staff Group 1']).components(abjad.Staff)[0]:
1674     leaf1 = abjad.select(staff).leaves()[0]
1675     last_leaf = abjad.select(staff).leaves()[-1]
1676     abjad.attach(metro, leaf1)
1677     abjad.attach(bar_line, last_leaf)
1678

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```

1679 for staff in abjad.select(score['Staff Group 2']).components(abjad.Staff)[0]:
1680     leaf1 = abjad.select(staff).leaves()[0]
1681     last_leaf = abjad.select(staff).leaves()[-1]
1682     abjad.attach(metro, leaf1)
1683     abjad.attach(bar_line, last_leaf)
1684
1685 for staff in abjad.select(score['Staff Group 3']).components(abjad.Staff)[0]:
1686     leaf1 = abjad.select(staff).leaves()[0]
1687     last_leaf = abjad.select(staff).leaves()[-1]
1688     abjad.attach(metro, leaf1)
1689     abjad.attach(bar_line, last_leaf)
1690
1691 for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1692     leaf1 = abjad.select(staff).leaves()[7]
1693     abjad.attach(mark1, leaf1)
1694
1695 for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1696     leaf1 = abjad.select(staff).leaves()[7]
1697     abjad.attach(mark1, leaf1)
1698
1699 for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1700     leaf1 = abjad.select(staff).leaves()[7]
1701     abjad.attach(mark1, leaf1)
1702
1703 for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1704     leaf2 = abjad.select(staff).leaves()[16]
1705     abjad.attach(mark2, leaf2)
1706
1707 for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1708     leaf2 = abjad.select(staff).leaves()[16]
1709     abjad.attach(mark2, leaf2)
1710
1711 for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1712     leaf2 = abjad.select(staff).leaves()[16]
1713     abjad.attach(mark2, leaf2)
1714
1715 for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1716     leaf3 = abjad.select(staff).leaves()[22]
1717     abjad.attach(mark3, leaf3)
1718
1719 for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1720     leaf3 = abjad.select(staff).leaves()[22]
1721     abjad.attach(mark3, leaf3)
1722
1723 for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1724     leaf3 = abjad.select(staff).leaves()[22]
1725     abjad.attach(mark3, leaf3)
1726
1727 for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1728     leaf4 = abjad.select(staff).leaves()[29]
1729     abjad.attach(mark4, leaf4)
1730
1731 for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1732     leaf4 = abjad.select(staff).leaves()[29]

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1733     abjad.attach(mark4, leaf4)
1734
1735     for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1736         leaf4 = abjad.select(staff).leaves()[29]
1737         abjad.attach(mark4, leaf4)
1738
1739     for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1740         leaf5 = abjad.select(staff).leaves()[34]
1741         abjad.attach(mark5, leaf5)
1742
1743     for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1744         leaf5 = abjad.select(staff).leaves()[34]
1745         abjad.attach(mark5, leaf5)
1746
1747     for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1748         leaf5 = abjad.select(staff).leaves()[34]
1749         abjad.attach(mark5, leaf5)
1750
1751     for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1752         leaf6 = abjad.select(staff).leaves()[39]
1753         abjad.attach(mark6, leaf6)
1754
1755     for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1756         leaf6 = abjad.select(staff).leaves()[39]
1757         abjad.attach(mark6, leaf6)
1758
1759     for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1760         leaf6 = abjad.select(staff).leaves()[39]
1761         abjad.attach(mark6, leaf6)
1762
1763     for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
1764         abjad.Instrument.transpose_from_sounding_pitch(staff)
1765
1766     for staff in abjad.iterate(score['Staff Group 2']).components(abjad.Staff):
1767         abjad.Instrument.transpose_from_sounding_pitch(staff)
1768
1769     for staff in abjad.iterate(score['Staff Group 3']).components(abjad.Staff):
1770         abjad.Instrument.transpose_from_sounding_pitch(staff)
1771
1772     score_file = abjad.LilyPondFile.new(
1773         score,
1774         includes=['first_stylesheet.ily', '/Users/evansdsg2/abjad/docs/source/
1775             _stylesheets/abjad.ily'],
1776     )
1777
1778     abjad.SegmentMaker.comment_measure_numbers(score)
1779     #####
1780     directory = '/Users/evansdsg2/Scores/tianshu/tianshu/Segments/Segment_II'
1781     pdf_path = f'{directory}/Segment_II.pdf'
1782     path = pathlib.Path('Segment_II.pdf')
1783     if path.exists():
1784         print(f'Removing {pdf_path} ...')
1785         path.unlink()

```

```

1786 time_1 = time.time()
1787 print(f'Persisting {pdf_path} ...')
1788 result = abjad.persist(score_file).as_pdf(pdf_path)
1789 print(result[0])
1790 print(result[1])
1791 print(result[2])
1792 success = result[3]
1793 if success is False:
1794     print('LilyPond failed!')
1795 time_2 = time.time()
1796 total_time = time_2 - time_1
1797 print(f'Total time: {total_time} seconds')
1798 if path.exists():
1799     print(f'Opening {pdf_path} ...')
1800     os.system(f'open {pdf_path}')

```

Code Example A.12: Tianshu Segment_II

A.3.1.3 SEGMENT_III

```

1 import abjad
2 import itertools
3 import os
4 import pathlib
5 import time
6 import abjadext.rmakers
7 from MusicMaker import MusicMaker
8 from AttachmentHandler import AttachmentHandler
9 from random import random
10 from random import seed
11
12 print('Interpreting file ...')
13
14 time_signatures = [
15     abjad.TimeSignature(pair) for pair in [
16         (5, 4), (2, 4), (4, 4), (3, 4), (4, 4), (4, 4),
17         (4, 4), (4, 4), (5, 4), (5, 4), (3, 4), (3, 4),
18         (4, 4), (4, 4), (5, 4), (5, 4), (3, 4), (3, 4),
19         (2, 4), (3, 4), (4, 4), (3, 4), (4, 4), (3, 4),
20         (5, 4), (3, 4), (3, 4), (4, 4), (3, 4), (3, 4),
21         (4, 4), (5, 4), (4, 4), (3, 4), (5, 4), (5, 4),
22         (5, 4), (5, 4), (4, 4), (4, 4), (5, 4), (5, 4),
23         (4, 4), (4, 4), (3, 4), (4, 4), (4, 4), (3, 4),
24         (5, 4),
25     ]
26 ]
27
28 bounds = abjad.mathtools.cumulative_sums([_.duration for _ in time_signatures])
29
30 def reduceMod3(rw):
31     return [(x % 4) for x in rw]
32

```

```

33 def reduceMod5(rw):
34     return [(x % 6) for x in rw]
35
36 def reduceMod7(rw):
37     return [(x % 8) for x in rw]
38
39 def reduceMod9(rw):
40     return [(x % 10) for x in rw]
41
42 def reduceMod11(rw):
43     return [(x % 12) for x in rw]
44
45 def reduceMod13(rw):
46     return [(x % 14) for x in rw]
47
48 seed(1)
49 flute_random_walk_one = []
50 flute_random_walk_one.append(-1 if random() < 0.5 else 1)
51 for i in range(1, 1000):
52     movement = -1 if random() < 0.5 else 1
53     value = flute_random_walk_one[i-1] + movement
54     flute_random_walk_one.append(value)
55 flute_random_walk_one = [abs(x) for x in flute_random_walk_one]
56 flute_chord_one = [0, 6, 8, 15, 23, 15, 8, 6, ]
57 flute_notes_one = [flute_chord_one[x] for x in reduceMod7(
    flute_random_walk_one)]
58
59 seed(2)
60 clarinet_random_walk_one = []
61 clarinet_random_walk_one.append(-1 if random() < 0.5 else 1)
62 for i in range(1, 1000):
63     movement = -1 if random() < 0.5 else 1
64     value = clarinet_random_walk_one[i-1] + movement
65     clarinet_random_walk_one.append(value)
66 clarinet_random_walk_one = [abs(x) for x in clarinet_random_walk_one]
67 clarinet_chord_one = [-10, 0, 6, 8, 15, 23, 15, 8, 6, 0, ]
68 clarinet_notes_one = [clarinet_chord_one[x] for x in reduceMod9(
    clarinet_random_walk_one)]
69
70 seed(3)
71 bassoon_random_walk_one = []
72 bassoon_random_walk_one.append(-1 if random() < 0.5 else 1)
73 for i in range(1, 1000):
74     movement = -1 if random() < 0.5 else 1
75     value = bassoon_random_walk_one[i-1] + movement
76     bassoon_random_walk_one.append(value)
77 bassoon_random_walk_one = [abs(x) for x in bassoon_random_walk_one]
78 bassoon_chord_one = [-19, -15, -10, 0, -10, -15, ]
79 bassoon_notes_one = [bassoon_chord_one[x] for x in reduceMod5(
    bassoon_random_walk_one)]
80
81 seed(4)
82 horn_random_walk_one = []
83 horn_random_walk_one.append(-1 if random() < 0.5 else 1)

```

```

84 for i in range(1, 1000):
85     movement = -1 if random() < 0.5 else 1
86     value = horn_random_walk_one[i-1] + movement
87     horn_random_walk_one.append(value)
88 horn_random_walk_one = [abs(x) for x in horn_random_walk_one]
89 horn_chord_one = [-19, -15, -10, 0, 6, 0, -10, -15, ]
90 horn_notes_one = [horn_chord_one[x] for x in reduceMod7(horn_random_walk_one)]
91
92 seed(5)
93 trumpet_random_walk_one = []
94 trumpet_random_walk_one.append(-1 if random() < 0.5 else 1)
95 for i in range(1, 1000):
96     movement = -1 if random() < 0.5 else 1
97     value = trumpet_random_walk_one[i-1] + movement
98     trumpet_random_walk_one.append(value)
99 trumpet_random_walk_one = [abs(x) for x in trumpet_random_walk_one]
100 trumpet_chord_one = [0, 6, 8, 15, 8, 6, ]
101 trumpet_notes_one = [trumpet_chord_one[x] for x in reduceMod5(
    trumpet_random_walk_one)]
102
103 seed(6)
104 trombone_random_walk_one = []
105 trombone_random_walk_one.append(-1 if random() < 0.5 else 1)
106 for i in range(1, 1000):
107     movement = -1 if random() < 0.5 else 1
108     value = trombone_random_walk_one[i-1] + movement
109     trombone_random_walk_one.append(value)
110 trombone_random_walk_one = [abs(x) for x in trombone_random_walk_one]
111 trombone_chord_one = [-19, -15, -10, 0, -10, -15, ]
112 trombone_notes_one = [trombone_chord_one[x] for x in reduceMod5(
    trombone_random_walk_one)]
113
114 seed(7)
115 tuba_random_walk_one = []
116 tuba_random_walk_one.append(-1 if random() < 0.5 else 1)
117 for i in range(1, 1000):
118     movement = -1 if random() < 0.5 else 1
119     value = tuba_random_walk_one[i-1] + movement
120     tuba_random_walk_one.append(value)
121 tuba_random_walk_one = [abs(x) for x in tuba_random_walk_one]
122 tuba_chord_one = [-29, -20, -19, -15, -10, -15, -19, -20, ]
123 tuba_notes_one = [tuba_chord_one[x] for x in reduceMod7(tuba_random_walk_one)]
124
125 seed(8)
126 violin1_random_walk_one = []
127 violin1_random_walk_one.append(-1 if random() < 0.5 else 1)
128 for i in range(1, 1000):
129     movement = -1 if random() < 0.5 else 1
130     value = violin1_random_walk_one[i-1] + movement
131     violin1_random_walk_one.append(value)
132 violin1_random_walk_one = [abs(x) for x in violin1_random_walk_one]
133 violin1_chord_one = [0, 6, 8, 15, 23, 34, 37, 34, 23, 15, 8, 6, ]
134 violin1_notes_one = [violin1_chord_one[x] for x in reduceMod11(
    violin1_random_walk_one)]

```



```

135
136 seed(9)
137 violin2_random_walk_one = []
138 violin2_random_walk_one.append(-1 if random() < 0.5 else 1)
139 for i in range(1, 1000):
140     movement = -1 if random() < 0.5 else 1
141     value = violin2_random_walk_one[i-1] + movement
142     violin2_random_walk_one.append(value)
143 violin2_random_walk_one = [abs(x) for x in violin2_random_walk_one]
144 violin2_chord_one = [0, 6, 8, 15, 23, 15, 8, 6, ]
145 violin2_notes_one = [violin2_chord_one[x] for x in reduceMod7(
    violin2_random_walk_one)]
146
147 seed(10)
148 viola_random_walk_one = []
149 viola_random_walk_one.append(-1 if random() < 0.5 else 1)
150 for i in range(1, 1000):
151     movement = -1 if random() < 0.5 else 1
152     value = viola_random_walk_one[i-1] + movement
153     viola_random_walk_one.append(value)
154 viola_random_walk_one = [abs(x) for x in viola_random_walk_one]
155 viola_chord_one = [-10, 0, 6, 8, 15, 8, 6, 0, ]
156 viola_notes_one = [viola_chord_one[x] for x in reduceMod7(
    viola_random_walk_one)]
157
158 seed(11)
159 cello_random_walk_one = []
160 cello_random_walk_one.append(-1 if random() < 0.5 else 1)
161 for i in range(1, 1000):
162     movement = -1 if random() < 0.5 else 1
163     value = cello_random_walk_one[i-1] + movement
164     cello_random_walk_one.append(value)
165 cello_random_walk_one = [abs(x) for x in cello_random_walk_one]
166 cello_chord_one = [-20, -19, -15, -10, 0, 6, 8, 15, 8, 6, 0, -10, -15, -19, ]
167 cello_notes_one = [cello_chord_one[x] for x in reduceMod13(
    cello_random_walk_one)]
168
169 seed(12)
170 bass_random_walk_one = []
171 bass_random_walk_one.append(-1 if random() < 0.5 else 1)
172 for i in range(1, 1000):
173     movement = -1 if random() < 0.5 else 1
174     value = bass_random_walk_one[i-1] + movement
175     bass_random_walk_one.append(value)
176 bass_random_walk_one = [abs(x) for x in bass_random_walk_one]
177 bass_chord_one = [-29, -20, -19, -15, -10, 0, -10, -15, -19, -20, ]
178 bass_notes_one = [bass_chord_one[x] for x in reduceMod9(bass_random_walk_one)]
179
180 flute_scale = [37, ]
181 clarinet_scale = [8, ]
182 bassoon_scale = [8, ]
183 horn_scale = [8, ]
184 trumpet_scale = [0, ]
185 trombone_scale = [-10, ]

```

```

186 tuba_scale = [-19, ]
187 violin1_scale = [30, 29.5, 29, 28.5, 28, 27.5, 27, 26.5, 26, 25.5, 25, 24.5,
    24, 23.5, 23, 22.5, 22, 21.5, 21, 20.5, 20, 19.5, 19, 19.5, 20, 20.5, 21,
    21.5, 22, 22.5, 23, 23.5, 24, 24.5, 25, 25.5, 26, 26.5, 27, 27.5, 28,
    28.5, 29, 29.5, ]
188 violin2_scale = [19, 18.5, 18, 17.5, 17, 16.5, 16, 15.5, 15, 14.5, 14, 13.5,
    13, 12.5, 12, 11.5, 11, 10.5, 10, 9.5, 9, 8.5, 8, 8.5, 9, 9.5, 10, 10.5,
    11, 11.5, 12, 12.5, 13, 13.5, 14, 14.5, 15, 15.5, 16, 16.5, 17, 17.5, 18,
    18.5, ]
189 viola_scale = [8, 7.5, 7, 6.5, 6, 5.5, 5, 4.5, 4, 3.5, 3, 2.5, 2, 1.5, 1, 0.5,
    0, -0.5, -1, -1.5, -2, -2.5, -3, -2.5, -2, -1.5, -1, -0.5, 0, 0.5, 1,
    1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 5.5, 6, 6.5, 7, 7.5, ]
190 cello_scale = [-3, -3.5, -4, -4.5, -5, -5.5, -6, -6.5, -7, -7.5, -8, -8.5, -9,
    -9.5, -10, -10.5, -11, -11.5, -12, -12.5, -13, -13.5, -14, -13.5, -13,
    -12.5, -12, -11.5, -11, -10.5, -10, -9.5, -9, -8.5, -8, -7.5, -7, -6.5,
    -6, -5.5, -5, -4.5, -4, -3.5, ]
191 bass_scale = [-14, -14.5, -15, -15.5, -16, -16.5, -17, -17.5, -18, -18.5, -19,
    -19.5, -20, -20.5, -21, -21.5, -22, -22.5, -23, -23.5, -24, -24.5, -25,
    -24.5, -24, -23.5, -23, -22.5, -22, -21.5, -21, -20.5, -20, -19.5, -19,
    -18.5, -18, -17.5, -17, -16.5, -16, -15.5, -15, -14.5, ]
192
193 seed(1)
194 flute_random_walk_two = []
195 flute_random_walk_two.append(-1 if random() < 0.5 else 1)
196 for i in range(1, 1000):
197     movement = -1 if random() < 0.5 else 1
198     value = flute_random_walk_two[i-1] + movement
199     flute_random_walk_two.append(value)
200 flute_random_walk_two = [abs(x) for x in flute_random_walk_two]
201 flute_chord_two = [2, 8, 11, 22, 30, 22, 11, 8, ]
202 flute_notes_two = [flute_chord_two[x] for x in reduceMod7(
    flute_random_walk_two)]
203
204 seed(2)
205 clarinet_random_walk_two = []
206 clarinet_random_walk_two.append(-1 if random() < 0.5 else 1)
207 for i in range(1, 1000):
208     movement = -1 if random() < 0.5 else 1
209     value = clarinet_random_walk_two[i-1] + movement
210     clarinet_random_walk_two.append(value)
211 clarinet_random_walk_two = [abs(x) for x in clarinet_random_walk_two]
212 clarinet_chord_two = [-8, -7, 2, 8, 11, 22, 11, 8, 2, -7, ]
213 clarinet_notes_two = [clarinet_chord_two[x] for x in reduceMod9(
    clarinet_random_walk_two)]
214
215 seed(3)
216 bassoon_random_walk_two = []
217 bassoon_random_walk_two.append(-1 if random() < 0.5 else 1)
218 for i in range(1, 1000):
219     movement = -1 if random() < 0.5 else 1
220     value = bassoon_random_walk_two[i-1] + movement
221     bassoon_random_walk_two.append(value)
222 bassoon_random_walk_two = [abs(x) for x in bassoon_random_walk_two]
223 bassoon_chord_two = [-17, -12, -8, -7, 2, -7, -8, -12, ]

```

```

224 bassoon_notes_two = [bassoon_chord_two[x] for x in reduceMod7(
    bassoon_random_walk_two)]
225
226 seed(4)
227 horn_random_walk_two = []
228 horn_random_walk_two.append(-1 if random() < 0.5 else 1)
229 for i in range(1, 1000):
230     movement = -1 if random() < 0.5 else 1
231     value = horn_random_walk_two[i-1] + movement
232     horn_random_walk_two.append(value)
233 horn_random_walk_two = [abs(x) for x in horn_random_walk_two]
234 horn_chord_two = [-17, -12, -8, -7, 2, -7, -8, -12, ]
235 horn_notes_two = [horn_chord_two[x] for x in reduceMod7(horn_random_walk_two)]
236
237 seed(5)
238 trumpet_random_walk_two = []
239 trumpet_random_walk_two.append(-1 if random() < 0.5 else 1)
240 for i in range(1, 1000):
241     movement = -1 if random() < 0.5 else 1
242     value = trumpet_random_walk_two[i-1] + movement
243     trumpet_random_walk_two.append(value)
244 trumpet_random_walk_two = [abs(x) for x in trumpet_random_walk_two]
245 trumpet_chord_two = [2, 8, 11, 8, ]
246 trumpet_notes_two = [trumpet_chord_two[x] for x in reduceMod3(
    trumpet_random_walk_two)]
247
248 seed(6)
249 trombone_random_walk_two = []
250 trombone_random_walk_two.append(-1 if random() < 0.5 else 1)
251 for i in range(1, 1000):
252     movement = -1 if random() < 0.5 else 1
253     value = trombone_random_walk_two[i-1] + movement
254     trombone_random_walk_two.append(value)
255 trombone_random_walk_two = [abs(x) for x in trombone_random_walk_two]
256 trombone_chord_two = [-17, -12, -8, -7, 2, -7, -8, -12, ]
257 trombone_notes_two = [trombone_chord_two[x] for x in reduceMod7(
    trombone_random_walk_two)]
258
259 seed(7)
260 tuba_random_walk_two = []
261 tuba_random_walk_two.append(-1 if random() < 0.5 else 1)
262 for i in range(1, 1000):
263     movement = -1 if random() < 0.5 else 1
264     value = tuba_random_walk_two[i-1] + movement
265     tuba_random_walk_two.append(value)
266 tuba_random_walk_two = [abs(x) for x in tuba_random_walk_two]
267 tuba_chord_two = [-27, -17, -12, -8, -7, -8, -12, -17, ]
268 tuba_notes_two = [tuba_chord_two[x] for x in reduceMod7(tuba_random_walk_two)]
269
270 seed(8)
271 violin1_random_walk_two = []
272 violin1_random_walk_two.append(-1 if random() < 0.5 else 1)
273 for i in range(1, 1000):
274     movement = -1 if random() < 0.5 else 1

```

```

275     value = violin1_random_walk_two[i-1] + movement
276     violin1_random_walk_two.append(value)
277 violin1_random_walk_two = [abs(x) for x in violin1_random_walk_two]
278 violin1_chord_two = [2, 8, 11, 22, 30, 37, 39, 37, 30, 22, 11, 8, ]
279 violin1_notes_two = [violin1_chord_two[x] for x in reduceMod11(
    violin1_random_walk_two)]
280
281 seed(9)
282 violin2_random_walk_two = []
283 violin2_random_walk_two.append(-1 if random() < 0.5 else 1)
284 for i in range(1, 1000):
285     movement = -1 if random() < 0.5 else 1
286     value = violin2_random_walk_two[i-1] + movement
287     violin2_random_walk_two.append(value)
288 violin2_random_walk_two = [abs(x) for x in violin2_random_walk_two]
289 violin2_chord_two = [2, 8, 11, 22, 30, 22, 11, 8, ]
290 violin2_notes_two = [violin2_chord_two[x] for x in reduceMod7(
    violin2_random_walk_two)]
291
292 seed(10)
293 viola_random_walk_two = []
294 viola_random_walk_two.append(-1 if random() < 0.5 else 1)
295 for i in range(1, 1000):
296     movement = -1 if random() < 0.5 else 1
297     value = viola_random_walk_two[i-1] + movement
298     viola_random_walk_two.append(value)
299 viola_random_walk_two = [abs(x) for x in viola_random_walk_two]
300 viola_chord_two = [-12, -8, -7, 2, 8, 11, 22, 11, 8, 2, -7, -8, ]
301 viola_notes_two = [viola_chord_two[x] for x in reduceMod11(
    viola_random_walk_two)]
302
303 seed(11)
304 cello_random_walk_two = []
305 cello_random_walk_two.append(-1 if random() < 0.5 else 1)
306 for i in range(1, 1000):
307     movement = -1 if random() < 0.5 else 1
308     value = cello_random_walk_two[i-1] + movement
309     cello_random_walk_two.append(value)
310 cello_random_walk_two = [abs(x) for x in cello_random_walk_two]
311 cello_chord_two = [-17, -12, -8, -7, 2, 8, 2, -7, -8, -12,]
312 cello_notes_two = [cello_chord_two[x] for x in reduceMod9(
    cello_random_walk_two)]
313
314 seed(12)
315 bass_random_walk_two = []
316 bass_random_walk_two.append(-1 if random() < 0.5 else 1)
317 for i in range(1, 1000):
318     movement = -1 if random() < 0.5 else 1
319     value = bass_random_walk_two[i-1] + movement
320     bass_random_walk_two.append(value)
321 bass_random_walk_two = [abs(x) for x in bass_random_walk_two]
322 bass_chord_two = [-27, -17, -12, -8, -7, 2, -7, -8, -12, -17, ]
323 bass_notes_two = [bass_chord_two[x] for x in reduceMod9(bass_random_walk_two)]
324

```

```

325 rmaker_one = abjadext.rmakers.TaleaRhythmMaker(
326     talea=abjadext.rmakers.Talea(
327         counts=[6, 2, 4, 2, 6, 1, 12, 8, 10, ],
328         denominator=16,
329     ),
330     beam_specifier=abjadext.rmakers.BeamSpecifier(
331         beam_divisions_together=True,
332         beam_rests=False,
333     ),
334     extra_counts_per_division=[0, 1, 0, -1],
335     burnish_specifier=abjadext.rmakers.BurnishSpecifier(
336         left_classes=[abjad.Note, abjad.Rest],
337         left_counts=[1, 0, 1],
338     ),
339     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
340         trivialize=True,
341         extract_trivial=True,
342         rewrite_rest_filled=True,
343     ),
344 )
345
346 rmaker_two = abjadext.rmakers.NoteRhythmMaker()
347
348 rmaker_three = abjadext.rmakers.IncisedRhythmMaker(
349     incise_specifier=abjadext.rmakers.InciseSpecifier(
350         prefix_talea=[-1],
351         prefix_counts=[0, 1, 1, 0],
352         suffix_talea=[-1],
353         suffix_counts=[1, 0],
354         talea_denominator=16,
355     ),
356 )
357
358 attachment_handler_one = AttachmentHandler(
359     starting_dynamic='mp',
360     ending_dynamic='f',
361     hairpin_indicator='<|',
362     articulation='',
363 )
364
365 attachment_handler_two = AttachmentHandler(
366     starting_dynamic='mp',
367     ending_dynamic='mf',
368     hairpin_indicator='--',
369     articulation='tenuto',
370 )
371
372 attachment_handler_three = AttachmentHandler(
373     starting_dynamic='mf',
374     ending_dynamic='f',
375     hairpin_indicator='--',
376     articulation='marcato',
377 )
378

```

```

379 #####oboe#####
380 flutemusicmaker_one = MusicMaker(
381     rmaker=rmaker_one,
382     pitches=flute_scale,
383     continuous=True,
384     attachment_handler=attachment_handler_one,
385 )
386 flutemusicmaker_two = MusicMaker(
387     rmaker=rmaker_two,
388     pitches=flute_notes_two,
389     continuous=True,
390     attachment_handler=attachment_handler_two,
391 )
392 flutemusicmaker_three = MusicMaker(
393     rmaker=rmaker_three,
394     pitches=flute_notes_one,
395     continuous=True,
396     attachment_handler=attachment_handler_three,
397 )
398 #####violin1#####
399 violin1musicmaker_one = MusicMaker(
400     rmaker=rmaker_one,
401     pitches=violin1_scale,
402     continuous=True,
403     attachment_handler=attachment_handler_one,
404 )
405 violin1musicmaker_two = MusicMaker(
406     rmaker=rmaker_two,
407     pitches=violin1_notes_two,
408     continuous=True,
409     attachment_handler=attachment_handler_two,
410 )
411 violin1musicmaker_three = MusicMaker(
412     rmaker=rmaker_three,
413     pitches=violin1_notes_one,
414     continuous=True,
415     attachment_handler=attachment_handler_three,
416 )
417 #####trumpet#####
418 trumpetmusicmaker_one = MusicMaker(
419     rmaker=rmaker_one,
420     pitches=trumpet_scale,
421     continuous=True,
422     attachment_handler=attachment_handler_one,
423 )
424 trumpetmusicmaker_two = MusicMaker(
425     rmaker=rmaker_two,
426     pitches=trumpet_notes_two,
427     continuous=True,
428     attachment_handler=attachment_handler_two,
429 )
430 trumpetmusicmaker_three = MusicMaker(
431     rmaker=rmaker_three,
432     pitches=trumpet_notes_one,

```

```

433     continuous=True,
434     attachment_handler=attachment_handler_three,
435 )
436 #####clarinet#####
437 clarinetmusicmaker_one = MusicMaker(
438     rmaker=rmaker_one,
439     pitches=clarinet_scale,
440     continuous=True,
441     attachment_handler=attachment_handler_one,
442 )
443 clarinetmusicmaker_two = MusicMaker(
444     rmaker=rmaker_two,
445     pitches=clarinet_notes_two,
446     continuous=True,
447     attachment_handler=attachment_handler_two,
448 )
449 clarinetmusicmaker_three = MusicMaker(
450     rmaker=rmaker_three,
451     pitches=clarinet_notes_one,
452     continuous=True,
453     attachment_handler=attachment_handler_three,
454 )
455 #####violin2#####
456 violin2musicmaker_one = MusicMaker(
457     rmaker=rmaker_one,
458     pitches=violin2_scale,
459     continuous=True,
460     attachment_handler=attachment_handler_one,
461 )
462 violin2musicmaker_two = MusicMaker(
463     rmaker=rmaker_two,
464     pitches=violin2_notes_two,
465     continuous=True,
466     attachment_handler=attachment_handler_two,
467 )
468 violin2musicmaker_three = MusicMaker(
469     rmaker=rmaker_three,
470     pitches=violin2_notes_one,
471     continuous=True,
472     attachment_handler=attachment_handler_three,
473 )
474 #####viola#####
475 violamusicmaker_one = MusicMaker(
476     rmaker=rmaker_one,
477     pitches=viola_scale,
478     continuous=True,
479     attachment_handler=attachment_handler_one,
480 )
481 violamusicmaker_two = MusicMaker(
482     rmaker=rmaker_two,
483     pitches=viola_notes_two,
484     continuous=True,
485     attachment_handler=attachment_handler_two,
486 )

```

```

487 violamusicmaker_three = MusicMaker(
488     rmaker=rmaker_three,
489     pitches=viola_notes_one,
490     continuous=True,
491     attachment_handler=attachment_handler_three,
492 )
493 #####bassoon#####
494 bassoonmusicmaker_one = MusicMaker(
495     rmaker=rmaker_one,
496     pitches=bassoon_scale,
497     continuous=True,
498     attachment_handler=attachment_handler_one,
499 )
500 bassoonmusicmaker_two = MusicMaker(
501     rmaker=rmaker_two,
502     pitches=bassoon_notes_two,
503     continuous=True,
504     attachment_handler=attachment_handler_two,
505 )
506 bassoonmusicmaker_three = MusicMaker(
507     rmaker=rmaker_three,
508     pitches=bassoon_notes_one,
509     continuous=True,
510     attachment_handler=attachment_handler_three,
511 )
512 #####trombone#####
513 trombonemusicmaker_one = MusicMaker(
514     rmaker=rmaker_one,
515     pitches=trombone_scale,
516     continuous=True,
517     attachment_handler=attachment_handler_one,
518 )
519 trombonemusicmaker_two = MusicMaker(
520     rmaker=rmaker_two,
521     pitches=trombone_notes_two,
522     continuous=True,
523     attachment_handler=attachment_handler_two,
524 )
525 trombonemusicmaker_three = MusicMaker(
526     rmaker=rmaker_three,
527     pitches=trombone_notes_one,
528     continuous=True,
529     attachment_handler=attachment_handler_three,
530 )
531 #####cello#####
532 cellomusicmaker_one = MusicMaker(
533     rmaker=rmaker_one,
534     pitches=cello_scale,
535     continuous=True,
536     attachment_handler=attachment_handler_one,
537 )
538 cellomusicmaker_two = MusicMaker(
539     rmaker=rmaker_two,
540     pitches=cello_notes_two,

```



```

541     continuous=True,
542     attachment_handler=attachment_handler_two,
543 )
544 celломusicmaker_three = MusicMaker(
545     rmaker=rmaker_three,
546     pitches=cello_notes_one,
547     continuous=True,
548     attachment_handler=attachment_handler_three,
549 )
550 #####horn#####
551 hornmusicmaker_one = MusicMaker(
552     rmaker=rmaker_one,
553     pitches=horn_scale,
554     continuous=True,
555     attachment_handler=attachment_handler_one,
556 )
557 hornmusicmaker_two = MusicMaker(
558     rmaker=rmaker_two,
559     pitches=horn_notes_two,
560     continuous=True,
561     attachment_handler=attachment_handler_two,
562 )
563 hornmusicmaker_three = MusicMaker(
564     rmaker=rmaker_three,
565     pitches=horn_notes_one,
566     continuous=True,
567     attachment_handler=attachment_handler_three,
568 )
569 #####tuba#####
570 tubamusicmaker_one = MusicMaker(
571     rmaker=rmaker_one,
572     pitches=tuba_scale,
573     continuous=True,
574     attachment_handler=attachment_handler_one,
575 )
576 tubamusicmaker_two = MusicMaker(
577     rmaker=rmaker_two,
578     pitches=tuba_notes_two,
579     continuous=True,
580     attachment_handler=attachment_handler_two,
581 )
582 tubamusicmaker_three = MusicMaker(
583     rmaker=rmaker_three,
584     pitches=tuba_notes_one,
585     continuous=True,
586     attachment_handler=attachment_handler_three,
587 )
588 #####bass#####
589 bassmusicmaker_one = MusicMaker(
590     rmaker=rmaker_one,
591     pitches=bass_scale,
592     continuous=True,
593     attachment_handler=attachment_handler_one,
594 )

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595 bassmusicmaker_two = MusicMaker(
596     rmaker=rmaker_two,
597     pitches=bass_notes_two,
598     continuous=True,
599     attachment_handler=attachment_handler_two,
600 )
601 bassmusicmaker_three = MusicMaker(
602     rmaker=rmaker_three,
603     pitches=bass_notes_one,
604     continuous=True,
605     attachment_handler=attachment_handler_three,
606 )
607
608 silence_maker = abjadext.rmakers.NoteRhythmMaker(
609     division_masks=[
610         abjadext.rmakers.SilenceMask(
611             pattern=abjad.index([0], 1),
612         ),
613     ],
614 )
615
616
617 class MusicSpecifier:
618
619     def __init__(self, music_maker, voice_name):
620         self.music_maker = music_maker
621         self.voice_name = voice_name
622
623
624 print('Collecting timespans and rmakers ...')
625 ###group one###
626 voice_1_timespan_list = abjad.TimespanList([
627     abjad.AnnotatedTimespan(
628         start_offset=start_offset,
629         stop_offset=stop_offset,
630         annotation=MusicSpecifier(
631             music_maker=music_maker,
632             voice_name='Voice 1',
633         ),
634     )
635     for start_offset, stop_offset, music_maker in [
636         [(9, 4), (10, 4), flutemusicmaker_one],
637         [(15, 4), (18, 4), flutemusicmaker_two],
638         [(22, 4), (25, 4), flutemusicmaker_three],
639         [(27, 4), (30, 4), flutemusicmaker_one],
640         [(30, 4), (32, 4), flutemusicmaker_one],
641         [(35, 4), (39, 4), flutemusicmaker_two],
642         [(42, 4), (43, 4), flutemusicmaker_three],
643         [(43, 4), (44, 4), flutemusicmaker_three],
644         [(45, 4), (46, 4), flutemusicmaker_one],
645         [(46, 4), (50, 4), flutemusicmaker_one],
646         [(54, 4), (57, 4), flutemusicmaker_two],
647         [(59, 4), (60, 4), flutemusicmaker_three],
648         [(65, 4), (67, 4), flutemusicmaker_one],

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649     [(67, 4), (69, 4), flutemusicmaker_one],
650     [(70, 4), (72, 4), flutemusicmaker_two],
651     [(72, 4), (75, 4), flutemusicmaker_two],
652     [(76, 4), (78, 4), flutemusicmaker_three],
653     [(81, 4), (82, 4), flutemusicmaker_one],
654     [(82, 4), (85, 4), flutemusicmaker_one],
655     [(90, 4), (91, 4), flutemusicmaker_two],
656     [(93, 4), (94, 4), flutemusicmaker_three],
657     [(94, 4), (96, 4), flutemusicmaker_three],
658     [(100, 4), (104, 4), flutemusicmaker_one],
659     [(104, 4), (105, 4), flutemusicmaker_one],
660     [(106, 4), (107, 4), flutemusicmaker_two],
661     [(107, 4), (108, 4), flutemusicmaker_two],
662     [(111, 4), (114, 4), flutemusicmaker_one],
663     [(114, 4), (115, 4), flutemusicmaker_one],
664     [(116, 4), (119, 4), flutemusicmaker_one],
665     [(119, 4), (120, 4), flutemusicmaker_one],
666     [(121, 4), (123, 4), flutemusicmaker_one],
667     [(123, 4), (125, 4), flutemusicmaker_one],
668     [(126, 4), (131, 4), flutemusicmaker_two],
669     [(131, 4), (133, 4), flutemusicmaker_two],
670     [(136, 4), (141, 4), flutemusicmaker_two],
671     [(148, 4), (150, 4), flutemusicmaker_two],
672     [(150, 4), (153, 4), flutemusicmaker_three],
673     [(155, 4), (159, 4), flutemusicmaker_three],
674     [(162, 4), (164, 4), flutemusicmaker_three],
675     [(168, 4), (171, 4), flutemusicmaker_three],
676     [(173, 4), (175, 4), flutemusicmaker_three],
677     [(175, 4), (177, 4), flutemusicmaker_three],
678     [(180, 4), (182, 4), flutemusicmaker_three],
679     [(186, 4), (190, 4), flutemusicmaker_three],
680     [(190, 4), (191, 4), silence_maker],
681 ]
682 ])
683
684 voice_5_timespan_list = abjad.TimespanList([
685     abjad.AnnotatedTimespan(
686         start_offset=start_offset,
687         stop_offset=stop_offset,
688         annotation=MusicSpecifier(
689             music_maker=music_maker,
690             voice_name='Voice 5',
691         ),
692     )
693     for start_offset, stop_offset, music_maker in [
694         [(9, 4), (10, 4), trumpetmusicmaker_one],
695         [(14, 4), (18, 4), trumpetmusicmaker_two],
696         [(23, 4), (25, 4), trumpetmusicmaker_three],
697         [(27, 4), (30, 4), trumpetmusicmaker_one],
698         [(30, 4), (32, 4), trumpetmusicmaker_one],
699         [(35, 4), (39, 4), trumpetmusicmaker_two],
700         [(42, 4), (43, 4), trumpetmusicmaker_three],
701         [(43, 4), (44, 4), trumpetmusicmaker_three],
702         [(45, 4), (46, 4), trumpetmusicmaker_one],

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703     [(46, 4), (50, 4), trumpetmusicmaker_one],
704     [(54, 4), (57, 4), trumpetmusicmaker_two],
705     [(59, 4), (60, 4), trumpetmusicmaker_three],
706     [(65, 4), (67, 4), trumpetmusicmaker_one],
707     [(67, 4), (69, 4), trumpetmusicmaker_one],
708     [(70, 4), (72, 4), trumpetmusicmaker_two],
709     [(72, 4), (75, 4), trumpetmusicmaker_two],
710     [(76, 4), (78, 4), trumpetmusicmaker_three],
711     [(81, 4), (82, 4), trumpetmusicmaker_one],
712     [(82, 4), (85, 4), trumpetmusicmaker_one],
713     [(90, 4), (91, 4), trumpetmusicmaker_two],
714     [(93, 4), (94, 4), trumpetmusicmaker_three],
715     [(94, 4), (96, 4), trumpetmusicmaker_three],
716     [(100, 4), (104, 4), trumpetmusicmaker_one],
717     [(104, 4), (105, 4), trumpetmusicmaker_one],
718     [(106, 4), (107, 4), trumpetmusicmaker_two],
719     [(107, 4), (108, 4), trumpetmusicmaker_two],
720     [(111, 4), (114, 4), trumpetmusicmaker_one],
721     [(114, 4), (115, 4), trumpetmusicmaker_one],
722     [(116, 4), (119, 4), trumpetmusicmaker_one],
723     [(119, 4), (120, 4), trumpetmusicmaker_one],
724     [(121, 4), (123, 4), trumpetmusicmaker_one],
725     [(123, 4), (125, 4), trumpetmusicmaker_one],
726     [(126, 4), (131, 4), trumpetmusicmaker_two],
727     [(131, 4), (133, 4), trumpetmusicmaker_two],
728     [(136, 4), (141, 4), trumpetmusicmaker_two],
729     [(148, 4), (150, 4), trumpetmusicmaker_two],
730     [(150, 4), (154, 4), trumpetmusicmaker_three],
731     [(157, 4), (159, 4), trumpetmusicmaker_three],
732     [(163, 4), (164, 4), trumpetmusicmaker_three],
733     [(164, 4), (166, 4), trumpetmusicmaker_three],
734     [(168, 4), (172, 4), trumpetmusicmaker_three],
735     [(175, 4), (177, 4), trumpetmusicmaker_three],
736     [(181, 4), (183, 4), trumpetmusicmaker_three],
737     [(183, 4), (184, 4), trumpetmusicmaker_three],
738     [(186, 4), (190, 4), trumpetmusicmaker_three],
739 ]
740 ])
741
742 voice_8_timespan_list = abjad.TimespanList([
743     abjad.AnnotatedTimespan(
744         start_offset=start_offset,
745         stop_offset=stop_offset,
746         annotation=MusicSpecifier(
747             music_maker=music_maker,
748             voice_name='Voice 8',
749         ),
750     )
751     for start_offset, stop_offset, music_maker in [
752         [(9, 4), (10, 4), violin1musicmaker_one],
753         [(14, 4), (18, 4), violin1musicmaker_two],
754         [(22, 4), (25, 4), violin1musicmaker_three],
755         [(27, 4), (30, 4), violin1musicmaker_one],
756         [(35, 4), (39, 4), violin1musicmaker_two],

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757 [(42, 4), (43, 4), violin1musicmaker_three],
758 [(43, 4), (44, 4), violin1musicmaker_three],
759 [(45, 4), (46, 4), violin1musicmaker_one],
760 [(46, 4), (50, 4), violin1musicmaker_one],
761 [(54, 4), (57, 4), violin1musicmaker_two],
762 [(59, 4), (60, 4), violin1musicmaker_three],
763 [(65, 4), (67, 4), violin1musicmaker_one],
764 [(67, 4), (69, 4), violin1musicmaker_one],
765 [(70, 4), (72, 4), violin1musicmaker_two],
766 [(72, 4), (75, 4), violin1musicmaker_two],
767 [(76, 4), (78, 4), violin1musicmaker_three],
768 [(81, 4), (82, 4), violin1musicmaker_one],
769 [(82, 4), (85, 4), violin1musicmaker_one],
770 [(90, 4), (91, 4), violin1musicmaker_two],
771 [(93, 4), (94, 4), violin1musicmaker_three],
772 [(94, 4), (96, 4), violin1musicmaker_three],
773 [(100, 4), (104, 4), violin1musicmaker_one],
774 [(104, 4), (105, 4), violin1musicmaker_one],
775 [(106, 4), (107, 4), violin1musicmaker_two],
776 [(107, 4), (108, 4), violin1musicmaker_two],
777 [(111, 4), (114, 4), violin1musicmaker_one],
778 [(114, 4), (115, 4), violin1musicmaker_one],
779 [(116, 4), (119, 4), violin1musicmaker_one],
780 [(119, 4), (120, 4), violin1musicmaker_one],
781 [(121, 4), (123, 4), violin1musicmaker_one],
782 [(123, 4), (125, 4), violin1musicmaker_one],
783 [(126, 4), (131, 4), violin1musicmaker_two],
784 [(131, 4), (133, 4), violin1musicmaker_two],
785 [(136, 4), (141, 4), violin1musicmaker_two],
786 [(148, 4), (150, 4), violin1musicmaker_two],
787 [(150, 4), (152, 4), violin1musicmaker_three],
788 [(156, 4), (159, 4), violin1musicmaker_three],
789 [(161, 4), (164, 4), violin1musicmaker_three],
790 [(164, 4), (165, 4), violin1musicmaker_three],
791 [(168, 4), (170, 4), violin1musicmaker_three],
792 [(174, 4), (175, 4), violin1musicmaker_three],
793 [(175, 4), (177, 4), violin1musicmaker_three],
794 [(179, 4), (183, 4), violin1musicmaker_three],
795 [(186, 4), (190, 4), violin1musicmaker_three],
796 ]
797 ])
798
799 ###group two###
800 voice_2_timespan_list = abjad.TimespanList([
801     abjad.AnnotatedTimespan(
802         start_offset=start_offset,
803         stop_offset=stop_offset,
804         annotation=MusicSpecifier(
805             music_maker=music_maker,
806             voice_name='Voice 2',
807         ),
808     )
809     for start_offset, stop_offset, music_maker in [
810         [(2, 4), (5, 4), clarinetmusicmaker_one],

