# DIY Midi klavír

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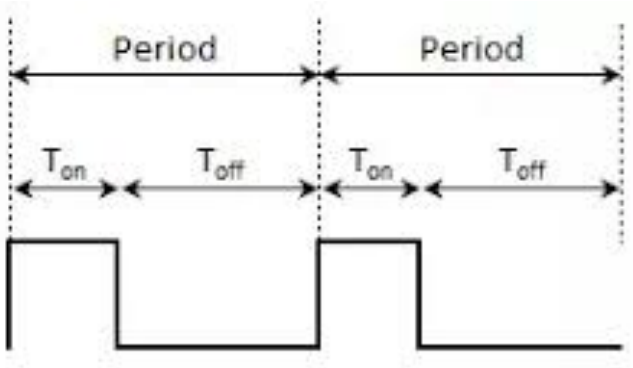
http://L.valky.eu/klavir

# 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%

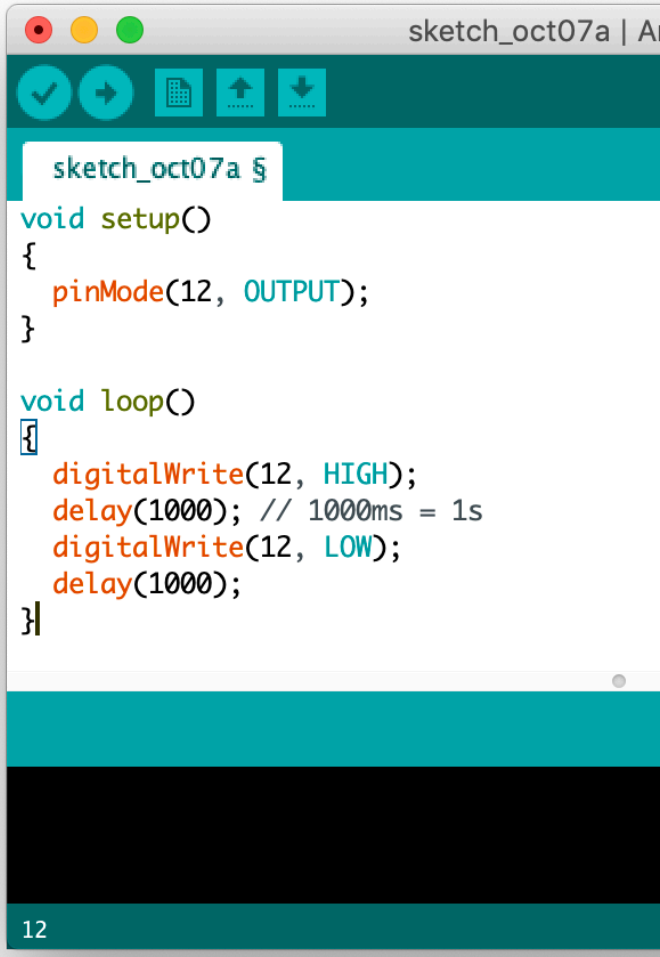



Period = 1 / Frequency

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

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

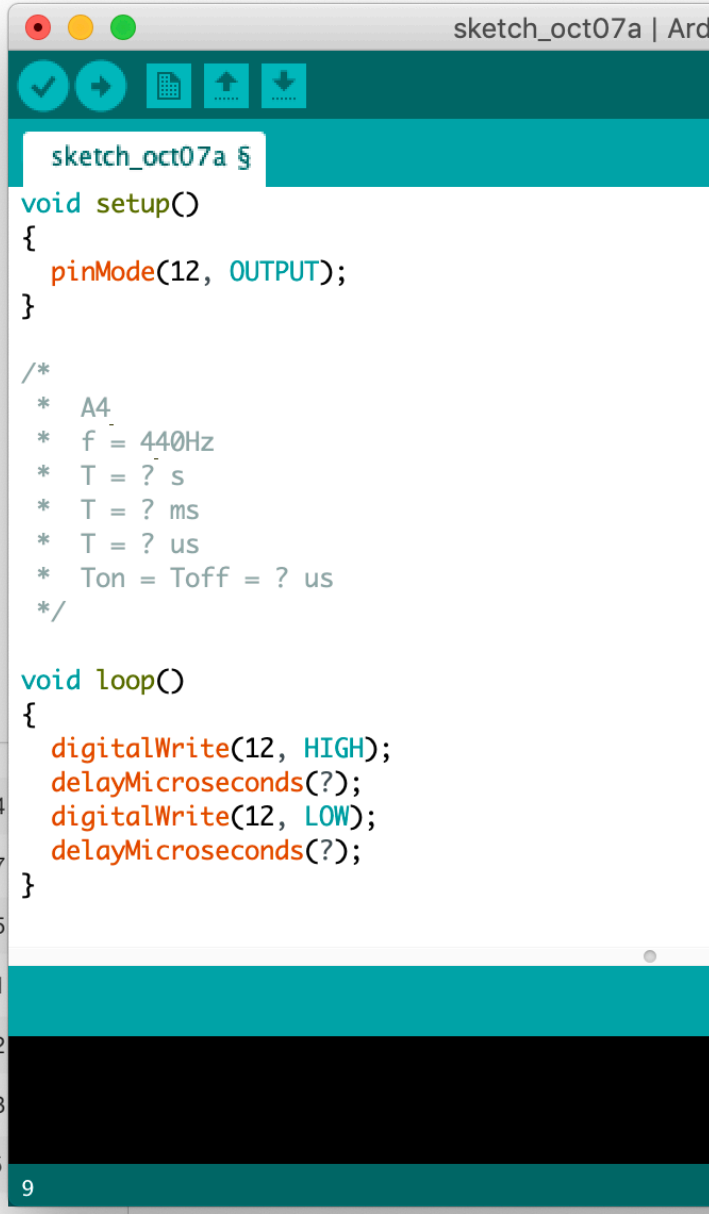
(On Percentage)



