

The Composer's Materials

Module 1 of *Music: Under the Hood*

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Outline

- Basic elements of music
- Musical notation
- Harmonic partials
- Intervals and chords
- Keys
- Cadences
- Temperament
- Just tuning



Basic Elements of Music

- **Rhythm**

- Everyone loves music with a “beat”
 - Some composers emphasize rhythm
 - Stravinsky, jazz composers, pop stars
- Rhythm is ever-present
 - Heartbeat, walking
 - Same tempos reflected in music!
- Rhythm and dance are universal
 - Dance seems to be genetic in humans



Basic Elements of Music

- **Melody**

- Based in song

- Some composers emphasize melody
 - Chopin, Schubert, Broadway composers

- Song is basic to human expression

- May be original form of communication
 - Later replaced by language



Western Music

- **Harmony**

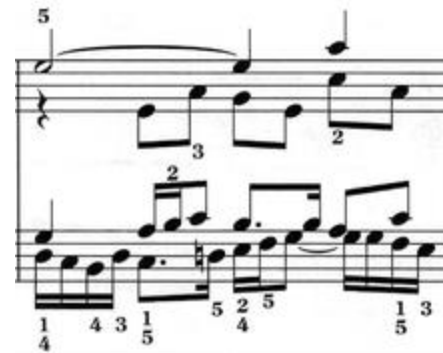
- A fundamental characteristic of music

- Even a single tone creates harmony (upper partials)
- Allows us to make sense of tones sounded together

- **Counterpoint**

- Interaction of different “voices”

- We can follow the voices if they are in harmony.



Western Music

- **Abstraction**

- Western music is fundamentally abstract
 - More accurately, nonrepresentational.
 - Exceptions: Beethoven's *Pastoral Symphony*, etc.
- Most **visual** art is representational
 - Exception: Islamic art
 - Even “abstract” art is often representational



Western Music

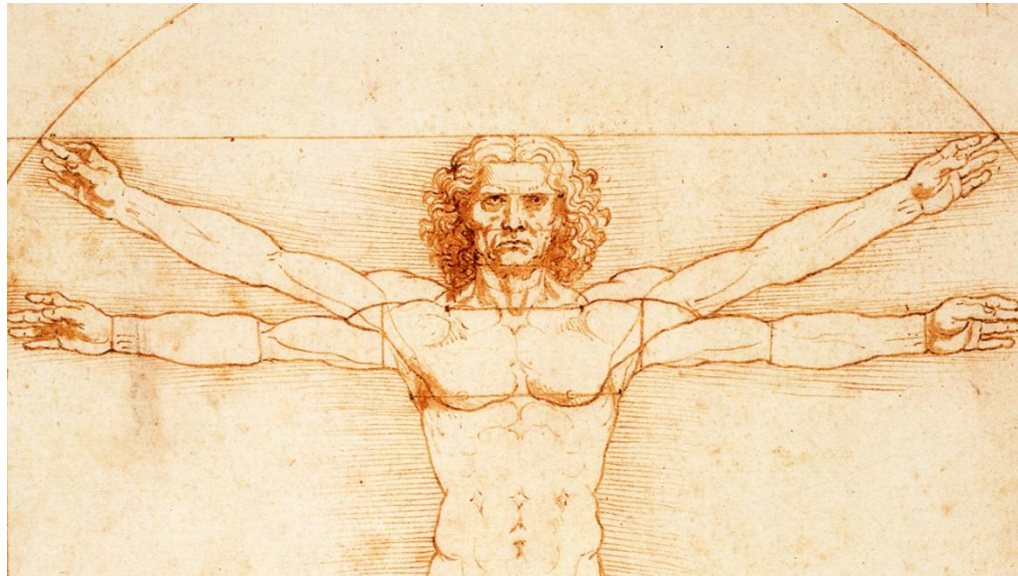
- **It is complex**

- The ear is analytic like no other sense
 - Breaks down every sound into its components
 - The eye cannot do this.
 - Western music takes advantage of this.
- This allows us to understand multiple voices
 - Makes harmony & counterpoint possible.



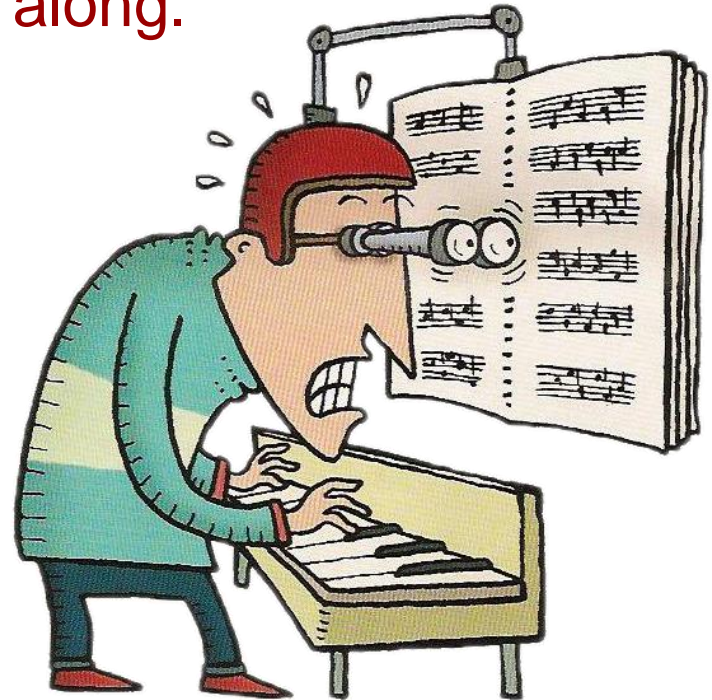
Western Music

- **Basic challenge of Western music**
 - Make abstract music intelligible
 - This course is about how composers do this.
 - Address the full human being
 - Intellectual as well as emotional.



Musical Notation

- One doesn't "read" music as one reads French.
 - It is a **graphic** representation
 - The development of notation made Western music possible.
 - You will catch on as we go along.