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811     [(10, 4), (11, 4), clarinetmusicmaker_two],
812     [(11, 4), (13, 4), clarinetmusicmaker_two],
813     [(16, 4), (18, 4), clarinetmusicmaker_three],
814     [(21, 4), (22, 4), clarinetmusicmaker_one],
815     [(22, 4), (25, 4), clarinetmusicmaker_one],
816     [(35, 4), (40, 4), clarinetmusicmaker_one],
817     [(44, 4), (46, 4), clarinetmusicmaker_two],
818     [(46, 4), (47, 4), clarinetmusicmaker_two],
819     [(49, 4), (50, 4), clarinetmusicmaker_three],
820     [(55, 4), (59, 4), clarinetmusicmaker_one],
821     [(62, 4), (64, 4), clarinetmusicmaker_two],
822     [(65, 4), (67, 4), clarinetmusicmaker_three],
823     [(67, 4), (70, 4), clarinetmusicmaker_three],
824     [(70, 4), (71, 4), clarinetmusicmaker_three],
825     [(73, 4), (75, 4), clarinetmusicmaker_two],
826     [(75, 4), (76, 4), clarinetmusicmaker_two],
827     [(80, 4), (82, 4), clarinetmusicmaker_one],
828     [(82, 4), (85, 4), clarinetmusicmaker_one],
829     [(86, 4), (88, 4), clarinetmusicmaker_two],
830     [(91, 4), (94, 4), clarinetmusicmaker_three],
831     [(94, 4), (95, 4), clarinetmusicmaker_three],
832     [(100, 4), (101, 4), clarinetmusicmaker_two],
833     [(103, 4), (104, 4), clarinetmusicmaker_one],
834     [(104, 4), (106, 4), clarinetmusicmaker_one],
835     [(110, 4), (114, 4), clarinetmusicmaker_one],
836     [(115, 4), (119, 4), clarinetmusicmaker_one],
837     [(120, 4), (123, 4), clarinetmusicmaker_one],
838     [(123, 4), (124, 4), clarinetmusicmaker_one],
839     [(125, 4), (126, 4), clarinetmusicmaker_two],
840     [(129, 4), (131, 4), clarinetmusicmaker_two],
841     [(131, 4), (134, 4), clarinetmusicmaker_two],
842     [(141, 4), (144, 4), clarinetmusicmaker_two],
843     [(149, 4), (150, 4), clarinetmusicmaker_two],
844     [(155, 4), (159, 4), clarinetmusicmaker_three],
845     [(162, 4), (164, 4), clarinetmusicmaker_three],
846     [(165, 4), (168, 4), clarinetmusicmaker_three],
847     [(168, 4), (170, 4), clarinetmusicmaker_three],
848     [(174, 4), (175, 4), clarinetmusicmaker_three],
849     [(175, 4), (177, 4), clarinetmusicmaker_three],
850     [(179, 4), (180, 4), clarinetmusicmaker_three],
851     [(185, 4), (186, 4), clarinetmusicmaker_three],
852     [(186, 4), (190, 4), clarinetmusicmaker_three],
853 ]
854 ])
855
856 voice_9_timespan_list = abjad.TimespanList([
857     abjad.AnnotatedTimespan(
858         start_offset=start_offset,
859         stop_offset=stop_offset,
860         annotation=MusicSpecifier(
861             music_maker=music_maker,
862             voice_name='Voice 9',
863         ),
864     )

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865     for start_offset, stop_offset, music_maker in [
866         [(2, 4), (5, 4), violin2musicmaker_one],
867         [(9, 4), (11, 4), violin2musicmaker_two],
868         [(11, 4), (13, 4), violin2musicmaker_two],
869         [(16, 4), (18, 4), violin2musicmaker_three],
870         [(21, 4), (22, 4), violin2musicmaker_one],
871         [(22, 4), (23, 4), violin2musicmaker_one],
872         [(35, 4), (40, 4), violin2musicmaker_one],
873         [(44, 4), (46, 4), violin2musicmaker_two],
874         [(46, 4), (47, 4), violin2musicmaker_two],
875         [(49, 4), (50, 4), violin2musicmaker_three],
876         [(55, 4), (59, 4), violin2musicmaker_one],
877         [(62, 4), (64, 4), violin2musicmaker_two],
878         [(65, 4), (67, 4), violin2musicmaker_three],
879         [(67, 4), (70, 4), violin2musicmaker_three],
880         [(70, 4), (71, 4), violin2musicmaker_three],
881         [(73, 4), (75, 4), violin2musicmaker_two],
882         [(75, 4), (76, 4), violin2musicmaker_two],
883         [(80, 4), (82, 4), violin2musicmaker_one],
884         [(82, 4), (85, 4), violin2musicmaker_one],
885         [(86, 4), (88, 4), violin2musicmaker_two],
886         [(91, 4), (94, 4), violin2musicmaker_three],
887         [(94, 4), (95, 4), violin2musicmaker_three],
888         [(100, 4), (101, 4), violin2musicmaker_two],
889         [(103, 4), (104, 4), violin2musicmaker_one],
890         [(104, 4), (106, 4), violin2musicmaker_one],
891         [(110, 4), (114, 4), violin2musicmaker_one],
892         [(115, 4), (119, 4), violin2musicmaker_one],
893         [(120, 4), (123, 4), violin2musicmaker_one],
894         [(123, 4), (124, 4), violin2musicmaker_one],
895         [(125, 4), (126, 4), violin2musicmaker_two],
896         [(129, 4), (131, 4), violin2musicmaker_two],
897         [(131, 4), (134, 4), violin2musicmaker_two],
898         [(141, 4), (144, 4), violin2musicmaker_two],
899         [(149, 4), (150, 4), violin2musicmaker_two],
900         [(154, 4), (157, 4), violin2musicmaker_three],
901         [(159, 4), (160, 4), violin2musicmaker_three],
902         [(165, 4), (168, 4), violin2musicmaker_three],
903         [(168, 4), (169, 4), violin2musicmaker_three],
904         [(172, 4), (174, 4), violin2musicmaker_three],
905         [(175, 4), (179, 4), violin2musicmaker_three],
906         [(179, 4), (180, 4), violin2musicmaker_three],
907         [(184, 4), (186, 4), violin2musicmaker_three],
908         [(186, 4), (190, 4), violin2musicmaker_three],
909     ]
910 ]))
911
912 voice_10_timespan_list = abjad.TimespanList([
913     abjad.AnnotatedTimespan(
914         start_offset=start_offset,
915         stop_offset=stop_offset,
916         annotation=MusicSpecifier(
917             music_maker=music_maker,
918             voice_name='Voice 10',

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```

919     ),
920 )
921 for start_offset, stop_offset, music_maker in [
922     [(2, 4), (5, 4), violamusicmaker_one],
923     [(9, 4), (11, 4), violamusicmaker_two],
924     [(11, 4), (13, 4), violamusicmaker_two],
925     [(17, 4), (18, 4), violamusicmaker_three],
926     [(21, 4), (22, 4), violamusicmaker_one],
927     [(22, 4), (25, 4), violamusicmaker_one],
928     [(29, 4), (30, 4), violamusicmaker_two],
929     [(30, 4), (32, 4), violamusicmaker_two],
930     [(35, 4), (40, 4), violamusicmaker_one],
931     [(44, 4), (46, 4), violamusicmaker_two],
932     [(46, 4), (47, 4), violamusicmaker_two],
933     [(49, 4), (50, 4), violamusicmaker_three],
934     [(55, 4), (59, 4), violamusicmaker_one],
935     [(62, 4), (64, 4), violamusicmaker_two],
936     [(65, 4), (67, 4), violamusicmaker_three],
937     [(67, 4), (70, 4), violamusicmaker_three],
938     [(70, 4), (71, 4), violamusicmaker_three],
939     [(73, 4), (75, 4), violamusicmaker_two],
940     [(75, 4), (76, 4), violamusicmaker_two],
941     [(80, 4), (82, 4), violamusicmaker_one],
942     [(82, 4), (85, 4), violamusicmaker_one],
943     [(86, 4), (88, 4), violamusicmaker_two],
944     [(91, 4), (94, 4), violamusicmaker_three],
945     [(94, 4), (95, 4), violamusicmaker_three],
946     [(100, 4), (101, 4), violamusicmaker_two],
947     [(103, 4), (104, 4), violamusicmaker_one],
948     [(104, 4), (106, 4), violamusicmaker_one],
949     [(110, 4), (114, 4), violamusicmaker_one],
950     [(115, 4), (119, 4), violamusicmaker_one],
951     [(120, 4), (123, 4), violamusicmaker_one],
952     [(123, 4), (124, 4), violamusicmaker_one],
953     [(125, 4), (126, 4), violamusicmaker_two],
954     [(129, 4), (131, 4), violamusicmaker_two],
955     [(131, 4), (134, 4), violamusicmaker_two],
956     [(141, 4), (144, 4), violamusicmaker_two],
957     [(149, 4), (150, 4), violamusicmaker_two],
958     [(153, 4), (154, 4), violamusicmaker_three],
959     [(154, 4), (155, 4), violamusicmaker_three],
960     [(156, 4), (159, 4), violamusicmaker_three],
961     [(159, 4), (161, 4), violamusicmaker_three],
962     [(165, 4), (168, 4), violamusicmaker_three],
963     [(170, 4), (171, 4), violamusicmaker_three],
964     [(176, 4), (179, 4), violamusicmaker_three],
965     [(179, 4), (180, 4), violamusicmaker_three],
966     [(183, 4), (185, 4), violamusicmaker_three],
967     [(186, 4), (190, 4), violamusicmaker_three],
968 ]
969 ])
970
971 ###group three###
972 voice_3_timespan_list = abjad.TimespanList([

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```

973 abjad.AnnotatedTimespan(
974     start_offset=start_offset,
975     stop_offset=stop_offset,
976     annotation=MusicSpecifier(
977         music_maker=music_maker,
978         voice_name='Voice 3',
979     ),
980 )
981 for start_offset, stop_offset, music_maker in [
982     [(7, 4), (11, 4), bassoonmusicmaker_one],
983     [(15, 4), (16, 4), bassoonmusicmaker_two],
984     [(19, 4), (22, 4), bassoonmusicmaker_three],
985     [(22, 4), (23, 4), bassoonmusicmaker_three],
986     [(27, 4), (30, 4), bassoonmusicmaker_one],
987     [(32, 4), (35, 4), bassoonmusicmaker_two],
988     [(35, 4), (36, 4), bassoonmusicmaker_three],
989     [(37, 4), (40, 4), bassoonmusicmaker_two],
990     [(40, 4), (42, 4), bassoonmusicmaker_two],
991     [(46, 4), (49, 4), bassoonmusicmaker_one],
992     [(51, 4), (52, 4), bassoonmusicmaker_three],
993     [(57, 4), (59, 4), bassoonmusicmaker_two],
994     [(59, 4), (61, 4), bassoonmusicmaker_two],
995     [(64, 4), (66, 4), bassoonmusicmaker_one],
996     [(67, 4), (70, 4), bassoonmusicmaker_three],
997     [(70, 4), (72, 4), bassoonmusicmaker_one],
998     [(72, 4), (73, 4), bassoonmusicmaker_one],
999     [(77, 4), (79, 4), bassoonmusicmaker_two],
1000    [(79, 4), (82, 4), bassoonmusicmaker_two],
1001    [(83, 4), (85, 4), bassoonmusicmaker_three],
1002    [(88, 4), (89, 4), bassoonmusicmaker_two],
1003    [(89, 4), (92, 4), bassoonmusicmaker_two],
1004    [(97, 4), (98, 4), bassoonmusicmaker_one],
1005    [(100, 4), (103, 4), bassoonmusicmaker_two],
1006    [(107, 4), (110, 4), bassoonmusicmaker_three],
1007    [(110, 4), (112, 4), bassoonmusicmaker_one],
1008    [(113, 4), (114, 4), bassoonmusicmaker_one],
1009    [(114, 4), (117, 4), bassoonmusicmaker_one],
1010    [(118, 4), (119, 4), bassoonmusicmaker_one],
1011    [(119, 4), (122, 4), bassoonmusicmaker_one],
1012    [(123, 4), (125, 4), bassoonmusicmaker_one],
1013    [(126, 4), (131, 4), bassoonmusicmaker_two],
1014    [(138, 4), (141, 4), bassoonmusicmaker_two],
1015    [(146, 4), (150, 4), bassoonmusicmaker_two],
1016    [(150, 4), (154, 4), bassoonmusicmaker_three],
1017    [(154, 4), (155, 4), bassoonmusicmaker_three],
1018    [(159, 4), (162, 4), bassoonmusicmaker_three],
1019    [(164, 4), (165, 4), bassoonmusicmaker_three],
1020    [(170, 4), (172, 4), bassoonmusicmaker_three],
1021    [(172, 4), (174, 4), bassoonmusicmaker_three],
1022    [(177, 4), (179, 4), bassoonmusicmaker_three],
1023    [(180, 4), (183, 4), bassoonmusicmaker_three],
1024    [(183, 4), (185, 4), bassoonmusicmaker_three],
1025    [(186, 4), (190, 4), bassoonmusicmaker_three],
1026 ]

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```

1027 ])
1028
1029 voice_6_timespan_list = abjad.TimespanList([
1030     abjad.AnnotatedTimespan(
1031         start_offset=start_offset,
1032         stop_offset=stop_offset,
1033         annotation=MusicSpecifier(
1034             music_maker=music_maker,
1035             voice_name='Voice 6',
1036         ),
1037     )
1038     for start_offset, stop_offset, music_maker in [
1039         [(7, 4), (11, 4), trombonemusicmaker_one],
1040         [(14, 4), (16, 4), trombonemusicmaker_two],
1041         [(19, 4), (22, 4), trombonemusicmaker_three],
1042         [(22, 4), (23, 4), trombonemusicmaker_three],
1043         [(27, 4), (29, 4), trombonemusicmaker_one],
1044         [(35, 4), (36, 4), trombonemusicmaker_three],
1045         [(37, 4), (40, 4), trombonemusicmaker_two],
1046         [(40, 4), (42, 4), trombonemusicmaker_two],
1047         [(46, 4), (49, 4), trombonemusicmaker_one],
1048         [(51, 4), (52, 4), trombonemusicmaker_three],
1049         [(57, 4), (59, 4), trombonemusicmaker_two],
1050         [(59, 4), (61, 4), trombonemusicmaker_two],
1051         [(64, 4), (66, 4), trombonemusicmaker_one],
1052         [(67, 4), (70, 4), trombonemusicmaker_three],
1053         [(70, 4), (72, 4), trombonemusicmaker_one],
1054         [(72, 4), (73, 4), trombonemusicmaker_one],
1055         [(77, 4), (79, 4), trombonemusicmaker_two],
1056         [(79, 4), (82, 4), trombonemusicmaker_two],
1057         [(83, 4), (85, 4), trombonemusicmaker_three],
1058         [(88, 4), (89, 4), trombonemusicmaker_two],
1059         [(89, 4), (92, 4), trombonemusicmaker_two],
1060         [(97, 4), (98, 4), trombonemusicmaker_one],
1061         [(100, 4), (103, 4), trombonemusicmaker_two],
1062         [(107, 4), (110, 4), trombonemusicmaker_three],
1063         [(110, 4), (112, 4), trombonemusicmaker_one],
1064         [(113, 4), (114, 4), trombonemusicmaker_one],
1065         [(114, 4), (117, 4), trombonemusicmaker_one],
1066         [(118, 4), (119, 4), trombonemusicmaker_one],
1067         [(119, 4), (122, 4), trombonemusicmaker_one],
1068         [(123, 4), (125, 4), trombonemusicmaker_one],
1069         [(126, 4), (131, 4), trombonemusicmaker_two],
1070         [(138, 4), (141, 4), trombonemusicmaker_two],
1071         [(146, 4), (150, 4), trombonemusicmaker_two],
1072         [(150, 4), (154, 4), trombonemusicmaker_three],
1073         [(157, 4), (159, 4), trombonemusicmaker_three],
1074         [(160, 4), (164, 4), trombonemusicmaker_three],
1075         [(164, 4), (165, 4), trombonemusicmaker_three],
1076         [(169, 4), (172, 4), trombonemusicmaker_three],
1077         [(174, 4), (175, 4), trombonemusicmaker_three],
1078         [(180, 4), (183, 4), trombonemusicmaker_three],
1079         [(183, 4), (184, 4), trombonemusicmaker_three],
1080         [(186, 4), (190, 4), trombonemusicmaker_three],

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1081 ]
1082 ])
1083
1084 voice_11_timespan_list = abjad.TimespanList([
1085     abjad.AnnotatedTimespan(
1086         start_offset=start_offset,
1087         stop_offset=stop_offset,
1088         annotation=MusicSpecifier(
1089             music_maker=music_maker,
1090             voice_name='Voice 11',
1091         ),
1092     )
1093     for start_offset, stop_offset, music_maker in [
1094         [(7, 4), (11, 4), cellomusicmaker_one],
1095         [(14, 4), (16, 4), cellomusicmaker_two],
1096         [(21, 4), (22, 4), cellomusicmaker_three],
1097         [(22, 4), (23, 4), cellomusicmaker_three],
1098         [(27, 4), (30, 4), cellomusicmaker_one],
1099         [(35, 4), (36, 4), cellomusicmaker_three],
1100         [(37, 4), (40, 4), cellomusicmaker_two],
1101         [(40, 4), (42, 4), cellomusicmaker_two],
1102         [(46, 4), (49, 4), cellomusicmaker_one],
1103         [(51, 4), (52, 4), cellomusicmaker_three],
1104         [(57, 4), (59, 4), cellomusicmaker_two],
1105         [(59, 4), (61, 4), cellomusicmaker_two],
1106         [(64, 4), (66, 4), cellomusicmaker_one],
1107         [(67, 4), (70, 4), cellomusicmaker_three],
1108         [(70, 4), (72, 4), cellomusicmaker_one],
1109         [(72, 4), (73, 4), cellomusicmaker_one],
1110         [(77, 4), (79, 4), cellomusicmaker_two],
1111         [(79, 4), (82, 4), cellomusicmaker_two],
1112         [(83, 4), (85, 4), cellomusicmaker_three],
1113         [(88, 4), (89, 4), cellomusicmaker_two],
1114         [(89, 4), (92, 4), cellomusicmaker_two],
1115         [(97, 4), (98, 4), cellomusicmaker_one],
1116         [(100, 4), (103, 4), cellomusicmaker_two],
1117         [(107, 4), (110, 4), cellomusicmaker_three],
1118         [(110, 4), (112, 4), cellomusicmaker_one],
1119         [(113, 4), (114, 4), cellomusicmaker_one],
1120         [(114, 4), (117, 4), cellomusicmaker_one],
1121         [(118, 4), (119, 4), cellomusicmaker_one],
1122         [(119, 4), (122, 4), cellomusicmaker_one],
1123         [(123, 4), (125, 4), cellomusicmaker_one],
1124         [(126, 4), (131, 4), cellomusicmaker_two],
1125         [(138, 4), (141, 4), cellomusicmaker_two],
1126         [(146, 4), (150, 4), cellomusicmaker_two],
1127         [(150, 4), (153, 4), cellomusicmaker_three],
1128         [(155, 4), (156, 4), cellomusicmaker_three],
1129         [(161, 4), (164, 4), cellomusicmaker_three],
1130         [(164, 4), (165, 4), cellomusicmaker_three],
1131         [(168, 4), (170, 4), cellomusicmaker_three],
1132         [(171, 4), (172, 4), cellomusicmaker_three],
1133         [(172, 4), (175, 4), cellomusicmaker_three],
1134         [(175, 4), (176, 4), cellomusicmaker_three],

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1135         [(180, 4), (183, 4), cellomusicmaker_three],
1136         [(185, 4), (186, 4), cellomusicmaker_three],
1137         [(186, 4), (190, 4), cellomusicmaker_three],
1138     ]
1139 ])
1140
1141 ###group four###
1142 voice_4_timespan_list = abjad.TimespanList([
1143     abjad.AnnotatedTimespan(
1144         start_offset=start_offset,
1145         stop_offset=stop_offset,
1146         annotation=MusicSpecifier(
1147             music_maker=music_maker,
1148             voice_name='Voice 4',
1149         ),
1150     )
1151     for start_offset, stop_offset, music_maker in [
1152         [(0, 4), (5, 4), hornmusicmaker_one],
1153         [(8, 4), (10, 4), hornmusicmaker_two],
1154         [(14, 4), (18, 4), hornmusicmaker_three],
1155         [(21, 4), (22, 4), hornmusicmaker_one],
1156         [(22, 4), (23, 4), hornmusicmaker_one],
1157         [(38, 4), (40, 4), hornmusicmaker_two],
1158         [(41, 4), (43, 4), hornmusicmaker_one],
1159         [(43, 4), (46, 4), hornmusicmaker_one],
1160         [(50, 4), (53, 4), hornmusicmaker_three],
1161         [(55, 4), (56, 4), hornmusicmaker_two],
1162         [(61, 4), (64, 4), hornmusicmaker_one],
1163         [(64, 4), (65, 4), hornmusicmaker_one],
1164         [(68, 4), (70, 4), hornmusicmaker_three],
1165         [(70, 4), (72, 4), hornmusicmaker_two],
1166         [(72, 4), (74, 4), hornmusicmaker_two],
1167         [(79, 4), (80, 4), hornmusicmaker_three],
1168         [(82, 4), (85, 4), hornmusicmaker_two],
1169         [(89, 4), (94, 4), hornmusicmaker_one],
1170         [(95, 4), (97, 4), hornmusicmaker_two],
1171         [(100, 4), (104, 4), hornmusicmaker_three],
1172         [(109, 4), (110, 4), hornmusicmaker_two],
1173         [(110, 4), (111, 4), hornmusicmaker_one],
1174         [(112, 4), (114, 4), hornmusicmaker_one],
1175         [(114, 4), (116, 4), hornmusicmaker_one],
1176         [(117, 4), (119, 4), hornmusicmaker_one],
1177         [(119, 4), (121, 4), hornmusicmaker_one],
1178         [(122, 4), (123, 4), hornmusicmaker_one],
1179         [(123, 4), (125, 4), hornmusicmaker_one],
1180         [(133, 4), (136, 4), hornmusicmaker_two],
1181         [(142, 4), (146, 4), hornmusicmaker_two],
1182         [(146, 4), (150, 4), hornmusicmaker_two],
1183         [(153, 4), (154, 4), hornmusicmaker_three],
1184         [(154, 4), (155, 4), hornmusicmaker_three],
1185         [(159, 4), (162, 4), hornmusicmaker_three],
1186         [(164, 4), (168, 4), hornmusicmaker_three],
1187         [(171, 4), (172, 4), hornmusicmaker_three],
1188         [(172, 4), (173, 4), hornmusicmaker_three],

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1189     [(177, 4), (179, 4), hornmusicmaker_three],
1190     [(179, 4), (180, 4), hornmusicmaker_three],
1191     [(182, 4), (183, 4), hornmusicmaker_three],
1192     [(183, 4), (186, 4), hornmusicmaker_three],
1193     [(186, 4), (190, 4), hornmusicmaker_three],
1194 ]
1195 ])
1196
1197 voice_7_timespan_list = abjad.TimespanList([
1198     abjad.AnnotatedTimespan(
1199         start_offset=start_offset,
1200         stop_offset=stop_offset,
1201         annotation=MusicSpecifier(
1202             music_maker=music_maker,
1203             voice_name='Voice 7',
1204         ),
1205     )
1206     for start_offset, stop_offset, music_maker in [
1207         [(0, 4), (5, 4), tubamusicmaker_one],
1208         [(8, 4), (10, 4), tubamusicmaker_two],
1209         [(14, 4), (18, 4), tubamusicmaker_three],
1210         [(21, 4), (22, 4), tubamusicmaker_one],
1211         [(22, 4), (23, 4), tubamusicmaker_one],
1212         [(26, 4), (30, 4), tubamusicmaker_two],
1213         [(38, 4), (40, 4), tubamusicmaker_two],
1214         [(41, 4), (43, 4), tubamusicmaker_one],
1215         [(43, 4), (46, 4), tubamusicmaker_one],
1216         [(50, 4), (53, 4), tubamusicmaker_three],
1217         [(55, 4), (56, 4), tubamusicmaker_two],
1218         [(61, 4), (64, 4), tubamusicmaker_one],
1219         [(64, 4), (65, 4), tubamusicmaker_one],
1220         [(68, 4), (70, 4), tubamusicmaker_three],
1221         [(70, 4), (72, 4), tubamusicmaker_two],
1222         [(72, 4), (74, 4), tubamusicmaker_two],
1223         [(79, 4), (80, 4), tubamusicmaker_three],
1224         [(82, 4), (85, 4), tubamusicmaker_two],
1225         [(89, 4), (94, 4), tubamusicmaker_one],
1226         [(95, 4), (97, 4), tubamusicmaker_two],
1227         [(100, 4), (104, 4), tubamusicmaker_three],
1228         [(109, 4), (110, 4), tubamusicmaker_two],
1229         [(110, 4), (111, 4), tubamusicmaker_one],
1230         [(112, 4), (114, 4), tubamusicmaker_one],
1231         [(114, 4), (116, 4), tubamusicmaker_one],
1232         [(117, 4), (119, 4), tubamusicmaker_one],
1233         [(119, 4), (121, 4), tubamusicmaker_one],
1234         [(122, 4), (123, 4), tubamusicmaker_one],
1235         [(123, 4), (125, 4), tubamusicmaker_one],
1236         [(133, 4), (136, 4), tubamusicmaker_two],
1237         [(142, 4), (146, 4), tubamusicmaker_two],
1238         [(146, 4), (150, 4), tubamusicmaker_two],
1239         [(154, 4), (157, 4), tubamusicmaker_three],
1240         [(159, 4), (163, 4), tubamusicmaker_three],
1241         [(166, 4), (168, 4), tubamusicmaker_three],
1242         [(172, 4), (175, 4), tubamusicmaker_three],

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1243         [(177, 4), (179, 4), tubamusicmaker_three],
1244         [(179, 4), (181, 4), tubamusicmaker_three],
1245         [(184, 4), (186, 4), tubamusicmaker_three],
1246         [(186, 4), (190, 4), tubamusicmaker_three],
1247     ]
1248 })
1249
1250 voice_12_timespan_list = abjad.TimespanList([
1251     abjad.AnnotatedTimespan(
1252         start_offset=start_offset,
1253         stop_offset=stop_offset,
1254         annotation=MusicSpecifier(
1255             music_maker=music_maker,
1256             voice_name='Voice 12',
1257         ),
1258     )
1259     for start_offset, stop_offset, music_maker in [
1260         [(0, 4), (5, 4), bassmusicmaker_one],
1261         [(8, 4), (10, 4), bassmusicmaker_two],
1262         [(14, 4), (18, 4), bassmusicmaker_three],
1263         [(21, 4), (22, 4), bassmusicmaker_one],
1264         [(22, 4), (23, 4), bassmusicmaker_one],
1265         [(38, 4), (40, 4), bassmusicmaker_two],
1266         [(41, 4), (43, 4), bassmusicmaker_one],
1267         [(43, 4), (46, 4), bassmusicmaker_one],
1268         [(50, 4), (53, 4), bassmusicmaker_three],
1269         [(55, 4), (56, 4), bassmusicmaker_two],
1270         [(61, 4), (64, 4), bassmusicmaker_one],
1271         [(64, 4), (65, 4), bassmusicmaker_one],
1272         [(68, 4), (70, 4), bassmusicmaker_three],
1273         [(70, 4), (72, 4), bassmusicmaker_two],
1274         [(72, 4), (74, 4), bassmusicmaker_two],
1275         [(79, 4), (80, 4), bassmusicmaker_three],
1276         [(82, 4), (85, 4), bassmusicmaker_two],
1277         [(89, 4), (94, 4), bassmusicmaker_one],
1278         [(95, 4), (97, 4), bassmusicmaker_two],
1279         [(100, 4), (104, 4), bassmusicmaker_three],
1280         [(109, 4), (110, 4), bassmusicmaker_two],
1281         [(110, 4), (111, 4), bassmusicmaker_one],
1282         [(112, 4), (114, 4), bassmusicmaker_one],
1283         [(114, 4), (116, 4), bassmusicmaker_one],
1284         [(117, 4), (119, 4), bassmusicmaker_one],
1285         [(119, 4), (121, 4), bassmusicmaker_one],
1286         [(122, 4), (123, 4), bassmusicmaker_one],
1287         [(123, 4), (125, 4), bassmusicmaker_one],
1288         [(133, 4), (136, 4), bassmusicmaker_two],
1289         [(142, 4), (146, 4), bassmusicmaker_two],
1290         [(146, 4), (150, 4), bassmusicmaker_two],
1291         [(152, 4), (154, 4), bassmusicmaker_three],
1292         [(154, 4), (156, 4), bassmusicmaker_three],
1293         [(159, 4), (161, 4), bassmusicmaker_three],
1294         [(165, 4), (168, 4), bassmusicmaker_three],
1295         [(170, 4), (172, 4), bassmusicmaker_three],
1296         [(172, 4), (174, 4), bassmusicmaker_three],

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1297         [(177, 4), (179, 4), bassmusicmaker_three],
1298         [(183, 4), (186, 4), bassmusicmaker_three],
1299         [(186, 4), (190, 4), bassmusicmaker_three],
1300     ]
1301 ])
1302
1303 all_timespan_lists = {
1304     'Voice 1': voice_1_timespan_list,
1305     'Voice 2': voice_2_timespan_list,
1306     'Voice 3': voice_3_timespan_list,
1307     'Voice 4': voice_4_timespan_list,
1308     'Voice 5': voice_5_timespan_list,
1309     'Voice 6': voice_6_timespan_list,
1310     'Voice 7': voice_7_timespan_list,
1311     'Voice 8': voice_8_timespan_list,
1312     'Voice 9': voice_9_timespan_list,
1313     'Voice 10': voice_10_timespan_list,
1314     'Voice 11': voice_11_timespan_list,
1315     'Voice 12': voice_12_timespan_list,
1316 }
1317
1318 global_timespan = abjad.Timespan(
1319     start_offset=0,
1320     stop_offset=max(_.stop_offset for _ in all_timespan_lists.values())
1321 )
1322
1323 for voice_name, timespan_list in all_timespan_lists.items():
1324     silences = abjad.TimespanList([global_timespan])
1325     silences.extend(timespan_list)
1326     silences.sort()
1327     silences.compute_logical_xor()
1328     for silence_timespan in silences:
1329         timespan_list.append(
1330             abjad.AnnotatedTimespan(
1331                 start_offset=silence_timespan.start_offset,
1332                 stop_offset=silence_timespan.stop_offset,
1333                 annotation=MusicSpecifier(
1334                     music_maker=None,
1335                     voice_name=voice_name,
1336                 ),
1337             )
1338         )
1339     timespan_list.sort()
1340
1341 for voice_name, timespan_list in all_timespan_lists.items():
1342     shards = timespan_list.split_at_offsets(bounds)
1343     split_timespan_list = abjad.TimespanList()
1344     for shard in shards:
1345         split_timespan_list.extend(shard)
1346     split_timespan_list.sort()
1347     all_timespan_lists[voice_name] = timespan_list
1348
1349 score = abjad.Score([
1350     abjad.Staff(lilypond_type='TimeSignatureContext', name='Global Context 1')

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,
1351     abjad.StaffGroup(
1352         [
1353             abjad.Staff([abjad.Voice(name='Voice 1')], name='Staff 1',
1354             lilypond_type='Staff'),
1355             abjad.Staff([abjad.Voice(name='Voice 2')], name='Staff 2',
1356             lilypond_type='Staff'),
1357             abjad.Staff([abjad.Voice(name='Voice 3')], name='Staff 3',
1358             lilypond_type='Staff'),
1359         ],
1360         name='Staff Group 1',
1361     ),
1362     abjad.Staff(lilypond_type='TimeSignatureContext', name='Global Context 2')
1363 ,
1364     abjad.StaffGroup(
1365         [
1366             abjad.Staff([abjad.Voice(name='Voice 4')], name='Staff 4',
1367             lilypond_type='Staff'),
1368             abjad.Staff([abjad.Voice(name='Voice 5')], name='Staff 5',
1369             lilypond_type='Staff'),
1370             abjad.Staff([abjad.Voice(name='Voice 6')], name='Staff 6',
1371             lilypond_type='Staff'),
1372             abjad.Staff([abjad.Voice(name='Voice 7')], name='Staff 7',
1373             lilypond_type='Staff'),
1374         ],
1375         name='Staff Group 2',
1376     ),
1377     abjad.Staff(lilypond_type='TimeSignatureContext', name='Global Context 3')
1378 ,
1379     abjad.StaffGroup(
1380         [
1381             abjad.Staff([abjad.Voice(name='Voice 8')], name='Staff 8',
1382             lilypond_type='Staff'),
1383             abjad.Staff([abjad.Voice(name='Voice 9')], name='Staff 9',
1384             lilypond_type='Staff'),
1385             abjad.Staff([abjad.Voice(name='Voice 10')], name='Staff 10',
1386             lilypond_type='Staff'),
1387             abjad.Staff([abjad.Voice(name='Voice 11')], name='Staff 11',
1388             lilypond_type='Staff'),
1389             abjad.Staff([abjad.Voice(name='Voice 12')], name='Staff 12',
1390             lilypond_type='Staff'),
1391         ],
1392         name='Staff Group 3',
1393     )
1394 ],
1395 )
1396
1397 for time_signature in time_signatures:
1398     skip = abjad.Skip(1, multiplier=(time_signature))
1399     abjad.attach(time_signature, skip)
1400     score['Global Context 1'].append(skip)
1401
1402 for time_signature in time_signatures:
1403     skip = abjad.Skip(1, multiplier=(time_signature))

```



```

1390     abjad.attach(time_signature, skip)
1391     score['Global Context 2'].append(skip)
1392
1393     for time_signature in time_signatures:
1394         skip = abjad.Skip(1, multiplier=(time_signature))
1395         abjad.attach(time_signature, skip)
1396         score['Global Context 3'].append(skip)
1397
1398     print('Making containers ...')
1399
1400     def make_container(music_maker, durations):
1401         selections = music_maker(durations)
1402         container = abjad.Container([])
1403         container.extend(selections)
1404         return container
1405
1406     def key_function(timespan):
1407         return timespan.annotation.music_maker or silence_maker
1408
1409     for voice_name, timespan_list in all_timespan_lists.items():
1410         for music_maker, grouper in itertools.groupby(
1411             timespan_list,
1412             key=key_function,
1413         ):
1414             durations = [timespan.duration for timespan in grouper]
1415             container = make_container(music_maker, durations)
1416             voice = score[voice_name]
1417             voice.append(container)
1418
1419     print('Splitting and rewriting ...')
1420
1421     for voice in abjad.iterate(score['Staff Group 1']).components(abjad.Voice):
1422         for i, shard in enumerate(abjad.mutate(voice[:]).split(time_signatures)):
1423             time_signature = time_signatures[i]
1424             abjad.mutate(shard).rewrite_meter(time_signature)
1425
1426     for voice in abjad.iterate(score['Staff Group 2']).components(abjad.Voice):
1427         for i, shard in enumerate(abjad.mutate(voice[:]).split(time_signatures)):
1428             time_signature = time_signatures[i]
1429             abjad.mutate(shard).rewrite_meter(time_signature)
1430
1431     for voice in abjad.iterate(score['Staff Group 3']).components(abjad.Voice):
1432         for i, shard in enumerate(abjad.mutate(voice[:]).split(time_signatures)):
1433             time_signature = time_signatures[i]
1434             abjad.mutate(shard).rewrite_meter(time_signature)
1435
1436     print('Beaming runs ...')
1437
1438     for voice in abjad.select(score).components(abjad.Voice):
1439         for run in abjad.select(voice).runs():
1440             if 1 < len(run):
1441                 specifier = abjadext.rmakers.BeamSpecifier(
1442                     beam_each_division=False,
1443                 )

```

```

1444     specifier(run)
1445     abjad.attach(abjad.StartBeam(), run[0])
1446     abjad.attach(abjad.StopBeam(), run[-1])
1447     for leaf in run:
1448         if abjad.Duration(1, 4) <= leaf.written_duration:
1449             continue
1450         previous_leaf = abjad.inspect(leaf).leaf(-1)
1451         next_leaf = abjad.inspect(leaf).leaf(1)
1452         if (isinstance(next_leaf, (abjad.Chord, abjad.Note)) and
1453             abjad.Duration(1, 4) <= next_leaf.written_duration):
1454             left = previous_leaf.written_duration.flag_count
1455             right = leaf.written_duration.flag_count
1456             beam_count = abjad.BeamCount(
1457                 left=left,
1458                 right=right,
1459             )
1460             abjad.attach(beam_count, leaf)
1461             continue
1462         if (isinstance(previous_leaf, (abjad.Chord, abjad.Note)) and
1463             abjad.Duration(1, 4) <= previous_leaf.written_duration):
1464             left = leaf.written_duration.flag_count
1465             right = next_leaf.written_duration.flag_count
1466             beam_count = abjad.BeamCount(
1467                 left=left,
1468                 right=right,
1469             )
1470             abjad.attach(beam_count, leaf)
1471
1472     print('Beautifying score ...')
1473     for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
1474         for selection in abjad.select(staff).components(abjad.Rest):
1475             group_by_contiguity():
1476                 start_command = abjad.LilyPondLiteral(
1477                     r'\stopStaff \once \override Staff.StaffSymbol.line-count = #1 \
1478                     startStaff',
1479                     format_slot='before',
1480                 )
1481                 stop_command = abjad.LilyPondLiteral(
1482                     r'\stopStaff \startStaff',
1483                     format_slot='after',
1484                 )
1485                 abjad.attach(start_command, selection[0])
1486                 abjad.attach(stop_command, selection[-1])
1487
1488     for staff in abjad.iterate(score['Staff Group 2']).components(abjad.Staff):
1489         for selection in abjad.select(staff).components(abjad.Rest):
1490             group_by_contiguity():
1491                 start_command = abjad.LilyPondLiteral(
1492                     r'\stopStaff \once \override Staff.StaffSymbol.line-count = #1 \
1493                     startStaff',
1494                     format_slot='before',
1495                 )
1496                 stop_command = abjad.LilyPondLiteral(
1497                     r'\stopStaff \startStaff',

```

```

1494         format_slot='after',
1495     )
1496     abjad.attach(start_command, selection[0])
1497     abjad.attach(stop_command, selection[-1])
1498
1499 for staff in abjad.iterate(score['Staff Group 3']).components(abjad.Staff):
1500     for selection in abjad.select(staff).components(abjad.Rest):
1501         group_by_contiguity():
1502             start_command = abjad.LilyPondLiteral(
1503                 r'\stopStaff \once \override Staff.StaffSymbol.line-count = #1 \
1504                 startStaff',
1505                 format_slot='before',
1506             )
1507             stop_command = abjad.LilyPondLiteral(
1508                 r'\stopStaff \startStaff',
1509                 format_slot='after',
1510             )
1511             abjad.attach(start_command, selection[0])
1512             abjad.attach(stop_command, selection[-1])
1513
1514 print('Stopping Hairpins ...')
1515 for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
1516     for rest in abjad.iterate(staff).components(abjad.Rest):
1517         previous_leaf = abjad.inspect(rest).leaf(-1)
1518         if isinstance(previous_leaf, abjad.Note):
1519             abjad.attach(abjad.StopHairpin(), rest)
1520         elif isinstance(previous_leaf, abjad.Chord):
1521             abjad.attach(abjad.StopHairpin(), rest)
1522         elif isinstance(previous_leaf, abjad.Rest):
1523             pass
1524
1525 for staff in abjad.iterate(score['Staff Group 2']).components(abjad.Staff):
1526     for rest in abjad.iterate(staff).components(abjad.Rest):
1527         previous_leaf = abjad.inspect(rest).leaf(-1)
1528         if isinstance(previous_leaf, abjad.Note):
1529             abjad.attach(abjad.StopHairpin(), rest)
1530         elif isinstance(previous_leaf, abjad.Chord):
1531             abjad.attach(abjad.StopHairpin(), rest)
1532         elif isinstance(previous_leaf, abjad.Rest):
1533             pass
1534
1535 for staff in abjad.iterate(score['Staff Group 3']).components(abjad.Staff):
1536     for rest in abjad.iterate(staff).components(abjad.Rest):
1537         previous_leaf = abjad.inspect(rest).leaf(-1)
1538         if isinstance(previous_leaf, abjad.Note):
1539             abjad.attach(abjad.StopHairpin(), rest)
1540         elif isinstance(previous_leaf, abjad.Chord):
1541             abjad.attach(abjad.StopHairpin(), rest)
1542         elif isinstance(previous_leaf, abjad.Rest):
1543             pass
1544
1545 print('Adding pitch material ...')
1546 def cyc(lst):
1547     count = 0

```

```

1546     while True:
1547         yield lst[count%len(lst)]
1548         count += 1
1549
1550     print('Adding attachments ...')
1551     bar_line = abjad.BarLine('||')
1552     metro = abjad.MetronomeMark((1, 4), 60)
1553     markup1 = abjad.Markup(r'\bold { M }')
1554     markup2 = abjad.Markup(r'\bold { N }')
1555     markup3 = abjad.Markup(r'\bold { O }')
1556     markup4 = abjad.Markup(r'\bold { P }')
1557     markup5 = abjad.Markup(r'\bold { Q }')
1558     markup6 = abjad.Markup(r'\bold { R }')
1559     mark1 = abjad.RehearsalMark(markup=markup1)
1560     mark2 = abjad.RehearsalMark(markup=markup2)
1561     mark3 = abjad.RehearsalMark(markup=markup3)
1562     mark4 = abjad.RehearsalMark(markup=markup4)
1563     mark5 = abjad.RehearsalMark(markup=markup5)
1564     mark6 = abjad.RehearsalMark(markup=markup6)
1565
1566     instruments1 = cyc([
1567         abjad.Flute(),
1568         abjad.ClarinetInBFlat(),
1569         abjad.Bassoon(),
1570     ])
1571
1572     instruments2 = cyc([
1573         abjad.FrenchHorn(),
1574         abjad.Trumpet(),
1575         abjad.TenorTrombone(),
1576         abjad.Tuba(),
1577     ])
1578
1579     instruments3 = cyc([
1580         abjad.Violin(),
1581         abjad.Violin(),
1582         abjad.Viola(),
1583         abjad.Cello(),
1584         abjad.Contrabass(),
1585     ])
1586
1587     clefs1 = cyc([
1588         abjad.Clef('treble'),
1589         abjad.Clef('treble'),
1590         abjad.Clef('bass'),
1591     ])
1592
1593     clefs2 = cyc([
1594         abjad.Clef('treble'),
1595         abjad.Clef('treble'),
1596         abjad.Clef('bass'),
1597         abjad.Clef('bass'),
1598     ])
1599

```

```

1600 clefs3 = cyc([
1601     abjad.Clef('treble'),
1602     abjad.Clef('treble'),
1603     abjad.Clef('alto'),
1604     abjad.Clef('bass'),
1605     abjad.Clef('bass'),
1606 ])
1607
1608 abbreviations1 = cyc([
1609     abjad.MarginMarkup(markup=abjad.Markup('fl.'),),
1610     abjad.MarginMarkup(markup=abjad.Markup('cl.'),),
1611     abjad.MarginMarkup(markup=abjad.Markup('bssn.'),),
1612 ])
1613
1614 abbreviations2 = cyc([
1615     abjad.MarginMarkup(markup=abjad.Markup('hr.'),),
1616     abjad.MarginMarkup(markup=abjad.Markup('trp.'),),
1617     abjad.MarginMarkup(markup=abjad.Markup('trmb.'),),
1618     abjad.MarginMarkup(markup=abjad.Markup('tb.'),),
1619 ])
1620
1621 abbreviations3 = cyc([
1622     abjad.MarginMarkup(markup=abjad.Markup('vln.I'),),
1623     abjad.MarginMarkup(markup=abjad.Markup('vln.II'),),
1624     abjad.MarginMarkup(markup=abjad.Markup('vla.'),),
1625     abjad.MarginMarkup(markup=abjad.Markup('vc.'),),
1626     abjad.MarginMarkup(markup=abjad.Markup('cb.'),),
1627 ])
1628
1629 names1 = cyc([
1630     abjad.StartMarkup(markup=abjad.Markup('Flute'),),
1631     abjad.StartMarkup(markup=abjad.Markup('Clarinet'),),
1632     abjad.StartMarkup(markup=abjad.Markup('Bassoon'),),
1633 ])
1634
1635 names2 = cyc([
1636     abjad.StartMarkup(markup=abjad.Markup('Horn'),),
1637     abjad.StartMarkup(markup=abjad.Markup('Trumpet'),),
1638     abjad.StartMarkup(markup=abjad.Markup('Trombone'),),
1639     abjad.StartMarkup(markup=abjad.Markup('Tuba'),),
1640 ])
1641
1642 names3 = cyc([
1643     abjad.StartMarkup(markup=abjad.Markup('Violin I'),),
1644     abjad.StartMarkup(markup=abjad.Markup('Violin II'),),
1645     abjad.StartMarkup(markup=abjad.Markup('Viola'),),
1646     abjad.StartMarkup(markup=abjad.Markup('Violoncello'),),
1647     abjad.StartMarkup(markup=abjad.Markup('Contrabass'),),
1648 ])
1649
1650 for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
1651     leaf1 = abjad.select(staff).leaves()[0]
1652     abjad.attach(next(instruments1), leaf1)
1653     abjad.attach(next(abbreviations1), leaf1)

```

