DIY Midi klavír

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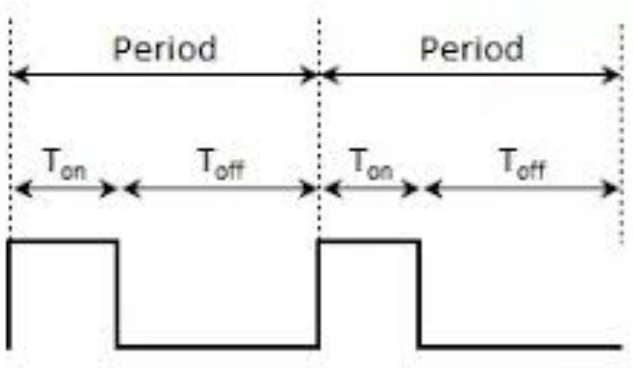
http://L.valky.eu/klavir

U0: Prvý tón

- Arduino -> Tools -> Port
- Arduino -> Tools -> Board -> Arduino Leonardo
- Od akej frekvencie vnímame kmitanie ako tón?
- Perióda T [s]
- Frekvencia f [Hz]
- Strieda (duty cycle) 50%

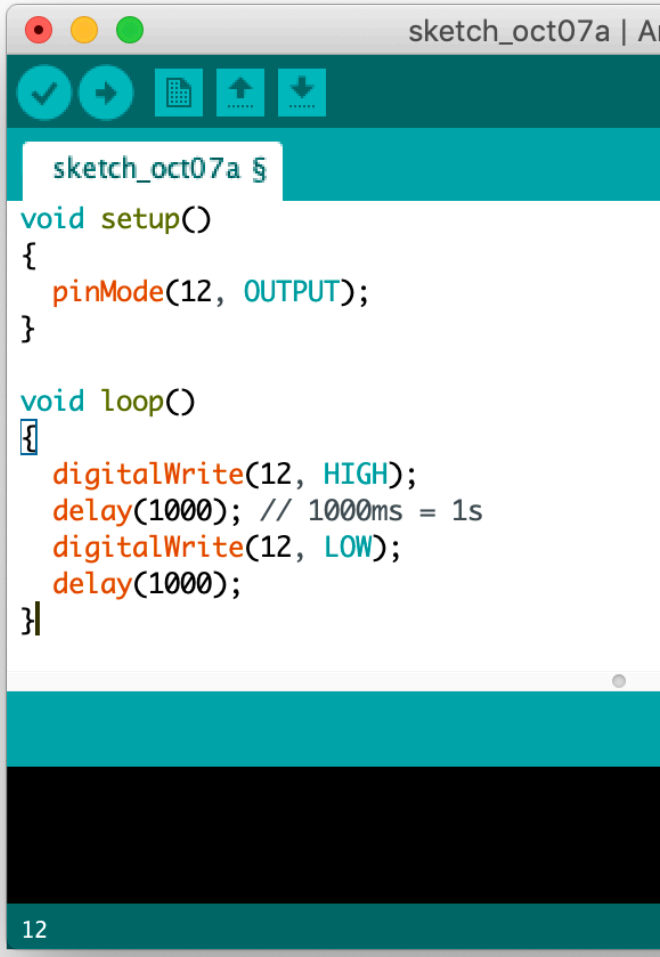


Period = 1 / Frequency

Period = $T_{on} + T_{off}$

Duty Cycle = $T_{on} / (T_{on} + T_{off}) * 100$

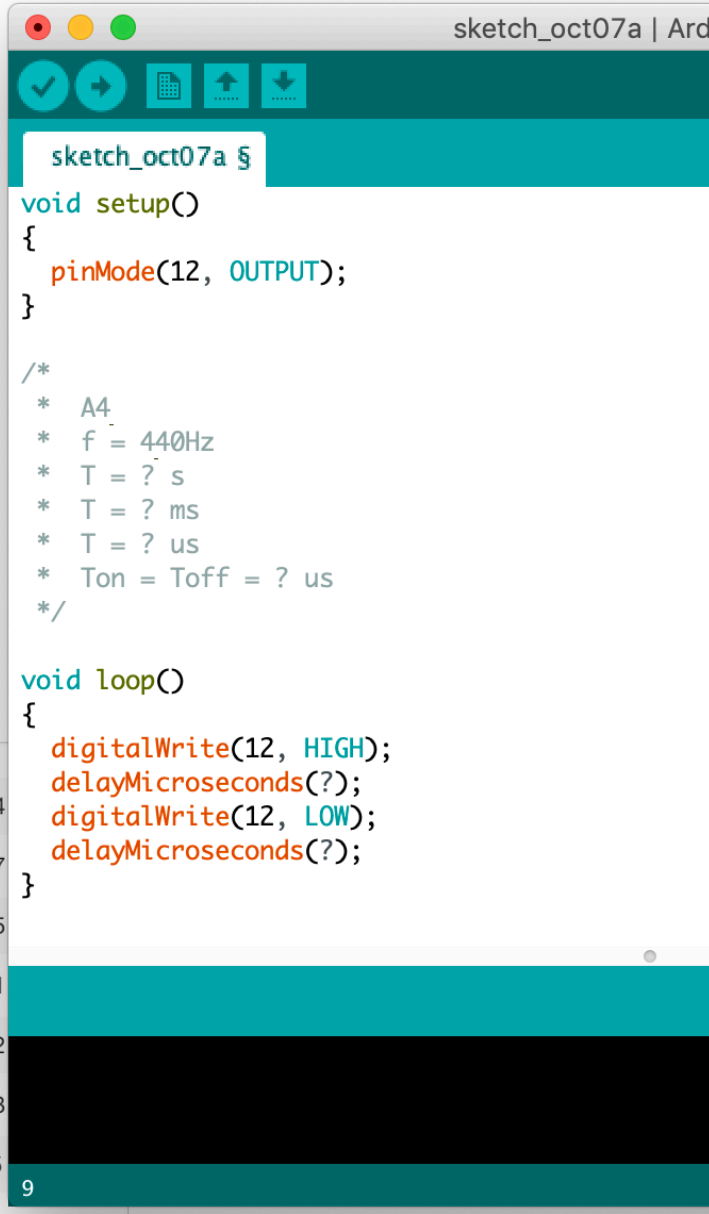
(On Percentage)