# U1: Tón A4

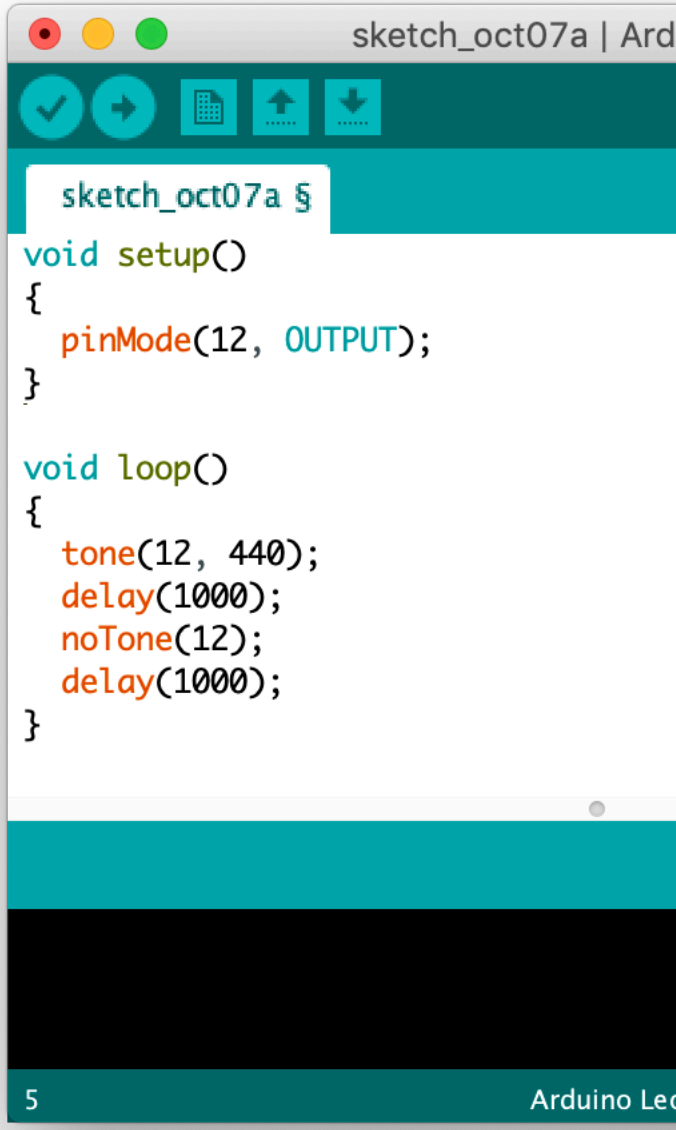
- Frekvencia 440 Hz
- 1 s = 1000 ms = 1 000 000 us
- delay(milisekundy)
- delayMicroseconds(mikrosekundy)
- max 15000 !

| | 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 |



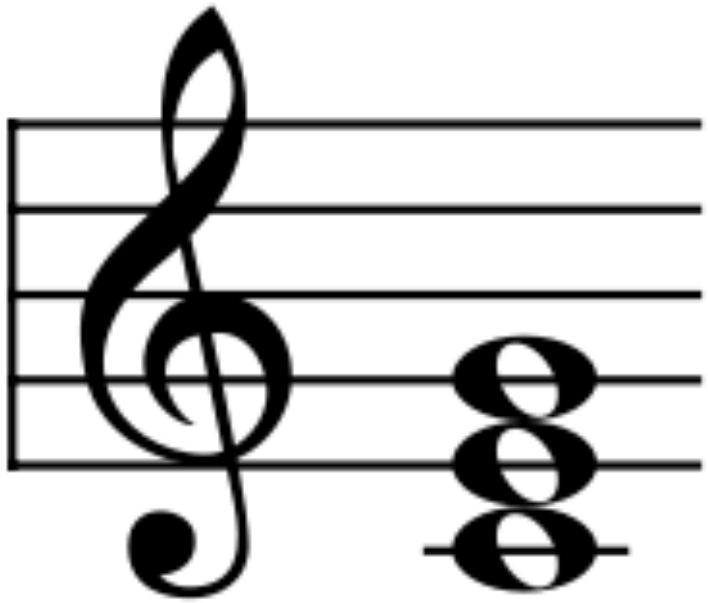
# U2: Funkcia tone()

