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No-C-Notes

Summary of the Project

No-C-Notes is an audio music transcription service created by Christina Cotruvo. Just like an audio book speaks the words from a book, No-C-Notes reads and spells out the sheet music for those with visual impairments.

The program takes XML files of music pieces and creates audio files that tell the user what notes to play in a piece. The main problem is sometimes the notes aren't written in the correct order in the XML files. To fix this, we use the default-x attribute and other elements in a note to assemble the audio track in the correct order.

The Approach

My approach to solving this problem was to give each note a unique ID. This makes it easier for the sorting function to compare the unique ID of the previous note to the current one to determine which should be written first.

There are five elements that make up the ID for each note. The first is the measure number and I take this number and multiply it by 100000. Then I add the default-x number. That number is written as an attribute for each note within the XML. The third element is the note duration. For instance, this could be a whole, quarter, eighth, or sixteenth note and longer notes should be written first.

After the note duration comes the octave number. There are seven octaves and the lowest one should be written first. Lastly, the step value is appended to the end of the unique ID. This is the letter value in a note (low to high: C, D, E, F, G, A, B). Again, lowest tone should be written first.

Here is the dissection of a note in measure three of Happy Birthday.

Happy Birthday - Measure Three

UNIQUE ID	NOTES				
30000000 300013342 300077341 300140345	Measure Three. quarter-D four. quarter-C four. quarter-G four.				
		Unique ID	for quart	er-C fou	r
С С	$\cap \cap$	\cap	7	7	



After unique ID was created for each note, it was added to a multidimensional array with all notes and their attributes from that measure. Then the array was sent to the sorting method I wrote and the sorted array was returned and the audio track is assembled.

Here is an example of where this sorting method was helpful:

Sorting Example - Christmas in Killarney (M 15)

BEFORE Measure Fifteen. Chord A minor. eighth-E Four. eighth-A four. eighth-A four. eighth-B four. Chord A minor sevel eighth-C five. quarter-A four. eighth-B four. with-balf-E Four.	nth.		ted in order as the XML file	
hofersCerting [[1	5000/	0/F1 alabth	C fire)	
{1	500414 500530	3451, eighth, 4346, quartei 0447, eighth, 3243, half, -,	, -, A four, .} -, B four, .}	

BEFORE SORTING



After I finished sorting all notes correctly, there were a few smaller issues I needed to fix. I needed to code items for 6-4 time, add the mezzo-piano dynamic, and sort items in the voice map alphabetically so items are easier to find.

Timeline & Hours

Original timeline:

- Week 9: Recreate the loop that looks through each measure and sorts by the <default-x> value.
- Week 10: Continue to work on the loop and sorting each note by the default-x value.
- Week 11: Start working on sorting notations by the default-y value.
- Week 12: Continue to sort elements by default-y value, ensure this works with the default-x values.
- Week 13: Start to add rules and logic for elements that weren't included in the first version of the app.
- Week 14: Continue to add rules and logic for elements.
- Week 15: Run through many pieces of music to find bugs that may still be in the code.
- Week 16: Add sounds to the voice map.

Original estimation of how long it will take to complete each task

- Rewriting the loop and sorting all elements by default-x and default-y values: 20 hours
- Writing rules and logic for all new elements: 15 hours
- Other bug fixes: 10 hours
- Adding new elements to the database: 5 hours

Total hours estimated: 50 hours

Tasks Completed & Dates:

Actual hours spent: 57 hours

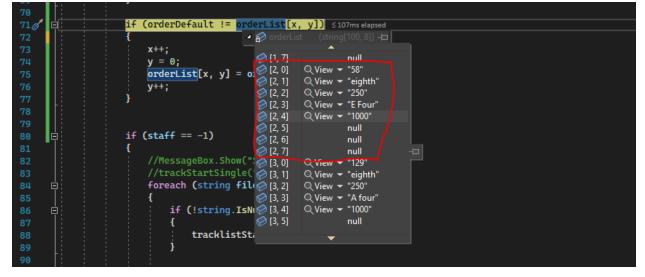
Week 10 Tasks

- Take all music notes in one measure and put into an array
- Loop through the array and pull out the default-x number for each music note

In this first screenshot I'm taking all notes in a measure and putting them into a multidimensional array called orderList.

