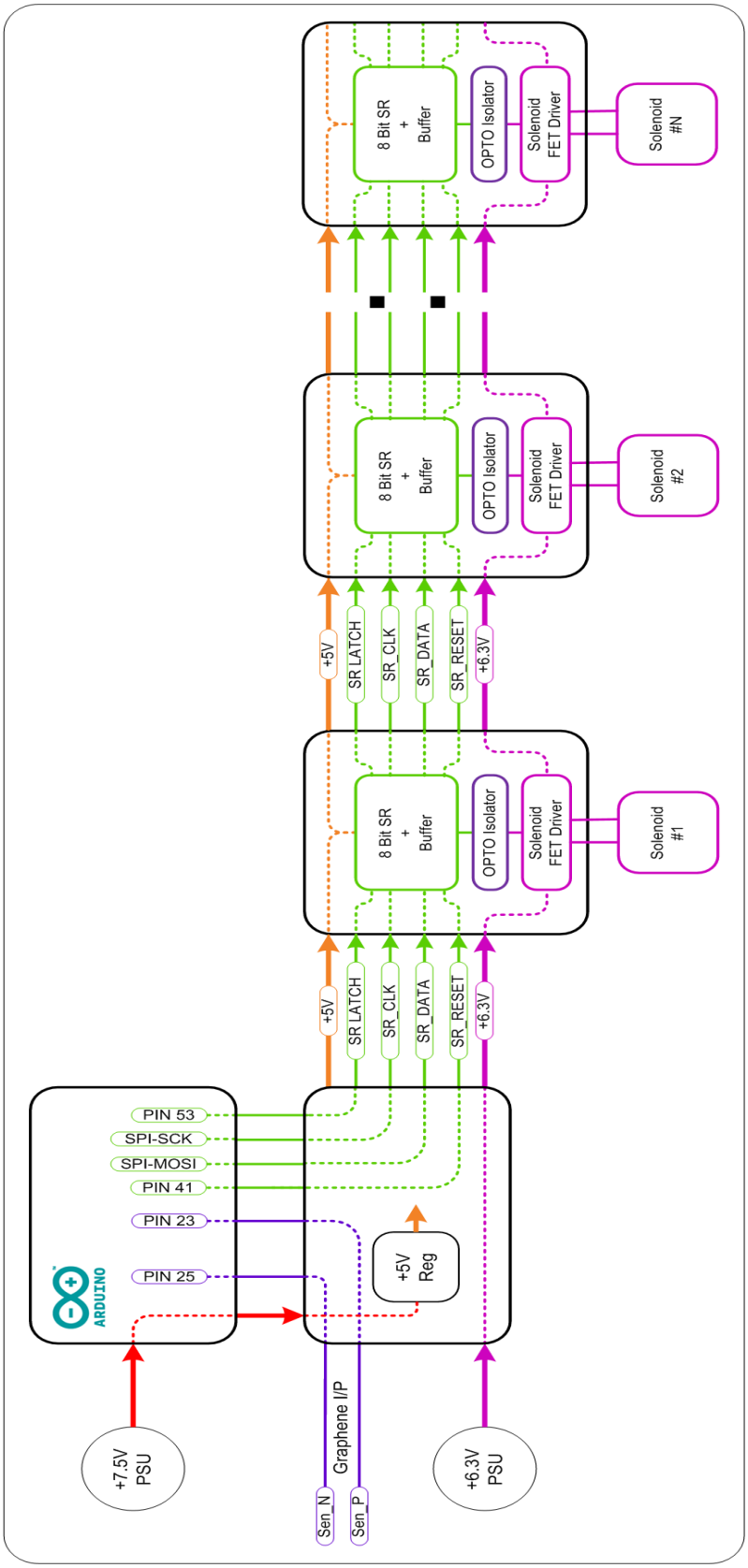
GLOCK-O-BOT

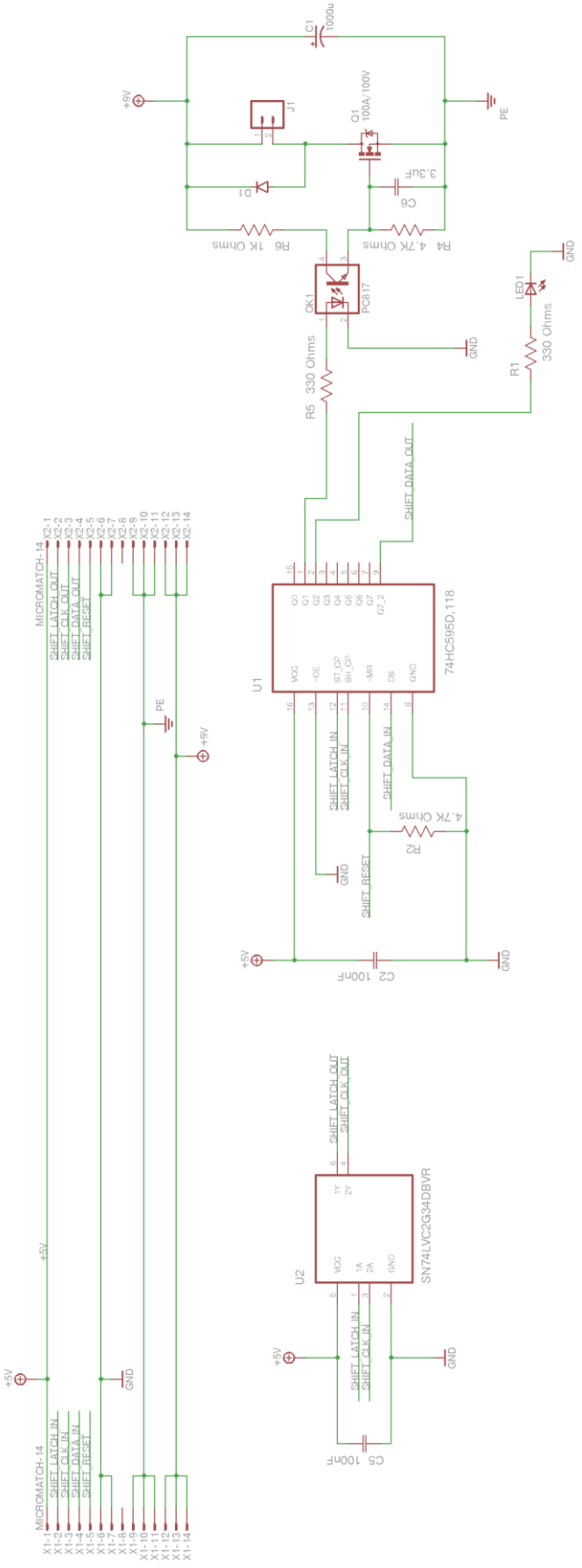
DESIGN GUIDE

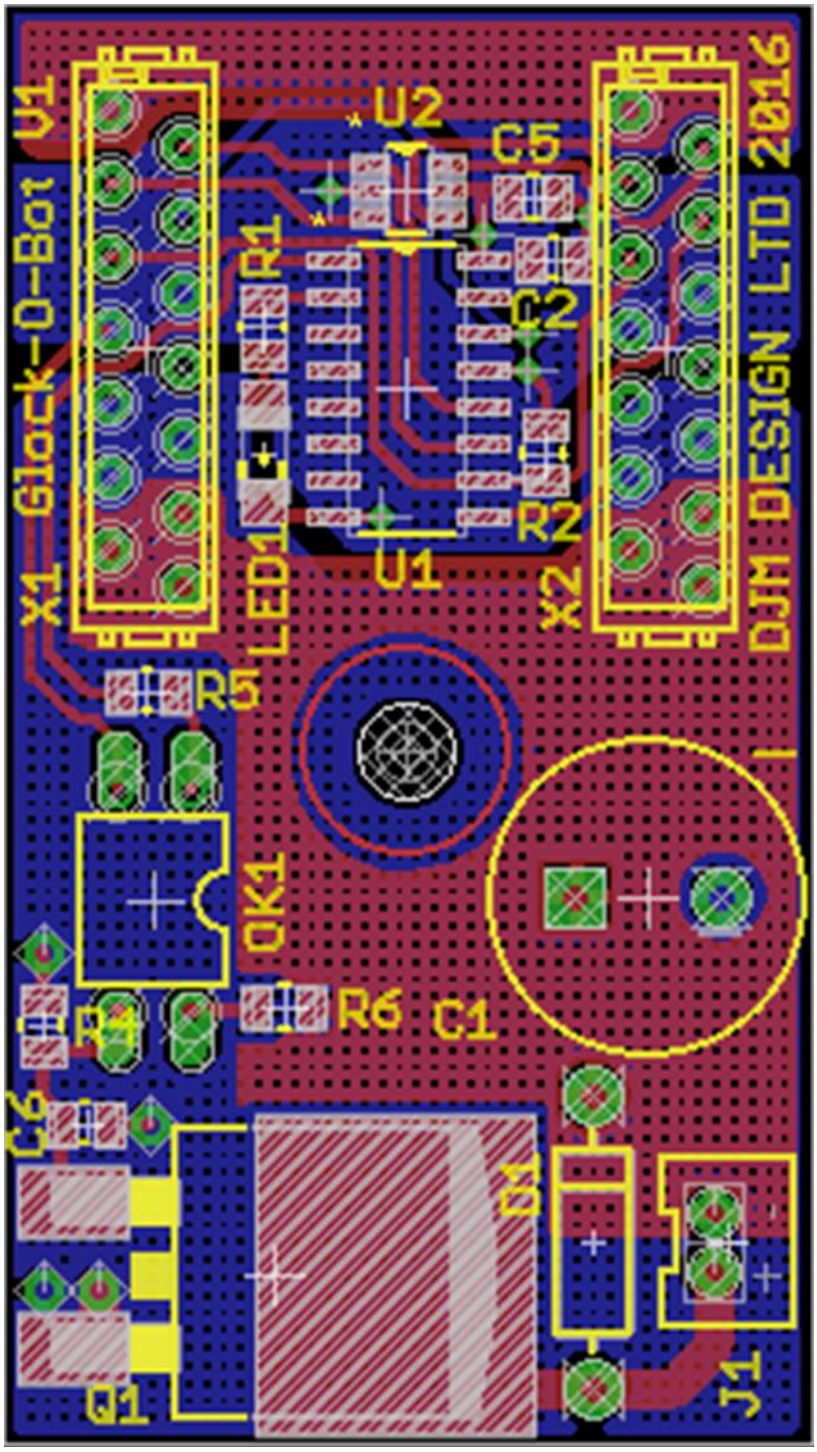
VERSION 1.0
SEPTEMBER 2016

1.1. SYSTEM DIAGRAM



1.2. SCHEMATICS

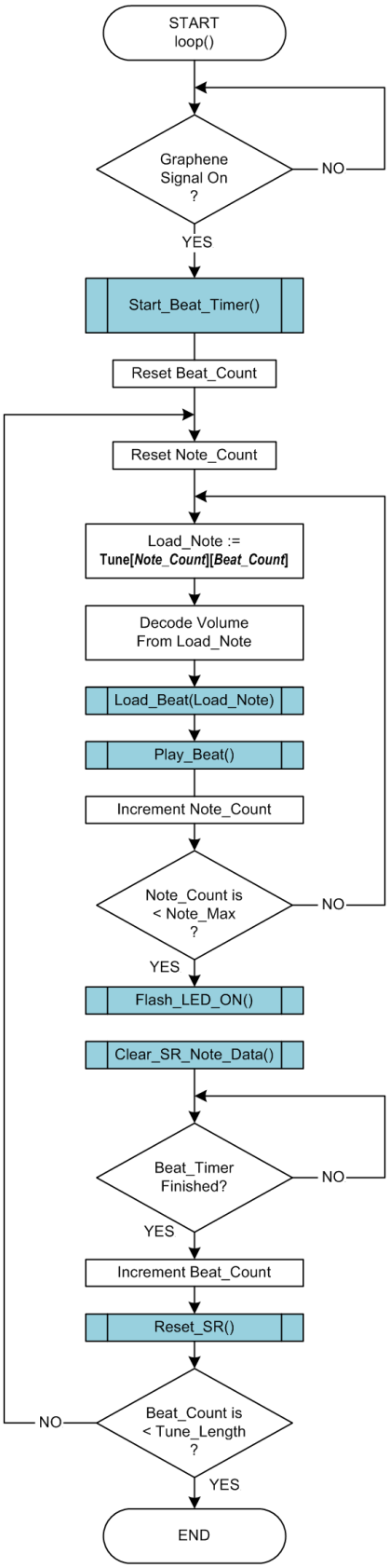


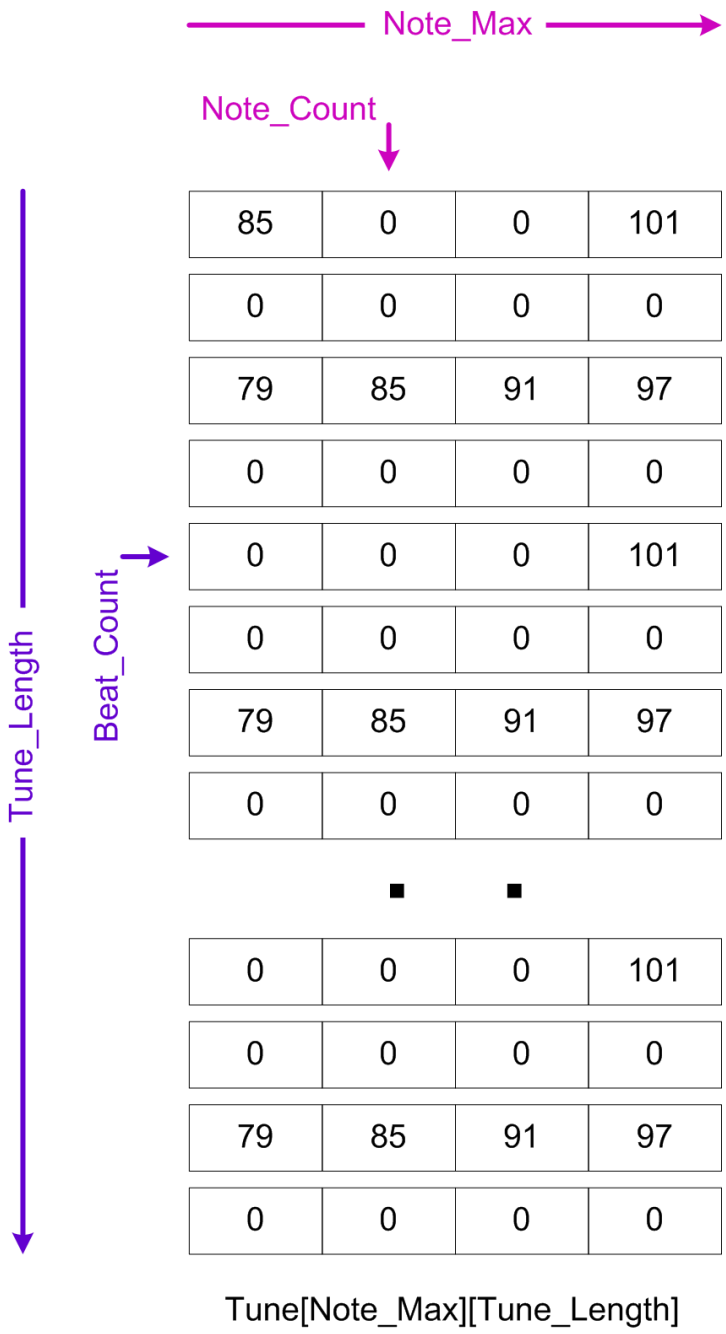

V1
Glock-O-Bot
X1
U2
C5
R1
C2
R2
U1
LED1
X2
DJM DESIGN LTD 2016
R5
OK1
R6
C1
C6
D1
J1
Q1

1.4. BILL OF MATERIALS

Part	Value	Description	FARNELL
C1	1000uF 16V	Capacitor Polarized	9693610
C2	100nF 0805 50V	CAPACITOR, 0805	1414663
C5	100nF 0805 50V	CAPACITOR, 0805	1414663
C6	3.3uF 0805 16V	CAPACITOR, 0805	DO NOT FIT!!
D1	Diode 1N4001	Diode	9564993
J1		Standard 2-pin 2mm	9491856
LED1	Green	LED 1206	8530076
OK1	FOD817A	SHARP OPTO COUPLER	2322514
Q1	BUK9637-100E	Common NMOSFET Parts	2254193
R1	330 Ohms	RESISTOR, 0805	2073741
R2	47K Ohms	RESISTOR, 0805	9333274
R4	4.7K Ohms	RESISTOR, 0805	9333266
R5	330 Ohms	RESISTOR, 0805	2073741
R6	1K Ohms	RESISTOR, 0805	2073606
U1	74HC595D,118	8-bit serial-in parallel-out shift register	1201269
U2	SN74LVC2G34DBVR	DUAL BUFFER GATE	1470888
X1	MICROMATCH-14	Micro Match 14 8-215464-4 / 1-215464-4	3784678
X2	MICROMATCH-14	Micro Match 14 8-215464-4 / 1-215464-4	3784678

2.1. FLOW DIAGRAM





Tune[Note_Max][Tune_Length]

2.3. KEY VARIABLE DESCRIPTIONS

Tune_Length	Used first dimension in the Tune array and is the total number of quantised steps in the tune
Note_Max	Used as second dimension in the Tune array and is the number of concurrent single note Tracks
Beat_Time	Is the duration of the quantised step in micro seconds and is derived from the Tempo. This is the value used to set the interrupt timer and acts as the main time reference for the tune.
Graphene_Signal	Used as the flag when checking if Graphene has signal a start.
Next_Beat	Used as a flag to monitor if the interrupt timer has triggered to indicate the start of the next time step.