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



# U3: C dur

- Z akých tónov sa skladá akord?



sketch_oct07a | Arduino 1.8.5

sketch_oct07a §

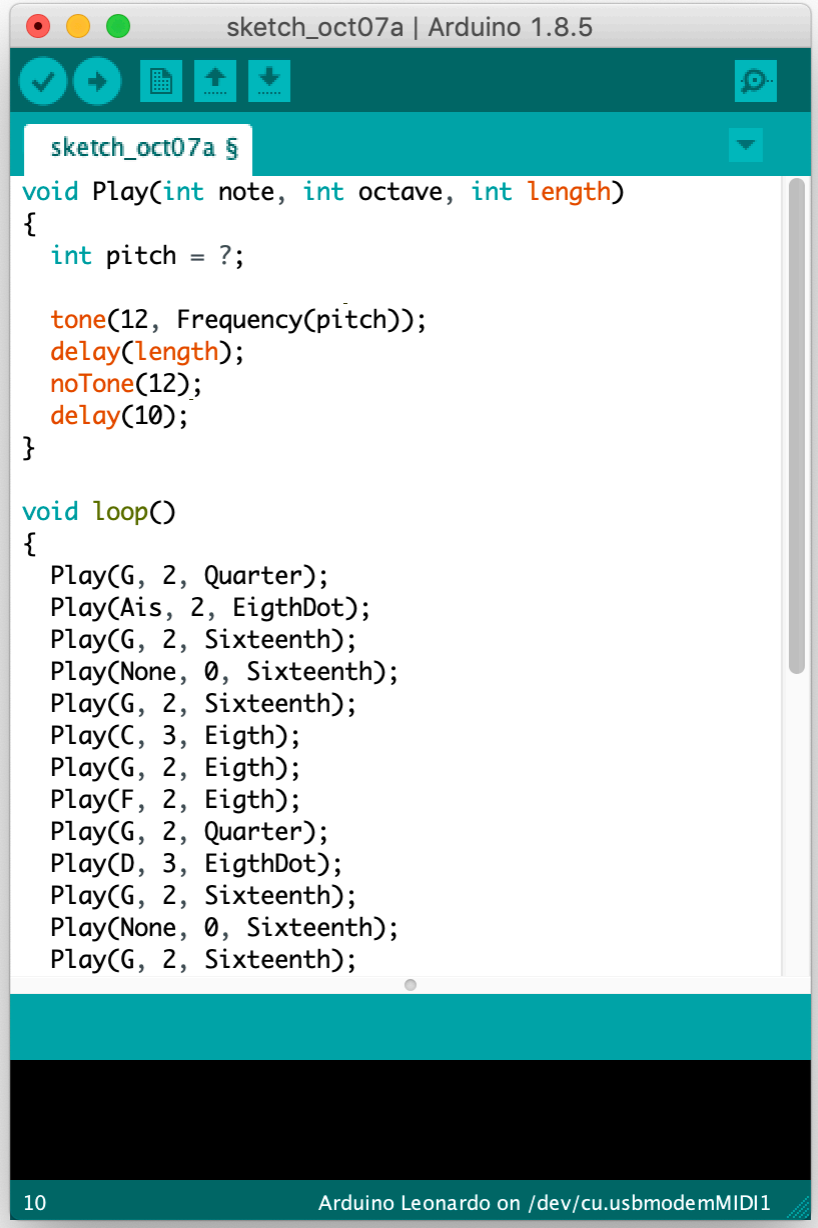
```