121	
121 122 🖻	if (staff == 1 staff == 99)
123	
124	<pre>string stupidString = "";</pre>
125	
123 124 125 126	foreach (string filename in items)
127	{
128	if (!string.IsNullOrEmpty(filename))
129	€ 1
130 🖋	<pre>tracklistStaff1.Add(filename);</pre>
131	
132	
133 🗉	if (!handed)
134	
135	//&& Int32.TryParse(filename, out erasethis)
136 🗉	if (!filename.Contains("Measure") && !filename.Contains("Hand"))
137	
138	handed = true;
139	
140	
141	
142	
143 🗉	if (!filename.Contains("Measure") && !filename.Contains("Hand") && !filename.Contains("1000") && !filename.Contains("250"))
144	
145	<pre>noteOrRestRight = true;</pre>
144 145 146	
147	<pre>stupidString += filename;</pre>
147 148	
149	//Adding note attributes to orderList
150	orderList[x, y] = filename;
149 150 151 152 153	y++;
152	
153	
154	
155	
156	
157	

Then I pulled out the default-x for each number and added it to the first spot in the array.



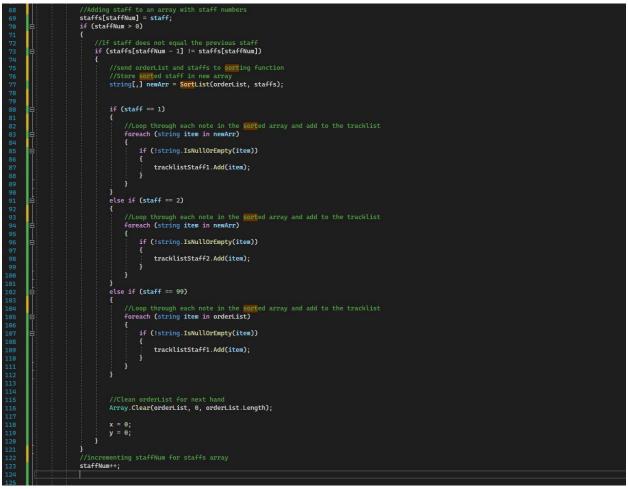
Week 11 Tasks

- Create a sorting function to sorts all numbers by default-x from smallest to largest (5.5 hours)
 - \circ Send each measure to the sorting function by staff 1.5 hours
 - Create the sorting function 3 hours
 - \circ Add the items in the new list to the track list that gets printed out 1 hour

In this screenshot I created the method that will sort all of the notes.

```
Interence
public static string[,] SortList(string[,] orderList, int[] staffs)
{
346 🖗
                              // Get the length of the first dimension (number of rows)
int rows = orderList.GetLength(0);
                             // Create a list of tuples to store the array values and their corresponding first number
List<Tuple<string[], int>> tupleList = new List<Tuple<string[], int>>();
                              // Iterate over the array and add each row as a tuple to the list for (int i = 0; i < rows; i++)
                                    int firstNumber;
if (int.TryParse(orderList[i, 0], out firstNumber))
                                          // Copy the row into a string array
string[] rowArray = new string[orderList.GetLength(1)];
for (int j = 0; j < orderList.GetLength(1); j++)</pre>
                                                rowArray[j] = orderList[i, j];
                                          // Add the row as a tuple to the list
tupleList.Add(new Tuple<string[], int>(rowArray, firstNumber));
                                    3
                              // Sort the list by the first number
tupleList.Sort((a, b) => a.Item2.CompareTo(b.Item2));
                              // Create a new array to hold the sorted values
string[,] sortedArray = new string[tupleList.Count, orderList.GetLength(1)];
                              // Copy the sorted tuples into the new array
for (int i = 0; i < tupleList.Count; i++)</pre>
                                    for (int j = 0; j < orderList.GetLength(1); j++)</pre>
                                          sortedArray[i, j] = tupleList[i].Item1[j];
                                    3
                              // Return the sorted array
                              return sortedArray;
```

