TWELVE-TONE COMPOSITION, Part One

Basic twelve-tone operations

Twelve-tone music is based on a series of pitches (row) that contains all twelve pitch classes with no recurrences. Any pitch can be reiterated until the next pitch class in the series occurs.

Example 1 is a row extracted from Schoenberg's first twelve-tone composition. The pitches are numbered according to their position in the chromatic scale beginning on E. E is numbered 0 because it is the first note of the row or the reference pitch. The pitch class numbers of the remaining notes indicated their distance above E in half-steps.

Example 1: Row from Suite, Op. 25, Schoenberg

Forms of the Row

A row is an ordered set of pitches that is also called a twelve-tone row, set, or series. Forms of this ordered set include the original row (Prime), its inversion, retrograde, and retrograde-inversion. Each of these forms can begin on any of the twelve pitch classes; that is, each can be transposed to eleven other pitch levels.

The prime version of the row (also call original) is a collection of pitches in a specific order. In reference to a twelve-tone row, "prime" means "original form," a different meaning than the "prime form" of an unordered set discussed in the previous chapter. The retrograde form of the row is created by writing the notes in the original version in reverse order.

The inversion form is the melodic inversion of the original, all intervals written upside down, all interval directions changed. The Retrograde inversion is created by writing all of the notes of the inversion in reverse order.

Modulo 12 Operations

One can use modulo 12 arithmetic to describe any form of a row. It can also be used to transform one form of a row to another form. For example, complete a transposition by adding the number of the transposing interval to the pitch class number (transposition = PC number + T number, mod 12). Complete an inversion by subtracting the pitch class number from 12 (inversion = 12 - PC number, mod 12). Write the retrograde by reversing the order of the pitch class numbers. Write the retrograde-inversion by reversing the order of pitch class numbers in the inversion.

The Reference Pitch

The reference pitch of the original and inversion forms is always the first note. The first pitch in the untransposed original and its inversion is always numbered 0. The first pitch of any transposition is always 0 plus the interval number of the transposition , modulo 12.

The first pitch of the original is the last pitch of the retrograde, thus, the reference pitch of the retrograde and the retrograde inversion forms is always the last note. The last pitch of any transposition of the retrograde or a retrograde inversion is always 0 plus the transposition interval number.

The Twelve-Tone Matrix

Any twelve-tone composition is based on several forms of a row. One can easily create and refer to a table of row forms when analyzing or composing a serial composition. This table is called variously a twelve-tone matrix, twelve-by-twelve array, or magic square.

The steps below describe how to construct a twelve-tone matrix on a twelve-by-twelve grid (see example 2)
1. Write the untransposed original version in first row of the grid. Include the pitch class numbers.

2. Subtract the pitch class numbers of the original version from 12 to produce the pitch class numbers of the inversion. Translate these numbers into pitch names and write the inversion in first column of the grid. Include the pitch class numbers.

3. Write all transpositions of the original form using the pitch class number in the first column as the reference pitch for the transposition. Complete the transpositions by adding the number at the beginning of each row to the pitch class numbers of the original row. If the result is greater than 11, subtract 12.

4. The left-to-right diagonal will contain only PCØ if all operations are correct.

Example 2: The first steps in making a twelve-tone matrix (Op. 25 row).

<table>
<thead>
<tr>
<th>PC nº: 8 1 3 9 2 11 4 10 7 8 5 6</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>C#</th>
<th>F#</th>
<th>D#</th>
<th>G#</th>
<th>D</th>
<th>B</th>
<th>C</th>
<th>A</th>
<th>B♭</th>
</tr>
</thead>
<tbody>
<tr>
<td>Po, original row Add 11 to every PC number in Po Add 9 → Add 3 → Add 10 → Add 1 → Add 8 → Add 2 → Add 5 → Add 4 → Add 7 → Add 6 →</td>
<td>D#</td>
<td>11</td>
<td>E</td>
<td>0</td>
<td>C#</td>
<td>9</td>
<td>E</td>
<td>0</td>
<td>G</td>
<td>3</td>
<td>E</td>
<td>0</td>
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<td></td>
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<td>F</td>
<td>1</td>
<td></td>
<td>E</td>
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<td></td>
<td>D</td>
<td>10</td>
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<td>E</td>
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<td>B♭</td>
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<td></td>
<td>E</td>
<td>0</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>E</td>
</tr>
</tbody>
</table>

The pitch class number in any square is the sum of the numbers at the beginning of its row and the top of its column. Subtract 12 from any integer larger than 11. The top-to-bottom diagonal always contains PCØ. This is true of all rows, so use this as a proof of accuracy.

To complete the matrix in columns instead or rows, add the number in the first column to each pitch class number in
the first column. The number at the top of each column serves as the reference pitch for each transposition of the inversion.

When the matrix is complete, one can find any retrograde form by reading a row backwards (right to left). One can find any retrograde inversion form by reading an inversion backwards (bottom to top). The reference pitch of the prime and retrograde forms is always in the first column. The reference pitch of the inversion and the retrograde inversion is always in the top row.

For example, the bottom row of the grid contains P6 and R6. The right-most column contains I6 and RI6. The transposition interval of all these forms is 6, expressed as T6.