2.4. GLOBAL FUNCTION DESCRIPTION

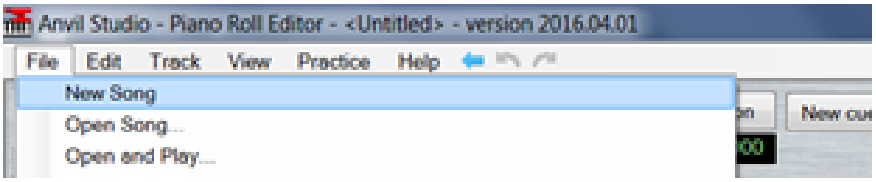
Clear_SR_Note_Data()	Clears the internal shift register note data array SR_Note_Data[]
Clear_SR_LED_Data()	Clears the internal shift register LED data array SR_LED_Data[]
Load_Beat(unsigned char Note)	Sets the internal SR data arrays with the correct bits for the note passed to it
Flash_LED_ON()	Sends the internal SR LED data array to the Glock-O-Bot
Load_LED_SR()	Used to shift the LED data out to Glock-O-Bot with the SPI library functions
Play_Beat()	Used to send internal note data to Glock-O-Bot and play the loaded single note
Reset_SR()	Clears all bits of the Glock-O-Bot shift register
Set_SR()	latches data from Glock-O-Bot SR to its output pins
Load_Notes_SR()	Used to shift the note data out to Glock-O-Bot with the SPI library functions
Start_Beat_Timer()	Configures and Starts the internal Timer to count for one quantised beat time
ISR(TIMER1_OVF_vect)	Interrupt subroutine called when Timer on expires

3. MIDI FILE CONVERSION

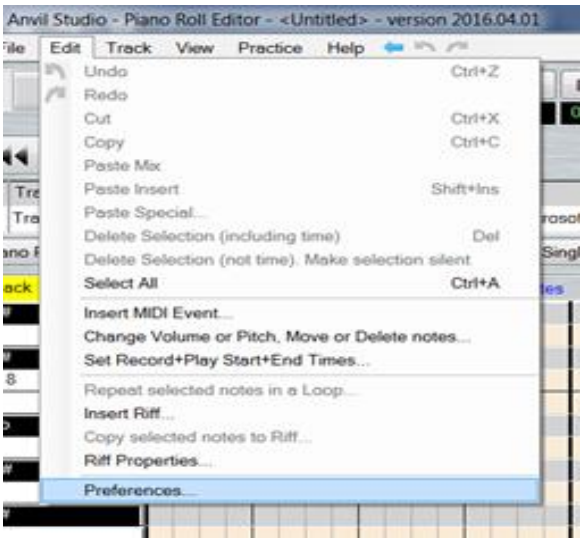
3.1. ANVIL STUDIO

First download and install Anvil Studio from: http://www.anvilstudio.com/

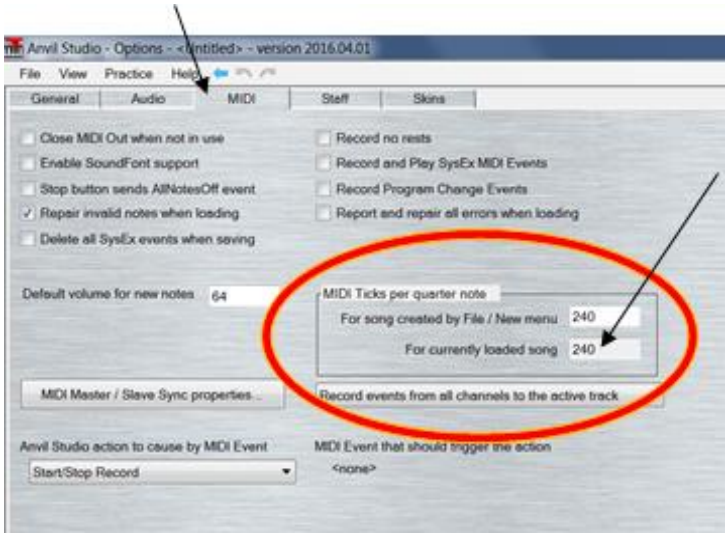
Make sure you have opened an empty file so that there aren't any fixed preferences



Go into Edit / Preferences



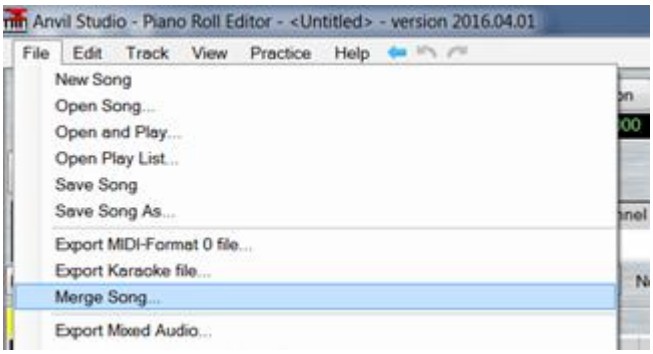
Click on the midi tab



!!! MAKE SURE TICKS = 240!!!

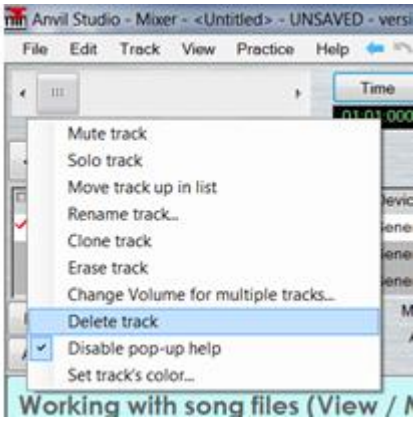
this will make for smooth integer quantization

Next import your midi file by clicking on merge song, and browse to your file

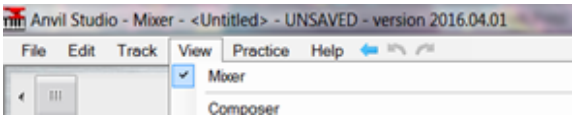


For the purpose of this guide I am using a short tune from the Super Mario game

You will have an extra track but you can delete it by right clicking the tick on the left and selecting delete track



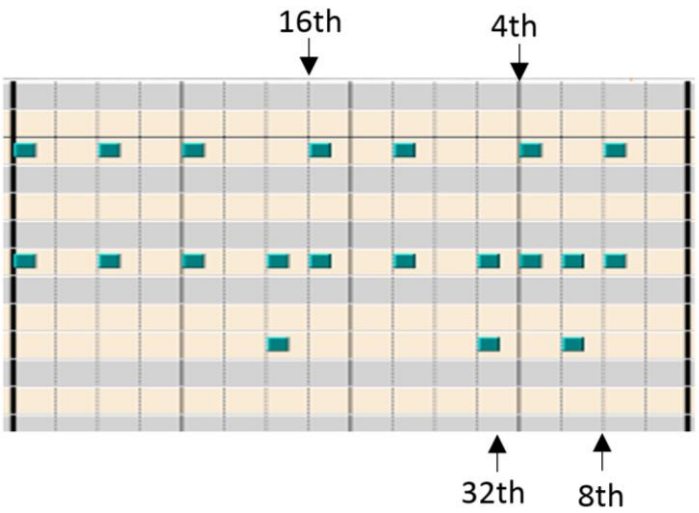
By default, you will be in the mixer view



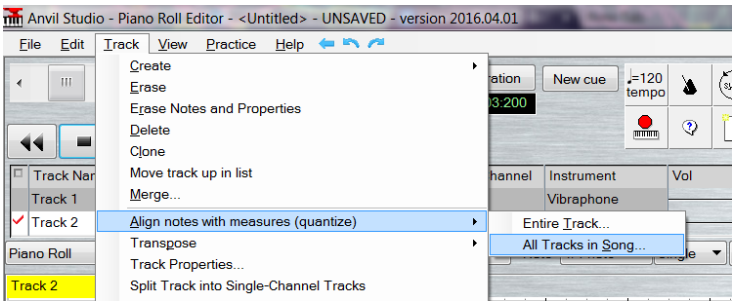
However, to change the view to the "Piano Roll Editor" to check that you have only one note playing at a time in each track, which is important given how the Arduino code works. Remember to check each of your tracks separately by selecting them in the viewer. Remember the recommendation to limit the maximum of concurrently played tracks to four.