Musical Notation

[Audio file](#)

Low notes appear lower
High notes appear higher

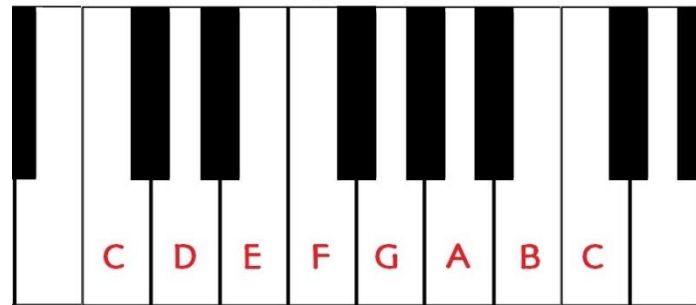
Piano

The image shows a musical score for a piano in 4/4 time. It consists of two staves: a treble clef staff (top) and a bass clef staff (bottom). The treble clef staff has a treble clef and a 4/4 time signature. The bass clef staff has a bass clef and a 4/4 time signature. The word 'Piano' is written to the left of the staves, with a brace grouping them. The score is divided into seven measures. In the first measure, the treble staff has a whole rest and the bass staff has a whole note G2. In the second measure, the treble staff has a whole note G3 and the bass staff has a whole note G2. In the third measure, the treble staff has a whole note G4 and the bass staff has a whole rest. In the fourth measure, the treble staff has a whole rest and the bass staff has a whole rest. In the fifth measure, the treble staff has a whole rest and the bass staff has a whole rest. In the sixth measure, the treble staff has a whole rest and the bass staff has a whole rest. In the seventh measure, the treble staff has a whole rest and the bass staff has a whole rest. Above the treble staff, the text 'Low notes appear lower' and 'High notes appear higher' is written. To the right of the text, there are two small diagrams: the first shows a note on a staff with a stem extending downwards, and the second shows a note on a staff with a stem extending upwards.

Musical Notation

[Audio file](#)

C Major Scale



8 Consecutive notes form a scale using white notes on the piano.

Pno.

Treble clef

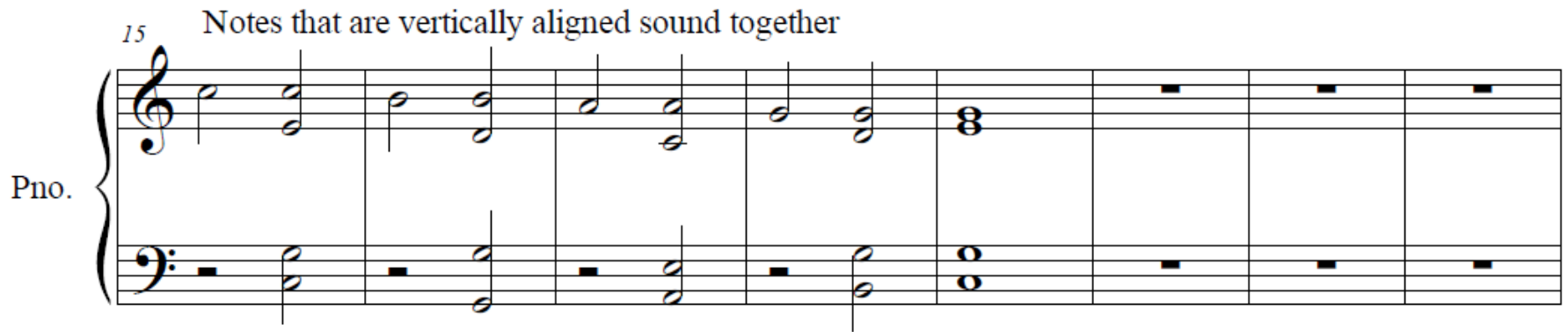
Bass clef

The musical notation shows the C Major Scale on a piano. The treble clef staff contains the notes C, D, E, F, G, A, B, C. The bass clef staff contains the notes C, D, E, F, G, A, B, C. The notes are written as quarter notes, and the scale is played consecutively.

Musical Notation

Audio file

15 Notes that are vertically aligned sound together



The image shows a piano score for measures 15 through 22. The right-hand staff (treble clef) contains notes in pairs of eighth notes, with the notes in each pair vertically aligned. The left-hand staff (bass clef) contains notes in pairs of eighth notes, also vertically aligned with the right-hand staff. This vertical alignment indicates that notes in the same column are played simultaneously. The notation includes a fermata over the final note of the right-hand staff in measure 15.

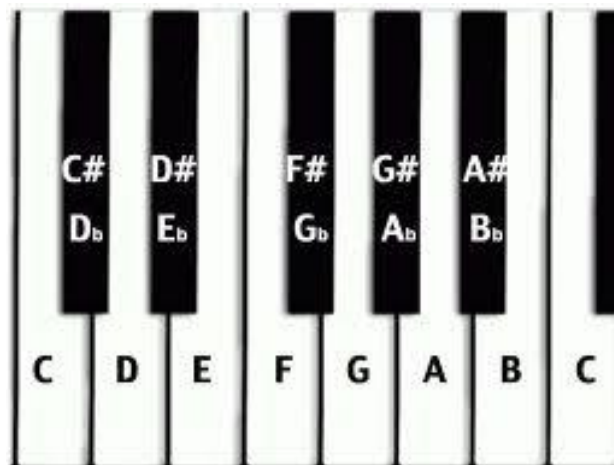
Audio file

23 Notes with more black move faster



The image shows a piano score for measures 23 through 26. The right-hand staff (treble clef) contains notes with increasing density and articulation. Measures 23 and 24 have sparse notes, while measures 25 and 26 feature dense, rapid passages of notes with many black accents, indicating a faster tempo or more frequent articulation. The left-hand staff (bass clef) contains notes with black accents, mirroring the right-hand staff's articulation.

[Audio file](#)



27 Attaching a sharp makes the note a half-step higher (the next highest black key on the piano).

Pno.

This is called the chromatic scale.

Musical notation for a chromatic scale starting on middle C. The scale is written in a grand staff with treble and bass clefs. The notes are: C, C#, D, D#, E, E#, F, F#, G, G#, A, A#, B, B#, C. The sharps are shown as # symbols. The text "This is called the chromatic scale." is written across the middle of the staff.

