

The Plainchant of the Byzantine Catholic Church

Week 1: Musical background for this course

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Sound, frequency, and pitch

- Sound – vibrations in a fluid medium (normally air)
- Frequency – the rate of vibration, usually measured in cycles per second (cps) or Hertz (Hz).
- Pitch – the *apparent* frequency of a sound, as perceived by hearing.
 - Most sounds are composed of several frequencies at once, and the ear and brain must sort them out
 - In many languages, higher-frequency sounds are referred to as “high” sounds, and lower-frequency sounds are referred to as “low” sounds. This sorting of sounds occurs even to people with no sense of the physical property of sound as vibrations in air.
- Human beings can hear a much wider range of pitches than they can generate by speaking or singing
- Early natural philosophers used a stringed instrument with a movable bridge, called a monochord, to investigate sounds with different frequency ratios.



Pitch ratios and musical intervals

An **interval** is the pitch difference we “hear” between two different sounds. The human vocal and hearing system causes us to prefer some intervals over others. Early experimenters found that these “natural” intervals were associated with pitch ratios consisting of small numbers. For example:

Doubling a frequency (a ratio of 2:1) creates a tone that sounds “like” the original sound, but higher. The corresponding pitch interval is called an **octave**. Two notes an octave apart sound “the same”.

Increasing a frequency by 50% (a ratio of 3:2) gives a bright, trumpet-like interval, which we call a **perfect fifth** (for reasons we will see in a moment).

Increasing a frequency by a third (a ratio of 4:3) produces a solid-sounding interval, which we call a **perfect fourth**.

Increasing a frequency by two-thirds (a ratio of 5:3) gives a **major sixth**.

Increasing a frequency by one fourth (a ratio of 5:4) gives a **major third**.



Pitch ratios and musical intervals

Increasing a frequency by one eighth (a ratio of 9:8) gives a **major second**.

Increasing a frequency a seven eighths (a ratio of 15:8) gives a **major seventh** – just barely less than an octave.

Now, if we start with a single pitch and arrange these intervals from our starting pitch in order, we get:

1:1	9:8	5:4	4:3	3:2	5:3	15:8	2:1
Starting pitch	Major second	Major third	Perfect fourth	Perfect fifth	Major sixth	Major seventh	Octave

If we sing these pitches in order, we get the familiar **major scale** of Western music – which most of us learned in childhood to associate with the pitch-names, “do re mi fa so la ti do”. (These names were invented in the Middle Ages to help singers learn new melodies.)

Breaking this scale down, we discover that the interval between any two steps of this scale is either a major second, which we call a **tone** or **whole tone**, and an interval half that size, which we call a **semitone** or **half tone**. A semitone is the interval from the major seventh (ti) up to the octave.



The major scale

For now, let's add the pitch names to our table:

1:1	9:8	5:4	4:3	3:2	5:3	15:8	2:1
Starting pitch	Major second	Major third	Perfect fourth	Perfect fifth	Major sixth	Major seventh	Octave
Do	Re	Mi	Fa	So	La	Ti	Do

Each of the intervals from one note to the next is a whole step – EXCEPT for mi to fa, and ti to do. Those are half steps. So the “sound” of a major scale is the sound of

whole – whole – half – whole – whole – whole – half

Or

tone – tone – semitone – tone – tone – tone – semitone

We can sing this scale up – do re mi fa so la ti do – or down – do ti la so fa mi re do. We can also begin on any pitch we like.

As a shorthand, we could say that the major scale has half-steps at 3-4 and 7-8.



The minor scale

When singing using the major scale, the pitch “do” acts as a sort of “home pitch”. But if we sing the same scale, starting on la instead, it has a very different sound:

la – ti – do – re – mi – fa – so – la

And back down again:

la – so – fa – mi – re – do – ti – la

This scale, with half-steps between the second and third notes, and the fifth and sixth notes, is called a **(natural) minor scale**.

You can make eight different scales in this way, by starting at different places on the major scale and singing eight consecutive notes. The major and minor scales are the ones most used in Western classical music.

All of these are called **diatonic** scales – they are made up of whole steps and half-steps, in a certain regular order (for example, there are never two consecutive half-step intervals in the scale).



Other possibilities for scales

All these scales have had seven notes (not counting the repeating “do”). But this is not the only possibility.