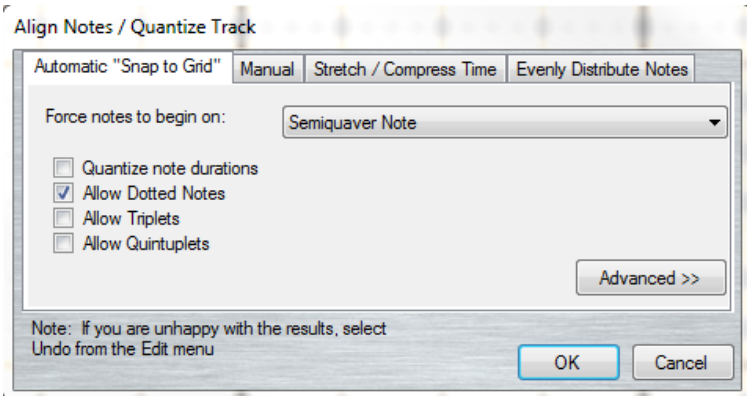
While doing this you will also want to check what the smallest time value of a note is in all the tracks, this will be used to align all the notes to a fixed grid (timeline). This typically ranges from a quarter note to thirty tooth of a note (demisemiquaver) and set the granularity of the Arduino's time-base.

In this example it is 16th note as all the smallest notes start on at least the 16th's line

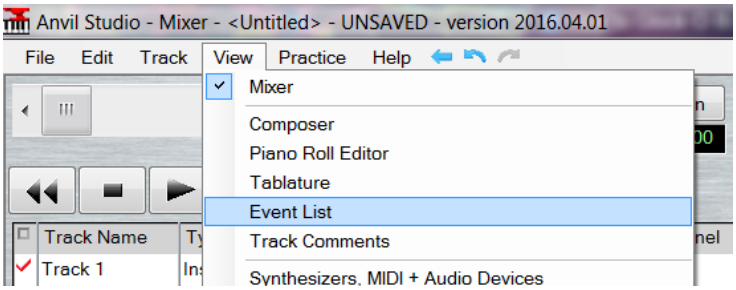


Once you have checked all your tracks you will have to quantize (Align the notes) with the smallest value you just found:

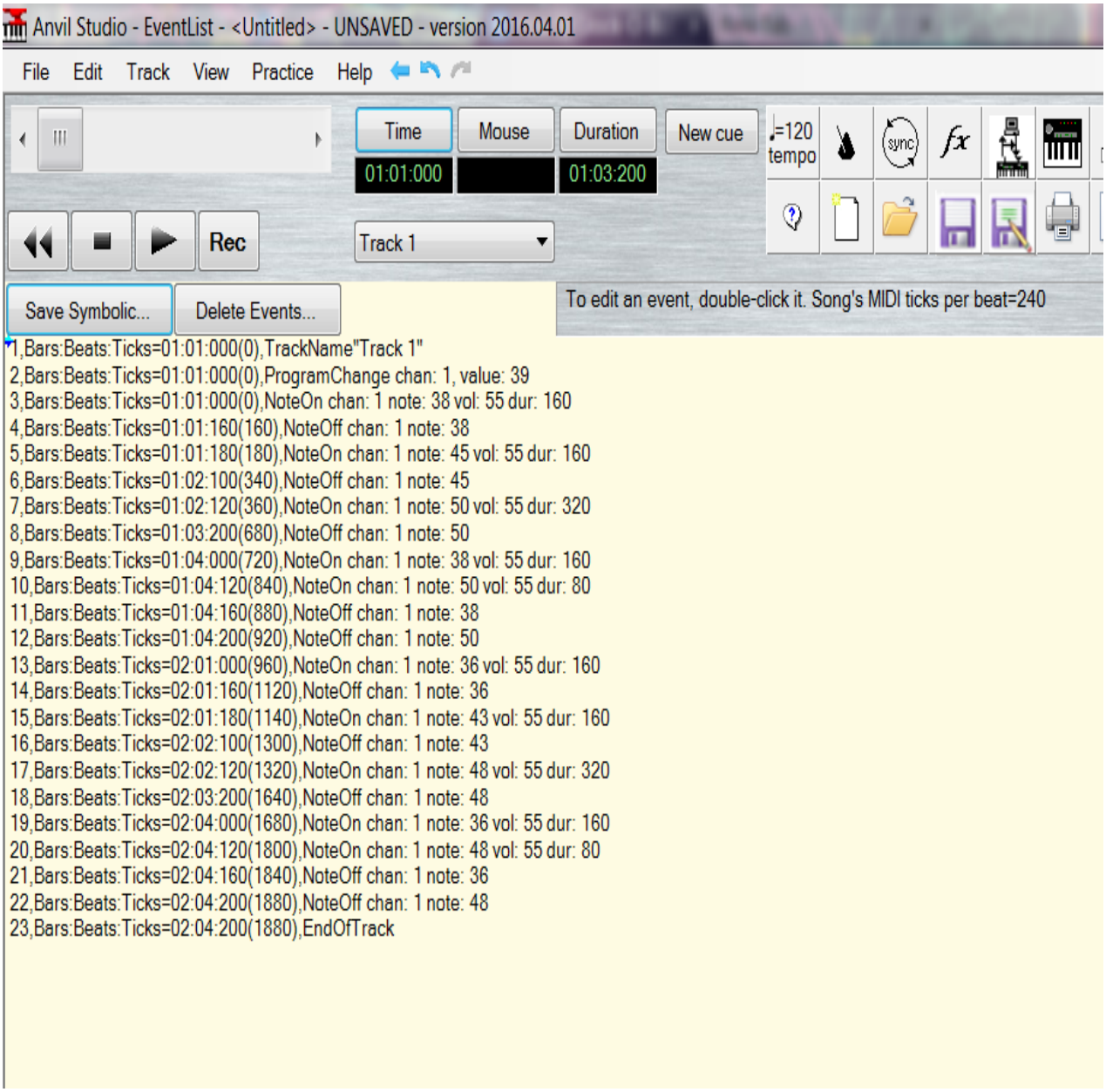




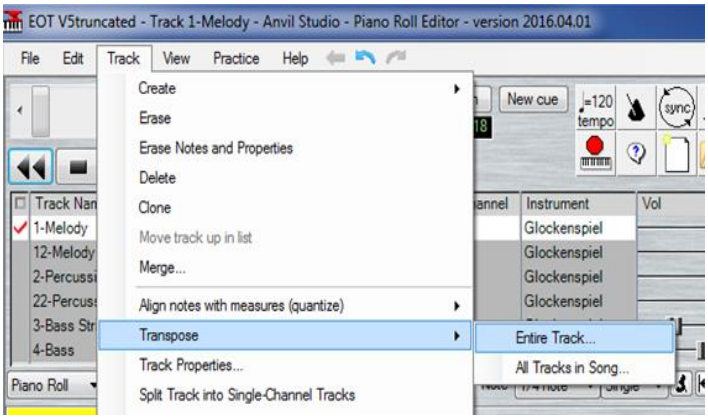
The Glock-O-Bot only has a Midi note range from 79-109, so you may need to transpose your tracks to bring them into the range. You can view the Midi notes being played by switching to the event viewer and scrolling through each selected track. To go into the event list select View / Event List

