

1-1-2021

Teaching Half-Diminished and Fully-Diminished Leading-Tone 7th Chords: Using a Pattern-based Approach

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Telesco, Paula J. (2021) "Teaching Half-Diminished and Fully-Diminished Leading-Tone 7th Chords: Using a Pattern-based Approach," *Journal of Music Theory Pedagogy*. Vol. 35, Article 12.
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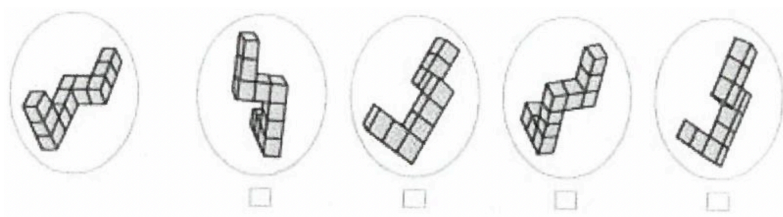
Teaching Half-Diminished and Fully-Diminished Leading-Tone 7th Chords: Using a Pattern-based Approach

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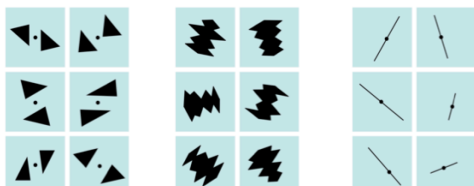
Recognizing and notating diatonic dominant-function leading-tone seventh chords often causes confusion for students. While the dominant 7th chord is identical in parallel major and minor keys, the leading-tone seventh is not. Leading-tone sevenths differ from dominant 7ths by just one note, yet students typically have difficulty spelling them. The attached set of materials offer a systematic pattern-based approach to spelling leading-tone seventh chords in major and minor keys, with four different but complimentary approaches.

This pattern-based pedagogical approach is taken because pattern recognition ability has been shown to be an important predictor of success in Music Theory courses. Nancy Rogers and Jane Clendinning have tested this correlation and their results are consistent with this assertion.¹ Rogers and Clendinning ran a study in which they administered “a battery of tests addressing basic numeracy, spatial skills, and pattern recognition.”² Their study included several standard tests such as the following:

1. Mental rotation of an object: students have to determine which of four objects are rotations of the original object. An example follows:



2. Geometric Invariants Test: students have to determine which of the six images in each group don't match the other five. An example follows:



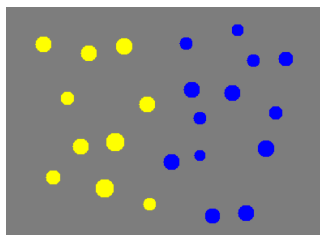
¹ Nancy Rogers, Jane Piper Clendinning, Sara Hart, and Colleen Ganley: “Specific Mathematical and Spatial Abilities Correlate with Music Theory Abilities,” *Proceedings of the 14th International Conference on Music Perception and Cognition*, 2014, http://www.icmpc.org/icmpc14/files/ICMPC14_Proceedings.pdf

² Much has been written about the relationship between music and mathematical abilities; see, for example, Barroso, Connie, Colleen M. Ganley, Sara A. Hart, Nancy Rogers, and Jane P. Clendinning, “The Relative Importance of Math- and Music-related Cognitive and Affective Factors in Predicting Undergraduate Music Theory Achievement,” *Applied Cognitive Psychology* 33 no. 5 (Sept. 1, 2019): 771–83, doi:10.1002/acp.3518.

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3. Approximate Number System Test: students were shown collections of intermixed blue and yellow dots, with five to twenty dots per color, for 600 milliseconds (ms) and had to determine whether there was a larger number of yellow dots or a larger number of blue dots. An example is shown below.



Rogers and Clendinning also devised specifically musical tests, such as their “Standard Music Notation Recognition Test.” Students saw images of common musical symbols for 500 ms and had to determine whether a given example of musical notation represented correct standard notation. A few examples follow:

1. Students had to determine whether the sharps and flats in key signatures were in the correct or incorrect order, or whether they were on the correct line or space:



2. Students had to determine whether individual notes had their stems and flags going in the correct direction:



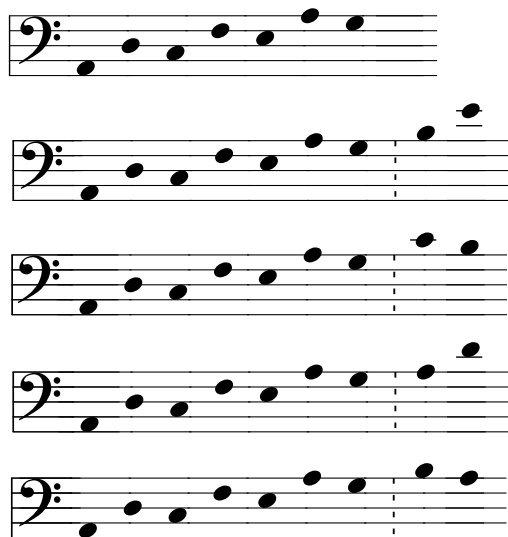
3. Students saw one-measure rhythms in either 3/4 or 6/8 and had to determine whether the beaming was correct for the given meter:



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Another specifically musical test was their “Musical Pattern Continuation Test.” This is analogous to the number sequence test whereby one has to determine the next number in a series of numbers. For example: 2, 4, 6 _____. Their “Musical Pattern Continuation Test” asks students to evaluate a given melodic pattern and then choose from four possible continuations the one that maintains the established melodic pattern. One such example is shown below:



Rogers and Clendinning say their “Musical Pattern Continuation Test” was the “single most successful measure” that predicted success in Music Theory, “correlating with performance in all music theory courses.”

Hence, it can be advantageous for students to be provided with exercises that are presented in such a way that a simple pattern can be grasped, thereby enabling them to learn and understand more fully a new concept. Such practice has the additional benefit of continuously sensitizing the student to the multitudinous patterns in music, an important skill for any musician to have. I have found that approaching all topics in a way that utilizes and reinforces pattern recognition to be a helpful strategy.

While there is an abundance of scientific and psychological literature available on pattern recognition, I have found no such research on how one can teach pattern recognition. There are various blog posts about doing number puzzles and object puzzles, much like the examples shown above, and several articles concerning using pattern recognition to teach piano to beginning students, but nothing concerning how to improve this ability for music theory studies.³ Nevertheless, I believe that approaching musical topics as this handout and worksheet do, utilizing a pattern-based approach, supports the development of pattern awareness.

³ One interesting post is the following from The Ohio State University, which condenses and summarizes the findings of a highly technical article, co-authored by one of their faculty members: Ohio State University, "This is your brain detecting patterns: It is different from other kinds of learning, study shows." ScienceDaily. www.sciencedaily.com/releases/2018/05/180531114642.htm (accessed June 10, 2021). The complete article is Arkady Kononov, Ian Krajbich, “Neurocomputational Dynamics of Sequence Learning,” *Neuron*, 2018; DOI: [10.1016/j.neuron.2018.05.013](https://doi.org/10.1016/j.neuron.2018.05.013)

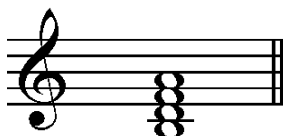
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Following are the four complimentary approaches recommended in this handout:

I. Notating Leading-Tone Seventh Chords in Keys Given the Key Signature

1. In a major key, the diatonic leading-tone seventh chord ($\text{vii}^{\circ 7}$) is a *half-diminished* seventh built on the leading tone, $\uparrow\hat{7}/\text{ti}$, a m2 below tonic. The chord comprises scale degrees $\uparrow\hat{7} \hat{2} \hat{4} \uparrow\hat{6}$ (*ti re fa la*).⁴ To notate this chord, one needs to first determine the leading tone, then add a diatonic 3rd, 5th and 7th above the root. In a major key, no accidentals are required because all necessary accidentals are included in the key signature:

C: $\text{vii}^{\circ 7}$

2. In a minor key, the diatonic leading-tone seventh chord ($\text{vii}^{\circ 7}$) is a *fully-diminished* seventh, likewise built on the leading tone, $\uparrow\hat{7}/\text{ti}$. (This is often a point of confusion for some students, who try to build a diminished 7th chord on the subtonic, $\downarrow\hat{7}/\text{te}$, the M2 below tonic). The chord comprises scale degrees $\uparrow\hat{7} \hat{2} \hat{4} \flat\hat{6}/\downarrow\hat{6}$ (*ti re fa le*). One needs to first add an accidental to the 7th scale degree to create a leading tone, then add a diatonic 3rd, 5th and 7th above the root. And again, other than the leading tone, no other accidentals are required because all necessary accidentals are included in the key signature:

c: $\text{vii}^{\circ 7}$

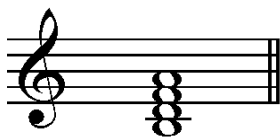
⁴ The symbol $\uparrow\hat{7}$ refers to the leading tone, a m2 below tonic. The symbol $\downarrow\hat{7}$ refers to the subtonic, a M2 below tonic in a minor key. The symbol $\uparrow\hat{6}$ refers to the major 6th scale degree, e.g., A \sharp in C major, while $\flat\hat{6}/\downarrow\hat{6}$ refers to the minor 6th scale degree in a minor key, e.g., A \flat in the key of c minor. The symbol $\hat{6}$ without an arrow refers to the 6th scale degree in general without specifically referring to a major or minor key.

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II. Notating Leading-Tone Seventh Chords in Keys Without a Key Signature: Intervals Above a Root

1. To notate the diatonic $vii^{\circ 7}$ in a major key without benefit of a key signature, one needs to first determine the leading tone, then add the specific intervals of a $m3$, $^{\circ}5$, and $m7$ above the root ($\uparrow\hat{7}$ $\hat{2}$ $\hat{4}$ $\uparrow\hat{6}$; *ti re fa la*). Various accidentals will be required for different keys:⁵

C: $vii^{\circ 7}$

2. To notate the diatonic $vii^{\circ 7}$ in a minor key without benefit of a key signature, one again needs to first determine the leading tone, then add the specific intervals of a $m3$, $^{\circ}5$, and $^{\circ}7$ above its root. Various accidentals will be required for different keys. Note that it is the 7th of the chord that differs between major and minor keys:

c: $vii^{\circ 7}$ **III. Notating Leading-Tone Seventh Chords as the Upper Three Notes of a V^7 , With an Added 7th**

A third approach to notating the diatonic $vii^{\circ 7}$ or $vii^{\circ 7}$ is to first recognize that the vii° triad in either a major or minor key is the upper three notes of the V^7 chord:

1. Spell a dominant 7th.
2. Omit the root ($\hat{5}/sol$)
3. In a major key, add a $m7$ ($\uparrow\hat{6}/la$) above the leading tone. This $m7$ is a $M2$ above the root of the V^7 —this is most easily seen when the V^7 is in first inversion (shown below).
4. In a minor key, add a $d7$ ($\flat\hat{6}/\downarrow\hat{6}/le$) above the leading tone. This $d7$ ($\flat\hat{6}/\downarrow\hat{6}/le$) is a $m2$ above the root of the V^7 , most easily seen when the V^7 is in first inversion.

⁵ The instructor is encouraged to stress that being able to spell a half-diminished seventh on any root is helpful for spelling not just the leading-tone seventh in a major key, but also the half-diminished supertonic seventh ($ii^{\circ 7}$) in a minor-key. Those chords are discussed in a separate handout.

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C: V⁷ vii^{°7}



c: V⁷ vii^{°7}



C: V₅[♭] vii^{°7}



c: V₅[♭] vii^{°7}

IV. Notating Leading-Tone Seventh Chords as the Upper Four Notes of a V⁹

Many musicians think of leading-tone 7th chords as dominant 9th chords with missing roots, and some instructors may choose to introduce the dominant 9th before introducing the leading-tone seventh.

1. The diatonic dominant 9th in a major key is a major-minor 7th with a *major* 9th. It has a M3, P5, m7, and M9 above its root, and comprises scale degrees $\hat{5} \uparrow \hat{7} \hat{2} \hat{4} \uparrow \hat{6}$ (*sol ti re fa la*). To notate vii^{°7} in a major key as part of a V⁹:

- (1) spell a dominant major 9th
- (2) omit the root

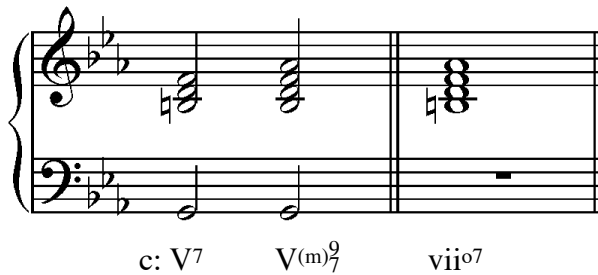


C: V⁷ V^{(M)9} vii^{°7}

2. The diatonic dominant 9th in a minor key is a major-minor 7th with a *minor* 9th. It has a M3, P5, m7, and m9 above its root, and comprises scale degrees $\hat{5} \uparrow \hat{7} \hat{2} \hat{4} \flat \hat{6} / \downarrow \hat{6}$ (*sol ti re fa le*). To notate vii^{°7} in a minor key:

- (1) notate a dominant minor 9th, remembering to include the leading tone
- (2) omit the root

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Layout of the Worksheets

The student handout below includes two worksheets. The instructor may choose to use one or both of them, or some of each. Answer keys are provided for each worksheet. These exercises can be done in class or assigned, or both. Students can notate their answers on the provided worksheets, or create their answers in a free notation program like Noteflight. Having access to a keyboard, whether an actual one or a virtual one as in Noteflight, or any number of free online keyboards, is very helpful. Here is the link to one such free keyboard: <https://virtualpiano.eu/>

In Worksheet 1, key signatures are provided and students are asked to notate leading-tone sevenths in every major and minor key, going successively up from C major and minor to B major and minor, and culminating with C \flat major. Worksheet 1 is the easier of the two worksheets since notating in a given key signature requires fewer steps (and less mental processing) than when notating without a key signature (as shown in approaches I and II above). The virtue of having students notate chords within a given key signature is that it allows them to see what a chord looks like in that key. Visual cues are vitally important to being able to read music and grasp “chunks,” or chords, rather than individual notes.⁶

In Worksheet 2, students are asked to notate the chords without benefit of a key signature. This requires more steps than notating within a key signature. Here, students must think in terms of intervals above a root (reinforcing intervallic thinking). Musicians need to be able to spell chords independent of a key signature and recognize certain groups of notes as comprising specific chords. This worksheet provides practice in that skill.

Patterns

Both worksheets are designed with the pedagogical goal of fostering students’ ability to recognize and take advantage of patterns as they notate chords, and to inculcate in them the habit of looking for patterns in music. There are several patterns that may be pointed out to students:

⁶ George A. Miller wrote the seminal article on “chunking,” our ability to grasp several items as one single grouped item. This allows us to process greater amounts of information at a time, rather than just one item at a time, as for example, the way we remember phone numbers or Social Security numbers. See Miller, “The magical number seven, plus or minus two: some limits on our capacity for processing information,” *Psychological Review* 63, no. 2 (1956): 81–97. doi:10.1037/h0043158.

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Worksheet 1: Key Signatures Included

1. Transposing between keys with the same letter name

When transposing up from one major key to another with the same letter name (C major to C# major, for example), the letter names of the chord tones will be the same in each key. So for example, the chordal tones in C major are B, D, F, A, while in C# major they are B#, D#, F#, A#, but no accidentals need to be added because they are already included in the key signature:

C: vii^o7 C#: vii^o7

The same is true in minor with respect to the letter names, but an accidental is required for the leading tone. If the the leading tone was a natural note in the first chord, it will be a sharp in the second chord:

c: vii^o7 c#: vii^o7

2. Transposing between keys with different letter names

When transposing up by step from one letter name to another, all notes move up by one line or space. So for example, when moving from C# to D, letter names B, D, F, A (space notes) move up to C, E, G, B (line notes). And again, no accidentals need to be added because they are already included in the key signature:

C#: vii^o7 D: vii^o7

The same is true for minor keys. All notes move up by one line or space to the next letter name, and an accidental is needed for the leading tone. If the the leading tone was a natural note in the first chord, it will be a sharp in the second chord:

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c: vii^o7 d: vii^o7

Worksheet 2: No Key Signatures Included

1. Keys with the same letter name

When transposing up from one key to another with the same letter name (E \flat major to E major, for example), the letter names of the chord tones will be the same in each key (just as they were in Worksheet 1), but now accidentals will need to be added. Everything is transposed up by an augmented unison, meaning all flats become naturals and all naturals become sharps. This applies to both major and minor keys. When approached this way, it can help make spelling chords in keys with many sharps or flats a bit less intimidating:

E \flat : vii^o7 E: vii^o7

e \flat : vii^o7 e: vii^o7

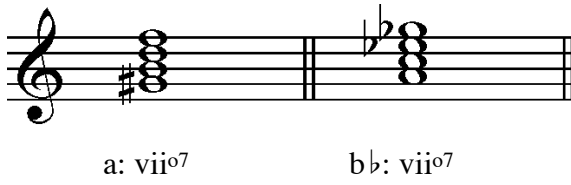
2. Keys with different letter name

When transposing up by step from one key to another with different letter names, all notes move up by one line or space to the next letter name by the same amount, either a M2 or a m2. So for example, when moving up a M2 from F major to G major, letter names/line notes E, G, B \flat , D move to F \sharp , A, C, E (space notes); when moving up a m2 from A minor to B \flat minor, letter names G \sharp , B, D, F move to A, C, E \flat , G \flat . This applies to both major and minor keys:

F: vii^o7 G: vii^o7

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The student handout and worksheets follow.