U1: Tón A4

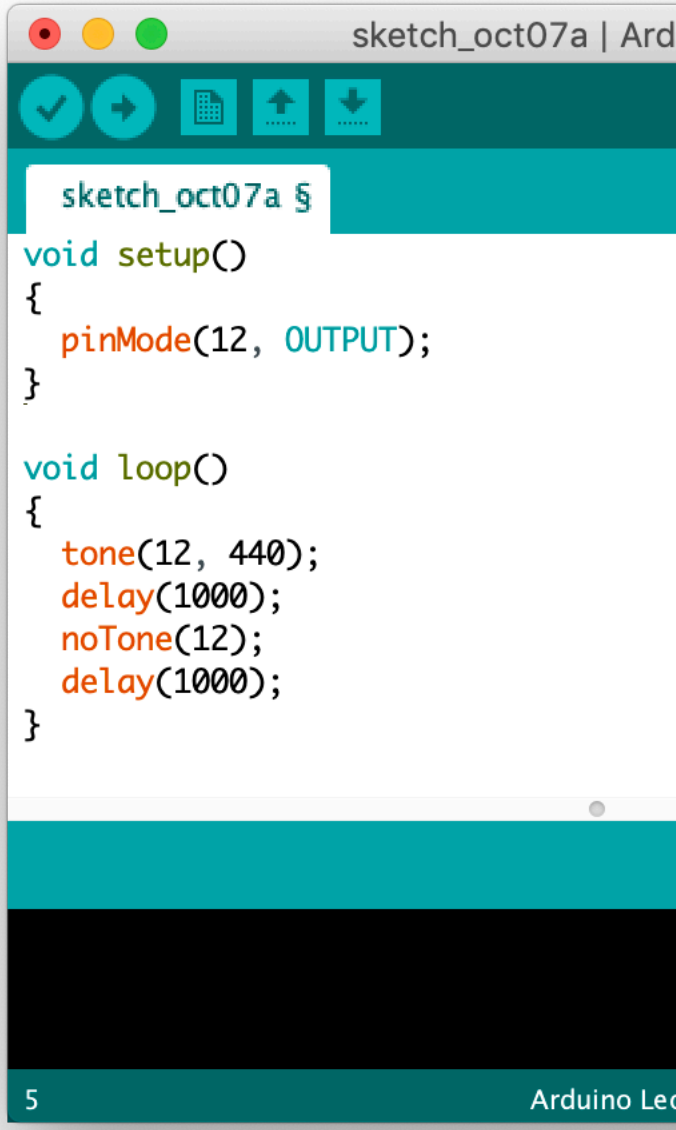
- Frekvencia 440 Hz
- 1 s = 1000 ms = 1 000 000 us
- delay(milisekundy)
- delayMicroseconds(mikrosekundy)
- max 15000 !

	C	C#	D	Eb	E	F	F#	G	G#	A	Bb	
0	16.35	17.32	18.35	19.45	20.60	21.83	23.12	24.50	25.96	27.50	29.14	
1	32.70	34.65	36.71	38.89	41.20	43.65	46.25	49.00	51.91	55.00	58.27	
2	65.41	69.30	73.42	77.78	82.41	87.31	92.50	98.00	103.8	110.0	116.5	
3	130.8	138.6	146.8	155.6	164.8	174.6	185.0	196.0	207.7	220.0	233.1	
4	261.6	277.2	293.7	311.1	329.6	349.2	370.0	392.0	415.3	440.0	466.2	
5	523.3	554.4	587.3	622.3	659.3	698.5	740.0	784.0	830.6	880.0	932.3	
6	1047	1109	1175	1245	1319	1397	1480	1568	1661	1760	1865	
7	2093	2217	2349	2489	2637	2794	2960	3136	3322	3520	3729	3951
8	4186	4435	4699	4978	5274	5588	5920	6272	6645	7040	7459	7902



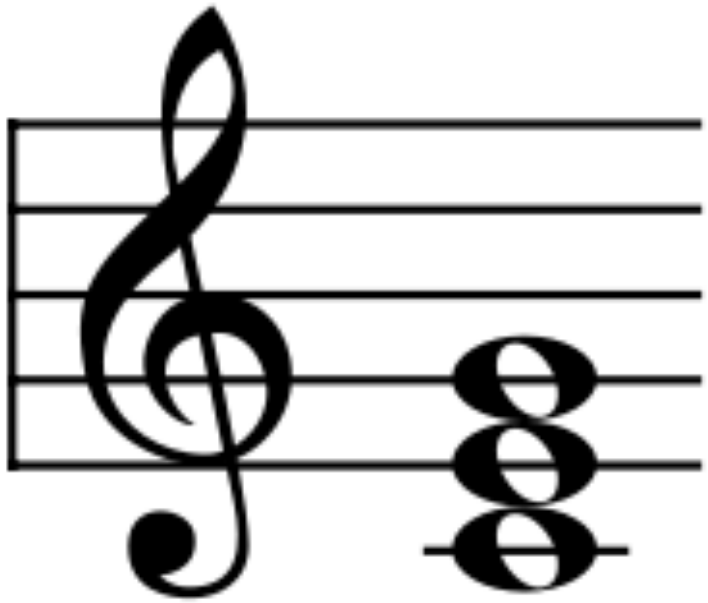
U2: Funkcia tone()

- tone(pin, frekvencia v Hz)
- noTone(pin)



U3: C dur

- Z akých tónov sa skladá akord?



