[SQUEAKING]

[RUSTLING]

[CLICKING]

MICHAEL SCOTT ASATO CUTHBERT: Hello, computational musicologist and music theorists. While you're working on your own representation formats, I want to introduce one representation format, indeed, the most commonly used representation format for common Western music notation scores. And that is MusicXML created by Michael Good around the year 2000.

Looking over at the MusicXML website, we can see their version of Hello World! As you know, in programming traditions, it's become traditional to print out the word Hello, World to show how a programming language works. In music notation, it's become common, instead, to show how note middle C would be represented, whole note or something like that.

And here's the example of that middle C whole note in MusicXML One of the things you can see in MusicXML, just like any XML or HTML, we have these things called tags which are enclosed in angle brackets. Then we have a content for the tag, and then the tag is closed with those same angle brackets with a slash in front.

Tags can enclose other tags. So the score part encloses a tag called part-name, and then it's closed later. And tags can also have attributes, id equals P1. And we'll look at those in just a little bit.

Let's scroll down to the note. So all of that is to set up what we might normally do for a note. So a note is a tag called note. Within it, there's a tag called pitch. Within that, there's a tag called step. And the step has a single letter.

This is very similar to music21. In fact, I borrowed these concepts from here, so that the accidental would be encoded elsewhere. Then the octave is encoded as a single number, then the pitch is closed.

After that, we have a duration tag. And we'll get back to that in a second. But it's duration 4. And then there's something called a type, which is different. And it says whole, so it says that this note's type is a whole note. We have the duration and the type encoded separately, because the type explains to notation software how to represent this note, what it should look like. And the duration, instead, tells it how long it is.

So you could, in theory, put a duration of any number and a type of any number, and you could make things that looked very different from how they sounded or how they were represented. In practice, most notation software reads one or the other of these, so that's kind of too bad.

The duration 4 does not, like in music21 represent necessarily four quarter notes. What it does is it refers back to the last tag within an attributes tag called divisions. And this says how many parts should a quarter note be divided up into.

So in this case, because the only note is a whole note, we can just divide up the quarter note into one part, not divide it at all, and then say a whole note has four of these. But if we were going to later have an eighth note, then this would have to be at least 2, because the quarter note can be divided into two parts. If we might have 16th notes, it would need to be 4 because it can be divided into four parts. And if we were going to have 16th notes and triplets also, then it would need to be 12 because you can divide it into 12 different ways.

In practice, these divisions usually end up being much higher numbers. Some people use 16, 3, 8, 4, which is a power of 2. I like using a high power of 2 multiplied by 3, multiplied by 5, multiplied by 7, so I can exactly represent triplets, quintuplets, septuplets, things like that. But you can change this division with each, I think, at least each measure, so that you can make sure that whatever you're going to be representing will be there.

We can also see that there's a key signature, and that's marked in the number of fifths from C. So remember your circle of fifths. If you want a key signature of D major of two sharps, that would be 2. If you want B major, that should be 5. If you want F major, well, we're going the other way, so that's going to be negative 1, so we can represent keys that way.

Time, you can probably figure out. Beats and beat type are 4/4. Could be called numerator and denominator. But it is one of these things about MusicXML that the format likes to show the musical meaning, not just how it's going to be laid out.

We have the clef. Instead of saying it's treble clef, we say that it is a G clef on line 2. And so here is some of the basics of MusicXML You can go to musicxml.com and read more about this. We're going to look at a few other components of MusicXML before going on. But you're not necessarily need to learn everything about it.

So if we're looking at how MusicXML works, we're going to look at a slightly more complex example than just a single quarter note. We have a vocal part and then a piano part represented on two staves. Here, we're using a divisions that's a higher number than 1, negative 3 for the key signature, and then we can explicitly encode that it's actually in minor So. We're not in E-flat major. We're in C minor, right?

There's transposition. But we don't need to know that for this. The pitch element, the note element, I'm sorry to say, sorry, can also have ties on it and can have lyrics. We can say that this is an end of a syllable that ends "meil." And we end in extension. This is another thing you can do in XML-based formats. If you want to open a tag and immediately close it, you can just put a slash at the end, instead.

We'll look at tied notes, even though it's just a little thing. And that is that there are two different parts in a tied note in MusicXML and for a number of things in MusicXML. There is the tie element which represents conceptually, is this note tie.

And then there is the tied, with a D element. And that says, how do we draw the tie on the page. So you can draw a tie without having a note that sounds tied or is conceived of as tied. Or you can have sounds conceived of as tied but not drawn.

And this shows up in other places, namely in accidentals because you can imagine a B-flat, you conceive of it as a B-flat, but you also put a flat sign in front of it. The next B in that same measure, you conceive of it is B-flat, but you don't put a flat sign in front of it. So there's a distinction between how we represent a note on paper and how we conceive of it. And this is very important, also.

We can look over here at chords and see that a cord is simply-- here's a 3-note chord. We start with a note. It's a C in octave 4, And then we have the next note has this empty chord tag that says it's part of a chord of the previous note. So in MusicXML, if you want to know whether something is a chord, you won't know it from the first node. You'll only know it from the second note on. Here's an example where we have E-flat altered by negative 1 semitones, and then the next note G.

Here's a little example of multi-part music, and especially this part where we have two different voices in the same measure. So we have two chords that can be represented as just a single set of note elements. And then we have a chord here and a chord here, but in between, we have this separate voice with separate stem directions and so on.

One of the things that MusicXML does, is that when you get to a certain point, you're reading through all of your durations. They're all considered to be in a row. You get to maybe the end of the measure, and you can back up a certain number of divisions, and then you can go forward again.

In this case, you would probably just back up 8. But a lot of notation software seems to only use backup to go to the beginning of the measure. And then if you need to skip forward, you use a forward again.

And it is also customary, though not strictly required, I don't believe, but almost a lot of notation, things that read MusicXML, we call them consumers of MusicXML. A lot of them might have a problem or might crash if you don't include what's customary, again, then you end at the end of the measure by going forward until the very end.

There's all kinds of other things on repeats, on sound suggestions, and so on. But one of the things you can see is that, compared to some of the thoughts we had on compact representations, MusicXML is very verbose. It takes up a lot of space on the screen. It takes up a good amount of space on disk, though not nearly as much as this video would ever take.

So there is a compressed format, and they call it MXL. We call .XML or .musicxml, the file extension for standard MusicXML format, and .MXL if it's just gzipped. And right now, we're working on ways so that a gzip archive can include the score, maybe a compressed score, a transposed score, and also all of the parts. So new things are still coming out with MusicXML.

And we will turn to learning more about MusicXML from the creator.