```

1654     abjad.attach(next(names1), leaf1)
1655     abjad.attach(next(clefs1), leaf1)
1656
1657     for staff in abjad.iterate(score['Staff Group 2']).components(abjad.Staff):
1658         leaf1 = abjad.select(staff).leaves()[0]
1659         abjad.attach(next(instruments2), leaf1)
1660         abjad.attach(next(abbreviations2), leaf1)
1661         abjad.attach(next(names2), leaf1)
1662         abjad.attach(next(clefs2), leaf1)
1663
1664     for staff in abjad.iterate(score['Staff Group 3']).components(abjad.Staff):
1665         leaf1 = abjad.select(staff).leaves()[0]
1666         abjad.attach(next(instruments3), leaf1)
1667         abjad.attach(next(abbreviations3), leaf1)
1668         abjad.attach(next(names3), leaf1)
1669         abjad.attach(next(clefs3), leaf1)
1670
1671     for staff in abjad.select(score['Staff Group 1']).components(abjad.Staff)[0]:
1672         leaf1 = abjad.select(staff).leaves()[0]
1673         last_leaf = abjad.select(staff).leaves()[-1]
1674         abjad.attach(metro, leaf1)
1675         abjad.attach(bar_line, last_leaf)
1676
1677     for staff in abjad.select(score['Staff Group 2']).components(abjad.Staff)[0]:
1678         leaf1 = abjad.select(staff).leaves()[0]
1679         last_leaf = abjad.select(staff).leaves()[-1]
1680         abjad.attach(metro, leaf1)
1681         abjad.attach(bar_line, last_leaf)
1682
1683     for staff in abjad.select(score['Staff Group 3']).components(abjad.Staff)[0]:
1684         leaf1 = abjad.select(staff).leaves()[0]
1685         last_leaf = abjad.select(staff).leaves()[-1]
1686         abjad.attach(metro, leaf1)
1687         abjad.attach(bar_line, last_leaf)
1688
1689     for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1690         leaf1 = abjad.select(staff).leaves()[7]
1691         abjad.attach(mark1, leaf1)
1692
1693     for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1694         leaf1 = abjad.select(staff).leaves()[7]
1695         abjad.attach(mark1, leaf1)
1696
1697     for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1698         leaf1 = abjad.select(staff).leaves()[7]
1699         abjad.attach(mark1, leaf1)
1700
1701     for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1702         leaf2 = abjad.select(staff).leaves()[16]
1703         abjad.attach(mark2, leaf2)
1704
1705     for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1706         leaf2 = abjad.select(staff).leaves()[16]
1707         abjad.attach(mark2, leaf2)

```

```

1708
1709 for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1710     leaf2 = abjad.select(staff).leaves()[16]
1711     abjad.attach(mark2, leaf2)
1712
1713 for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1714     leaf3 = abjad.select(staff).leaves()[22]
1715     abjad.attach(mark3, leaf3)
1716
1717 for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1718     leaf3 = abjad.select(staff).leaves()[22]
1719     abjad.attach(mark3, leaf3)
1720
1721 for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1722     leaf3 = abjad.select(staff).leaves()[22]
1723     abjad.attach(mark3, leaf3)
1724
1725 for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1726     leaf4 = abjad.select(staff).leaves()[29]
1727     abjad.attach(mark4, leaf4)
1728
1729 for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1730     leaf4 = abjad.select(staff).leaves()[29]
1731     abjad.attach(mark4, leaf4)
1732
1733 for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1734     leaf4 = abjad.select(staff).leaves()[29]
1735     abjad.attach(mark4, leaf4)
1736
1737 for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1738     leaf5 = abjad.select(staff).leaves()[34]
1739     abjad.attach(mark5, leaf5)
1740
1741 for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1742     leaf5 = abjad.select(staff).leaves()[34]
1743     abjad.attach(mark5, leaf5)
1744
1745 for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1746     leaf5 = abjad.select(staff).leaves()[34]
1747     abjad.attach(mark5, leaf5)
1748
1749 for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1750     leaf6 = abjad.select(staff).leaves()[39]
1751     abjad.attach(mark6, leaf6)
1752
1753 for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1754     leaf6 = abjad.select(staff).leaves()[39]
1755     abjad.attach(mark6, leaf6)
1756
1757 for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1758     leaf6 = abjad.select(staff).leaves()[39]
1759     abjad.attach(mark6, leaf6)
1760
1761 for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):

```

```

1762     abjad.Instrument.transpose_from_sounding_pitch(staff)
1763
1764 for staff in abjad.iterate(score['Staff Group 2']).components(abjad.Staff):
1765     abjad.Instrument.transpose_from_sounding_pitch(staff)
1766
1767 for staff in abjad.iterate(score['Staff Group 3']).components(abjad.Staff):
1768     abjad.Instrument.transpose_from_sounding_pitch(staff)
1769
1770 score_file = abjad.LilyPondFile.new(
1771     score,
1772     includes=['first_stylesheet.ily', '/Users/evansdsg2/abjad/docs/source/
1773         _stylesheets/abjad.ily'],
1774 )
1775
1776 abjad.SegmentMaker.comment_measure_numbers(score)
1777 #####
1778
1779 directory = '/Users/evansdsg2/Scores/tianshu/tianshu/Segments/Segment_III'
1780 pdf_path = f'{directory}/Segment_III.pdf'
1781 path = pathlib.Path('Segment_III.pdf')
1782 if path.exists():
1783     print(f'Removing {pdf_path} ...')
1784     path.unlink()
1785
1786 time_1 = time.time()
1787 print(f'Persisting {pdf_path} ...')
1788 result = abjad.persist(score_file).as_pdf(pdf_path)
1789 print(result[0])
1790 print(result[1])
1791 print(result[2])
1792 success = result[3]
1793 if success is False:
1794     print('LilyPond failed!')
1795
1796 time_2 = time.time()
1797 total_time = time_2 - time_1
1798 print(f'Total time: {total_time} seconds')
1799
1800 if path.exists():
1801     print(f'Opening {pdf_path} ...')
1802     os.system(f'open {pdf_path}')

```

Code Example A.13: Tianshu Segment_III

A.3.1.4 SEGMENT_IV

```

1 import abjad
2 import itertools
3 import os
4 import pathlib
5 import time
6 import abjadext.rmakers
7 from MusicMaker import MusicMaker
8 from AttachmentHandler import AttachmentHandler
9 from random import random
10 from random import seed

```



```

11
12 print('Interpreting file ...')
13
14 time_signatures = [
15     abjad.TimeSignature(pair) for pair in [
16         (5, 4), (2, 4), (4, 4), (3, 4), (4, 4), (4, 4),
17         (4, 4), (4, 4), (5, 4), (5, 4), (3, 4), (3, 4),
18         (4, 4), (4, 4), (5, 4), (5, 4), (3, 4), (3, 4),
19         (2, 4), (3, 4), (4, 4), (3, 4), (4, 4), (3, 4),
20         (5, 4), (3, 4), (3, 4), (4, 4), (3, 4), (3, 4),
21         (4, 4), (5, 4), (4, 4), (3, 4), (5, 4), (5, 4),
22         (5, 4), (5, 4), (4, 4), (4, 4), (5, 4), (5, 4),
23         (4, 4), (4, 4), (3, 4), (4, 4), (4, 4), (3, 4),
24         (9, 8),
25     ]
26 ]
27
28 bounds = abjad.mathtools.cumulative_sums([_.duration for _ in time_signatures
29 ])
30
31 def reduceMod3(rw):
32     return [(x % 4) for x in rw]
33
34 def reduceMod5(rw):
35     return [(x % 6) for x in rw]
36
37 def reduceMod7(rw):
38     return [(x % 8) for x in rw]
39
40 def reduceMod9(rw):
41     return [(x % 10) for x in rw]
42
43 def reduceMod13(rw):
44     return [(x % 14) for x in rw]
45
46 seed(1)
47 flute_random_walk_one = []
48 flute_random_walk_one.append(-1 if random() < 0.5 else 1)
49 for i in range(1, 1000):
50     movement = -1 if random() < 0.5 else 1
51     value = flute_random_walk_one[i-1] + movement
52     flute_random_walk_one.append(value)
53 flute_random_walk_one = [abs(x) for x in flute_random_walk_one]
54 flute_chord_one = [2, 12, 18, 20, 25, 20, 18, 12, ]
55 flute_notes_one = [flute_chord_one[x] for x in reduceMod7(
56     flute_random_walk_one)]
57
58 seed(2)
59 clarinet_random_walk_one = []
60 clarinet_random_walk_one.append(-1 if random() < 0.5 else 1)
61 for i in range(1, 1000):
62     movement = -1 if random() < 0.5 else 1
63     value = clarinet_random_walk_one[i-1] + movement
64     clarinet_random_walk_one.append(value)

```

```

63 clarinet_random_walk_one = [abs(x) for x in clarinet_random_walk_one]
64 clarinet_chord_one = [-5, 2, 12, 18, 20, 18, 12, 2, ]
65 clarinet_notes_one = [clarinet_chord_one[x] for x in reduceMod7(
    clarinet_random_walk_one)]
66
67 seed(3)
68 bassoon_random_walk_one = []
69 bassoon_random_walk_one.append(-1 if random() < 0.5 else 1)
70 for i in range(1, 1000):
71     movement = -1 if random() < 0.5 else 1
72     value = bassoon_random_walk_one[i-1] + movement
73     bassoon_random_walk_one.append(value)
74 bassoon_random_walk_one = [abs(x) for x in bassoon_random_walk_one]
75 bassoon_chord_one = [-19, -8, -5, 2, 12, 2, -5, -8, ]
76 bassoon_notes_one = [bassoon_chord_one[x] for x in reduceMod7(
    bassoon_random_walk_one)]
77
78 seed(4)
79 horn_random_walk_one = []
80 horn_random_walk_one.append(-1 if random() < 0.5 else 1)
81 for i in range(1, 1000):
82     movement = -1 if random() < 0.5 else 1
83     value = horn_random_walk_one[i-1] + movement
84     horn_random_walk_one.append(value)
85 horn_random_walk_one = [abs(x) for x in horn_random_walk_one]
86 horn_chord_one = [-19, -8, -5, 2, 12, 18, 12, 2, -5, -8, ]
87 horn_notes_one = [horn_chord_one[x] for x in reduceMod9(horn_random_walk_one)]
88
89 seed(5)
90 trumpet_random_walk_one = []
91 trumpet_random_walk_one.append(-1 if random() < 0.5 else 1)
92 for i in range(1, 1000):
93     movement = -1 if random() < 0.5 else 1
94     value = trumpet_random_walk_one[i-1] + movement
95     trumpet_random_walk_one.append(value)
96 trumpet_random_walk_one = [abs(x) for x in trumpet_random_walk_one]
97 trumpet_chord_one = [-5, 2, 12, 18, 20, 18, 12, 2, ]
98 trumpet_notes_one = [trumpet_chord_one[x] for x in reduceMod7(
    trumpet_random_walk_one)]
99
100 seed(6)
101 trombone_random_walk_one = []
102 trombone_random_walk_one.append(-1 if random() < 0.5 else 1)
103 for i in range(1, 1000):
104     movement = -1 if random() < 0.5 else 1
105     value = trombone_random_walk_one[i-1] + movement
106     trombone_random_walk_one.append(value)
107 trombone_random_walk_one = [abs(x) for x in trombone_random_walk_one]
108 trombone_chord_one = [-19, -8, -5, 2, -5, -8, ]
109 trombone_notes_one = [trombone_chord_one[x] for x in reduceMod5(
    trombone_random_walk_one)]
110
111 seed(7)
112 tuba_random_walk_one = []

```

```

113 tuba_random_walk_one.append(-1 if random() < 0.5 else 1)
114 for i in range(1, 1000):
115     movement = -1 if random() < 0.5 else 1
116     value = tuba_random_walk_one[i-1] + movement
117     tuba_random_walk_one.append(value)
118 tuba_random_walk_one = [abs(x) for x in tuba_random_walk_one]
119 tuba_chord_one = [-27, -19, -8, -5, 2, -5, -8, -19, ]
120 tuba_notes_one = [tuba_chord_one[x] for x in reduceMod7(tuba_random_walk_one)]
121
122 seed(8)
123 violin1_random_walk_one = []
124 violin1_random_walk_one.append(-1 if random() < 0.5 else 1)
125 for i in range(1, 1000):
126     movement = -1 if random() < 0.5 else 1
127     value = violin1_random_walk_one[i-1] + movement
128     violin1_random_walk_one.append(value)
129 violin1_random_walk_one = [abs(x) for x in violin1_random_walk_one]
130 violin1_chord_one = [-5, 2, 12, 18, 20, 25, 34, 35, 34, 25, 20, 18, 12, 2, ]
131 violin1_notes_one = [violin1_chord_one[x] for x in reduceMod13(
    violin1_random_walk_one)]
132
133 seed(9)
134 violin2_random_walk_one = []
135 violin2_random_walk_one.append(-1 if random() < 0.5 else 1)
136 for i in range(1, 1000):
137     movement = -1 if random() < 0.5 else 1
138     value = violin2_random_walk_one[i-1] + movement
139     violin2_random_walk_one.append(value)
140 violin2_random_walk_one = [abs(x) for x in violin2_random_walk_one]
141 violin2_chord_one = [-5, 2, 12, 18, 20, 18, 12, 2, ]
142 violin2_notes_one = [violin2_chord_one[x] for x in reduceMod7(
    violin2_random_walk_one)]
143
144 seed(10)
145 viola_random_walk_one = []
146 viola_random_walk_one.append(-1 if random() < 0.5 else 1)
147 for i in range(1, 1000):
148     movement = -1 if random() < 0.5 else 1
149     value = viola_random_walk_one[i-1] + movement
150     viola_random_walk_one.append(value)
151 viola_random_walk_one = [abs(x) for x in viola_random_walk_one]
152 viola_chord_one = [-8, -5, 2, 12, 18, 12, 2, -5, ]
153 viola_notes_one = [viola_chord_one[x] for x in reduceMod7(
    viola_random_walk_one)]
154
155 seed(11)
156 cello_random_walk_one = []
157 cello_random_walk_one.append(-1 if random() < 0.5 else 1)
158 for i in range(1, 1000):
159     movement = -1 if random() < 0.5 else 1
160     value = cello_random_walk_one[i-1] + movement
161     cello_random_walk_one.append(value)
162 cello_random_walk_one = [abs(x) for x in cello_random_walk_one]
163 cello_chord_one = [-19, -8, -5, 2, 12, 2, -5, -8]

```

```

164 cello_notes_one = [cello_chord_one[x] for x in reduceMod7(
    cello_random_walk_one)]
165
166 seed(12)
167 bass_random_walk_one = []
168 bass_random_walk_one.append(-1 if random() < 0.5 else 1)
169 for i in range(1, 1000):
170     movement = -1 if random() < 0.5 else 1
171     value = bass_random_walk_one[i-1] + movement
172     bass_random_walk_one.append(value)
173 bass_random_walk_one = [abs(x) for x in bass_random_walk_one]
174 bass_chord_one = [-27, -19, -8, -5, 2, -5, -8, -19, ]
175 bass_notes_one = [bass_chord_one[x] for x in reduceMod7(bass_random_walk_one)]
176
177 flute_scale = [39, ]
178 clarinet_scale = [18, ]
179 bassoon_scale = [12, ]
180 horn_scale = [-5, ]
181 trumpet_scale = [12, ]
182 trombone_scale = [-5, ]
183 tuba_scale = [-27, ]
184 violin1_scale = [30, 29.5, 29, 28.5, 28, 27.5, 27, 26.5, 26, 25.5, 25, 24.5,
    24, 23.5, 23, 22.5, 22, 21.5, 21, 20.5, 20, 19.5, 19, 19.5, 20, 20.5, 21,
    21.5, 22, 22.5, 23, 23.5, 24, 24.5, 25, 25.5, 26, 26.5, 27, 27.5, 28,
    28.5, 29, 29.5, ]
185 violin2_scale = [19, 18.5, 18, 17.5, 17, 16.5, 16, 15.5, 15, 14.5, 14, 13.5,
    13, 12.5, 12, 11.5, 11, 10.5, 10, 9.5, 9, 8.5, 8, 8.5, 9, 9.5, 10, 10.5,
    11, 11.5, 12, 12.5, 13, 13.5, 14, 14.5, 15, 15.5, 16, 16.5, 17, 17.5, 18,
    18.5, ]
186 viola_scale = [8, 7.5, 7, 6.5, 6, 5.5, 5, 4.5, 4, 3.5, 3, 2.5, 2, 1.5, 1, 0.5,
    0, -0.5, -1, -1.5, -2, -2.5, -3, -2.5, -2, -1.5, -1, -0.5, 0, 0.5, 1,
    1.5, 2, 2.5, 3, 3.5, 4, 4.5, 5, 5.5, 6, 6.5, 7, 7.5, ]
187 cello_scale = [-3, -3.5, -4, -4.5, -5, -5.5, -6, -6.5, -7, -7.5, -8, -8.5, -9,
    -9.5, -10, -10.5, -11, -11.5, -12, -12.5, -13, -13.5, -14, -13.5, -13,
    -12.5, -12, -11.5, -11, -10.5, -10, -9.5, -9, -8.5, -8, -7.5, -7, -6.5,
    -6, -5.5, -5, -4.5, -4, -3.5, ]
188 bass_scale = [-14, -14.5, -15, -15.5, -16, -16.5, -17, -17.5, -18, -18.5, -19,
    -19.5, -20, -20.5, -21, -21.5, -22, -22.5, -23, -23.5, -24, -24.5, -25,
    -24.5, -24, -23.5, -23, -22.5, -22, -21.5, -21, -20.5, -20, -19.5, -19,
    -18.5, -18, -17.5, -17, -16.5, -16, -15.5, -15, -14.5, ]
189
190 seed(1)
191 flute_random_walk_two = []
192 flute_random_walk_two.append(-1 if random() < 0.5 else 1)
193 for i in range(1, 1000):
194     movement = -1 if random() < 0.5 else 1
195     value = flute_random_walk_two[i-1] + movement
196     flute_random_walk_two.append(value)
197 flute_random_walk_two = [abs(x) for x in flute_random_walk_two]
198 flute_chord_two = [4, 12, 18, 22, 23, 22, 18, 12, ]
199 flute_notes_two = [flute_chord_two[x] for x in reduceMod7(
    flute_random_walk_two)]
200
201 seed(2)

```

```

202 clarinet_random_walk_two = []
203 clarinet_random_walk_two.append(-1 if random() < 0.5 else 1)
204 for i in range(1, 1000):
205     movement = -1 if random() < 0.5 else 1
206     value = clarinet_random_walk_two[i-1] + movement
207     clarinet_random_walk_two.append(value)
208 clarinet_random_walk_two = [abs(x) for x in clarinet_random_walk_two]
209 clarinet_chord_two = [-10, -7, 4, 12, 18, 22, 18, 12, 4, -7, ]
210 clarinet_notes_two = [clarinet_chord_two[x] for x in reduceMod9(
    clarinet_random_walk_two)]
211
212 seed(3)
213 bassoon_random_walk_two = []
214 bassoon_random_walk_two.append(-1 if random() < 0.5 else 1)
215 for i in range(1, 1000):
216     movement = -1 if random() < 0.5 else 1
217     value = bassoon_random_walk_two[i-1] + movement
218     bassoon_random_walk_two.append(value)
219 bassoon_random_walk_two = [abs(x) for x in bassoon_random_walk_two]
220 bassoon_chord_two = [-17, -10, -7, 4, 12, 4, -7, -10, ]
221 bassoon_notes_two = [bassoon_chord_two[x] for x in reduceMod7(
    bassoon_random_walk_two)]
222
223 seed(4)
224 horn_random_walk_two = []
225 horn_random_walk_two.append(-1 if random() < 0.5 else 1)
226 for i in range(1, 1000):
227     movement = -1 if random() < 0.5 else 1
228     value = horn_random_walk_two[i-1] + movement
229     horn_random_walk_two.append(value)
230 horn_random_walk_two = [abs(x) for x in horn_random_walk_two]
231 horn_chord_two = [-17, -10, -7, 4, -7, -10, ]
232 horn_notes_two = [horn_chord_two[x] for x in reduceMod5(horn_random_walk_two)]
233
234 seed(5)
235 trumpet_random_walk_two = []
236 trumpet_random_walk_two.append(-1 if random() < 0.5 else 1)
237 for i in range(1, 1000):
238     movement = -1 if random() < 0.5 else 1
239     value = trumpet_random_walk_two[i-1] + movement
240     trumpet_random_walk_two.append(value)
241 trumpet_random_walk_two = [abs(x) for x in trumpet_random_walk_two]
242 trumpet_chord_two = [4, 12, 18, 12, ]
243 trumpet_notes_two = [trumpet_chord_two[x] for x in reduceMod3(
    trumpet_random_walk_two)]
244
245 seed(6)
246 trombone_random_walk_two = []
247 trombone_random_walk_two.append(-1 if random() < 0.5 else 1)
248 for i in range(1, 1000):
249     movement = -1 if random() < 0.5 else 1
250     value = trombone_random_walk_two[i-1] + movement
251     trombone_random_walk_two.append(value)
252 trombone_random_walk_two = [abs(x) for x in trombone_random_walk_two]

```

```

253 trombone_chord_two = [-17, -10, -7, 4, -7, -10, ]
254 trombone_notes_two = [trombone_chord_two[x] for x in reduceMod5(
    trombone_random_walk_two)]
255
256 seed(7)
257 tuba_random_walk_two = []
258 tuba_random_walk_two.append(-1 if random() < 0.5 else 1)
259 for i in range(1, 1000):
260     movement = -1 if random() < 0.5 else 1
261     value = tuba_random_walk_two[i-1] + movement
262     tuba_random_walk_two.append(value)
263 tuba_random_walk_two = [abs(x) for x in tuba_random_walk_two]
264 tuba_chord_two = [-27, -17, -10, -7, 4, -7, -10, -17, ]
265 tuba_notes_two = [tuba_chord_two[x] for x in reduceMod7(tuba_random_walk_two)]
266
267 seed(8)
268 violin1_random_walk_two = []
269 violin1_random_walk_two.append(-1 if random() < 0.5 else 1)
270 for i in range(1, 1000):
271     movement = -1 if random() < 0.5 else 1
272     value = violin1_random_walk_two[i-1] + movement
273     violin1_random_walk_two.append(value)
274 violin1_random_walk_two = [abs(x) for x in violin1_random_walk_two]
275 violin1_chord_two = [4, 12, 18, 22, 23, 32, 37, 39, 37, 32, 23, 22, 18, 12, ]
276 violin1_notes_two = [violin1_chord_two[x] for x in reduceMod13(
    violin1_random_walk_two)]
277
278 seed(9)
279 violin2_random_walk_two = []
280 violin2_random_walk_two.append(-1 if random() < 0.5 else 1)
281 for i in range(1, 1000):
282     movement = -1 if random() < 0.5 else 1
283     value = violin2_random_walk_two[i-1] + movement
284     violin2_random_walk_two.append(value)
285 violin2_random_walk_two = [abs(x) for x in violin2_random_walk_two]
286 violin2_chord_two = [4, 12, 18, 22, 23, 32, 23, 22, 18, 12, ]
287 violin2_notes_two = [violin2_chord_two[x] for x in reduceMod9(
    violin2_random_walk_two)]
288
289 seed(10)
290 viola_random_walk_two = []
291 viola_random_walk_two.append(-1 if random() < 0.5 else 1)
292 for i in range(1, 1000):
293     movement = -1 if random() < 0.5 else 1
294     value = viola_random_walk_two[i-1] + movement
295     viola_random_walk_two.append(value)
296 viola_random_walk_two = [abs(x) for x in viola_random_walk_two]
297 viola_chord_two = [-10, -7, 4, 12, 18, 12, 4, -7, ]
298 viola_notes_two = [viola_chord_two[x] for x in reduceMod7(
    viola_random_walk_two)]
299
300 seed(11)
301 cello_random_walk_two = []
302 cello_random_walk_two.append(-1 if random() < 0.5 else 1)

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```

303 for i in range(1, 1000):
304     movement = -1 if random() < 0.5 else 1
305     value = cello_random_walk_two[i-1] + movement
306     cello_random_walk_two.append(value)
307 cello_random_walk_two = [abs(x) for x in cello_random_walk_two]
308 cello_chord_two = [-17, -10, -7, 4, 12, 4, -7, -10, ]
309 cello_notes_two = [cello_chord_two[x] for x in reduceMod7(
    cello_random_walk_two)]
310
311 seed(12)
312 bass_random_walk_two = []
313 bass_random_walk_two.append(-1 if random() < 0.5 else 1)
314 for i in range(1, 1000):
315     movement = -1 if random() < 0.5 else 1
316     value = bass_random_walk_two[i-1] + movement
317     bass_random_walk_two.append(value)
318 bass_random_walk_two = [abs(x) for x in bass_random_walk_two]
319 bass_chord_two = [-27, -17, -10, -7, 4, -7, -10, -17, ]
320 bass_notes_two = [bass_chord_two[x] for x in reduceMod7(bass_random_walk_two)]
321
322 rmaker_one = abjadext.rmakers.TaleaRhythmMaker(
323     talea=abjadext.rmakers.Talea(
324         counts=[2, 3, 2, 1, 4, 3, 1, 4, 5, 1],
325         denominator=8,
326     ),
327     beam_specifier=abjadext.rmakers.BeamSpecifier(
328         beam_divisions_together=True,
329         beam_rests=False,
330     ),
331     extra_counts_per_division=[1, 1, 0, -1, 0],
332     burnish_specifier=abjadext.rmakers.BurnishSpecifier(
333         left_classes=[abjad.Note, abjad.Rest],
334         left_counts=[0, 1, 1],
335     ),
336     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
337         trivialize=True,
338         extract_trivial=True,
339         rewrite_rest_filled=True,
340     ),
341 )
342
343 rmaker_two = abjadext.rmakers.TaleaRhythmMaker(
344     talea=abjadext.rmakers.Talea(
345         counts=[2, 1, 3, 1, 4, 1, 1, 5],
346         denominator=16,
347     ),
348     beam_specifier=abjadext.rmakers.BeamSpecifier(
349         beam_divisions_together=True,
350         beam_rests=False,
351     ),
352     extra_counts_per_division=[0, 1, 0, -1],
353     burnish_specifier=abjadext.rmakers.BurnishSpecifier(
354         left_classes=[abjad.Note, abjad.Rest],
355         left_counts=[1, 1, 0, 0],

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```

356         right_classes=[abjad.Note, abjad.Rest],
357         right_counts=[1, 0, 0, 1],
358     ),
359     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
360         trivialize=True,
361         extract_trivial=True,
362         rewrite_rest_filled=True,
363     ),
364 )
365
366 rmaker_three = abjadext.rmakers.TaleaRhythmMaker(
367     talea=abjadext.rmakers.Talea(
368         counts=[1, 2, 1, 3, 1, 4, 5, 1, 1],
369         denominator=16,
370     ),
371     beam_specifier=abjadext.rmakers.BeamSpecifier(
372         beam_divisions_together=True,
373         beam_rests=False,
374     ),
375     extra_counts_per_division=[0, 1, 0, -1],
376     burnish_specifier=abjadext.rmakers.BurnishSpecifier(
377         left_classes=[abjad.Note, abjad.Rest],
378         left_counts=[1, 0, 1],
379     ),
380     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
381         trivialize=True,
382         extract_trivial=True,
383         rewrite_rest_filled=True,
384     ),
385 )
386
387
388 attachment_handler_one = AttachmentHandler(
389     starting_dynamic='mf',
390     ending_dynamic='ff',
391     hairpin_indicator='<',
392     articulation='',
393 )
394
395 attachment_handler_two = AttachmentHandler(
396     starting_dynamic='ff',
397     ending_dynamic='mf',
398     hairpin_indicator='>',
399     articulation='',
400 )
401
402 attachment_handler_three = AttachmentHandler(
403     starting_dynamic='p',
404     ending_dynamic='pp',
405     hairpin_indicator='--',
406     articulation='tenuto',
407 )
408
409 #####oboe#####

```



```

410 flutemusicmaker_one = MusicMaker(
411     rmaker=rmaker_one,
412     pitches=flute_scale,
413     continuous=True,
414     attachment_handler=attachment_handler_one,
415 )
416 flutemusicmaker_two = MusicMaker(
417     rmaker=rmaker_two,
418     pitches=flute_notes_two,
419     continuous=True,
420     attachment_handler=attachment_handler_two,
421 )
422 flutemusicmaker_three = MusicMaker(
423     rmaker=rmaker_three,
424     pitches=flute_notes_one,
425     continuous=True,
426     attachment_handler=attachment_handler_three,
427 )
428 #####violin1#####
429 violin1musicmaker_one = MusicMaker(
430     rmaker=rmaker_one,
431     pitches=violin1_scale,
432     continuous=True,
433     attachment_handler=attachment_handler_one,
434 )
435 violin1musicmaker_two = MusicMaker(
436     rmaker=rmaker_two,
437     pitches=violin1_notes_two,
438     continuous=True,
439     attachment_handler=attachment_handler_two,
440 )
441 violin1musicmaker_three = MusicMaker(
442     rmaker=rmaker_three,
443     pitches=violin1_notes_one,
444     continuous=True,
445     attachment_handler=attachment_handler_three,
446 )
447 #####trumpet#####
448 trumpetmusicmaker_one = MusicMaker(
449     rmaker=rmaker_one,
450     pitches=trumpet_scale,
451     continuous=True,
452     attachment_handler=attachment_handler_one,
453 )
454 trumpetmusicmaker_two = MusicMaker(
455     rmaker=rmaker_two,
456     pitches=trumpet_notes_two,
457     continuous=True,
458     attachment_handler=attachment_handler_two,
459 )
460 trumpetmusicmaker_three = MusicMaker(
461     rmaker=rmaker_three,
462     pitches=trumpet_notes_one,
463     continuous=True,

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464     attachment_handler=attachment_handler_three,
465 )
466 #####clarinet#####
467 clarinetmusicmaker_one = MusicMaker(
468     rmaker=rmaker_one,
469     pitches=clarinet_scale,
470     continuous=True,
471     attachment_handler=attachment_handler_one,
472 )
473 clarinetmusicmaker_two = MusicMaker(
474     rmaker=rmaker_two,
475     pitches=clarinet_notes_two,
476     continuous=True,
477     attachment_handler=attachment_handler_two,
478 )
479 clarinetmusicmaker_three = MusicMaker(
480     rmaker=rmaker_three,
481     pitches=clarinet_notes_one,
482     continuous=True,
483     attachment_handler=attachment_handler_three,
484 )
485 #####violin2#####
486 violin2musicmaker_one = MusicMaker(
487     rmaker=rmaker_one,
488     pitches=violin2_scale,
489     continuous=True,
490     attachment_handler=attachment_handler_one,
491 )
492 violin2musicmaker_two = MusicMaker(
493     rmaker=rmaker_two,
494     pitches=violin2_notes_two,
495     continuous=True,
496     attachment_handler=attachment_handler_two,
497 )
498 violin2musicmaker_three = MusicMaker(
499     rmaker=rmaker_three,
500     pitches=violin2_notes_one,
501     continuous=True,
502     attachment_handler=attachment_handler_three,
503 )
504 #####viola#####
505 violamusicmaker_one = MusicMaker(
506     rmaker=rmaker_one,
507     pitches=viola_scale,
508     continuous=True,
509     attachment_handler=attachment_handler_one,
510 )
511 violamusicmaker_two = MusicMaker(
512     rmaker=rmaker_two,
513     pitches=viola_notes_two,
514     continuous=True,
515     attachment_handler=attachment_handler_two,
516 )
517 violamusicmaker_three = MusicMaker(

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518     rmaker=rmaker_three,
519     pitches=viola_notes_one,
520     continuous=True,
521     attachment_handler=attachment_handler_three,
522 )
523 #####bassoon#####
524 bassoonmusicmaker_one = MusicMaker(
525     rmaker=rmaker_one,
526     pitches=bassoon_scale,
527     continuous=True,
528     attachment_handler=attachment_handler_one,
529 )
530 bassoonmusicmaker_two = MusicMaker(
531     rmaker=rmaker_two,
532     pitches=bassoon_notes_two,
533     continuous=True,
534     attachment_handler=attachment_handler_two,
535 )
536 bassoonmusicmaker_three = MusicMaker(
537     rmaker=rmaker_three,
538     pitches=bassoon_notes_one,
539     continuous=True,
540     attachment_handler=attachment_handler_three,
541 )
542 #####trombone#####
543 trombonemusicmaker_one = MusicMaker(
544     rmaker=rmaker_one,
545     pitches=trombone_scale,
546     continuous=True,
547     attachment_handler=attachment_handler_one,
548 )
549 trombonemusicmaker_two = MusicMaker(
550     rmaker=rmaker_two,
551     pitches=trombone_notes_two,
552     continuous=True,
553     attachment_handler=attachment_handler_two,
554 )
555 trombonemusicmaker_three = MusicMaker(
556     rmaker=rmaker_three,
557     pitches=trombone_notes_one,
558     continuous=True,
559     attachment_handler=attachment_handler_three,
560 )
561 #####cello#####
562 cellomusicmaker_one = MusicMaker(
563     rmaker=rmaker_one,
564     pitches=cello_scale,
565     continuous=True,
566     attachment_handler=attachment_handler_one,
567 )
568 cellomusicmaker_two = MusicMaker(
569     rmaker=rmaker_two,
570     pitches=cello_notes_two,
571     continuous=True,

