[SQUEAKING]

[RUSTLING]

[CLICKING]

MICHAEL SCOTT ASATO CUTHBERT: OK, any questions? Problem set 4 was just turned in. A couple people have asked for and been granted small extensions on that. I'm not going to be talking through the solution set today. But anything that came up that you found interesting appalling, strange? Adam?

AUDIENCE: For the t and the i, I used that o of n factorial algorithm.

MICHAEL SCOTT ASATO CUTHBERT: The o of n factorial algorithm, how high can n get?

AUDIENCE: 25.

MICHAEL SCOTT ASATO CUTHBERT: 25, for what?

AUDIENCE: If I had 25 notes and I was trying to find optic or OPTC, it turns off within a few seconds.

MICHAEL SCOTT ASATO CUTHBERT: So you have an o of n factorial algorithm, which is usually one of the worst you'd ever be thinking about, except for n to the n. N to the n is worse, right? I can't remember.

These are the types of things, as a professional music person, you don't really have to think. Once you're thinking about things this bad, you usually don't. But yeah, 25 was the number that I was weirdly thinking that would constrain n. Anybody have a different number that often comes up in music for the max, the n? Yeah?

AUDIENCE: 12.

MICHAEL SCOTT ASATO CUTHBERT: 12, with 12 pitches. You can end up with an algorithm that is o of 12 factorial-- which is decently big but not too bad-- which reduces to o of?

AUDIENCE: 1.

MICHAEL SCOTT ASATO CUTHBERT: 1. Very slow 1, but o of 1. I don't think that would be that bad. I believe there is an algorithm that runs in o of n time, I believe.

It might be o of n squared. I'll look back at it. There is a way to go better, but good. For this class, again, you're not going to be quizzed on your algorithmic complexity of your work, but it's always a good thing to be thinking about as we do things. I took the summer to look through all the places where I wasn't using heap tables. I don't know if anybody-- do they cover heaps in 6009 or in--

AUDIENCE:

6006.

MICHAEL SCOTT ASATO CUTHBERT: 6006, OK. The idea of an organization that allows you to, at any point, get the smallest or the largest value, but not everything else is sorted. That can be a very useful tool quite often. Good. Most of the things aren't going to be on that. Any other questions or weird concerns that come up? I'll be curious, after class, to figure out where 25 comes from.

AUDIENCE:

I just put in 25 notes. And then, c actually killed a lot of them.

MICHAEL SCOTT ASATO CUTHBERT: As long as you do your cardinality or your-- what's the other one? o? What's the octave? Sorry, I was hearing optic, but you were saying octave, which is correct.

As long as you've done something like that, the OPC, which is almost always a requirement for using t or i the transposition operation-- the transposition and inversion operations can, in some cases, not be well defined, especially if you're thinking of a chord.

When you invert, the order of the notes change. In a melody, the order obviously matters more. Good. Yeah?

AUDIENCE:

Can you give some intuition for when inversion is useful? Doing the assignment, it's just hard for me to wrap my mind around.

MICHAEL SCOTT ASATO CUTHBERT: Yeah, when is it useful? One of the first reasons why it can be useful is a lot of composers have thought it's useful, including tonal composers like Bach. But 20th century composers like Arnold Schoenberg or Karlheinz Stockhausen, they've used inversion symmetry a lot.

The other thing is that things that are inversions of each other have the same interval structure. If you're playing with a piece and you're thinking about oh, how can I reuse those intervals, that can be a place that's done. I think you can Google online people singing "Happy Birthday" in inversion and stuff like that.

Quite a number of people do hear it in special cases as an equivalence class, as we saw with the Gustav Holst example, where the sixth time through the *Chaconne* theme, he decides to play upside down. Do you remember that from the band thing that we have? That's one of the places that's there.

I think we've moved to a world that's different from even 25, 30 years ago, where it was this notion that, oh, eventually, we're all going to hear inversions the way we hear transpositions. I think that that's not something composers are asserting as much. Great question. Other things?

There was one case that I haven't run your things through that is interesting, that almost all-- I'll just go over here-- almost all musical structures that are built on the same numbers of intervals, once you do reduce them, octave equivalent so on-- such as here, we have a major third, especially if we don't care about spelling. Here, we have a minor third. Together, we have a perfect fifth.

Here, we have minor, major perfect fifth. major triad, minor triad. Most cases, chords that have the same interval content, can be transposed or inverted to make each other. The cool thing is there's a very few exceptions to that rule.

