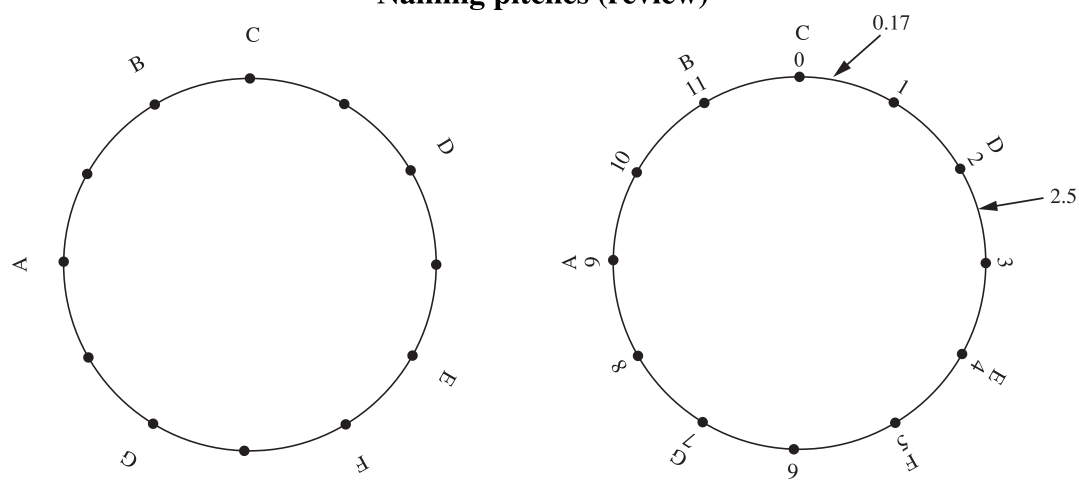
MU 209 Handout 1 (adapted from material by Dmitri Tymoczko, Princeton University)

Naming pitches (review)

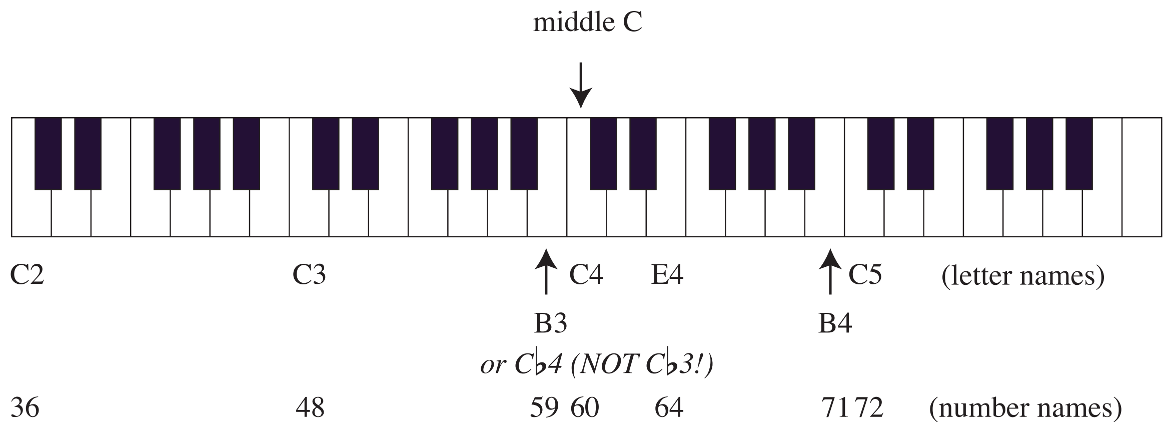


1. Pitch and pitch class. A *pitch* is a specific note, like middle C or the G a perfect fifth above it. A *pitch class* is a note type, like “C” or “G”—it’s what we end up with when we ignore what octave pitches are in. Pitches live on a line, while pitch classes live on a circle. (Pitch is like time, whereas pitch class is like time-of-day.) Note Western music divides the pitch-class circle into 12 units, just like an ordinary clock, meaning you’re never far from a model of pitch-class space.