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572     attachment_handler=attachment_handler_two,
573 )
574 cellomusicmaker_three = MusicMaker(
575     rmaker=rmaker_three,
576     pitches=cello_notes_one,
577     continuous=True,
578     attachment_handler=attachment_handler_three,
579 )
580 #####horn#####
581 hornmusicmaker_one = MusicMaker(
582     rmaker=rmaker_one,
583     pitches=horn_scale,
584     continuous=True,
585     attachment_handler=attachment_handler_one,
586 )
587 hornmusicmaker_two = MusicMaker(
588     rmaker=rmaker_two,
589     pitches=horn_notes_two,
590     continuous=True,
591     attachment_handler=attachment_handler_two,
592 )
593 hornmusicmaker_three = MusicMaker(
594     rmaker=rmaker_three,
595     pitches=horn_notes_one,
596     continuous=True,
597     attachment_handler=attachment_handler_three,
598 )
599 #####tuba#####
600 tubamusicmaker_one = MusicMaker(
601     rmaker=rmaker_one,
602     pitches=tuba_scale,
603     continuous=True,
604     attachment_handler=attachment_handler_one,
605 )
606 tubamusicmaker_two = MusicMaker(
607     rmaker=rmaker_two,
608     pitches=tuba_notes_two,
609     continuous=True,
610     attachment_handler=attachment_handler_two,
611 )
612 tubamusicmaker_three = MusicMaker(
613     rmaker=rmaker_three,
614     pitches=tuba_notes_one,
615     continuous=True,
616     attachment_handler=attachment_handler_three,
617 )
618 #####bass#####
619 bassmusicmaker_one = MusicMaker(
620     rmaker=rmaker_one,
621     pitches=bass_scale,
622     continuous=True,
623     attachment_handler=attachment_handler_one,
624 )
625 bassmusicmaker_two = MusicMaker(

```

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626     rmaker=rmaker_two,
627     pitches=bass_notes_two,
628     continuous=True,
629     attachment_handler=attachment_handler_two,
630 )
631 bassmusicmaker_three = MusicMaker(
632     rmaker=rmaker_three,
633     pitches=bass_notes_one,
634     continuous=True,
635     attachment_handler=attachment_handler_three,
636 )
637
638 silence_maker = abjadext.rmakers.NoteRhythmMaker(
639     division_masks=[
640         abjadext.rmakers.SilenceMask(
641             pattern=abjad.index([0], 1),
642         ),
643     ],
644 )
645
646
647 class MusicSpecifier:
648
649     def __init__(self, music_maker, voice_name):
650         self.music_maker = music_maker
651         self.voice_name = voice_name
652
653
654 print('Collecting timespans and rmakers ...')
655 ###group one###
656 voice_1_timespan_list = abjad.TimespanList([
657     abjad.AnnotatedTimespan(
658         start_offset=start_offset,
659         stop_offset=stop_offset,
660         annotation=MusicSpecifier(
661             music_maker=music_maker,
662             voice_name='Voice 1',
663         ),
664     )
665     for start_offset, stop_offset, music_maker in [
666         [(9, 4), (10, 4), flutemusicmaker_one],
667         [(15, 4), (18, 4), flutemusicmaker_two],
668         [(22, 4), (25, 4), flutemusicmaker_three],
669         [(27, 4), (30, 4), flutemusicmaker_one],
670         [(30, 4), (32, 4), flutemusicmaker_one],
671         [(35, 4), (39, 4), flutemusicmaker_two],
672         [(42, 4), (43, 4), flutemusicmaker_three],
673         [(43, 4), (44, 4), flutemusicmaker_three],
674         [(45, 4), (46, 4), flutemusicmaker_one],
675         [(46, 4), (50, 4), flutemusicmaker_one],
676         [(54, 4), (57, 4), flutemusicmaker_two],
677         [(59, 4), (60, 4), flutemusicmaker_three],
678         [(65, 4), (67, 4), flutemusicmaker_one],
679         [(67, 4), (69, 4), flutemusicmaker_one],

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680     [(70, 4), (72, 4), flutemusicmaker_two],
681     [(72, 4), (75, 4), flutemusicmaker_two],
682     [(76, 4), (78, 4), flutemusicmaker_three],
683     [(81, 4), (82, 4), flutemusicmaker_one],
684     [(82, 4), (85, 4), flutemusicmaker_one],
685     [(90, 4), (91, 4), flutemusicmaker_two],
686     [(93, 4), (94, 4), flutemusicmaker_three],
687     [(94, 4), (96, 4), flutemusicmaker_three],
688     [(100, 4), (104, 4), flutemusicmaker_one],
689     [(104, 4), (105, 4), flutemusicmaker_one],
690     [(106, 4), (107, 4), flutemusicmaker_two],
691     [(107, 4), (108, 4), flutemusicmaker_two],
692     [(111, 4), (114, 4), flutemusicmaker_one],
693     [(114, 4), (115, 4), flutemusicmaker_one],
694     [(116, 4), (119, 4), flutemusicmaker_one],
695     [(119, 4), (120, 4), flutemusicmaker_one],
696     [(121, 4), (123, 4), flutemusicmaker_one],
697     [(123, 4), (125, 4), flutemusicmaker_one],
698     [(126, 4), (131, 4), flutemusicmaker_two],
699     [(131, 4), (133, 4), flutemusicmaker_two],
700     [(136, 4), (141, 4), flutemusicmaker_two],
701     [(148, 4), (150, 4), flutemusicmaker_two],
702     [(150, 4), (153, 4), flutemusicmaker_three],
703     [(155, 4), (159, 4), flutemusicmaker_three],
704     [(162, 4), (164, 4), flutemusicmaker_three],
705     [(168, 4), (171, 4), flutemusicmaker_three],
706     [(173, 4), (175, 4), flutemusicmaker_three],
707     [(175, 4), (177, 4), flutemusicmaker_three],
708     [(180, 4), (182, 4), flutemusicmaker_three],
709     [(186, 4), (190, 4), flutemusicmaker_three],
710     [(190, 4), (381, 8), silence_maker],
711 ]
712 ])
713
714 voice_5_timespan_list = abjad.TimespanList([
715     abjad.AnnotatedTimespan(
716         start_offset=start_offset,
717         stop_offset=stop_offset,
718         annotation=MusicSpecifier(
719             music_maker=music_maker,
720             voice_name='Voice 5',
721         ),
722     )
723     for start_offset, stop_offset, music_maker in [
724         [(9, 4), (10, 4), trumpetmusicmaker_one],
725         [(14, 4), (18, 4), trumpetmusicmaker_two],
726         [(23, 4), (25, 4), trumpetmusicmaker_three],
727         [(27, 4), (30, 4), trumpetmusicmaker_one],
728         [(30, 4), (32, 4), trumpetmusicmaker_one],
729         [(35, 4), (39, 4), trumpetmusicmaker_two],
730         [(42, 4), (43, 4), trumpetmusicmaker_three],
731         [(43, 4), (44, 4), trumpetmusicmaker_three],
732         [(45, 4), (46, 4), trumpetmusicmaker_one],
733         [(46, 4), (50, 4), trumpetmusicmaker_one],

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734 [(54, 4), (57, 4), trumpetmusicmaker_two],
735 [(59, 4), (60, 4), trumpetmusicmaker_three],
736 [(65, 4), (67, 4), trumpetmusicmaker_one],
737 [(67, 4), (69, 4), trumpetmusicmaker_one],
738 [(70, 4), (72, 4), trumpetmusicmaker_two],
739 [(72, 4), (75, 4), trumpetmusicmaker_two],
740 [(76, 4), (78, 4), trumpetmusicmaker_three],
741 [(81, 4), (82, 4), trumpetmusicmaker_one],
742 [(82, 4), (85, 4), trumpetmusicmaker_one],
743 [(90, 4), (91, 4), trumpetmusicmaker_two],
744 [(93, 4), (94, 4), trumpetmusicmaker_three],
745 [(94, 4), (96, 4), trumpetmusicmaker_three],
746 [(100, 4), (104, 4), trumpetmusicmaker_one],
747 [(104, 4), (105, 4), trumpetmusicmaker_one],
748 [(106, 4), (107, 4), trumpetmusicmaker_two],
749 [(107, 4), (108, 4), trumpetmusicmaker_two],
750 [(111, 4), (114, 4), trumpetmusicmaker_one],
751 [(114, 4), (115, 4), trumpetmusicmaker_one],
752 [(116, 4), (119, 4), trumpetmusicmaker_one],
753 [(119, 4), (120, 4), trumpetmusicmaker_one],
754 [(121, 4), (123, 4), trumpetmusicmaker_one],
755 [(123, 4), (125, 4), trumpetmusicmaker_one],
756 [(126, 4), (131, 4), trumpetmusicmaker_two],
757 [(131, 4), (133, 4), trumpetmusicmaker_two],
758 [(136, 4), (141, 4), trumpetmusicmaker_two],
759 [(148, 4), (150, 4), trumpetmusicmaker_two],
760 [(150, 4), (154, 4), trumpetmusicmaker_three],
761 [(157, 4), (159, 4), trumpetmusicmaker_three],
762 [(163, 4), (164, 4), trumpetmusicmaker_three],
763 [(164, 4), (166, 4), trumpetmusicmaker_three],
764 [(168, 4), (172, 4), trumpetmusicmaker_three],
765 [(175, 4), (177, 4), trumpetmusicmaker_three],
766 [(181, 4), (183, 4), trumpetmusicmaker_three],
767 [(183, 4), (184, 4), trumpetmusicmaker_three],
768 [(186, 4), (190, 4), trumpetmusicmaker_three],
769 ]
770 ])
771
772 voice_8_timespan_list = abjad.TimespanList([
773     abjad.AnnotatedTimespan(
774         start_offset=start_offset,
775         stop_offset=stop_offset,
776         annotation=MusicSpecifier(
777             music_maker=music_maker,
778             voice_name='Voice 8',
779         ),
780     )
781     for start_offset, stop_offset, music_maker in [
782         [(9, 4), (10, 4), violin1musicmaker_one],
783         [(14, 4), (18, 4), violin1musicmaker_two],
784         [(22, 4), (25, 4), violin1musicmaker_three],
785         [(27, 4), (30, 4), violin1musicmaker_one],
786         [(35, 4), (39, 4), violin1musicmaker_two],
787         [(42, 4), (43, 4), violin1musicmaker_three],

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788     [(43, 4), (44, 4), violin1musicmaker_three],
789     [(45, 4), (46, 4), violin1musicmaker_one],
790     [(46, 4), (50, 4), violin1musicmaker_one],
791     [(54, 4), (57, 4), violin1musicmaker_two],
792     [(59, 4), (60, 4), violin1musicmaker_three],
793     [(65, 4), (67, 4), violin1musicmaker_one],
794     [(67, 4), (69, 4), violin1musicmaker_one],
795     [(70, 4), (72, 4), violin1musicmaker_two],
796     [(72, 4), (75, 4), violin1musicmaker_two],
797     [(76, 4), (78, 4), violin1musicmaker_three],
798     [(81, 4), (82, 4), violin1musicmaker_one],
799     [(82, 4), (85, 4), violin1musicmaker_one],
800     [(90, 4), (91, 4), violin1musicmaker_two],
801     [(93, 4), (94, 4), violin1musicmaker_three],
802     [(94, 4), (96, 4), violin1musicmaker_three],
803     [(100, 4), (104, 4), violin1musicmaker_one],
804     [(104, 4), (105, 4), violin1musicmaker_one],
805     [(106, 4), (107, 4), violin1musicmaker_two],
806     [(107, 4), (108, 4), violin1musicmaker_two],
807     [(111, 4), (114, 4), violin1musicmaker_one],
808     [(114, 4), (115, 4), violin1musicmaker_one],
809     [(116, 4), (119, 4), violin1musicmaker_one],
810     [(119, 4), (120, 4), violin1musicmaker_one],
811     [(121, 4), (123, 4), violin1musicmaker_one],
812     [(123, 4), (125, 4), violin1musicmaker_one],
813     [(126, 4), (131, 4), violin1musicmaker_two],
814     [(131, 4), (133, 4), violin1musicmaker_two],
815     [(136, 4), (141, 4), violin1musicmaker_two],
816     [(148, 4), (150, 4), violin1musicmaker_two],
817     [(150, 4), (152, 4), violin1musicmaker_three],
818     [(156, 4), (159, 4), violin1musicmaker_three],
819     [(161, 4), (164, 4), violin1musicmaker_three],
820     [(164, 4), (165, 4), violin1musicmaker_three],
821     [(168, 4), (170, 4), violin1musicmaker_three],
822     [(174, 4), (175, 4), violin1musicmaker_three],
823     [(175, 4), (177, 4), violin1musicmaker_three],
824     [(179, 4), (183, 4), violin1musicmaker_three],
825     [(186, 4), (190, 4), violin1musicmaker_three],
826 ]
827 ])
828
829 ###group two###
830 voice_2_timespan_list = abjad.TimespanList([
831     abjad.AnnotatedTimespan(
832         start_offset=start_offset,
833         stop_offset=stop_offset,
834         annotation=MusicSpecifier(
835             music_maker=music_maker,
836             voice_name='Voice 2',
837         ),
838     )
839     for start_offset, stop_offset, music_maker in [
840         [(2, 4), (5, 4), clarinetmusicmaker_one],
841         [(10, 4), (11, 4), clarinetmusicmaker_two],

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842     [(11, 4), (13, 4), clarinetmusicmaker_two],
843     [(16, 4), (18, 4), clarinetmusicmaker_three],
844     [(21, 4), (22, 4), clarinetmusicmaker_one],
845     [(22, 4), (25, 4), clarinetmusicmaker_one],
846     [(35, 4), (40, 4), clarinetmusicmaker_one],
847     [(44, 4), (46, 4), clarinetmusicmaker_two],
848     [(46, 4), (47, 4), clarinetmusicmaker_two],
849     [(49, 4), (50, 4), clarinetmusicmaker_three],
850     [(55, 4), (59, 4), clarinetmusicmaker_one],
851     [(62, 4), (64, 4), clarinetmusicmaker_two],
852     [(65, 4), (67, 4), clarinetmusicmaker_three],
853     [(67, 4), (70, 4), clarinetmusicmaker_three],
854     [(70, 4), (71, 4), clarinetmusicmaker_three],
855     [(73, 4), (75, 4), clarinetmusicmaker_two],
856     [(75, 4), (76, 4), clarinetmusicmaker_two],
857     [(80, 4), (82, 4), clarinetmusicmaker_one],
858     [(82, 4), (85, 4), clarinetmusicmaker_one],
859     [(86, 4), (88, 4), clarinetmusicmaker_two],
860     [(91, 4), (94, 4), clarinetmusicmaker_three],
861     [(94, 4), (95, 4), clarinetmusicmaker_three],
862     [(100, 4), (101, 4), clarinetmusicmaker_two],
863     [(103, 4), (104, 4), clarinetmusicmaker_one],
864     [(104, 4), (106, 4), clarinetmusicmaker_one],
865     [(110, 4), (114, 4), clarinetmusicmaker_one],
866     [(115, 4), (119, 4), clarinetmusicmaker_one],
867     [(120, 4), (123, 4), clarinetmusicmaker_one],
868     [(123, 4), (124, 4), clarinetmusicmaker_one],
869     [(125, 4), (126, 4), clarinetmusicmaker_two],
870     [(129, 4), (131, 4), clarinetmusicmaker_two],
871     [(131, 4), (134, 4), clarinetmusicmaker_two],
872     [(141, 4), (144, 4), clarinetmusicmaker_two],
873     [(149, 4), (150, 4), clarinetmusicmaker_two],
874     [(155, 4), (159, 4), clarinetmusicmaker_three],
875     [(162, 4), (164, 4), clarinetmusicmaker_three],
876     [(165, 4), (168, 4), clarinetmusicmaker_three],
877     [(168, 4), (170, 4), clarinetmusicmaker_three],
878     [(174, 4), (175, 4), clarinetmusicmaker_three],
879     [(175, 4), (177, 4), clarinetmusicmaker_three],
880     [(179, 4), (180, 4), clarinetmusicmaker_three],
881     [(185, 4), (186, 4), clarinetmusicmaker_three],
882     [(186, 4), (190, 4), clarinetmusicmaker_three],
883 ]
884 ])
885
886 voice_9_timespan_list = abjad.TimespanList([
887     abjad.AnnotatedTimespan(
888         start_offset=start_offset,
889         stop_offset=stop_offset,
890         annotation=MusicSpecifier(
891             music_maker=music_maker,
892             voice_name='Voice 9',
893         ),
894     )
895     for start_offset, stop_offset, music_maker in [

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896     [(2, 4), (5, 4), violin2musicmaker_one],
897     [(9, 4), (11, 4), violin2musicmaker_two],
898     [(11, 4), (13, 4), violin2musicmaker_two],
899     [(16, 4), (18, 4), violin2musicmaker_three],
900     [(21, 4), (22, 4), violin2musicmaker_one],
901     [(22, 4), (23, 4), violin2musicmaker_one],
902     [(35, 4), (40, 4), violin2musicmaker_one],
903     [(44, 4), (46, 4), violin2musicmaker_two],
904     [(46, 4), (47, 4), violin2musicmaker_two],
905     [(49, 4), (50, 4), violin2musicmaker_three],
906     [(55, 4), (59, 4), violin2musicmaker_one],
907     [(62, 4), (64, 4), violin2musicmaker_two],
908     [(65, 4), (67, 4), violin2musicmaker_three],
909     [(67, 4), (70, 4), violin2musicmaker_three],
910     [(70, 4), (71, 4), violin2musicmaker_three],
911     [(73, 4), (75, 4), violin2musicmaker_two],
912     [(75, 4), (76, 4), violin2musicmaker_two],
913     [(80, 4), (82, 4), violin2musicmaker_one],
914     [(82, 4), (85, 4), violin2musicmaker_one],
915     [(86, 4), (88, 4), violin2musicmaker_two],
916     [(91, 4), (94, 4), violin2musicmaker_three],
917     [(94, 4), (95, 4), violin2musicmaker_three],
918     [(100, 4), (101, 4), violin2musicmaker_two],
919     [(103, 4), (104, 4), violin2musicmaker_one],
920     [(104, 4), (106, 4), violin2musicmaker_one],
921     [(110, 4), (114, 4), violin2musicmaker_one],
922     [(115, 4), (119, 4), violin2musicmaker_one],
923     [(120, 4), (123, 4), violin2musicmaker_one],
924     [(123, 4), (124, 4), violin2musicmaker_one],
925     [(125, 4), (126, 4), violin2musicmaker_two],
926     [(129, 4), (131, 4), violin2musicmaker_two],
927     [(131, 4), (134, 4), violin2musicmaker_two],
928     [(141, 4), (144, 4), violin2musicmaker_two],
929     [(149, 4), (150, 4), violin2musicmaker_two],
930     [(154, 4), (157, 4), violin2musicmaker_three],
931     [(159, 4), (160, 4), violin2musicmaker_three],
932     [(165, 4), (168, 4), violin2musicmaker_three],
933     [(168, 4), (169, 4), violin2musicmaker_three],
934     [(172, 4), (174, 4), violin2musicmaker_three],
935     [(175, 4), (179, 4), violin2musicmaker_three],
936     [(179, 4), (180, 4), violin2musicmaker_three],
937     [(184, 4), (186, 4), violin2musicmaker_three],
938     [(186, 4), (190, 4), violin2musicmaker_three],
939 ]
940 ])
941
942 voice_10_timespan_list = abjad.TimespanList([
943     abjad.AnnotatedTimespan(
944         start_offset=start_offset,
945         stop_offset=stop_offset,
946         annotation=MusicSpecifier(
947             music_maker=music_maker,
948             voice_name='Voice 10',
949         ),

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```

950 )
951 for start_offset, stop_offset, music_maker in [
952     [(2, 4), (5, 4), violamusicmaker_one],
953     [(9, 4), (11, 4), violamusicmaker_two],
954     [(11, 4), (13, 4), violamusicmaker_two],
955     [(17, 4), (18, 4), violamusicmaker_three],
956     [(21, 4), (22, 4), violamusicmaker_one],
957     [(22, 4), (25, 4), violamusicmaker_one],
958     [(29, 4), (30, 4), violamusicmaker_two],
959     [(30, 4), (32, 4), violamusicmaker_two],
960     [(35, 4), (40, 4), violamusicmaker_one],
961     [(44, 4), (46, 4), violamusicmaker_two],
962     [(46, 4), (47, 4), violamusicmaker_two],
963     [(49, 4), (50, 4), violamusicmaker_three],
964     [(55, 4), (59, 4), violamusicmaker_one],
965     [(62, 4), (64, 4), violamusicmaker_two],
966     [(65, 4), (67, 4), violamusicmaker_three],
967     [(67, 4), (70, 4), violamusicmaker_three],
968     [(70, 4), (71, 4), violamusicmaker_three],
969     [(73, 4), (75, 4), violamusicmaker_two],
970     [(75, 4), (76, 4), violamusicmaker_two],
971     [(80, 4), (82, 4), violamusicmaker_one],
972     [(82, 4), (85, 4), violamusicmaker_one],
973     [(86, 4), (88, 4), violamusicmaker_two],
974     [(91, 4), (94, 4), violamusicmaker_three],
975     [(94, 4), (95, 4), violamusicmaker_three],
976     [(100, 4), (101, 4), violamusicmaker_two],
977     [(103, 4), (104, 4), violamusicmaker_one],
978     [(104, 4), (106, 4), violamusicmaker_one],
979     [(110, 4), (114, 4), violamusicmaker_one],
980     [(115, 4), (119, 4), violamusicmaker_one],
981     [(120, 4), (123, 4), violamusicmaker_one],
982     [(123, 4), (124, 4), violamusicmaker_one],
983     [(125, 4), (126, 4), violamusicmaker_two],
984     [(129, 4), (131, 4), violamusicmaker_two],
985     [(131, 4), (134, 4), violamusicmaker_two],
986     [(141, 4), (144, 4), violamusicmaker_two],
987     [(149, 4), (150, 4), violamusicmaker_two],
988     [(153, 4), (154, 4), violamusicmaker_three],
989     [(154, 4), (155, 4), violamusicmaker_three],
990     [(156, 4), (159, 4), violamusicmaker_three],
991     [(159, 4), (161, 4), violamusicmaker_three],
992     [(165, 4), (168, 4), violamusicmaker_three],
993     [(170, 4), (171, 4), violamusicmaker_three],
994     [(176, 4), (179, 4), violamusicmaker_three],
995     [(179, 4), (180, 4), violamusicmaker_three],
996     [(183, 4), (185, 4), violamusicmaker_three],
997     [(186, 4), (190, 4), violamusicmaker_three],
998 ]
999 ])
1000
1001 ###group three###
1002 voice_3_timespan_list = abjad.TimespanList([
1003     abjad.AnnotatedTimespan(

```

```

1004     start_offset=start_offset,
1005     stop_offset=stop_offset,
1006     annotation=MusicSpecifier(
1007         music_maker=music_maker,
1008         voice_name='Voice 3',
1009     ),
1010 )
1011 for start_offset, stop_offset, music_maker in [
1012     [(7, 4), (11, 4), bassoonmusicmaker_one],
1013     [(15, 4), (16, 4), bassoonmusicmaker_two],
1014     [(19, 4), (22, 4), bassoonmusicmaker_three],
1015     [(22, 4), (23, 4), bassoonmusicmaker_three],
1016     [(27, 4), (30, 4), bassoonmusicmaker_one],
1017     [(32, 4), (35, 4), bassoonmusicmaker_two],
1018     [(35, 4), (36, 4), bassoonmusicmaker_three],
1019     [(37, 4), (40, 4), bassoonmusicmaker_two],
1020     [(40, 4), (42, 4), bassoonmusicmaker_two],
1021     [(46, 4), (49, 4), bassoonmusicmaker_one],
1022     [(51, 4), (52, 4), bassoonmusicmaker_three],
1023     [(57, 4), (59, 4), bassoonmusicmaker_two],
1024     [(59, 4), (61, 4), bassoonmusicmaker_two],
1025     [(64, 4), (66, 4), bassoonmusicmaker_one],
1026     [(67, 4), (70, 4), bassoonmusicmaker_three],
1027     [(70, 4), (72, 4), bassoonmusicmaker_one],
1028     [(72, 4), (73, 4), bassoonmusicmaker_one],
1029     [(77, 4), (79, 4), bassoonmusicmaker_two],
1030     [(79, 4), (82, 4), bassoonmusicmaker_two],
1031     [(83, 4), (85, 4), bassoonmusicmaker_three],
1032     [(88, 4), (89, 4), bassoonmusicmaker_two],
1033     [(89, 4), (92, 4), bassoonmusicmaker_two],
1034     [(97, 4), (98, 4), bassoonmusicmaker_one],
1035     [(100, 4), (103, 4), bassoonmusicmaker_two],
1036     [(107, 4), (110, 4), bassoonmusicmaker_three],
1037     [(110, 4), (112, 4), bassoonmusicmaker_one],
1038     [(113, 4), (114, 4), bassoonmusicmaker_one],
1039     [(114, 4), (117, 4), bassoonmusicmaker_one],
1040     [(118, 4), (119, 4), bassoonmusicmaker_one],
1041     [(119, 4), (122, 4), bassoonmusicmaker_one],
1042     [(123, 4), (125, 4), bassoonmusicmaker_one],
1043     [(126, 4), (131, 4), bassoonmusicmaker_two],
1044     [(138, 4), (141, 4), bassoonmusicmaker_two],
1045     [(146, 4), (150, 4), bassoonmusicmaker_two],
1046     [(150, 4), (154, 4), bassoonmusicmaker_three],
1047     [(154, 4), (155, 4), bassoonmusicmaker_three],
1048     [(159, 4), (162, 4), bassoonmusicmaker_three],
1049     [(164, 4), (165, 4), bassoonmusicmaker_three],
1050     [(170, 4), (172, 4), bassoonmusicmaker_three],
1051     [(172, 4), (174, 4), bassoonmusicmaker_three],
1052     [(177, 4), (179, 4), bassoonmusicmaker_three],
1053     [(180, 4), (183, 4), bassoonmusicmaker_three],
1054     [(183, 4), (185, 4), bassoonmusicmaker_three],
1055     [(186, 4), (190, 4), bassoonmusicmaker_three],
1056 ]
1057 ))

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1058
1059 voice_6_timespan_list = abjad.TimespanList([
1060     abjad.AnnotatedTimespan(
1061         start_offset=start_offset,
1062         stop_offset=stop_offset,
1063         annotation=MusicSpecifier(
1064             music_maker=music_maker,
1065             voice_name='Voice 6',
1066         ),
1067     )
1068     for start_offset, stop_offset, music_maker in [
1069         [(7, 4), (11, 4), trombonemusicmaker_one],
1070         [(14, 4), (16, 4), trombonemusicmaker_two],
1071         [(19, 4), (22, 4), trombonemusicmaker_three],
1072         [(22, 4), (23, 4), trombonemusicmaker_three],
1073         [(27, 4), (29, 4), trombonemusicmaker_one],
1074         [(35, 4), (36, 4), trombonemusicmaker_three],
1075         [(37, 4), (40, 4), trombonemusicmaker_two],
1076         [(40, 4), (42, 4), trombonemusicmaker_two],
1077         [(46, 4), (49, 4), trombonemusicmaker_one],
1078         [(51, 4), (52, 4), trombonemusicmaker_three],
1079         [(57, 4), (59, 4), trombonemusicmaker_two],
1080         [(59, 4), (61, 4), trombonemusicmaker_two],
1081         [(64, 4), (66, 4), trombonemusicmaker_one],
1082         [(67, 4), (70, 4), trombonemusicmaker_three],
1083         [(70, 4), (72, 4), trombonemusicmaker_one],
1084         [(72, 4), (73, 4), trombonemusicmaker_one],
1085         [(77, 4), (79, 4), trombonemusicmaker_two],
1086         [(79, 4), (82, 4), trombonemusicmaker_two],
1087         [(83, 4), (85, 4), trombonemusicmaker_three],
1088         [(88, 4), (89, 4), trombonemusicmaker_two],
1089         [(89, 4), (92, 4), trombonemusicmaker_two],
1090         [(97, 4), (98, 4), trombonemusicmaker_one],
1091         [(100, 4), (103, 4), trombonemusicmaker_two],
1092         [(107, 4), (110, 4), trombonemusicmaker_three],
1093         [(110, 4), (112, 4), trombonemusicmaker_one],
1094         [(113, 4), (114, 4), trombonemusicmaker_one],
1095         [(114, 4), (117, 4), trombonemusicmaker_one],
1096         [(118, 4), (119, 4), trombonemusicmaker_one],
1097         [(119, 4), (122, 4), trombonemusicmaker_one],
1098         [(123, 4), (125, 4), trombonemusicmaker_one],
1099         [(126, 4), (131, 4), trombonemusicmaker_two],
1100         [(138, 4), (141, 4), trombonemusicmaker_two],
1101         [(146, 4), (150, 4), trombonemusicmaker_two],
1102         [(150, 4), (154, 4), trombonemusicmaker_three],
1103         [(157, 4), (159, 4), trombonemusicmaker_three],
1104         [(160, 4), (164, 4), trombonemusicmaker_three],
1105         [(164, 4), (165, 4), trombonemusicmaker_three],
1106         [(169, 4), (172, 4), trombonemusicmaker_three],
1107         [(174, 4), (175, 4), trombonemusicmaker_three],
1108         [(180, 4), (183, 4), trombonemusicmaker_three],
1109         [(183, 4), (184, 4), trombonemusicmaker_three],
1110         [(186, 4), (190, 4), trombonemusicmaker_three],
1111     ]

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1112 ])
1113
1114 voice_11_timespan_list = abjad.TimespanList([
1115     abjad.AnnotatedTimespan(
1116         start_offset=start_offset,
1117         stop_offset=stop_offset,
1118         annotation=MusicSpecifier(
1119             music_maker=music_maker,
1120             voice_name='Voice 11',
1121         ),
1122     )
1123     for start_offset, stop_offset, music_maker in [
1124         [(7, 4), (11, 4), cellomusicmaker_one],
1125         [(14, 4), (16, 4), cellomusicmaker_two],
1126         [(21, 4), (22, 4), cellomusicmaker_three],
1127         [(22, 4), (23, 4), cellomusicmaker_three],
1128         [(27, 4), (30, 4), cellomusicmaker_one],
1129         [(35, 4), (36, 4), cellomusicmaker_three],
1130         [(37, 4), (40, 4), cellomusicmaker_two],
1131         [(40, 4), (42, 4), cellomusicmaker_two],
1132         [(46, 4), (49, 4), cellomusicmaker_one],
1133         [(51, 4), (52, 4), cellomusicmaker_three],
1134         [(57, 4), (59, 4), cellomusicmaker_two],
1135         [(59, 4), (61, 4), cellomusicmaker_two],
1136         [(64, 4), (66, 4), cellomusicmaker_one],
1137         [(67, 4), (70, 4), cellomusicmaker_three],
1138         [(70, 4), (72, 4), cellomusicmaker_one],
1139         [(72, 4), (73, 4), cellomusicmaker_one],
1140         [(77, 4), (79, 4), cellomusicmaker_two],
1141         [(79, 4), (82, 4), cellomusicmaker_two],
1142         [(83, 4), (85, 4), cellomusicmaker_three],
1143         [(88, 4), (89, 4), cellomusicmaker_two],
1144         [(89, 4), (92, 4), cellomusicmaker_two],
1145         [(97, 4), (98, 4), cellomusicmaker_one],
1146         [(100, 4), (103, 4), cellomusicmaker_two],
1147         [(107, 4), (110, 4), cellomusicmaker_three],
1148         [(110, 4), (112, 4), cellomusicmaker_one],
1149         [(113, 4), (114, 4), cellomusicmaker_one],
1150         [(114, 4), (117, 4), cellomusicmaker_one],
1151         [(118, 4), (119, 4), cellomusicmaker_one],
1152         [(119, 4), (122, 4), cellomusicmaker_one],
1153         [(123, 4), (125, 4), cellomusicmaker_one],
1154         [(126, 4), (131, 4), cellomusicmaker_two],
1155         [(138, 4), (141, 4), cellomusicmaker_two],
1156         [(146, 4), (150, 4), cellomusicmaker_two],
1157         [(150, 4), (153, 4), cellomusicmaker_three],
1158         [(155, 4), (156, 4), cellomusicmaker_three],
1159         [(161, 4), (164, 4), cellomusicmaker_three],
1160         [(164, 4), (165, 4), cellomusicmaker_three],
1161         [(168, 4), (170, 4), cellomusicmaker_three],
1162         [(171, 4), (172, 4), cellomusicmaker_three],
1163         [(172, 4), (175, 4), cellomusicmaker_three],
1164         [(175, 4), (176, 4), cellomusicmaker_three],
1165         [(180, 4), (183, 4), cellomusicmaker_three],

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1166         [(185, 4), (186, 4), cellomusicmaker_three],
1167         [(186, 4), (190, 4), cellomusicmaker_three],
1168     ]
1169 ])
1170
1171 ###group four###
1172 voice_4_timespan_list = abjad.TimespanList([
1173     abjad.AnnotatedTimespan(
1174         start_offset=start_offset,
1175         stop_offset=stop_offset,
1176         annotation=MusicSpecifier(
1177             music_maker=music_maker,
1178             voice_name='Voice 4',
1179         ),
1180     )
1181     for start_offset, stop_offset, music_maker in [
1182         [(0, 4), (5, 4), hornmusicmaker_one],
1183         [(8, 4), (10, 4), hornmusicmaker_two],
1184         [(14, 4), (18, 4), hornmusicmaker_three],
1185         [(21, 4), (22, 4), hornmusicmaker_one],
1186         [(22, 4), (23, 4), hornmusicmaker_one],
1187         [(38, 4), (40, 4), hornmusicmaker_two],
1188         [(41, 4), (43, 4), hornmusicmaker_one],
1189         [(43, 4), (46, 4), hornmusicmaker_one],
1190         [(50, 4), (53, 4), hornmusicmaker_three],
1191         [(55, 4), (56, 4), hornmusicmaker_two],
1192         [(61, 4), (64, 4), hornmusicmaker_one],
1193         [(64, 4), (65, 4), hornmusicmaker_one],
1194         [(68, 4), (70, 4), hornmusicmaker_three],
1195         [(70, 4), (72, 4), hornmusicmaker_two],
1196         [(72, 4), (74, 4), hornmusicmaker_two],
1197         [(79, 4), (80, 4), hornmusicmaker_three],
1198         [(82, 4), (85, 4), hornmusicmaker_two],
1199         [(89, 4), (94, 4), hornmusicmaker_one],
1200         [(95, 4), (97, 4), hornmusicmaker_two],
1201         [(100, 4), (104, 4), hornmusicmaker_three],
1202         [(109, 4), (110, 4), hornmusicmaker_two],
1203         [(110, 4), (111, 4), hornmusicmaker_one],
1204         [(112, 4), (114, 4), hornmusicmaker_one],
1205         [(114, 4), (116, 4), hornmusicmaker_one],
1206         [(117, 4), (119, 4), hornmusicmaker_one],
1207         [(119, 4), (121, 4), hornmusicmaker_one],
1208         [(122, 4), (123, 4), hornmusicmaker_one],
1209         [(123, 4), (125, 4), hornmusicmaker_one],
1210         [(133, 4), (136, 4), hornmusicmaker_two],
1211         [(142, 4), (146, 4), hornmusicmaker_two],
1212         [(146, 4), (150, 4), hornmusicmaker_two],
1213         [(153, 4), (154, 4), hornmusicmaker_three],
1214         [(154, 4), (155, 4), hornmusicmaker_three],
1215         [(159, 4), (162, 4), hornmusicmaker_three],
1216         [(164, 4), (168, 4), hornmusicmaker_three],
1217         [(171, 4), (172, 4), hornmusicmaker_three],
1218         [(172, 4), (173, 4), hornmusicmaker_three],
1219         [(177, 4), (179, 4), hornmusicmaker_three],

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1220         [(179, 4), (180, 4), hornmusicmaker_three],
1221         [(182, 4), (183, 4), hornmusicmaker_three],
1222         [(183, 4), (186, 4), hornmusicmaker_three],
1223         [(186, 4), (190, 4), hornmusicmaker_three],
1224     ]
1225 ])
1226
1227 voice_7_timespan_list = abjad.TimespanList([
1228     abjad.AnnotatedTimespan(
1229         start_offset=start_offset,
1230         stop_offset=stop_offset,
1231         annotation=MusicSpecifier(
1232             music_maker=music_maker,
1233             voice_name='Voice 7',
1234         ),
1235     )
1236     for start_offset, stop_offset, music_maker in [
1237         [(0, 4), (5, 4), tubamusicmaker_one],
1238         [(8, 4), (10, 4), tubamusicmaker_two],
1239         [(14, 4), (18, 4), tubamusicmaker_three],
1240         [(21, 4), (22, 4), tubamusicmaker_one],
1241         [(22, 4), (23, 4), tubamusicmaker_one],
1242         [(26, 4), (30, 4), tubamusicmaker_two],
1243         [(38, 4), (40, 4), tubamusicmaker_two],
1244         [(41, 4), (43, 4), tubamusicmaker_one],
1245         [(43, 4), (46, 4), tubamusicmaker_one],
1246         [(50, 4), (53, 4), tubamusicmaker_three],
1247         [(55, 4), (56, 4), tubamusicmaker_two],
1248         [(61, 4), (64, 4), tubamusicmaker_one],
1249         [(64, 4), (65, 4), tubamusicmaker_one],
1250         [(68, 4), (70, 4), tubamusicmaker_three],
1251         [(70, 4), (72, 4), tubamusicmaker_two],
1252         [(72, 4), (74, 4), tubamusicmaker_two],
1253         [(79, 4), (80, 4), tubamusicmaker_three],
1254         [(82, 4), (85, 4), tubamusicmaker_two],
1255         [(89, 4), (94, 4), tubamusicmaker_one],
1256         [(95, 4), (97, 4), tubamusicmaker_two],
1257         [(100, 4), (104, 4), tubamusicmaker_three],
1258         [(109, 4), (110, 4), tubamusicmaker_two],
1259         [(110, 4), (111, 4), tubamusicmaker_one],
1260         [(112, 4), (114, 4), tubamusicmaker_one],
1261         [(114, 4), (116, 4), tubamusicmaker_one],
1262         [(117, 4), (119, 4), tubamusicmaker_one],
1263         [(119, 4), (121, 4), tubamusicmaker_one],
1264         [(122, 4), (123, 4), tubamusicmaker_one],
1265         [(123, 4), (125, 4), tubamusicmaker_one],
1266         [(133, 4), (136, 4), tubamusicmaker_two],
1267         [(142, 4), (146, 4), tubamusicmaker_two],
1268         [(146, 4), (150, 4), tubamusicmaker_two],
1269         [(154, 4), (157, 4), tubamusicmaker_three],
1270         [(159, 4), (163, 4), tubamusicmaker_three],
1271         [(166, 4), (168, 4), tubamusicmaker_three],
1272         [(172, 4), (175, 4), tubamusicmaker_three],
1273         [(177, 4), (179, 4), tubamusicmaker_three],

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1274         [(179, 4), (181, 4), tubamusicmaker_three],
1275         [(184, 4), (186, 4), tubamusicmaker_three],
1276         [(186, 4), (190, 4), tubamusicmaker_three],
1277     ]
1278 ])
1279
1280 voice_12_timespan_list = abjad.TimespanList([
1281     abjad.AnnotatedTimespan(
1282         start_offset=start_offset,
1283         stop_offset=stop_offset,
1284         annotation=MusicSpecifier(
1285             music_maker=music_maker,
1286             voice_name='Voice 12',
1287         ),
1288     )
1289     for start_offset, stop_offset, music_maker in [
1290         [(0, 4), (5, 4), bassmusicmaker_one],
1291         [(8, 4), (10, 4), bassmusicmaker_two],
1292         [(14, 4), (18, 4), bassmusicmaker_three],
1293         [(21, 4), (22, 4), bassmusicmaker_one],
1294         [(22, 4), (23, 4), bassmusicmaker_one],
1295         [(38, 4), (40, 4), bassmusicmaker_two],
1296         [(41, 4), (43, 4), bassmusicmaker_one],
1297         [(43, 4), (46, 4), bassmusicmaker_one],
1298         [(50, 4), (53, 4), bassmusicmaker_three],
1299         [(55, 4), (56, 4), bassmusicmaker_two],
1300         [(61, 4), (64, 4), bassmusicmaker_one],
1301         [(64, 4), (65, 4), bassmusicmaker_one],
1302         [(68, 4), (70, 4), bassmusicmaker_three],
1303         [(70, 4), (72, 4), bassmusicmaker_two],
1304         [(72, 4), (74, 4), bassmusicmaker_two],
1305         [(79, 4), (80, 4), bassmusicmaker_three],
1306         [(82, 4), (85, 4), bassmusicmaker_two],
1307         [(89, 4), (94, 4), bassmusicmaker_one],
1308         [(95, 4), (97, 4), bassmusicmaker_two],
1309         [(100, 4), (104, 4), bassmusicmaker_three],
1310         [(109, 4), (110, 4), bassmusicmaker_two],
1311         [(110, 4), (111, 4), bassmusicmaker_one],
1312         [(112, 4), (114, 4), bassmusicmaker_one],
1313         [(114, 4), (116, 4), bassmusicmaker_one],
1314         [(117, 4), (119, 4), bassmusicmaker_one],
1315         [(119, 4), (121, 4), bassmusicmaker_one],
1316         [(122, 4), (123, 4), bassmusicmaker_one],
1317         [(123, 4), (125, 4), bassmusicmaker_one],
1318         [(133, 4), (136, 4), bassmusicmaker_two],
1319         [(142, 4), (146, 4), bassmusicmaker_two],
1320         [(146, 4), (150, 4), bassmusicmaker_two],
1321         [(152, 4), (154, 4), bassmusicmaker_three],
1322         [(154, 4), (156, 4), bassmusicmaker_three],
1323         [(159, 4), (161, 4), bassmusicmaker_three],
1324         [(165, 4), (168, 4), bassmusicmaker_three],
1325         [(170, 4), (172, 4), bassmusicmaker_three],
1326         [(172, 4), (174, 4), bassmusicmaker_three],
1327         [(177, 4), (179, 4), bassmusicmaker_three],

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1328         [(183, 4), (186, 4), bassmusicmaker_three],
1329         [(186, 4), (190, 4), bassmusicmaker_three],
1330     ]
1331 ])
1332
1333 all_timespan_lists = {
1334     'Voice 1': voice_1_timespan_list,
1335     'Voice 2': voice_2_timespan_list,
1336     'Voice 3': voice_3_timespan_list,
1337     'Voice 4': voice_4_timespan_list,
1338     'Voice 5': voice_5_timespan_list,
1339     'Voice 6': voice_6_timespan_list,
1340     'Voice 7': voice_7_timespan_list,
1341     'Voice 8': voice_8_timespan_list,
1342     'Voice 9': voice_9_timespan_list,
1343     'Voice 10': voice_10_timespan_list,
1344     'Voice 11': voice_11_timespan_list,
1345     'Voice 12': voice_12_timespan_list,
1346 }
1347
1348 global_timespan = abjad.Timespan(
1349     start_offset=0,
1350     stop_offset=max(_.stop_offset for _ in all_timespan_lists.values())
1351 )
1352
1353
1354 for voice_name, timespan_list in all_timespan_lists.items():
1355     silences = abjad.TimespanList([global_timespan])
1356     silences.extend(timespan_list)
1357     silences.sort()
1358     silences.compute_logical_xor()
1359     for silence_timespan in silences:
1360         timespan_list.append(
1361             abjad.AnnotatedTimespan(
1362                 start_offset=silence_timespan.start_offset,
1363                 stop_offset=silence_timespan.stop_offset,
1364                 annotation=MusicSpecifier(
1365                     music_maker=None,
1366                     voice_name=voice_name,
1367                 ),
1368             )
1369         )
1370     timespan_list.sort()
1371
1372
1373 for voice_name, timespan_list in all_timespan_lists.items():
1374     shards = timespan_list.split_at_offsets(bounds)
1375     split_timespan_list = abjad.TimespanList()
1376     for shard in shards:
1377         split_timespan_list.extend(shard)
1378     split_timespan_list.sort()
1379     all_timespan_lists[voice_name] = timespan_list
1380
1381 score = abjad.Score([

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1382     abjad.Staff(lilypond_type='TimeSignatureContext', name='Global Context 1')
1383 ,
1384     abjad.StaffGroup(
1385         [
1386             abjad.Staff([abjad.Voice(name='Voice 1')], name='Staff 1',
1387                 lilypond_type='Staff'),
1388             abjad.Staff([abjad.Voice(name='Voice 2')], name='Staff 2',
1389                 lilypond_type='Staff'),
1390             abjad.Staff([abjad.Voice(name='Voice 3')], name='Staff 3',
1391                 lilypond_type='Staff'),
1392         ],
1393         name='Staff Group 1',
1394     ),
1395     abjad.Staff(lilypond_type='TimeSignatureContext', name='Global Context 2')
1396 ,
1397     abjad.StaffGroup(
1398         [
1399             abjad.Staff([abjad.Voice(name='Voice 4')], name='Staff 4',
1400                 lilypond_type='Staff'),
1401             abjad.Staff([abjad.Voice(name='Voice 5')], name='Staff 5',
1402                 lilypond_type='Staff'),
1403             abjad.Staff([abjad.Voice(name='Voice 6')], name='Staff 6',
1404                 lilypond_type='Staff'),
1405             abjad.Staff([abjad.Voice(name='Voice 7')], name='Staff 7',
1406                 lilypond_type='Staff'),
1407         ],
1408         name='Staff Group 2',
1409     ),
1410     abjad.Staff(lilypond_type='TimeSignatureContext', name='Global Context 3')
1411 ,
1412     abjad.StaffGroup(
1413         [
1414             abjad.Staff([abjad.Voice(name='Voice 8')], name='Staff 8',
1415                 lilypond_type='Staff'),
1416             abjad.Staff([abjad.Voice(name='Voice 9')], name='Staff 9',
1417                 lilypond_type='Staff'),
1418             abjad.Staff([abjad.Voice(name='Voice 10')], name='Staff 10',
1419                 lilypond_type='Staff'),
1420             abjad.Staff([abjad.Voice(name='Voice 11')], name='Staff 11',
1421                 lilypond_type='Staff'),
1422             abjad.Staff([abjad.Voice(name='Voice 12')], name='Staff 12',
1423                 lilypond_type='Staff'),
1424         ],
1425         name='Staff Group 3',
1426     )
1427 ],
1428 )
1429
1430 for time_signature in time_signatures:
1431     skip = abjad.Skip(1, multiplier=(time_signature))
1432     abjad.attach(time_signature, skip)
1433     score['Global Context 1'].append(skip)
1434
1435

```

```

1421 for time_signature in time_signatures:
1422     skip = abjad.Skip(1, multiplier=(time_signature))
1423     abjad.attach(time_signature, skip)
1424     score['Global Context 2'].append(skip)
1425
1426 for time_signature in time_signatures:
1427     skip = abjad.Skip(1, multiplier=(time_signature))
1428     abjad.attach(time_signature, skip)
1429     score['Global Context 3'].append(skip)
1430
1431 print('Making containers ...')
1432
1433 def make_container(music_maker, durations):
1434     selections = music_maker(durations)
1435     container = abjad.Container([])
1436     container.extend(selections)
1437     return container
1438
1439 def key_function(timespan):
1440     return timespan.annotation.music_maker or silence_maker
1441
1442 for voice_name, timespan_list in all_timespan_lists.items():
1443     for music_maker, grouper in itertools.groupby(
1444         timespan_list,
1445         key=key_function,
1446     ):
1447         durations = [timespan.duration for timespan in grouper]
1448         container = make_container(music_maker, durations)
1449         voice = score[voice_name]
1450         voice.append(container)
1451
1452 print('Splitting and rewriting ...')
1453
1454 for voice in abjad.iterate(score['Staff Group 1']).components(abjad.Voice):
1455     for i, shard in enumerate(abjad.mutate(voice[:]).split(time_signatures)):
1456         time_signature = time_signatures[i]
1457         abjad.mutate(shard).rewrite_meter(time_signature)
1458
1459 for voice in abjad.iterate(score['Staff Group 2']).components(abjad.Voice):
1460     for i, shard in enumerate(abjad.mutate(voice[:]).split(time_signatures)):
1461         time_signature = time_signatures[i]
1462         abjad.mutate(shard).rewrite_meter(time_signature)
1463
1464 for voice in abjad.iterate(score['Staff Group 3']).components(abjad.Voice):
1465     for i, shard in enumerate(abjad.mutate(voice[:]).split(time_signatures)):
1466         time_signature = time_signatures[i]
1467         abjad.mutate(shard).rewrite_meter(time_signature)
1468
1469 print('Beaming runs ...')
1470
1471 for voice in abjad.select(score).components(abjad.Voice):
1472     for run in abjad.select(voice).runs():
1473         if 1 < len(run):
1474             specifier = abjadext.rmakers.BeamSpecifier(

```

```

1475         beam_each_division=False,
1476     )
1477     specifier(run)
1478     abjad.attach(abjad.StartBeam(), run[0])
1479     abjad.attach(abjad.StopBeam(), run[-1])
1480     for leaf in run:
1481         if abjad.Duration(1, 4) <= leaf.written_duration:
1482             continue
1483         previous_leaf = abjad.inspect(leaf).leaf(-1)
1484         next_leaf = abjad.inspect(leaf).leaf(1)
1485         if (isinstance(next_leaf, (abjad.Chord, abjad.Note)) and
1486             abjad.Duration(1, 4) <= next_leaf.written_duration):
1487             left = previous_leaf.written_duration.flag_count
1488             right = leaf.written_duration.flag_count
1489             beam_count = abjad.BeamCount(
1490                 left=left,
1491                 right=right,
1492             )
1493             abjad.attach(beam_count, leaf)
1494             continue
1495         if (isinstance(previous_leaf, (abjad.Chord, abjad.Note)) and
1496             abjad.Duration(1, 4) <= previous_leaf.written_duration):
1497             left = leaf.written_duration.flag_count
1498             right = next_leaf.written_duration.flag_count
1499             beam_count = abjad.BeamCount(
1500                 left=left,
1501                 right=right,
1502             )
1503             abjad.attach(beam_count, leaf)
1504
1505     print('Beautifying score ...')
1506     for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
1507         for selection in abjad.select(staff).components(abjad.Rest).
1508             group_by_contiguity():
1509             start_command = abjad.LilyPondLiteral(
1510                 r'\stopStaff \once \override Staff.StaffSymbol.line-count = #1 \
1511                 startStaff',
1512                 format_slot='before',
1513             )
1514             stop_command = abjad.LilyPondLiteral(
1515                 r'\stopStaff \startStaff',
1516                 format_slot='after',
1517             )
1518             abjad.attach(start_command, selection[0])
1519             abjad.attach(stop_command, selection[-1])
1520
1521     for staff in abjad.iterate(score['Staff Group 2']).components(abjad.Staff):
1522         for selection in abjad.select(staff).components(abjad.Rest).
1523             group_by_contiguity():
1524             start_command = abjad.LilyPondLiteral(
1525                 r'\stopStaff \once \override Staff.StaffSymbol.line-count = #1 \
1526                 startStaff',
1527                 format_slot='before',
1528             )

```

```

1525         stop_command = abjad.LilyPondLiteral(
1526             r'\stopStaff \startStaff',
1527             format_slot='after',
1528         )
1529         abjad.attach(start_command, selection[0])
1530         abjad.attach(stop_command, selection[-1])
1531
1532     for staff in abjad.iterate(score['Staff Group 3']).components(abjad.Staff):
1533         for selection in abjad.select(staff).components(abjad.Rest).
group_by_contiguity():
1534             start_command = abjad.LilyPondLiteral(
1535                 r'\stopStaff \once \override Staff.StaffSymbol.line-count = #1 \
startStaff',
1536                 format_slot='before',
1537             )
1538             stop_command = abjad.LilyPondLiteral(
1539                 r'\stopStaff \startStaff',
1540                 format_slot='after',
1541             )
1542             abjad.attach(start_command, selection[0])
1543             abjad.attach(stop_command, selection[-1])
1544
1545     print('Stopping Hairpins ...')
1546     for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
1547         for rest in abjad.iterate(staff).components(abjad.Rest):
1548             previous_leaf = abjad.inspect(rest).leaf(-1)
1549             if isinstance(previous_leaf, abjad.Note):
1550                 abjad.attach(abjad.StopHairpin(), rest)
1551             elif isinstance(previous_leaf, abjad.Chord):
1552                 abjad.attach(abjad.StopHairpin(), rest)
1553             elif isinstance(previous_leaf, abjad.Rest):
1554                 pass
1555
1556     for staff in abjad.iterate(score['Staff Group 2']).components(abjad.Staff):
1557         for rest in abjad.iterate(staff).components(abjad.Rest):
1558             previous_leaf = abjad.inspect(rest).leaf(-1)
1559             if isinstance(previous_leaf, abjad.Note):
1560                 abjad.attach(abjad.StopHairpin(), rest)
1561             elif isinstance(previous_leaf, abjad.Chord):
1562                 abjad.attach(abjad.StopHairpin(), rest)
1563             elif isinstance(previous_leaf, abjad.Rest):
1564                 pass
1565
1566     for staff in abjad.iterate(score['Staff Group 3']).components(abjad.Staff):
1567         for rest in abjad.iterate(staff).components(abjad.Rest):
1568             previous_leaf = abjad.inspect(rest).leaf(-1)
1569             if isinstance(previous_leaf, abjad.Note):
1570                 abjad.attach(abjad.StopHairpin(), rest)
1571             elif isinstance(previous_leaf, abjad.Chord):
1572                 abjad.attach(abjad.StopHairpin(), rest)
1573             elif isinstance(previous_leaf, abjad.Rest):
1574                 pass
1575
1576     print('Adding pitch material ...')