sketch_oct07a | Arduino 1.8.5

sketch_oct07a §

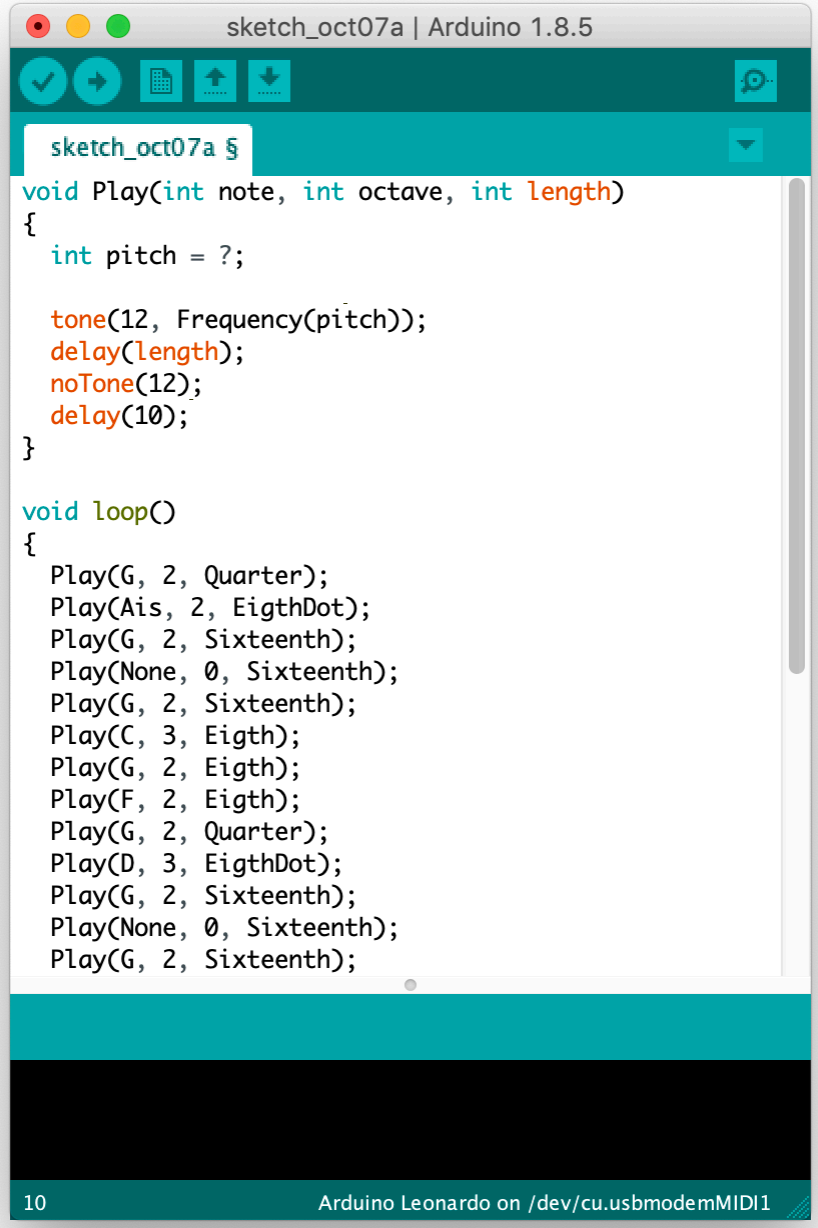
```
/*  C dur = ? ? ?
 *
 *  ?6 = ? Hz
 *  ?6 = ? Hz
 *  ?6 = ? Hz
 */

void loop()
{
  tone(12, ?);
  delay(200);
  tone(12, ?);
  delay(200);
  tone(12, ?);
  delay(200);
  noTone(12);
  delay(5000);
}
```

1 Arduino Leonardo on /dev/cu.usbmodemMIDI1

U4: Melódia

- Vygenerujte si melódiu
- http://L.valky.eu/klavirgen
- pitch
- duration (trvanie, bodka)
- tempo, BPM, 4/4 rytmus



Pitch

Note	-1	0	1	2	3	4	5	6	7	8	9
C	0	12	24	36	48	60	72	84	96	108	120
C#	1	13	25	37	49	61	73	85	97	109	121
D	2	14	26	38	50	62	74	86	98	110	122
D#	3	15	27	39	51	63	75	87	99	111	123
E	4	16	28	40	52	64	76	88	100	112	124
F	5	17	29	41	53	65	77	89	101	113	125
F#	6	18	30	42	54	66	78	90	102	114	126
G	7	19	31	43	55	67	79	91	103	115	127
G#	8	20	32	44	56	68	80	92	104	116	
A	9	21	33	45	57	69	81	93	105	117	
A#	10	22	34	46	58	70	82	94	106	118	
B	11	23	35	47	59	71	83	95	107	119	