Kinds of Rows

Sets Containing Tonal Cells

Serial music is sometimes regarded as atonal because, in theory, equal emphasis on all twelve tones will create a state in which no tonal focus can be heard. In reality, tonal focus is difficult to avoid. Most small collections of intervals focus on a particular pitch. One can diffuse this focus by avoiding recurring emphasis on particular pitches or by avoiding interval root reinforcement in a cell. Actually, serial music can be tonal if the composer emphasizes tonal cells. A tonal cell contains a root. Examine any row to see if tonal cells are part of its nature. Rhythmic emphasis on the root of a cell will underscore its tonal nature.

Tonal cells are circled in example 3. Each cell is bound by a perfect fifth. Arrows show the roots of these fifths. The first four cells intersect (overlap) by one note. Each intersection contains the root of a cell. The notes in the fifth cell, a C# major triad, are marked with a bracket because this cell intersects deeper into the previous cell than the others.

Example 3: A set containing tonal cells (row from Violin Concerto, Alban Berg, 1935)

The next passage outlines tonic to dominant progressions in two minor keys (see row in Example 3). The numbers by the notes indicate their order in the row.

Example 4: Violin Concerto, mm11-14 Alban Berg

The row in example 6 is organized in three tetrachords that suggest the keys of D minor, C minor, and C# minor respectively. The root of each tetrachord cell is marked with an arrow. Each root is the first strong interval root in the tetrachord. Possible secondary roots are indicated by arrows enclosed in parenthesis.

Example 5: Series of Liberty Row from Il Prigioniero Dallapiccola

Example 6 contains a harmonization of two semitone patterns, E♭-D and F-E. Another semitone pattern, A♯-B, is a pedal. The excerpt begins with strong focus on B. The number by each note indicates its order in the original row (see example 9).

Example 6: Quaderno musicale di Annalibera 1952, no. 1, Simbolo Dallapiccola
In spite of sharp dissonances, the passage in example 7 has the effect of an authentic cadence in E♭. The original row is shown in example 15.

Example 7: Ode to Napoleon, Op. 41 Schoenberg

All-Interval Sets

A series of pitches is also a series of intervals. A row (as an ordered collection of intervals) can be designed to emphasize certain intervals. The rows in examples 8 and 9 contain a sequence of every interval.

Example 8: Row in Song and Lyric Suite Berg

Example 9: Row from Quaderno Musicale di Annalibera, No. 6, Fregi, mm1-4 Luigi Dallapiccola

Symmetrical Sets
The intervals in example 11 are arranged in a symmetrical pattern. The brackets link corresponding intervals in the two halves of the row. The second hexachord of this row is a retrograde inversion of the first hexachord. Any set that has this feature will have interval symmetry like that shown here. Webern used similar sets in his Symphony, Op. 21; Cantata 1, Op.29; and, Variations for Orchestra, Op. 30.

Example 11: Symmetrical row in Quartet Op. 28 Webern

![Symmetrical row in Quartet Op. 28 Webern](image)

The intervals in the next row (example 12) occur in order of increasing size. When the intervals are identified by interval classes numbers, the retrograde-inversion symmetry becomes apparent.

Example 12: Symmetrical all-interval set in Il canto sospeso Nono

![Symmetrical all-interval set in Il canto sospeso Nono](image)

Set Class Content

A row is also a sequence of set classes. Set classes contribute to a row's unique identity and melodic/harmonic potential. Set inventories (set typing) can be used to arrange the possibilities into a catalog of fewer genres, creating a more manageable situation. This arrangement also helps reveal the composer's method. For example, both Schoenberg and Webern deliberately created rows of transformations of one kind of subset (see examples 13 and 14).

To inventory the set classes contained a row, all sets must be placed in normal form. This is the first step toward finding their prime form. The lowest pitch in normal form is indicated by the integer 0 (i.e. 0 1 4).

The integers indicate the relative distance above a reference pitch in half steps. The numbers also represent an inventory of the intervals in the pattern. For example, the trichord 0 1 4 contains a minor second and a major third above the reference pitch.

Prime form is the most compact version of a set and its inversion. Prime form is written in parenthesis, (0 1 4), the lowest note always 0.

Example 13 contains a row based on recurrences of the set class 0 1 4. The notes in each trichord are arranged in normal form (low-to-high order) in the second staff. The third staff contains the prime form of the trichords. Normal and prime forms are identical in the first and third trichords. The third staff is not a twelve-tone row.


![Row in Concerto for Nine Instruments, Op. 24 Webern](image)

The row in example 14 was also based on one set class 0 1 4. As in example 13, the prime form of the second and fourth trichords is the inversion of the normal form. The third staff illustrates prime forms and is not a twelve-tone row. Compare examples 13 and 14.

Example 14: Row in Ode to Napoleon, Op. 41 Schoenberg

![Row in Ode to Napoleon, Op. 41 Schoenberg](image)
Derived Set

A derived set consists of variations of the first few notes of the row. The previous two examples were derived sets. Examples 15 and 16 show how these rows were derived from the first trichord. The abbreviations indicate various forms of the row (PØ= untransposed original, RI7 is the retrograde inversion at T7, R6 is the retrograde at T6, and I1 is the inversion at T1). The arrows point to the reference pitches which are the first note in P and I form and the last note in R and RI forms.


All trichords and hexachords are derived in example 16 (HØ = the original untransposed hexachord, H2 = the hexachord at T2)

Example 16: Derived set in Ode to Napoleon Op. 41 Schoenberg

The next row (example 17) has both tetrachord and hexachord divisions. The second tetrachord is also R4, and the third as RI9.

Example 17: Derived set in Op. 28 Webern

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