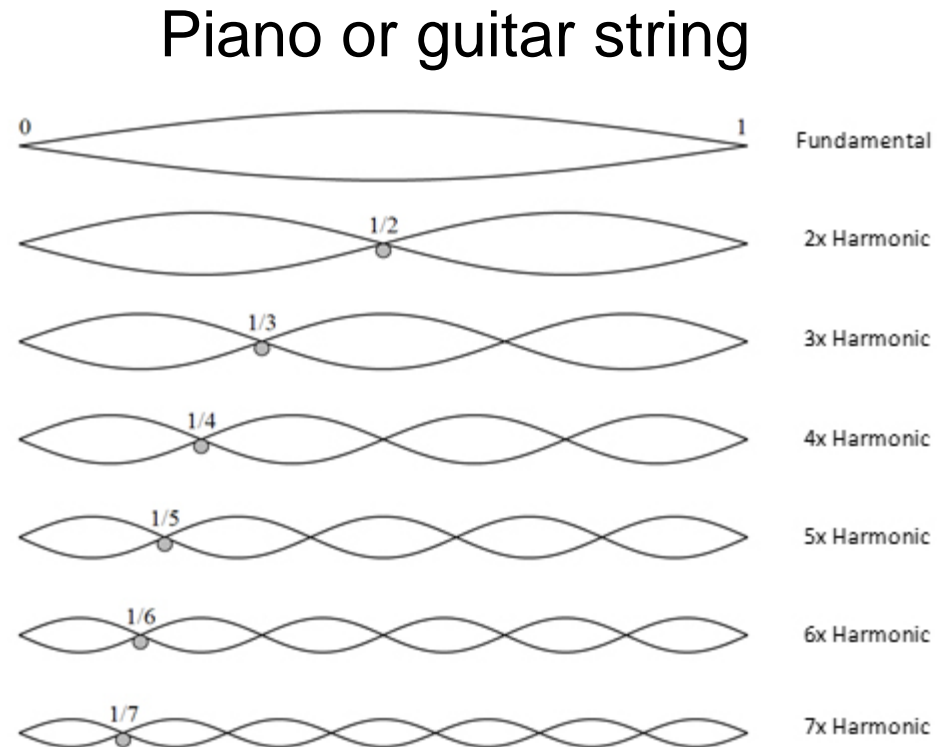
34 Attaching a flat makes the note a half-step lower (the next lowest black key on the piano).

Pno.

Musical notation for a chromatic scale starting on middle C. The scale is written in a grand staff with treble and bass clefs. The notes are: C, B, B♭, A, A♭, G, G♭, F, F♭, E, E♭, D, D♭, C. The flats are shown as b symbols.

Harmonics

- Acoustic instruments generate **harmonics** of each tone
 - Multiples of the original frequency.
 - Also called **harmonic partials** or **overtones**
 - 1st overtone = 2nd harmonic



Harmonics

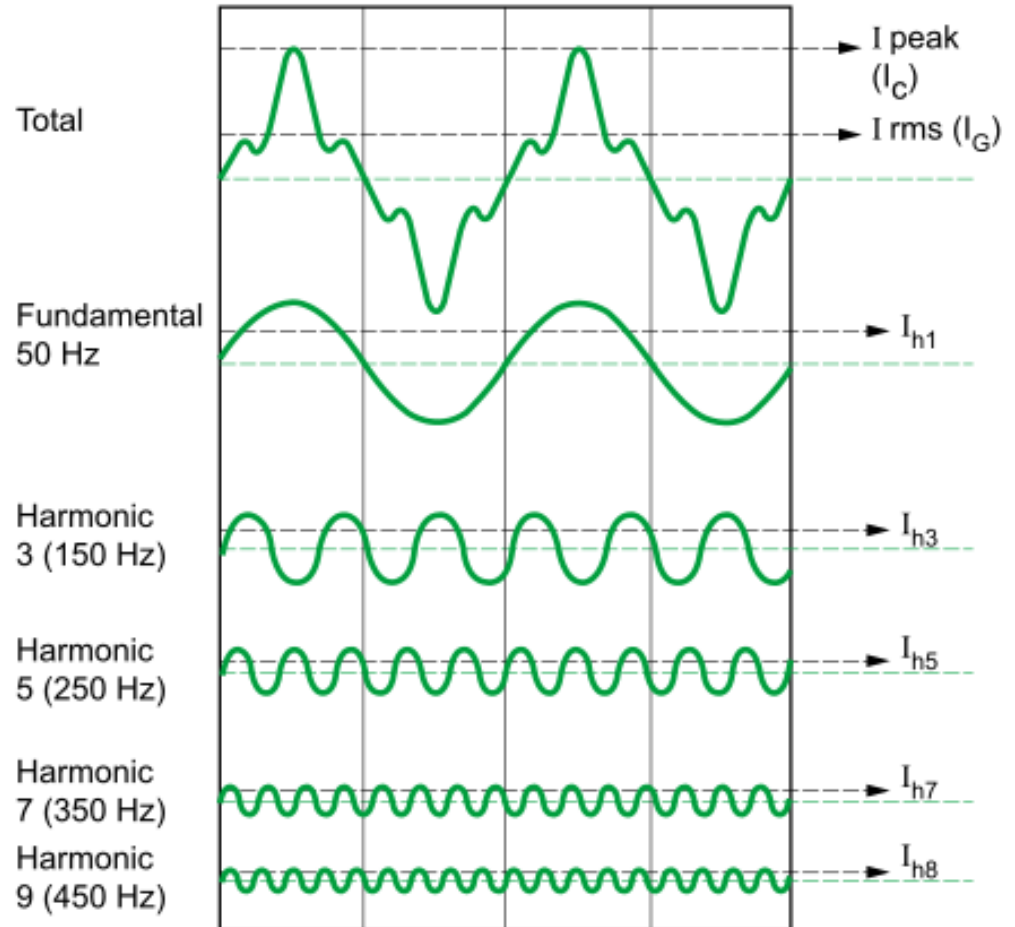
- Musical timbre

- is based on the relative strength of harmonics

- This is **Fourier analysis**



- The ear performs Fourier analysis!