Oktáva

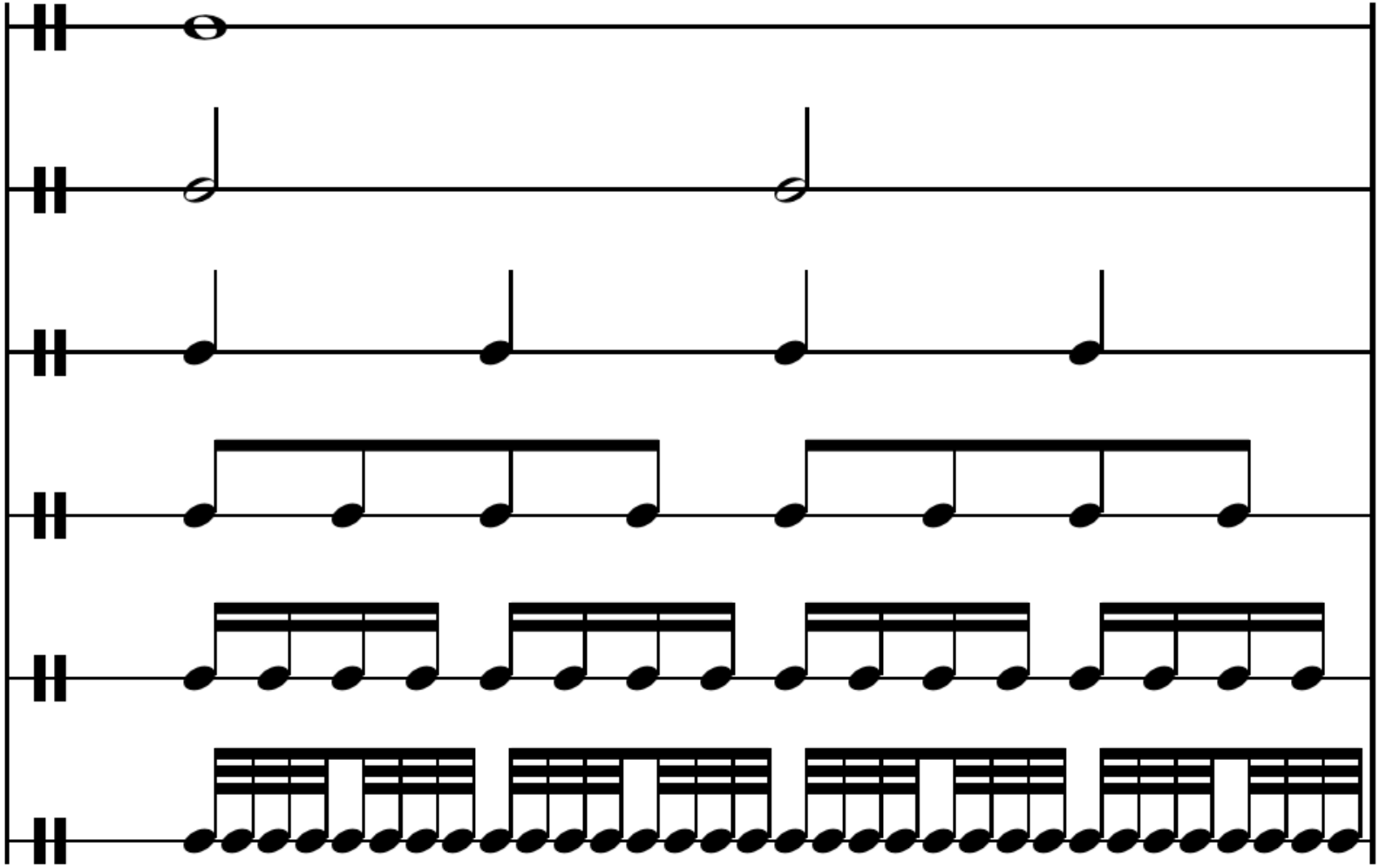
Frekvencia tónu

NOTE FREQUENCY CHART | HEROIC AUDIO

	Octave 0	Octave 1	Octave 2	Octave 3	Octave 4	Octave 5	Octave 6	Octave 7	Octave 8	Octave 9	Octave 10
C	16.35	32.70	65.41	130.81	261.63	523.25	1046.50	2093.00	4186.01	8372.02	16744.04
C#	17.32	34.65	69.30	138.59	277.18	554.37	1108.73	2217.46	4434.92	8869.84	17739.69
D	18.35	36.71	73.42	146.83	293.66	587.33	1174.66	2349.32	4698.64	9397.27	18794.55
D#	19.45	38.89	77.78	155.56	311.13	622.25	1244.51	2489.02	4978.03	9956.06	19912.13
E	20.60	41.20	82.41	164.81	329.63	659.26	1318.51	2637.02	5274.04	10548.08	
F	21.83	43.65	87.31	174.61	349.23	698.46	1396.91	2793.83	5587.65	11175.30	
F#	23.12	46.25	92.50	185.00	369.99	739.99	1479.98	2959.96	5919.91	11839.82	
G	24.50	49.00	98.00	196.00	392.00	783.99	1567.98	3135.96	6271.93	12543.86	
G#	25.96	51.91	103.83	207.65	415.30	830.61	1661.22	3322.44	6644.88	13289.75	
A	27.50	55.00	110.00	220.00	440.00	880.00	1760.00	3520.00	7040.00	14080.00	
A#	29.14	58.27	116.54	233.08	466.16	932.33	1864.66	3729.31	7458.62	14917.24	
B	30.87	61.74	123.47	246.94	493.88	987.77	1975.53	3951.07	7902.13	15804.26	

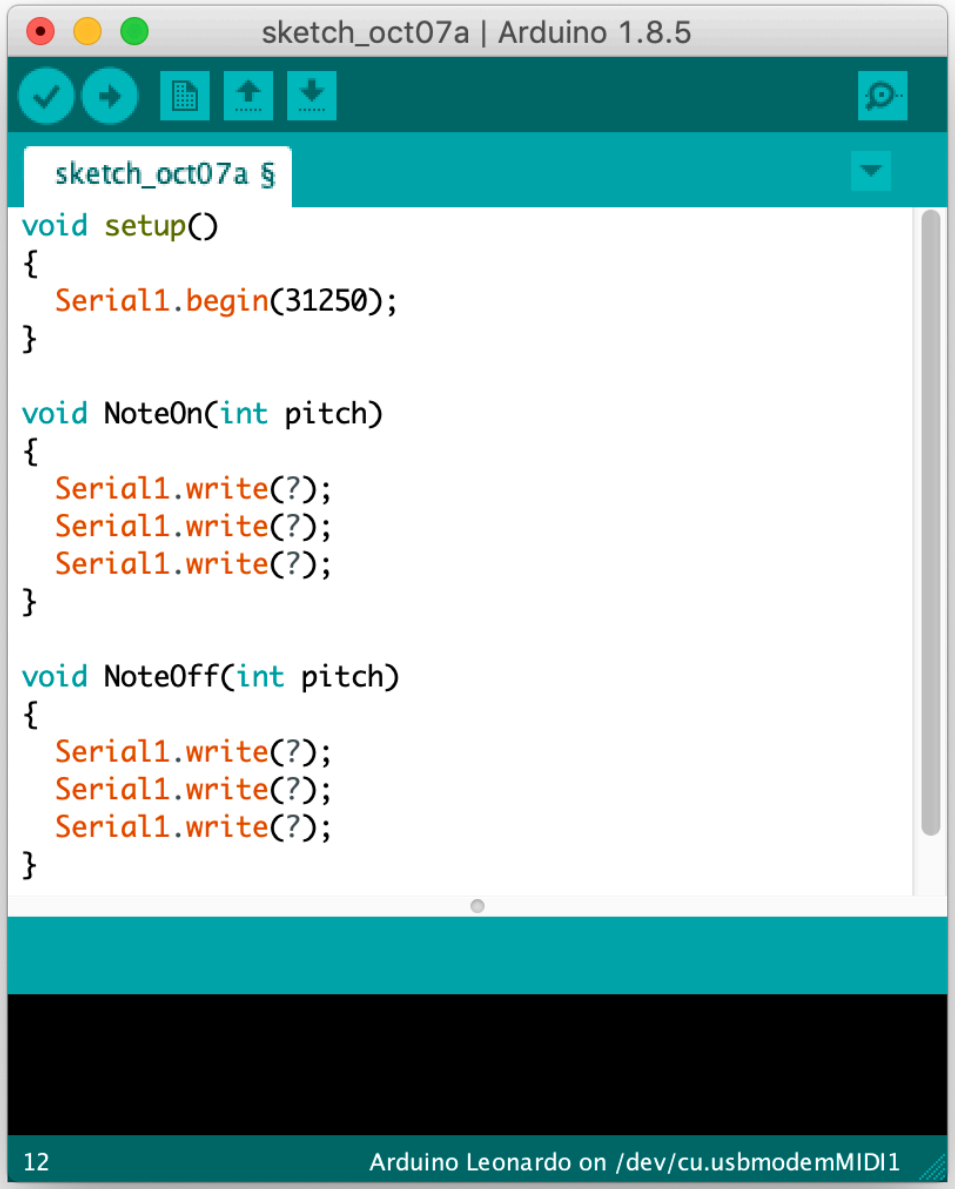
Duration

- Celá / Whole
- Pólová / Half
- Štvrtinová / Quarter
- Osminová / Eigth
- 1/16 / Sixteenth
- 1/32 / Thirtytwo
-



