Classical-Romantic Compositions: A Musical Variation Analysis

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Abstract

This study looks into the patterns found in the musical scores of selected composers in the Classical-Romantic period. Random masterpieces were taken from six (6) composers with five (5) musical compositions from each. The image of each musical score was analyzed to obtain its fractal dimension, with the idea of identifying a signature style of music for each composer. Findings revealed that there was consistency with less variance of the fractal dimensions of musical scores for each composer. Furthermore, the minimal disparity of the fractal dimensions across composers, discloses the common influence of Classical-Romantic era where pieces during this period are mostly homophonic, and capitalize on melody and accompaniment.

Keywords: classical music, fractal dimension, musical score, musical composition

1.0 Introduction

Classical music draws varied reaction from people. For the unlettered in music, this genre is perceived as belonging to the past, ancient, and plain instrumental. To those exposed in music, familiarity with the musical pieces enables them to identify correctly the title of the music played or hazard guesses as to the title and composer of the seemingly familiar music being played. There are also those who just want to enjoy classical music without being bothered by any technicality.

Classical music is largely distinguished by its system of staff or musical notation, creating a musical part or score, which is in use since the 16th century. Western staff notation is used by composers to prescribe to the performer the pitch, speed, meter, individual rhythms and exact execution of a piece of music. This leaves less room for practices such as improvisation. The major time divisions of classical music are the early music period, which includes Medieval (500–1400) and Renaissance (1400–1600), the Common practice period, which includes the Baroque (1600–1750), Classical (1750–1830) and Romantic (1804–1949) periods, and the modern and contemporary period, which includes 20th century (1900–2000) and contemporary (1975–current).The dates are generalizations, since the periods overlapped and the categories are somewhat arbitrary(www.classical.net, 1995-2013).

Musical genres can be categorized using the axiomatic triangle (art music, popular music or traditional music), or by period (50's rock ,17th cent music, etc.) technique and instrumentation, fusion origins (blues rock, latin jazz), or social function (wedding music, Christmas music). With the influx of musical pieces, machine learning algorithms and pattern recognition techniques to automate the process of classification and indexing are used in large digital music libraries. This is not only to check if the audio data is music or non-music but is also useful in searching databases for certain types of music (Han Ju, Jian-Xin and Van Dongen, 2010). In their work entitled Classification of

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Musical Styles using liquid State Machines, Han Ju and his co-authors recommended the bio-inspired techniques such as Artificial Neural Networks (ANNS) in addressing one of the problems in Music Information retrieval which is music style classification. With increasing computational power, biologically realistic ANNS, has become popular in solving problems including pattern recognition, time series forecasting and function. Salamon, Rocha, and Gomez, in a study on musical genre proposed a method using a high level melodic characteristic extracted from the audio signal of polyphonic music.

The available works on musical genre recognize similarities in musical compositions yet are silent to the question if musical compositions belonging to one and the same composer have indeed the same characteristics? This is especially true with classical music, which may sound all the same to a person. The possibility of similarities in composition across the classical composers is also worth exploring as well as the likelihood of the relationship of musical composition and its fractal dimension.

2.0 Concept of a Fractal and Fractal Dimensions

Classical geometry considers objects that have integral dimensions: points have zero dimension, lines have one dimension, planes have two dimensions and cubes have three dimensions. Within a plane, one can represent points and straight lines and other geometric objects as shown below:

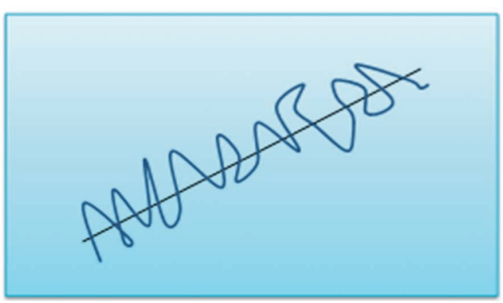

Figure 1: A fractal object in a plane

It is possible to represent geometric objects within a plane that are neither points nor lines like the squiggly line in Figure 1. This squiggly geometric object cannot have dimension equal to 1 because it fills up more space than a line; it cannot have dimension equal to 2 because it does not form an area. Hence, its dimension λ has to be between 1 and 2 like $\lambda = 1.63$. We will say that the squiggly line is a fractal (a geometric object having fractional dimension).