For example, a pentatonic scale (five notes per octave) is used around the world in folk music. Here is the scale used in Stephen Foster’s “O Susannah”:

do – re – mi – so – la – do

This sort of scale avoids several kinds of clashing or “dissonance” that can occur when you have half-steps in the scale.

A chromatic scale consists entirely of half step intervals:

do – di – re – ri – mi – fa – fi – so – si – la – li – ti – do

Any some cultures break out of the half-step, whole-step system entirely. Indian and Arabic music, for example, make use of “micro-tunings” that involve smaller intervals.



But what NOTE am I supposed to sing?

All of the discussion so far has assumed an arbitrary starting note. This works for one singer, or for several people singing in octaves; one person picks a note and everyone can sing the “same” melody, starting with that note.

But as soon as several people sing in harmony, or play several instruments together, it becomes important to be able to talk about particular pitches – if only to tune the instruments together.

Early musicians in the West associated the letters A through G with the notes of the natural minor scale, and began giving them standard pitches. For example, the modern “concert A” pitch is 440 Hz.

To go from a minor scale to a major scale, we have to work our way up from la to do – in other words, from A to C. So the major scale beginning on C became a sort of “default” scale in western music:

C – D – E – F – G – A – B – C

do – re – mi – fa – so – la – ti – do

As a consequence, there are half-steps **between E and F**, and **between B and C**.



Letter names – sharps and flats

With this system, we can name any pitch in the usual diatonic scales. To refer to the remaining pitches in the chromatic scale (which also sneak in when we harmonize music), we use the sharp sign (#) placed after a letter to mean the pitch one-half step higher than the letter's usual pitch, and a flat sign (♭) to mean the pitch one half-step lower. So a chromatic scale would be:

C – C# – D – D# – E – F – F# – G – G# – A – A# – B – C

Notice that there are no half-steps between E and F, or between B and C!

On a piano, the white keys correspond to letter names in this scale with no sharps or flats, while the black keys correspond to the chromatic pitches in between.

So now we can write down musical pitches. For example, we could put note names over the words of a song and give some idea how to sing it – as long as you knew, for example, how long to hold each note. If several people are singing in harmony, we might have several letters over each word, which gets confusing. So we really need a way to put a lot of musical information on a page.



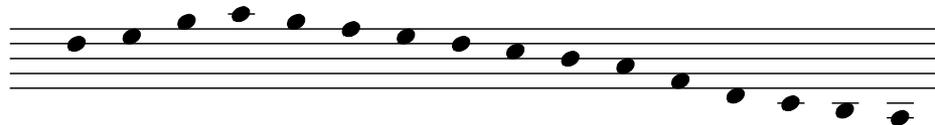
Writing music on a page – one solution

The modern solution to this problem was first provided in the Middle Ages. Draw several parallel lines, and put marks on the lines for the notes – the “higher” the pitch, the higher the mark. Use different marks to show how long to hold each note; any words that are sung can go over or under the musical marks or “notes.”

In the modern version of this solution, we use a 5-line **staff**. Each line on the staff, and each space between the lines, corresponds to a particular note:



If the music is higher or lower than the staff, we can add small ledger lines to temporarily extend it:

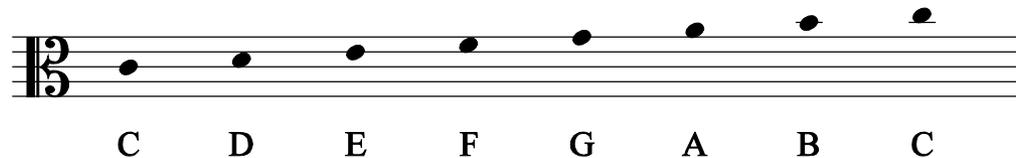


We still need a way to associate a particular line or space with a particular note.

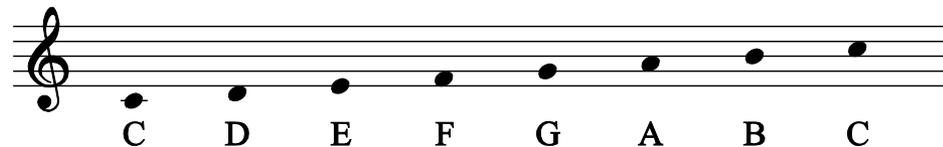


Placing notes on the staff

One early solution assigned the C of the C major scale to the middle line of a five-line staff, and put a mark called a **clef** (from the Latin work for key, *clevis*) on this line as a “key” to reading the music. This clef (the “C clef” or “alto clef”) consists of two backwards letter C’s, and shows that the line between the C’s is... the note C.



