Junior Synthesizer elektor september 1983 Nothing generates quite so much interest in computers by raw beginners as a computer that makes noises. This is particularly true with children and especially if the computer can actually play its own tune on command. It can encourage them to take a serious interest in programming and/or computers in general.

Junior Synthesizer

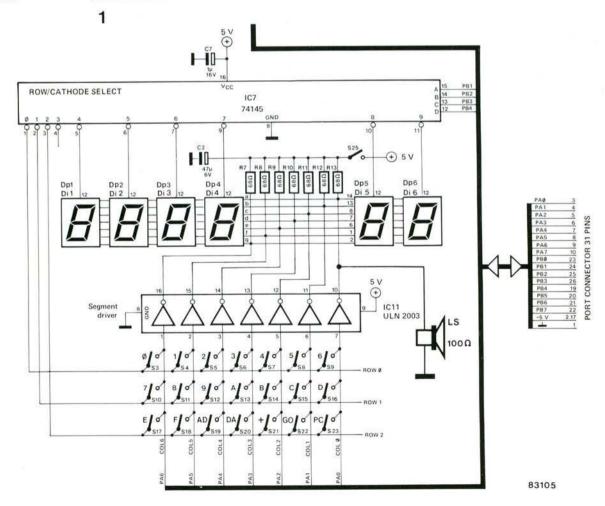
make your computer play your favourite tunes When a flood of new musical instruments appeared that could be controlled by a microprocessor, some of the many Junior Computer owners must certainly have combined the two ideas. Actually this computer lends itself quite readily to controlling an analogue synthesizer. However, some people have probably not yet taught their computer to play music and so to make it easier we have written a program to turn your Junior Computer into a Junior Synthesizer.

A singing display

The only 'hardware' needed for this JC to JS conversion is a $100~\Omega$ loudspeaker that is connected between one of the display driver

outputs of IC11 and ground. No other special interface is needed as the only component used is connected directly to the existing circuit. The audio signal that feeds the loudspeaker is produced by the 6532 on the main board of the computer, and consists of a series of pulses whose frequency is determined by the software. The tune to be played is memorized in page \$0300 and is made up of a series of bytes, two of which are needed for each note to be played. The first is placed in an even address and corresponds to the pitch of the note; the second, corresponding to the duration of the note, is placed in the next odd address. The pitch depends on the frequency of the pulses, and the duration depends on how long the signal lasts.

A. Bricart



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There are four values of duration possible:
minim, equal to two crotchets, each equal
to two quavers which in turn are each equal
to two semi-quavers. The durations are calculated from the computer clock which
has a frequency of 1 MHz. For example, the
note 'A' at 440 Hz has a pulselength of
2.28 ms. With a symmetrical waveform, the space lasts 1.14 ms. There is already a timing stage available in the computer (DELAY).
So for our 'A', this delay has to be executed
81 times before inverting the logic level
(81 x 14 μ s \approx 1.14 ms). Thus the hexa-
decimal value of the pitch of this note is \$51 (81 in decimal).
Because the program is years simple only

Because the program is very simple, only the \$0300 page (up to \$03FF) can be used to memorize a melody, so it can only have 127 notes at most. The tempo is fixed by the contents of location MULT (\$0002) which can be changed to increase or decrease the speed of play. The rhythm is determined by the magnitude of the bytes in the uneven addresses, although, of course, the value of the durations also varies with the pitch of the notes.

When the processor finds the value \$00 in an even address (pitch), it is silent for a certain length of time which is normally determined by the contents of the immediately following uneven address. If on the other hand, the value \$00 is in an uneven address the tune is stopped and starts again from the beginning.

In the example given here, the Junior plays the Menuet du Bourgeois Gentilhomme by J. B. Lully, but with a little experimentation you can probably make it play 'Chopsticks' as well!