/*  C dur = ? ? ?
 *
 *  ?6 = ? Hz
 *  ?6 = ? Hz
 *  ?6 = ? Hz
 */

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

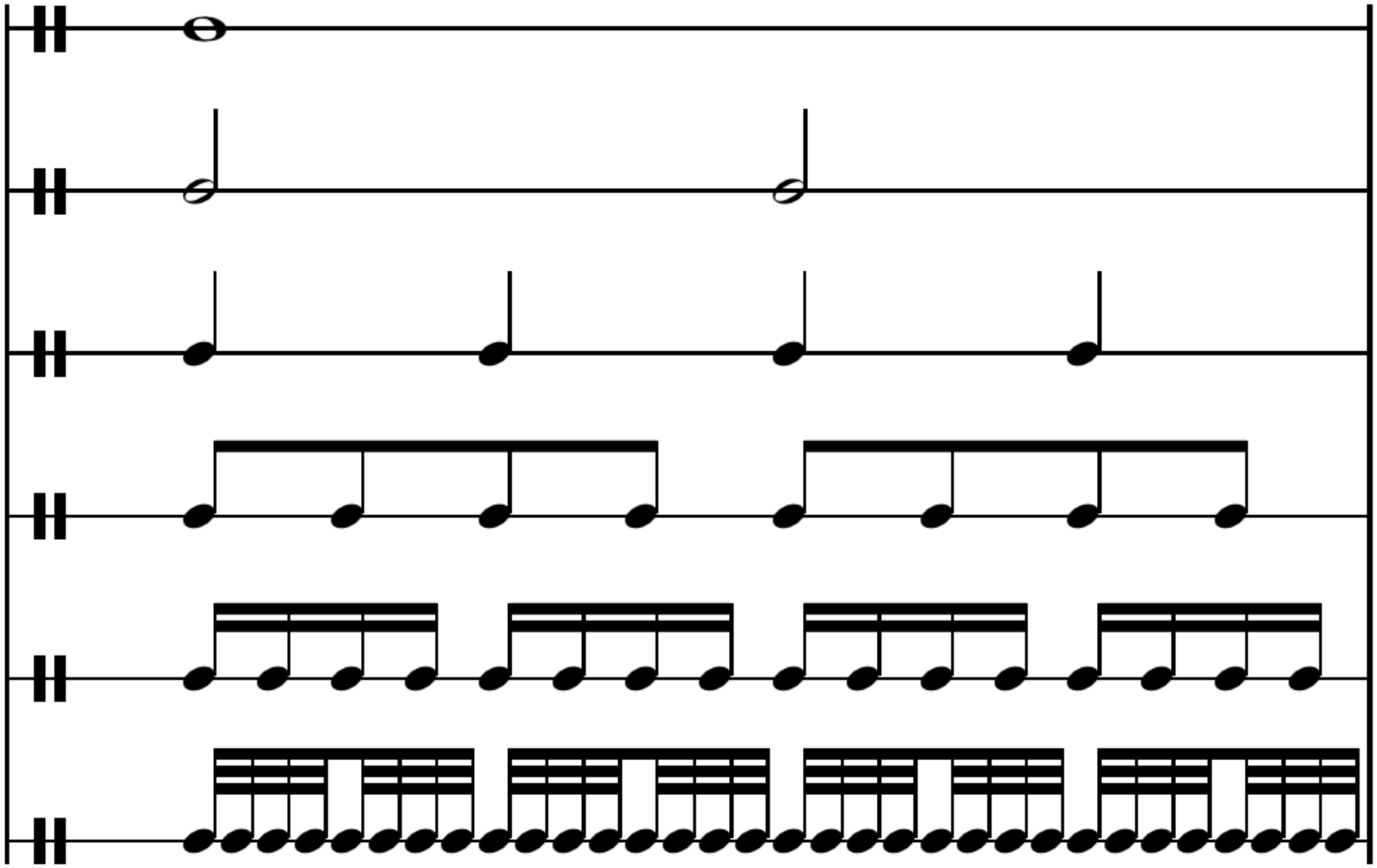
# Frekvencia tónu

**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 | |

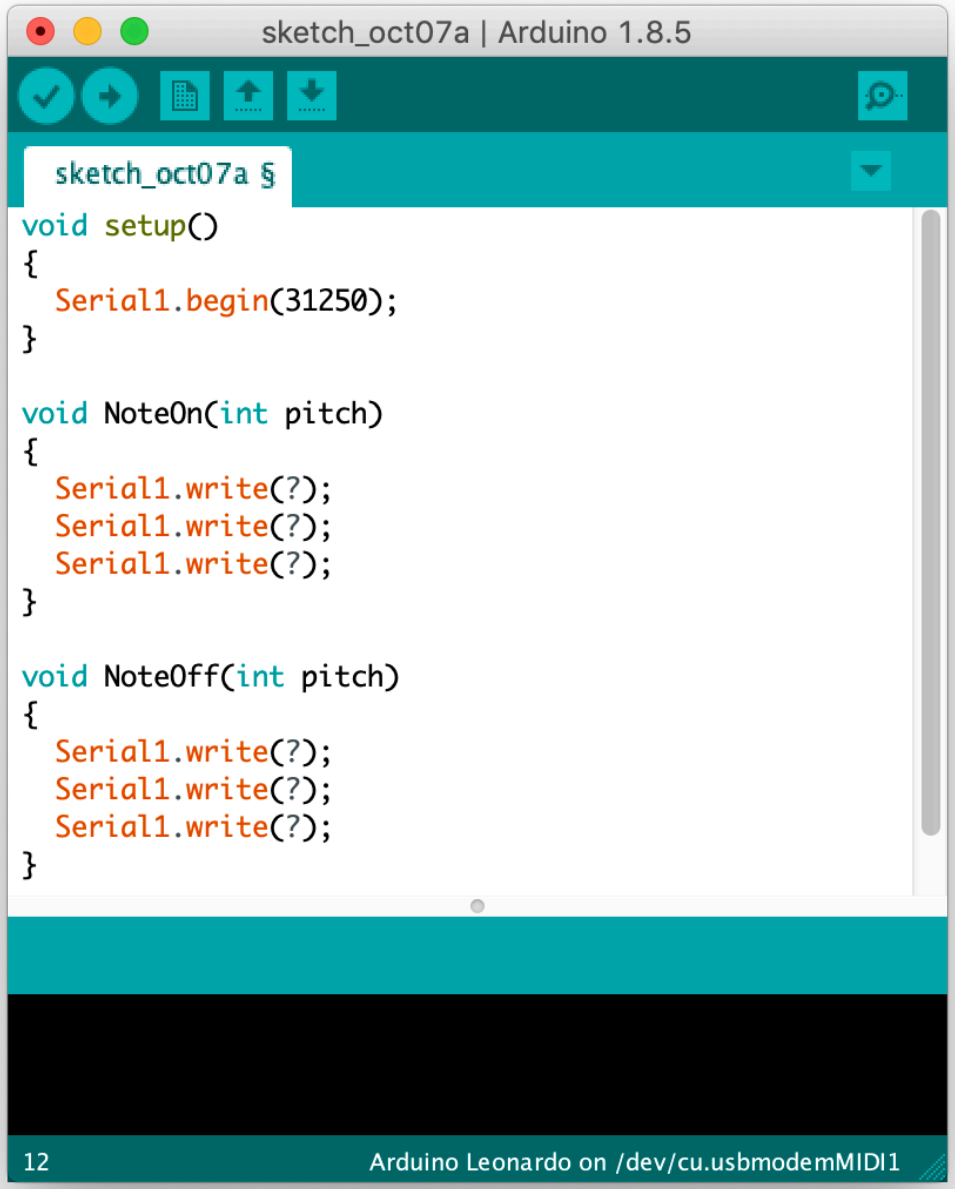
# Duration

- Cela / Whole
- Polova / Half
- Stvrtinova / Quarter
- Osminova / Eigth
- 1/16 / Sixteenth
- 1/32 / Thirtytwo
-



