

# Math, Music and Identity

## Research Paper

**Due: Friday, April 10**

For this assignment, you will investigate one composer and a particular piece (or set of pieces) written by that composer demonstrating some mathematical concept or technique. Roughly half of your paper should focus on historical aspects: biographical information about the composer's life, type of music they wrote, how your particular piece fits within their collected works, background information about your piece, etc. The other half of your paper should be a thorough, mathematical analysis of the piece (or set of pieces) of music. This analysis can be your own interpretation of another scholarly work and/or may involve your own investigations based on concepts we have discussed in class.

If you are writing about a composer we have discussed in class, you are welcome to use my lecture notes on the course webpage as a model of the type of analysis I am looking for. The primary textbook for the course is also an excellent source demonstrating the type of in-depth analysis expected in your paper. You are encouraged to meet with me if you are having trouble with the analysis portion of your paper.

You should be as specific as possible in your analysis. For example, instead of writing, "Bach uses lots of inversions in the top two voice parts," a more precise analysis would read, "Bach employs an inversion about middle C in the top two voice parts from measures 35 - 40, although this inversion is not an exact horizontal reflection; it remains within the key of G major." At the same time, it would be boring to read two pages full of sentences such as the previous one. Your goal is to write an analysis that is thorough but also presents the information in a way that is readable and understandable. Topic sentences and summarizing statements will be quite useful toward that aim.

The paper should be 6–8 double-spaced pages in length, not including your appendix or bibliography. This is intended to be a research paper, so you are required to use at least four scholarly sources (historical, mathematical, musical, etc.) Although Wikipedia is useful for background information or links to other sources, it does not count as a legitimate source. The staff in the music library can assist you with finding good sources. Be sure to read your paper over carefully several times before submitting it. The quality of your writing is very important and will factor into your overall grade. It is recommended that you have a classmate read a draft version of your paper and that you seek out assistance from the Writer's Workshop if necessary.

**Important:** Be sure to include an appendix at the end of your paper with at least a few pages of the musical score you analyzed and are discussing. I expect you to refer directly to the music in your appendix (or you can include it within the flow of your paper if that works). Do not assume that I have the score of the music you are discussing in front of me. I will want to see the music so that I can check some of your analysis.

All of your sources should be listed at the end of your paper in a bibliography, whether you quote from them directly or not. You should follow the guidelines below for citing sources, making sure to be consistent throughout your paper and within the bibliography itself.

1. Identify direct quotations with quotes and a note in parentheses after the quote, e.g., (Diamond, p. 235), giving information where the quote can be found within your source.
2. If you are paraphrasing or summarizing information from a source but do not use a direct quote, you should still include a reference to that source in the text using either a number or some form of the author's last name. For example, you might end a sentence with [6], [Dia] or [Diamond] to indicate that the ideas being currently presented come from source #6 in your bibliography or from the source written by Diamond. Be sure to distinguish between multiple sources written by the same author.
3. List all your sources in a Bibliography at the end of your paper:
  - a) Books: give the author, the title, the publisher, and year of publication.
  - b) Journal, magazine or newspaper articles: give the author, the title of the article, the title of the journal, magazine or newspaper, the date (or year) of publication, and the starting and final page of the specific article.
  - c) Encyclopedias: give the author (if given), the name of the article, the name of the reference book, the edition, the year of publication, and the starting and final page of the specific article.
  - d) Websites: give an author (if you can determine that), the full URL (Internet address), and the date you accessed it (since information on the Internet often changes).

## Deadlines:

- Friday, February 27: Submit the name of your composer, the piece or pieces of music you will be analyzing, and a few sources.
- Monday, March 30: Submit an opening paragraph and a detailed outline of your research paper.
- Friday, April 10: Research Paper due at the start of class.

## Composers:

Below is a list of possible composers for your paper, including some suggested pieces for study or topics to investigate, and, in some cases, a relevant source. Many of these composers are discussed in the course textbook. Feel free to suggest your own composer or musical group.