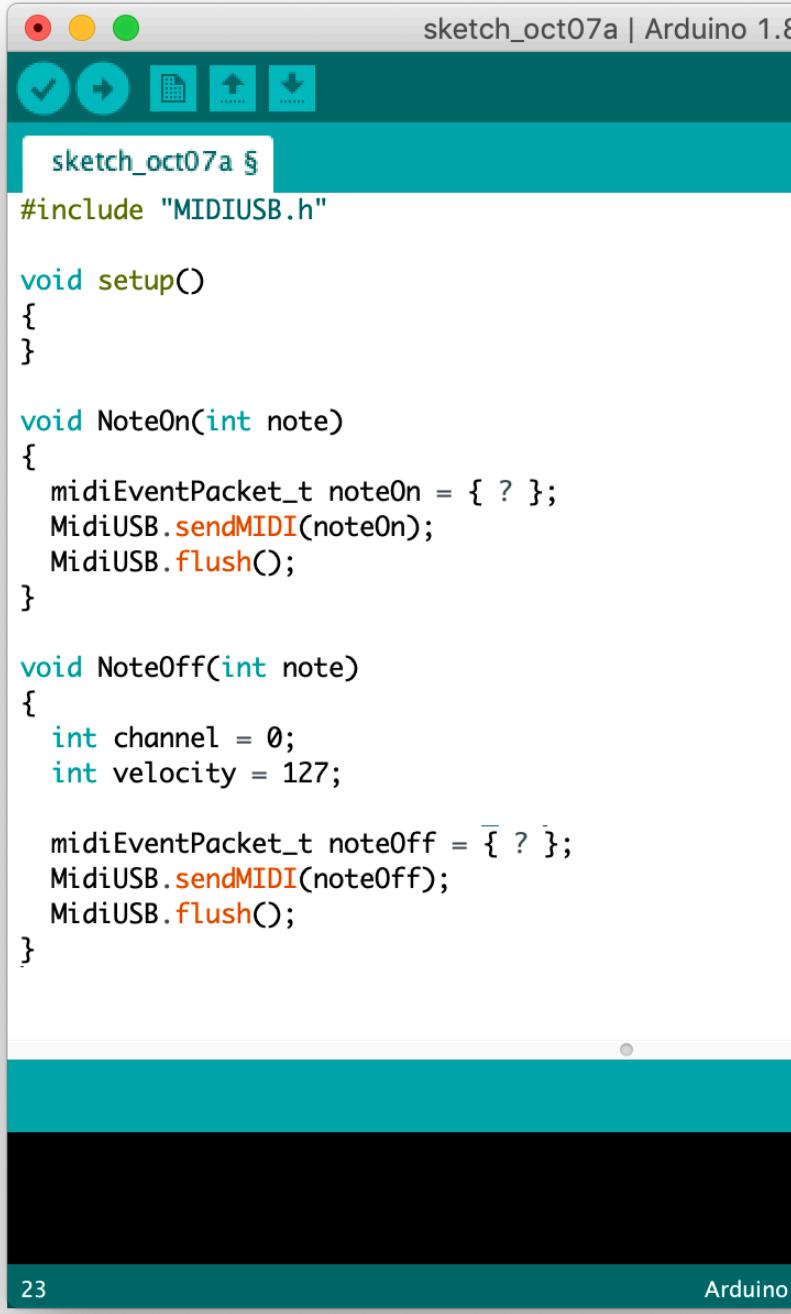
U5: Midi Eventy

- NoteOn
  - kanal 0x80..0x8F
  - pitch 0..127
  - velocity 0..127
- NoteOff
  - kanal 0x90..0x9F
  - Pitch 0..127
  - Velocity 0..127
- Program change
  - Kanal 0xC0..0xCF
  - Číslo inštrumentu (0=Grand piano)