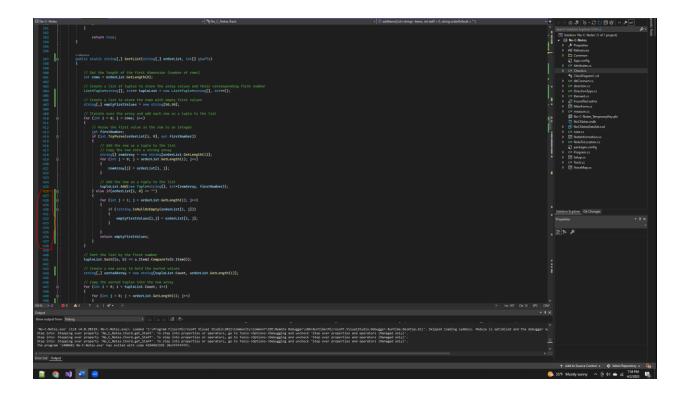
And here is where we loop through all of the notes and send the array to the sorting method shown above.



Week 12 Tasks

- Printing all notes in order by default-x number 4.5 hours
 - Printing out measure number for both hands 1hour
 - Printing out all notes for both hands 3 hours
 - Stop printing the default-x number 30 minutes
- Start working on getting chords to print in the correct place 2 hours
- Add another measure to test 30 minutes

Here's the adjustment to the sorting function to accept entries that do not have a default-x number tied to it. For example, "Measure" doesn't have a value tied to it so it is printed in the same place it was found.



Next, I took the default-x numbers out of the printout.

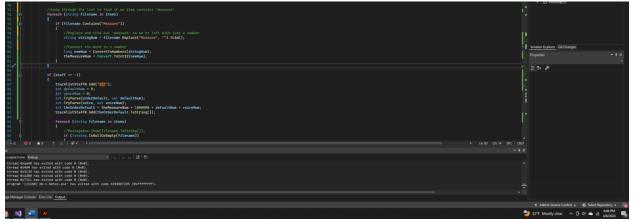
446 447 B	// Carry the sorted taylor into the new array for (int : 0 : i ot tayloristic.comt; i=0)		
448	for (int j = 0; j < enderList.GetLength(1); j++)		
450	//Turn if fattement off to print default-x values if () > 01	Solution Explorer	Git Changes
453 454	SorteMray(i, j] = tupleList(i).Itent(j);	Properties	- 0
1 1		29 /	
457			
459	/ / Returns the sected array		
461			
463 8	z-intervose visida trackStart()		
464			
466 467 E	<pre>string starticection = "C:\SoundS\Weasure "; if (startMeasure = 0")</pre>		
468 469	{ tracklocaties.Add(*C:\\sunds\\Pickup Mesure*);		
478	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1		
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Week 13 Tasks

- Fix the last measure getting lost in the printout. 4 hours
 - I had a meeting with a programmer where we tried to figure out why the last measure wasn't printing and then found out we needed my code to execute later in the program.
 2 hours
 - I spent the remaining two hours moving the code and putting the pieces back together.
 2 hours

- Fix the program so it sorts notes by measure (Bonus) 4 hours
 - First, I tried to mess with the sorting function. 1.5 hours
- Test, test, test 1 hour
- Send to client to test 1 hour

Here I looped through the list of attributes being passed into addItems and looked for one that contained "Measure" (an item would come in as 'Measure One'). Then I would replace the word 'Measure' with empty quotes and trim the empty spaces. After, I would convert the word to a number to create the first part of the unique ID for each note.