The most famous one is, any transposition or inversion of this-- I'll use pitch class numbers 0, 1, 3, 7-- 0, 1, 4-- that's an E. 4, 6, 0, 1, 4, 6. Somebody, while I'm getting a new pen, verify those have the same interval content. Do they both have a semitone somewhere?

Yeah, between the 0 and the 1, right? Sorry, you do need that better pen before you do it. Do they both have a whole step? Yeah, where's the whole step in the first one?

AUDIENCE: Is it 3?

AUDIENCE: 1 to 3?

MICHAEL SCOTT ASATO CUTHBERT: 1 to 3, yes. It's written this way with spelling thing, so it's a little bit hard. Do they both have a minor third?

AUDIENCE: Yes.

MICHAEL SCOTT ASATO CUTHBERT: Do they both have a major third?

AUDIENCE: Yes.

MICHAEL SCOTT ASATO CUTHBERT: This one's a little bit harder. Yeah, so 2 things at 4. There's the major third. There's a major third. Do they both have a perfect fourth?

AUDIENCE: Yeah.

MICHAEL SCOTT ASATO CUTHBERT: Where's the perfect fourth in this? This one's pretty easy. Here, the perfect fourth is because we have octave equivalents. We just move this one up and then, we get a perfect fourth.

Do they have a tritone, [INAUDIBLE] augmented triad? Yeah, this one's pretty easy, because there's a tritone from the lowest to highest. Here, it's between the first and the last.

This one's particularly interesting, because any four-note chord will have six intervals in it. If we think of how many semitones, how many whole steps, how many minor thirds, major thirds, perfect fourths, tritones, and everything else above that is just an inversion of these. They each have one. It's called the all-interval tetrachords.

The fascinating thing is that you cannot invert one to make the other. There's only a few things like this. They're called z-related. Nobody really knows what the z stands for. It's not a Russian propaganda thing or whatever.

They're z-related and they always come in pairs. If we used a 16-tone system, then all the z-related things come in triples. Somebody has worked out the math. If we use a 30-tone system, they all come in groups of 5.

It's one of these things that, those of us in music theory, have never worked with a mathematician to figure out what the general pattern is of where z-related systems come. Nice little aside, but kind of the fun things you can do if you're doing a little bit more pure math side and less computation. Yeah, Jake?

AUDIENCE: That would be an interesting, fun project.

MICHAEL SCOTT ASATO CUTHBERT: That would be--

AUDIENCE: [INAUDIBLE].

MICHAEL SCOTT ASATO CUTHBERT: --that would be a final project that, have a backup plan. Do not vet your entire grade on being able to figure it out. But yeah, enumerating various things would be great. And a lot of people who are interested in post-tonal music will be interested in that.

Good, OK, let's move off the computer. We've gone from computer to math. Let's go to pure music. I'm going to play in a second-- but you can get started-- that chorale I've passed out for you, the class theme, "Chorale Alleluia," "Alleluia Chorale."

Your job, talk with other people around this. Let's spend five minutes just doing whatever Roman numeral or other analysis you've been taught on this project. Let's not all start at the beginning, so that some of us can have some interesting comments about the end or something. Five minutes until I give more instructions. If you talk with each other, you'll make fewer mistakes.

OK, let's bring it back for a second. Everybody, I'm going to start by asking people for something that they found interesting. Let's number our measures, so measure one, two, three, four, five, six, seven, eight, nine. Did I count that right?

When you say, if there's something interesting in a specific place, that I want to know it. We'll jump around a little bit. Jason, what did you find that's interesting?

AUDIENCE: I believe the phrase starting at the end of the first measure, the Alleluia, I think it's 5, 1, 5 1 and then, in A major.

MICHAEL SCOTT ASATO CUTHBERT: 5, 1, 5, 1.

AUDIENCE: The following one is basically 5, 1, 5, 1, but in F-sharp minor instead.

MICHAEL SCOTT ASATO CUTHBERT: Oh, so you're interesting thing is that we have some sort of-- I don't know, what do you call it-- modulating sequence? Modulating or repetition on different keys, this is the one that I wanted to get rid of. Good.

Let's see. Who hasn't been called on in a while? Angelica?

AUDIENCE: This is the [INAUDIBLE]. It's weird that they chose the F-sharp minor, because if you look at it A major, it's like it goes to the major third a lot, [INAUDIBLE].