```

```

1577 def cyc(lst):
1578     count = 0
1579     while True:
1580         yield lst[count%len(lst)]
1581         count += 1
1582
1583
1584 print('Adding attachments ...')
1585 bar_line = abjad.BarLine('|.|')
1586 metro = abjad.MetronomeMark((1, 4), 120)
1587 markup1 = abjad.Markup(r'\bold { S }')
1588 markup2 = abjad.Markup(r'\bold { T }')
1589 markup3 = abjad.Markup(r'\bold { U }')
1590 markup4 = abjad.Markup(r'\bold { V }')
1591 markup5 = abjad.Markup(r'\bold { W }')
1592 markup6 = abjad.Markup(r'\bold { X }')
1593 mark1 = abjad.RehearsalMark(markup=markup1)
1594 mark2 = abjad.RehearsalMark(markup=markup2)
1595 mark3 = abjad.RehearsalMark(markup=markup3)
1596 mark4 = abjad.RehearsalMark(markup=markup4)
1597 mark5 = abjad.RehearsalMark(markup=markup5)
1598 mark6 = abjad.RehearsalMark(markup=markup6)
1599
1600 instruments1 = cyc([
1601     abjad.Flute(),
1602     abjad.ClarinetInBFlat(),
1603     abjad.Bassoon(),
1604 ])
1605
1606 instruments2 = cyc([
1607     abjad.FrenchHorn(),
1608     abjad.Trumpet(),
1609     abjad.TenorTrombone(),
1610     abjad.Tuba(),
1611 ])
1612
1613 instruments3 = cyc([
1614     abjad.Violin(),
1615     abjad.Violin(),
1616     abjad.Viola(),
1617     abjad.Cello(),
1618     abjad.Contrabass(),
1619 ])
1620
1621 clefs1 = cyc([
1622     abjad.Clef('treble'),
1623     abjad.Clef('treble'),
1624     abjad.Clef('bass'),
1625 ])
1626
1627 clefs2 = cyc([
1628     abjad.Clef('treble'),
1629     abjad.Clef('treble'),
1630     abjad.Clef('bass'),

```

```

1631     abjad.Clef('bass'),
1632 ])
1633
1634 clefs3 = cyc([
1635     abjad.Clef('treble'),
1636     abjad.Clef('treble'),
1637     abjad.Clef('alto'),
1638     abjad.Clef('bass'),
1639     abjad.Clef('bass'),
1640 ])
1641
1642 abbreviations1 = cyc([
1643     abjad.MarginMarkup(markup=abjad.Markup('fl.'),),
1644     abjad.MarginMarkup(markup=abjad.Markup('cl.'),),
1645     abjad.MarginMarkup(markup=abjad.Markup('bssn.'),),
1646 ])
1647
1648 abbreviations2 = cyc([
1649     abjad.MarginMarkup(markup=abjad.Markup('hr.'),),
1650     abjad.MarginMarkup(markup=abjad.Markup('trp.'),),
1651     abjad.MarginMarkup(markup=abjad.Markup('trmb.'),),
1652     abjad.MarginMarkup(markup=abjad.Markup('tb.'),),
1653 ])
1654
1655 abbreviations3 = cyc([
1656     abjad.MarginMarkup(markup=abjad.Markup('vln.I'),),
1657     abjad.MarginMarkup(markup=abjad.Markup('vln.II'),),
1658     abjad.MarginMarkup(markup=abjad.Markup('vla.'),),
1659     abjad.MarginMarkup(markup=abjad.Markup('vc.'),),
1660     abjad.MarginMarkup(markup=abjad.Markup('cb.'),),
1661 ])
1662
1663 names1 = cyc([
1664     abjad.StartMarkup(markup=abjad.Markup('Flute'),),
1665     abjad.StartMarkup(markup=abjad.Markup('Clarinet'),),
1666     abjad.StartMarkup(markup=abjad.Markup('Bassoon'),),
1667 ])
1668
1669 names2 = cyc([
1670     abjad.StartMarkup(markup=abjad.Markup('Horn'),),
1671     abjad.StartMarkup(markup=abjad.Markup('Trumpet'),),
1672     abjad.StartMarkup(markup=abjad.Markup('Trombone'),),
1673     abjad.StartMarkup(markup=abjad.Markup('Tuba'),),
1674 ])
1675
1676 names3 = cyc([
1677     abjad.StartMarkup(markup=abjad.Markup('Violin I'),),
1678     abjad.StartMarkup(markup=abjad.Markup('Violin II'),),
1679     abjad.StartMarkup(markup=abjad.Markup('Viola'),),
1680     abjad.StartMarkup(markup=abjad.Markup('Violoncello'),),
1681     abjad.StartMarkup(markup=abjad.Markup('Contrabass'),),
1682 ])
1683
1684 for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):

```



```

1685 leaf1 = abjad.select(staff).leaves()[0]
1686 abjad.attach(next(instruments1), leaf1)
1687 abjad.attach(next(abbreviations1), leaf1)
1688 abjad.attach(next(names1), leaf1)
1689 abjad.attach(next(clefs1), leaf1)
1690
1691 for staff in abjad.iterate(score['Staff Group 2']).components(abjad.Staff):
1692     leaf1 = abjad.select(staff).leaves()[0]
1693     abjad.attach(next(instruments2), leaf1)
1694     abjad.attach(next(abbreviations2), leaf1)
1695     abjad.attach(next(names2), leaf1)
1696     abjad.attach(next(clefs2), leaf1)
1697
1698 for staff in abjad.iterate(score['Staff Group 3']).components(abjad.Staff):
1699     leaf1 = abjad.select(staff).leaves()[0]
1700     abjad.attach(next(instruments3), leaf1)
1701     abjad.attach(next(abbreviations3), leaf1)
1702     abjad.attach(next(names3), leaf1)
1703     abjad.attach(next(clefs3), leaf1)
1704
1705 for staff in abjad.select(score['Staff Group 1']).components(abjad.Staff)[0]:
1706     leaf1 = abjad.select(staff).leaves()[0]
1707     last_leaf = abjad.select(staff).leaves()[-1]
1708     abjad.attach(metro, leaf1)
1709     abjad.attach(bar_line, last_leaf)
1710
1711 for staff in abjad.select(score['Staff Group 2']).components(abjad.Staff)[0]:
1712     leaf1 = abjad.select(staff).leaves()[0]
1713     last_leaf = abjad.select(staff).leaves()[-1]
1714     abjad.attach(metro, leaf1)
1715     abjad.attach(bar_line, last_leaf)
1716
1717 for staff in abjad.select(score['Staff Group 3']).components(abjad.Staff)[0]:
1718     leaf1 = abjad.select(staff).leaves()[0]
1719     last_leaf = abjad.select(staff).leaves()[-1]
1720     abjad.attach(metro, leaf1)
1721     abjad.attach(bar_line, last_leaf)
1722
1723 for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1724     leaf1 = abjad.select(staff).leaves()[7]
1725     abjad.attach(mark1, leaf1)
1726
1727 for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1728     leaf1 = abjad.select(staff).leaves()[7]
1729     abjad.attach(mark1, leaf1)
1730
1731 for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1732     leaf1 = abjad.select(staff).leaves()[7]
1733     abjad.attach(mark1, leaf1)
1734
1735 for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1736     leaf2 = abjad.select(staff).leaves()[16]
1737     abjad.attach(mark2, leaf2)
1738

```

```

1739 for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1740     leaf2 = abjad.select(staff).leaves()[16]
1741     abjad.attach(mark2, leaf2)
1742
1743 for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1744     leaf2 = abjad.select(staff).leaves()[16]
1745     abjad.attach(mark2, leaf2)
1746
1747 for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1748     leaf3 = abjad.select(staff).leaves()[22]
1749     abjad.attach(mark3, leaf3)
1750
1751 for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1752     leaf3 = abjad.select(staff).leaves()[22]
1753     abjad.attach(mark3, leaf3)
1754
1755 for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1756     leaf3 = abjad.select(staff).leaves()[22]
1757     abjad.attach(mark3, leaf3)
1758
1759 for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1760     leaf4 = abjad.select(staff).leaves()[29]
1761     abjad.attach(mark4, leaf4)
1762
1763 for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1764     leaf4 = abjad.select(staff).leaves()[29]
1765     abjad.attach(mark4, leaf4)
1766
1767 for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1768     leaf4 = abjad.select(staff).leaves()[29]
1769     abjad.attach(mark4, leaf4)
1770
1771 for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1772     leaf5 = abjad.select(staff).leaves()[34]
1773     abjad.attach(mark5, leaf5)
1774
1775 for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1776     leaf5 = abjad.select(staff).leaves()[34]
1777     abjad.attach(mark5, leaf5)
1778
1779 for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1780     leaf5 = abjad.select(staff).leaves()[34]
1781     abjad.attach(mark5, leaf5)
1782
1783 for staff in abjad.iterate(score['Global Context 1']).components(abjad.Staff):
1784     leaf6 = abjad.select(staff).leaves()[39]
1785     abjad.attach(mark6, leaf6)
1786
1787 for staff in abjad.iterate(score['Global Context 2']).components(abjad.Staff):
1788     leaf6 = abjad.select(staff).leaves()[39]
1789     abjad.attach(mark6, leaf6)
1790
1791 for staff in abjad.iterate(score['Global Context 3']).components(abjad.Staff):
1792     leaf6 = abjad.select(staff).leaves()[39]

```

```

1793     abjad.attach(mark6, leaf6)
1794
1795     for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
1796         abjad.Instrument.transpose_from_sounding_pitch(staff)
1797
1798     for staff in abjad.iterate(score['Staff Group 2']).components(abjad.Staff):
1799         abjad.Instrument.transpose_from_sounding_pitch(staff)
1800
1801     for staff in abjad.iterate(score['Staff Group 3']).components(abjad.Staff):
1802         abjad.Instrument.transpose_from_sounding_pitch(staff)
1803
1804     score_file = abjad.LilyPondFile.new(
1805         score,
1806         includes=['first_stylesheet.ily', '/Users/evansdsg2/abjad/docs/source/
1807             _stylesheets/abjad.ily'],
1808     )
1809
1809     abjad.SegmentMaker.comment_measure_numbers(score)
1810     #####
1811
1812     directory = '/Users/evansdsg2/Scores/tianshu/tianshu/Segments/Segment_IV'
1813     pdf_path = f'{directory}/Segment_IV.pdf'
1814     path = pathlib.Path('Segment_IV.pdf')
1815     if path.exists():
1816         print(f'Removing {pdf_path} ...')
1817         path.unlink()
1818     time_1 = time.time()
1819     print(f'Persisting {pdf_path} ...')
1820     result = abjad.persist(score_file).as_pdf(pdf_path)
1821     print(result[0])
1822     print(result[1])
1823     print(result[2])
1824     success = result[3]
1825     if success is False:
1826         print('LilyPond failed!')
1827     time_2 = time.time()
1828     total_time = time_2 - time_1
1829     print(f'Total time: {total_time} seconds')
1830     if path.exists():
1831         print(f'Opening {pdf_path} ...')
1832         os.system(f'open {pdf_path}')

```

Code Example A.14: Tianshu Segment_IV

A.3.2 STYLESHEET

```

1 Tianshu Stylesheet.
2 % 2018-07-17 19:54
3
4 \version "2.19.82"

```

```

5 \language "english"
6 #(set-default-paper-size "11x17portrait")
7 #(set-global-staff-size 12)
8 \include "ekmel.ily"
9 \ekmelicStyle evans
10
11 \header {
12     tagline = ##f
13     breakbefore = ##t
14     dedication = \markup \override #'(
15         font-name . "Didot"
16         ) \fontsize #6 \italic {
17         "for Ensemble Ibis"
18     }
19     title = \markup { \epsfile #Y #30
20     #"/Users/evansdsg2/Scores//tianshu/tianshu/Segments/Segment_I/tianshu_title.
21     eps"
22     }
23     subtitle = \markup \override #'(
24         font-name . "Didot"
25         ) \fontsize #9 \bold \center-column {
26         "Tianshu"
27     }
28     subsubtitle = \markup \override #'(
29         font-name . "Didot"
30         ) \fontsize #5 \center-column {
31         "for twelve players"
32     }
33     arranger = \markup \override #'(
34         font-name . "Didot"
35         ) \fontsize #2.3 {
36         "Gregory Rowland Evans"
37     }

```

```

37 }
38
39 \layout {
40     \accidentalStyle forget
41     %\accidentalStyle modern
42     %\accidentalStyle modern-cautionary
43     %\accidentalStyle neo-modern
44     %\accidentalStyle dodecaphonic
45     indent = #5
46     %ragged-last = ##t
47     %ragged-right = ##t
48     %left-margin = #15
49     \context {
50         \name TimeSignatureContext
51         \type Engraver_group
52         \numericTimeSignature
53         \consists Axis_group_engraver
54         \consists Bar_number_engraver
55         \consists Time_signature_engraver
56         \consists Mark_engraver
57         \consists Metronome_mark_engraver
58         \override BarNumber.Y-extent = #'(0 . 0)
59         \override BarNumber.Y-offset = 0
60         \override BarNumber.extra-offset = #'(-4 . 0)
61         %\override BarNumber.font-name = "Didot"
62         \override BarNumber.stencil = #(
63             make-stencil-boxer 0.1 0.7 ly:text-interface::print
64         )
65         \override BarNumber.font-size = 1
66         \override BarNumber.padding = 4
67         \override MetronomeMark.X-extent = #'(0 . 0)
68         \override MetronomeMark.Y-extent = #'(0 . 0)
69         \override MetronomeMark.break-align-symbols = #'(left-edge)

```

```

70 \override MetronomeMark.extra-offset = #'(0 . 4)
71 \override MetronomeMark.font-size = 3
72 \override RehearsalMark.stencil = #(
73     make-stencil-circler 0.1 0.7 ly:text-interface::print
74 )
75 \override RehearsalMark.X-extent = #'(0 . 0)
76 \override RehearsalMark.X-offset = 6
77 \override RehearsalMark.Y-offset = -2.25
78 \override RehearsalMark.break-align-symbols = #'(time-signature)
79 \override RehearsalMark.break-visibility = #end-of-line-invisible
80 \override RehearsalMark.font-name = "Didot"
81 \override RehearsalMark.font-size = 8
82 \override RehearsalMark.outside-staff-priority = 500
83 \override RehearsalMark.self-alignment-X = #center
84     \override TimeSignature.X-extent = #'(0 . 0)
85     \override TimeSignature.X-offset = #ly:self-alignment-interface::x-
aligned-on-self
86     \override TimeSignature.Y-extent = #'(0 . 0)
87     \override TimeSignature.break-align-symbol = ##f
88     \override TimeSignature.break-visibility = #end-of-line-invisible
89     \override TimeSignature.font-size = #6
90     \override TimeSignature.self-alignment-X = #center
91 \override TimeSignature.whiteout = ##t
92     \override VerticalAxisGroup.default-staff-staff-spacing = #'(
93 (basic-distance . 0) (minimum-distance . 10) (padding . 6) (stretchability
94 . 0)
95 )
96 }
97 \context {
98     \Score
99     \remove Bar_number_engraver
100     \remove Mark_engraver
    \accepts TimeSignatureContext

```

```

101 \override BarLine.bar-extent = #'(-2 . 2)
102 \override Beam.breakable = ##t
103 \override Beam.concaveness = #10000
104 \override Glissando.breakable = ##t
105 \override SpacingSpanner.strict-grace-spacing = ##t
106 \override SpacingSpanner.strict-note-spacing = ##t
107 \override SpacingSpanner.uniform-stretching = ##t
108 \override StaffGrouper.staff-staff-spacing = #'(
109   (basic-distance . 25) (minimum-distance . 25) (padding . 3)
110 )
111 \override TupletBracket.bracket-visibility = ##t
112 \override TupletBracket.minimum-length = #3
113 \override TupletBracket.padding = #2
114 \override TupletBracket.springs-and-rods = #ly:spanner::set-spacing-
rods
115 \override TupletNumber.text = #tuplet-number::calc-fraction-text
116 proportionalNotationDuration = #(ly:make-moment 1 42)
117 autoBeaming = ##f
118 tupletFullLength = ##t
119 }
120 \context {
121   \Voice
122   \remove Forbid_line_break_engraver
123 }
124 \context {
125   \Staff
126   \remove Time_signature_engraver
127 }
128 \context {
129   \RhythmicStaff
130   \remove Time_signature_engraver
131 }
132 \context {

```

```

133     \StaffGroup
134 }
135 }
136
137 \paper {
138
139     top-margin = 1.5\cm
140     bottom-margin = 1.5\cm
141
142     %top-margin = .90\in
143     oddHeaderMarkup = \markup ""
144     evenHeaderMarkup = \markup ""
145     oddFooterMarkup = \markup \fill-line {
146         ""
147         \concat {
148             "~"
149             \fontsize #2
150             \fromproperty #'page:page-number-string "~"
151         }
152         ""
153     }
154     evenFooterMarkup = \markup \fill-line {
155         ""
156         \concat { "~" \fontsize #2
157             \fromproperty #'page:page-number-string "~"
158         } ""
159     }
160 }

```

Code Example A.15: Tianshu Stylesheet

A.4 FOUR AGES OF SAND (FOR FLUTE, ALTO SAXOPHONE, AND VIOLONCELLO) SOURCE CODE

A.4.1 SEGMENTS

A.4.1.1 SEGMENT_I

```

1 import abjad
2 import itertools
3 import os
4 import pathlib
5 import time
6 import abjadext.rmakers
7 from MusicMaker import MusicMaker
8 from AttachmentHandler import AttachmentHandler
9 from random import random
10 from random import seed
11
12 print('Interpreting file ...')
13
14 time_signatures = [
15     abjad.TimeSignature(pair) for pair in [
16         (9, 8), (6, 8), (5, 4), (4, 4), (6, 8),
17         (3, 8), (4, 4), (3, 4), (5, 8), (4, 4),
18         (11, 8),
19     ]
20 ]
21
22 bounds = abjad.mathtools.cumulative_sums([_.duration for _ in time_signatures
23 ])
24
25 def reduceMod3(rw):
26     return [(x % 4) for x in rw]
27
28 def reduceMod7(rw):
29     return [(x % 8) for x in rw]
30
31 def reduceMod9(rw):
32     return [(x % 10) for x in rw]
33
34 def cyc(lst):
35     count = 0
36     while True:
37         yield lst[count%len(lst)]
38         count += 1
39
40 def grouper(lst1, lst2):
41     def cyc(lst):

```

```

41     c = 0
42     while True:
43         yield lst[c%len(lst)]
44         c += 1
45     lst1 = cyc(lst1)
46     return [next(lst1) if i == 1 else [next(lst1) for _ in range(i)] for i in
47           lst2]
48 seed(1)
49 flute_random_walk_one = []
50 flute_random_walk_one.append(-1 if random() < 0.5 else 1)
51 for i in range(1, 1000):
52     movement = -1 if random() < 0.5 else 1
53     value = flute_random_walk_one[i-1] + movement
54     flute_random_walk_one.append(value)
55 flute_random_walk_one = [abs(x) for x in flute_random_walk_one]
56 flute_chord_one = [1, 2, 9, 10, 18, 27, 18, 10, 9, 2, ]
57 flute_notes_one = [flute_chord_one[x] for x in reduceMod9(
58     flute_random_walk_one)]
59 seed(4)
60 saxophone_random_walk_one = []
61 saxophone_random_walk_one.append(-1 if random() < 0.5 else 1)
62 for i in range(1, 1000):
63     movement = -1 if random() < 0.5 else 1
64     value = saxophone_random_walk_one[i-1] + movement
65     saxophone_random_walk_one.append(value)
66 saxophone_random_walk_one = [abs(x) for x in saxophone_random_walk_one]
67 saxophone_chord_one = [-8, 1, 2, 9, 10, 9, 2, 1, ]
68 saxophone_notes_one = [saxophone_chord_one[x] for x in reduceMod7(
69     saxophone_random_walk_one)]
70 seed(8)
71 cello_random_walk_one = []
72 cello_random_walk_one.append(-1 if random() < 0.5 else 1)
73 for i in range(1, 1000):
74     movement = -1 if random() < 0.5 else 1
75     value = cello_random_walk_one[i-1] + movement
76     cello_random_walk_one.append(value)
77 cello_random_walk_one = [abs(x) for x in cello_random_walk_one]
78 cello_chord_one = [-24, -17, -16, -8, 1, 2, 1, -8, -16, -17, ]
79 cello_notes_one = [cello_chord_one[x] for x in reduceMod9(
80     cello_random_walk_one)]
81 seed(1)
82 flute_random_walk_two = []
83 flute_random_walk_two.append(-1 if random() < 0.5 else 1)
84 for i in range(1, 1000):
85     movement = -1 if random() < 0.5 else 1
86     value = flute_random_walk_two[i-1] + movement
87     flute_random_walk_two.append(value)
88 flute_random_walk_two = [abs(x) for x in flute_random_walk_two]
89 flute_chord_two = [1, 9, 18, 9, ]
90 flute_notes_two = [flute_chord_two[x] for x in reduceMod3(

```

```

    flute_random_walk_two))
91
92 seed(4)
93 saxophone_random_walk_two = []
94 saxophone_random_walk_two.append(-1 if random() < 0.5 else 1)
95 for i in range(1, 1000):
96     movement = -1 if random() < 0.5 else 1
97     value = saxophone_random_walk_two[i-1] + movement
98     saxophone_random_walk_two.append(value)
99 saxophone_random_walk_two = [abs(x) for x in saxophone_random_walk_two]
100 saxophone_chord_two = [-8, 2, 10, 2, ]
101 saxophone_notes_two = [saxophone_chord_two[x] for x in reduceMod3(
    saxophone_random_walk_two)]
102
103 seed(8)
104 cello_random_walk_two = []
105 cello_random_walk_two.append(-1 if random() < 0.5 else 1)
106 for i in range(1, 1000):
107     movement = -1 if random() < 0.5 else 1
108     value = cello_random_walk_two[i-1] + movement
109     cello_random_walk_two.append(value)
110 cello_random_walk_two = [abs(x) for x in cello_random_walk_two]
111 cello_chord_two = [-24, -16, 1, -16, ]
112 cello_notes_two = [cello_chord_two[x] for x in reduceMod3(
    cello_random_walk_two)]
113
114 seed(1)
115 flute_random_walk_three = []
116 flute_random_walk_three.append(-1 if random() < 0.5 else 1)
117 for i in range(1, 1000):
118     movement = -1 if random() < 0.5 else 1
119     value = flute_random_walk_three[i-1] + movement
120     flute_random_walk_three.append(value)
121 flute_random_walk_three = [abs(x) for x in flute_random_walk_three]
122 flute_chord_three = [2, 10, 27, 10, ]
123 flute_notes_three = [flute_chord_three[x] for x in reduceMod3(
    flute_random_walk_three)]
124
125 seed(4)
126 saxophone_random_walk_three = []
127 saxophone_random_walk_three.append(-1 if random() < 0.5 else 1)
128 for i in range(1, 1000):
129     movement = -1 if random() < 0.5 else 1
130     value = saxophone_random_walk_three[i-1] + movement
131     saxophone_random_walk_three.append(value)
132 saxophone_random_walk_three = [abs(x) for x in saxophone_random_walk_three]
133 saxophone_chord_three = [1, 2, 10, 2, ]
134 saxophone_notes_three = [saxophone_chord_three[x] for x in reduceMod3(
    saxophone_random_walk_three)]
135
136 seed(8)
137 cello_random_walk_three = []
138 cello_random_walk_three.append(-1 if random() < 0.5 else 1)
139 for i in range(1, 1000):

```

```

140 movement = -1 if random() < 0.5 else 1
141 value = cello_random_walk_three[i-1] + movement
142 cello_random_walk_three.append(value)
143 cello_random_walk_three = [abs(x) for x in cello_random_walk_three]
144 cello_chord_three = [-17, -8, 2, -8, ]
145 cello_notes_three = [cello_chord_three[x] for x in reduceMod3(
    cello_random_walk_three)]
146
147
148 rmaker_one = abjadext.rmakers.TaleaRhythmMaker(
149     talea=abjadext.rmakers.Talea(
150         counts=[2, 7, 2, 3, 2, 4, 7, 2, 5, 6],
151         denominator=32,
152     ),
153     beam_specifier=abjadext.rmakers.BeamSpecifier(
154         beam_divisions_together=True,
155         beam_rests=False,
156     ),
157     extra_counts_per_division=[0, 1, 0, -1, 1, ],
158     burnish_specifier=abjadext.rmakers.BurnishSpecifier(
159         left_classes=[abjad.Note, abjad.Rest],
160         left_counts=[1, 0, 1],
161     ),
162     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
163         trivialize=True,
164         extract_trivial=True,
165         rewrite_rest_filled=True,
166     ),
167 )
168
169 rmaker_two = abjadext.rmakers.TaleaRhythmMaker(
170     talea=abjadext.rmakers.Talea(
171         counts=[1, 2, 2, 3, 3, 3, 2, 2, 1, ],
172         denominator=16,
173     ),
174     beam_specifier=abjadext.rmakers.BeamSpecifier(
175         beam_divisions_together=True,
176         beam_rests=False,
177     ),
178     extra_counts_per_division=[1, 0, -1, 0, 1],
179     burnish_specifier=abjadext.rmakers.BurnishSpecifier(
180         left_classes=[abjad.Note, abjad.Rest],
181         left_counts=[1, 0, 1],
182     ),
183     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
184         trivialize=True,
185         extract_trivial=True,
186         rewrite_rest_filled=True,
187     ),
188 )
189
190 rmaker_three = abjadext.rmakers.EvenDivisionRhythmMaker(
191     denominators=[16, 16, 8, 16, 16, 8],
192     extra_counts_per_division=[1, 0, 0, -1, 0, 1, -1, 0],

```

```

193     burnish_specifier=abjadext.rmakers.BurnishSpecifier(
194         left_classes=[abjad.Rest],
195         left_counts=[1],
196         right_classes=[abjad.Rest],
197         right_counts=[1],
198         outer_divisions_only=True,
199     ),
200     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
201         trivialize=True,
202         extract_trivial=True,
203         rewrite_rest_filled=True,
204     ),
205 )
206
207
208 attachment_handler_one = AttachmentHandler(
209     starting_dynamic='mf',
210     ending_dynamic='p',
211     hairpin_indicator='--',
212     articulation='accent',
213 )
214
215 attachment_handler_two = AttachmentHandler(
216     starting_dynamic='mf',
217     ending_dynamic='ff',
218     hairpin_indicator='<',
219     articulation='tenuto',
220 )
221
222 attachment_handler_three = AttachmentHandler(
223     starting_dynamic='ff',
224     ending_dynamic='mp',
225     hairpin_indicator='|>',
226     articulation='',
227 )
228
229 #####oboe#####
230 flutemusicmaker_one = MusicMaker(
231     rmaker=rmaker_one,
232     pitches=flute_notes_one,
233     continuous=True,
234     attachment_handler=attachment_handler_one,
235 )
236 flutemusicmaker_two = MusicMaker(
237     rmaker=rmaker_two,
238     pitches=flute_notes_two,
239     continuous=True,
240     attachment_handler=attachment_handler_two,
241 )
242 flutemusicmaker_three = MusicMaker(
243     rmaker=rmaker_three,
244     pitches=flute_notes_three,
245     continuous=True,
246     attachment_handler=attachment_handler_three,

```

```

247 )
248 #####saxophone#####
249 saxophonemusicmaker_one = MusicMaker(
250     rmaker=rmaker_one,
251     pitches=saxophone_notes_one,
252     continuous=True,
253     attachment_handler=attachment_handler_one,
254 )
255 saxophonemusicmaker_two = MusicMaker(
256     rmaker=rmaker_two,
257     pitches=saxophone_notes_two,
258     continuous=True,
259     attachment_handler=attachment_handler_two,
260 )
261 saxophonemusicmaker_three = MusicMaker(
262     rmaker=rmaker_three,
263     pitches=saxophone_notes_three,
264     continuous=True,
265     attachment_handler=attachment_handler_three,
266 )
267 #####cello#####
268 cellomusicmaker_one = MusicMaker(
269     rmaker=rmaker_one,
270     pitches=cello_notes_one,
271     continuous=True,
272     attachment_handler=attachment_handler_one,
273 )
274 cellomusicmaker_two = MusicMaker(
275     rmaker=rmaker_two,
276     pitches=cello_notes_two,
277     continuous=True,
278     attachment_handler=attachment_handler_two,
279 )
280 cellomusicmaker_three = MusicMaker(
281     rmaker=rmaker_three,
282     pitches=cello_notes_three,
283     continuous=True,
284     attachment_handler=attachment_handler_three,
285 )
286
287 silence_maker = abjadext.rmakers.NoteRhythmMaker(
288     division_masks=[
289         abjadext.rmakers.SilenceMask(
290             pattern=abjad.index([0], 1),
291         ),
292     ],
293 )
294
295 class MusicSpecifier:
296
297     def __init__(self, music_maker, voice_name):
298         self.music_maker = music_maker
299         self.voice_name = voice_name
300

```

```

301
302 print('Collecting timespans and rmakers ...')
303 ###group one###
304 voice_1_timespan_list = abjad.TimespanList([
305     abjad.AnnotatedTimespan(
306         start_offset=start_offset,
307         stop_offset=stop_offset,
308         annotation=MusicSpecifier(
309             music_maker=music_maker,
310             voice_name='Voice 1',
311         ),
312     )
313     for start_offset, stop_offset, music_maker in [
314         [(0, 8), (3, 8), flutemusicmaker_one],
315         [(4, 8), (8, 8), flutemusicmaker_two],
316         [(10, 8), (12, 8), flutemusicmaker_three],
317         [(12, 8), (15, 8), flutemusicmaker_one],
318         [(18, 8), (24, 8), flutemusicmaker_two],
319         [(28, 8), (33, 8), flutemusicmaker_three],
320         [(33, 8), (35, 8), flutemusicmaker_one],
321         [(40, 8), (42, 8), flutemusicmaker_two],
322         [(42, 8), (44, 8), flutemusicmaker_three],
323         [(44, 8), (48, 8), flutemusicmaker_one],
324         [(54, 8), (55, 8), flutemusicmaker_two],
325         [(62, 8), (64, 8), flutemusicmaker_three],
326         [(72, 8), (75, 8), flutemusicmaker_one],
327         [(76, 8), (79, 8), flutemusicmaker_two],
328         [(79, 8), (80, 8), silence_maker],
329     ]
330 ])
331
332 voice_3_timespan_list = abjad.TimespanList([
333     abjad.AnnotatedTimespan(
334         start_offset=start_offset,
335         stop_offset=stop_offset,
336         annotation=MusicSpecifier(
337             music_maker=music_maker,
338             voice_name='Voice 3',
339         ),
340     )
341     for start_offset, stop_offset, music_maker in [
342         [(9, 8), (12, 8), saxophonemusicmaker_one],
343         [(20, 8), (24, 8), saxophonemusicmaker_two],
344         [(31, 8), (33, 8), saxophonemusicmaker_three],
345         [(33, 8), (36, 8), saxophonemusicmaker_one],
346         [(42, 8), (48, 8), saxophonemusicmaker_two],
347         [(53, 8), (56, 8), saxophonemusicmaker_three],
348         [(56, 8), (60, 8), saxophonemusicmaker_one],
349         [(64, 8), (69, 8), saxophonemusicmaker_two],
350         [(69, 8), (72, 8), saxophonemusicmaker_three],
351         [(75, 8), (79, 8), saxophonemusicmaker_one],
352     ]
353 ])
354

```

```

355 voice_8_timespan_list = abjad.TimespanList([
356     abjad.AnnotatedTimespan(
357         start_offset=start_offset,
358         stop_offset=stop_offset,
359         annotation=MusicSpecifier(
360             music_maker=music_maker,
361             voice_name='Voice 8',
362         ),
363     )
364     for start_offset, stop_offset, music_maker in [
365         [(15, 8), (18, 8), cello_musicmaker_one],
366         [(18, 8), (22, 8), cello_musicmaker_two],
367         [(25, 8), (29, 8), cello_musicmaker_three],
368         [(29, 8), (32, 8), cello_musicmaker_one],
369         [(35, 8), (39, 8), cello_musicmaker_two],
370         [(39, 8), (42, 8), cello_musicmaker_three],
371         [(45, 8), (50, 8), cello_musicmaker_one],
372         [(50, 8), (52, 8), cello_musicmaker_two],
373         [(55, 8), (56, 8), cello_musicmaker_three],
374         [(56, 8), (61, 8), cello_musicmaker_one],
375         [(61, 8), (62, 8), cello_musicmaker_two],
376         [(65, 8), (69, 8), cello_musicmaker_three],
377         [(69, 8), (72, 8), cello_musicmaker_one],
378         [(75, 8), (79, 8), cello_musicmaker_two],
379     ]
380 ])
381
382 all_timespan_lists = {
383     'Voice 1': voice_1_timespan_list,
384     'Voice 3': voice_3_timespan_list,
385     'Voice 8': voice_8_timespan_list,
386 }
387
388 global_timespan = abjad.Timespan(
389     start_offset=0,
390     stop_offset=max(_.stop_offset for _ in all_timespan_lists.values())
391 )
392
393
394 for voice_name, timespan_list in all_timespan_lists.items():
395     silences = abjad.TimespanList([global_timespan])
396     silences.extend(timespan_list)
397     silences.sort()
398     silences.compute_logical_xor()
399     for silence_timespan in silences:
400         timespan_list.append(
401             abjad.AnnotatedTimespan(
402                 start_offset=silence_timespan.start_offset,
403                 stop_offset=silence_timespan.stop_offset,
404                 annotation=MusicSpecifier(
405                     music_maker=None,
406                     voice_name=voice_name,
407                 ),
408             )

```



```

409         )
410         timespan_list.sort()
411
412     for voice_name, timespan_list in all_timespan_lists.items():
413         shards = timespan_list.split_at_offsets(bounds)
414         split_timespan_list = abjad.TimespanList()
415         for shard in shards:
416             split_timespan_list.extend(shard)
417         split_timespan_list.sort()
418         all_timespan_lists[voice_name] = timespan_list
419
420     score = abjad.Score([
421         abjad.Staff(lilypond_type='TimeSignatureContext', name='Global Context'),
422         abjad.StaffGroup(
423             [
424                 abjad.Staff([abjad.Voice(name='Voice 1')], name='Staff 1',
425                     lilypond_type='Staff'),
426                 abjad.Staff([abjad.Voice(name='Voice 3')], name='Staff 3',
427                     lilypond_type='Staff'),
428                 abjad.Staff([abjad.Voice(name='Voice 8')], name='Staff 8',
429                     lilypond_type='Staff'),
430             ],
431             name='Staff Group 1',
432         ),
433     ]),
434
435     for time_signature in time_signatures:
436         skip = abjad.Skip(1, multiplier=(time_signature))
437         abjad.attach(time_signature, skip)
438         score['Global Context'].append(skip)
439
440     print('Making containers ...')
441
442     def make_container(music_maker, durations):
443         selections = music_maker(durations)
444         container = abjad.Container([])
445         container.extend(selections)
446         return container
447
448     def key_function(timespan):
449         return timespan.annotation.music_maker or silence_maker
450
451     for voice_name, timespan_list in all_timespan_lists.items():
452         for music_maker, grouper in itertools.groupby(
453             timespan_list,
454             key=key_function,
455         ):
456             durations = [timespan.duration for timespan in grouper]
457             container = make_container(music_maker, durations)
458             voice = score[voice_name]
459             voice.append(container)

```

```

460 print('Splitting and rewriting ...')
461
462 for voice in abjad.iterate(score['Staff Group 1']).components(abjad.Voice):
463     for i, shard in enumerate(abjad.mutate(voice[:]).split(time_signatures)):
464         time_signature = time_signatures[i]
465         abjad.mutate(shard).rewrite_meter(time_signature)
466
467 print('Beaming runs ...')
468
469 for voice in abjad.select(score).components(abjad.Voice):
470     for run in abjad.select(voice).runs():
471         if 1 < len(run):
472             specifier = abjadext.rmakers.BeamSpecifier(
473                 beam_each_division=False,
474                 )
475             specifier(run)
476             abjad.attach(abjad.StartBeam(), run[0])
477             abjad.attach(abjad.StopBeam(), run[-1])
478             for leaf in run:
479                 if abjad.Duration(1, 4) <= leaf.written_duration:
480                     continue
481                 previous_leaf = abjad.inspect(leaf).leaf(-1)
482                 next_leaf = abjad.inspect(leaf).leaf(1)
483                 if (isinstance(next_leaf, (abjad.Chord, abjad.Note)) and
484                     abjad.Duration(1, 4) <= next_leaf.written_duration):
485                     left = previous_leaf.written_duration.flag_count
486                     right = leaf.written_duration.flag_count
487                     beam_count = abjad.BeamCount(
488                         left=left,
489                         right=right,
490                     )
491                     abjad.attach(beam_count, leaf)
492                     continue
493                 if (isinstance(previous_leaf, (abjad.Chord, abjad.Note)) and
494                     abjad.Duration(1, 4) <= previous_leaf.written_duration):
495                     left = leaf.written_duration.flag_count
496                     right = next_leaf.written_duration.flag_count
497                     beam_count = abjad.BeamCount(
498                         left=left,
499                         right=right,
500                     )
501                     abjad.attach(beam_count, leaf)
502
503 print('Stopping Hairpins ...')
504 for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
505     for rest in abjad.iterate(staff).components(abjad.Rest):
506         previous_leaf = abjad.inspect(rest).leaf(-1)
507         if isinstance(previous_leaf, abjad.Note):
508             abjad.attach(abjad.StopHairpin(), rest)
509         elif isinstance(previous_leaf, abjad.Chord):
510             abjad.attach(abjad.StopHairpin(), rest)
511         elif isinstance(previous_leaf, abjad.Rest):
512             pass
513

```

```

514 print('Adding attachments ...')
515 bar_line = abjad.BarLine('||')
516 metro = abjad.MetronomeMark((1, 4), 60)
517 markup1 = abjad.Markup(r'\bold { A }')
518 markup2 = abjad.Markup(r'\bold { B }')
519 markup3 = abjad.Markup(r'\bold { C }')
520 markup4 = abjad.Markup(r'\bold { D }')
521 markup5 = abjad.Markup(r'\bold { E }')
522 markup6 = abjad.Markup(r'\bold { F }')
523 mark1 = abjad.RehearsalMark(markup=markup1)
524 mark2 = abjad.RehearsalMark(markup=markup2)
525 mark3 = abjad.RehearsalMark(markup=markup3)
526 mark4 = abjad.RehearsalMark(markup=markup4)
527 mark5 = abjad.RehearsalMark(markup=markup5)
528 mark6 = abjad.RehearsalMark(markup=markup6)
529
530 instruments1 = cyc([
531     abjad.Flute(),
532     abjad.AltoSaxophone(),
533     abjad.Cello(),
534 ])
535
536 clefs1 = cyc([
537     abjad.Clef('treble'),
538     abjad.Clef('treble'),
539     abjad.Clef('bass'),
540 ])
541
542 abbreviations1 = cyc([
543     abjad.MarginMarkup(markup=abjad.Markup('fl.'),),
544     abjad.MarginMarkup(markup=abjad.Markup('sx.'),),
545     abjad.MarginMarkup(markup=abjad.Markup('vc.'),),
546 ])
547
548 names1 = cyc([
549     abjad.StartMarkup(markup=abjad.Markup('Flute'),),
550     abjad.StartMarkup(markup=abjad.Markup('Saxophone'),),
551     abjad.StartMarkup(markup=abjad.Markup('Violoncello'),),
552 ])
553
554 for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
555     leaf1 = abjad.select(staff).leaves()[0]
556     abjad.attach(next(instruments1), leaf1)
557     abjad.attach(next(abbreviations1), leaf1)
558     abjad.attach(next(names1), leaf1)
559     abjad.attach(next(clefs1), leaf1)
560
561 for staff in abjad.select(score['Staff Group 1']).components(abjad.Staff)[0]:
562     leaf1 = abjad.select(staff).leaves()[0]
563     last_leaf = abjad.select(staff).leaves()[-1]
564     abjad.attach(metro, leaf1)
565     abjad.attach(bar_line, last_leaf)
566
567 for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):

```

```

568     abjad.Instrument.transpose_from_sounding_pitch(staff)
569
570 score_file = abjad.LilyPondFile.new(
571     score,
572     includes=['first_stylesheet.ily', '/Users/evansdsg2/abjad/docs/source/
573         _stylesheets/abjad.ily'],
574 )
575 abjad.SegmentMaker.comment_measure_numbers(score)
576 #####
577
578 directory = '/Users/evansdsg2/Scores/four_ages_of_sand/four_ages_of_sand/
579     Segments/Segment_I'
580 pdf_path = f'{directory}/Segment_I.pdf'
581 path = pathlib.Path('Segment_I.pdf')
582 if path.exists():
583     print(f'Removing {pdf_path} ...')
584     path.unlink()
585 time_1 = time.time()
586 print(f'Persisting {pdf_path} ...')
587 result = abjad.persist(score_file).as_pdf(pdf_path)
588 print(result[0])
589 print(result[1])
590 print(result[2])
591 success = result[3]
592 if success is False:
593     print('LilyPond failed!')
594 time_2 = time.time()
595 total_time = time_2 - time_1
596 print(f'Total time: {total_time} seconds')
597 if path.exists():
598     print(f'Opening {pdf_path} ...')
599     os.system(f'open {pdf_path}')

```

Code Example A.16: Four Ages of Sand Segment_I

A.4.1.2 SEGMENT_II

```

1 import abjad
2 import itertools
3 import os
4 import pathlib
5 import time
6 import abjadext.rmakers
7 from MusicMaker import MusicMaker
8 from AttachmentHandler import AttachmentHandler
9 from random import random
10 from random import seed
11
12 print('Interpreting file ...')
13
14 time_signatures = [
15     abjad.TimeSignature(pair) for pair in [

```

```

16         (9, 8), (6, 8), (5, 4), (4, 4), (6, 8),
17         (3, 8), (4, 4), (3, 4), (5, 8), (4, 4),
18         (11, 8),
19     ]
20 ]
21
22 bounds = abjad.mathtools.cumulative_sums([_.duration for _ in time_signatures
23 ])
24
25 def reduceMod3(rw):
26     return [(x % 4) for x in rw]
27
28 def reduceMod9(rw):
29     return [(x % 10) for x in rw]
30
31 def cyc(lst):
32     count = 0
33     while True:
34         yield lst[count%len(lst)]
35         count += 1
36
37 def grouper(lst1, lst2):
38     def cyc(lst):
39         c = 0
40         while True:
41             yield lst[c%len(lst)]
42             c += 1
43     lst1 = cyc(lst1)
44     return [next(lst1) if i == 1 else [next(lst1) for _ in range(i)] for i in
45             lst2]
46
47 seed(1)
48 flute_random_walk_one = []
49 flute_random_walk_one.append(-1 if random() < 0.5 else 1)
50 for i in range(1, 1000):
51     movement = -1 if random() < 0.5 else 1
52     value = flute_random_walk_one[i-1] + movement
53     flute_random_walk_one.append(value)
54 flute_random_walk_one = [abs(x) for x in flute_random_walk_one]
55 flute_chord_one = [0, 11, 14, 17, 18, 22, 18, 17, 14, 11, ]
56 flute_notes_one = [flute_chord_one[x] for x in reduceMod9(
57     flute_random_walk_one)]
58
59 seed(4)
60 saxophone_random_walk_one = []
61 saxophone_random_walk_one.append(-1 if random() < 0.5 else 1)
62 for i in range(1, 1000):
63     movement = -1 if random() < 0.5 else 1
64     value = saxophone_random_walk_one[i-1] + movement
65     saxophone_random_walk_one.append(value)
66 saxophone_random_walk_one = [abs(x) for x in saxophone_random_walk_one]
67 saxophone_chord_one = [-8, -5, -4, 0, 11, 14, 11, 0, -4, -5, ]
68 saxophone_notes_one = [saxophone_chord_one[x] for x in reduceMod9(
69     saxophone_random_walk_one)]

```

```

66
67 seed(8)
68 cello_random_walk_one = []
69 cello_random_walk_one.append(-1 if random() < 0.5 else 1)
70 for i in range(1, 1000):
71     movement = -1 if random() < 0.5 else 1
72     value = cello_random_walk_one[i-1] + movement
73     cello_random_walk_one.append(value)
74 cello_random_walk_one = [abs(x) for x in cello_random_walk_one]
75 cello_chord_one = [-22, -11, -8, -5, -4, 0, -4, -5, -8, -11, ]
76 cello_notes_one = [cello_chord_one[x] for x in reduceMod9(
    cello_random_walk_one)]
77
78 seed(1)
79 flute_random_walk_two = []
80 flute_random_walk_two.append(-1 if random() < 0.5 else 1)
81 for i in range(1, 1000):
82     movement = -1 if random() < 0.5 else 1
83     value = flute_random_walk_two[i-1] + movement
84     flute_random_walk_two.append(value)
85 flute_random_walk_two = [abs(x) for x in flute_random_walk_two]
86 flute_chord_two = [0, 14, 18, 14, ]
87 flute_notes_two = [flute_chord_two[x] for x in reduceMod3(
    flute_random_walk_two)]
88
89 seed(4)
90 saxophone_random_walk_two = []
91 saxophone_random_walk_two.append(-1 if random() < 0.5 else 1)
92 for i in range(1, 1000):
93     movement = -1 if random() < 0.5 else 1
94     value = saxophone_random_walk_two[i-1] + movement
95     saxophone_random_walk_two.append(value)
96 saxophone_random_walk_two = [abs(x) for x in saxophone_random_walk_two]
97 saxophone_chord_two = [-8, -4, 11, -4, ]
98 saxophone_notes_two = [saxophone_chord_two[x] for x in reduceMod3(
    saxophone_random_walk_two)]
99
100 seed(8)
101 cello_random_walk_two = []
102 cello_random_walk_two.append(-1 if random() < 0.5 else 1)
103 for i in range(1, 1000):
104     movement = -1 if random() < 0.5 else 1
105     value = cello_random_walk_two[i-1] + movement
106     cello_random_walk_two.append(value)
107 cello_random_walk_two = [abs(x) for x in cello_random_walk_two]
108 cello_chord_two = [-22, -8, -4, -8, ]
109 cello_notes_two = [cello_chord_two[x] for x in reduceMod3(
    cello_random_walk_two)]
110
111 seed(1)
112 flute_random_walk_three = []
113 flute_random_walk_three.append(-1 if random() < 0.5 else 1)
114 for i in range(1, 1000):
115     movement = -1 if random() < 0.5 else 1