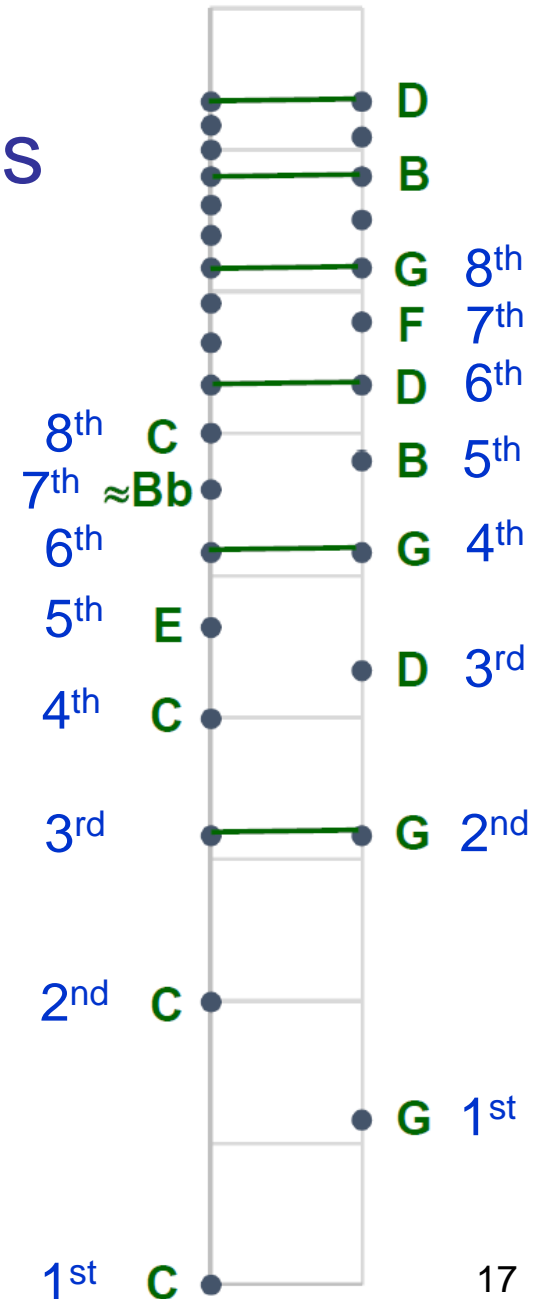
Harmonious Intervals

- It is easy to recognize intervals whose frequencies have simple ratios.
 - They have many harmonics in common.

Harmonious Intervals

- It is easy to recognize intervals whose frequencies have simple ratios.
 - They have many harmonics in common.
 - For example, a **perfect fifth**...

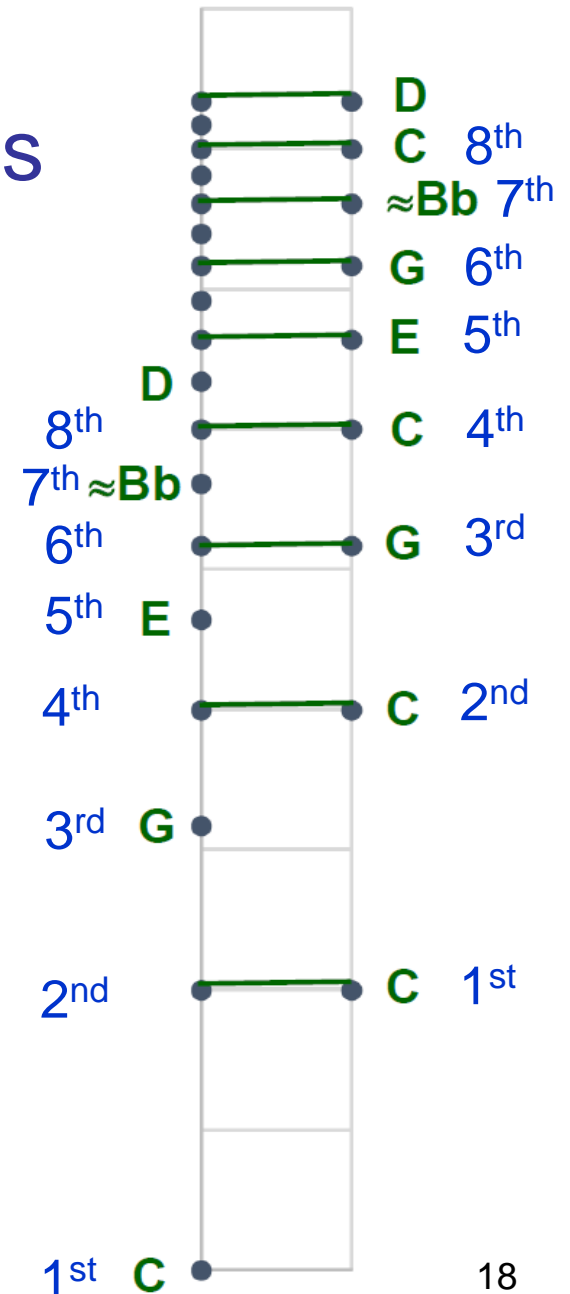
Harmonics of C and G,
which have frequency ratio 2:3



Harmonious Intervals

- It is easy to recognize intervals whose frequencies have simple ratios.
 - They have many harmonics in common.
 - For example, an **octave**...