Eventually, however, musicians decided that they wanted the C major scale to cover the lower part of the five-line staff, and they began writing C on the first ledger lines under the staff. The new clef consisted of a stylized letter G, with a curlicue in the middle surrounding the line that the pitch G (two lines above C) ends up on.



Starting the scale somewhere other than C

One drawback of the staff so far is that C is in an inconvenient place for chant melodies, which often go up and down from the starting pitch. Using the staff shown above, with C as our starting pitch, the notes of the melody could easily go “off the chart” and be hard to follow. Changing the clef for each chant would be confusing; it would be easier to keep the same clef, and just start our major scale on another note. In other words, we start with another pitch as do – something other than C.

If we start a major scale on D, we need whole-whole-half-whole-whole-whole-half.

D up a whole step is E

E up a whole step is F#

F# up a half step is G

G up a whole step is A

A up a whole step is B

B up a whole step is C#

C# up a half step is D

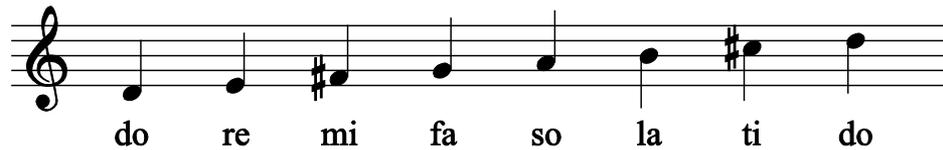
So the major scale starting on D is

D – E – F# – G – A – B – C# – D

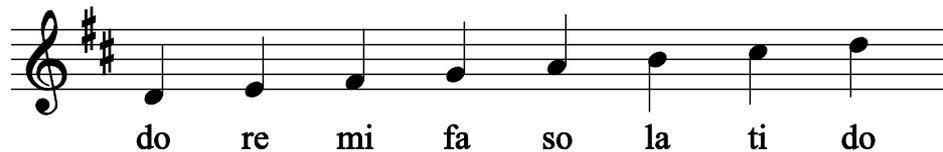


Key signatures

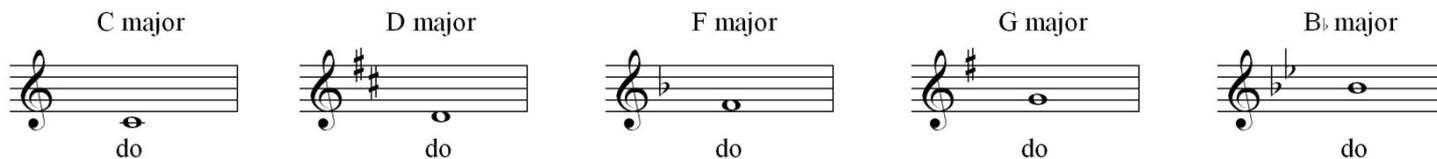
We can put sharp signs before every note of the scale:



or gather them at the start of the line, and have them apply to all the F's and C's in the music:



Using this technique, we can start a major scale anywhere we like on the staff, while still keeping the notes on the same lines and spaces. The sharps (or flats) at the start of each line of music are called the **key signature**. If any other notes require sharp or flat signs (or a **natural**, ♮, which cancels a sharp or flat), we add them before a note, and they apply to the next “bar line” in the music.



Marking note duration

We use different **note shapes** to show the length of each musical note:



The four note types here are the whole note, half note, quarter note, and eighth note. Each note is held half as long as the previous type of note.

A **dot** immediately after a note increases its duration by half, so a dotted half note is equal to three quarter notes. Notes can also be “tied” together to make up a single longer note. And eighth notes can be “barred” together to show how they are grouped together, even if sung separately.