The fractal dimension of an object defines its roughness, ruggedness or fragmentation. The higher the fractal dimension, the more rugged and irregular-looking is the object. Thus, although fractals are rough and irregular objects, the pattern of irregularities are repeated over and over again. This is called the self-similarity property of fractal. Benoit Mandelbrot (1967) is acknowledged as the mathematician who opened roughness as a legitimate topic for investigation in modern science. He claimed that nature and natural processes are fractals, while uniform, smooth and continuous patterns are man-made concepts and pervade mathematical analysis. He also said that by introducing "randomness" into the situation, one gets more realistic fractal representations.

After the publication of Mandelbrot's book: Fractals: The Geometry of Nature, many scientists used fractals with great success (Cohen (1987) on fractal antennae; Krummel et al. (1987) on forest fractals and others). It has found applications in various disciplines as well as in many areas of practical technology.

3.0 Research Design and Methods

The study is designed to assess the viability of using fractal analysis in the classification of classical-romantic composers based on the fractal dimensions of their musical scores. A total of five (5) musical scores were taken as sample from each composer. These images were uniformly converted

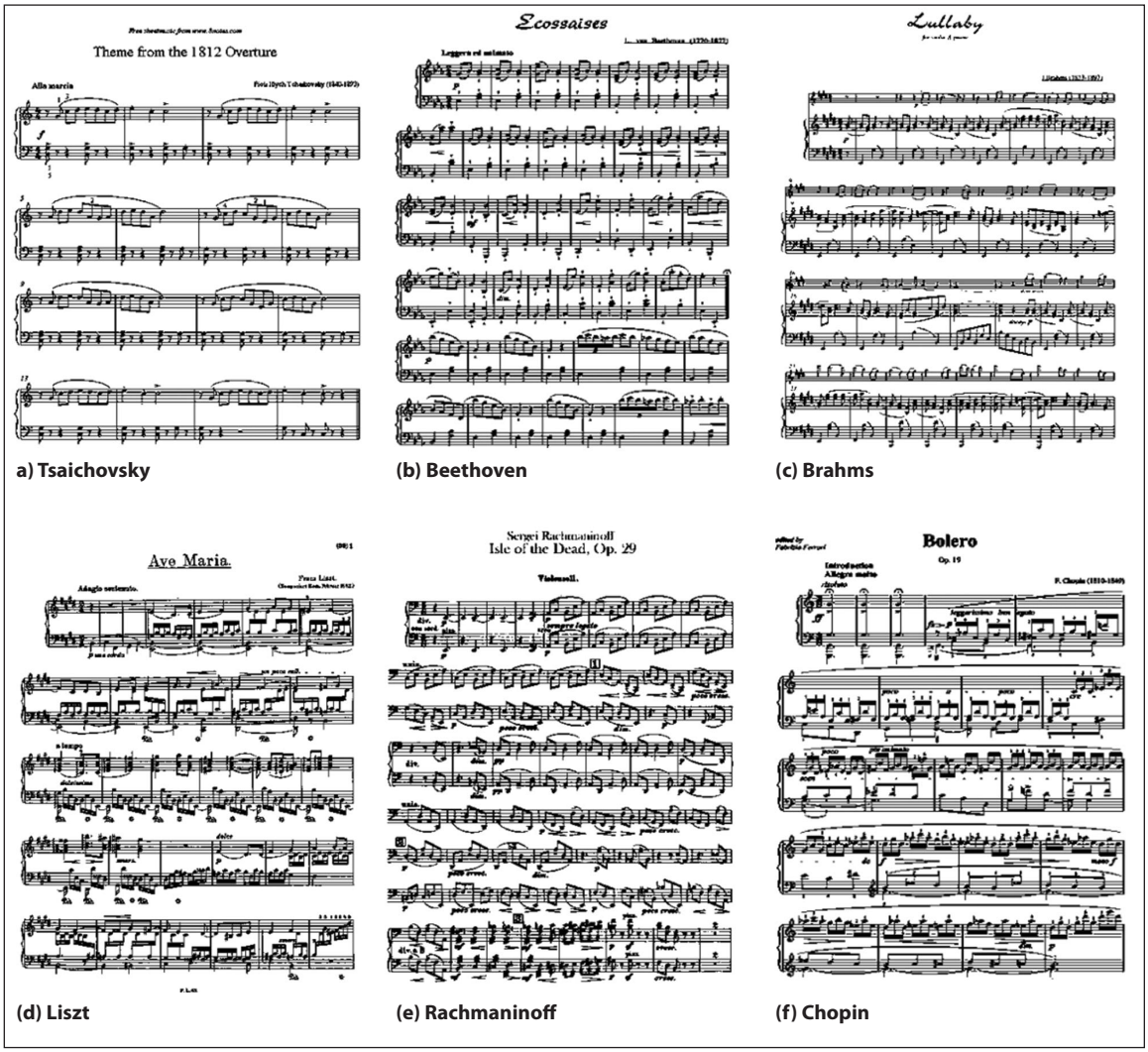

Figure 2: Sample Musical Scores

from an original jpeg format to a black & white bmp file with the same threshold level to eliminate noise and tested using FRAKOUT software to obtain its fractal dimension. The fractal dimension explains the complexity and ruggedness of the scores of each composer.

4.0 Results and Discussions

Figure 2 shows a portion of the samples scores for each composer. The sample images where converted into a similar threshold level to eliminate noise.

Table 1 shows the fractal dimensions of the different musical scores from each composer. The table revealed that the fractal dimension from each musical score per composer was not that diverse from each other. This implies that each composer has a "signature" or style that manifests itself in his compositions. In likewise manner, the closeness of the fractal dimensions across composers, discloses the influence that the Classical-Romantic era induced on the composers and their musical