MICHAEL SCOTT ASATO CUTHBERT: So we're starting in A major and then, it goes to the-- what did you say?

AUDIENCE: Then, it goes to F-sharp minor. It's a [INAUDIBLE] to go from A major, because it goes between a sixth and a major third.

MICHAEL SCOTT ASATO CUTHBERT: It goes down a sixth and then, what?

AUDIENCE: Then, it goes between a major third and the sixth chord, minor sixth.

MICHAEL SCOTT ASATO CUTHBERT: It goes from a minor sixth chord to a major sixth chord at some point. Cool, great, super, very interesting. We'll keep going. Who hasn't been called? Jordan?

AUDIENCE: Something interesting, I guess, is-- I was trying to figure out what the chord was, that measure two, the last chord? I don't know what to call that.

MICHAEL SCOTT ASATO CUTHBERT: Yeah, who gave a label to a chord here? OK, good. Let's see, Matthew, what label did you give it?

AUDIENCE: V 6 of VI.

MICHAEL SCOTT ASATO CUTHBERT: V 6 of VI. For those who don't yet translating those numbers to symbols, were you thinking of something like?

AUDIENCE: Yes.

MICHAEL SCOTT ASATO CUTHBERT: OK. Over time, you do learn to hear the lower cases and the slashes and the things, what's in Roman numerals and what's in Arabic. Anybody give a different thing for that? Yeah?

AUDIENCE: I kind of have a Java question.

MICHAEL SCOTT ASATO CUTHBERT: Just let me-- let's finish on this particular question.

AUDIENCE: It is.

MICHAEL SCOTT ASATO CUTHBERT: It is? OK, go ahead.

AUDIENCE: I worked from the end. I just kind of assumed it was an F-sharp minor, like this was just like the V 6.

MICHAEL SCOTT ASATO CUTHBERT: This was just in V 6. Good, so I think we're getting to the next question. How many people noted a key change in the piece?

Not everybody got far enough to do this. One person did, two people. You presumably did or did not?

AUDIENCE: I only got halfway through measure three.

MICHAEL SCOTT ASATO CUTHBERT: That's fine. Good. Anybody not find a key change? John. For those who did think of a key change, where did you put the key change? Adam?

AUDIENCE: Between measure seven and eight.

MICHAEL SCOTT ASATO CUTHBERT: Between measure seven and eight, five, six, seven, between here a key change. Good, any other things? Jason?

AUDIENCE: I didn't get that far, but it does feel like there is a key change between two and three.

MICHAEL SCOTT ASATO CUTHBERT: Between two and three, great. Where would we put it exactly? If you are buying Jason's thing, is it-- if you're going with Jason's, where would you put that?

AUDIENCE: In between the two measures of that eight letter word, within the fermata, second measure of third and fourth beats.

MICHAEL SCOTT ASATO CUTHBERT: Second measure between third and fourth beat, just after the fermata. Anybody would place another place? Anybody think that it might be ambiguous, and that we might be kind of floating between two keys for a while when we do certain key changes?

Anyone ever think that? There's a type of p-chord, that chord thing that begins with a p, that some people use for that. Yeah, John?

AUDIENCE: Picardy?

MICHAEL SCOTT ASATO CUTHBERT: Picardy is a type of chord. It does apply to this piece. Where do we see some that might be a Picardy? Anybody, Picardy third, a major third in a minor context? Yeah?

AUDIENCE: The very last chord?

MICHAEL SCOTT ASATO CUTHBERT: Very last chord, yep.

AUDIENCE: I think the key word you were looking for is pivot.

MICHAEL SCOTT ASATO CUTHBERT: Pivot, yep. We went with two different ones. We got two different great p-chords. Pivot chords are what some people use to say that oh, you know, this is the moment when we're in two keys for a while.

I remember asking my teacher, OK, well, can there be a pivot region? One teacher said, no. You choose a chord and stick to it. And then, another teacher said, no, of course. There could be.

Good. A couple of things, for those who did do the end or get to the end, how many thought we were in A major at the end? How many thought we were in F-sharp major? How many thought we were in F-sharp minor?

A couple, how many thought we were in another key altogether, D Locrian? No? OK, good. Whew, that last one is the only one that I wouldn't have liked. Somebody who thought we were in F-sharp major, explain to the F-sharp minor people why they're wrong. Yeah, go ahead.