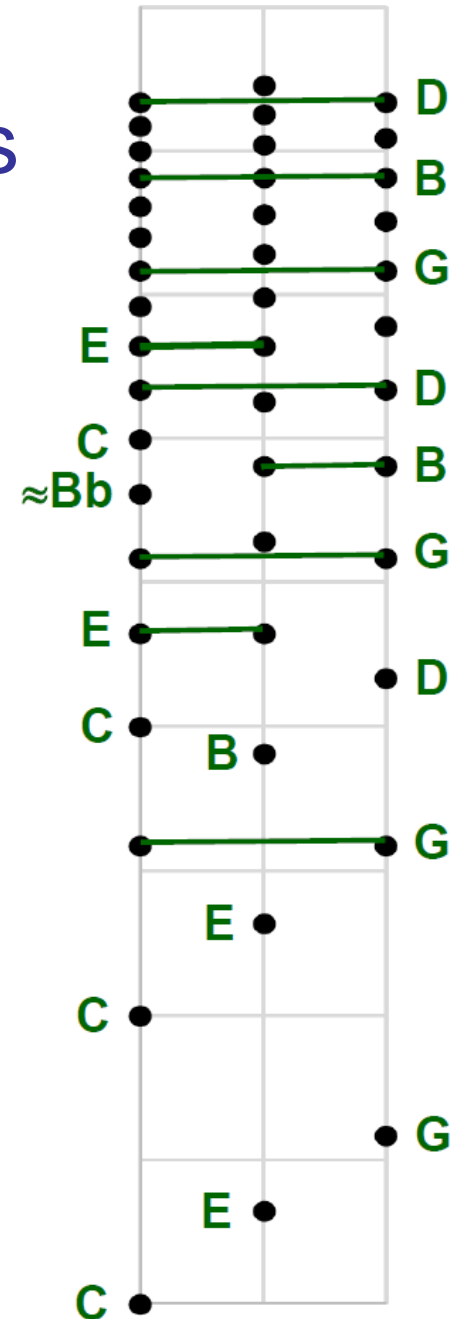
Harmonics of C and C octave,
which have frequency ratio 1:2



Harmonious Intervals

- It is easy to recognize intervals whose frequencies have simple ratios.
 - They have many harmonics in common.
 - For example, a **major triad**...

Harmonics of C, E and G,
which have frequency ratios 3:4:5



Intervals

Ratios with smaller numbers indicate greater consonance

[Audio file](#)

The image displays two staves of musical notation in 4/4 time, illustrating various intervals and their corresponding frequency ratios. The first staff shows intervals from the second to the fifth, and the second staff shows intervals from the minor sixth to the octave. Each interval is represented by a pair of notes on a five-line staff, with the ratio of their frequencies written above them. The notes are connected by a slur, and the time signature '4' is indicated at the beginning of each staff.

Interval	Ratio
Second	8:9
Minor third	5:6
Major third	4:5
Fourth	3:4
Tritone	32:45
Fifth	2:3
Minor sixth	5:8
Major sixth	3:5
Minor seventh	9:16
Major seventh	8:15
Octave	1:2

Intervals

Major second 8:9

[Audio file](#)

Happy Birthday

Piano

Hap - py birth - day to you...

Intervals

Minor third 4:5

[Audio file](#)

Greensleeves

Piano

A - las my love _____ you do me wrong...

The image shows a musical score for the piece 'Greensleeves' in 3/4 time. The score is written for piano and includes a vocal line. The first two notes of the vocal line, 'A' and 'las', are enclosed in a red rectangular box. The interval between these two notes is a minor third, which is highlighted in green in the text above. The lyrics are 'A - las my love _____ you do me wrong...'. The piano accompaniment consists of a simple bass line with a few notes.

Intervals

Major third 5:6

[Audio file](#)



Careful: Not all doorbells ring a major 3rd!

Cukoos? They sing a minor 3rd, major 3rd, or 4th, depending on the time of year.

[Audio file](#)

When the Saints Go Marching In

Piano

Oh when the saints go march-in' in Oh when the saints go march-in' in...

The image shows a piano accompaniment for the hymn "When the Saints Go Marching In". It consists of two staves: a treble clef staff and a bass clef staff. The treble staff contains the melody, and the bass staff contains a simple accompaniment of quarter notes. The lyrics are written below the treble staff. A red box highlights the first two notes of the melody: a G4 and an A4, which form a major third interval.

Intervals

Fourth 3:4

[Audio file](#)

Wedding March (Wagner)

Piano

The image shows a musical score for a piano accompaniment. The score is in 2/4 time and consists of two staves: a treble clef staff and a bass clef staff. The treble clef staff contains a melody of eighth and quarter notes. The bass clef staff contains a simple bass line of quarter notes. A red box highlights the first measure of the treble clef staff, which contains a quarter note G4, a dotted quarter note A4, and an eighth note B4. This interval is a major third.

Intervals

Tritone 32:45

[Audio file](#)

Maria (Bernstein/Sondheim)

Piano

M - ri - a! Ma - ri - a Ma - ri - a Ma - ri - a!

Intervals

Fifth 2:3

[Audio file](#)

Twinkle, Twinkle, Little Star

Piano



Twin-kle twin-kle lit-tle star, How I won-der what you are.

Intervals

Minor sixth 5:8

[Audio file](#)

Love Story (Taylor Swift)

Piano

Where do I be - gin to tell the sto-ry of how great a love can be...

Intervals

Major sixth 3:5

[Audio file](#)



[Audio file](#)

My Bonnie Lies Over the Ocean

Piano

My Bon - nie lies o - ver the o - cean,

The image shows a musical score for the piano accompaniment of the song "My Bonnie Lies Over the Ocean". The score is in 3/4 time and consists of two staves: a treble clef staff and a bass clef staff. The treble staff contains the melody, and the bass staff contains the piano accompaniment. The lyrics are written below the treble staff. A red box highlights the first two notes of the melody, which are G4 and D5, forming a major sixth interval. The lyrics "My Bon" are aligned with these two notes.

Intervals

Minor seventh 9:16

[Audio file](#)

Somewhere (Bernstein/Sondheim)

Piano

There's a place for us... Some-where a place for us...

Intervals

Major seventh 8:15

[Audio file](#)

I Love You (Cole Porter)

Piano

The image shows a musical score for the piano accompaniment of the song "I Love You" by Cole Porter. The score is written in treble and bass clefs with a common time signature (C). The lyrics are: "I love you hums the A - pril breeze". A red box highlights the interval between the notes G4 and F#5 in the second measure, which is a major seventh. The piano part consists of a single melodic line in the treble clef and a bass line in the bass clef. The bass line is mostly silent, with a few notes in the second and third measures.

Intervals

Ratios with smaller numbers indicate greater consonance

[Audio file](#)

The image displays two staves of musical notation in 4/4 time, illustrating various intervals and their corresponding frequency ratios. The first staff shows intervals from the second to the fifth, and the second staff shows intervals from the minor sixth to the octave. Each interval is represented by a pair of notes on a five-line staff, with the ratio and name of the interval written above the notes.