Table 1: Fractal Dimension of Selected Musical Scores

Musical Score	Beethoven	Chopin	Rachmaninoff	Tchaicovsky	Liszt	Bhrams
1	1.7552	1.6961	1.7623	1.6303	1.7931	1.7349
2	1.7131	1.7872	1.8527	1.7377	1.7143	1.7438
3	1.6407	1.6986	1.7515	1.7270	1.7309	1.7537
4	1.7312	1.7913	1.8249	1.7302	1.7367	1.7284
5	1.7460	1.7935	1.7047	1.7272	1.8091	1.7254

pieces. The musical master pieces during this period are mostly homophonic, and capitalize on melody and accompaniment. Tempo changes are used a lot by the composers in this period and silence as an effect is very much evidenced, too. Hence, the closeness in the fractal dimensions of the sample musical scores above gives credence to the fact that the influence of composers on each other and the period immediately preceding them. The Classical Period is witness to the development of composers from being employees of one person or family to the growth public concert. The composers themselves start to organize these public concerts that gave way to the establishment of the 50 member orchestra. Characteristic to the Classical period is the introduction of the trombone and the piano replacing the popularity of the lute, hapsicord and organ of the previous musical period (www.library.thinkquest.org, 2012).

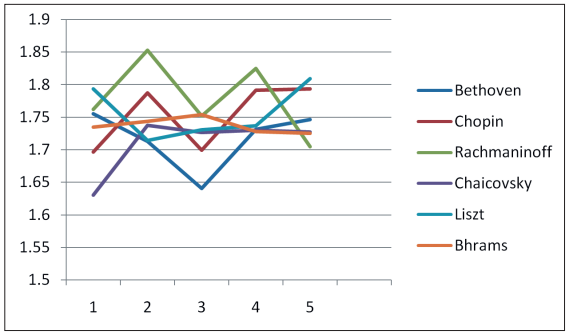

Figure 3 Plot of Fractal Dimension of Selected Musical Scores

Figure 3 plots the respective fractal dimension in relation to the other composers. Among the six composers, Rachmaninoff has the more complex musical scores on the 2nd and 4th sampled scores. It is interesting to note that there seem to be a certain range of fractal dimensions for each composer. However, due to the limited number of observations, this perceived trend is not that apparent and the distinctive style of each composer is not that pronounced either.

Table 2. Average Fractal Dimension

Composers	Mean	RANK
Rachmaninoff	1.7792	1
Liszt	1.7568	2
Chopin	1.7533	3
Bhrams	1.7372	4
Beethoven	1.7172	5
Tchaicovsky	1.7105	6