AUDIENCE: All the A-sharps in the last two bars are indicators. But also, I think we thought that the fermata measures seven sounded like the dominant V of an F-sharp minor, but it ended up resolving into F-sharp major in the next chord, which kind of persists into the next two measures.

MICHAEL SCOTT ASATO CUTHBERT: OK, good. A couple of things that I heard that's always a very good way of not necessarily winning, but advancing an analysis argument, he said, it sounded like. Good, always thinking, let our ears do it, not just what's written on the paper. Somebody who was an F-sharp minor winner, try to convince the F-sharp major people that they're wrong. Yeah, John?

AUDIENCE: Quite a bit of the piece, like here, hints a lot at F-sharp minor. You have a lot of C-sharp major chords leading to F-sharp minor. The last two measures can be seen as Bach just kind of stylizing things while keeping it still in F-sharp, F-sharp minor.

MICHAEL SCOTT ASATO CUTHBERT: So a stylization, but that doesn't change?

AUDIENCE: [INAUDIBLE] technique is.

MICHAEL SCOTT ASATO CUTHBERT: Yeah, so we can have a disagreement on this. I'm not going to say, at this moment, which side I'm more on because I can see the validity of both sides. Because I know the world of Bach, I myself cannot really hear it as oh, we're still in A major and we are ending on the sixth chord and the sixth chords are very important.

But on the other hand, if I listen to a lot more contemporary popular music where VI is a perfectly valid chord to begin on and occasionally to end on, seems quite possible. Good. So we just spent 30 minutes looking at one chorale in particular.

That's not something we're going to do very often in this class. But that is the normal way of analyzing music, right? So what I want to do is to bring up the concepts of what we're doing with corpus analysis, which is what we're going to be doing for most of the rest of this unit.

I'll just put this up for a second. There's a way I can blink this. Does that work? Yep, there we go.

We often think-- you may have heard this in one of your literature classes about close reading, where you're looking through and finding all of Mark Twain's metaphors, or all of Jane Austen's foreshadowings, and how many Greek-rooted words are used in this sentence, this paragraph, compared to the Latin words or the Anglo-Saxon ones. Close reading is the main type of literary analysis.

It goes back to the '80s, but really, in the last 20 years, there's been a movement associated with the computer called distant reading. Other people were doing this before, but the term is connected to a literary critic named Franco Moretti. That's not going to be on an exam or anything.

The notion is that distant reading is something you do when you're not close enough to the text to really make these kinds of precise arguments, but you are far enough away that you can see not just one text, but multiple texts. Some of us who work on corpus studies in music have started replacing these terms with close listening, which is conventional music analysis, and distant listening, which is corpus studies.

What do you think some of the things that we can do with close reading or close listening better-- close analysis, whatever you want to call it-- better than distant analysis?

AUDIENCE: Close analysis, we can look for specific phrases, motifs, like that.

MICHAEL SCOTT ASATO CUTHBERT: Specific phrases or motifs, yep. Anything else, you think? Let's think of the world we're in today, not the world of 5,000 years in the future, or maybe five minutes, depending on what happened at OpenAI today, where the computer can do many things that it can't do. What are some things that we're going to start losing? Yeah?

AUDIENCE: I have a question.

MICHAEL SCOTT ASATO CUTHBERT: Yeah?

AUDIENCE: What makes distance listening different than close listening. Because in a corpus study, you can study everything in close listening.

MICHAEL SCOTT ASATO CUTHBERT: Sure. Let's think of some of the things. Let's think of some of the things. We'll go back to literature. What are some of the things that humans are good at in picking out of literature that computers are still not very good at?

AUDIENCE: More abstract. We can be like, oh, this is an allusion to Shakespeare. Similarly, we can notice patterns that are hard to really condense into one formula or function. Or it can be like, oh, this is a similar melody to something that was used previously.

MICHAEL SCOTT ASATO CUTHBERT: That's a good one. Other things? What about for you? Let's start with one that's in my head, but I really want to make sure we don't lose track of this. Anyone have a piece of music they love?

OK, almost everybody. Good. How did you fall in love with that piece of music?

AUDIENCE: Listening to it.

MICHAEL SCOTT ASATO CUTHBERT: Listening to it, good. How many people have fallen in love with a piece of music via corpus studies? Ooh, this one has 47% of sharps. Let's not forget that the reason why we make music and listen to it is the enjoyment happens at the close level.