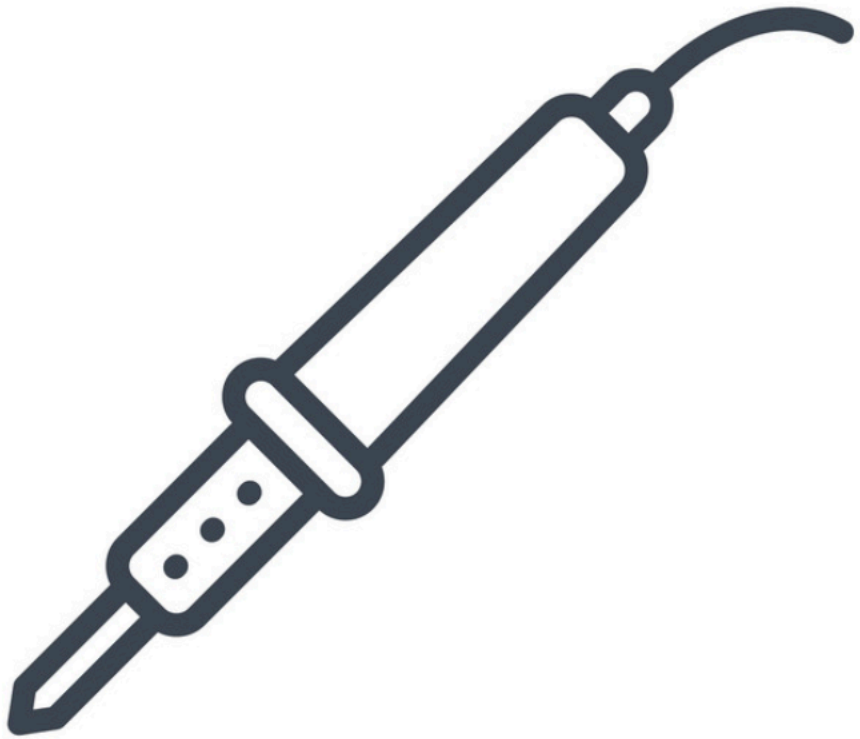


U6: USB MIDI

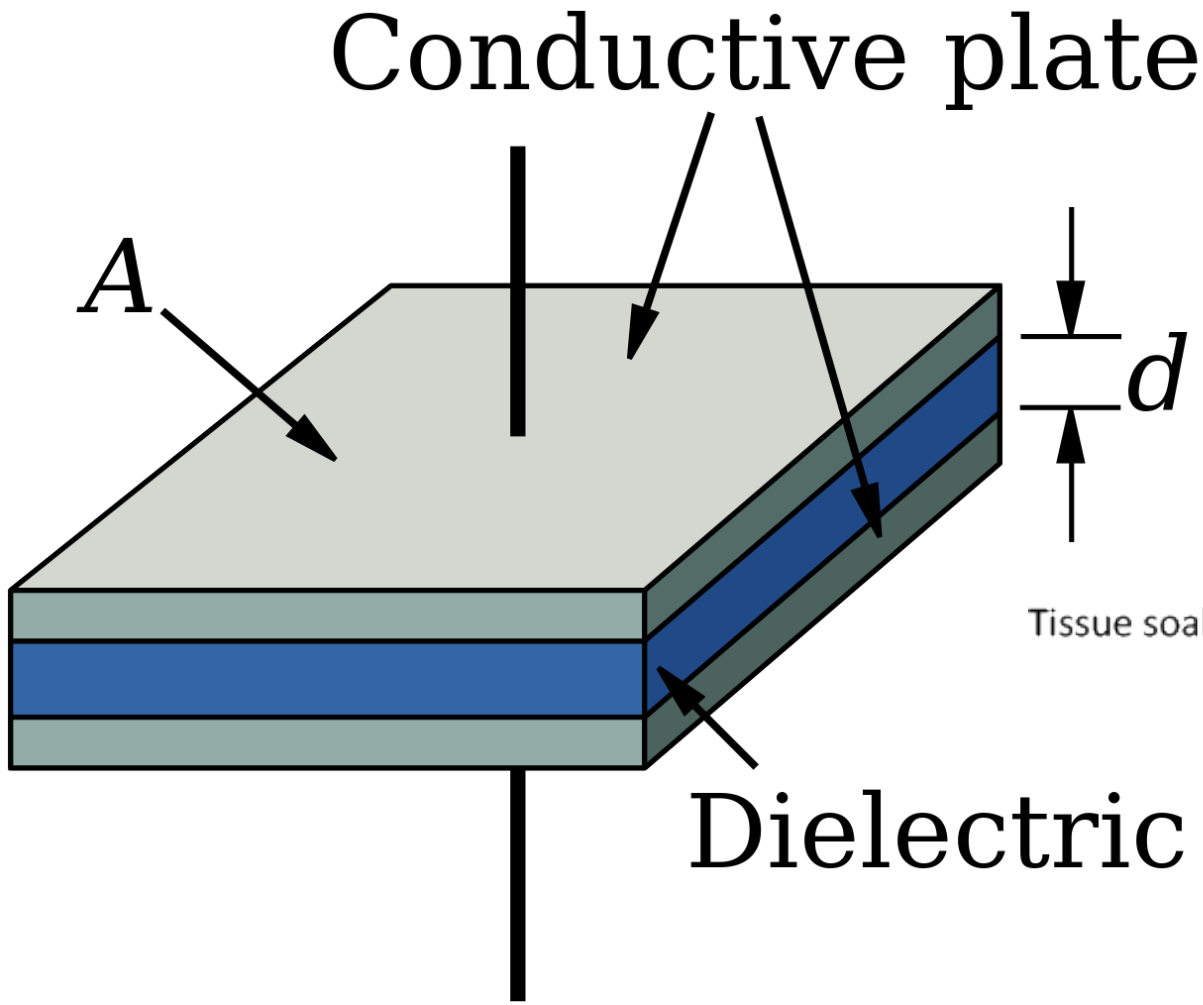
- #include “MIDIUSB.h”
- Note on event:
  - midiEventPacket_t noteOn = {0x09, 0x90 | channel, pitch, velocity};
  - MidiUSB.sendMIDI(noteOn);
  - MidiUSB.flush();
- Note off event:
  - midiEventPacket_t noteOff = {0x08, 0x80 | channel, pitch, velocity};
  - MidiUSB.sendMIDI(noteOff);
  - MidiUSB.flush();