Table 2 showed the rank of the means of the fractal dimensions of each composer. Rachmaninoff registered the highest mean, while Tchaicovsky sported the least average. The mean or average of these musical scores reflects the complexity of such musical piece. Rachmaninoff's works feature prominently the piano. Understandably enough, as one of the finest pianists of his time, he makes it a point to explore fully the possibilities of the instrument. As one of the last great composers of Romanticsm of the Russian Classical Music, Rachmaninoff's works displayed variety, with

textures carefully contrasted. Though his earlier works were influenced by Tchaikovsky, his later works showed much refinement throughout the years with the use of unusually wide spaced chords for bell like sounds that attracted him as a boy. The complexity of his works is evidenced in his musical scores and is manifested the more in the computed fractal dimension for each composer. Tchaikovsky's works on the other hand, exhibit the least complexity based on the computed mean of the fractal dimensions of the sample musical scores. By describing his works as least complex, this does not mean that these musical scores have lesser movements. In fact, many of his works are difficult to put lyrics on because of its being loaded with a lot of movements. These movements, however, are tempered by his penchant for melody which tended to be self- contained, and functioned with a mindset of stasis and repetition rather than the one of progress and on-going development. Repetition is a natural part of Tchaikovsky's music. His use of sequences within melodies (repeating a tune at a higher or lower pitch in the same voice) is very evident. Yet, his musical genius could keep a listener's interest from flagging by integrating melody, tonality, rhythm and sound color as an indivisible whole rather than as separate elements and manipulate different parts of it as needed.

4.0 Conclusion

Music is fractal. It is a product of nature. The sound of the blowing wind, of the cascading rain and waterfalls, and the crying of a baby are reproduced by the composers through the strokes of his hand that writes the musical score printed in "notes" and given birth and life by a singer or orchestra. The properties of fractal like self-similarity, scale invariant, roughness or ruggedness, and the fractional dimension are very much demonstrated in Music. The ruggedness or roughness characteristic of fractal is very evident in the arrangement and combination of the eight musical notes, tempo, rhythm, pitch and melody especially in the works of musicians belonging to the Classical-Romantic period. Analyzing the fractal dimension of the classical composers' musical scores gives a vivid view of the characteristics of his works and the ruggedness of its notes.

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APPENDIX

BEETHOVEN' COMPOSITIONS

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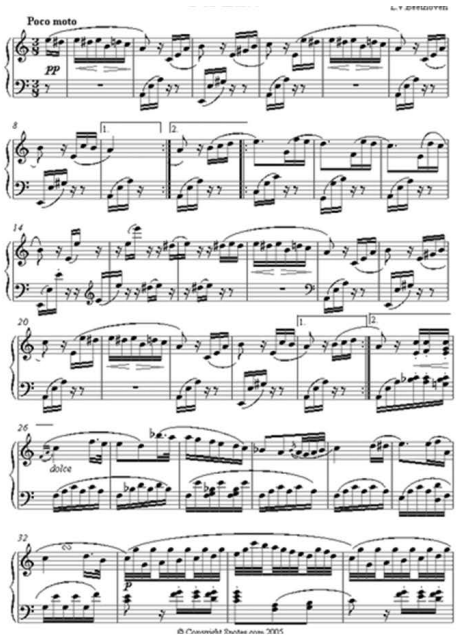

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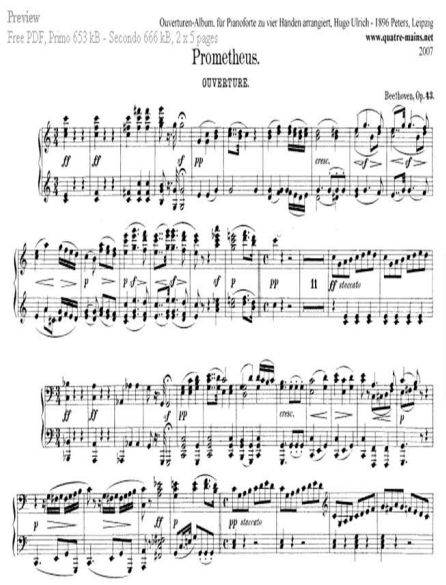

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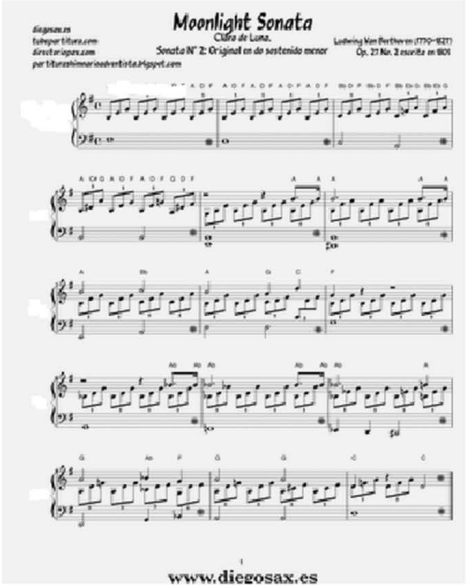

