MATH 110: Mathematics and Music
CD #1: Rhythm

   This CD illustrates the importance of rhythm in music by featuring many different styles of music (classical, pop, Cuban, Indian, African) as well as many different time signatures (eg. $\frac{2}{4}$, $\frac{3}{4}$, $\frac{4}{4}$, $\frac{5}{4}$, $\frac{6}{8}$, cut time). Some polyrhythmic music (multiple rhythms played simultaneously) is included as well. As you listen to each piece, try to hear the different time signatures in the music. It is particularly useful to distinguish between similar meters such as $\frac{3}{4}$ versus $\frac{6}{8}$. The music compiled here accompanies the three class lectures on rhythm (1/22, 1/24 and 1/26).

1. John Philip Sousa, *The Stars and Stripes Forever*, 1896. Track 58 on a CD compiled by Wynton Marsalis entitled Music Examples to Accompany Marsalis on Music, Sony Classical. This piece is in cut time (C with a vertical slash through the middle) which is equivalent to a $\frac{2}{2}$ meter. Incidentally, this is the official march of the USA.

2. Pyotr Ilyich Tchaikovsky, *The Nutcracker Suite: Russian Dance*, Op. 71A, 1892. Track 6 from the Fantasia Motion Picture Soundtrack, the Walt Disney Company. This lively dance in $\frac{2}{4}$ time accelerates to a climactic finish. Notice Tchaikovsky's use of the tambourine.

3. Cuarteto Oriente, *Mueve La Cintura Mulata*, Cuban **son** music. Track 8 on the Putumayo CD Afro-Latin, Putumayo World Music, 1998. This features the common Afro-Cuban 3-2 son clave rhythmic pattern discussed in class. The pattern derives from West African music and nearly all Afro-Cuban music (including salsa) centers around this famous clave rhythm. Try and tap out the 3-2 clave rhythm laid down by the claves.

4. Vieja Trova Santiaguera, *Me Dieron La Clave*, Cuban **guaracha**. Track 11 on the Putumayo CD Afro-Latin, Putumayo World Music, 1998. In contrast to the previous piece, the rhythmic underpinning here is the 2-3 clave rhythm. Can you hear the difference?

5. Pyotr Ilyich Tchaikovsky, *The Nutcracker Suite: Waltz of the Flowers*, Op. 71A, 1892. Track 7 from the Fantasia Motion Picture Soundtrack, the Walt Disney Company. This waltz, like most, is in $\frac{3}{4}$ time. To count along, say "one-two-three" along with the "oom-pah-pah" in the lower strings. If you've never been to a performance of this masterful ballet performed live to Tchaikovsky's enchanting music, go see it next holiday season.

6. Billy Joel, *The Piano Man*, 1973. Track 1 on Disc 1 of his Greatest Hits album, Blackwood Music Inc. The $\frac{3}{4}$ meter rarely finds its way into popular rock music as it does here with this classic from one of the founders of piano rock. This meter is more common in the country/western genre. Billy Joel studied classical music at an early age and as a result, much of his music shows a deeper melodic and rhythmic sophistication than most "pop" music.

7. Franz Gruber, *Silent Night* (words by Josef Mohr), 1820. Track 3 on a Windham Hill CD entitled Windham Hill: The Night before Christmas, performed by Barbara Higbie, Sony BMG Music Entertainment. This famous Christmas carol is an excellent example of $\frac{6}{8}$ meter. Note the difference with the two previous pieces in $\frac{3}{4}$ time. Although it is possible to count along with the piece in 3, it is most definitely not a waltz. Music in $\frac{6}{8}$ time often has a swaying, singsongy feel to it and the typical bar is usually subdivided in two rather than six. The English folk song *Greensleeves* is another popular example of this compound meter.

8. Pyotr Ilyich Tchaikovsky, *Allegro con grazia*, 2nd movement of the Symphony, No. 6, "Pathetique", Op. 74, 1893. Track 2 from a Chicago Symphony recording, conducted by Claudio Abbado, CBS Records. The entire second movement of this symphony is in $\frac{5}{4}$ time, a very unusual meter for its day. The five beats of each measure can be broken down into $2 + 3$ giving the music its dance-like character. Try counting along directly from the start of the movement by repeating "one-two one-two-three" over and over again.

9. *Raga for Tabla* (Indian classical music). Track 2 from a CD entitled The Best of India, Madacy Entertainment Group, Inc. 2001. (Unfortunately, no information is given concerning the names of the performers.) The tabla is a common Indian percussion instrument central to Indian classical music, consisting of two drums, one for each hand. The two hand drums are different sizes and timbres. Often, a tabla player is asked to simultaneously subdivide a measure into a different numbers of beats for each hand, (say 7 versus 11), a task that requires years of training. As discussed in class, the least common multiple is the underlying mathematical principle at work. Notice the variety and complexity of the rhythms in this piece.

10. *Improvisations for Tabla and Vamsa* (Indian classical music). Track 6 from the previous CD featuring a creative collaboration between tabla and the bamboo flute *vamsa*. The young mathematician/musician Manjul Bhargava at Princeton University claims that it is crucial for the number of units of an Indian rhythm to be a prime number. In this way it cannot be subdivided into equal parts, making for more complex yet interesting music. The French composer Olivier Messiaen was aware of this importance and used many Indian rhythms in his music. Check out the link on the course homepage where you can listen to Bhargava play the tabla and hear an interview with him on National Public Radio discussing connections between math and music.

11. Babatunde Olatunji, *Ajaja*, 1988. Track 1 from a CD entitled Drums of Passion: The Invocation, Rykodisc, 360° Productions. This polyrhythmic African music features an array of performers on various percussion instruments such as the Djembe drum, the Talking drum, the Hoop drum, the Junjun drum and cowbell. Try and distinguish each individual part, noting both its independent motif as well as how it contributes to the entire ensemble. Note that the title of the piece is a palindrome.

12. Igor Stravinsky, *Le Sacre Du Printemps* (The Rite of Spring), 1913. Track 5 of a recording by the Cleveland Orchestra conducted by Pierre Boulez. This is the first of an amazing two-part piece "Scenes of Pagan Russia." One of the great orchestral masterpieces of the 20th century, this work features dissonance, polytonality and polyrhythms. The work premiered as a ballet in Paris and the jarring rhythms accompanied with the exotic, sexual dance led to a riot in the theater! Notice the way Stravinsky uses a variety of orchestral sounds to create passion and fury in his music, all the while keeping it rhythmically vibrant through ostinato (repetition of the same note,) multiple meters (at one point he changes from $\frac{5}{4}$ to $\frac{7}{4}$ to $\frac{6}{4}$ in consecutive measures) and polyrhythmic creativity. This is a marvelous piece of music to see performed live by a huge orchestra. You are encouraged to listen to the complete piece, on reserve in the music library for our course.