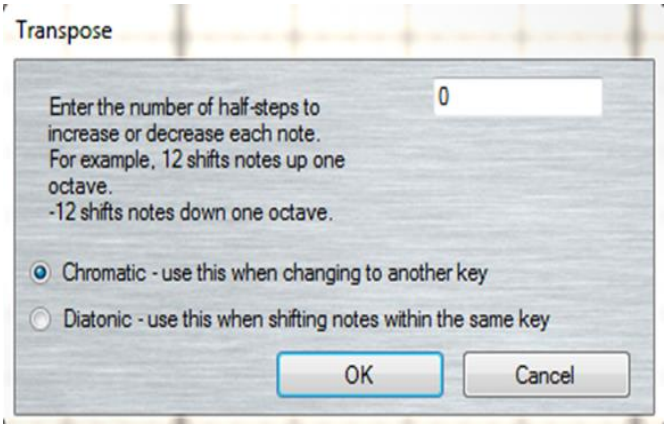


It should look something like this

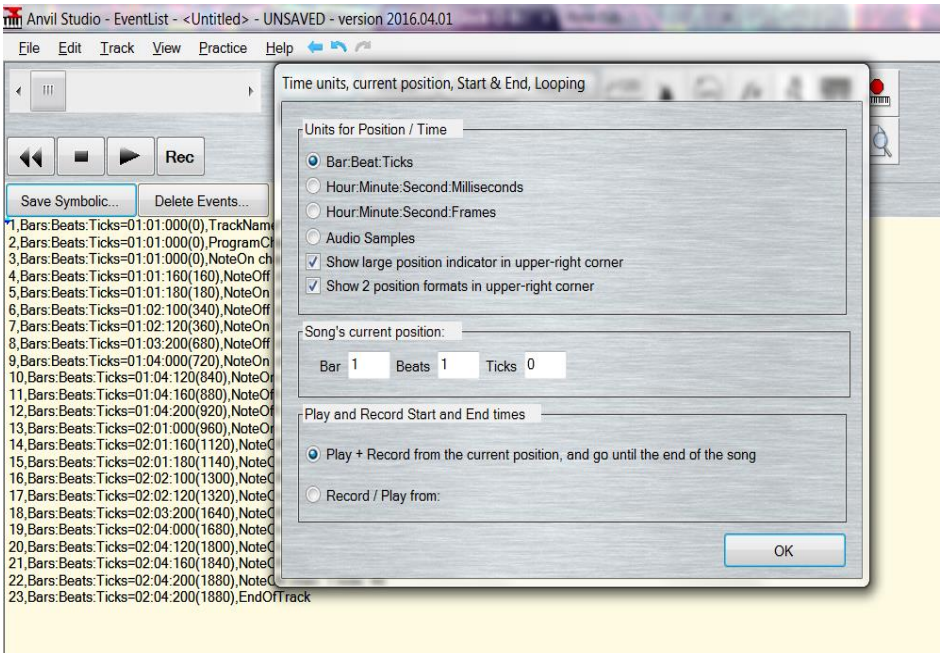


If the notes are out of range, they can be shifted up or down using the Track / Transpose / Entire Track...



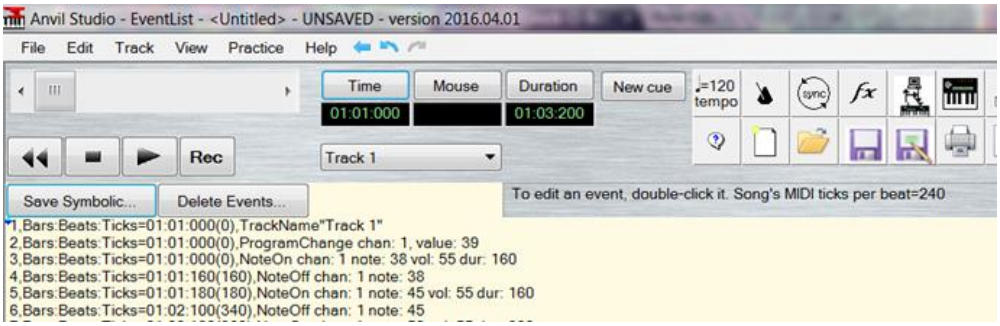


Now you are ready to export your edited tracks to text files, but first make sure you have set your time mode to bars beats and ticks



Use the 'Save Symbolic' button in the Event List viewer to save each of your tracks separately to a text file.

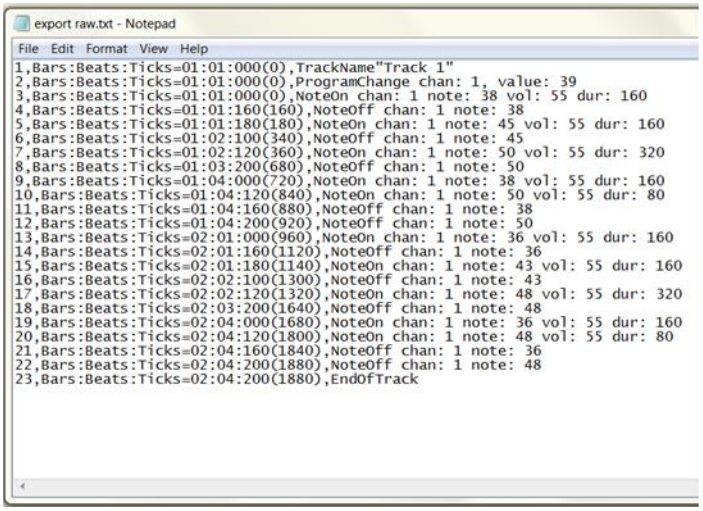
The example below would save Track 1 as this is selected the currently selected track.



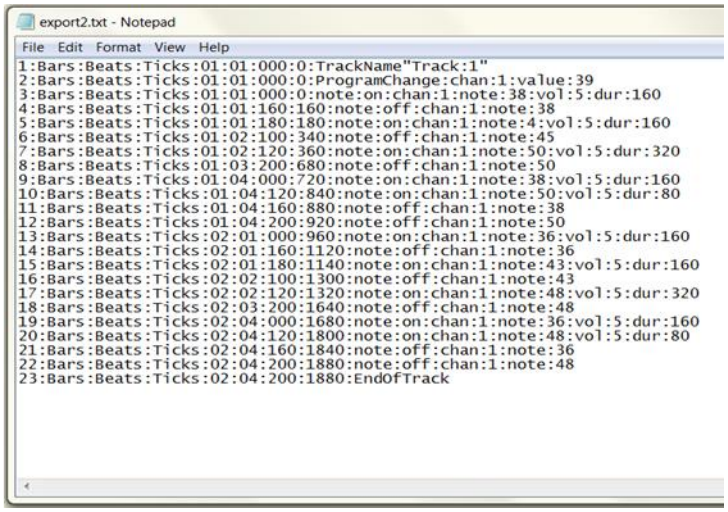
3.2. EVENT LIST TEXT FILE PROCESSING

In order to import the data from the event list text files into Excel, the data needs to be correctly delimited. This can be done using find and replace on text strings in Notepad and adding in the colons so that that all the data is properly delimited by a unique character (i.e. colon :)

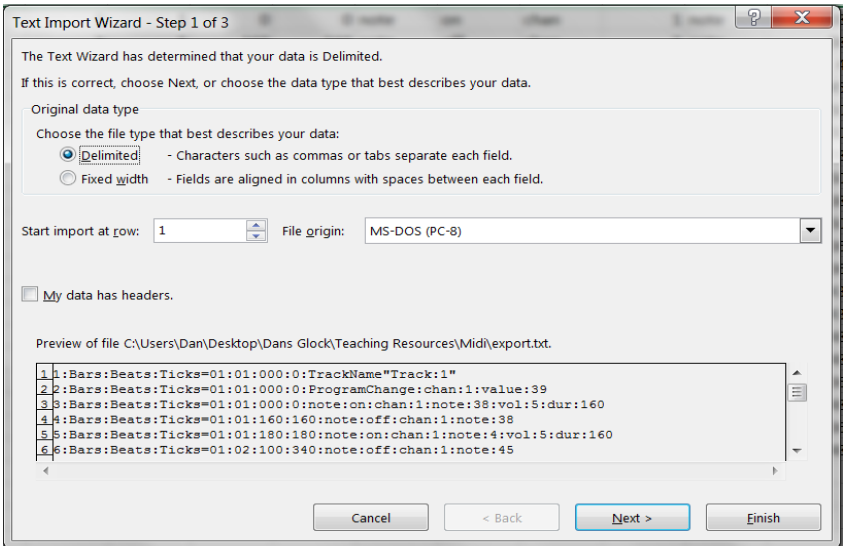
Before:



After:

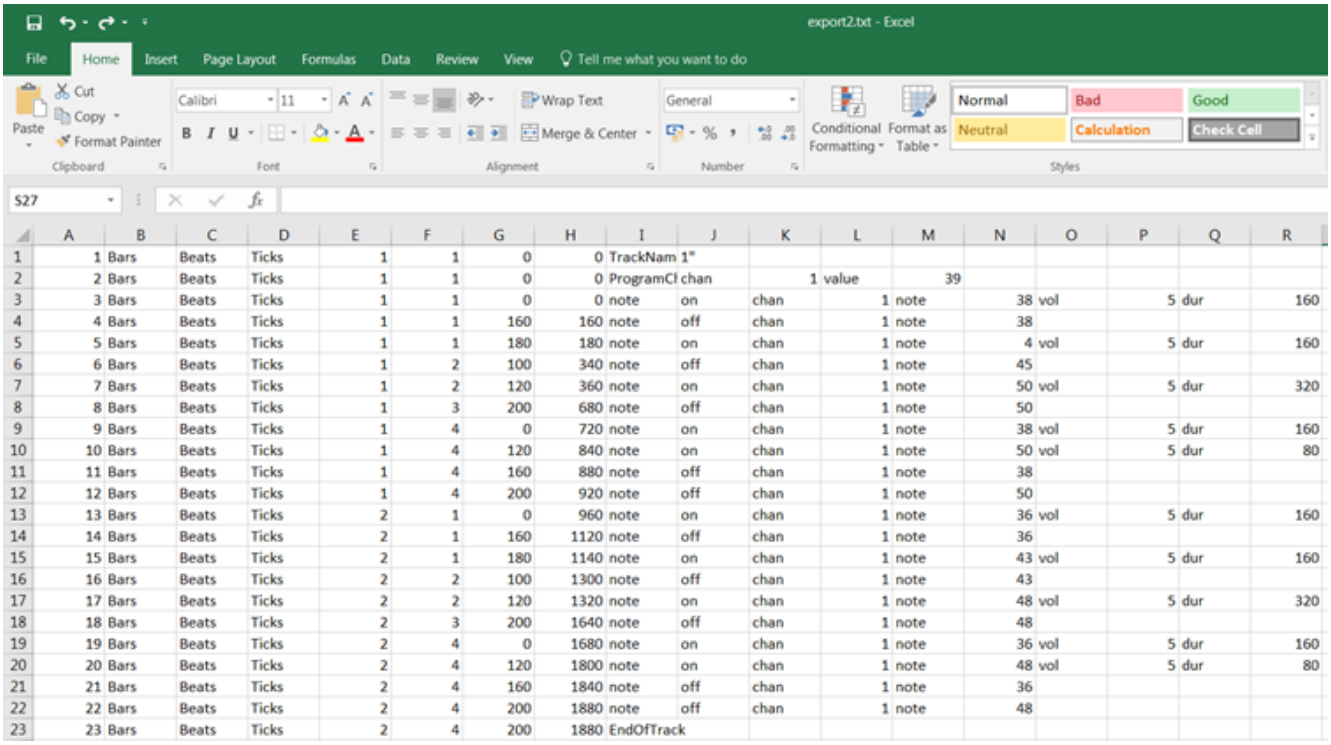


Each tracks event list can them be imported into an Excel file using the text import wizard shown below:



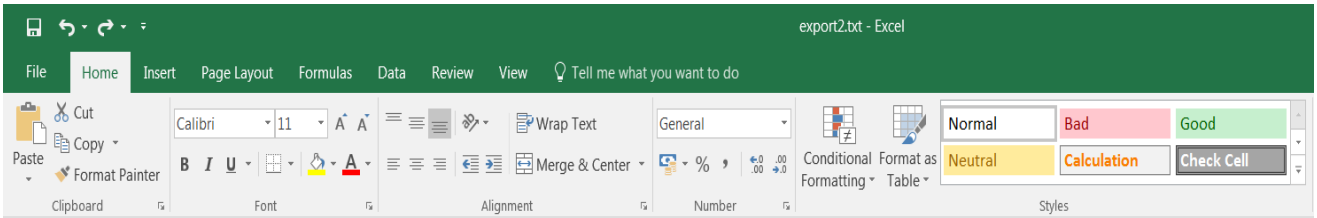
First click next, then the empty box and type ":" without the quote marks, finally click finished

You should then see something like this in Excel:



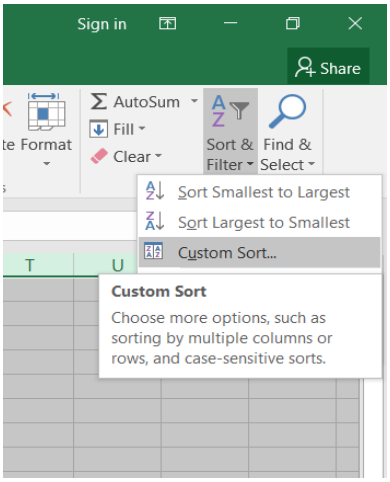
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	1	Bars	Beats	Ticks	1	1	0	0	TrackNam	1"								
2	2	Bars	Beats	Ticks	1	1	0	0	ProgramCl	chan		1	value	39				
3	3	Bars	Beats	Ticks	1	1	0	0	note	on	chan	1	note	38	vol	5	dur	160
4	4	Bars	Beats	Ticks	1	1	160	160	note	off	chan	1	note	38				
5	5	Bars	Beats	Ticks	1	1	180	180	note	on	chan	1	note	4	vol	5	dur	160
6	6	Bars	Beats	Ticks	1	2	100	340	note	off	chan	1	note	45				
7	7	Bars	Beats	Ticks	1	2	120	360	note	on	chan	1	note	50	vol	5	dur	320
8	8	Bars	Beats	Ticks	1	3	200	680	note	off	chan	1	note	50				
9	9	Bars	Beats	Ticks	1	4	0	720	note	on	chan	1	note	38	vol	5	dur	160
10	10	Bars	Beats	Ticks	1	4	120	840	note	on	chan	1	note	50	vol	5	dur	80
11	11	Bars	Beats	Ticks	1	4	160	880	note	off	chan	1	note	38				
12	12	Bars	Beats	Ticks	1	4	200	920	note	off	chan	1	note	50				
13	13	Bars	Beats	Ticks	2	1	0	960	note	on	chan	1	note	36	vol	5	dur	160
14	14	Bars	Beats	Ticks	2	1	160	1120	note	off	chan	1	note	36				
15	15	Bars	Beats	Ticks	2	1	180	1140	note	on	chan	1	note	43	vol	5	dur	160
16	16	Bars	Beats	Ticks	2	2	100	1300	note	off	chan	1	note	43				
17	17	Bars	Beats	Ticks	2	2	120	1320	note	on	chan	1	note	48	vol	5	dur	320
18	18	Bars	Beats	Ticks	2	3	200	1640	note	off	chan	1	note	48				
19	19	Bars	Beats	Ticks	2	4	0	1680	note	on	chan	1	note	36	vol	5	dur	160
20	20	Bars	Beats	Ticks	2	4	120	1800	note	on	chan	1	note	48	vol	5	dur	80
21	21	Bars	Beats	Ticks	2	4	160	1840	note	off	chan	1	note	36				
22	22	Bars	Beats	Ticks	2	4	200	1880	note	off	chan	1	note	48				
23	23	Bars	Beats	Ticks	2	4	200	1880	EndOfTrack									

Delete the first few header rows and last few footer rows, to leave just the note on and note off events