Then, for each tracklist, I parsed the default-x and voice values to numbers. Then I multiplied the measure number times 100000 and added on the default-x and voice numbers to create a unique ID for each note. This was added to the tracklist.

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Down where items are printed to the screen, I looped through the tracklist for each staff and added all of the attributes into a jagged array. Then I sent it to the sorting function.



Week 14 Tasks

- Incorporate feedback from my client about the order of the notes 5 hours, 45 minutes
 - \circ Take out voice number and sort by note duration and pitch 3 hours
 - Debug sorting errors 2 hours, 15 minutes
 - Remove unique IDs from unfound items 30 minutes
- Include 'mezzo piano' in the program 1 hour
- Fix tied note errors 1 hour
- Test with multiple pieces 1 hour

During this week I started by reading the feedback I received from my client. There were a few instances where notes were still printing in the wrong order because the unique IDs were the same. My client's solution was to sort by note duration (quarter note, whole note, etc.) if both default-x numbers are the same. If the note duration is the same, sort by pitch.

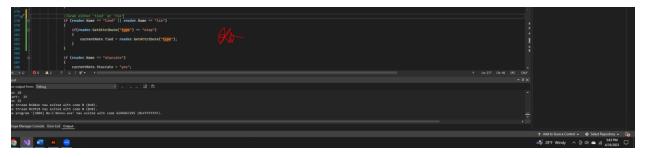
The first thing I did was pass the octave, step, and note duration into the method where items are added into the tracklist. Then I assigned values to those variables based on the advice from my client. She said longer notes should be printed first, so a whole note gets a value of 1. Then higher pitches should be printed first compared to lower pitches.

90			Search Solution Explorer (Ctrl+:)
91 92		satisfic (step)	Solution 'No-C-Notes' (1 of 1 project)
93			a 🖻 No-C-Notes کر Properties کر
94		step = "?";	 Properties 348 References
95 96		break;	Common
97		step = "6";	App.config
98			
99		cases top: "5";	
100		step a, break;	*g ClassDiagram1.cd
102			 CH direction.cs
103		step = "4";	C DirectionType.cs
104		break; case=set=	▶ C# Bement.cs
105		step = *3*;	FoundText.edmx
107		break;	MainForm.cs
168		case top: "2";	C ^{III} measure.cs
110		step = -ar; break;	No-C-Notes_TemperaryKey.pfx NoCNotes.mdb
111			NoCNotesDataSet.asd
112			CF notecs
113		break; HO	NoteInformation.cs
115		step = "6";	
116			packages.config
117			 C II Program.cs Setup.cs
119			 Les setupics C "Tack.cs
120		if (type.Contains("shole") type.Contains("shole"))	VoiceMap.cs
121			
122		type - 1;	
124		else if (type.Contains("Half") type.Contains("Half"))	
125 126			
127 128] else if (type.Contains("quarter") type.Contains("quarter"))	
129		type = "3";	Solution Explorer Git Changes
131			
132 133			
134			211 👥 🔎
136		slee if (type.Contains("sixteenth") type.Contains("Sixteenth"))	
138 139			
148		els if (type.Contains("thirty-second") type.Contains("Thirty-Second")) (
142 143			
144		else if (type.Contains("sixty-fourth") type.Contains("Sixty-Fourth")) {	
146			
148			
149		t toma ##*	
s - Q	80 41		
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e progra	am [3084] No-	Castes.ee' has exited with code 4398(2795 (8);fffffff),	
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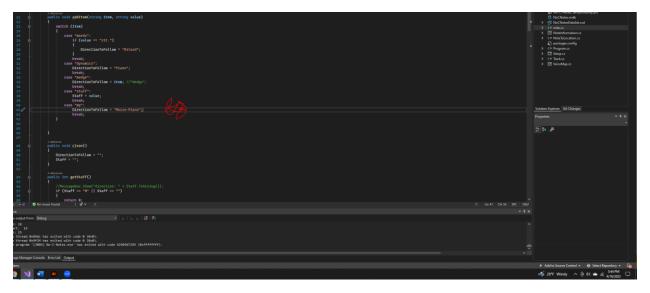
Next, I added it all together. I appended type, octave, and step to the unique ID to create a variable that will always be unique.