277.2 261.6 247 233.1 220.6 207.6 196	81 89 91 99 A2 AC B6	6F 69 63 5D 58 53 4E	37 34 31 2F 2C 2A 27	1C 1A 19 17 16 15 14	ØE ØC ØC ØB ØB ØA
261.6 247 233.1 220.6 207.6	89 91 99 A2 AC	69 63 5D 58 53	34 31 2F 2C 2A	1A 19 17 16 15	ØC ØC ØB ØB
261.6 247 233.1 220.6	89 91 99 A2	69 63 5D 58 53	34 31 2F 2C	1A 19 17 16	ØC ØC ØB
261.6 247 233.1	89 91 99	69 63 5D	34 31 2F	1A 19 17	ØC ØC
261.6 247	89 91	69 63	34 31	1A 19	ØC.
261.6	89	69	34	1A	ØD
	5.55555	25174	10000	(1)(5)(1)(5)(6)	285
277.2	81	6F	37	1C	ØE
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		1000000000		ULCONU. U.	ØE
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	100000000000000000000000000000000000000	125000000000000000000000000000000000000	347470	222200	10
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	10000000				15
		1000000		V. 31/1/200	16
THE CO. P. L.	1112000	33 (3.78)		31850 E. U.	17
	1,7,0,7,	5750.00		1000000	19
		100000000000000000000000000000000000000	1 1123000		14
		25,231,000,0			10
	500,000	200000		1,000	10
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10.70		1 1	49533333		25
			390, 13,0700		27
			477.00		2/
				7774-7571	20
200000000000000000000000000000000000000	2000000		100		31 2F
		1 1			34
	0.0000000000000000000000000000000000000	1	127000		3
	10.7 (13.7%)		100000000000000000000000000000000000000		38
			0 0000000000	5000	38
	3583893			576557	4:
	Hz 1318.5 1244.5 1174.6 1108.7 1046.5 988 932.3 880 830.6 784 740 659.2 622.2 652.2 652.3 494 466.1 440 415.3 3392 3370 349.2 329.6 311.1 293.6	1318.5 1B 1244.5 1D 1174.6 1E 1108.7 20 1046.5 22 988 24 932.3 26 880 29 830.6 2B 784 2E 740 30 698.4 33 659.2 36 652.2 39 5554.3 3D 5554.3 41 4140 51 415.3 56 392 5B 370 61 349.2 66 329.6 6C 3311.1 73	1318.5 1B 1244.5 1D 1174.6 1E 1108.7 20 1046.5 22 988 24 932.3 26 880 29 830.6 2B 740 30 698.4 33 659.2 36 622.2 39 F9 657.3 3D EB 6523.2 44 D1 494 48 C6 466.1 4D BA 440 51 B0 440 51 B0 440 51 B0 440 51 B0 440 51 B0 440 51 B0 440 61 9D BA 440 61 80 80 80 80 80 80 80 80 80 80 80 80 80	1318.5 1B 1244.5 1D F9 1174.6 1E EB 1108.7 20 DE 1046.5 22 D1 1088 24 C6 932.3 26 BA 880 29 B0 830.6 2B A6 784 2E 9D 740 30 94 760 30 SE 754.3 3D EB 7569.2 36 SE 7569.2 36 SE 7562.2 39 F9 70 66 SE 7568.3 41 DE 7568.3 56 A6 75 75 76 76 76 76 76 76 76 76 76 76 76 76 76	1318.5

Table 1

Table 1. The codes for the pitch and duration of the notes shown here can make the Junior Computer play your favourite tune.