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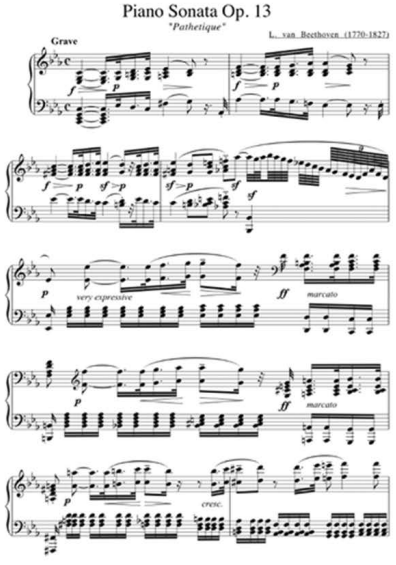

BRAHM'S COMPOSITION

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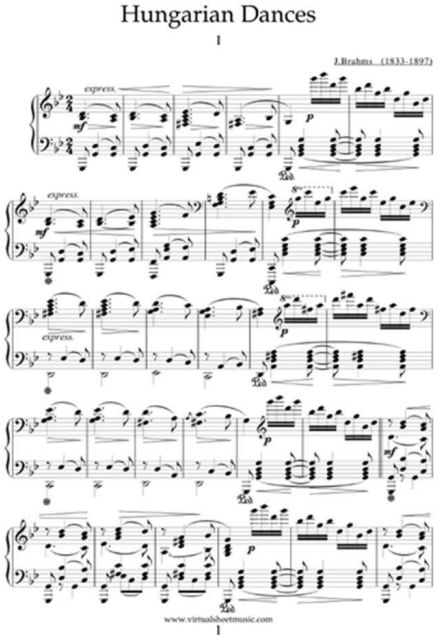

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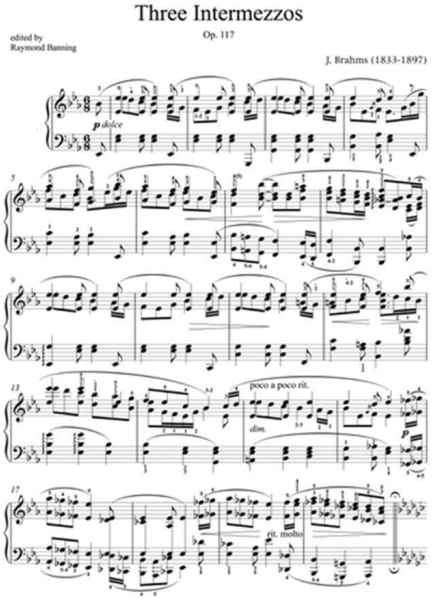

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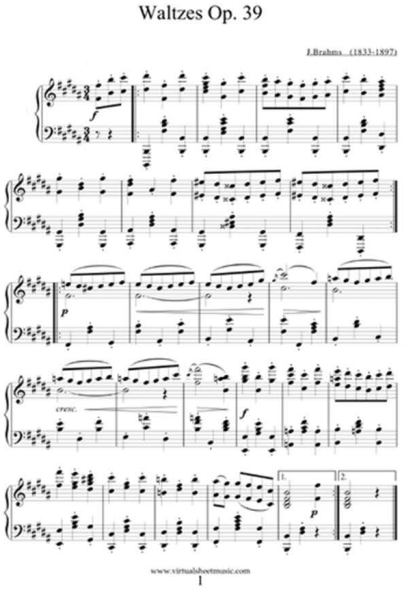

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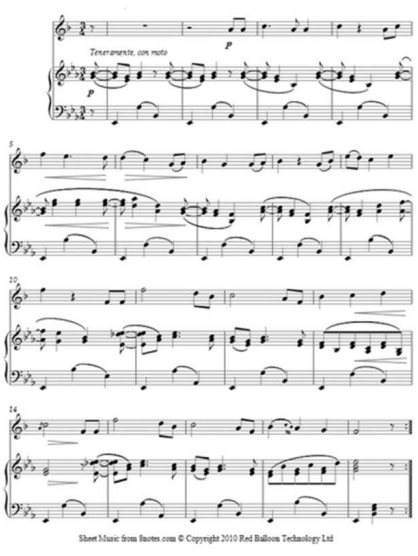