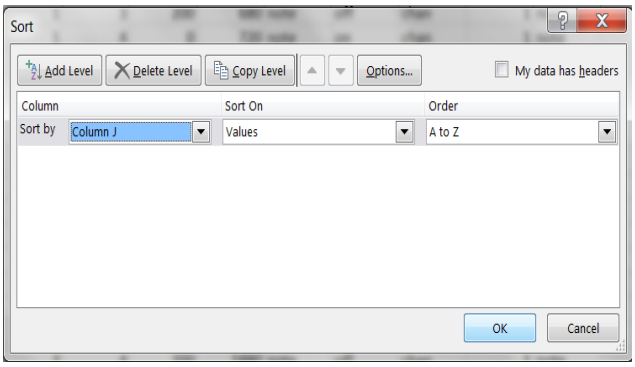


	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1	1	Bars	Beats	Ticks	1	1	0	0	TrackNam	1"								
2	2	Bars	Beats	Ticks	1	1	0	0	ProgramCl	chan		1	value	39				
3	3	Bars	Beats	Ticks	1	1	0	0	note	on	chan	1	note	38	vol	5	dur	160
4	4	Bars	Beats	Ticks	1	1	160	160	note	off	chan	1	note	38				
5	5	Bars	Beats	Ticks	1	1	180	180	note	on	chan	1	note	4	vol	5	dur	160
6	6	Bars	Beats	Ticks	1	2	100	340	note	off	chan	1	note	45				
7	7	Bars	Beats	Ticks	1	2	120	360	note	on	chan	1	note	50	vol	5	dur	320
8	8	Bars	Beats	Ticks	1	3	200	680	note	off	chan	1	note	50				
9	9	Bars	Beats	Ticks	1	4	0	720	note	on	chan	1	note	38	vol	5	dur	160
10	10	Bars	Beats	Ticks	1	4	120	840	note	on	chan	1	note	50	vol	5	dur	80
11	11	Bars	Beats	Ticks	1	4	160	880	note	off	chan	1	note	38				
12	12	Bars	Beats	Ticks	1	4	200	920	note	off	chan	1	note	50				
13	13	Bars	Beats	Ticks	2	1	0	960	note	on	chan	1	note	36	vol	5	dur	160
14	14	Bars	Beats	Ticks	2	1	160	1120	note	off	chan	1	note	36				
15	15	Bars	Beats	Ticks	2	1	180	1140	note	on	chan	1	note	43	vol	5	dur	160
16	16	Bars	Beats	Ticks	2	2	100	1300	note	off	chan	1	note	43				
17	17	Bars	Beats	Ticks	2	2	120	1320	note	on	chan	1	note	48	vol	5	dur	320
18	18	Bars	Beats	Ticks	2	3	200	1640	note	off	chan	1	note	48				
19	19	Bars	Beats	Ticks	2	4	0	1680	note	on	chan	1	note	36	vol	5	dur	160
20	20	Bars	Beats	Ticks	2	4	120	1800	note	on	chan	1	note	48	vol	5	dur	80
21	21	Bars	Beats	Ticks	2	4	160	1840	note	off	chan	1	note	36				
22	22	Bars	Beats	Ticks	2	4	200	1880	note	off	chan	1	note	48				
23	23	Bars	Beats	Ticks	2	4	200	1880	EndOfTrack									

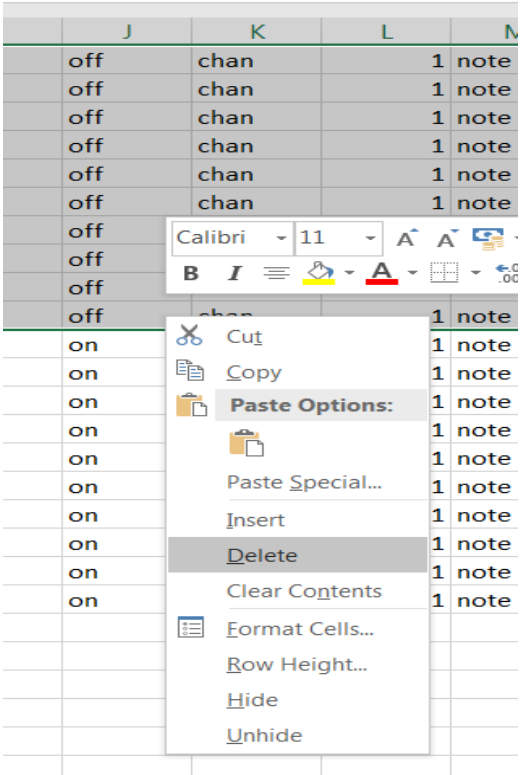
Then select the whole spreadsheet and sort the data using the column with on off in (column J below):



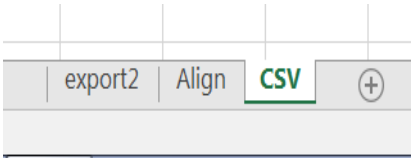
Sort alphabetically by column J:



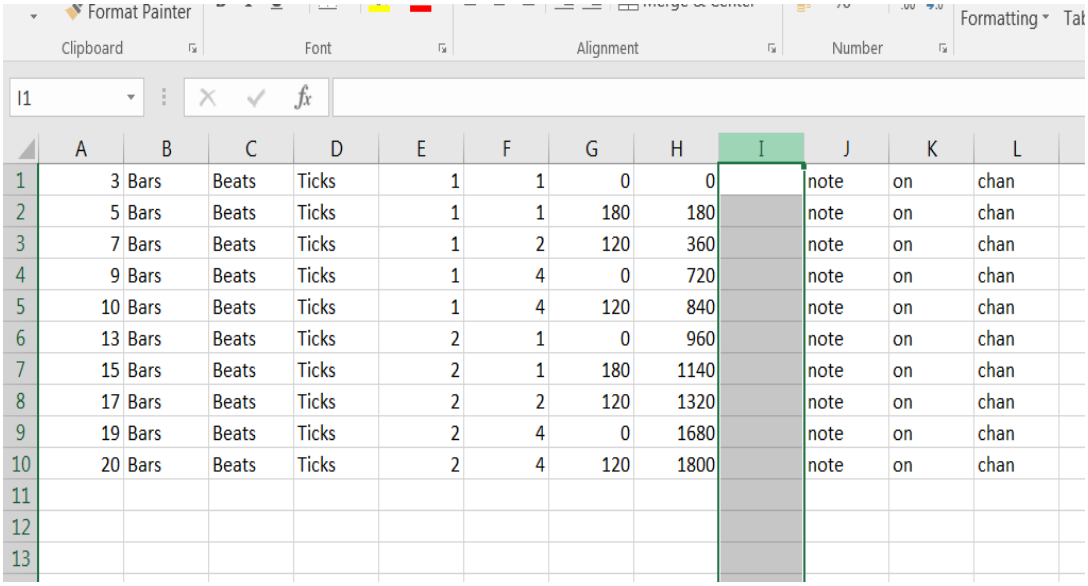
Then delete all the rows that say note off because we only need to know when the note starts:



Now add two new worksheet tabs at the base naming one “Align” and the other “CSV”:



Make an extra column after the total number of ticks



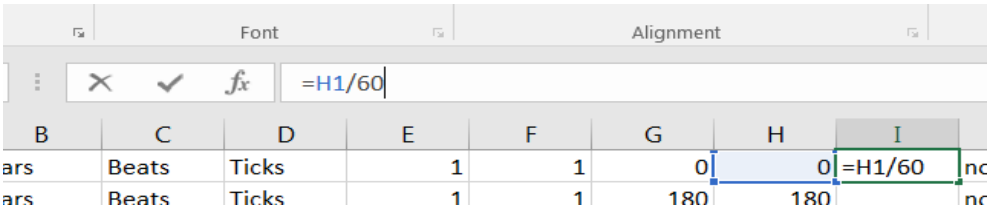
	A	B	C	D	E	F	G	H	I	J	K	L
1	3	Bars	Beats	Ticks	1	1	0	0		note	on	chan
2	5	Bars	Beats	Ticks	1	1	180	180		note	on	chan
3	7	Bars	Beats	Ticks	1	2	120	360		note	on	chan
4	9	Bars	Beats	Ticks	1	4	0	720		note	on	chan
5	10	Bars	Beats	Ticks	1	4	120	840		note	on	chan
6	13	Bars	Beats	Ticks	2	1	0	960		note	on	chan
7	15	Bars	Beats	Ticks	2	1	180	1140		note	on	chan
8	17	Bars	Beats	Ticks	2	2	120	1320		note	on	chan
9	19	Bars	Beats	Ticks	2	4	0	1680		note	on	chan
10	20	Bars	Beats	Ticks	2	4	120	1800		note	on	chan
11												
12												
13												

Input the cell equation = H1 / (value of Ticks per smallest note) and drag down so the column has the same length as the adjacent ones. The values in this column equate to the time base values when an associated note should be played.

You calculated the smallest note size during quantization in section 1.1 and we set 240 Ticks per quarter note in the initial preferences setup. So the value used could be:

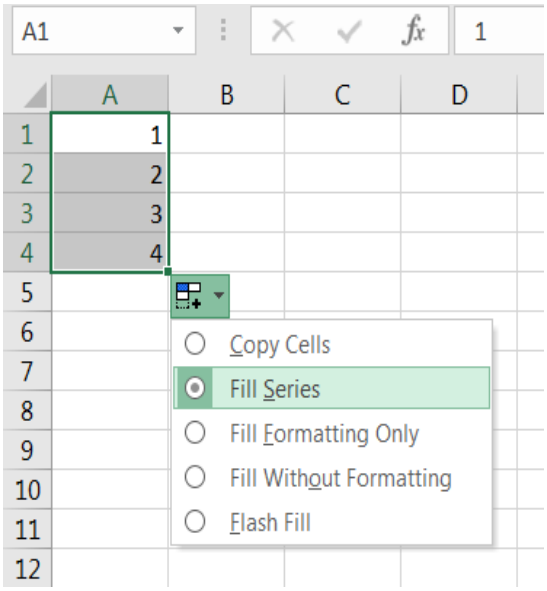
Crotchet	1/4	240
Quaver	1/8	120
Semiquaver	1/16	60
Demisemiquaver	1/32	30

In this example the quantization was to a 16th so we put = H1/60 in the function box



The last value in this column should be noted and compared the last value for in the same column for all your other tracks. The largest value defining the maximum length of you tune and the dimension of the notes array (***Tune_Length***)

Open the Align worksheet and add in all the numbers from 1 to maximum tune length selected above. (You can do this by typing in the number 1 into the first cell and dragging it down a few places and selecting the option fill series and dragging it down to the maximum tune length value.)