```

```

116     value = flute_random_walk_three[i-1] + movement
117     flute_random_walk_three.append(value)
118 flute_random_walk_three = [abs(x) for x in flute_random_walk_three]
119 flute_chord_three = [11, 17, 22, 17, ]
120 flute_notes_three = [flute_chord_three[x] for x in reduceMod3(
    flute_random_walk_three)]
121
122 seed(4)
123 saxophone_random_walk_three = []
124 saxophone_random_walk_three.append(-1 if random() < 0.5 else 1)
125 for i in range(1, 1000):
126     movement = -1 if random() < 0.5 else 1
127     value = saxophone_random_walk_three[i-1] + movement
128     saxophone_random_walk_three.append(value)
129 saxophone_random_walk_three = [abs(x) for x in saxophone_random_walk_three]
130 saxophone_chord_three = [-5, -4, 11, -4, ]
131 saxophone_notes_three = [saxophone_chord_three[x] for x in reduceMod3(
    saxophone_random_walk_three)]
132
133 seed(8)
134 cello_random_walk_three = []
135 cello_random_walk_three.append(-1 if random() < 0.5 else 1)
136 for i in range(1, 1000):
137     movement = -1 if random() < 0.5 else 1
138     value = cello_random_walk_three[i-1] + movement
139     cello_random_walk_three.append(value)
140 cello_random_walk_three = [abs(x) for x in cello_random_walk_three]
141 cello_chord_three = [-11, -5, 0, -5, ]
142 cello_notes_three = [cello_chord_three[x] for x in reduceMod3(
    cello_random_walk_three)]
143
144 rmaker_one = abjadext.rmakers.TaleaRhythmMaker(
145     talea=abjadext.rmakers.Talea(
146         counts=[3, 1, 3, 1, 3, 1, 3, 1, 3, 1],
147         denominator=16,
148     ),
149     beam_specifier=abjadext.rmakers.BeamSpecifier(
150         beam_divisions_together=True,
151         beam_rests=False,
152     ),
153     extra_counts_per_division=[1, 0, -1, 0],
154     burnish_specifier=abjadext.rmakers.BurnishSpecifier(
155         left_classes=[abjad.Note, abjad.Rest],
156         left_counts=[1, 0, 1],
157     ),
158     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
159         trivialize=True,
160         extract_trivial=True,
161         rewrite_rest_filled=True,
162     ),
163 )
164
165 rmaker_two = abjadext.rmakers.TaleaRhythmMaker(
166     talea=abjadext.rmakers.Talea(

```

```

167     counts=[1, 2, 2, 3, 3, 3, 2, 2, 1, ],
168     denominator=16,
169 ),
170 beam_specifier=abjadext.rmakers.BeamSpecifier(
171     beam_divisions_together=True,
172     beam_rests=False,
173 ),
174 extra_counts_per_division=[0, -1, 0, 1],
175 burnish_specifier=abjadext.rmakers.BurnishSpecifier(
176     left_classes=[abjad.Note, abjad.Rest],
177     left_counts=[1, 0, 1],
178 ),
179 tuplet_specifier=abjadext.rmakers.TupletSpecifier(
180     trivialize=True,
181     extract_trivial=True,
182     rewrite_rest_filled=True,
183 ),
184 )
185
186 rmaker_three = abjadext.rmakers.EvenDivisionRhythmMaker(
187     denominators=[8, 16, 8, 16, 8, 16],
188     extra_counts_per_division=[-1, 0, 1, -1, 0, 1, 0, 0],
189     burnish_specifier=abjadext.rmakers.BurnishSpecifier(
190         left_classes=[abjad.Rest],
191         left_counts=[1],
192         right_classes=[abjad.Rest],
193         right_counts=[1],
194         outer_divisions_only=True,
195     ),
196     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
197         trivialize=True,
198         extract_trivial=True,
199         rewrite_rest_filled=True,
200     ),
201 )
202
203 attachment_handler_one = AttachmentHandler(
204     starting_dynamic='f',
205     ending_dynamic='mp',
206     hairpin_indicator='--',
207     articulation='accent',
208 )
209
210 attachment_handler_two = AttachmentHandler(
211     starting_dynamic='fff',
212     ending_dynamic='mf',
213     hairpin_indicator='|>',
214     articulation='tenuto',
215 )
216
217 attachment_handler_three = AttachmentHandler(
218     starting_dynamic='pp',
219     ending_dynamic='mf',
220     hairpin_indicator='<',

```



```

221     articulation='',
222 )
223
224 #####oboe#####
225 flutemusicmaker_one = MusicMaker(
226     rmaker=rmaker_one,
227     pitches=flute_notes_one,
228     continuous=True,
229     attachment_handler=attachment_handler_one,
230 )
231 flutemusicmaker_two = MusicMaker(
232     rmaker=rmaker_two,
233     pitches=flute_notes_two,
234     continuous=True,
235     attachment_handler=attachment_handler_two,
236 )
237 flutemusicmaker_three = MusicMaker(
238     rmaker=rmaker_three,
239     pitches=flute_notes_three,
240     continuous=True,
241     attachment_handler=attachment_handler_three,
242 )
243 #####saxophone#####
244 saxophonemusicmaker_one = MusicMaker(
245     rmaker=rmaker_one,
246     pitches=saxophone_notes_one,
247     continuous=True,
248     attachment_handler=attachment_handler_one,
249 )
250 saxophonemusicmaker_two = MusicMaker(
251     rmaker=rmaker_two,
252     pitches=saxophone_notes_two,
253     continuous=True,
254     attachment_handler=attachment_handler_two,
255 )
256 saxophonemusicmaker_three = MusicMaker(
257     rmaker=rmaker_three,
258     pitches=saxophone_notes_three,
259     continuous=True,
260     attachment_handler=attachment_handler_three,
261 )
262 #####cello#####
263 cellomusicmaker_one = MusicMaker(
264     rmaker=rmaker_one,
265     pitches=cello_notes_one,
266     continuous=True,
267     attachment_handler=attachment_handler_one,
268 )
269 cellomusicmaker_two = MusicMaker(
270     rmaker=rmaker_two,
271     pitches=cello_notes_two,
272     continuous=True,
273     attachment_handler=attachment_handler_two,
274 )

```

```

275 cellomusicmaker_three = MusicMaker(
276     rmaker=rmaker_three,
277     pitches=cello_notes_three,
278     continuous=True,
279     attachment_handler=attachment_handler_three,
280 )
281
282 silence_maker = abjadext.rmakers.NoteRhythmMaker(
283     division_masks=[
284         abjadext.rmakers.SilenceMask(
285             pattern=abjad.index([0], 1),
286         ),
287     ],
288 )
289
290
291 class MusicSpecifier:
292
293     def __init__(self, music_maker, voice_name):
294         self.music_maker = music_maker
295         self.voice_name = voice_name
296
297
298 print('Collecting timespans and rmakers ...')
299 ###group one###
300 voice_1_timespan_list = abjad.TimespanList([
301     abjad.AnnotatedTimespan(
302         start_offset=start_offset,
303         stop_offset=stop_offset,
304         annotation=MusicSpecifier(
305             music_maker=music_maker,
306             voice_name='Voice 1',
307         ),
308     )
309     for start_offset, stop_offset, music_maker in [
310         [(15, 8), (18, 8), flutemusicmaker_one],
311         [(18, 8), (22, 8), flutemusicmaker_two],
312         [(25, 8), (29, 8), flutemusicmaker_three],
313         [(29, 8), (32, 8), flutemusicmaker_one],
314         [(35, 8), (39, 8), flutemusicmaker_two],
315         [(39, 8), (42, 8), flutemusicmaker_three],
316         [(45, 8), (50, 8), flutemusicmaker_one],
317         [(50, 8), (52, 8), flutemusicmaker_two],
318         [(55, 8), (56, 8), flutemusicmaker_three],
319         [(56, 8), (61, 8), flutemusicmaker_one],
320         [(61, 8), (62, 8), flutemusicmaker_two],
321         [(65, 8), (69, 8), flutemusicmaker_three],
322         [(69, 8), (72, 8), flutemusicmaker_one],
323         [(75, 8), (79, 8), flutemusicmaker_two],
324     ]
325 ])
326
327 voice_3_timespan_list = abjad.TimespanList([
328     abjad.AnnotatedTimespan(

```

```

329     start_offset=start_offset,
330     stop_offset=stop_offset,
331     annotation=MusicSpecifier(
332         music_maker=music_maker,
333         voice_name='Voice 3',
334     ),
335 )
336 for start_offset, stop_offset, music_maker in [
337     [(0, 8), (3, 8), saxophonemusicmaker_one],
338     [(4, 8), (8, 8), saxophonemusicmaker_two],
339     [(10, 8), (12, 8), saxophonemusicmaker_three],
340     [(12, 8), (15, 8), saxophonemusicmaker_one],
341     [(18, 8), (24, 8), saxophonemusicmaker_two],
342     [(28, 8), (33, 8), saxophonemusicmaker_three],
343     [(33, 8), (35, 8), saxophonemusicmaker_one],
344     [(40, 8), (42, 8), saxophonemusicmaker_two],
345     [(42, 8), (44, 8), saxophonemusicmaker_three],
346     [(44, 8), (48, 8), saxophonemusicmaker_one],
347     [(54, 8), (55, 8), saxophonemusicmaker_two],
348     [(62, 8), (64, 8), saxophonemusicmaker_three],
349     [(72, 8), (75, 8), saxophonemusicmaker_one],
350     [(76, 8), (79, 8), saxophonemusicmaker_two],
351     [(79, 8), (80, 8), silence_maker],
352 ]
353 ])
354
355 voice_8_timespan_list = abjad.TimespanList([
356     abjad.AnnotatedTimespan(
357         start_offset=start_offset,
358         stop_offset=stop_offset,
359         annotation=MusicSpecifier(
360             music_maker=music_maker,
361             voice_name='Voice 8',
362         ),
363     )
364     for start_offset, stop_offset, music_maker in [
365         [(9, 8), (12, 8), cellomusicmaker_one],
366         [(20, 8), (24, 8), cellomusicmaker_two],
367         [(31, 8), (33, 8), cellomusicmaker_three],
368         [(33, 8), (36, 8), cellomusicmaker_one],
369         [(42, 8), (48, 8), cellomusicmaker_two],
370         [(53, 8), (56, 8), cellomusicmaker_three],
371         [(56, 8), (60, 8), cellomusicmaker_one],
372         [(64, 8), (69, 8), cellomusicmaker_two],
373         [(69, 8), (72, 8), cellomusicmaker_three],
374         [(75, 8), (79, 8), cellomusicmaker_one],
375     ]
376 ])
377
378 all_timespan_lists = {
379     'Voice 1': voice_1_timespan_list,
380     'Voice 3': voice_3_timespan_list,
381     'Voice 8': voice_8_timespan_list,
382 }

```

```

383
384
385 global_timespan = abjad.Timespan(
386     start_offset=0,
387     stop_offset=max(_.stop_offset for _ in all_timespan_lists.values())
388 )
389
390 for voice_name, timespan_list in all_timespan_lists.items():
391     silences = abjad.TimespanList([global_timespan])
392     silences.extend(timespan_list)
393     silences.sort()
394     silences.compute_logical_xor()
395     for silence_timespan in silences:
396         timespan_list.append(
397             abjad.AnnotatedTimespan(
398                 start_offset=silence_timespan.start_offset,
399                 stop_offset=silence_timespan.stop_offset,
400                 annotation=MusicSpecifier(
401                     music_maker=None,
402                     voice_name=voice_name,
403                 ),
404             )
405         )
406     timespan_list.sort()
407
408 for voice_name, timespan_list in all_timespan_lists.items():
409     shards = timespan_list.split_at_offsets(bounds)
410     split_timespan_list = abjad.TimespanList()
411     for shard in shards:
412         split_timespan_list.extend(shard)
413     split_timespan_list.sort()
414     all_timespan_lists[voice_name] = timespan_list
415
416 score = abjad.Score([
417     abjad.Staff(lilypond_type='TimeSignatureContext', name='Global Context'),
418     abjad.StaffGroup(
419         [
420             abjad.Staff([abjad.Voice(name='Voice 1')], name='Staff 1',
421                 lilypond_type='Staff'),
422             abjad.Staff([abjad.Voice(name='Voice 3')], name='Staff 3',
423                 lilypond_type='Staff'),
424             abjad.Staff([abjad.Voice(name='Voice 8')], name='Staff 8',
425                 lilypond_type='Staff'),
426         ],
427         name='Staff Group 1',
428     ),
429 ],
430 )
431
432 for time_signature in time_signatures:
433     skip = abjad.Skip(1, multiplier=(time_signature))
434     abjad.attach(time_signature, skip)
435     score['Global Context'].append(skip)
436

```

```

434 print('Making containers ...')
435
436 def make_container(music_maker, durations):
437     selections = music_maker(durations)
438     container = abjad.Container([])
439     container.extend(selections)
440     return container
441
442 def key_function(timespan):
443     return timespan.annotation.music_maker or silence_maker
444
445 for voice_name, timespan_list in all_timespan_lists.items():
446     for music_maker, grouper in itertools.groupby(
447         timespan_list,
448         key=key_function,
449     ):
450         durations = [timespan.duration for timespan in grouper]
451         container = make_container(music_maker, durations)
452         voice = score[voice_name]
453         voice.append(container)
454
455 print('Splitting and rewriting ...')
456
457 for voice in abjad.iterate(score['Staff Group 1']).components(abjad.Voice):
458     for i, shard in enumerate(abjad.mutate(voice[:]).split(time_signatures)):
459         time_signature = time_signatures[i]
460         abjad.mutate(shard).rewrite_meter(time_signature)
461
462 print('Beaming runs ...')
463
464 for voice in abjad.select(score).components(abjad.Voice):
465     for run in abjad.select(voice).runs():
466         if 1 < len(run):
467             specifier = abjadext.rmakers.BeamSpecifier(
468                 beam_each_division=False,
469             )
470             specifier(run)
471             abjad.attach(abjad.StartBeam(), run[0])
472             abjad.attach(abjad.StopBeam(), run[-1])
473             for leaf in run:
474                 if abjad.Duration(1, 4) <= leaf.written_duration:
475                     continue
476                 previous_leaf = abjad.inspect(leaf).leaf(-1)
477                 next_leaf = abjad.inspect(leaf).leaf(1)
478                 if (isinstance(next_leaf, (abjad.Chord, abjad.Note)) and
479                     abjad.Duration(1, 4) <= next_leaf.written_duration):
480                     left = previous_leaf.written_duration.flag_count
481                     right = leaf.written_duration.flag_count
482                     beam_count = abjad.BeamCount(
483                         left=left,
484                         right=right,
485                     )
486                     abjad.attach(beam_count, leaf)
487                     continue

```

```

488         if (isinstance(previous_leaf, (abjad.Chord, abjad.Note)) and
489             abjad.Duration(1, 4) <= previous_leaf.written_duration):
490             left = leaf.written_duration.flag_count
491             right = next_leaf.written_duration.flag_count
492             beam_count = abjad.BeamCount(
493                 left=left,
494                 right=right,
495             )
496             abjad.attach(beam_count, leaf)
497
498     print('Stopping Hairpins ...')
499     for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
500         for rest in abjad.iterate(staff).components(abjad.Rest):
501             previous_leaf = abjad.inspect(rest).leaf(-1)
502             if isinstance(previous_leaf, abjad.Note):
503                 abjad.attach(abjad.StopHairpin(), rest)
504             elif isinstance(previous_leaf, abjad.Chord):
505                 abjad.attach(abjad.StopHairpin(), rest)
506             elif isinstance(previous_leaf, abjad.Rest):
507                 pass
508
509     print('Adding attachments ...')
510     bar_line = abjad.BarLine('||')
511     metro = abjad.MetronomeMark((1, 4), 60)
512     markup1 = abjad.Markup(r'\bold { A }')
513     markup2 = abjad.Markup(r'\bold { B }')
514     markup3 = abjad.Markup(r'\bold { C }')
515     markup4 = abjad.Markup(r'\bold { D }')
516     markup5 = abjad.Markup(r'\bold { E }')
517     markup6 = abjad.Markup(r'\bold { F }')
518     mark1 = abjad.RehearsalMark(markup=markup1)
519     mark2 = abjad.RehearsalMark(markup=markup2)
520     mark3 = abjad.RehearsalMark(markup=markup3)
521     mark4 = abjad.RehearsalMark(markup=markup4)
522     mark5 = abjad.RehearsalMark(markup=markup5)
523     mark6 = abjad.RehearsalMark(markup=markup6)
524
525     def _apply_numerators_and_tech(staff, nums, tech):
526         numerators = cyc(nums)
527         techs = cyc(tech)
528         for logical_tie in abjad.select(staff).logical_ties(pitched=True):
529             tech = next(techs)
530             numerator = next(numerators)
531             bcp = abjad.BowContactPoint((numerator, 5))
532             technis = abjad.BowMotionTechnique(tech)
533             for note in logical_tie:
534                 abjad.attach(bcp, note)
535                 abjad.attach(technis, note)
536         for run in abjad.select(staff).runs():
537             abjad.bow_contact_spanner(run, omit_bow_changes=False)
538
539     instruments1 = cyc([
540         abjad.Flute(),
541         abjad.AltoSaxophone(),

```

```

542     abjad.Cello(),
543 ])
544
545 clefs1 = cyc([
546     abjad.Clef('treble'),
547     abjad.Clef('treble'),
548     abjad.Clef('bass'),
549 ])
550
551 abbreviations1 = cyc([
552     abjad.MarginMarkup(markup=abjad.Markup('fl.'),),
553     abjad.MarginMarkup(markup=abjad.Markup('sx.'),),
554     abjad.MarginMarkup(markup=abjad.Markup('vc.'),),
555 ])
556
557 names1 = cyc([
558     abjad.StartMarkup(markup=abjad.Markup('Flute'),),
559     abjad.StartMarkup(markup=abjad.Markup('Saxophone'),),
560     abjad.StartMarkup(markup=abjad.Markup('Violoncello'),),
561 ])
562
563 for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
564     leaf1 = abjad.select(staff).leaves()[0]
565     abjad.attach(next(instruments1), leaf1)
566     abjad.attach(next(abbreviations1), leaf1)
567     abjad.attach(next(names1), leaf1)
568     abjad.attach(next(clefs1), leaf1)
569
570 for staff in abjad.select(score['Staff Group 1']).components(abjad.Staff)[0]:
571     leaf1 = abjad.select(staff).leaves()[0]
572     last_leaf = abjad.select(staff).leaves()[-1]
573     #abjad.attach(metro, leaf1)
574     abjad.attach(bar_line, last_leaf)
575
576 for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
577     abjad.Instrument.transpose_from_sounding_pitch(staff)
578
579 score_file = abjad.LilyPondFile.new(
580     score,
581     includes=['first_stylesheet.ily', '/Users/evansdsg2/abjad/docs/source/
582         _stylesheets/abjad.ily'],
583 )
584
585 abjad.SegmentMaker.comment_measure_numbers(score)
586 #####
587
588 directory = '/Users/evansdsg2/Scores/four_ages_of_sand/four_ages_of_sand/
589     Segments/Segment_II'
590 pdf_path = f'{directory}/Segment_II.pdf'
591 path = pathlib.Path('Segment_II.pdf')
592 if path.exists():
593     print(f'Removing {pdf_path} ...')
594     path.unlink()
595 time_1 = time.time()

```

```

594 print(f'Persisting {pdf_path} ...')
595 result = abjad.persist(score_file).as_pdf(pdf_path)
596 print(result[0])
597 print(result[1])
598 print(result[2])
599 success = result[3]
600 if success is False:
601     print('LilyPond failed!')
602 time_2 = time.time()
603 total_time = time_2 - time_1
604 print(f'Total time: {total_time} seconds')
605 if path.exists():
606     print(f'Opening {pdf_path} ...')
607     os.system(f'open {pdf_path}')

```

Code Example A.17: Four Ages of Sand Segment_II

A.4.1.3 SEGMENT_III

```

1 import abjad
2 import itertools
3 import os
4 import pathlib
5 import time
6 import abjadext.rmakers
7 from MusicMaker import MusicMaker
8 from AttachmentHandler import AttachmentHandler
9 from random import random
10 from random import seed
11
12 print('Interpreting file ...')
13
14 time_signatures = [
15     abjad.TimeSignature(pair) for pair in [
16         (9, 8), (6, 8), (5, 4), (4, 4), (6, 8),
17         (3, 8), (4, 4), (3, 4), (5, 8), (4, 4),
18         (11, 8),
19     ]
20 ]
21
22 bounds = abjad.mathtools.cumulative_sums([_.duration for _ in time_signatures
23 ])
24
25 def reduceMod1(rw):
26     return [(x % 2) for x in rw]
27
28 def reduceMod3(rw):
29     return [(x % 4) for x in rw]
30
31 def reduceMod5(rw):
32     return [(x % 6) for x in rw]
33
34 def reduceMod7(rw):

```



```

34     return [(x % 8) for x in rw]
35
36 def cyc(lst):
37     count = 0
38     while True:
39         yield lst[count%len(lst)]
40         count += 1
41
42 def grouper(lst1, lst2):
43     def cyc(lst):
44         c = 0
45         while True:
46             yield lst[c%len(lst)]
47             c += 1
48     lst1 = cyc(lst1)
49     return [next(lst1) if i == 1 else [next(lst1) for _ in range(i)] for i in
50             lst2]
51
52 seed(1)
53 flute_random_walk_one = []
54 flute_random_walk_one.append(-1 if random() < 0.5 else 1)
55 for i in range(1, 1000):
56     movement = -1 if random() < 0.5 else 1
57     value = flute_random_walk_one[i-1] + movement
58     flute_random_walk_one.append(value)
59 flute_random_walk_one = [abs(x) for x in flute_random_walk_one]
60 flute_chord_one = [2, 11, 12, 20, 31, 20, 12, 11, ]
61 flute_notes_one = [flute_chord_one[x] for x in reduceMod7(
62     flute_random_walk_one)]
63
64 seed(4)
65 saxophone_random_walk_one = []
66 saxophone_random_walk_one.append(-1 if random() < 0.5 else 1)
67 for i in range(1, 1000):
68     movement = -1 if random() < 0.5 else 1
69     value = saxophone_random_walk_one[i-1] + movement
70     saxophone_random_walk_one.append(value)
71 saxophone_random_walk_one = [abs(x) for x in saxophone_random_walk_one]
72 saxophone_chord_one = [-10, 2, 11, 12, 1, 2, ]
73 saxophone_notes_one = [saxophone_chord_one[x] for x in reduceMod5(
74     saxophone_random_walk_one)]
75
76 seed(8)
77 cello_random_walk_one = []
78 cello_random_walk_one.append(-1 if random() < 0.5 else 1)
79 for i in range(1, 1000):
80     movement = -1 if random() < 0.5 else 1
81     value = cello_random_walk_one[i-1] + movement
82     cello_random_walk_one.append(value)
83 cello_random_walk_one = [abs(x) for x in cello_random_walk_one]
84 cello_chord_one = [-18, -10, 2, -10, ]
85 cello_notes_one = [cello_chord_one[x] for x in reduceMod3(
86     cello_random_walk_one)]

```

```

84 seed(1)
85 flute_random_walk_two = []
86 flute_random_walk_two.append(-1 if random() < 0.5 else 1)
87 for i in range(1, 1000):
88     movement = -1 if random() < 0.5 else 1
89     value = flute_random_walk_two[i-1] + movement
90     flute_random_walk_two.append(value)
91 flute_random_walk_two = [abs(x) for x in flute_random_walk_two]
92 flute_chord_two = [2, 12, 31, 12, ]
93 flute_notes_two = [flute_chord_two[x] for x in reduceMod3(
    flute_random_walk_two)]
94
95 seed(4)
96 saxophone_random_walk_two = []
97 saxophone_random_walk_two.append(-1 if random() < 0.5 else 1)
98 for i in range(1, 1000):
99     movement = -1 if random() < 0.5 else 1
100    value = saxophone_random_walk_two[i-1] + movement
101    saxophone_random_walk_two.append(value)
102 saxophone_random_walk_two = [abs(x) for x in saxophone_random_walk_two]
103 saxophone_chord_two = [11, 20, ]
104 saxophone_notes_two = [saxophone_chord_two[x] for x in reduceMod1(
    saxophone_random_walk_two)]
105
106 seed(8)
107 cello_random_walk_two = []
108 cello_random_walk_two.append(-1 if random() < 0.5 else 1)
109 for i in range(1, 1000):
110    movement = -1 if random() < 0.5 else 1
111    value = cello_random_walk_two[i-1] + movement
112    cello_random_walk_two.append(value)
113 cello_random_walk_two = [abs(x) for x in cello_random_walk_two]
114 cello_chord_two = [-18, 2, ]
115 cello_notes_two = [cello_chord_two[x] for x in reduceMod1(
    cello_random_walk_two)]
116
117 seed(1)
118 flute_random_walk_three = []
119 flute_random_walk_three.append(-1 if random() < 0.5 else 1)
120 for i in range(1, 1000):
121    movement = -1 if random() < 0.5 else 1
122    value = flute_random_walk_three[i-1] + movement
123    flute_random_walk_three.append(value)
124 flute_random_walk_three = [abs(x) for x in flute_random_walk_three]
125 flute_chord_three = [11, 20, ]
126 flute_notes_three = [flute_chord_three[x] for x in reduceMod1(
    flute_random_walk_three)]
127
128 seed(4)
129 saxophone_random_walk_three = []
130 saxophone_random_walk_three.append(-1 if random() < 0.5 else 1)
131 for i in range(1, 1000):
132    movement = -1 if random() < 0.5 else 1
133    value = saxophone_random_walk_three[i-1] + movement

```

```

134     saxophone_random_walk_three.append(value)
135 saxophone_random_walk_three = [abs(x) for x in saxophone_random_walk_three]
136 saxophone_chord_three = [2, 12, ]
137 saxophone_notes_three = [saxophone_chord_three[x] for x in reduceMod1(
    saxophone_random_walk_three)]
138
139 seed(8)
140 cello_random_walk_three = []
141 cello_random_walk_three.append(-1 if random() < 0.5 else 1)
142 for i in range(1, 1000):
143     movement = -1 if random() < 0.5 else 1
144     value = cello_random_walk_three[i-1] + movement
145     cello_random_walk_three.append(value)
146 cello_random_walk_three = [abs(x) for x in cello_random_walk_three]
147 cello_notes_three = [-10, ]
148
149 rmaker_one = abjadext.rmakers.TaleaRhythmMaker(
150     talea=abjadext.rmakers.Talea(
151         counts=[2, 1, 3, 2, 2, 3, 1, ],
152         denominator=16,
153     ),
154     beam_specifier=abjadext.rmakers.BeamSpecifier(
155         beam_divisions_together=True,
156         beam_rests=False,
157     ),
158     extra_counts_per_division=[0, 1, 0, -1],
159     burnish_specifier=abjadext.rmakers.BurnishSpecifier(
160         left_classes=[abjad.Note, abjad.Rest],
161         left_counts=[1, 0, 1],
162     ),
163     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
164         trivialize=True,
165         extract_trivial=True,
166         rewrite_rest_filled=True,
167     ),
168 )
169
170 rmaker_two = abjadext.rmakers.TaleaRhythmMaker(
171     talea=abjadext.rmakers.Talea(
172         counts=[1, 2, 2, 3, 3, 3, 2, 2, 1, ],
173         denominator=16,
174     ),
175     beam_specifier=abjadext.rmakers.BeamSpecifier(
176         beam_divisions_together=True,
177         beam_rests=False,
178     ),
179     extra_counts_per_division=[1, 0, -1, 0],
180     burnish_specifier=abjadext.rmakers.BurnishSpecifier(
181         left_classes=[abjad.Note, abjad.Rest],
182         left_counts=[1, 0, 1],
183     ),
184     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
185         trivialize=True,
186         extract_trivial=True,

```

```

187         rewrite_rest_filled=True,
188     ),
189 )
190
191 rmaker_three = abjadext.rmakers.EvenDivisionRhythmMaker(
192     denominators=[16, 16, 8, 16, 16, 8],
193     extra_counts_per_division=[1, 0, 0, -1, 0, 1, -1, 0],
194     burnish_specifier=abjadext.rmakers.BurnishSpecifier(
195         left_classes=[abjad.Rest],
196         left_counts=[1],
197         right_classes=[abjad.Rest],
198         right_counts=[1],
199         outer_divisions_only=True,
200     ),
201     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
202         trivialize=True,
203         extract_trivial=True,
204         rewrite_rest_filled=True,
205     ),
206 )
207
208 attachment_handler_one = AttachmentHandler(
209     starting_dynamic='p',
210     ending_dynamic='mp',
211     hairpin_indicator='--',
212     articulation='accent',
213 )
214
215 attachment_handler_two = AttachmentHandler(
216     starting_dynamic='fff',
217     ending_dynamic='mf',
218     hairpin_indicator='>',
219     articulation='tenuto',
220 )
221
222 attachment_handler_three = AttachmentHandler(
223     starting_dynamic='mp',
224     ending_dynamic='ff',
225     hairpin_indicator='<|',
226     articulation='',
227 )
228
229 #####oboe#####
230 flutemusicmaker_one = MusicMaker(
231     rmaker=rmaker_one,
232     pitches=flute_notes_one,
233     continuous=True,
234     attachment_handler=attachment_handler_one,
235 )
236 flutemusicmaker_two = MusicMaker(
237     rmaker=rmaker_two,
238     pitches=flute_notes_two,
239     continuous=True,
240     attachment_handler=attachment_handler_two,

```

```

241 )
242 flutemusicmaker_three = MusicMaker(
243     rmaker=rmaker_three,
244     pitches=flute_notes_three,
245     continuous=True,
246     attachment_handler=attachment_handler_three,
247 )
248 #####saxophone#####
249 saxophonemusicmaker_one = MusicMaker(
250     rmaker=rmaker_one,
251     pitches=saxophone_notes_one,
252     continuous=True,
253     attachment_handler=attachment_handler_one,
254 )
255 saxophonemusicmaker_two = MusicMaker(
256     rmaker=rmaker_two,
257     pitches=saxophone_notes_two,
258     continuous=True,
259     attachment_handler=attachment_handler_two,
260 )
261 saxophonemusicmaker_three = MusicMaker(
262     rmaker=rmaker_three,
263     pitches=saxophone_notes_three,
264     continuous=True,
265     attachment_handler=attachment_handler_three,
266 )
267 #####cello#####
268 cellomusicmaker_one = MusicMaker(
269     rmaker=rmaker_one,
270     pitches=cello_notes_one,
271     continuous=True,
272     attachment_handler=attachment_handler_one,
273 )
274 cellomusicmaker_two = MusicMaker(
275     rmaker=rmaker_two,
276     pitches=cello_notes_two,
277     continuous=True,
278     attachment_handler=attachment_handler_two,
279 )
280 cellomusicmaker_three = MusicMaker(
281     rmaker=rmaker_three,
282     pitches=cello_notes_three,
283     continuous=True,
284     attachment_handler=attachment_handler_three,
285 )
286
287 silence_maker = abjadext.rmakers.NoteRhythmMaker(
288     division_masks=[
289         abjadext.rmakers.SilenceMask(
290             pattern=abjad.index([0], 1),
291             ),
292     ],
293 )
294

```

```

295
296 class MusicSpecifier:
297
298     def __init__(self, music_maker, voice_name):
299         self.music_maker = music_maker
300         self.voice_name = voice_name
301
302 print('Collecting timespans and rmakers ...')
303 ###group one###
304 voice_1_timespan_list = abjad.TimespanList([
305     abjad.AnnotatedTimespan(
306         start_offset=start_offset,
307         stop_offset=stop_offset,
308         annotation=MusicSpecifier(
309             music_maker=music_maker,
310             voice_name='Voice 1',
311         ),
312     )
313     for start_offset, stop_offset, music_maker in [
314         [(9, 8), (12, 8), flutemusicmaker_one],
315         [(20, 8), (24, 8), flutemusicmaker_two],
316         [(31, 8), (33, 8), flutemusicmaker_three],
317         [(33, 8), (36, 8), flutemusicmaker_one],
318         [(42, 8), (48, 8), flutemusicmaker_two],
319         [(53, 8), (56, 8), flutemusicmaker_three],
320         [(56, 8), (60, 8), flutemusicmaker_one],
321         [(64, 8), (69, 8), flutemusicmaker_two],
322         [(69, 8), (72, 8), flutemusicmaker_three],
323         [(75, 8), (79, 8), flutemusicmaker_one],
324     ]
325 ])
326
327 voice_3_timespan_list = abjad.TimespanList([
328     abjad.AnnotatedTimespan(
329         start_offset=start_offset,
330         stop_offset=stop_offset,
331         annotation=MusicSpecifier(
332             music_maker=music_maker,
333             voice_name='Voice 3',
334         ),
335     )
336     for start_offset, stop_offset, music_maker in [
337         [(15, 8), (18, 8), saxophonemusicmaker_one],
338         [(18, 8), (22, 8), saxophonemusicmaker_two],
339         [(25, 8), (29, 8), saxophonemusicmaker_three],
340         [(29, 8), (32, 8), saxophonemusicmaker_one],
341         [(35, 8), (39, 8), saxophonemusicmaker_two],
342         [(39, 8), (42, 8), saxophonemusicmaker_three],
343         [(45, 8), (50, 8), saxophonemusicmaker_one],
344         [(50, 8), (52, 8), saxophonemusicmaker_two],
345         [(55, 8), (56, 8), saxophonemusicmaker_three],
346         [(56, 8), (61, 8), saxophonemusicmaker_one],
347         [(61, 8), (62, 8), saxophonemusicmaker_two],
348         [(65, 8), (69, 8), saxophonemusicmaker_three],

```

```

349     [(69, 8), (72, 8), saxophonemusicmaker_one],
350     [(75, 8), (79, 8), saxophonemusicmaker_two],
351 ]
352 ])
353
354 voice_8_timespan_list = abjad.TimespanList([
355     abjad.AnnotatedTimespan(
356         start_offset=start_offset,
357         stop_offset=stop_offset,
358         annotation=MusicSpecifier(
359             music_maker=music_maker,
360             voice_name='Voice 8',
361         ),
362     )
363     for start_offset, stop_offset, music_maker in [
364         [(0, 8), (3, 8), cellomusicmaker_one],
365         [(4, 8), (8, 8), cellomusicmaker_two],
366         [(10, 8), (12, 8), cellomusicmaker_three],
367         [(12, 8), (15, 8), cellomusicmaker_one],
368         [(18, 8), (24, 8), cellomusicmaker_two],
369         [(28, 8), (33, 8), cellomusicmaker_three],
370         [(33, 8), (35, 8), cellomusicmaker_one],
371         [(40, 8), (42, 8), cellomusicmaker_two],
372         [(42, 8), (44, 8), cellomusicmaker_three],
373         [(44, 8), (48, 8), cellomusicmaker_one],
374         [(54, 8), (55, 8), cellomusicmaker_two],
375         [(62, 8), (64, 8), cellomusicmaker_three],
376         [(72, 8), (75, 8), cellomusicmaker_one],
377         [(76, 8), (79, 8), cellomusicmaker_two],
378         [(79, 8), (80, 8), silence_maker],
379     ]
380 ])
381
382 all_timespan_lists = {
383     'Voice 1': voice_1_timespan_list,
384     'Voice 3': voice_3_timespan_list,
385     'Voice 8': voice_8_timespan_list,
386 }
387
388 global_timespan = abjad.Timespan(
389     start_offset=0,
390     stop_offset=max(_.stop_offset for _ in all_timespan_lists.values())
391 )
392
393 for voice_name, timespan_list in all_timespan_lists.items():
394     silences = abjad.TimespanList([global_timespan])
395     silences.extend(timespan_list)
396     silences.sort()
397     silences.compute_logical_xor()
398     for silence_timespan in silences:
399         timespan_list.append(
400             abjad.AnnotatedTimespan(
401                 start_offset=silence_timespan.start_offset,
402                 stop_offset=silence_timespan.stop_offset,

```

```

403         annotation=MusicSpecifier(
404             music_maker=None,
405             voice_name=voice_name,
406         ),
407     )
408 )
409 timespan_list.sort()
410
411 for voice_name, timespan_list in all_timespan_lists.items():
412     shards = timespan_list.split_at_offsets(bounds)
413     split_timespan_list = abjad.TimespanList()
414     for shard in shards:
415         split_timespan_list.extend(shard)
416     split_timespan_list.sort()
417     all_timespan_lists[voice_name] = timespan_list
418
419 score = abjad.Score([
420     abjad.Staff(lilypond_type='TimeSignatureContext', name='Global Context'),
421     abjad.StaffGroup(
422         [
423             abjad.Staff([abjad.Voice(name='Voice 1')], name='Staff 1',
424             lilypond_type='Staff'),
425             abjad.Staff([abjad.Voice(name='Voice 3')], name='Staff 3',
426             lilypond_type='Staff'),
427             abjad.Staff([abjad.Voice(name='Voice 8')], name='Staff 8',
428             lilypond_type='Staff'),
429         ],
430         name='Staff Group 1',
431     ),
432 ],
433 )
434
435 for time_signature in time_signatures:
436     skip = abjad.Skip(1, multiplier=(time_signature))
437     abjad.attach(time_signature, skip)
438     score['Global Context'].append(skip)
439
440 print('Making containers ...')
441
442 def make_container(music_maker, durations):
443     selections = music_maker(durations)
444     container = abjad.Container([])
445     container.extend(selections)
446     return container
447
448 def key_function(timespan):
449     return timespan.annotation.music_maker or silence_maker
450
451 for voice_name, timespan_list in all_timespan_lists.items():
452     for music_maker, grouper in itertools.groupby(
453         timespan_list,
454         key=key_function,
455     ):
456         durations = [timespan.duration for timespan in grouper]

```



```

454         container = make_container(music_maker, durations)
455         voice = score[voice_name]
456         voice.append(container)
457
458     print('Splitting and rewriting ...')
459
460     for voice in abjad.iterate(score['Staff Group 1']).components(abjad.Voice):
461         for i, shard in enumerate(abjad.mutate(voice[:]).split(time_signatures)):
462             time_signature = time_signatures[i]
463             abjad.mutate(shard).rewrite_meter(time_signature)
464
465     print('Beaming runs ...')
466
467     for voice in abjad.select(score).components(abjad.Voice):
468         for run in abjad.select(voice).runs():
469             if 1 < len(run):
470                 specifier = abjadext.rmakers.BeamSpecifier(
471                     beam_each_division=False,
472                 )
473                 specifier(run)
474                 abjad.attach(abjad.StartBeam(), run[0])
475                 abjad.attach(abjad.StopBeam(), run[-1])
476                 for leaf in run:
477                     if abjad.Duration(1, 4) <= leaf.written_duration:
478                         continue
479                     previous_leaf = abjad.inspect(leaf).leaf(-1)
480                     next_leaf = abjad.inspect(leaf).leaf(1)
481                     if (isinstance(next_leaf, (abjad.Chord, abjad.Note)) and
482                         abjad.Duration(1, 4) <= next_leaf.written_duration):
483                         left = previous_leaf.written_duration.flag_count
484                         right = leaf.written_duration.flag_count
485                         beam_count = abjad.BeamCount(
486                             left=left,
487                             right=right,
488                         )
489                         abjad.attach(beam_count, leaf)
490                         continue
491                     if (isinstance(previous_leaf, (abjad.Chord, abjad.Note)) and
492                         abjad.Duration(1, 4) <= previous_leaf.written_duration):
493                         left = leaf.written_duration.flag_count
494                         right = next_leaf.written_duration.flag_count
495                         beam_count = abjad.BeamCount(
496                             left=left,
497                             right=right,
498                         )
499                         abjad.attach(beam_count, leaf)
500
501     print('Stopping Hairpins ...')
502     for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
503         for rest in abjad.iterate(staff).components(abjad.Rest):
504             previous_leaf = abjad.inspect(rest).leaf(-1)
505             if isinstance(previous_leaf, abjad.Note):
506                 abjad.attach(abjad.StopHairpin(), rest)
507             elif isinstance(previous_leaf, abjad.Chord):

```

```

508         abjad.attach(abjad.StopHairpin(), rest)
509     elif isinstance(previous_leaf, abjad.Rest):
510         pass
511
512     print('Adding attachments ...')
513     bar_line = abjad.BarLine('||')
514     metro = abjad.MetronomeMark((1, 4), 60)
515     markup1 = abjad.Markup(r'\bold { A }')
516     markup2 = abjad.Markup(r'\bold { B }')
517     markup3 = abjad.Markup(r'\bold { C }')
518     markup4 = abjad.Markup(r'\bold { D }')
519     markup5 = abjad.Markup(r'\bold { E }')
520     markup6 = abjad.Markup(r'\bold { F }')
521     mark1 = abjad.RehearsalMark(markup=markup1)
522     mark2 = abjad.RehearsalMark(markup=markup2)
523     mark3 = abjad.RehearsalMark(markup=markup3)
524     mark4 = abjad.RehearsalMark(markup=markup4)
525     mark5 = abjad.RehearsalMark(markup=markup5)
526     mark6 = abjad.RehearsalMark(markup=markup6)
527
528     def _apply_numerators_and_tech(staff, nums, tech):
529         numerators = cyc(nums)
530         techs = cyc(tech)
531         for logical_tie in abjad.select(staff).logical_ties(pitched=True):
532             tech = next(techs)
533             numerator = next(numerators)
534             bcp = abjad.BowContactPoint((numerator, 5))
535             technis = abjad.BowMotionTechnique(tech)
536             for note in logical_tie:
537                 abjad.attach(bcp, note)
538                 abjad.attach(technis, note)
539         for run in abjad.select(staff).runs():
540             abjad.bow_contact_spanner(run, omit_bow_changes=False)
541
542     instruments1 = cyc([
543         abjad.Flute(),
544         abjad.AltoSaxophone(),
545         abjad.Cello(),
546     ])
547
548     clefs1 = cyc([
549         abjad.Clef('treble'),
550         abjad.Clef('treble'),
551         abjad.Clef('bass'),
552     ])
553
554     abbreviations1 = cyc([
555         abjad.MarginMarkup(markup=abjad.Markup('fl.'),),
556         abjad.MarginMarkup(markup=abjad.Markup('sx.'),),
557         abjad.MarginMarkup(markup=abjad.Markup('vc.'),),
558     ])
559
560     names1 = cyc([
561         abjad.StartMarkup(markup=abjad.Markup('Flute'),),

```

```

562     abjad.StartMarkup(markup=abjad.Markup('Saxophone'),),
563     abjad.StartMarkup(markup=abjad.Markup('Violoncello'),),
564 ])
565
566 for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
567     leaf1 = abjad.select(staff).leaves()[0]
568     abjad.attach(next(instruments1), leaf1)
569     abjad.attach(next(abbreviations1), leaf1)
570     abjad.attach(next(names1), leaf1)
571     abjad.attach(next(clefs1), leaf1)
572
573 for staff in abjad.select(score['Staff Group 1']).components(abjad.Staff)[0]:
574     leaf1 = abjad.select(staff).leaves()[0]
575     last_leaf = abjad.select(staff).leaves()[-1]
576     #abjad.attach(metro, leaf1)
577     abjad.attach(bar_line, last_leaf)
578
579 for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
580     abjad.Instrument.transpose_from_sounding_pitch(staff)
581
582 score_file = abjad.LilyPondFile.new(
583     score,
584     includes=['first_stylesheet.ily', '/Users/evansdsg2/abjad/docs/source/
585               _stylesheets/abjad.ily'],
586 )
587
588 abjad.SegmentMaker.comment_measure_numbers(score)
589 #####
590
591 directory = '/Users/evansdsg2/Scores/four_ages_of_sand/four_ages_of_sand/
592             Segments/Segment_III'
593 pdf_path = f'{directory}/Segment_III.pdf'
594 path = pathlib.Path('Segment_III.pdf')
595 if path.exists():
596     print(f'Removing {pdf_path} ...')
597     path.unlink()
598 time_1 = time.time()
599 print(f'Persisting {pdf_path} ...')
600 result = abjad.persist(score_file).as_pdf(pdf_path)
601 print(result[0])
602 print(result[1])
603 print(result[2])
604 success = result[3]
605 if success is False:
606     print('LilyPond failed!')
607 time_2 = time.time()
608 total_time = time_2 - time_1
609 print(f'Total time: {total_time} seconds')
610 if path.exists():
611     print(f'Opening {pdf_path} ...')
612     os.system(f'open {pdf_path}')