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Major seventh	8:15
Octave	1:2

Common chords

Ratios with smaller numbers indicate greater consonance

[Audio file](#)

Major triad
3:4:5

Major sixth chord
12:15:18:20

Dominant seventh chord
36:45:54:64

Musical notation for three chords on a treble clef staff. The first measure shows a Major triad (C4, E4, G4) in 4/4 time. The second measure shows a Major sixth chord (C4, E4, G4, Bb4) in 10/4 time. The third measure shows a Dominant seventh chord (C4, E4, G4, Bb4) in 4/4 time.

Major seventh chord
8:10:12:15

Minor triad
10:12:15

Diminished chord
125:150:180:216

Musical notation for three chords on a treble clef staff. The first measure shows a Major seventh chord (C4, E4, G4, Bb4) in 4/4 time. The second measure shows a Minor triad (C4, Eb4, G4) in 8/4 time. The third measure shows a Diminished chord (C4, Eb4, G4, Bb4) in 10/4 time.

Minor sixth chord
27:32:40:45

Minor seventh chord
10:12:15:18

Augmented triad
16:20:25

Musical notation for three chords on a treble clef staff. The first measure shows a Minor sixth chord (C4, Eb4, G4) in 7/4 time. The second measure shows a Minor seventh chord (C4, Eb4, G4, Bb4) in 4/4 time. The third measure shows an Augmented triad (C4, E4, G#4) in 8/4 time.

Chords

Example: "Blue Moon" (1933)

Richard Rogers (music) and Lorenz Hart (lyrics)

[Audio file from *Manhattan Melodrama* \(1934\) 0:06](#)

[Audio file of the excerpt below](#)

The image displays two systems of piano accompaniment for the song "Blue Moon". Each system consists of a grand staff with a treble and bass clef. Above the treble staff, various chords are labeled, and below the bass staff, figured bass notation is provided.

System 1:

- Chord labels: Major triad, Minor triad, Minor 7th, Dominant 7th, Major triad, Minor triad.
- Figured bass: Leo, *Leo, *Leo, *Leo, *Leo, *Leo, *Leo, *

System 2:

- Chord labels: Minor 7th+9th, Dominant 7th + 6th, Major triad, Minor triad, Minor 7th, Dominant 7th+4th,9th, Major triad.
- Figured bass: Leo, *Leo, *Leo, *Leo, *Leo, *Leo, *Leo, Leo, *

Chords

Example: Diminished chord 125:150:180:216

J. S. Bach

TOCCATA II.

Adagio.

Diminished chord

[Audio file \(0:11\)](#)

Manuale.

Pedale.

Prestissimo.

Chords

Example: Minor 6 chord 27:32:40:45

Most popular sound for US freight trains

[Audio file \(0:08\)](#)



Chords

Example: "Five Minutes More" (1946)
Jule Styne (music) and Sammy Cahn (lyrics)

[Audio file](#)

The image displays a musical score for the song "Five Minutes More". It features a vocal line and a piano accompaniment. The score is annotated with chord diagrams and fingering numbers. The chords are categorized into Major 6th and Minor 7th.

Major 6th Chords (Red boxes):

- C6
- Db7
- C6
- E7
- F6

Minor 7th Chords (Blue boxes):

- A7
- Dm7
- D7
- G7
- Dm7

The lyrics are: "Five Min - utes More on - ly Five Min - utes More. Let me stay, — let me stay —"

Handwritten fingering numbers are present throughout the score, such as 3 4 2 in the piano part and 3 5 3 2 1 2 in the vocal part.

Page number: 36

Chords

Example: "Five Minutes More" (1946)

The image shows a musical score for the song "Five Minutes More" (1946). The score is written for voice and piano. The lyrics are: "in your arms Here am I beg - ging for on - ly Five Min - utes More, On - ly Five Min - utes More of your charms." The score is annotated with chord diagrams and labels. Red boxes highlight specific chords: C6 (Major 6th), D7, and F7. Blue boxes highlight Dm7 (Minor 7th) and G7. Handwritten annotations include "Major 6th" in red and "Minor 7th" in blue. The score is divided into two systems. The first system covers the lyrics "in your arms Here am I beg - ging for on - ly". The second system covers "Five Min - utes More, On - ly Five Min - utes More of your charms." The chords are: G7, C6, G11, C6, D7, C6, E7, F6, A7, Dm7, D7, G7, Dm7, G7, C6, F7.

Major 6th

Minor 7th

in your arms Here am I beg - ging for on - ly

Five Min - utes More, On - ly Five Min - utes More of your charms.

Chord diagrams shown: G7, C6, G11, C6, D7, C6, E7, F6, A7, Dm7, D7, G7, Dm7, G7, C6, F7.

Chords

Example: "A Man and a Woman" (1946)
Francis Lai (music) and Pierre Barouh (lyrics)

[Audio file](#)

Moderately

Dmaj7

Major 7th

When hearts are pass-ing in the night, In the lone-ly night.
si-lence of the mist, Of the morn-ing mist.

mp - mf

Detailed description: This block shows the first system of the musical score. It features a vocal line and a piano accompaniment. The tempo is marked 'Moderately'. A guitar chord diagram for Dmaj7 is shown above the vocal line. An orange box highlights a section of the piano accompaniment, with the text 'Major 7th' written above it. The lyrics are: 'When hearts are pass-ing in the night, In the lone-ly night. si-lence of the mist, Of the morn-ing mist.' The dynamic marking is *mp - mf*.

C#7

Then they must hold each oth-er tight, Oh so ver-y tight—
When lips are wait-ing to be kissed, Long-ing to be kissed,—

Detailed description: This block shows the second system of the musical score. It features a vocal line and a piano accompaniment. A guitar chord diagram for C#7 is shown above the vocal line. The lyrics are: 'Then they must hold each oth-er tight, Oh so ver-y tight— When lips are wait-ing to be kissed, Long-ing to be kissed,—'

Chords

Example: "A Man and a Woman" (1946)

The image displays two systems of musical notation for the song "A Man and a Woman" (1946). Each system includes a vocal line, a piano accompaniment, and guitar chord diagrams. The first system features a Cmaj7 chord diagram and the text "Major 7th" in orange. The second system features F#m7, B7, and Ema7 chord diagrams. Orange boxes highlight the piano accompaniment for the first system and the guitar chord diagrams for the second system.