In the Align work book paste the time base values from column I in the first (export2) work book to column D and take note of its length in terms of the row in which the final value is. (Note only paste values)

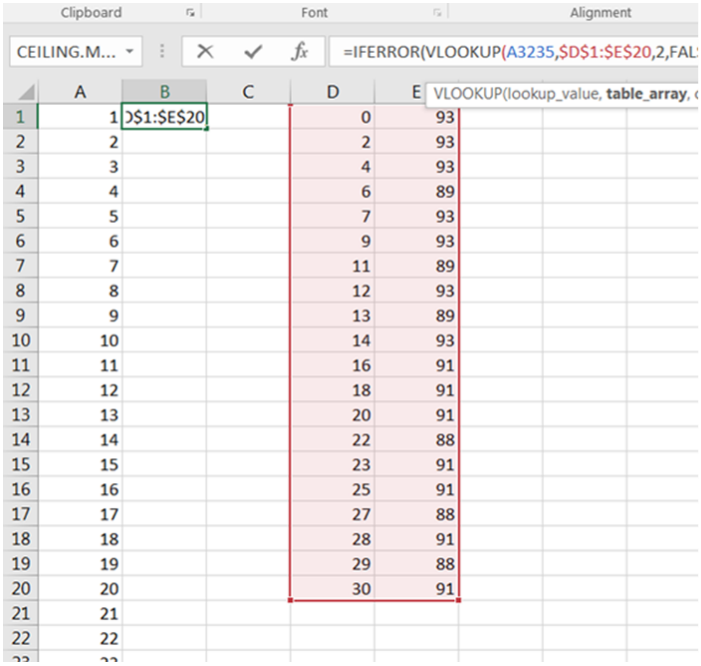
	A	B	C	D	E
1	1			0	(Ctrl)
2	2			2	
3	3			4	
4	4			6	
5	5			7	
6	6			9	
7	7			11	
8	8			12	
9	9			13	
10	10			14	
11	11			16	
12	12			18	
13	13			20	
14	14			22	
15	15			23	
16	16			25	
17	17			27	
18	18			28	
19	19			29	
20	20			30	
21	21				
22	22				

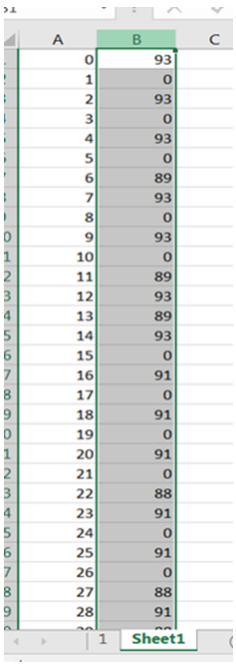
In the Align work book paste the note values from column O in the first (export2) work book to column E. We now have the time base values of when a note should be played in column D and the corresponding note to be played in column E.

For our data array which is sized to the maximum tune length we need fill it with the appropriate notes at the associated time base location and fill all other locations with zero. To do this we use the following Excel function

= IFERROR(VLOOKUP(A1,D1:E*Length*,2,FALSE),0) where *Length* is the row number with the final value of column E in

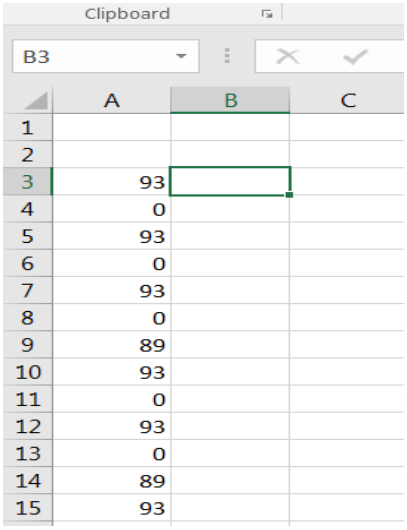
Place this formula in cell B1 and drag down to the end of column A





Select and copy these values from column B and open the CSV work book

Paste the values into column A in the CSV work book (Note only paste values) and insert two blank rows above it.



	A
1	
2	
3	93
4	0
5	93
6	0
7	93
8	0
9	89
10	93
11	0
12	93
13	0
14	89
15	93

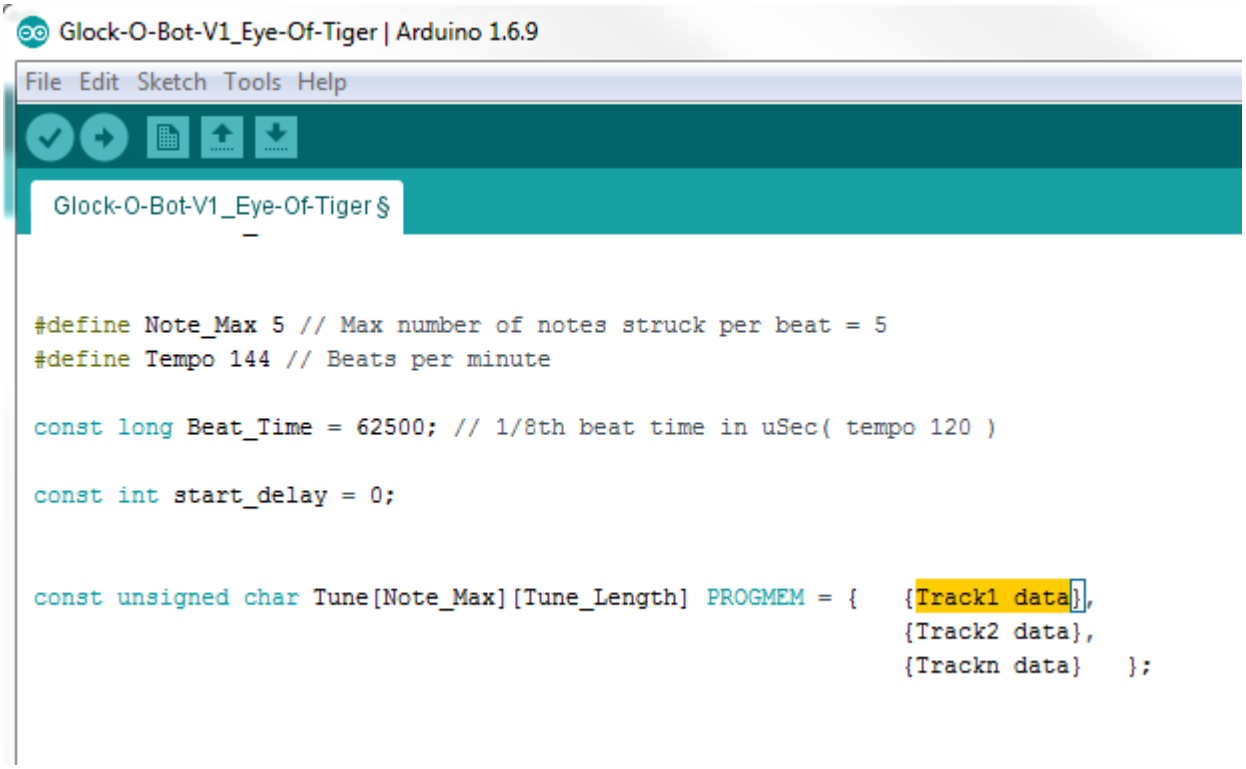
Then using copy and paste-transpose pivot the data in column A so that it is stored horizontally in row1. This ensures each value is exported with a comma delimiter when the work sheet is save as a CSV file.

First save the document as an excel document and then with the CSV workbook open, as a .CSV file. The data in this file can be used directly in the Glock-O-Bot code.

Repeat all steps in this section for each track you have exported out of Anvil Studio.

3.4. IMPORT INTO ARDUINO CODE

Rename the CSV file to (document name).txt open text file with Notepad and select all and copy the data. In Arduino paste it between the curly brackets in the Glock-O-Bots code in the position highlighted below, repeat for all your tracks.



Remember to set the key variables to match your midi track conversion.