228		
229		if (staff == 1 staff == 99) //
230		
231		
232	112 2 2	<pre>tracklistStaff1.Add("ZZZ");</pre>
233		
234		//If orderDefault is a decimal, take away the decimal
234		if (orderDefault. Is a doctant, care and the doctant if (orderDefault.Contains("))
	P	ir (urverberautt.containst -))
236		
237		orderDefault = orderDefault.Replace(".", "");
238		
239		
240		
241		float.TryParse(orderDefault, out defaultNum);
242		
243		
244		long octaveNum = ConvertToNumbers(octave);
245		
246		
247		<pre>octave = octaveNum.ToString();</pre>
248		
249		//Multiply measure number by one hundred thousand and add defaultNum
250		float theOrderDefault = theMeasureNum * 100000 + defaultNum;
251		
252		//Append type, octave, and step to the orderDefault number and add to tracklist
253		string order = theorderDefault.IoString() + type + octave + step;
255		strang of a two beauty for the constraints of the steep, trackliststaff. Add(order);
254	• HE - E - E -	
255		foreach (string filename in items)
		foreach (string filename in items)
257		<pre>//MessageBox.Show(filename.ToString());</pre>
258		
259		if (!string.IsNullorEmpty(filename))
260		
261		<pre>tracklistStaff1.Add(filename);</pre>
262		
263		
264		if (!handed)
265		
266		
267		if (!filename.Contains("Measure") && !filename.Contains("Hand"))
268		
269		handed = true;
270		
271		
272		
273		
274		if (!filename.Contains("Measure") && !filename.Contains("Hand") && !filename.Contains("1000") && !filename.Contains("250"))
275		
276		noteOrRestRight = true;
277		
278		
279		
2800		
2000		

After finishing the problems above, I moved on to fixing tied notes. Tied notes weren't printed in the correct places even though they were written in the XML. I found that the program was looking for the word "tied" when sometimes only "tie" was written in the XML. I modified the program below to also accept "tie."



Lastly, there are different dynamics in music to tell the reader how loud to play. Piano is soft while mezzo-piano is half soft. The program didn't have a rule for mezzo-piano so it printed piano instead. I added a rule to this switch case to say if <mp/> is passed in, that means mezzo-piano should be written.



Week 15 Tasks

- Read feedback from client and make all octave tones lowercase 1 hour
- Fix mezzo-piano issue 1.5 hours
- Fix 'with' issue 3 hours
- Changes to voice map 1.5 hours

The first issue I tackled during week 15 was printing mezzo-piano in the right place. I realized that mezzo-piano was bring printed on the wrong staff. This piece of music didn't have a staff so it was supposed to be listed as -1 but instead was 0. I added three lines of code to this if statement that gets the staff to say if staff is equal to null then return -1 for the staff value.

	Network .	
55 8	Analysis in getstaff()	
20 27		
58 El	jé (Staff == **) Staff == **)	
60		
éz e	else if (Staff == mull) //To catch when staff is equal to -1	Solution Explorer Git Changes
61 64		
65	N	
66	int returnValue = Convert.TaInt32(Staff);	11 P4 /
68 69		
78		
72 8	public List <string> gutput(string timing)</string>	
73 74 75	List <string> outputtees = new List<string>O;</string></string>	
76 8	if(DirectionTofollow == "Wadge"){	
77	i e	
29 L	e130	
A1 1	outputitess.Add(DirectionToFolles):	
- 🤄 🕑 No iss		
Jt .		
output from: Debug		
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The client wanted all notes to be automatically sorted under the voice map's "Found Text" column for easier viewing. It was an easy line of code I added to line 54 of the screenshot below.