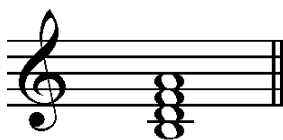
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Diatonic leading-tone seventh chords are dominant-function chords. However, while the dominant 7th chord (V^7) is identical in parallel major and minor keys, the leading-tone seventh is not. This handout and attached worksheets offer a systematic pattern-based approach to spelling leading-tone seventh chords in major and minor keys, with four different but complimentary approaches. This pattern-based pedagogical approach is taken because pattern recognition ability has been shown to be an important predictor of success in Music Theory courses. These worksheets are therefore designed to take advantage of patterns to assist the student in learning to recognize and spell these chords.

In both major and minor keys, leading-tone sevenths are always built on the leading tone, $\uparrow\hat{7}/ti$, the m2 below tonic, but never on the subtonic, or lowered 7th scale degree, $\downarrow\hat{7}/te$, the M2 below tonic. There are four different approaches you can use to spell these chords:

I. Notating Leading-Tone Seventh Chords in Keys Given the Key Signature

1. In a major key, the diatonic leading-tone seventh chord ($vii^{\circ 7}$) is a *half-diminished* seventh built on the leading tone, $\uparrow\hat{7}/ti$, a m2 below tonic. The chord comprises scale degrees $\uparrow\hat{7} \hat{2} \hat{4} \uparrow\hat{6}$ (*ti re fa la*).¹ To notate this chord, one needs to first determine the leading tone, then add a diatonic 3rd, 5th and 7th above the root. In a major key, no accidentals are required because all necessary accidentals are included in the key signature:



C: $vii^{\circ 7}$

2. In a minor key, the diatonic leading-tone seventh chord ($vii^{\circ 7}$) is a *fully-diminished* seventh, likewise built on the leading tone, $\uparrow\hat{7}/ti$, a m2 below tonic. The chord comprises scale degrees $\uparrow\hat{7} \hat{2} \hat{4} \flat\hat{6}/\downarrow\hat{6}$ (*ti re fa le*). One needs to first add an accidental to the 7th scale degree to create a leading tone, then add a diatonic 3rd, 5th and 7th above the root. And again, other than the leading tone, no other accidentals are required because all necessary accidentals are included in the key signature:

¹ The symbol $\uparrow\hat{7}$ refers to the leading tone, a m2 below tonic. The symbol $\downarrow\hat{7}$ refers to the subtonic, a M2 below tonic in a minor key. The symbol $\uparrow\hat{6}$ refers to the major 6th scale degree, e.g., $A\sharp$ in C major, while $\flat\hat{6}/\downarrow\hat{6}$ refers to the minor 6th scale degree in a minor key, e.g., $A\flat$ in the key of c minor. The symbol $\hat{6}$ without an arrow refers to the 6th scale degree in general without specifically referring to a major or minor key.

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c: vii^{o7}

II. Notating Leading-Tone Seventh Chords in Keys Without a Key Signature: Intervals Above a Root

1. To notate the diatonic vii^{o7} in a major key without benefit of a key signature, one needs to first determine the leading tone ($\hat{7}/ti$), then add the specific intervals of a m3, ^o5, and m7 above the root ($\uparrow\hat{7} \hat{2} \hat{4} \uparrow\hat{6}$; *ti re fa la*). Various accidentals will be required for different keys:²



C: vii^{o7}

2. To notate the diatonic vii^{o7} in a minor key without benefit of a key signature, one again needs to first determine the leading tone ($\uparrow\hat{7}/ti$), then add the specific intervals of a m3, ^o5, and ^o7 above its root. Various accidentals will be required for different keys. Note that it is the 7th of the chord that differs between major and minor keys:



c: vii^{o7}

III. Notating Leading-Tone Seventh Chords as the Upper Three Notes of a V⁷, With an Added 7th

A third approach to notating the diatonic vii^{o7} or vii^{o7} is to first recognize that the vii^o triad in either a major or minor key is the upper three notes of the V⁷ chord:

1. Spell a dominant 7th.
2. Omit the root ($\hat{5}/sol$)
3. In a major key, add a m7 ($\uparrow\hat{6}/la$) above the leading tone. This m7 is a M2 above the root of the V⁷—this is most easily seen when the V⁷ is in first inversion (shown below).