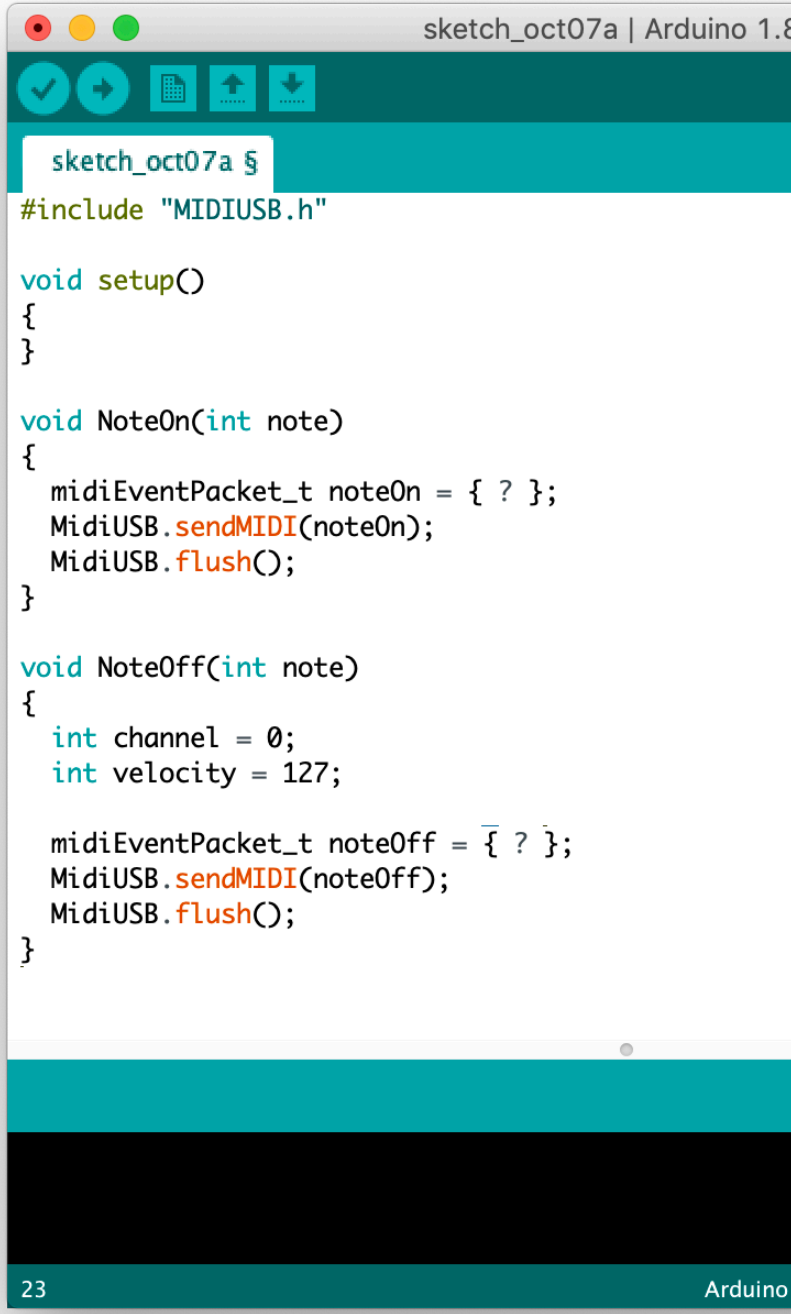
# U5: Midi Eventy

- 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)

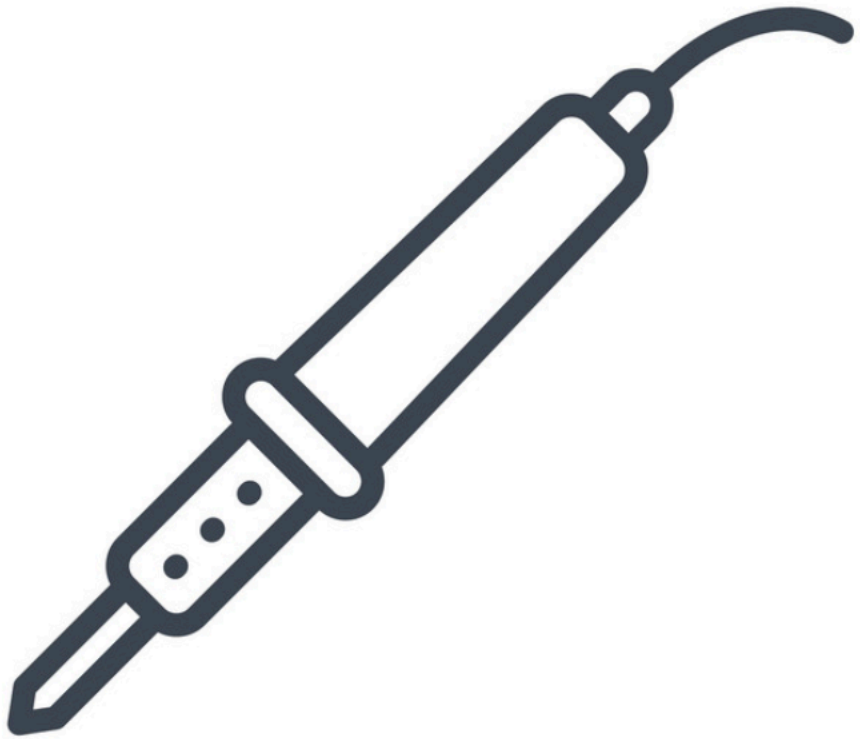


# U6: USB MIDI

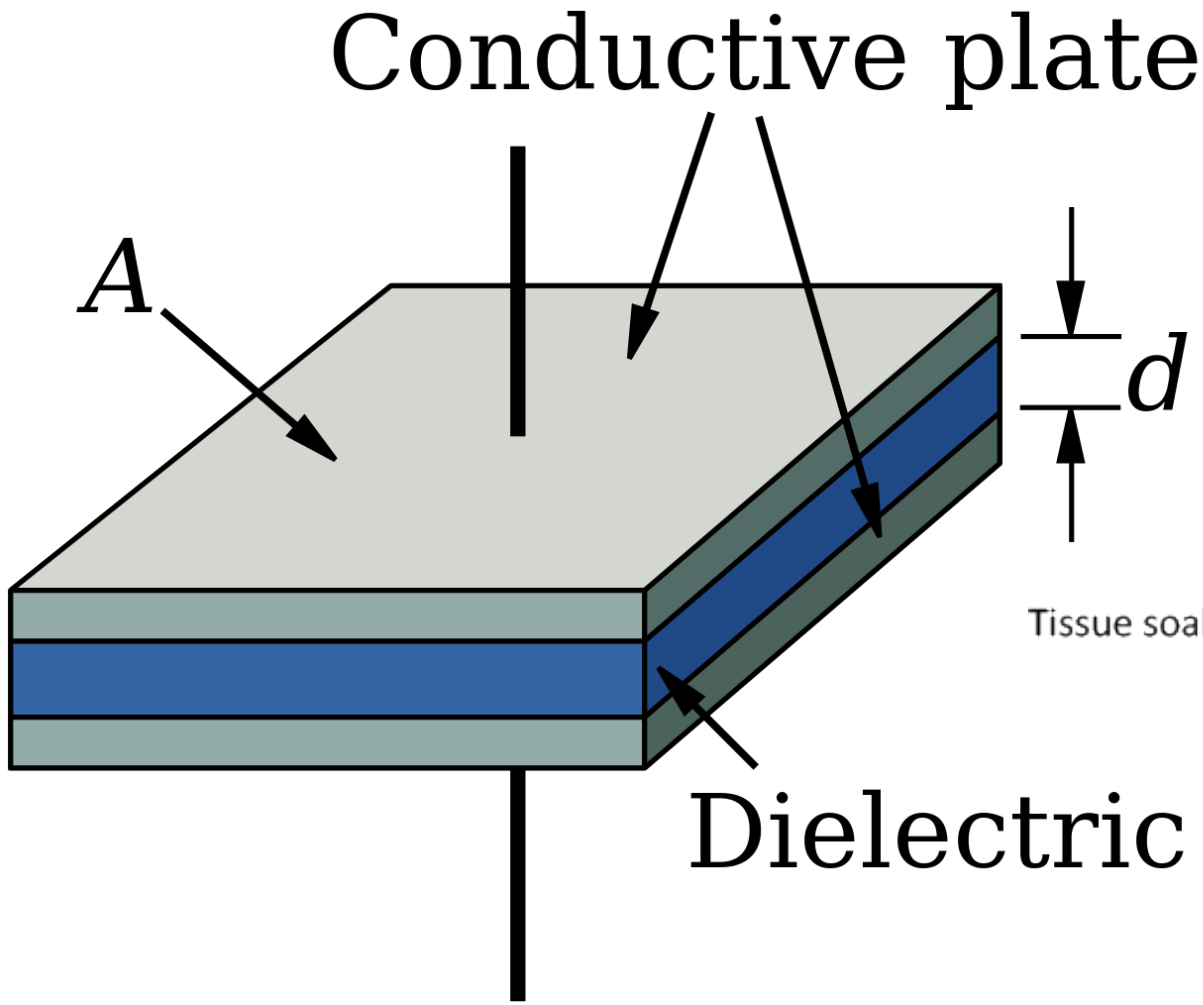