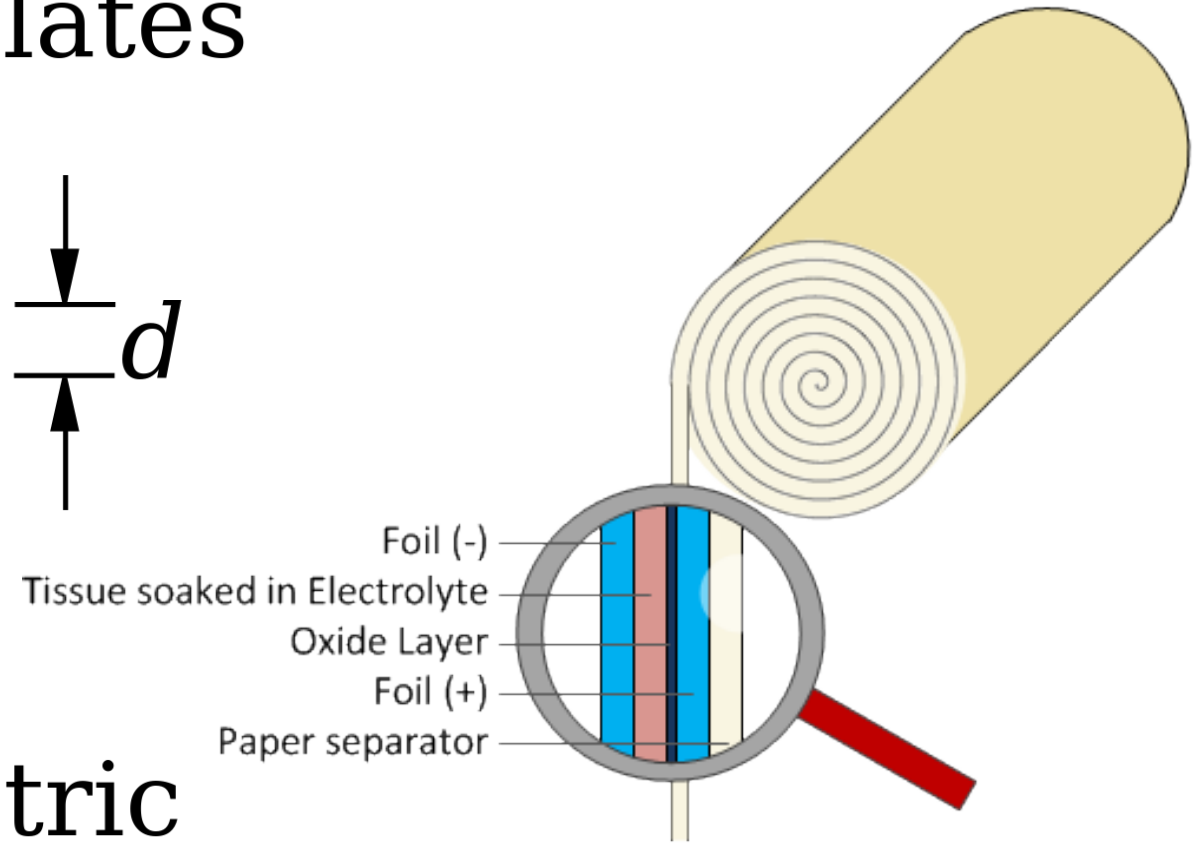


Spájkujeme!