² Note that being able to spell a half-diminished seventh on any root is helpful for spelling not just the leading-tone seventh in a major key, but also the half-diminished supertonic seventh (ii^{o7}) in a minor-key. Those chords are discussed in a separate handout.

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4. In a minor key, add a d7 ($\flat\hat{6}/\downarrow\hat{6}/le$) above the leading tone. This d7 ($\flat\hat{6}/\downarrow\hat{6}/le$) is a m2 above the root of the V^7 , most easily seen when the V^7 is in first inversion.



C: V^7 $vii^{\circ 7}$



c: V^7 $vii^{\circ 7}$



C: $V^{\frac{6}{3}}$ $vii^{\circ 7}$



c: $V^{\frac{6}{3}}$ $vii^{\circ 7}$

IV. Notating Leading-Tone Seventh Chords as the Upper Four Notes of a V^9

Many musicians think of leading-tone 7th chords as dominant 9th chords with missing roots, and some instructors may choose to introduce the dominant 9th before introducing the leading-tone seventh.

1. The diatonic dominant 9th in a major key is a major-minor 7th with a *major* 9th. It has a M3, P5, m7, and M9 above its root, and comprises scale degrees $\hat{5} \uparrow \hat{7} \hat{2} \hat{4} \uparrow \hat{6}$ (*sol ti re fa la*). To notate $vii^{\circ 7}$ in a major key as part of a V^9 :

- (1) spell a dominant major 9th
- (2) omit the root ($\hat{5}/sol$)



C: V^7 $V^{(M)9}$ $vii^{\circ 7}$

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2. The diatonic dominant 9th in a minor key is a major-minor 7th with a *minor* 9th. It has a M3, P5, m7, and m9 above its root, and comprises scale degrees $\hat{5} \uparrow \hat{7} \hat{2} \hat{4} \flat\hat{6}/\downarrow\hat{6}$ (*sol ti re fa le*). To notate $\text{vii}^{\circ 7}$ in a minor key:

- (1) notate a dominant minor 9th, remembering to include the leading tone
- (2) omit the root ($\hat{5}/\text{sol}$)

The image shows a musical staff with two systems. The first system contains two chords: a dominant 7th chord (V7) and a dominant minor 9th chord (V(m)9). The second system contains a fully diminished 7th chord (vii°7). The chords are written in C minor (three flats). The V7 chord has notes G4, Bb4, D5, F5. The V(m)9 chord has notes G4, Bb4, D5, F5, Ab5. The vii°7 chord has notes F5, Ab5, Bb5, D6. The bass line shows the root notes: G4, G4, and F5.

c: V⁷ V^{(m)9} vii^{°7}

In the following two worksheets, you will be spelling half-diminished and fully-diminished seventh chords. They are presented in two different ways, and your instructor may choose to have you do one way, both, or some of each.

1. In Worksheet 1, key signatures are provided and you will be notating leading-tone sevenths in root position in every major and minor key, going successively up from C major and minor to B major and minor, and culminating with C \flat major. Notating chords within a given key signature allows you to see what a chord looks like in that key. Visual cues are vitally important to being able to read music and grasp “chunks,” or chords, rather than individual notes.³
2. In Worksheet 2, you will be notating these chords in root position in every major and minor key, going successively up from C major and minor to B major and minor, and culminating with C \flat major, but without the benefit of a key signature. Here, you must think in terms of specific intervals above a root. Musicians need to be able to spell chords independent of a key signature and recognize certain groups of notes as comprising specific chords. This worksheet provides practice in that skill.

Patterns

There are several patterns you should be aware of as you do these worksheets. Recognizing these patterns will help you spell the chords, and help you to start seeing the larger picture—to recognize chords as units, rather than just individual notes. These patterns are noted below:

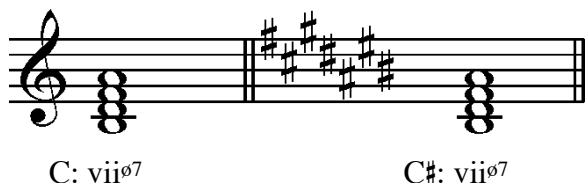
³ George A. Miller wrote the seminal article on “chunking,” our ability to grasp several items as one single grouped item. This allows us to process greater amounts of information at a time, rather than just one item at a time, as for example, the way we remember phone numbers or Social Security numbers. See Miller, “The magical number seven, plus or minus two: some limits on our capacity for processing information,” *Psychological Review* 63, no. 2 (1956): 81–97. doi:10.1037/h0043158.