```

Code Example A.18: Four Ages of Sand Segment_III

A.4.1.4 SEGMENT_IV

```

1 import abjad
2 import itertools
3 import os
4 import pathlib
5 import time
6 import abjadext.rmakers
7 from MusicMaker import MusicMaker
8 from AttachmentHandler import AttachmentHandler
9 from random import random
10 from random import seed
11
12 print('Interpreting file ...')
13
14 time_signatures = [
15     abjad.TimeSignature(pair) for pair in [
16         (9, 8), (6, 8), (5, 4), (4, 4), (6, 8),
17         (3, 8), (4, 4), (3, 4), (5, 8), (4, 4),
18         (11, 8),
19     ]
20 ]
21
22 bounds = abjad.mathtools.cumulative_sums([_.duration for _ in time_signatures
23 ])
24
25 def reduceMod1(rw):
26     return [(x % 2) for x in rw]
27
28 def reduceMod3(rw):
29     return [(x % 4) for x in rw]
30
31 def reduceMod5(rw):
32     return [(x % 6) for x in rw]
33
34 def reduceMod7(rw):
35     return [(x % 8) for x in rw]
36
37 def cyc(lst):
38     count = 0
39     while True:
40         yield lst[count%len(lst)]
41         count += 1
42
43 def grouper(lst1, lst2):
44     def cyc(lst):
45         c = 0
46         while True:
47             yield lst[c%len(lst)]
48             c += 1
49     lst1 = cyc(lst1)
50     return [next(lst1) if i == 1 else [next(lst1) for _ in range(i)] for i in

```

```

    lst2]

50
51 seed(1)
52 flute_random_walk_one = []
53 flute_random_walk_one.append(-1 if random() < 0.5 else 1)
54 for i in range(1, 1000):
55     movement = -1 if random() < 0.5 else 1
56     value = flute_random_walk_one[i-1] + movement
57     flute_random_walk_one.append(value)
58 flute_random_walk_one = [abs(x) for x in flute_random_walk_one]
59 flute_chord_one = [2, 13, 16, 20, 31, 20, 16, 13, ]
60 flute_notes_one = [flute_chord_one[x] for x in reduceMod7(
    flute_random_walk_one)]

61
62 seed(4)
63 saxophone_random_walk_one = []
64 saxophone_random_walk_one.append(-1 if random() < 0.5 else 1)
65 for i in range(1, 1000):
66     movement = -1 if random() < 0.5 else 1
67     value = saxophone_random_walk_one[i-1] + movement
68     saxophone_random_walk_one.append(value)
69 saxophone_random_walk_one = [abs(x) for x in saxophone_random_walk_one]
70 saxophone_chord_one = [-3, 2, 13, 16, 13, 2, ]
71 saxophone_notes_one = [saxophone_chord_one[x] for x in reduceMod5(
    saxophone_random_walk_one)]

72
73 seed(8)
74 cello_random_walk_one = []
75 cello_random_walk_one.append(-1 if random() < 0.5 else 1)
76 for i in range(1, 1000):
77     movement = -1 if random() < 0.5 else 1
78     value = cello_random_walk_one[i-1] + movement
79     cello_random_walk_one.append(value)
80 cello_random_walk_one = [abs(x) for x in cello_random_walk_one]
81 cello_chord_one = [-21, -18, -14, -3, 2, -3, -14, -18, ]
82 cello_notes_one = [cello_chord_one[x] for x in reduceMod7(
    cello_random_walk_one)]

83
84 seed(1)
85 flute_random_walk_two = []
86 flute_random_walk_two.append(-1 if random() < 0.5 else 1)
87 for i in range(1, 1000):
88     movement = -1 if random() < 0.5 else 1
89     value = flute_random_walk_two[i-1] + movement
90     flute_random_walk_two.append(value)
91 flute_random_walk_two = [abs(x) for x in flute_random_walk_two]
92 flute_chord_two = [2, 16, 31, 16, ]
93 flute_notes_two = [flute_chord_two[x] for x in reduceMod3(
    flute_random_walk_two)]

94
95 seed(4)
96 saxophone_random_walk_two = []
97 saxophone_random_walk_two.append(-1 if random() < 0.5 else 1)
98 for i in range(1, 1000):

```

```

99     movement = -1 if random() < 0.5 else 1
100     value = saxophone_random_walk_two[i-1] + movement
101     saxophone_random_walk_two.append(value)
102 saxophone_random_walk_two = [abs(x) for x in saxophone_random_walk_two]
103 saxophone_chord_two = [-3, 13, ]
104 saxophone_notes_two = [saxophone_chord_two[x] for x in reduceMod1(
    saxophone_random_walk_two)]
105
106 seed(8)
107 cello_random_walk_two = []
108 cello_random_walk_two.append(-1 if random() < 0.5 else 1)
109 for i in range(1, 1000):
110     movement = -1 if random() < 0.5 else 1
111     value = cello_random_walk_two[i-1] + movement
112     cello_random_walk_two.append(value)
113 cello_random_walk_two = [abs(x) for x in cello_random_walk_two]
114 cello_chord_two = [-21, -14, 2, -14, ]
115 cello_notes_two = [cello_chord_two[x] for x in reduceMod3(
    cello_random_walk_two)]
116
117 seed(1)
118 flute_random_walk_three = []
119 flute_random_walk_three.append(-1 if random() < 0.5 else 1)
120 for i in range(1, 1000):
121     movement = -1 if random() < 0.5 else 1
122     value = flute_random_walk_three[i-1] + movement
123     flute_random_walk_three.append(value)
124 flute_random_walk_three = [abs(x) for x in flute_random_walk_three]
125 flute_chord_three = [13, 20, ]
126 flute_notes_three = [flute_chord_three[x] for x in reduceMod1(
    flute_random_walk_three)]
127
128 seed(4)
129 saxophone_random_walk_three = []
130 saxophone_random_walk_three.append(-1 if random() < 0.5 else 1)
131 for i in range(1, 1000):
132     movement = -1 if random() < 0.5 else 1
133     value = saxophone_random_walk_three[i-1] + movement
134     saxophone_random_walk_three.append(value)
135 saxophone_random_walk_three = [abs(x) for x in saxophone_random_walk_three]
136 saxophone_chord_three = [2, 16, ]
137 saxophone_notes_three = [saxophone_chord_three[x] for x in reduceMod1(
    saxophone_random_walk_three)]
138
139 seed(8)
140 cello_random_walk_three = []
141 cello_random_walk_three.append(-1 if random() < 0.5 else 1)
142 for i in range(1, 1000):
143     movement = -1 if random() < 0.5 else 1
144     value = cello_random_walk_three[i-1] + movement
145     cello_random_walk_three.append(value)
146 cello_random_walk_three = [abs(x) for x in cello_random_walk_three]
147 cello_chord_three = [-18, -3, ]
148 cello_notes_three = [cello_chord_three[x] for x in reduceMod1(

```

```

cello_random_walk_three))]
149
150 rmaker_one = abjadext.rmakers.TaleaRhythmMaker(
151     talea=abjadext.rmakers.Talea(
152         counts=[3, 6, 1, 4, 5, 1, 7, 1, 2, 1, ],
153         denominator=32,
154     ),
155     beam_specifier=abjadext.rmakers.BeamSpecifier(
156         beam_divisions_together=True,
157         beam_rests=False,
158     ),
159     extra_counts_per_division=[0, 1, 0, -1],
160     burnish_specifier=abjadext.rmakers.BurnishSpecifier(
161         left_classes=[abjad.Note, abjad.Rest],
162         left_counts=[1, 0, 1],
163     ),
164     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
165         trivialize=True,
166         extract_trivial=True,
167         rewrite_rest_filled=True,
168     ),
169 )
170
171 rmaker_two = abjadext.rmakers.TaleaRhythmMaker(
172     talea=abjadext.rmakers.Talea(
173         counts=[1, 1, 1, 3, 2, 1, 2, 1, 3, ],
174         denominator=16,
175     ),
176     beam_specifier=abjadext.rmakers.BeamSpecifier(
177         beam_divisions_together=True,
178         beam_rests=False,
179     ),
180     extra_counts_per_division=[1, 0, -1, 0],
181     burnish_specifier=abjadext.rmakers.BurnishSpecifier(
182         left_classes=[abjad.Note, abjad.Rest],
183         left_counts=[1, 0, 1],
184     ),
185     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
186         trivialize=True,
187         extract_trivial=True,
188         rewrite_rest_filled=True,
189     ),
190 )
191
192 rmaker_three = abjadext.rmakers.EvenDivisionRhythmMaker(
193     denominators=[16, 16, 8, 16, 16, 8],
194     extra_counts_per_division=[1, 0, 0, -1, 0, 1, -1, 0],
195     burnish_specifier=abjadext.rmakers.BurnishSpecifier(
196         left_classes=[abjad.Rest],
197         left_counts=[1],
198         right_classes=[abjad.Rest],
199         right_counts=[1],
200         outer_divisions_only=True,
201     ),

```

```

202     tuplet_specifier=abjadext.rmakers.TupletSpecifier(
203         trivialize=True,
204         extract_trivial=True,
205         rewrite_rest_filled=True,
206     ),
207 )
208
209 attachment_handler_one = AttachmentHandler(
210     starting_dynamic='p',
211     ending_dynamic='mp',
212     hairpin_indicator='--',
213     articulation='accent',
214 )
215
216 attachment_handler_two = AttachmentHandler(
217     starting_dynamic='fff',
218     ending_dynamic='mf',
219     hairpin_indicator='>',
220     articulation='tenuto',
221 )
222
223 attachment_handler_three = AttachmentHandler(
224     starting_dynamic='mp',
225     ending_dynamic='ff',
226     hairpin_indicator='<|',
227     articulation='',
228 )
229
230 #####oboe#####
231 flutemusicmaker_one = MusicMaker(
232     rmaker=rmaker_one,
233     pitches=flute_notes_one,
234     continuous=True,
235     attachment_handler=attachment_handler_one,
236 )
237 flutemusicmaker_two = MusicMaker(
238     rmaker=rmaker_two,
239     pitches=flute_notes_two,
240     continuous=True,
241     attachment_handler=attachment_handler_two,
242 )
243 flutemusicmaker_three = MusicMaker(
244     rmaker=rmaker_three,
245     pitches=flute_notes_three,
246     continuous=True,
247     attachment_handler=attachment_handler_three,
248 )
249 #####saxophone#####
250 saxophonemusicmaker_one = MusicMaker(
251     rmaker=rmaker_one,
252     pitches=saxophone_notes_one,
253     continuous=True,
254     attachment_handler=attachment_handler_one,
255 )

```



```

256 saxophonemusicmaker_two = MusicMaker(
257     rmaker=rmaker_two,
258     pitches=saxophone_notes_two,
259     continuous=True,
260     attachment_handler=attachment_handler_two,
261 )
262 saxophonemusicmaker_three = MusicMaker(
263     rmaker=rmaker_three,
264     pitches=saxophone_notes_three,
265     continuous=True,
266     attachment_handler=attachment_handler_three,
267 )
268 #####cello#####
269 cellomusicmaker_one = MusicMaker(
270     rmaker=rmaker_one,
271     pitches=cello_notes_one,
272     continuous=True,
273     attachment_handler=attachment_handler_one,
274 )
275 cellomusicmaker_two = MusicMaker(
276     rmaker=rmaker_two,
277     pitches=cello_notes_two,
278     continuous=True,
279     attachment_handler=attachment_handler_two,
280 )
281 cellomusicmaker_three = MusicMaker(
282     rmaker=rmaker_three,
283     pitches=cello_notes_three,
284     continuous=True,
285     attachment_handler=attachment_handler_three,
286 )
287
288 silence_maker = abjadext.rmakers.NoteRhythmMaker(
289     division_masks=[
290         abjadext.rmakers.SilenceMask(
291             pattern=abjad.index([0], 1),
292         ),
293     ],
294 )
295
296 class MusicSpecifier:
297
298     def __init__(self, music_maker, voice_name):
299         self.music_maker = music_maker
300         self.voice_name = voice_name
301
302 print('Collecting timespans and rmakers ...')
303 ###group one###
304 voice_1_timespan_list = abjad.TimespanList([
305     abjad.AnnotatedTimespan(
306         start_offset=start_offset,
307         stop_offset=stop_offset,
308         annotation=MusicSpecifier(
309             music_maker=music_maker,

```

```

310         voice_name='Voice 1',
311     ),
312 )
313     for start_offset, stop_offset, music_maker in [
314         [(0, 8), (3, 8), flutemusicmaker_one],
315         [(4, 8), (8, 8), flutemusicmaker_two],
316         [(10, 8), (12, 8), flutemusicmaker_three],
317         [(12, 8), (15, 8), flutemusicmaker_one],
318         [(18, 8), (24, 8), flutemusicmaker_two],
319         [(28, 8), (33, 8), flutemusicmaker_three],
320         [(33, 8), (35, 8), flutemusicmaker_one],
321         [(40, 8), (42, 8), flutemusicmaker_two],
322         [(42, 8), (44, 8), flutemusicmaker_three],
323         [(44, 8), (48, 8), flutemusicmaker_one],
324         [(54, 8), (55, 8), flutemusicmaker_two],
325         [(62, 8), (64, 8), flutemusicmaker_three],
326         [(72, 8), (75, 8), flutemusicmaker_one],
327         [(76, 8), (79, 8), flutemusicmaker_two],
328         [(79, 8), (80, 8), silence_maker],
329     ]
330 ])
331
332 voice_3_timespan_list = abjad.TimespanList([
333     abjad.AnnotatedTimespan(
334         start_offset=start_offset,
335         stop_offset=stop_offset,
336         annotation=MusicSpecifier(
337             music_maker=music_maker,
338             voice_name='Voice 3',
339         ),
340     )
341     for start_offset, stop_offset, music_maker in [
342         [(9, 8), (12, 8), saxophonemusicmaker_one],
343         [(20, 8), (24, 8), saxophonemusicmaker_two],
344         [(31, 8), (33, 8), saxophonemusicmaker_three],
345         [(33, 8), (36, 8), saxophonemusicmaker_one],
346         [(42, 8), (48, 8), saxophonemusicmaker_two],
347         [(53, 8), (56, 8), saxophonemusicmaker_three],
348         [(56, 8), (60, 8), saxophonemusicmaker_one],
349         [(64, 8), (69, 8), saxophonemusicmaker_two],
350         [(69, 8), (72, 8), saxophonemusicmaker_three],
351         [(75, 8), (79, 8), saxophonemusicmaker_one],
352     ]
353 ])
354
355 voice_8_timespan_list = abjad.TimespanList([
356     abjad.AnnotatedTimespan(
357         start_offset=start_offset,
358         stop_offset=stop_offset,
359         annotation=MusicSpecifier(
360             music_maker=music_maker,
361             voice_name='Voice 8',
362         ),
363     )

```

```

364     for start_offset, stop_offset, music_maker in [
365         [(15, 8), (18, 8), cellomusicmaker_one],
366         [(18, 8), (22, 8), cellomusicmaker_two],
367         [(25, 8), (29, 8), cellomusicmaker_three],
368         [(29, 8), (32, 8), cellomusicmaker_one],
369         [(35, 8), (39, 8), cellomusicmaker_two],
370         [(39, 8), (42, 8), cellomusicmaker_three],
371         [(45, 8), (50, 8), cellomusicmaker_one],
372         [(50, 8), (52, 8), cellomusicmaker_two],
373         [(55, 8), (56, 8), cellomusicmaker_three],
374         [(56, 8), (61, 8), cellomusicmaker_one],
375         [(61, 8), (62, 8), cellomusicmaker_two],
376         [(65, 8), (69, 8), cellomusicmaker_three],
377         [(69, 8), (72, 8), cellomusicmaker_one],
378         [(75, 8), (79, 8), cellomusicmaker_two],
379     ]
380 ])
381
382 all_timespan_lists = {
383     'Voice 1': voice_1_timespan_list,
384     'Voice 3': voice_3_timespan_list,
385     'Voice 8': voice_8_timespan_list,
386 }
387
388 global_timespan = abjad.Timespan(
389     start_offset=0,
390     stop_offset=max(_.stop_offset for _ in all_timespan_lists.values())
391 )
392
393 for voice_name, timespan_list in all_timespan_lists.items():
394     silences = abjad.TimespanList([global_timespan])
395     silences.extend(timespan_list)
396     silences.sort()
397     silences.compute_logical_xor()
398     for silence_timespan in silences:
399         timespan_list.append(
400             abjad.AnnotatedTimespan(
401                 start_offset=silence_timespan.start_offset,
402                 stop_offset=silence_timespan.stop_offset,
403                 annotation=MusicSpecifier(
404                     music_maker=None,
405                     voice_name=voice_name,
406                 ),
407             )
408         )
409     timespan_list.sort()
410
411 for voice_name, timespan_list in all_timespan_lists.items():
412     shards = timespan_list.split_at_offsets(bounds)
413     split_timespan_list = abjad.TimespanList()
414     for shard in shards:
415         split_timespan_list.extend(shard)
416     split_timespan_list.sort()
417     all_timespan_lists[voice_name] = timespan_list

```

```

418
419 score = abjad.Score([
420     abjad.Staff(lilypond_type='TimeSignatureContext', name='Global Context'),
421     abjad.StaffGroup(
422         [
423             abjad.Staff([abjad.Voice(name='Voice 1')], name='Staff 1',
424             lilypond_type='Staff'),
425             abjad.Staff([abjad.Voice(name='Voice 3')], name='Staff 3',
426             lilypond_type='Staff'),
427             abjad.Staff([abjad.Voice(name='Voice 8')], name='Staff 8',
428             lilypond_type='Staff'),
429         ],
430         name='Staff Group 1',
431     ),
432 ],
433 )
434
435 for time_signature in time_signatures:
436     skip = abjad.Skip(1, multiplier=(time_signature))
437     abjad.attach(time_signature, skip)
438     score['Global Context'].append(skip)
439
440 print('Making containers ...')
441
442 def make_container(music_maker, durations):
443     selections = music_maker(durations)
444     container = abjad.Container([])
445     container.extend(selections)
446     return container
447
448 def key_function(timespan):
449     return timespan.annotation.music_maker or silence_maker
450
451 for voice_name, timespan_list in all_timespan_lists.items():
452     for music_maker, grouper in itertools.groupby(
453         timespan_list,
454         key=key_function,
455     ):
456         durations = [timespan.duration for timespan in grouper]
457         container = make_container(music_maker, durations)
458         voice = score[voice_name]
459         voice.append(container)
460
461 print('Splitting and rewriting ...')
462
463 for voice in abjad.iterate(score['Staff Group 1']).components(abjad.Voice):
464     for i, shard in enumerate(abjad.mutate(voice[:]).split(time_signatures)):
465         time_signature = time_signatures[i]
466         abjad.mutate(shard).rewrite_meter(time_signature)
467
468 print('Beaming runs ...')
469
470 for voice in abjad.select(score).components(abjad.Voice):
471     for run in abjad.select(voice).runs():

```

```

469     if 1 < len(run):
470         specifier = abjadext.rmakers.BeamSpecifier(
471             beam_each_division=False,
472             )
473         specifier(run)
474         abjad.attach(abjad.StartBeam(), run[0])
475         abjad.attach(abjad.StopBeam(), run[-1])
476     for leaf in run:
477         if abjad.Duration(1, 4) <= leaf.written_duration:
478             continue
479         previous_leaf = abjad.inspect(leaf).leaf(-1)
480         next_leaf = abjad.inspect(leaf).leaf(1)
481         if (isinstance(next_leaf, (abjad.Chord, abjad.Note)) and
482             abjad.Duration(1, 4) <= next_leaf.written_duration):
483             left = previous_leaf.written_duration.flag_count
484             right = leaf.written_duration.flag_count
485             beam_count = abjad.BeamCount(
486                 left=left,
487                 right=right,
488             )
489             abjad.attach(beam_count, leaf)
490             continue
491         if (isinstance(previous_leaf, (abjad.Chord, abjad.Note)) and
492             abjad.Duration(1, 4) <= previous_leaf.written_duration):
493             left = leaf.written_duration.flag_count
494             right = next_leaf.written_duration.flag_count
495             beam_count = abjad.BeamCount(
496                 left=left,
497                 right=right,
498             )
499             abjad.attach(beam_count, leaf)
500
501     print('Stopping Hairpins ...')
502     for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
503         for rest in abjad.iterate(staff).components(abjad.Rest):
504             previous_leaf = abjad.inspect(rest).leaf(-1)
505             if isinstance(previous_leaf, abjad.Note):
506                 abjad.attach(abjad.StopHairpin(), rest)
507             elif isinstance(previous_leaf, abjad.Chord):
508                 abjad.attach(abjad.StopHairpin(), rest)
509             elif isinstance(previous_leaf, abjad.Rest):
510                 pass
511
512     print('Adding attachments ...')
513     bar_line = abjad.BarLine('|.|')
514     metro = abjad.MetronomeMark((1, 4), 60)
515     markup1 = abjad.Markup(r'\bold { A }')
516     markup2 = abjad.Markup(r'\bold { B }')
517     markup3 = abjad.Markup(r'\bold { C }')
518     markup4 = abjad.Markup(r'\bold { D }')
519     markup5 = abjad.Markup(r'\bold { E }')
520     markup6 = abjad.Markup(r'\bold { F }')
521     mark1 = abjad.RehearsalMark(markup=markup1)
522     mark2 = abjad.RehearsalMark(markup=markup2)

```

```

s23 mark3 = abjad.RehearsalMark(markup=markup3)
s24 mark4 = abjad.RehearsalMark(markup=markup4)
s25 mark5 = abjad.RehearsalMark(markup=markup5)
s26 mark6 = abjad.RehearsalMark(markup=markup6)
s27
s28 def _apply_numerators_and_tech(staff, nums, tech):
s29     numerators = cyc(nums)
s30     techs = cyc(tech)
s31     for logical_tie in abjad.select(staff).logical_ties(pitched=True):
s32         tech = next(techs)
s33         numerator = next(numerators)
s34         bcp = abjad.BowContactPoint((numerator, 5))
s35         technis = abjad.BowMotionTechnique(tech)
s36         for note in logical_tie:
s37             abjad.attach(bcp, note)
s38             abjad.attach(technis, note)
s39     for run in abjad.select(staff).runs():
s40         abjad.bow_contact_spanner(run, omit_bow_changes=False)
s41
s42 instruments1 = cyc([
s43     abjad.Flute(),
s44     abjad.AltoSaxophone(),
s45     abjad.Cello(),
s46 ])
s47
s48 clefs1 = cyc([
s49     abjad.Clef('treble'),
s50     abjad.Clef('treble'),
s51     abjad.Clef('bass'),
s52 ])
s53
s54 abbreviations1 = cyc([
s55     abjad.MarginMarkup(markup=abjad.Markup('fl.'),),
s56     abjad.MarginMarkup(markup=abjad.Markup('sx.'),),
s57     abjad.MarginMarkup(markup=abjad.Markup('vc.'),),
s58 ])
s59
s60 names1 = cyc([
s61     abjad.StartMarkup(markup=abjad.Markup('Flute'),),
s62     abjad.StartMarkup(markup=abjad.Markup('Saxophone'),),
s63     abjad.StartMarkup(markup=abjad.Markup('Violoncello'),),
s64 ])
s65
s66 for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
s67     leaf1 = abjad.select(staff).leaves()[0]
s68     abjad.attach(next(instruments1), leaf1)
s69     abjad.attach(next(abbreviations1), leaf1)
s70     abjad.attach(next(names1), leaf1)
s71     abjad.attach(next(clefs1), leaf1)
s72
s73 for staff in abjad.select(score['Staff Group 1']).components(abjad.Staff)[0]:
s74     leaf1 = abjad.select(staff).leaves()[0]
s75     last_leaf = abjad.select(staff).leaves()[-1]
s76     #abjad.attach(metro, leaf1)

```

```

577     abjad.attach(bar_line, last_leaf)
578
579 for staff in abjad.iterate(score['Staff Group 1']).components(abjad.Staff):
580     abjad.Instrument.transpose_from_sounding_pitch(staff)
581
582 score_file = abjad.LilyPondFile.new(
583     score,
584     includes=['first_stylesheet.ily', '/Users/evansdsg2/abjad/docs/source/
585               _stylesheets/abjad.ily'],
586 )
587
588 abjad.SegmentMaker.comment_measure_numbers(score)
589 #####
590
591 directory = '/Users/evansdsg2/Scores/four_ages_of_sand/four_ages_of_sand/
592             Segments/Segment_IV'
593 pdf_path = f'{directory}/Segment_IV.pdf'
594 path = pathlib.Path('Segment_IV.pdf')
595 if path.exists():
596     print(f'Removing {pdf_path} ...')
597     path.unlink()
598 time_1 = time.time()
599 print(f'Persisting {pdf_path} ...')
600 result = abjad.persist(score_file).as_pdf(pdf_path)
601 print(result[0])
602 print(result[1])
603 print(result[2])
604 success = result[3]
605 if success is False:
606     print('LilyPond failed!')
607 time_2 = time.time()
608 total_time = time_2 - time_1
609 print(f'Total time: {total_time} seconds')
610 if path.exists():
611     print(f'Opening {pdf_path} ...')
612     os.system(f'open {pdf_path}')

```

Code Example A.19: Four Ages of Sand Segment_IV

A.4.2 STYLESHEET

```

1 Four Ages of Sand Stylesheet.
2 % 2018-07-17 19:54
3
4 \version "2.19.82"
5 \language "english"
6 #(set-default-paper-size "letter")
7 #(set-global-staff-size 13)

```

```

8 \include "ekmel.ily"
9 \ekmelicStyle evans
10
11 \header {
12   tagline = ##f
13   breakbefore = ##t
14   title = \markup \override #'(
15     font-name . "Didot"
16     ) \fontsize #15 \bold \center-column {
17     "Four Ages of Sand"
18   }
19   subtitle = \markup \override #'(
20     font-name . "Didot"
21     ) \fontsize #4 \center-column {
22     "for flute, saxophone, and violoncello"
23   }
24   arranger = \markup \override #'(
25     font-name . "Didot"
26     ) \fontsize #2.5 {
27     "Gregory Rowland Evans"
28   }
29 }
30
31 \layout {
32   \accidentalStyle forget
33   %\accidentalStyle modern
34   %\accidentalStyle modern-cautionary
35   %\accidentalStyle neo-modern
36   %\accidentalStyle dodecaphonic
37   indent = #5
38   %ragged-last = ##t
39   %ragged-right = ##t
40   %left-margin = #15

```



```

41 \context {
42     \name TimeSignatureContext
43     \type Engraver_group
44     \numericTimeSignature
45     \consists Axis_group_engraver
46     \consists Bar_number_engraver
47     \consists Time_signature_engraver
48     \consists Mark_engraver
49     \consists Metronome_mark_engraver
50     \override BarNumber.Y-extent = #'(0 . 0)
51     \override BarNumber.Y-offset = 0
52     \override BarNumber.extra-offset = #'(-4 . 0)
53     %\override BarNumber.font-name = "Didot"
54     \override BarNumber.stencil = #(
55         make-stencil-boxer 0.1 0.7 ly:text-interface::print
56     )
57     \override BarNumber.font-size = 1
58     \override BarNumber.padding = 4
59     \override MetronomeMark.X-extent = #'(0 . 0)
60     \override MetronomeMark.Y-extent = #'(0 . 0)
61     \override MetronomeMark.break-align-symbols = #'(left-edge)
62     \override MetronomeMark.extra-offset = #'(0 . 4)
63     \override MetronomeMark.font-size = 3
64     \override RehearsalMark.stencil = #(
65         make-stencil-circler 0.1 0.7 ly:text-interface::print
66     )
67     \override RehearsalMark.X-extent = #'(0 . 0)
68     \override RehearsalMark.X-offset = 6
69     \override RehearsalMark.Y-offset = -2.25
70     \override RehearsalMark.break-align-symbols = #'(time-signature)
71     \override RehearsalMark.break-visibility = #end-of-line-invisible
72     \override RehearsalMark.font-name = "Didot"
73     \override RehearsalMark.font-size = 8

```

```

74 \override RehearsalMark.outside-staff-priority = 500
75 \override RehearsalMark.self-alignment-X = #center
76 \override TimeSignature.X-extent = #'(0 . 0)
77 \override TimeSignature.X-offset = #ly:self-alignment-interface::x-
aligned-on-self
78 \override TimeSignature.Y-extent = #'(0 . 0)
79 \override TimeSignature.Y-offset = -5
80 \override TimeSignature.break-align-symbol = ##f
81 \override TimeSignature.break-visibility = #end-of-line-invisible
82 \override TimeSignature.font-size = #4
83 \override TimeSignature.self-alignment-X = #center
84 \override VerticalAxisGroup.default-staff-staff-spacing = #'(
85 (basic-distance . 0) (minimum-distance . 10) (padding . 6) (stretchability
86 . 0)
87 )
88 \context {
89 \Score
90 \remove Bar_number_engraver
91 \remove Mark_engraver
92 \accepts TimeSignatureContext
93 \override BarLine.bar-extent = #'(-2 . 2)
94 \override Beam.breakable = ##t
95 \override Beam.concaveness = #10000
96 \override Beam.beam-thickness = #0.8
97 \override Beam.length-fraction = #1.5
98 \override DynamicText.font-size = #-2
99 \override Glissando.breakable = ##t
100 \override SpacingSpanner.strict-grace-spacing = ##t
101 \override SpacingSpanner.strict-note-spacing = ##t
102 \override SpacingSpanner.uniform-stretching = ##t
103 \override StaffGrouper.staff-staff-spacing = #'(
104 (basic-distance . 14) (minimum-distance . 14) (padding . 1)

```

```

105         s)
106     \override Stem.thickness = #0.75
107     \override TupletBracket.bracket-visibility = ##t
108     \override TupletBracket.minimum-length = #3
109     \override TupletBracket.padding = #2
110     \override TupletBracket.springs-and-rods = #ly:spanner::set-spacing-
rods
111     \override TupletNumber.text = #tuplet-number::calc-fraction-text
112     proportionalNotationDuration = #(ly:make-moment 1 40)
113     autoBeaming = ##f
114     tupletFullLength = ##t
115 }
116 \context {
117     \Voice
118     \remove Forbid_line_break_engraver
119 }
120 \context {
121     \Staff
122     \remove Time_signature_engraver
123     \hide BarLine
124 }
125 \context {
126     \RhythmicStaff
127     \remove Time_signature_engraver
128 }
129 \context {
130     \StaffGroup
131 }
132 }
133
134 \paper {
135
136     top-margin = 1.5\cm

```

```

137 bottom-margin = 1.5\cm
138
139 %top-margin = .90\in
140 oddHeaderMarkup = \markup ""
141 evenHeaderMarkup = \markup ""
142 oddFooterMarkup = \markup \fill-line {
143   ""
144   \concat {
145     "Four Ages of Sand   ~"
146     \fontsize #2
147     \fromproperty #'page:page-number-string "~          Evans"
148   }
149   ""
150 }
151 evenFooterMarkup = \markup \fill-line {
152   ""
153   \concat { "Four Ages of Sand   ~" \fontsize #2
154   \fromproperty #'page:page-number-string "~          Evans"
155   } ""
156 }
157 }

```

Code Example A.20: Four Ages of Sand Stylesheet

Resistance is not, then, in some limited sense a glorious banner of the past, but rather an unrelenting struggle and a new consciousness in continuous development through subjective action, its aim being the objective process that leads to those ideals for which so many fell and continue even now to be murdered.

The musician too takes part in this fight.
(2018, *Music and Revolution* pp.273–274)

Luigi Nono

B

Appendix of Scores

THE SCORES IN THIS APPENDIX were each composed in 2018. Work on the compositions was begun and completed in a fairly rapid succession. As can be seen in the source code of appendix A, these pieces feature many organizational similarities. The compositions should not be considered as a cycle or series, but individual works that happen to share certain consistent principles.

B.1 SCORES

B.1.1 CTHAR (FOR TWO CELLOS) SCORE

Cthar

for two cellos

2018

Gregory Rowland Evans

Cthar

for two cellos

Gregory Rowland Evans

$\frac{4}{4}$ ♩ = 60

$\frac{5}{4}$

Bow Hand

Violoncello I

Left Hand

Bow Hand

Violoncello II

Left Hand

$\frac{3}{4}$

B.H.

ve.I

L.H.

B.H.

ve.II

L.H.

$\frac{3}{4}$

Cthar -1- Evans

[illegible]

5/4

ord. ... sp.

mp

V

ord.

st.

3.5

17.35

mp

mf

p

11

4/4

B.H.

vc.I

L.H.

B.H.

vc.II

L.H.

V

3 5 4 5 3 5 1 5 4 5 2 5 4 5 1 5 3 5 1 5 3 5

msp.

5.4

17.10

ord.

13.12

mf

[illegible][illegible]

25 $\frac{5}{4}$ C $\frac{4}{4}$

B.H. $\frac{5}{4}$ $\frac{4}{4}$

ve.I st. - ord. sp. -

L.H. $\frac{5}{4}$ $\frac{4}{4}$

B.H. $\frac{5}{4}$ $\frac{4}{4}$

ve.II ord. - msp. ord. - st.

L.H. $\frac{5}{4}$ $\frac{4}{4}$

mp *ff* *mf* *p* *sp*

27 $\frac{3}{4}$ $\frac{4}{4}$

B.H. $\frac{3}{4}$ $\frac{4}{4}$

ve.I ord. - msp. ord.

L.H. $\frac{3}{4}$ $\frac{4}{4}$

B.H. $\frac{3}{4}$ $\frac{4}{4}$

ve.II ord. - sp. ord.

L.H. $\frac{3}{4}$ $\frac{4}{4}$

p *mp* *mf* *ff*

[illegible][illegible]

33 $\frac{5}{4}$ ①

B.H. $\begin{matrix} V \\ 4 \\ 5 \end{matrix} \begin{matrix} 2 \\ 5 \end{matrix} \begin{matrix} V \\ 4 \\ 5 \end{matrix} \begin{matrix} 2 \\ 5 \end{matrix} \begin{matrix} V \\ 1 \\ 5 \end{matrix} \begin{matrix} 4 \\ 5 \end{matrix} \begin{matrix} V \\ 4 \\ 5 \end{matrix} \begin{matrix} 3 \\ 5 \end{matrix} \begin{matrix} 4 \\ 5 \end{matrix}$
 st. - - ord.

ve.I $\begin{matrix} V \\ 1 \\ 5 \end{matrix} \begin{matrix} 2 \\ 5 \end{matrix} \begin{matrix} V \\ 1 \\ 5 \end{matrix} \begin{matrix} 4 \\ 5 \end{matrix}$
 sp. - - mp.

L.H. $\begin{matrix} 8 \text{ str.} \dots \dots \dots \end{matrix}$
 mp 7.6 ff

B.H. $\begin{matrix} V \\ 4 \\ 5 \end{matrix} \begin{matrix} 1 \\ 5 \end{matrix} \begin{matrix} 2 \\ 5 \end{matrix} \begin{matrix} V \\ 1 \\ 5 \end{matrix} \begin{matrix} 4 \\ 5 \end{matrix}$
 3.6 st.

ve.II ord. - - mp.

L.H. ff mp 11.12

35 $\frac{3}{4}$ $\frac{3}{4}$

B.H. $\begin{matrix} V \\ 1 \\ 5 \end{matrix} \begin{matrix} 4 \\ 5 \end{matrix} \begin{matrix} V \\ 1 \\ 5 \end{matrix} \begin{matrix} 4 \\ 5 \end{matrix}$
 ord. - - st.

ve.I 2.4 mp ff

B.H. $\begin{matrix} V \\ 4 \\ 5 \end{matrix} \begin{matrix} 1 \\ 5 \end{matrix} \begin{matrix} 2 \\ 5 \end{matrix} \begin{matrix} V \\ 1 \\ 5 \end{matrix} \begin{matrix} 4 \\ 5 \end{matrix}$
 7.6 sp.

ve.II mp ff

L.H. mp ff

37

The musical score for measures 37-38 of 'The Rose Tree' is presented for four parts: B.H. (Baritone), vc.I (Violoncello I), L.H. (Left Hand), and vc.II (Violoncello II). The score is divided into two systems. The first system covers measures 37 and the beginning of measure 38. The second system covers the remainder of measure 38. The B.H. part features a vocal line with lyrics 'The Rose Tree' and a piano accompaniment. The vc.I and L.H. parts provide a continuous accompaniment. The vc.II part also provides a continuous accompaniment. The score includes various musical notations such as notes, rests, and dynamic markings like 'mf' and 'sp'.

41 $\frac{5}{4}$ $\frac{4}{4}$

B.H. $\frac{5}{4}$ $\frac{4}{4}$

ve.I $\frac{5}{4}$ $\frac{4}{4}$

L.H. $\frac{5}{4}$ $\frac{4}{4}$

B.H. $\frac{5}{4}$ $\frac{4}{4}$

ve.II $\frac{5}{4}$ $\frac{4}{4}$

L.H. $\frac{5}{4}$ $\frac{4}{4}$

mp *ff* *ff* *ff*

ord. *ord.* *ord.* *ord.*

9.8 *7.8* *11.11* *7.8*

43 $\frac{5}{4}$ $\frac{4}{4}$

B.H. $\frac{5}{4}$ $\frac{4}{4}$

ve.I $\frac{5}{4}$ $\frac{4}{4}$

L.H. $\frac{5}{4}$ $\frac{4}{4}$

B.H. $\frac{5}{4}$ $\frac{4}{4}$

ve.II $\frac{5}{4}$ $\frac{4}{4}$

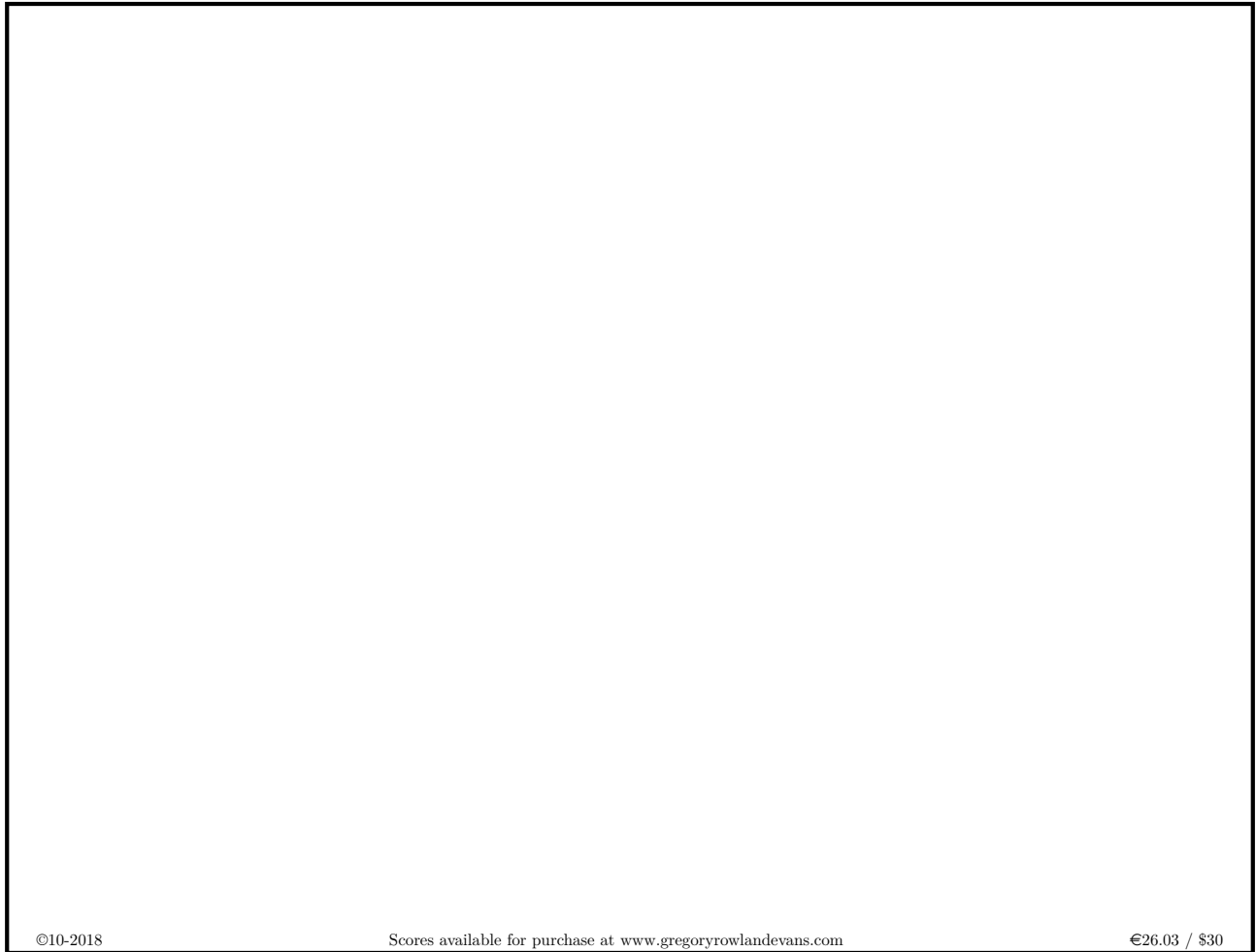
L.H. $\frac{5}{4}$ $\frac{4}{4}$

mf *mf* *mp* *ff* *p* *mp*

ord. *ord.* *ord.* *ord.* *ord.* *ord.*

9.8 *7.8* *11.11* *7.8* *6.4* *7.8*

map. *at.* *Stacc.*



B.1.2 TIANSHU (FOR 12 PLAYERS) SCORE

天書

Tianshu

for 12 players

2018

Gregory Rowland Evans

for Ensemble Ibis

天書

Tianshu
for twelve players

Gregory Rowland Evans

4 $\frac{3}{4}$ $\frac{4}{4}$ $\frac{4}{4}$

fl. mf fff mf

cl. mf mp ff p

basn. fff mp

4 $\frac{3}{4}$ $\frac{4}{4}$ $\frac{4}{4}$

hr. mp ff p

trp. fff mf

trmb. fff mp

tb. mp ff p

4 $\frac{3}{4}$ $\frac{4}{4}$ $\frac{4}{4}$

vln. I fff mf

vln. II mf mp p

vla. mf mp ff p

vc. mp

cb. mp ff p

-2-

7 $\frac{4}{4}$ $\frac{4}{4}$ ① $\frac{5}{4}$

fl. mp ff p mp

cl. mp

basn. ff p ff mf

7 $\frac{4}{4}$ $\frac{4}{4}$ ① $\frac{5}{4}$

hr. mp

trp. mp ff p mp

trmb. ff mp

tb. mp ff mf

7 $\frac{4}{4}$ $\frac{4}{4}$ ① $\frac{5}{4}$

vin.I mp ff mp

vin.II mp

vla. mp ff mf

vc. ff mp

cb. mp

13:12

3:4

10 $\frac{5}{4}$ $\frac{3}{4}$ $\frac{3}{4}$

fl. fff 17.10 mf mp 5.4 ff p

cl. p fff 9.8

basn. mp 5.4 fff 11.12 mf

10 $\frac{5}{4}$ $\frac{3}{4}$ $\frac{3}{4}$

hr. fff 5.4 mf p mp

trp. fff 15.16 mf mp 5.4 ff p

trmb. mp ff fff 5.4 mf

tb. fff 9.8 mf p mp

10 $\frac{5}{4}$ $\frac{3}{4}$ $\frac{3}{4}$

vin. I fff 17.16 mf mp 3.4 ff p

vin. II p fff 3.2

vla. p fff 5.4

vc. mp ff fff 2.4 mf

cb. p mp

13 $\frac{4}{4}$ $\frac{4}{4}$ $\frac{5}{4}$

fl. mp mp ff mf

cl. mf mp ff p

bsn. mp mp ff ff mf

13 $\frac{4}{4}$ $\frac{4}{4}$ $\frac{5}{4}$

hr. mp ff mf

trp. mp mf

trmb. p mp ff

tb. mp ff

13 $\frac{4}{4}$ $\frac{4}{4}$ $\frac{5}{4}$

vln. I mp ff mf

vln. II mf mp ff mp

vla. mf mp ff mp

vc. p mp ff ff

cb. mp ff ff mf

-5-

16 $\frac{5}{4}$ $\frac{3}{4}$ ③ $\frac{3}{4}$

fl. $mp \rightarrow ff$ p mp

cl. $fff \rightarrow mf$ mp ff

bsan. 7.8 mf p mp 11.12 ff

16 $\frac{5}{4}$ $\frac{3}{4}$ ③ $\frac{3}{4}$

hr. p mp mp ff

trp. 2.4 mp ff p mp

trmb. mf mp mp ff

tb. p mp mp ff

16 $\frac{5}{4}$ $\frac{3}{4}$ ③ $\frac{3}{4}$

vln. I mp ff p mp

vln. II $fff \rightarrow mf$ mp 7.8 ff

vla. $8.9 \dots \dots \dots$ fff mf mp 7.8 ff

vc. 9.8 mf mp mp ff

cb. p mp mp ff

[illegible]

23 $\frac{4}{4}$ C $\frac{3}{4}$ $\frac{5}{4}$

fl. mp fff mf mp

cl. mp fff mf mp

bas. mp fff mf

23 $\frac{4}{4}$ C $\frac{3}{4}$ $\frac{5}{4}$

hr. fff mf p

trp. mp fff mf mp

trmb. mp fff mf

tb. fff mf p

23 $\frac{4}{4}$ C $\frac{3}{4}$ $\frac{5}{4}$

vin. I mp mp

vin. II mp fff mf mp

vla. mp mp

vc. mp fff mf

cb. fff mf p

8va

7.12 11.12 5.4 11.12 5.4

29 $\frac{3}{4}$ $\frac{3}{4}$ ① $\frac{4}{4}$

fl. mp fff mf p

cl. mp mp

basn. mp fff p p

29 $\frac{3}{4}$ $\frac{3}{4}$ ① $\frac{4}{4}$

hr. fff p p

trp. mp fff mf p

trmb. mp fff mp p

tb. fff mp p

29 $\frac{3}{4}$ $\frac{3}{4}$ ① $\frac{4}{4}$

vln. I mp fff mf p

vln. II mp p

vla. mp p

vc. mp fff mp p

cb. fff mp p

-10-

32 $\frac{5}{4}$ $\frac{4}{4}$

fl. mp p mp p

cl. p p

basn. mp p mp

32 $\frac{5}{4}$ $\frac{4}{4}$

hr. mp p mp p

trp. mp p mp p

trmb. mp p mp

tb. mp p mp p

32 $\frac{5}{4}$ $\frac{4}{4}$

vin. I mp p mp p

vin. II mp p

vla. mp p

vc. mp p mp

cb. mp p mp p

Detailed description: This is a page of a musical score for orchestra, measures 32-35. The score is divided into three systems, each starting with a measure number in a box (32, 32, 32) and a time signature change from 5/4 to 4/4. The instruments are listed on the left: fl. (flute), cl. (clarinet), basn. (bassoon), hr. (horn), trp. (trumpet), trmb. (trombone), tb. (tuba), vin. I (violin I), vin. II (violin II), vla. (viola), vc. (violin), and cb. (cello). The dynamics are indicated by mp (mezzo-piano) and p (piano). The articulation is indicated by accents (>) and slurs. The notation includes stems, beams, and rests. The page number 340 is in the top right corner.