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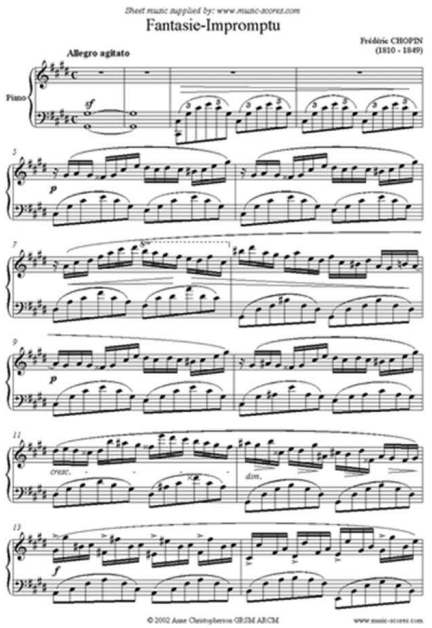

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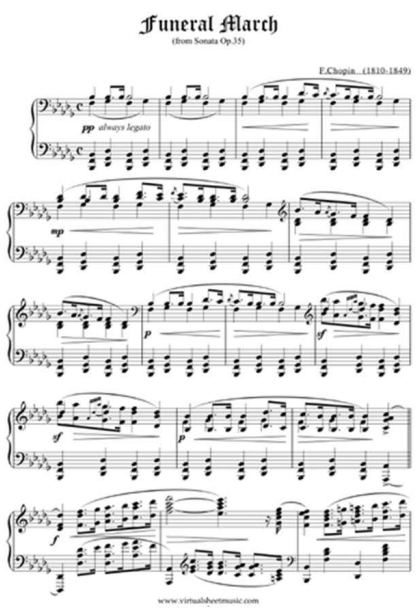

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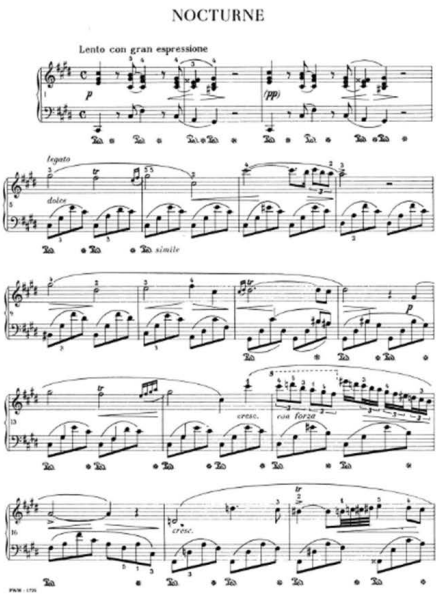

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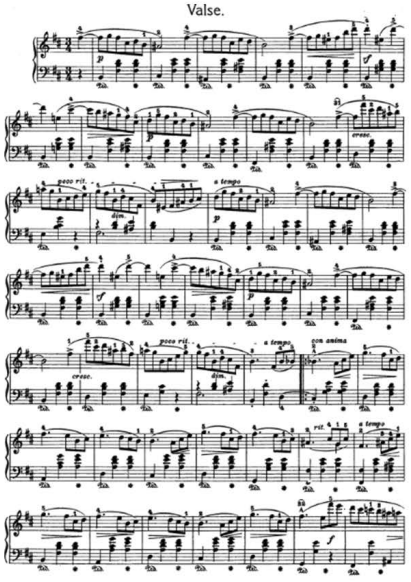

LISZT COMPOSITIONS

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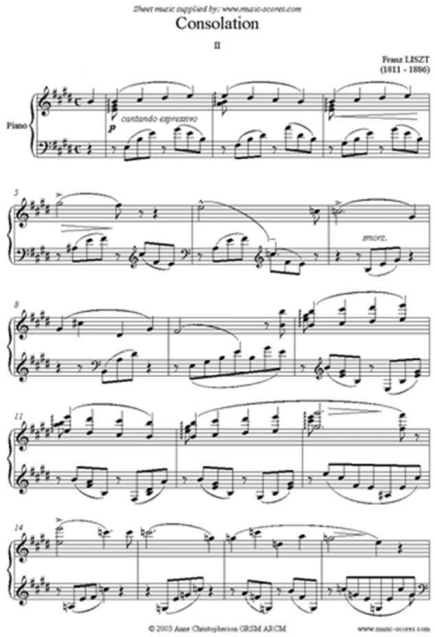