The other thing I was thinking of, with the literature, is this character, I'm reading *Crying in H Mart* right now. I don't know if anyone knows this memoir. But one of the characters in it is going through a very similar experience that I went through in my life, with a family death, and it was very deeply resonating with me.

Resonance outside your life-- not outside your life, I can't really everything outside my life-- outside the text. We'll use text to mean both literature and music. There is something.

What are some things, however, that distant listening or distant reading, that is to say, having a computer look at 1,000 pieces, might do better than close reading-- let's first assume we have infinite time-- than close reading 1,000 pieces? Yeah?

AUDIENCE: They can allow you to, more effectively when listening to a new piece, guess who the composer was or what the time period was.

MICHAEL SCOTT ASATO CUTHBERT: OK. So you could use that distance for guessing genre or period or authorship. You might be able to do that with the 1,000 scores, but that would take a lot longer. Good. What are other things we want to solve? Yeah?

AUDIENCE: I think it could do with a less abstract way of describing any patterns you might hear. It's easy to say something sounds similar, but actually analyzing it gives you words to put that into.

MICHAEL SCOTT ASATO CUTHBERT: So it gives you words for describing, gives words for describing similarity. And what else besides words for describing similarity? What are some other things that we like to get out of this class? Yeah?

AUDIENCE: Numbers.

MICHAEL SCOTT ASATO CUTHBERT: Numbers, statistics. These are some of the reasons why we want to be thinking this. But I think-- I'll just say, because I'm a couple of minutes behind where I'd like to be-- that the most effective way of working with any of new genre, new style, new anything is to start with close listening, close reading.

Start with the analysis that you've done now and try to do things by hand before moving to the programming. How are we going to do distant listening? How are we going to teach the computer to do this?

Because there's something that didn't come up, that the ambiguity and the types of oh, I'm going to have to make a judgment call on this, on where the modulation happened. Or is this really V6 of VI, or did we already jump directly to the new key? Or is this thing that I'm labeling actually a chord at all? Or is it a whole bunch of passing tones that happen to look like a chord?

These kinds of ambiguities are things that, I think, will come up when you're doing the close listening, close analysis. You'll know you have to account for them in some way during the distant analysis. And sometimes, accounting for them in some way is just leaving a footnote saying, there's this really complex problem, but I only saw it twice in close listening to four pieces, so hopefully we can ignore it as a rounding error, but at least declaring that.

Then, when you've done your corpus study, there's something really valuable about finding things that are interesting there. Right? What's that piece that completely throws-- that outlier piece that completely throws out, and going back and listening to it.

Maybe, it doesn't even have to be close listening, but actually just human listening, so that we get what's the end result, why we do any of this? So we can get to the enjoyment, the point of trying to do. One of my dream projects, you all have heard of IMSLP, huge music score.

I want to find the most interesting, unusual piece by every minor composer that's on there, that has the one piece that this one forgotten person, that she or he wrote, that we should actually be listening to. Maybe, it's not even the one piece, this 1/32 excerpt that Gruber wrote that I don't know and I'd love to know it. We're not there yet, not there yet. But maybe, we can get there.

Great. The next thing you're going to be doing is trying to figure out what kinds of things we can do this kind of close analysis on. We did the Irish music corpus in class on Wednesday. That was a pretty small corpus, was 60 pieces or something.

Then online, I gave you tools for using the entire Bach chorale corpus. If you want to find anything super unusual in there, that can be a good place, but be boring if those are the only two ones. Your next problem set, and it's up, is problem set five.

Let me put this back up here. This one, what we want to do is in groups of two, prepare three to five page short paper-- three pages is totally fine, five pages, sometimes, might be something that you want to do-- that tries to figure out some corpus that's out there that's been active in the past 10 years and try to figure out how it works and why it's out there and what its extent is.

What are the goals of the project? Who are the participants? How are the scores or other musical data encoded? I think I've forgotten to put on here, what's actually in there? What's the project actually trying to do?

I suppose that's the goal of the project, but what pieces are collected? What is the overall extent of the problem? What is it trying to solve? By doing this, how much of the problem do you think could be reasonably solved in a limited timetable?

You don't have to do all of these, except for the first one. We'll get to the last one. What are the strengths and weaknesses? What could you do with this corpus? What questions, relevant to this class, could you answer by having this?

Just like we did with the what questions could you answer with a whole collection of Bach chorales-- was that set p set one or three or something like that? You don't need to use the corpus to answer it. You're not being asked to download and do the things.