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Next, I added six four time to the Voice Map because it wasn't in there already. However, six four time wouldn't show up when I sent a piece of music through the program.

		Show Events (0 of 0)	
		Memory Usage	
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💀 VoiceMap		- CPU Usage	
	FoundText A	FileLocation Record CPU Profile	
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No-C-Notes®	Repeat ending	Repeat ending one way	
	Repeat ending	Repeat ending one and two way	
	Repeat ending	Repeat ending two way	
AUDIO MUSIC DESCRIPTION	Repeat reading	Repeat reading way	
	Rest	Rest.wav	
Close	Return to start	Return to start of repeat.wav	
	Right Hand	Right hand.wav	
	Ritard	Ritard.wav	
	Six eight time	Six eight time.wav	
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One of the last things the client requested I do was make all octave tones lower case. This was relatively easy, all I had to do was find where the notes were the numbers for the notes were bring printed and make them all lowercase. Now, instead of eighth-D Four, it's eighth-D four.

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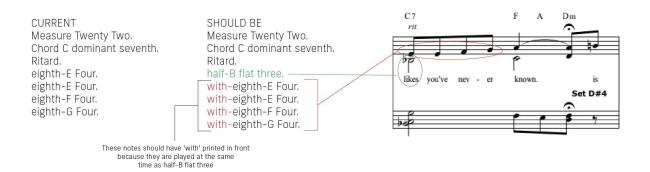
I used Monday.com to keep track of my project