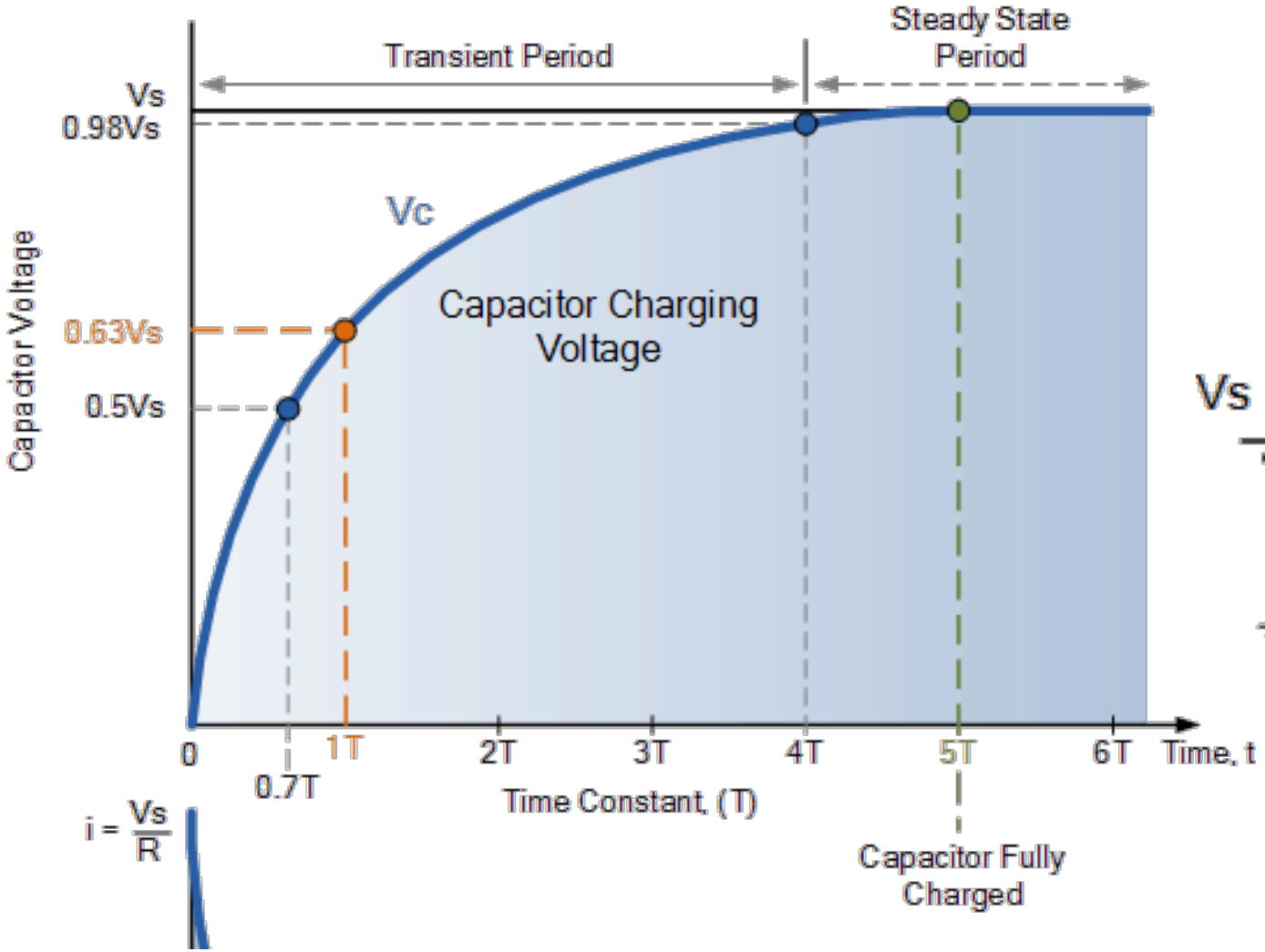


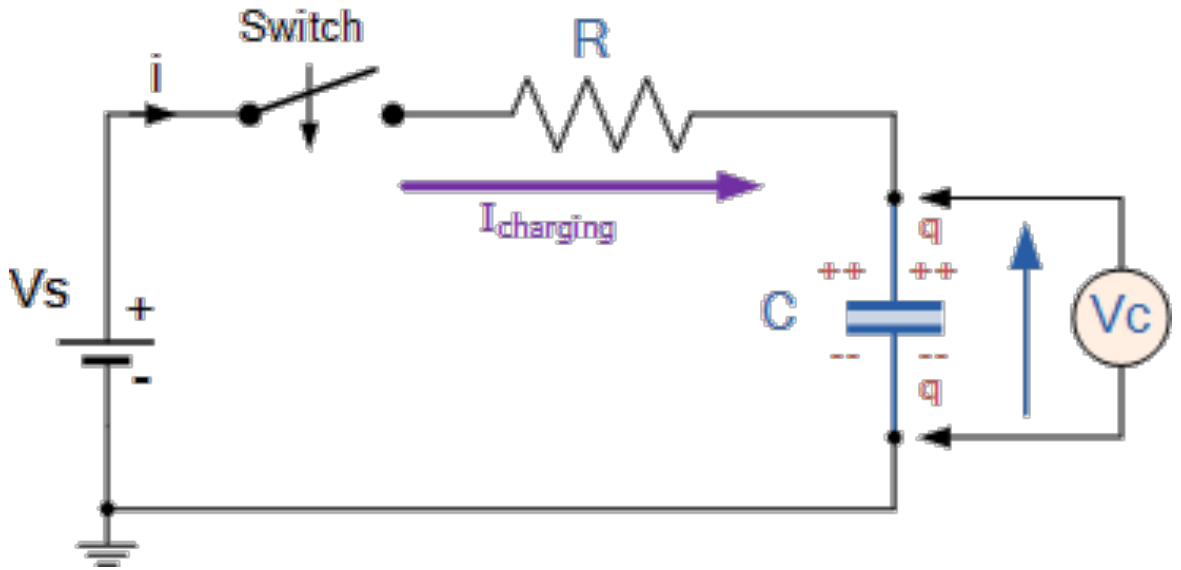
Kondenzátor





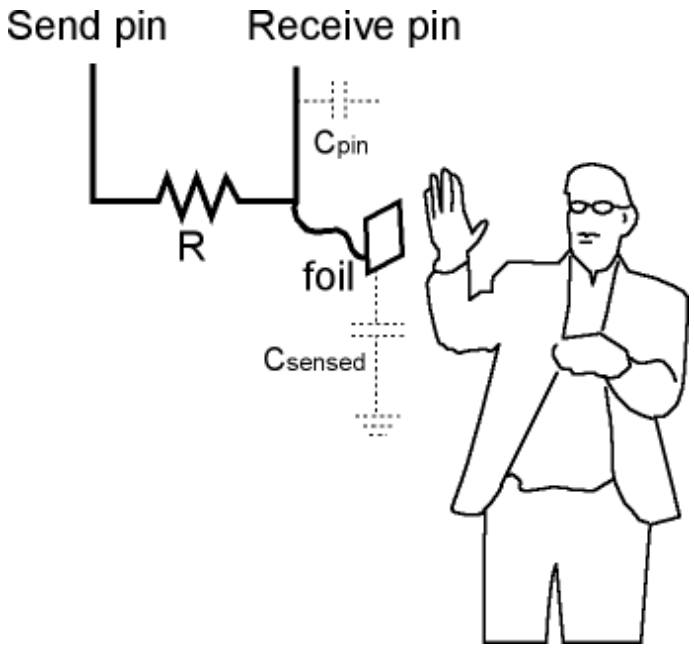
Nabíjanie RC článku

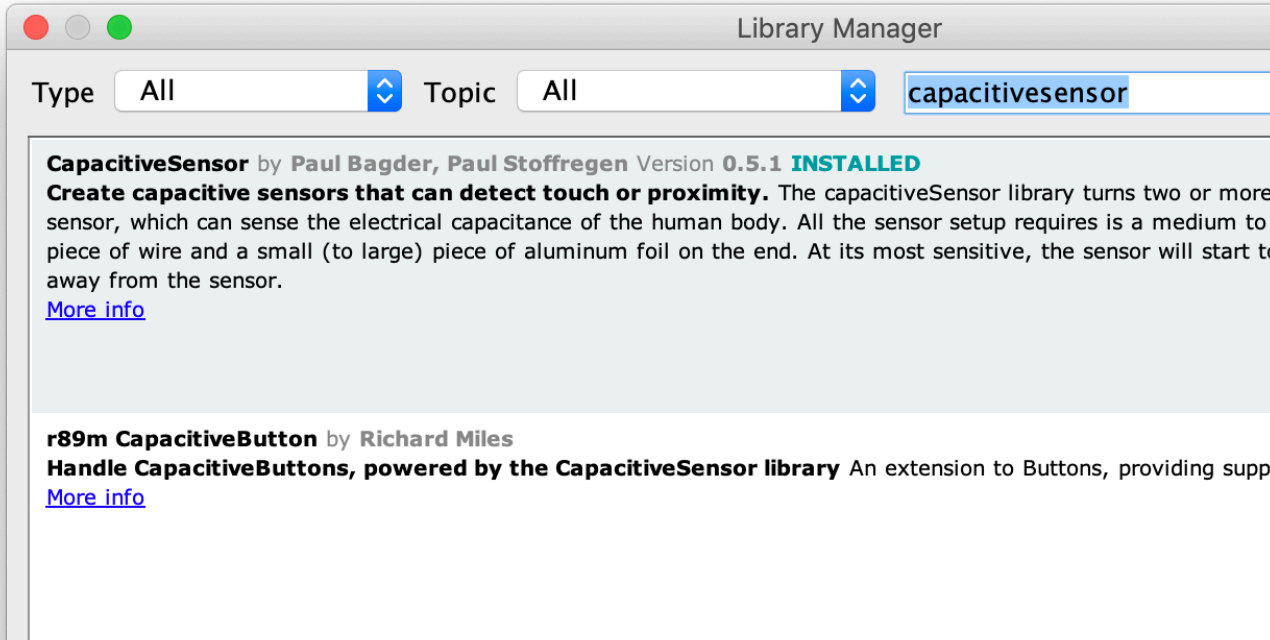




U07: Knižnica CapacitiveSensor

- Nainštalovať knižnicu “capacitivesensor”
- Otestovať





U08: Trigger

- Vypísať “On” a “Off” pri stlačení a uvoľnení klávesy
- Globálna premenná

U09: Štyri senzory

- Rozšíriť program na 4 nezávislé senzory
- Použiť tone a noTone
- Zahrať melódiu Kohutik jarabi

U10: Oktáva

- Rozšíriť program na celú oktávu
- Hrať tóny na piezo speakri
- Použiť piny 2, 3, 5, 7, 8, 10, 11, 12, A0, A1, A2, A3, A5

U11: Midi USB

- Posielať midi eventy cez USB a otestovať so softwarovým syntezátorom
- Midi DAW (Ableton, FL Studio, Garage band, Cubase, Logic Pro...)
- https://recursivearts.com/virtual-piano/

U12: Midi keyboard

- Posielať midi eventy cez UART

U12: Midi keyboard

- Preposielať midi eventy zo susedného arduina
- Nastaviť oktávu

```
void Preposli()
{
  while (Serial1.available())
  {
    Serial1.write(Serial1.read());
  }
}
```

Ďakujem!

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