Anyhow, you'll probably need to know a little bit about the kinds of music and the problems associated with the project and what they're trying to do. My preference is that you focus on a corpus of musical scores-- sorry, it's too high up there-- scores that can be readable by Music21 or something else. But if something really grabs you and you're like, this is the music I really like and it's all audio, it's all images or something like that, go ahead and do that.

Just the only two things I'm going to say, IMSLP and Wikipedia are out. Too obvious, right? I've given some places that you can begin. Some of them, I was nice enough to give the links and other ones I'm like, no, and then, some directories of projects and what you're going to be asked for-- URLs, screenshots, how deeply the questions you were answered.

Hope that you'll find this kind of fun. It's due in a week. What I want to do is give you now 10 minutes to find the person that you want to do this work with. The only caveat is you cannot have been in the same p set two group.

That's just because when we do a lot of group work and you have group grades, I want make sure that you're getting things from you. And so, we rotate that around. Start talking about what potential types of things you've seen or you've done.

This is a good time to Google and mess around on the internet in class with your professor's blessing. A couple of things going on here that just want to make sure that we get to, we're doing these big topics-- corpus studies, representation intervals and stuff like that.

But then, along the way, there's a bunch of little things that will make your life easier that eventually, you'll need to know how to deal with clefs and stuff. Make sure, if you haven't been reading through parts of the Music21 user's guide, that you continue to do that and that this is a place where you want to know something, there is the user's guide and the complete reference.

The complete reference doesn't really distinguish between what is important and what isn't. Whereas, hopefully, we've done a decent job explaining that. You should have, by now, read through up to chapter 6 here, if you haven't. Most MIT students probably won't need to go through chapter 5 on recursion and lists of lists if you're in this.

We've skipped chords and something called Chordify for a bit. I think you can-- well, we'll get to that later. But definitely start reading through the Music21 object thing. What is a Music21 object? You'll see durations are not Music21 objects. Not everything that's in Music21 is one.

Basically, the easiest definition is a Music21 object is something that can go into a stream. It knows how to position itself. It has a duration and some other things. We want to go through this at some point, just that when I'm giving an assignment, everything's unlocked here, how you can give.

Who has worked with JavaScript DOM manipulation, like get elements by clef? So quite a number of people have. Tried to make Music21 to be a lot like the version of JavaScript that was around at the time in 20 whenever it was, 2006, 2007. There's things like getElementById, get ElementByGroup.

Group is equivalent in Music21 to JavaScript class, the class of multiple things, the dot selector. Multiple things can be in the same group and so on. And then, there's a nice little discussion of the thing that will probably drive you baffled at some point, the active site, which is telling you which stream is.

We still haven't figured out who, that one bug that we saw in class, with the active site being wrong, or the get context by clef being wrong. This chapter just goes through the basic things. It will tell you how to sort objects, which will sometimes be useful, how to move two things at the same place and what sorting is.

The next chapter has a little bit of the details on how things work, how you can transpose a note, and how you can get back from the transposed note to its original note, and so on, except you're not-- yeah, I think transpose is about to be unlocked for you, because you've just done all of this work and a bunch of other little things. But that's kind of a little bit boring one.

Read through that. Read through the time signatures and beats and the keys and key signatures. This last one lets you do your first little algorithmic composition exercise toward the very end. Sorry, scrolling fast.

Here we go, where we can create a little melody, something like this, and automatically change it and have-- I don't know why sometimes this goes--

[MUSIC PLAYING]

--have a piece of music that I remember having to play a lot in junior high.

[MUSIC ENDS]

It's nice to make little algorithmic pieces before we write our first true algorithmic composition, for which will be problem set eight. Those are some of the things that you've probably been looking at. Also, optionally, you might want to go through clefs, articulations and ornaments.

We'll do a little bit of that now. We're not going to get time to get to intervals right now OK, so let's play with a little bit. If you have a second and you have your laptop out and if you have Jupyter able to be got up-- sorry I should have said that five minutes ago, like always. Like the way the conductor says, I want you to play a little bit louder and make sure you basically separate all the notes of 32 measures after A.

The worst order, sorry about that. That's just me vamping while we give this a chance to-- who cannot see a Jupyter Notebook that it's on? Suppose you can all see mine. So given the time, with 10 minutes, let's do a little bit of more work on things.

I'm going to import corpus, stream, note, meter. And we're going to look at a couple other little things in a piece by Joseph Haydn, so corpus parse. I'm going to assign it to Haydn, Haydn "Opus One," number one, movement one. That thing gives everybody a chance to do it. You can show it when you're ready.