2. Naming pitch classes. We have two systems for naming pitch classes: letters and numbers. Letters came first, and only the white notes have their own letter names. The black notes (like C♯) have to be named relative to some other pitch class. Note that every pitch class has an infinite number of letter names: C, B♯, A♯♯♯, etc. By contrast, in the numerical system every pitch class has a unique name (C = 0, C♯/D♭ = 1, D = 2, etc.). We can assign names even to pitch classes not found on the ordinary piano keyboard (for instance, the pitch class 2.5 is halfway between D and E♭.)

3. Naming pitches. We can use a similar system to label pitches: the most common method, *scientific pitch notation*, combines a letter name with a number indicating what octave a note is in; middle C is given the octave number 4, as are all notes less than an octave above it. **NB:** accidentals are applied *after* the letter and number are combined to generate a pitch: the note just below middle C can be labeled either B3 or C♭4! Similarly, C4 can also be called B♯3! This is terribly confusing but there it is.

It is also possible to use numbers to label pitches. Here middle C is given the number 60, the C♯ above that is 61, the D above that is 62, and so forth. To go from pitch numbers to pitch class numbers divide by 12 and keep only the remainder.



4. Naming intervals. An *interval* is a musical distance. Intervals can be named relative to letter names and relative to pitch numbers. Numerical pitch labels are the simplest, but they are less commonly used: the interval between middle C (C4, pitch number 60) and the D immediately above it (D4, pitch number 62) is *two ascending semitones*. The interval between D4 (62) and G3 (55) below it is *seven descending semitones*. To find the interval between two notes just count keys on a keyboard, or frets on a guitar, or …

As you know, the most common way to talk about musical distance (intervals) is a letter-based system. The interval between interval between any C (such as C♯4 or C♭4) and any D immediately above it (such as D♯4) is an ascending *second*. Believe it or not, this is because C and D are *one* letter name apart. Similarly, the interval between any C and any form of the E immediately above that is called an ascending *third*–because they are *two* letter notes apart. Note that a second is not necessarily smaller than a third: the interval C–D♯ is an *augmented second,* which is larger than the interval C♯-E♭, a *diminished third*.

Strictly speaking, this system is defined only for notated music. We cannot identify the letter-based interval between two notes just by listening.

SCALES!

I. Scales and musical distance. Abstractly, a scale determines a unit of musical distance, the *scale step*. In the scale C-D-E-F-G-A-B-C, the note D is one scale step above C. The note E is two scale steps, or a *third,* above C. F is three scale steps, or a *fourth,* above C. And so on. We can refer to this sort of distance, measured along the scale, as *scalar distance*.

We can transform any scalar passage by shifting each of its notes by the same number of scale steps. This process is called *scalar transposition* or transposition within the scale. For instance, we transform C-D-E ("Do, a deer") into D-E-F ("Re, a drop") by moving each note in the first pattern up one scale step. Scalar transposition introduces subtle but important variations into music: D-E-F sounds audibly similar to C-D-E, even though D-F is a minor third while C-E is a major third. Musically, it is important that these variations not be too large; otherwise scalar transposition will distort the character of a musical passage beyond recognition. The variations will be small only when a scale divides the octave relatively evenly.

Chromatic transposition is transposition relative to the chromatic scale. Usually, when a musician says "transposition," she has chromatic transposition in mind.

NOTE: scales give us a third way to measure musical distance, distinct from both the letter-name system and the numerical system. Consider the three ways of measuring the distance between the steps in the "octatonic" scale C-C♯-D♯-E-F♯-G-A-B♭.