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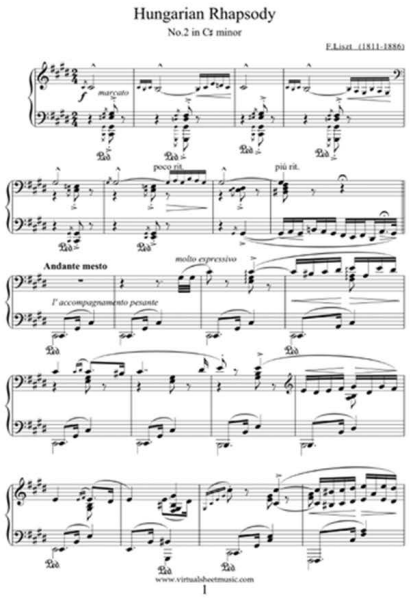

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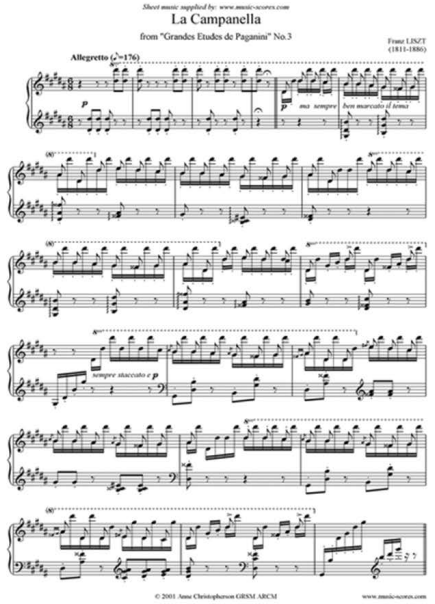

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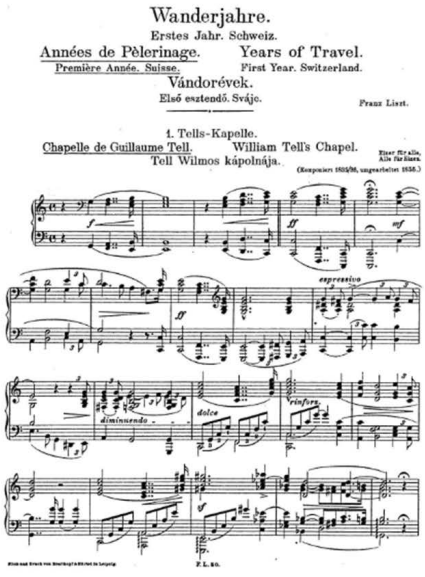

RACHMANINOFF COMPOSITIONS

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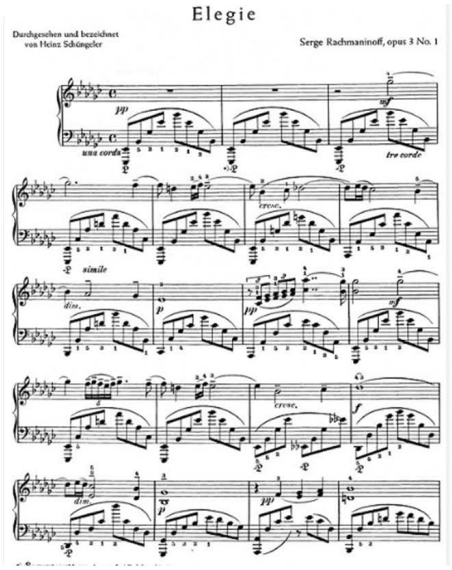

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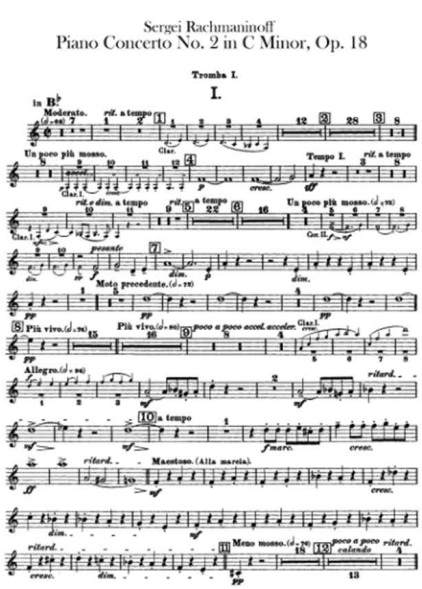