System 1:

Chord: Cmaj7

Major 7th

Lyrics: — And take a chance that in the light In to - mor - row's light
— Where is the rea - son to re - sist And de - ny a kiss.

System 2:

Chords: F#m7, B7, Ema7

Lyrics: — They'll stay to - geth - er — So much in love. And in the
— That holds a prom - ise — Of hap - pi - ness.

1. Tacet

Chords

Example: "A Man and a Woman" (1946)

Skipping to the end of the song...

Major 7th

fraid to take the chance, Real-ly take a chance Let your heart be-gin to dance,
mu-sic of a glance Of a fleet-ing glance to the mu-sic of ro-mance,

1. 2.

Let it sing and dance to the take a chance.
Of a new ro-mance

Keys

- One can start a scale on any one of the 12 chromatic notes.
 - This produces the 12 **keys**.
- Some keys are more **distant** from the **tonic** key
 - Tonic key = the one we start the music in.
 - More distant keys have **fewer notes in common**.



Keys

Some closely related keys

[Audio file](#)

C major scale = tonic = I G major = dominant = V

Piano

The image shows a musical score for piano in 4/4 time. It consists of two systems of staves. The first system shows the C major scale (tonic, I) in the first two measures and the G major scale (dominant, V) in the next two measures. The second system shows the F major scale (subdominant, IV) in the first two measures and the A minor scale (relative minor, vi) in the next two measures. The piano part is written in treble and bass clefs.

7 F major = subdominant = IV A minor = relative minor = vi

Pno.

The image shows a musical score for piano in 4/4 time, starting at measure 7. It consists of two systems of staves. The first system shows the F major scale (subdominant, IV) in the first two measures and the A minor scale (relative minor, vi) in the next two measures. The piano part is written in treble and bass clefs.

Keys

- Western music likes travel & adventure...
 - Start at home (tonic)
 - Travel to other lands (other keys)
 - Return home (tonic)
- Much music moves from tonic to dominant to tonic (I-V-I)
 - The return to the tonic is a **cadence**.

Cadences

[Audio file](#)

Cadence with passing tone

Cadence with suspension

Piano

1 I V I V⁷ I I V I

Cadence with appoggiatura

Plagal cadence (amen)

Deceptive cadence

Pno.

8 I V I I IV I I V VI^b

Cadences

[Audio file](#)

[Audio file](#)

[Audio file](#)

Cadence with passing tone

Cadence with suspension

Piano

The musical score is for piano in 4/4 time and consists of three measures. The first measure shows a cadence with a passing tone: the right hand plays a half note chord (I), followed by a quarter note chord (V) with a passing tone (F#) in the right hand, and a half note chord (I). The second measure shows a cadence with a dominant 7th chord: the right hand plays a half note chord (V⁷) and a half note chord (I). The third measure shows a cadence with a suspension: the right hand plays a half note chord (I), followed by a quarter note chord (V) with a suspension (F#) in the right hand, and a half note chord (I). The left hand plays a simple accompaniment of quarter notes.

Dominant 7 chord derives from passing tone in I-V cadence

Cadences

[Audio file](#)

Cadence with appoggiatura

I V I

[Audio file](#)

Plagal cadence (amen)

I IV I

[Audio file](#)

Deceptive cadence

I V VI^b

8

Pno.

The musical score is written for piano (Pno.) and consists of three measures, each illustrating a different cadence type. The first measure shows a cadence with appoggiatura, with chords I, V, and I. The second measure shows a plagal cadence (amen), with chords I, IV, and I. The third measure shows a deceptive cadence, with chords I, V, and VI^b. The score is written in a grand staff with a treble and bass clef. The first measure has a fermata over the final chord. The second measure has a fermata over the final chord. The third measure has a fermata over the final chord.

Cadences

[Audio file](#)

Cadence with passing tone

Cadence with suspension

Piano

1 I V I V⁷ I I V I

Cadence with appoggiatura

Plagal cadence (amen)

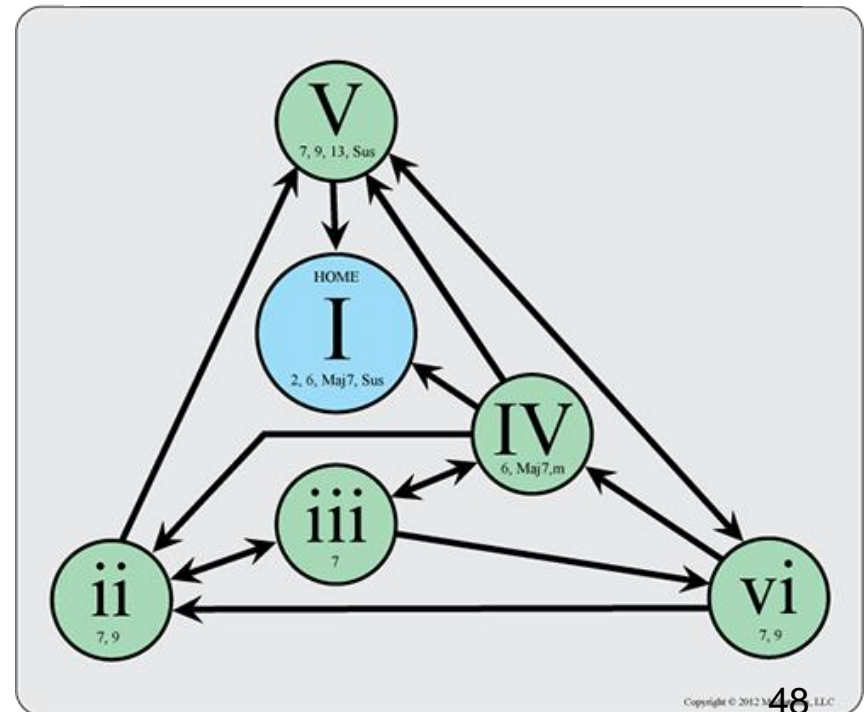
Deceptive cadence

Pno.