34 $\frac{3}{4}$ $\frac{5}{4}$ (E)

fl. mp fff 0.8

cl. mp $fff > mf$ fff 0.8

bsn. mp fff mf

34 $\frac{3}{4}$ $\frac{5}{4}$ (E)

hr. mp

trp. mp fff

trmb. p fff 21.20 mf

tb. mp

34 $\frac{3}{4}$ $\frac{5}{4}$ (E)

vin.I mp fff 8.00 1

vin.II mp fff 0.8

vla. mp fff 8.00 1

vc. p fff 19.20 mf

cb. mp

36 $\frac{5}{4}$

fl. $\frac{5}{4}$ mf fff mf

cl. $\frac{5}{4}$ mf

basn. $\frac{5}{4}$ fff mf

36 $\frac{5}{4}$

hr. $\frac{5}{4}$ fff mf

trp. $\frac{5}{4}$ mf fff mf

trmb. $\frac{5}{4}$ fff

tb. $\frac{5}{4}$ fff mf

36 $\frac{5}{4}$

vin. I $\frac{5}{4}$ mf fff mf

vin. II $\frac{5}{4}$ mf

vla. $\frac{5}{4}$ mf

vc. $\frac{5}{4}$ fff mf

cb. $\frac{5}{4}$

38 $\frac{5}{4}$ $\frac{4}{4}$

fl.

cl. *fff* *mf*

basn. *fff* 2.4

38 $\frac{5}{4}$ $\frac{4}{4}$

hr. *fff* 17.16 *mf*

trp. *fff* 5.4 *mf*

trmb. *fff* *mf*

tb. *fff* 9.8 15.16 *mf*

38 $\frac{5}{4}$ $\frac{4}{4}$

vln.I *fff* *mf*

vln.II *fff* *mf* 5.4 *fff* *mf*

vla. *fff* *mf* 5.4 *fff* *mf*

vc. *fff* 9.8 *mf*

cb. *fff* 9.8 *mf*

40 $\frac{4}{4}$ F $\frac{5}{4}$

fl. mp ff mp ff

cl. mp ff

bsn. mp ff

40 $\frac{4}{4}$ F $\frac{5}{4}$

hr. mp ff

trp. mp ff

trmb. mp ff

th. mp ff

40 $\frac{4}{4}$ F $\frac{5}{4}$

vn.I mp ff

vn.II mp ff

vla. mp ff

vc. mp ff

cb. mp ff

-15-

42 $\frac{5}{4}$ $\frac{4}{4}$

fl. mp 9.8 ff

cl. mp 7.8 ff mp

bsn. mp ff mp 5.4 ff

42 $\frac{5}{4}$ $\frac{4}{4}$

hr. mp 11.12 ff mp ff

trp. mp 5.4 ff

trmb. mp 17.16 ff

tb. mp ff mp 7.8 ff

42 $\frac{5}{4}$ $\frac{4}{4}$

vin. I mp 8.4 ff mp 3.4 ff

vin. II mp 5.4 ff mp

vla. mp 7.8 ff mp 7.8 ff

vc. mp 11.12 ff

cb. mp 7.8 ff mp 7.8 ff

-16-

44 $\frac{4}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

fl. mp ff mp 7.8 ff

cl. 9.8 ff mp 7.8 ff

bsn. mp 7.8 ff mp

44 $\frac{4}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

hr. mp 5.4 ff mp 7.8

trp. mp 7.8 ff mp ff

trmb. mp 11.12 ff mp ff

tb. mp ff mp 9.8

44 $\frac{4}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

vin.I mp ff mp 5.4 ff

vin.II ff mp 17.16

vla. mp 5.4 ff mp

vc. mp 9.8 ff mp 11.12 ff mp ff

cb. mp 9.8 ff mp 7.8 ff

-17-

47 $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

fl. mp 9.8 ff mp ff

cl. mp ff mp 5.4 ff

bsn. mp 12.12 ff mp 15.16 ff

47 $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

hr. ff mp 5.4 ff mp 15.16 ff

trp. mp 9.8 ff mp 15.16 ff

trmb. mp 12.12 ff mp 15.16 ff

tb. ff mp 7.8 ff

47 $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

vin.I mp 15.16 ff mp $8va$ ff

vin.II ff mp 7.8 ff

vla. ff mp ff mp $8va$ 17.16 ff

vc. mp 12.12 mp 15.16 ff

cb. mp 17.16 ff

-18-

50 $\frac{5}{4}$ $\text{♩} = 90$ $\frac{2}{4}$ $\frac{4}{4}$

fl. mf p mf p

cl. mf p mf

basn. mf p

50 $\frac{5}{4}$ $\frac{2}{4}$ $\frac{4}{4}$

hr. mf p mp

trp. mf p

trmb. mf p

tb. mf p mp

50 $\frac{5}{4}$ $\frac{2}{4}$ $\frac{4}{4}$

vin. I mf p mp

vin. II mf p mp

vla. mf p mp

vc. mf p

cb. mf p

53 $\frac{3}{4}$ $\frac{4}{4}$ $\frac{4}{4}$

fl. mp mf

cl. mp pp ff 3.2

basn. mf pp

53 $\frac{3}{4}$ $\frac{4}{4}$ $\frac{4}{4}$

hr. pp ff 3.2

trp. mf

trmb. mf pp

tb. pp ff 3.2 5.4 mf

53 $\frac{3}{4}$ $\frac{4}{4}$ $\frac{4}{4}$

vln. I mp

vln. II mf pp ff 3.2 mf 5.4

vla. mf pp ff 3.2 mf 5.4

vc. mp pp 3.2

cb. pp ff 3.2 mf 5.4

56 $\frac{4}{4}$ $\frac{4}{4}$ G

fl. pp ff mf 12.12

cl. mf 11.12 p

basn. 3.2 ff mf p

56 $\frac{4}{4}$ $\frac{4}{4}$ G

hr. 5.4 mf p

trp. pp 3.2 ff mf 11.12

trmb. 3.2 ff mf

tb. p mf

56 $\frac{4}{4}$ $\frac{4}{4}$ G

vin. I pp ff mf 7.6 p *Sua*

vin. II p 3.2

vla. 11.12 p mp

vc. 3.2 ff mf p

cb. p 3.2

58 $\frac{5}{4}$ $\frac{5}{4}$

fl. p mp

cl. mf p

basn. mp mf pp ff mp mf

58 $\frac{5}{4}$ $\frac{5}{4}$

hr. mf

trp. p mp

trmb. pp ff mp mf

tb. mp

58 $\frac{5}{4}$ $\frac{5}{4}$

vin.I mf mf

vin.II mf p

vla. mf mf p

vc. pp ff mp mf

cb. mp

60 $\frac{3}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

fl. pp ff mf p

cl. mf mp pp ff

basn. mp mf

60 $\frac{3}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

hr. mf p

trp. pp ff mf p

trmb. mp mf p

tb. mf p

60 $\frac{3}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

vin.I pp ff mf p

vin.II mp mf pp ff

vla. mp mf pp ff

vc. mf mf p

cb. mf p

-23-

63 $\frac{4}{4}$ $\frac{5}{4}$

fl. mp mf

cl. mf p 17.16

basn. pp ff mf

63 $\frac{4}{4}$ $\frac{5}{4}$

hr. pp ff mp

trp. mp mf

trmb. pp ff mf

tb. pp ff mf

63 $\frac{4}{4}$ $\frac{5}{4}$

vin. I mp mf

vin. II

vla. mf p 17.16

vc. pp ff mp

cb. pp ff mf

65 $\frac{5}{4}$ $\frac{3}{4}$ (H) $\frac{3}{4}$

fl. pp ff mf p

cl. mf pp

bsn. mp mf p pp ff

65 $\frac{5}{4}$ $\frac{3}{4}$ (H) $\frac{3}{4}$

hr. mf p pp ff

trp. pp ff mf p

trmb. mp mf p pp ff

tb. mf p pp ff

65 $\frac{5}{4}$ $\frac{3}{4}$ (H) $\frac{3}{4}$

vin.I pp ff mf p

vin.II mp pp

vla. mp pp

vc. mf mf p pp ff

cb. mf p pp ff

-25-

68 $\frac{2}{4}$ $\frac{3}{4}$ $\frac{4}{4}$ $\frac{3}{4}$

fl. mf mp pp ff mf

cl. ff mp mf mf

basn. mf p mf mp

68 $\frac{2}{4}$ $\frac{3}{4}$ $\frac{4}{4}$ $\frac{3}{4}$

hr. mf mp pp ff

trp. mf mp pp ff mf

trmb. mf p mf mp

tb. mp mf pp ff

68 $\frac{2}{4}$ $\frac{3}{4}$ $\frac{4}{4}$ $\frac{3}{4}$

vln. I mp mp pp ff

vln. II ff mf mp mf

vla. ff mf mp mf

vc. mf p mp mp

cb. mp mf pp ff

72 $\frac{4}{4}$ ① $\frac{3}{4}$ $\frac{5}{4}$

fl. $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

cl. $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

bsn. $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

hr. $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

trp. $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

trmb. $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

th. $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

vln. I $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

vln. II $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

vla. $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

vc. $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

cb. $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

-27-

75 $\frac{3}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

fl. mf ff mf

cl. ff mf mf

basn. p mp mf

76 $\frac{3}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

hr. mf pp ff

trp. ff mf

trmb. mp mf

tb. mp pp ff

77 $\frac{3}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

vln. I ff mf

vln. II ff mp mf

vla. ff mp

vc. mp mf

cb. mp pp ff

Stacc.

81 $\frac{5}{4}$ $\frac{4}{4}$ $\frac{3}{4}$

fl. mf p mf p mf p

cl. mf p mf p mp

basn. p mf p mf p

81 $\frac{5}{4}$ $\frac{4}{4}$ $\frac{3}{4}$

hr. p mf p mf p

trp. p mf p mf p

trmb. mf p mf p mf p

tb. p mf p mf p

81 $\frac{5}{4}$ $\frac{4}{4}$ $\frac{3}{4}$

vin. I. p mf p mf p

vin. II. mf p mf p mf

vla. mf p mf p mf

vc. p mf p mf p

cb. p mf p mf p

-30-

84 $\frac{5}{4}$ $\textcircled{\text{K}}$ $\frac{5}{4}$

fl. *mp* *mf*

cl. *mf* *mp*

basn. *mp*

84 $\frac{5}{4}$ $\textcircled{\text{K}}$ $\frac{5}{4}$

hr. *mp* *mf*

trp. *mp* *mf*

trmb. *mp*

tb. *mp* *mf*

84 $\frac{5}{4}$ $\textcircled{\text{K}}$ $\frac{5}{4}$

vln. I *mp* *mf*

vln. II *mp* *mp*

vla. *mp* *mp*

vc. *mp*

cb. *mp* *mf*

86 $\frac{5}{4}$ $\frac{5}{4}$

fl. mp

cl. mp mf

basn. mp mf

86 $\frac{5}{4}$ $\frac{5}{4}$

hr. mf

trp. mp

trmb. mp mf

tb. mp

86 $\frac{5}{4}$ $\frac{5}{4}$

vin. I mp

vin. II mp mf

vla. mp mf

vc. mp mf

cb. mp

88 $\frac{4}{4}$ $\frac{4}{4}$ ①

fl. mp pp ff

cl. mp

basn. mf pp ff

88 $\frac{4}{4}$ ①

hr. mp pp ff

trp. mp pp ff

trmb. mf pp ff

tb. mf

88 $\frac{4}{4}$ ①

vin. I mf pp ff

vin. II mf

vla. mf pp

vc. mp pp ff

cb. mf pp

90 $\frac{5}{4}$ $\frac{5}{4}$

fl. pp ff pp ff

cl. pp ff pp ff

basn. ff pp ff

90 $\frac{5}{4}$ $\frac{5}{4}$

hr. ff pp ff

trp. pp ff pp ff

trmb. pp ff pp ff

tb. pp ff pp ff

90 $\frac{5}{4}$ $\frac{5}{4}$

vin. I pp ff pp ff *Sua...*

vin. II pp ff pp ff

vla. ff pp ff

vc. pp ff pp

cb. ff pp ff

92 $\frac{4}{4}$ $\frac{4}{4}$ $\frac{3}{4}$

fl. pp ff pp ff

cl. pp ff pp ff

basn. pp ff pp ff

92 $\frac{4}{4}$ $\frac{4}{4}$ $\frac{3}{4}$

hr. pp ff pp ff

trp. pp ff pp ff

trmb. pp ff pp ff

tb. pp ff pp ff

92 $\frac{4}{4}$ $\frac{4}{4}$ $\frac{3}{4}$

vln. I. pp ff pp ff

vln. II. pp ff pp ff

vla. pp ff pp ff

vc. pp ff pp ff

cb. pp ff pp ff

95 $\frac{4}{4}$ $\frac{4}{4}$ $\frac{3}{4}$

fl. ff pp ff

cl. ff pp ff pp

basn. pp ff pp ff

95 $\frac{4}{4}$ $\frac{4}{4}$ $\frac{3}{4}$

hr. pp ff pp

trp. pp ff pp ff

trmb. pp ff

tb. pp ff pp

95 $\frac{4}{4}$ $\frac{4}{4}$ $\frac{3}{4}$

Viol. I ff pp ff

Viol. II pp ff pp

Vla. pp ff pp ff

vc. ff pp ff pp

cb. pp ff pp

98 $\frac{5}{4}$ $\frac{5}{4}$ $\text{♩} = 60$ $\frac{2}{4}$

fl. pp 3.2 ff mp 13.12 f

cl. 3.2 ff mp 13.12 f

bsn. pp 3.2 ff f

98 $\frac{5}{4}$ $\frac{5}{4}$ $\frac{2}{4}$

hr. 3.2 ff mp 19.20 f

trp. pp 3.2 ff

trmb. pp 3.2 ff

tb. 3.2 ff mp f

98 $\frac{5}{4}$ $\frac{5}{4}$ $\frac{2}{4}$

vin.I pp 3.2 ff f

vin.II 3.2 ff mp 11.12 f

vla. pp 3.2 ff mp f

vc. 3.2 ff

cb. 3.2 ff mp f

[illegible]

104 $\frac{4}{4}$ $\frac{4}{4}$ $\frac{4}{4}$ (M)

fl. mf f mp 11:12

cl. mp 11:12

basn. mf f mp 11:12

104 $\frac{4}{4}$ $\frac{4}{4}$ (M)

hr. mp 5:4 f

trp. mf 11:12

trmb. mf f mp f

tb. mp 5:4 f mf

104 $\frac{4}{4}$ $\frac{4}{4}$ (M)

vl. I mf f mp f

vl. II mp 5:4 f

vla. mp 5:4 f mp

vc. mf f mp f

cb. mp f

107 $\frac{5}{4}$ $\frac{5}{4}$

fl. f mf

cl. mp f

basn. mp mf mp

107 $\frac{5}{4}$ $\frac{5}{4}$

hr. mf

trp. mp

trmb. f mp

tb. mp

107 $\frac{5}{4}$ $\frac{5}{4}$

vin.I mf

vin.II mp f

vla. mf mp 19-20 f

vc. mf mp

cb. mp

109 $\frac{3}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

fl. mf f mp f

cl. mp mf f

basn. mf mp f

109 $\frac{3}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

hr. mp f mp f 11:12

trp. f mf mp f 5:4

trmb. mf mp f 10:12

tb. mp f 7:8

109 $\frac{3}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

vin.I f mf mp f 5:4

vin.II mp mf f

vla. mp mf f

vc. mf mp f 11:12

cb. mp f 9:8

112 $\frac{4}{4}$ $\frac{5}{4}$

fl. mp

cl. mp 17.16

basn. f mp

112 $\frac{4}{4}$ $\frac{5}{4}$

hr. mf mp

trp. mf

trmb. mf mp

tb. mf

112 $\frac{4}{4}$ $\frac{5}{4}$

vin. I mp

vin. II mp 15.16 f

vla. mp f

vc. f mp

cb. mf

114 $\frac{5}{4}$ $\frac{3}{4}$ (N) $\frac{3}{4}$

fl. mf mp f

cl. mf mf mf

bas. mf mp f

114 $\frac{5}{4}$ $\frac{3}{4}$ (N) $\frac{3}{4}$

hr. mp mf

trp. f mp f

trmb. mf mp f

tb. mp f mf

114 $\frac{5}{4}$ $\frac{3}{4}$ (N) $\frac{3}{4}$

vin. I f mp f

vin. II mf mf mf

vla. mf mf mf

vc. mf mp f

cb. mp f

-43-

117 $\frac{2}{4}$ $\frac{3}{4}$ $\frac{4}{4}$ $\frac{3}{4}$

fl. mp mf f mp 3.4

cl. f mp mf mp 3.4

bsn. mp 3.4 mp mf

117 $\frac{2}{4}$ $\frac{3}{4}$ $\frac{4}{4}$ $\frac{3}{4}$

hr. mp mf f

trp. mp mf mf mp 3.4

trmb. mp 7.8 f mp mf

tb. mp mf f

117 $\frac{2}{4}$ $\frac{3}{4}$ $\frac{4}{4}$ $\frac{3}{4}$

vln. I mp mf mf mp 5.4

vln. II f mp mf mp

vla. f mp mf mp 5.4

vc. mp 2.8 f mp mf

cb. mp mf mf

121 $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

fl. f mf mf

cl. f mp mf

bas. mf mp mf

121 $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

hr. mf mp

trp. f mp f

trmb. f mp mf

tb. mp mp f

121 $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

vln. I f mf f

vln. II f mp mf

vla. f mp mf

vc. mf mp mf

cb. mp mp

11-12 19-20 21-20

124 $\frac{3}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

fl. f mp 17.16

cl. mf mp

basn. f mf

124 $\frac{3}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

hr. mp mf

trp. mf mp 15.16

trmb. mp 5.4 f mf

tb. mf mf

124 $\frac{3}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

vin.I mf mp 15.16

vin.II mf mp

vla. mf mp 5.4

vc. mp mp

cb. mf f

127 $\frac{3}{4}$ $\frac{3}{4}$ (P) $\frac{4}{4}$

fl. f mp mf mp 11:12

cl. 9:8 f mp f

basn. mf f mp 9:8 f mp

127 $\frac{3}{4}$ $\frac{3}{4}$ (P) $\frac{4}{4}$

hr. mf mp mp

trp. f mp mf mp 13:12

trmb. mf f mp mp 5:4

tb. mp f mp 9:8

127 $\frac{3}{4}$ $\frac{3}{4}$ (P) $\frac{4}{4}$

vin.I f mp mf mp 13:12

vin.II 7:8 f mp f

vla. 17:16 f mp

vc. mf f mp f 5:4

cb. mp mp f 7:8

130 $\frac{5}{4}$ $\frac{4}{4}$

fl. f mp 13.12 f mp 7.8

cl. mp 15.16 f mp

basn. mp 11.12 mp 13.12 f

130 $\frac{5}{4}$ $\frac{4}{4}$

hr. mp 9.8 mp 7.8 f mp

trp. f mp 11.12 f mp 9.8

trmb. mp 5.4 f

tb. f mp f mp 5.4

130 $\frac{5}{4}$ $\frac{4}{4}$

vin.I f mp 11.12 f mp 9.8

vin.II mp 17.16 f mp

vla. mp f mp 11.12

vc. f mp f

cb. f mp 9.8 f mp

132 $\frac{3}{4}$ $\frac{5}{4}$ Q

fl. f mp

cl. 5.4 f mp

basn. mp f mp

132 $\frac{3}{4}$ $\frac{5}{4}$ Q

hr. 5.8 f

trp. f mp

trmb. mp 7.8 mp

tb. f

132 $\frac{3}{4}$ $\frac{5}{4}$ Q

vln. I f mp

vln. II 3.4 f mp

vla. f mp

vc. mp 5.8 f mp

cb. f

134 $\frac{5}{4}$ $\frac{5}{4}$

fl. *mf* *mp*

cl. *mf*

basn. *mp*

134 $\frac{5}{4}$ $\frac{5}{4}$

hr. *mp*

trp. *mf* *mp*

trmb. *mp*

tb. *mf*

134 $\frac{5}{4}$ $\frac{5}{4}$

vln. I *mf* *mp*

vln. II *mf*

vla. *mf*

vc. *mf*

cb. *mf*

136 $\frac{5}{4}$ $\frac{4}{4}$

fl. mp

cl. mf mp

basn. mf

136 $\frac{5}{4}$ $\frac{4}{4}$

hr. mp mf

trp. mf

trmb. mf

tb. mp mf

136 $\frac{5}{4}$ $\frac{4}{4}$

vln. I mp $\sharp 2$ mp

vln. II mf mp

vla. mf mp

vc. mp

cb. mp mf

138 $\frac{4}{4}$ \textcircled{R} $\frac{5}{4}$

fl. mf f mf

cl. f

basn. f mf

138 $\frac{4}{4}$ \textcircled{R} $\frac{5}{4}$

hr. f mf

trp. f mf

trmb. mf f

th. mf f

138 $\frac{4}{4}$ \textcircled{R} $\frac{5}{4}$

vin. I f mf f

vin. II mf f

vla. f mf mf f

vc. mf f f

cb. mf f

140 $\frac{5}{4}$ $\frac{4}{4}$

fl. f

cl. mf f

basn. mf f

140 $\frac{5}{4}$ $\frac{4}{4}$

hr. mf f

trp. f mf

trmb. mf f

tb. f mf

140 $\frac{5}{4}$ $\frac{4}{4}$

vin. I mf f mf

vin. II f mf f

vla. f mf f

vc. mf f mf

cb. mf f

142 $\frac{4}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

fl. mf f mf f

cl. f mf f

basn. mf f mf

142 $\frac{4}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

hr. mf f mf

trp. f mf

trmb. mf f mf

tb. mf f f

142 $\frac{4}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

vln. I f mf f *Solo*

vln. II mf f mf

vla. mf f

vc. f mf f

cb. f mf f

145 $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

fl. mf f

cl. mf f mf

basn. mf f mf

145 $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

hr. f mf f

trp. f mf f

trmb. mf f mf

tb. mf f mf

145 $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

vln. I mf f

vln. II f mf f

vla. f mf f

vc. mf mf f

cb. mf f mf

148 $\frac{5}{4}$ $\text{♩} = 120$ $\frac{2}{4}$ $\frac{4}{4}$

fl. mf ff ff mf

cl. mf ff ff mf

basn. mf ff ff mf

148 $\frac{5}{4}$ $\frac{2}{4}$ $\frac{4}{4}$

hr. mf ff ff mf

trp. ff

trmb. mf ff

tb. mf ff

148 $\frac{5}{4}$ $\frac{2}{4}$ $\frac{4}{4}$

vin. I mf

vin. II mf ff ff

vla. mf ff ff mf

vc. mf ff

cb. mf ff ff mf

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151 $\frac{3}{4}$ $\frac{4}{4}$ $\frac{4}{4}$

fl. ff mf

cl. ff mf p pp mf

bsn. ff mf p

151 $\frac{3}{4}$ $\frac{4}{4}$ $\frac{4}{4}$

hr. p pp mf

trp. ff mf

trmb. ff mf p

tb. p pp mf

151 $\frac{3}{4}$ $\frac{4}{4}$ $\frac{4}{4}$

vin. I ff mf

vin. II ff mf p pp mf

vla. ff p pp mf

vc. ff mf p

cb. p pp mf

154 $\frac{4}{4}$ $\frac{4}{4}$ S

fl. p pp mf 7.6

cl. ff

bas. pp mf 7.6 ff

154 $\frac{4}{4}$ S

hr. 3.2 ff

trp. p mf

trmb. 5.4 pp mf 5.4 ff

tb. 3.2 ff 17.16 mf

154 $\frac{4}{4}$ S

vin. I 18.12 p pp mf ff

vin. II 3.2 ff

vla. ff ff mf

vc. 3.4 pp mf 7.6 ff

cb. ff

156 $\frac{5}{4}$ $\frac{5}{4}$

fl. ff ff mf $17:10$

cl. mf $11:10$ ff

basn. ff $11:10$ mf p $0:4$ pp ff

156 $\frac{5}{4}$ $\frac{5}{4}$

hr. ff $0:4$ mf

trp. $0:4$ ff ff mf

trmb. p pp ff mf

tb. ff mf

156 $\frac{5}{4}$ $\frac{5}{4}$

vin. I ff $17:10$ mf *Stop*

vin. II mf ff

vla. ff $9:8$ mf mf $11:10$ ff

vc. p pp ff $11:12$ mf

cb. ff

158 $\frac{3}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

fl. p pp mf ff

cl. ff mf $ff > mf$ $p - pp$

bsn. ff mf mf ff

158 $\frac{3}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

hr. mf ff

trp. p pp mf ff

trmb. ff mf mf ff

tb. mf ff

158 $\frac{3}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

vin.I p pp mf ff

vin.II ff mf mf $p - pp$

vla. ff mf $p - pp$

vc. ff mf ff

cb. mf ff

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161 $\frac{4}{4}$ $\frac{5}{4}$

fl. ff mf

cl. mf ff

basn. p pp ff mf

161 $\frac{4}{4}$ $\frac{5}{4}$

hr. p pp ff mf

trp. ff mf

trmb. p pp ff mf

tb. p pp ff

161 $\frac{4}{4}$ $\frac{5}{4}$

vin.I ff mf

vin.II mf ff

vla. mf ff

vc. p pp ff mf

cb. p pp ff mf

-61-

163 $\frac{5}{4}$ $\frac{3}{4}$ ① $\frac{3}{4}$

fl. p pp mf ff

cl. ff mf p pp

bsan. ff mf mf p pp

163 $\frac{5}{4}$ $\frac{3}{4}$ ① $\frac{3}{4}$

hr. mf ff p pp

trp. p pp mf ff

trmb. ff mf mf p pp

tb. mf ff p pp

163 $\frac{5}{4}$ $\frac{3}{4}$ ① $\frac{3}{4}$

vin.I pp mf ff

vin.II ff mf p pp

vla. ff mf p pp

vc. ff mf mf ff p pp

cb. mf ff p pp

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166 $\frac{2}{4}$ $\frac{3}{4}$ $\frac{4}{4}$ $\frac{3}{4}$

fl. ff mf ff mf p pp mf

cl. ff mf mf

bsn. mf ff ff mf

166 $\frac{2}{4}$ $\frac{3}{4}$ $\frac{4}{4}$ $\frac{3}{4}$

hr. ff mf ff mf p pp mf

trp. ff mf ff mf p pp mf

trmb. mf ff ff mf ff mf

tb. ff mf p pp

166 $\frac{2}{4}$ $\frac{3}{4}$ $\frac{4}{4}$ $\frac{3}{4}$

vin. I ff mf ff mf p pp mf

vin. II p pp ff mf ff mf mf

vla. p pp ff mf ff mf mf

vc. mf ff ff mf ff mf

cb. ff mf ff mf p pp

8va.....

7.8 9.8 11.12 13.12 3.4 3.4 7.8 9.8 11.12 13.12 3.4 3.4 7.8 9.8 11.12 13.12 3.4 3.4 7.8 9.8 11.12 13.12 3.4 3.4

170 $\frac{4}{4}$ ① $\frac{3}{4}$ $\frac{5}{4}$

fl. $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

cl. $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

basn. $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

170 $\frac{4}{4}$ ① $\frac{3}{4}$ $\frac{5}{4}$

hr. $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

trp. $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

trmb. $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

tb. $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

170 $\frac{4}{4}$ ① $\frac{3}{4}$ $\frac{5}{4}$

vln. I $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

vln. II $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

vla. $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

vc. $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

cb. $\frac{4}{4}$ $\frac{3}{4}$ $\frac{5}{4}$

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173 $\frac{3}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

fl. pp mf

cl. pp ff mf

basn. mf ff

173 $\frac{3}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

hr. ff mf p pp

trp. pp mf

trmb. mf ff ff mf

tb. ff mf p pp

173 $\frac{3}{4}$ $\frac{3}{4}$ $\frac{4}{4}$

vln. I 7.8 mf 9.8

vln. II 3.4 pp $ff > mf$ mf 3.2

vla. 3.4 pp $ff > mf$ mf

vc. mf ff 11.12 mf

cb. ff 9.4 mf p pp

[illegible]

179 $\frac{5}{4}$ $\frac{4}{4}$

fl. ff mf 5.6 ff mf 5.4

cl. mf ff 5.6

basn. ff mf 3.2 ff 7.6

179 $\frac{5}{4}$ $\frac{4}{4}$

hr. ff mf 5.4 ff mf

trp. ff mf 7.6 ff mf

trmb. ff mf 3.2 ff 7.6

tb. ff mf 5.4 ff mf 3.2

179 $\frac{5}{4}$ $\frac{4}{4}$

vin.I ff mf 7.6 ff mf

vin.II mf ff mf 7.6

vla. mf ff mf 5.6

vc. ff mf 3.2 ff 7.6

cb. ff mf 3.4 ff 5.4 mf 3.2

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181 $\frac{3}{4}$ $\frac{5}{4}$ (W)

fl. ff mf 5.4

cl. ff mf 5.4

bssn. ff mf 21.20

181 $\frac{3}{4}$ $\frac{5}{4}$ (W)

hr. ff

trp. ff mf 19.20

trmb. ff mf 21.20

tb. ff

181 $\frac{3}{4}$ $\frac{5}{4}$ (W)

vin.I ff mf 2.4

vin.II ff mf 5.4

vla. ff mf 5.4

vc. ff mf

cb. ff

Stacc.

183 $\frac{5}{4}$

fl. ff $\xrightarrow{9.8}$ mf

cl. ff $\xrightarrow{11.12}$ mf

basn. ff $\xrightarrow{13.12}$ mf

183 $\frac{5}{4}$

hr. ff $\xrightarrow{13.12}$ mf

trp. ff $\xrightarrow{21.20}$ mf

trmb. ff $\xrightarrow{13.12}$ mf

tb. ff $\xrightarrow{13.12}$ mf

183 $\frac{5}{4}$

vin.I ff $\xrightarrow{9.8}$ mf

vin.II ff $\xrightarrow{11.12}$ mf

vla. ff $\xrightarrow{11.12}$ mf

vc. ff $\xrightarrow{13.12}$ mf

cb. ff $\xrightarrow{11.12}$ mf

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185 $\frac{5}{4}$ $\frac{4}{4}$

fl. ff mf 7.8

cl. ff mf 5.4

basn. ff mf 15.16

185 $\frac{5}{4}$ $\frac{4}{4}$

hr. ff mf 17.16

trp. ff mf

trmb. ff mf 15.16

tb. ff mf 15.16

185 $\frac{5}{4}$ $\frac{4}{4}$

vin.I ff mf 7.8

vin.II ff mf 5.4

vla. ff mf 5.4

vc. ff mf

cb. ff mf 17.16

187 $\frac{4}{4}$ \otimes $\frac{5}{4}$

fl. p 11.12 pp

cl. p pp

basn. p pp

187 $\frac{4}{4}$ \otimes $\frac{5}{4}$

hr. p 5.4 pp

trp. p 15.16 pp

trmb. p 15.16 pp

tb. p 13.12 pp

187 $\frac{4}{4}$ \otimes $\frac{5}{4}$

vl. I p pp

vl. II p

vla. p 5.4 pp

vc. p 13.12 pp

cb. p 9.8 pp

-71-

189 $\frac{5}{4}$ $\frac{4}{4}$

fl. p pp 9.8

cl. p pp 7.8

basn. p pp 5.4

189 $\frac{5}{4}$ $\frac{4}{4}$

hr. p pp 11.12

trp. p pp 5.4

trmb. p pp 17.16

tb. p pp 7.8

189 $\frac{5}{4}$ $\frac{4}{4}$

vin.I p pp

vin.II p pp 5.4

vla. p pp 7.8

vc. p pp 11.12

cb. p pp 7.8

[illegible]

194 $\frac{4}{4}$ $\frac{3}{4}$ $\frac{9}{8}$

fl. p pp p pp

cl. p p pp

bsn. p pp p pp

194 $\frac{4}{4}$ $\frac{3}{4}$ $\frac{9}{8}$

hr. pp p pp p pp

trp. p pp p pp

trmb. p pp p pp

tb. pp p pp

194 $\frac{4}{4}$ $\frac{3}{4}$ $\frac{9}{8}$

vin. I p pp p pp

vin. II pp p pp

vla. pp p pp

vc. p pp p pp

cb. p pp

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Other scores from Gregory Rowland Evans include:

UNACCOMPANIED	CHAMBER	ELECTROACOUSTIC	ORCHESTRAL
Five Excuses (for cello alone)	String Trio no.1	Bewegt die Erde:	Arquitectura 11611
Five Excuses (for piano alone)	Violin Concerto	B.E.vi : Ohrenquellen (for violin)	Metamorphoses (after Illouz)
Epiphora (for solo cello)	Five Excuses (for string trio)	B.E.vii : Staub (for laptop ensemble)	GUERRERO (12 saxophones)
Five Excuses (for xiao alone)	Adumbration "String Trio 2"	B.E.i : NGC 3370 (for percussion trio)	
	Hamon shū "String Quartet 1"	B.E.ii : Carinanchel (for viola)	
		B.E.iii : Arborealkartographie (for cello)	
		Sidereus Nuncius (for oboe)	

B.1.3 FOUR AGES OF SAND (FOR FLUTE, ALTO SAXOPHONE, AND VIOLONCELLO) SCORE

Four *Ages* of Sand

for Flute, Alto Saxophone, and Violoncello

2018

Gregory Rowland Evans

FOREWORD

"Four Ages of Sand" is the title and theme of a lecture given by Douglas Adams, outlining the history of humanity's awareness of their surroundings, leading to the present day where much of biological functions can be modeled computationally. The silicon chip is the fourth age of sand.

(G.R.E.)

PERFORMANCE NOTES

Accidentals apply only to the pitch which they immediately precede.

c.2'30"

Four Ages of Sand

for flute, saxophone, and violoncello

Gregory Rowland Evans

$\text{♩} = 60$

Flute

Saxophone

Violoncello

9:8

6

5:4

13:12

mf *p* *mf* *ff* *ff* *mp* *mf*

mf *p*

3

fl.

sx.

vc.

5/4

4/4

9:8

13:12

mf *ff* *ff* *mp* *ff* *mp* *mf* *p*

mf *ff* *ff* *mp* *mf* *p*

mf *p* *mf* *ff* *ff* *mp* *mf* *p*

5

fl.

sx.

vc.

6

3

4/4

15:16

13:12

9:8

21:20

mf *p* *mf* *ff* *mp* *mf* *ff* *p*

mf *ff* *mp* *mf* *ff* *mp* *mf* *p*

mf *ff* *mp* *mf* *ff* *mp* *mf* *p*

8

3/4 5/8 4/4

fl. *mf* *ff* *ff* *9:10*

sx. *ff* *mp* *mf* *p* *mf* *ff*

vc. *mf* *ff* *mf* *p* *ff* *ff* *mp*

11

11/8 9/8

fl. *mf* *p* *mf* *ff* *7:6*

sx. *ff* *5:6* *mp* *mf* *15:16* *p* *f* *mp* *fff* *7:8* *mf*

vc. *mf* *11:12* *mf* *7:8* *ff*

13

8/8 5/4

fl. *f* *mp* *fff* *mf* *7:6*

sx. *f* *5:6* *mp* *fff* *mf*

vc. *f* *5:6* *mp* *fff* *mf*

15

4/4 6/8 3/8

fl. *pp* *3:4* *f* *mp* *fff* *7:8* *mf* *pp* *mf* *5:4*

sx. *pp* *11:10* *mf* *f* *mp* *fff* *mf*

vc. *f* *mp*

18

18

4/4

9:10

3/4

fl.

9:10

mp

fff

mf

sx.

9:8

mp

fff

vc.

13:12

fff

mf

pp

mf

20

20

5/8

4/4

fl.

f

mp

fff

mf

3:2

pp

7:8

mf

sx.

pp

< mf

vc.

9:8

f

mp

fff

mf

22

22

11/8

fl.

f

7:6

mp

fff

mf

sx.

f

mp

fff

5:6

mf

vc.

pp

< mf

f

mp

23

23

9/8

8/8

fl.

p

mp

sx.

vc.

7:6

p

mp

fff

9:8

mf

mp

< ff

p

mp

25

Measures 25-26: Flute (fl.) has a melodic line starting at measure 25 with a 9:8 ratio. Saxophone (sx.) and Violoncello (vc.) provide harmonic support. Dynamics include *fff* and *mf*.

Measures 27-28: Flute (fl.) has a melodic line starting at measure 27 with a 7:6 ratio. Saxophone (sx.) and Violoncello (vc.) provide harmonic support. Dynamics include *p*, *mp*, *fff*, and *mf*.

Measures 29-30: Flute (fl.) has a melodic line starting at measure 29 with a 7:6 ratio. Saxophone (sx.) and Violoncello (vc.) provide harmonic support. Dynamics include *fff* and *mf*.

26

Measures 31-32: Flute (fl.) has a melodic line starting at measure 31 with a 7:6 ratio. Saxophone (sx.) and Violoncello (vc.) provide harmonic support. Dynamics include *mp*, *fff*, and *mf*.

Measures 33-34: Flute (fl.) has a melodic line starting at measure 33 with a 7:6 ratio. Saxophone (sx.) and Violoncello (vc.) provide harmonic support. Dynamics include *p*, *mp*, *fff*, and *mf*.

Measures 35-36: Flute (fl.) has a melodic line starting at measure 35 with a 7:6 ratio. Saxophone (sx.) and Violoncello (vc.) provide harmonic support. Dynamics include *fff* and *mf*.

28

Measures 37-38: Flute (fl.) has a melodic line starting at measure 37 with a 7:6 ratio. Saxophone (sx.) and Violoncello (vc.) provide harmonic support. Dynamics include *fff* and *mf*.

Measures 39-40: Flute (fl.) has a melodic line starting at measure 39 with a 7:6 ratio. Saxophone (sx.) and Violoncello (vc.) provide harmonic support. Dynamics include *mp*, *fff*, and *mf*.

Measures 41-42: Flute (fl.) has a melodic line starting at measure 41 with a 7:6 ratio. Saxophone (sx.) and Violoncello (vc.) provide harmonic support. Dynamics include *fff* and *mf*.

31

Measures 43-44: Flute (fl.) has a melodic line starting at measure 43 with a 9:10 ratio. Saxophone (sx.) and Violoncello (vc.) provide harmonic support. Dynamics include *p*, *mp*, *fff*, and *mf*.

Measures 45-46: Flute (fl.) has a melodic line starting at measure 45 with a 9:10 ratio. Saxophone (sx.) and Violoncello (vc.) provide harmonic support. Dynamics include *fff* and *mf*.

Measures 47-48: Flute (fl.) has a melodic line starting at measure 47 with a 9:10 ratio. Saxophone (sx.) and Violoncello (vc.) provide harmonic support. Dynamics include *fff* and *mf*.

33

11

fl. *mp* *p* 7:8 *mp*

sx. *p* *mp* *fff* *mf*

vc. *p* 7:6 *mp* *fff* 7:6 *mf*

34

fl. *p* *mp* *fff* 9:8 *mf* *mp* 5:4 *fff* *p* 13:12

sx. *p* 13:12 *mp*

vc. *p* 13:12 *mp*

36

fl. *fff* *mf*

sx. *fff* *mf*

vc. 13:12 9:8 *p* *mp* *fff* *mf*

37

Fl. $\frac{4}{4}$ $\frac{6}{8}$

SX.

Vc.

mp *ff* *p* *mp* *fff* *mf*

39

Fl. $\frac{3}{8}$ $\frac{4}{4}$ $\frac{3}{4}$

SX.

Vc.

fff *mf* *p* *15:16* *mp* *fff* *11:12* *mf* *mp* *fff* *3:4* *mf* *19:20* *mp* *fff* *3:4* *mf*

42

Fl. $\frac{3}{8}$ $\frac{4}{4}$

SX.

Vc.

p *15:16* *mp* *fff* *3:4* *mf* *fff* *mp* *fff* *mf*

44

Fl. $\frac{11}{8}$

SX.

Vc.

p *5:6* *fff* *7:6* *mf* *mp* *fff* *9:8* *mf* *13:12* *mp*

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Colophon

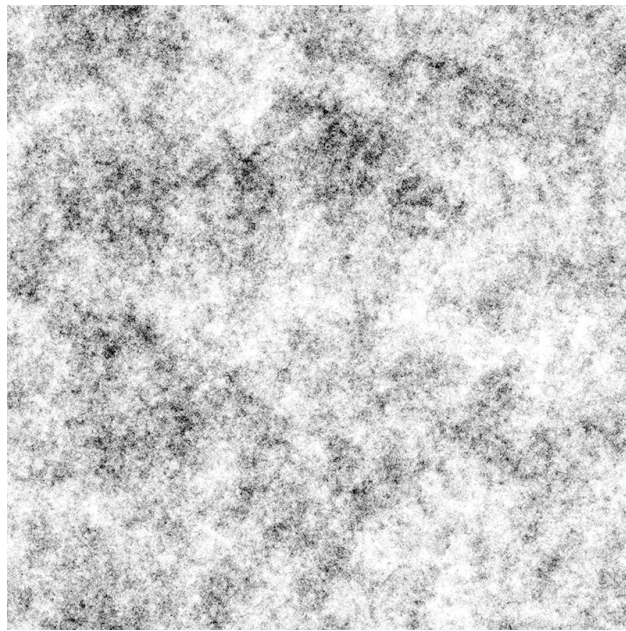


Figure B.1.1: A 2-dimensional random walk of 1000 iterations by Paul Bourke.

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