Main Table +							🖏 Integrate 🎯 🐑 M 🚥
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Project Week 9 - Code Comments		Status	Date Mar 12	Estimated Time (Hours) 0.5 Hours	Estimated Time Spent	Notes	+
Week 9 - Code Comments Week 10 Report		Done	Mar 12 Mar 19	1 Hours	0 Hours 1 Hours	I decided not to work on this over spring break.	
Week to report Week to code Comments		Done	Mar 19	0.5 Hours	0.5 Hours		
Week 11 Report	Ð	Done	Mar 25	1 Hours	1 Hours		
Week 11 - Code Comments		Done	Mar 25	0.5 Hours	0.5 Hours		
Week 12 Report		Done	Apr 2	1 Hours	1 Hours		
Week 12 - Code Comments		Done	Apr 2	0.5 Hours	0.5 Hours		
Wee 13 Report		Done	Apr 9	1 Hours	1 Hours		
Week 13- Code Comments		Done	Apr 9	0.5 Hours	0.5 Hours		
Week 14 Report	Ð	Done	Apr 16	1 Hours	1 Hours		
Week 14- Code Comments		Done	Apr 16	0.5 Hours	0.5 Hours		
Week 15 Report		Done	Apr 23	1 Hours	1 Hours		
Week 15- Code Comments		Done	Apr 23	0.5 Hours	0.5 Hours		
Capstone Project Final Report		Done	Apr 30	1 Hours	15 Hours		
+ Add project							
				10.5 Hours	10.5 Hours		
 Prep work 							
Project		Status	Date	Estimated Time (Hours)	Estimated Time Spent	Notes	
Get re-acquainted with the No-G-Notes code		Done	Date Ner 5	2 Hours	2 Hours		+
Make notes where things need to be changed.		Done	Mar 5	1 Hours	1 Hours	Spent time learning how the program works and thinking about h Found places where notes are written to audio tracks and to the	
Add project		Conc				Peake places where notes are written to above backs and to the _	
- constructions				3 Moure	3 kieure		
+ Add project							
 Default-X and Default-Y 							
Project		Status	Date	Estimated Time (Hours)	Estimated Time Spent	Notes	+
Get the CIF reader to take all of the notes in one music measure and put it into an array		Done	Mar 9	3 Hours	5 Hours	Pushed to the next week since I didn't work on this over spring br	
Default-X: Loop through the array and pull out the default-x number for each music note		Done	Mar 12	3 Hours	5 Hours	Looped through the array and have assigned a default-x value to	
Default-X: Use the sort function to sort all numbers by default-x from smallest to largest		Done	Mar 12	2 Hours	6 Hours	First two tasks have been completed but I don't have time to wo	
Successfully print all default-x notes in order		Done	Mar 19	4 Hours	4 Hours		
Fix sorting method to take values with no default-x		Done	Apr 2	0.5 Hours	1 Hours	Now it will print out measures	
Print notes in correct place		Done	Apr 2	1 Hours	2 Hours	Print all notes under the correct measure	
Take default -x numbers out of print		Done	Apr 2	0.5 Hours	0.5 Hours	Fixed the setting function to do this	
Add another measure to test to see how different notes and notations come out	Ð	Done	Apr 2	0.5 Hours	0.5 Hours	Added another measure to see if all notes continued to come ou	
Fix last measure getting lost	۲	Done	Apr 9	0.5 Hours	3 Hours	Recause the program doesn't call additions after the last list of \boldsymbol{n} .	
Phint chords in the correct place		Done	Apr 16	2 Hours	6 Hours	Chords don't have default-x number or anything that is helpful in .	
Incorporate the feedback from client		Done	Apr 16	6 Hours	6 Hours		
+ Add project		_		23 Marca	20.144.00		
				23 Hours sam	39 Hours sum		
 Logic and Voice Map 							
Project		Status	Date	Estimated Time (Hours)	Estimated Time Spent	Notes	+
Start to add rules and logic for elements that weren't included in the first version of the app. 3	G	Done	Apr 16	3 Hours	2 Hours		
Subitem Owner Status Date	Estin	nated Time (Hours)	Estimated Ti		Notas	+	
Mezzo-Piano		1 Hours	3 Hou				
Tied & Tie O O Dore Aor 16		1 Hours	1 Hou	n			
Correct fingerings ⊕ O Apr 23		1 Hours					
+ Add subitem							
Add sounds to the voice map (get list from client)		Dore	Apr 23	5 Hours	2 Hours		
Add sounds to the voice map (get 1st from chent) + Add project + Add project		Done	AGE 20	0 HOURS	2 10015		
Prof				8 Hours	4 Hours sum		
				5000	6470		

Tasks Not Completed

The only major bug I have not patched yet is determining when 'with' should be printed in a note. 'With' should be printed when two notes are played at the same time and the note with the longest duration should be printed first. Each shorter note after that should have 'with' in front of it. Here is an example:

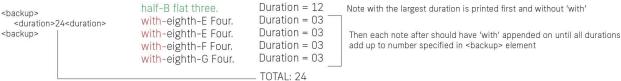
'With' Example - Christmas in Killarney (M 22)



THE SOLUTION

Each time there is a chord (two or more notes played at the same time), a <backup> element is printed in the XML and has a number value. Every note after that <backup> element has a <duration> value tied to it.

AN EXAMPLE



Reflection

Overall, this was a successful project and I completed most of the items on my list. I'm happy I was able to help someone who is using their skills to help others.

Throughout this project, I learned that things don't always go as planned so it is necessary to adapt quickly to set the project on the right course again. I also learned to overestimate my timelines on coding projects. I thought I was being generous by quoting 50 hours in the beginning. However, I hit roadblocks throughout the project and it took me longer than expected. 57 hours is probably a conservative guess, it may have easily taken almost 70 hours to get as far as I did.

Lastly, I am proud of myself for taking on this project when I knew it was going to be hard. Before this, I only had one semester of C# experience, and this is the biggest program I've ever worked with. While I struggled a lot, I was persistent and managed to complete most of the project.

Contact Information

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