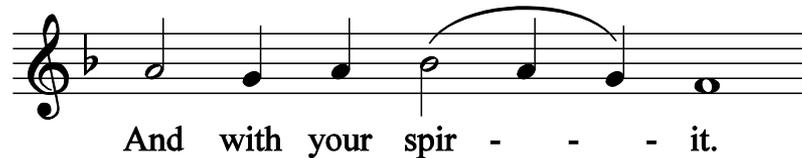


The text being chanted is normally placed below the staff, divided into syllables to match the music. When a syllable is sung through more than one note, a slur is used to group these notes together visually:

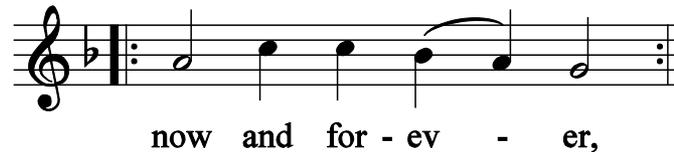


Marking divisions and repeats

Short vertical lines called **bar lines** divide up the music. In music with a regular meter or beat, they simply mark metric divisions. In chant, they may be used to mark phrases. A double bar may be used to mark the end of a piece of music:



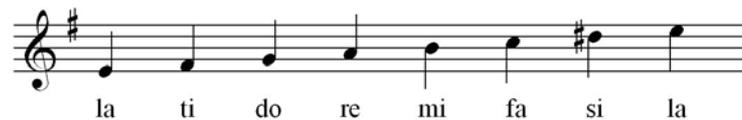
A final bar with two dots marks a repeat – a point at which the musicians go back to the beginning of the section to be repeated. The beginning of the repeat is marked by a repeat bar facing the other way.



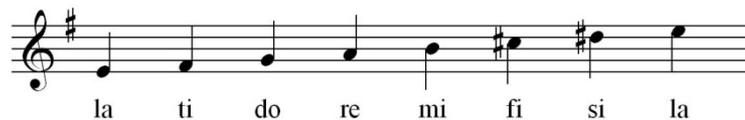
Harmonic and melodic minor scales

The half-step between ti and do in the major scale gives a sense of completion to reaching the home note of the scale; for this reason, ti is sometimes called a *leading tone*.

The (natural) minor scale lacks a leading tone, and can also cause dissonance (clashing) when melodies in this scale are harmonized in thirds. For this reason, the seventh degree of the scale is sometimes raised a half-step, giving us the **harmonic minor** scale:



But this causes a further problem – the interval between fa and si and one and a half steps, which is difficult to sing correctly. So when the minor scale is used for singing melodies, both the sixth and seventh degrees are raised, giving us the **melodic minor scale**:



Harmonic and melodic minor scales

To keep the “feel” of the minor tonality, the scale can be sung differently going up and going down:



The use of harmonic and melodic minor scales is an important part of the major / minor tonality used in Western music, and (as we will see later) has had an influence on prostopinije singing.



The music of language

Human speech is inherently musical, in that it makes use of pitch and rhythm – even if only in subtle ways.

Speech which stays on the exact same pitch lacks expression, we call “speaking in a monotone.” But when speech is *sung* on a single pitch, it can be sung with expression by varying the rhythm, intensity, and tone.

Speech which keeps an exact same rhythm sounds mechanical.

- Some languages, such as French, space syllables in a very regular way, while allowing slight variations.
- Other languages, such as English and Slavonic, are spoken in such a way that *accents* fall at regular intervals. These are called *stress-timed languages*.
- Speech associated with intensity, or to accompany regular motion (work, walking) may have a much more consistent rhythm. For example, each syllable may be given the same amount of time, regardless of accent.



Accent and Emphasis

Many languages require that certain parts of words be accented, by pitch, volume, or intensity. We are usually less sensitive to a missing accent than to an accent that appears in the wrong place.

In the same way, entire words or phrases can be highlighted. In some languages, emphasis can be added by moving parts of a phrase to the beginning or the end; by repetition; or by other rhetorical tools such as assonance and rhyme.

Complex utterances are usually divided up by pauses of varying lengths.

The end of a human speech – the conclusion – usually requires some special marking.

Whenever you are listening to speech or chant in this course, make an effort to notice how sound and meaning are interrelated in speech and song.



Things to remember from this lesson

- Our usual **diatonic scale of seven pitches** has a basis in both mathematics and the biology of human hearing and speaking / singing.
- It is possible to **give names to pitches** and sing them, without any sort of musical notation.
- There are many possible **musical scales**; Western classical and popular music relies mainly on the **major and minor scales**.
- Modern **five-line staff notation** is *one* way to record music.
- A **key signature** (pattern of sharps and flats at the start of a line of music) shows where the home pitch (“do”) is on the staff.
- **Human speech is inherently musical**, and some of our patterns of speaking can also apply to how we sing words, sentences, and longer utterances.