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 Student Handout and Worksheets
 Dr. Paula Telesco

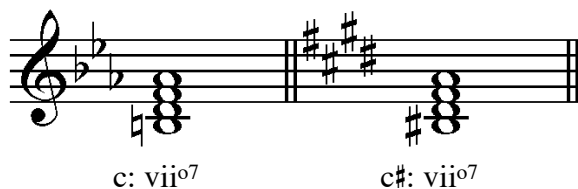
Worksheet 1: Key signatures included

1. Transposing between keys with the same letter name

When transposing up from one major key to another with the same letter name (C major to C# major, for example), the letter names of the chord tones will be the same in each key. So for example, the chordal tones in C major are B, D, F, A, while in C# major they are B#, D#, F#, A#, but no accidentals need to be added because they are already included in the key signature:

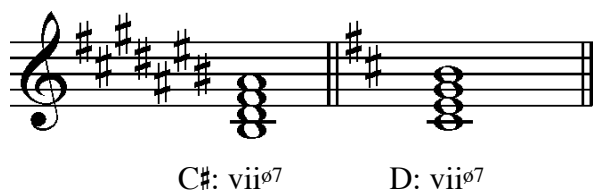


The same is true in minor with respect to the letter names, but an accidental is required for the leading tone. If the the leading tone was a natural note in the first chord, it will be a sharp in the second chord:



2. Transposing between keys with different letter names

When transposing up by step from one letter name to another, all notes move up by one line or space. So for example, when moving from C# to D, letter names B, D, F, A (space notes) move up to C, E, G, B (line notes). And again, no accidentals need to be added because they are already included in the key signature:



The same is true for minor keys. All notes move up by one line or space to the next letter name, and an accidental is needed for the leading tone. If the the leading tone was a natural note in the first chord, it will be a sharp in the second chord:

Notating Half-Diminished and Fully-Diminished Leading-Tone 7th Chords: Using a Pattern-based Approach

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c: vii^o7 d: vii^o7

Worksheet 2: No Key Signatures Included

1. Keys with the same letter name

When transposing up from one key to another with the same letter name (E^b major to E major, for example), the letter names of the chord tones will be the same in each key (just as they were in Worksheet 1), but now accidentals will be needed. Everything is transposed up by an augmented unison, meaning all flats become naturals and all naturals become sharps. This applies to both major and minor keys. When approached this way, it can help make spelling chords in keys with many sharps or flats a bit less intimidating:

E^b: vii^o7 E: vii^o7

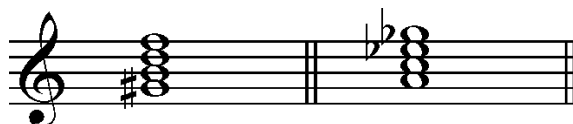
e^b: vii^o7 e: vii^o7

2. Keys with different letter name

When transposing up by step from one key to another with different letter names, all notes move up by one line or space to the next letter name by the same amount, either a M2 or a m2. So for example, when moving up a M2 from F major to G major, letter names E, G, B^b, D move to F[#], A, C, E (space notes); when moving up a m2 from A minor to B^b minor, letter names G[#], B, D, F move to A, C, E^b, G^b. This applies to both major and minor keys:

F: vii^o7 G: vii^o7

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a: vii^o7

b \flat : vii[°]7

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Worksheet I

Notate the requested leading-tone 7th chords in root position in each key. Determine the leading tone (the root of the chord), then add a diatonic 3rd, 5th and 7th above it. In a major key, no accidentals are required because all necessary accidentals are included in the key signature. In a minor key, you must add an accidental for the leading tone.

A musical staff in treble clef showing four leading-tone 7th chords in root position. The first two are in C major (C: vii^o7 and c: vii^o7) and the last two are in C minor (C#: vii^o7 and c#: vii^o7). Each chord is represented by a vertical line of notes on the staff.

C: vii^o7

c: vii^o7

C#: vii^o7

c#: vii^o7

A musical staff in treble clef showing four leading-tone 7th chords in root position. The first two are in D major (D: vii^o7 and d: vii^o7) and the last two are in D minor (D#: vii^o7 and d#: vii^o7). Each chord is represented by a vertical line of notes on the staff.