8 I V I I IV I I V VI^b

Cadences

- Dominant 7th chord is from V-I cadence
 - Passing tone creates 7th chord
 - Dominant 7th chord does not “lead to” tonic
- Harmony should flow organically from the music
 - Not be imposed from outside as a “standard” chord progression.



Cadences

Example: Adagio Cantabile from Pathétique Sonata L. van Beethoven (1798)

[Audio file \(performance\)](#)

[Audio file
\(excerpt\)](#)

$\text{♩} = 60$ I. Ab major - - - - - Bb⁷ V. Eb major - -

Piano

----- I. Ab --- F⁷ ii. Bb --- V. Eb --- I. Ab major (appoggiatura)

Pno.

Suspension

Example:
Agnus Dei
(from Adagio
or Strings)
Samuel Barber

G. Schirmer, Octavo No. 11486

Agnus Dei

ADAGIO FOR STRINGS, Op. 11, transcribed for mixed Chorus
with Organ or Piano Accompaniment

Samuel Barber

Molto adagio
molto espr.
pp

Soprano
A - gnus De -

Alto
A - gnus De -

Tenor
A - gnus De -

Bass
A - gnus De -

Organ or Piano*
Molto adagio
molto espr.
pp

Detailed description: This block shows the first system of the musical score. It includes staves for Soprano, Alto, Tenor, Bass, and Organ or Piano. The Soprano staff has a red circle around a note in the second measure. The tempo is 'Molto adagio' and the expression is 'molto espr.'. The dynamics are 'pp'.

[Audio file \(performance\)](#)

i, qui tol - lis pec - ca - ta mun -

i, qui tol -

i, qui tol - lis

i, qui tol -

i, qui tol -

Detailed description: This block shows the second system of the musical score. It includes staves for Soprano, Alto, Tenor, Bass, and Organ or Piano. The lyrics are 'i, qui tol - lis pec - ca - ta mun -', 'i, qui tol -', 'i, qui tol - lis', 'i, qui tol -', and 'i, qui tol -'. The dynamics are 'p'.

Suspension

Example:
Agnus Dei
(from Adagio
or Strings)
Samuel Barber

The image displays a musical score for the Agnus Dei movement from Samuel Barber's Adagio for Strings. The score is written in G minor (three flats) and 3/4 time. It features four vocal staves and a piano accompaniment. The lyrics are: "di, A - gnus De - i, qui tol - lis pec - ca - ta lis pec - ca - ta mun - di unis, pec - ca - ta mun - di, A - gnus De - i, A - gnus De - i, qui tol - lis pec - ca - ta mun - di, qui". A red circle highlights a suspension in the first vocal line, where a note is held over from the previous measure. The score includes dynamic markings such as *pp*, *mf*, *p*, and *molto espr.*, and performance instructions like "Solo Soprano".

Suspension

Example:
Agnus Dei
(from Adagio
or Strings)
Samuel Barber

The image displays a musical score for the Agnus Dei from Samuel Barber's Adagio for Strings. The score is written in G minor and 6/8 time. It features four vocal staves and a piano accompaniment. The lyrics are: "ca - ta, qui tol - lis pec - ca - ta mun - di, mi - se - re - i, qui tol - lis pec - ca - ta De - i, qui tol - lis, tol - lis pec - tol - lis pec - ca - ta re - no - bis, qui tol - lis, mun - di, A - gnus - ca - ta mun - di, qui tol - lis, mun - di, qui tol - lis". The score includes dynamic markings such as *mf*, *f*, *p*, *senza cresc.*, *più f sempre espr.*, and *unis.*. A red circle highlights a suspension in the third vocal staff, where a note is held over from the previous measure. The score is divided into two systems, with a circled 2 indicating the start of the second system.

Temperament

- There is a problem with playing all the keys with only 12 different notes.
 - The harmonic intervals are not exactly right.
- The pitches are adjusted so that every key is slightly out of tune.
 - The errors are the same in every key
 - **This is equal temperament.**



Temperament

Interval	Error
C-D (second)	Slightly flat
C-E (major third)	Sharp
C-F (fourth)	Slightly sharp
C-G (fifth)	Slightly flat
C-A (sixth)	Sharp
C-B (seventh)	Sharp

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 - **Someone did!**

Alternative Scales

- Advantages of 19-note chromatic were discovered during the Renaissance.
 - By Spanish organist and music theorist **Francisco de Salinas** (1530-1590).
 - Didn't catch on...



Just Tuning

Example: “Earth Song” for SATB Frank Ticheli (2006)

[Audio file \(choral performance\)](#)

[Audio file \(excerpt below\)](#)

$\text{♩} = 50$

Soprano
Alto
Tenor
Bass

Sing, Be, Live, See.

Sing, Be, Live, See.

Sing, Be, Live, See.

Sing, Be, Live, See.

The image shows a musical score for SATB voices in 4/4 time. The tempo is marked as quarter note = 50. The score is written for Soprano, Alto, Tenor, and Bass. The lyrics are "Sing, Be, Live, See." and are repeated for each voice part. The score includes just intonation tuning marks (double-headed arrows) above the notes, indicating specific intervals. The Soprano part starts on a whole note, followed by the Alto, Tenor, and Bass parts. The lyrics are written below the notes, with lines indicating the syllables. The score is in 4/4 time and features a variety of note values and rests.

Just Tuning

Example: “Earth Song” for SATB
Frank Ticheli (2006)

Ticheli's chord



[Audio file](#)

	Soprano/alto clash	Expand to maj 7th now consonant 4:6:10:15:16	Lower the 3rd still consonant 4:6:9:15:16	Drop root 6:9:15:16
Piano				

- The chord is **consonant** when performed with just tuning.
- Also, the A-B \flat clash produces a **beat note** that is exactly 2 octaves below the root B \flat .

Just Tuning

Example: “Alleluia” for SATB
Randall Thompson (1940)

Audio file

- Entire text consists of 2 words from Hebrew – *Alleluia, Amen*
- Performed by Octarium.
- Written for opening of Berkshire Music Center (Tanglewood)
- An example of how beautiful harmonious voices can be.
- Note major 6th chords (3 different inversions) just after climax (4:54, 5:08, 5:18)



Ozawa Hall, Tanglewood