This is the first string quartet that Haydn ever published pretty young, even though he was mostly an old man, thought of as a old man composer. Start with our close listening for even just a few seconds, until I grabbed the recording of this. What's interesting about the opening to anybody? John?

AUDIENCE:

It's in unison.

MICHAEL SCOTT ASATO CUTHBERT: It's all in unison.

[JOSEPH HAYDN - "OPUS ONE"]

Do we hear that it's all in unison? I didn't give you the second page because I did it in the notebook. Just remember, you can always show, haydn.show(musicxml.pdf) to get it or just to get the whole thing up. OK, so it's all in unison at the beginning.

We're not going to do another thing like we did with trying to figure out where are the notes outside the key. But go ahead and tell me, how many notes are there in this piece? So when you've got it, I'm not going to call on the first person to shout out. But let's just be sure we can still do something like that. What is the question that we're trying to do, somebody?

AUDIENCE:

How many notes are there?

MICHAEL SCOTT ASATO CUTHBERT: How many notes are there in this piece? who hasn't been called on very much? You haven't been called on.

Usually, I pick on you too much. What did you do on your thing? I assume you started with haydn.something.

AUDIENCE:

Yeah, well, I just did a for.

MICHAEL SCOTT ASATO CUTHBERT: For, OK, good.

AUDIENCE: I did for n in haydn and then, index note.note and I counted.

MICHAEL SCOTT ASATO CUTHBERT: note.note.

AUDIENCE: Actually, counter as well.

MICHAEL SCOTT ASATO CUTHBERT: Counter, good. i equals 0, right? i plus equals 1 and then i, good. We use-- what kind of iteration does this do?

AUDIENCE: Recurse.

MICHAEL SCOTT ASATO CUTHBERT: Recurse, good. So somebody get that number? That's good. I saw a lot of fors in the middle there.

What's another way we could do this? Does somebody have a different way? Yeah?

AUDIENCE: haydn.recurse.getElements.

MICHAEL SCOTT ASATO CUTHBERT: haydn.recurse.getElementsByClass('note.Note') And then?

AUDIENCE: Hold on. Oh.

MICHAEL SCOTT ASATO CUTHBERT: Like, yeah. It's when you forget to put that at the beginning that you really wish Python were more like JavaScript or Java, where you could just do dot length at the end. Good. Any other ways that people did it?

OK, enough note counting. By the way, you hope that this should-- len-- also get something pretty similar, so flattening. It doesn't matter which order you're iterating through. You're still going to hit every single thing, right? Good.

OK so, let's grab the viola part. I'll call it via equals and take a second to see if you can remember how to do that. What the question is going to be, this will be one of the last-- second to last thing.

Get the viola part. Let's change its clef to treble clef, because it will be a little bit harder for us to read who are not violists.

[STUDENTS DISCUSS]

You might need to, from Music21, import clef. I can't remember. Has everyone gotten-- raise your hand if you've gotten the viola part out, even if you not get the clef. Good.

I'm going to put in what I did to get that, haydn.parts['viola']. Notice, it's not case sensitive. Let me just make sure I got the right one. You could also have done index one, two, three, two.

Right? Good. Keep going on that. I'm going to go through a couple of ways I did it, viola-- we can call it alto clef, hopefully, it's that-- equals what? viola clef. Clef.first. Hopefully, that's right, or viola.recurse.getElementsByClass-- clef-- whatever.

Do this one. Here's one of the ways that you could do that. I'll just give the way that's probably not the best way, but looking at the time, I'll explain the best way later. We can put it as a G2 clef. We're going to change it.

The piece should be beginning with a bunch of B flats and it still is. So that's one way to do it. I want to just point out two things here. Notice, we did not change the stem directions of anything, so it looks a little bit weird. It looks very weird when you go from treble clef to bass clef or something like that.

The other thing is, what do you call it, altoc? Now, we have a particular subclass of clefs so that clefs are in a taxonomic-- or alto clef is in a taxonomy or meronymy with a generic clef.

AUDIENCE:

Taxonomy?

MICHAEL SCOTT ASATO CUTHBERT: Alto clef is another clef. Great. So we might be having a problem. We might need to see if there's a way we can actually replace it with another clef.

Thank you. I did broke my promise. You're 20 seconds late. Thanks, great class.