1. Milton Babbitt
  - *Composition for Four Instruments; Three Compositions for Piano*
  - Extension of Schoenberg's twelve-tone method to include rhythm and timbre
  - Book: *The Math Behind the Music* by Leon Harkleroad (see pp. 51–54)

## 2. Johann Sebastian Bach

- *The Musical Offering; The Well-Tempered Clavier*; (see Section 5.1)

## 3. Béla Bartók

- *Mikrokosmos*, Book 6, BB 105: No. 141, *Subject and Reflection*
- *Music for Strings, Percussion and Celesta*; use of the Golden Section and Fibonacci Numbers; (see Section 5.2)
- Book: *Béla Bartók: An Analysis of His Music* by Ernő Lendvai
- Article: “Bartók, Lendvai and the Principles of Proportional Analysis,” by Roy Howat, *Music Analysis*, Vol. 2, No. 1 (Mar., 1983), pp. 69–95

## 4. Wendy Carlos

- *Beauty in the Beast*; electronic music in non-traditional tunings, e.g., just intonation

## 5. Peter Maxwell Davies

- *Ave Maris Stella; A Mirror of Whitening Light*
- Use of magic squares (see Section 8.1). Composer’s website: <http://www.maxopus.com/>

## 6. Claude Debussy

- *La Mer* (Use of the Golden Section?)
- Book: *Debussy in Proportion: A Musical Analysis* by Roy Howat

## 7. Joseph Haydn

- Famous retrograde in the “Minuet and Trio” from his *Piano Sonata in A major* (Landon No. 41, Hob. XVI/26; see Section 5.1).

## 8. Paul Hindemith

- *Ludus Tonalis* (“Game of Tones”; see Section 5.1)

## 9. Sarah Hopkins

- *Return to Joy*; harmonic overtone singing, Australian landscapes, Harmonic Whirlies (more overtones), handbells
- Composer’s website: <http://www.sarahhopkins.com/bio>

10. György Ligeti
  - *Études for piano*, Book I and II; influence of fractal geometry on his music
  - Article: “Fractal dimension analysis of complexity in Ligeti piano pieces” by Rolf Bader, *Acoustical Society of America Journal*, Vol. 117, No. 4 (2005), pp. 2477–2477
11. Cindy McTee
  - *Einstein’s Dream*; *Circle Music I-IV*; Composer’s website: <http://www.cindymctee.com/>
12. Oliver Messiaen
  - Use of symmetry in time and pitch, non-retrogradable rhythms, and modes of limited transposition
  - *Quatuor pour la fin du temps* (“Quartet for the End of Time”)
13. Wolfgang Amadeus Mozart
  - *Musikalisches Würfelspiel* (“Musical Dice Game”)
  - The Golden Section in his piano sonatas? Article: “The Golden Section and the Piano Sonatas of Mozart” by John F. Putz, *Mathematics Magazine*, Vol. 68, No. 4 (1995), pp. 275–282
14. Tristan Murail
  - *Désintégrations* – “spectral” technique, decomposition of sound using computers and mathematics. Prof. Christopher Arrell (Music Dept.) is an expert in spectral music.
  - Composer’s website: <http://www.tristanmurail.com/en/index.html>
15. Steve Reich
  - *Four Organs*; the use of simple phase shifting to create entire pieces
  - *Clapping Music* (see Section 8.2). Article: “Clapping Music – A Combinatorial Problem” by Joel K. Haack, *The College Mathematics Journal*, Vol. 22, No. 3 (1991), pp. 224–227
16. Arnold Schoenberg
  - Twelve-tone method of composition (see Chapter 7)
  - *Piano Suite*, Op. 25; *Pierre Lunaire*, No. 18
17. Iannis Xenakis
  - *Metastasis*; *Pithoprakta*; (see Section 8.3)
  - Book: *Formalized Music: Thought and Mathematics in Composition* by Iannis Xenakis