JUNIOR

P:	200,25D														
Ø	1	2	3	4	5	6	7	8	9	A	В	C	D	E	F
A9	7F	8D	81	1A	A9	28	8D	82	1A	A9	00	85	22	A9	22
85	02	A6	00	BD	01	03	85	01	FØ	E 5	A9	40	8D	80	1A
20	50	02	A6	00	BC	00	03	FØ	08	A9	BF	8D	80	1A	20
50	02	C6	01	DØ	E5	C6	02	D2	D8	E6	22	E6	00	A 2	FF
CA	EA	EA	EA	DØ	FA	4C	ØE	02	00	00	00	00	22	22	22
A6	00	BC	00	ØЗ	A 2	02	CA	DØ	FD	88	DØ	F8	60		
	Ø A 9 8 5 2 Ø 5 Ø C A	Ø 1 A9 7F 85 Ø2 20 50 50 Ø2 CA EA	0 1 2 A9 7F 8D 85 02 A6 20 50 02 50 02 C6 CA EA EA	A9 7F 8D 81 85 Ø2 A6 ØØ 20 50 Ø2 A6 50 Ø2 C6 Ø1 CA EA EA EA	0 1 2 3 4 A9 7F 8D 81 1A 85 02 A6 00 BD 20 50 02 A6 00 50 02 C6 01 D0 CA EA EA EA D0	0 1 2 3 4 5 A9 7F 8D 81 1A A9 85 02 A6 00 BD 01 20 50 02 A6 00 BC 50 02 C6 01 D0 E5 CA EA EA EA D0 FA	Ø 1 2 3 4 5 6 A9 7F 8D 81 1A A9 28 85 Ø2 A6 ØØ BD Ø1 Ø3 20 5Ø Ø2 A6 ØØ BC ØØ 5Ø Ø2 C6 Ø1 DØ E5 C6 CA EA EA EA DØ FA 4C	Ø 1 2 3 4 5 6 7 A9 7F 8D 81 1A A9 Ø8 8D 85 Ø2 A6 ØØ BD Ø1 Ø3 85 2Ø 5Ø Ø2 A6 ØØ BC ØØ Ø3 5Ø Ø2 C6 Ø1 DØ E5 C6 Ø2 CA EA EA EA DØ FA 4C ØE	Ø 1 2 3 4 5 6 7 8 A9 7F 8D 81 1A A9 28 8D 82 85 Ø2 A6 ØØ BD Ø1 Ø3 85 Ø1 20 50 Ø2 A6 ØØ BC ØØ Ø3 FØ 50 Ø2 C6 Ø1 DØ E5 C6 Ø2 DØ CA EA EA EA EA DØ FA 4C ØE Ø2	Ø 1 2 3 4 5 6 7 8 9 A9 7F 8D 81 1A A9 28 8D 82 1A 85 02 A6 00 BD 01 03 85 01 F0 20 50 02 A6 00 BC 00 03 F0 08 50 02 C6 01 D0 E5 C6 02 D0 D8 CA EA EA EA D0 FA 4C 0E 02 00	Ø 1 2 3 4 5 6 7 8 9 A A9 7F 8D 81 1A A9 28 8D 82 1A A9 85 Ø2 A6 ØØ BD Ø1 Ø3 85 Ø1 FØ E5 20 50 Ø2 A6 ØØ BC ØØ Ø3 FØ Ø8 A9 50 Ø2 C6 Ø1 DØ E5 C6 Ø2 DØ D8 E6 CA EA EA EA DØ FA 4C ØE Ø2 ØØ ØØ	Ø 1 2 3 4 5 6 7 8 9 A B A9 7F 8D 81 1A A9 Ø8 8D 82 1A A9 Ø 85 Ø2 A6 ØØ BD Ø1 Ø3 85 Ø1 FØ E5 A9 20 50 Ø2 A6 ØØ BC ØØ Ø3 FØ Ø8 A9 BF 50 Ø2 C6 Ø1 DØ E5 C6 Ø2 DØ D8 E6 Ø2 CA EA EA EA DØ FA 4C ØE Ø2 ØØ ØØ Ø0	Ø 1 2 3 4 5 6 7 8 9 A B C A9 7F 8D 81 1A A9 Ø8 8D 82 1A A9 Ø0 85 85 Ø2 A6 Ø0 BD Ø1 Ø3 85 Ø1 FØ E5 A9 4Ø 20 50 Ø2 A6 Ø0 BC Ø0 Ø3 FØ Ø8 A9 BF 8D 50 Ø2 C6 Ø1 DØ E5 C6 Ø2 DØ D8 E6 Ø0 Ø0 Ø0 CA EA EA EA EA DØ FA 4C ØE Ø2 Ø0 Ø0 Ø0 Ø0 Ø0	Ø 1 2 3 4 5 6 7 8 9 A B C D A9 7F 8D 81 1A A9 Ø8 8D 82 1A A9 ØØ 85 ØØ 85 Ø2 A6 ØØ BD Ø1 Ø3 85 Ø1 FØ E5 A9 4Ø 8D 2Ø 5Ø Ø2 A6 ØØ BC ØØ Ø3 FØ Ø8 A9 BF 8D 8Ø 5Ø Ø2 C6 Ø1 DØ E5 C6 Ø2 DØ D8 E6 ØØ E6 ØØ	Ø 1 2 3 4 5 6 7 8 9 A B C D E A9 7F 8D 81 1A A9 Ø8 8D 82 1A A9 Ø0 85 Ø2 A9 85 Ø2 A6 Ø0 BD Ø1 Ø3 85 Ø1 FØ E5 A9 4Ø 8D 80 20 50 Ø2 A6 Ø0 BC Ø0 Ø3 FØ Ø8 A9 BF 8D 8D 1A 50 Ø2 C6 Ø1 DØ E5 C6 Ø2 DØ D8 E6 ØØ B0 Ø0 A2 CA EA EA EA EA DØ FA 4C ØE Ø2 ØØ ØØ ØØ ØØ ØØ ØØ

Table 2. This is the program which uses the 6532 and the display driver to generate an audio signal that is heard through the loudspeaker. No physical alteration to the existing circuit is needed.

JUNIOR

M																
HEXDU	MP:	300	3,3	6B												
	0	1	2	3	4	5	6	7	8	9	A	В	C	D	E	F
0300:	51	58	3D	EA	41	DE	3D	75	36	84	51	58	48	63	5B	9C
0310:	61	4A	5B	4E	6C	84	61	94	79	3A	51	58	3D	EA	41	DE
0320:	3D	75	36	84	51	58	48	63	5B	9C	61	4A	5B	4E	6C	84
0330:	61	94	79	3A	61	94	5B	4E	51	BØ	51	58	48	63	48	63
0340:	56	53	51	BØ	51	58	3D	EA	48	63	41	6F	41	6F	51	58
0350:	3D	75	3D	75	48	63	41	DE	3D	75	51	58	48	63	5B	9C
0360:	61	4A	5B	4E	6C	84	79	74	00	70	00	00				

Table 3. The sequence reproduced here corresponds to the notes and rhythm of the Menuet du Bourgeois Gentilhomme by Lully. The even addresses contain the pitches and the uneven addresses are the durations of the notes. Note that in some cases the durations are not exactly minims. The \$00 at \$036B acts as a repeat bar. It indicates that the piece is to be replayed from the start.