D: vii^o7

d: vii^o7

D#: vii^o7

d#: vii^o7

A musical staff in treble clef showing four leading-tone 7th chords in root position. The first two are in E major (E: vii^o7 and e: vii^o7) and the last two are in E minor (E#: vii^o7 and e#: vii^o7). Each chord is represented by a vertical line of notes on the staff.

E: vii^o7

e: vii^o7

E#: vii^o7

e#: vii^o7

A musical staff in bass clef showing four leading-tone 7th chords in root position. The first two are in F major (F: vii^o7 and f: vii^o7) and the last two are in F minor (F#: vii^o7 and f#: vii^o7). Each chord is represented by a vertical line of notes on the staff.

F: vii^o7

f: vii^o7

F#: vii^o7

f#: vii^o7

A musical staff in bass clef showing four leading-tone 7th chords in root position. The first two are in G major (G: vii^o7 and g: vii^o7) and the last two are in G minor (G#: vii^o7 and g#: vii^o7). Each chord is represented by a vertical line of notes on the staff.

G: vii^o7

g: vii^o7

G#: vii^o7

g#: vii^o7

A musical staff in bass clef showing four leading-tone 7th chords in root position. The first two are in A major (A: vii^o7 and a: vii^o7) and the last two are in A minor (A#: vii^o7 and a#: vii^o7). Each chord is represented by a vertical line of notes on the staff.

A: vii^o7

a: vii^o7

A#: vii^o7

a: vii^o7

a#: vii^o7

A musical staff in bass clef showing four leading-tone 7th chords in root position. The first two are in B major (B: vii^o7 and b: vii^o7) and the last two are in B minor (B#: vii^o7 and B#: vii^o7). Each chord is represented by a vertical line of notes on the staff.

B: vii^o7

b: vii^o7

B: vii^o7

b: vii^o7

B#: vii^o7

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Answer key to Worksheet I

C: vii^o7 c: vii^o7 C#: vii^o7 c#: vii^o7

Db: vii^o7 D: vii^o7 d: vii^o7 d#: vii^o7

Eb: vii^o7 eb: vii^o7 E: vii^o7 e: vii^o7

F: vii^o7 f: vii^o7 F#: vii^o7 f#: vii^o7

Gb: vii^o7 G: vii^o7 g: vii^o7 g#: vii^o7

Ab: vii^o7 ab: vii^o7 A: vii^o7 a: vii^o7 a#: vii^o7

Bb: vii^o7 bb: vii^o7 B: vii^o7 b: vii^o7 Cb: vii^o7

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Worksheet 2

Notate the requested half-diminished and fully-diminished 7th chord on each given note, which is the leading tone in each given key. Be sure to include all necessary accidentals. Do not use key signatures. Remember that a half-diminished seventh has a m3, °5, and m7 above the root, and a fully-diminished seventh chord has a m3, °5, and °7 above the root.

C: vii^ø7 c: vii^ø7 C#: vii^ø7 c#: vii^ø7

Db: vii^ø7 D: vii^ø7 d: vii^ø7 d#: vii^ø7

Eb: vii^ø7 eb: vii^ø7 E: vii^ø7 e: vii^ø7

F: vii^ø7 f: vii^ø7 F#: vii^ø7 f#: vii^ø7

Gb: vii^ø7 G: vii^ø7 g: vii^ø7 g#: vii^ø7

Ab: vii^ø7 ab: vii^ø7 A: vii^ø7 a: vii^ø7 a#: vii^ø7

Bb: vii^ø7 bb: vii^ø7 B: vii^ø7 b: vii^ø7 Cb: vii^ø7

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Answer key to Worksheet 2

C: vii^o7 c: vii^o7 C#: vii^o7 c#: vii^o7

Db: vii^o7 D: vii^o7 d: vii^o7 d#: vii^o7

Eb: vii^o7 eb: vii^o7 E: vii^o7 e: vii^o7

F: vii^o7 f: vii^o7 F#: vii^o7 f#: vii^o7

Gb: vii^o7 G: vii^o7 g: vii^o7 g#: vii^o7

Ab: vii^o7 ab: vii^o7 A: vii^o7 a: vii^o7 a#: vii^o7

Bb: vii^o7 bb: vii^o7 B: vii^o7 b: vii^o7 Cb: vii^o7