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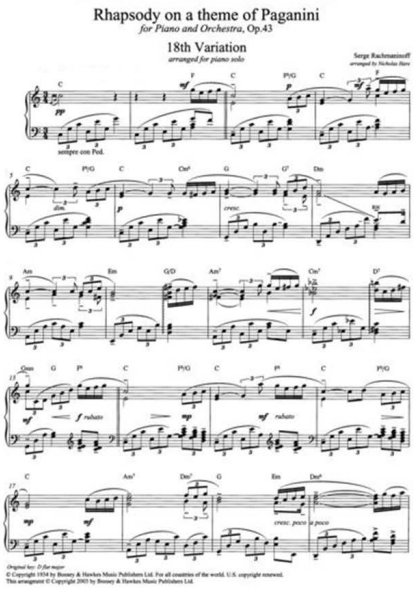

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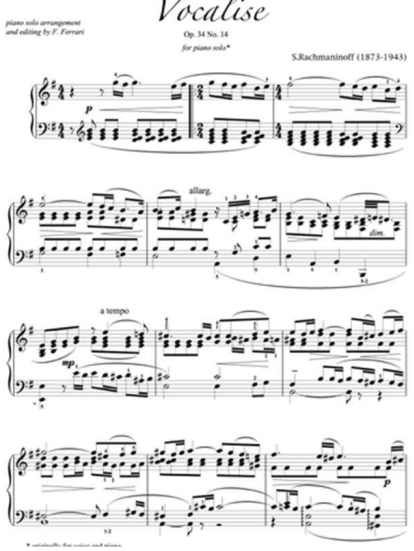

TCHAIKOVSKY'S COMPOSITIONS

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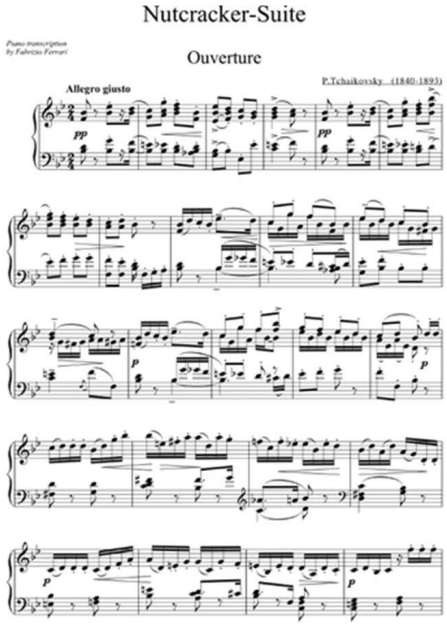

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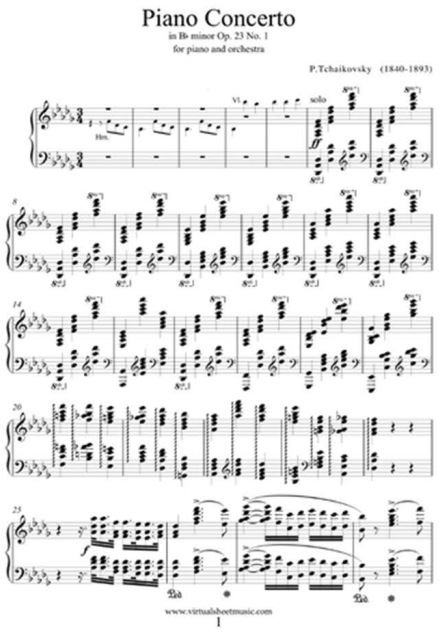

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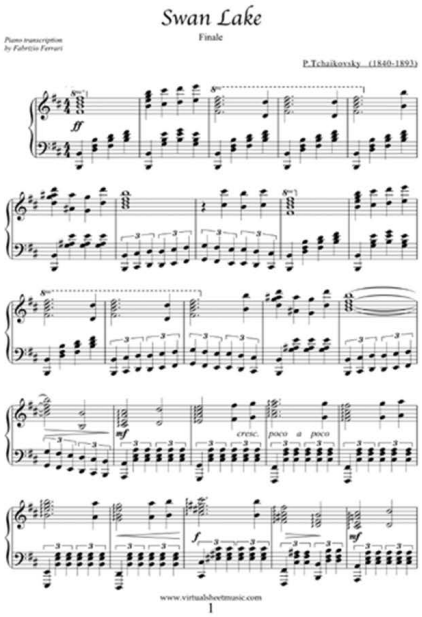

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