Scale step	Scalar distance	Chromatic distance	Letter name distance
C-C♯	1	1	augmented unison
C♯-D♯	1	2	major second
D♯-E	1	1	minor second
E-F♯	1	2	major second
F♯-G	1	1	minor second
G-A	1	2	major second
A-B♭	1	1	minor second
B♭-C	1	2	major second

Here the distance C-C♯ is one scale step, but it is written as an augmented unison; by contrast, the distance D♯-E is one scale step, but it is written as a minor second. There is no way to respell the notes so as to remove all the inconsistencies. In fact, unless a scale has seven notes, it is impossible to write the scale so that letter-name distance and scalar distance are consistent. This is one reason to be wary of standard musical notation!

II. Scale and mode, scale type and mode type. If we think of scales simply as devices for measuring musical distance, then scales do not need to have "first" notes. From this point of view, we could define a scale as a circular arrangement of pitch classes, such as C-D-E-F-G-A-B-[C]. (The brackets around the last C indicate that we have a circular ordering that has returned to its starting point.) A *mode* is a scale in which a particular note has been selected as primary, or *tonic*. Typically, the tonic note serves as the goal of melodic and harmonic motion; one typically finds that melodies end on the tonic of the mode. Notes of a mode are sometimes called *scale degrees* and are usually numbered starting from the tonic; the "first scale degree" is the tonic, the "second scale degree" is the note just above the tonic, and so on. For example, the C ionian mode C-D-E-F-G-A-B-C has C as its tonic and D as its second scale degree; the D dorian mode D-E-F-G-A-B-C-D has D as its tonic and E as its second scale degree. These two modes are different, even though they use the same notes!

The C diatonic scale C-D-E-F-G-A-B-[C] is different from the G diatonic scale G-A-B-C-D-E-F♯-[G], since the former has an F♮ while the latter has an F♯. But the two scales are related by chromatic transposition: every note in the G major scale is seven semitones above the corresponding note in the C major scale. For this reason, they sound very similar. Two scales belong to the same *scale type* if they are related by chromatic transposition. The C and G diatonic scales both belong to the *diatonic scale type*. Similarly, two modes to the same *mode type* if they are related by chromatic transposition; for example the D dorian mode D-E-F-G-A-B-C-D and the G dorian mode G-A-B♭-C-D-E-F-G belong to the *dorian mode type*.

WARNING: Musicians are not always consistent in their use of terminology: sometimes they use "scale" to mean "mode" (as in "the A natural minor scale"), and sometimes they use it to mean "scale type" (as in "the diatonic scale"). Sometimes "mode" means "mode type" ("the dorian mode"). As long as context makes your meaning clear, and it is perfectly fine to write and speak in this (somewhat informal) way.

Assignment: Deriving scales

Suppose we want to invent a scale that is (1) nearly even; (2) has only 5-8 notes; and (3) contains as many consonant intervals as possible. Since the perfect fifth is the most consonant interval[1], we might try building a scale so that every note has a perfect fifth above it: so C is in the scale, then we would include G, and D above that, and so on. Unfortunately, a stack of acoustically perfect fifths will *never* return to its starting point. (Remember that the acoustically pure fifth is slightly different from the equal tempered fifth of the ordinary piano.)

Try it! Build a scale by stacking fifths in this way. Keep going until you come to a pitch that is **close to** the note you started on (plus some number of octaves). "Collapse" the notes you derived so that they are all within the same octave register. Notate the result and identify the scale.

Now repeat this process but go farther (up more fifths) until you once again get to a pitch that is **close to** your starting note. As before, notate the result and identify the scale.

Finally, do this yet again, going up more and more fifths (if you run out of keyboard, just transpose you notes down by one or more octaves), once again until you arrive at a pitch close to your starting note. Notate and identify this third scale.

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[1] Actually the octave is even more consonant. The requirement that your scale is maximally stuffed with octaves is equivalent to the requirement that every note in the scale have an octave above and below it—in other words, that the scale be *octave repeating,* having the same pattern in every octave. These scales are both easy to remember, and maximally saturated with the most consonant interval.