- #include “MIDIUSB.h”
- Note on event:
  - midiEventPacket_t noteOn = {0x09, 0x90 | channel, pitch, velocity};
  - MidiUSB.sendMIDI(noteOn);
  - MidiUSB.flush();
- Note off event:
  - midiEventPacket_t noteOff = {0x08, 0x80 | channel, pitch, velocity};
  - MidiUSB.sendMIDI(noteOff);
  - MidiUSB.flush();

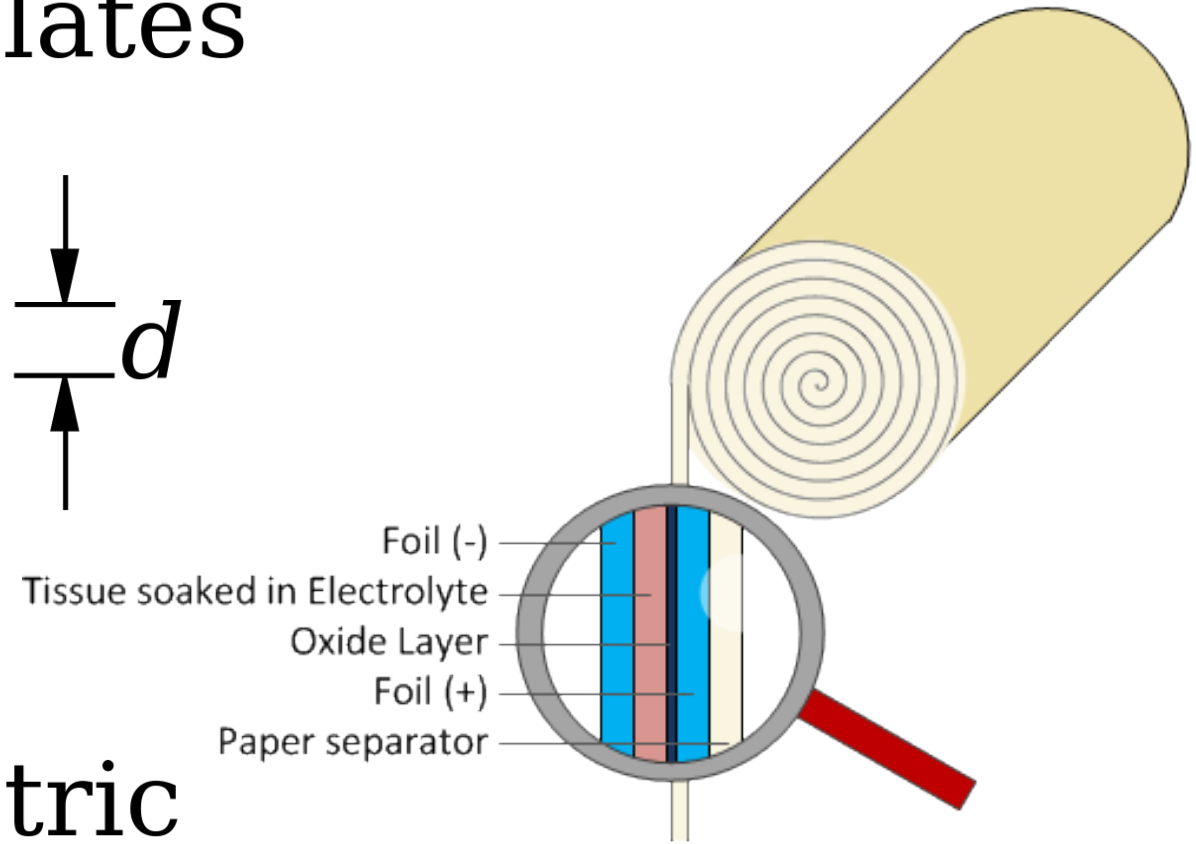


# Spájkujeme!

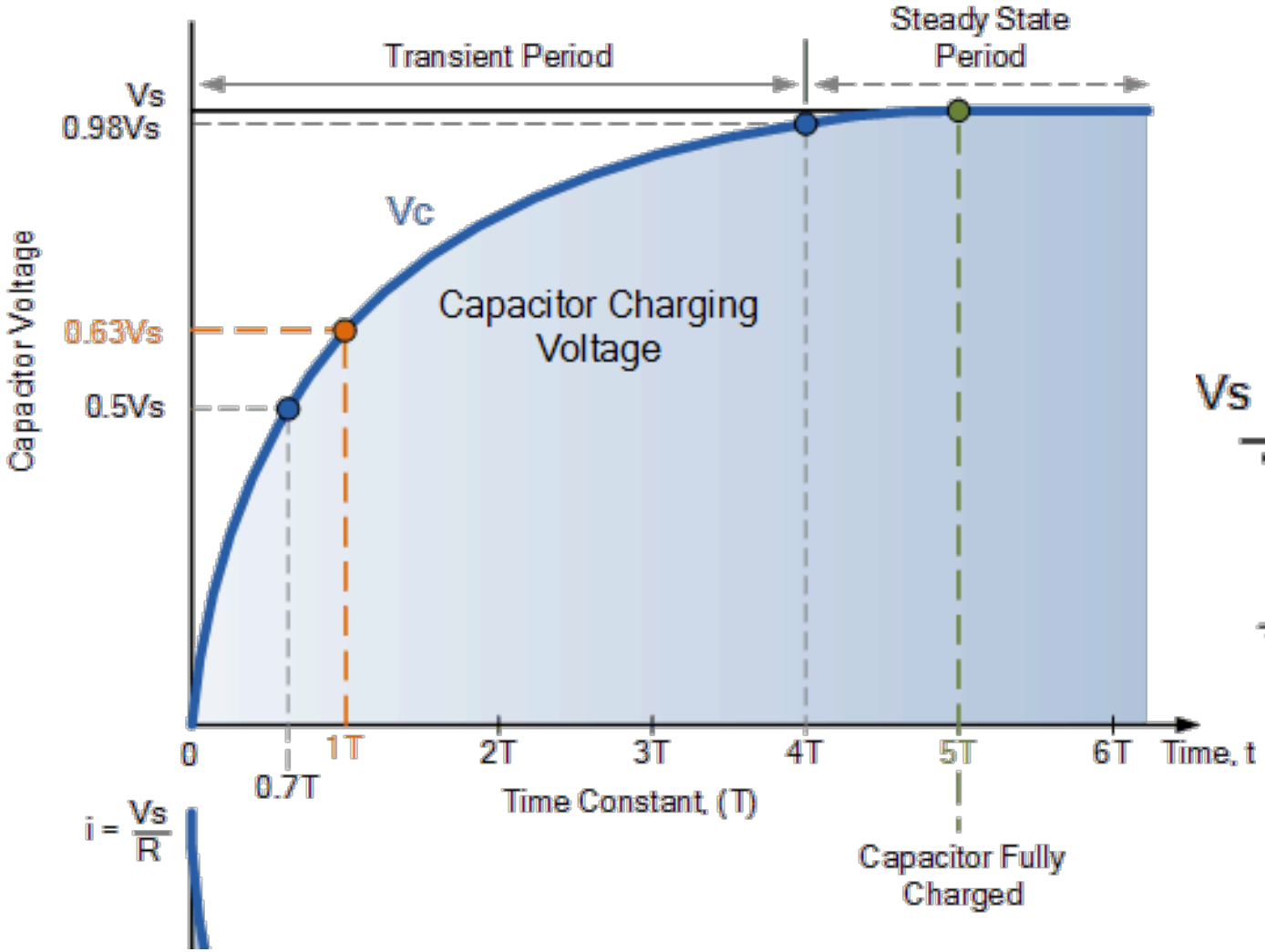


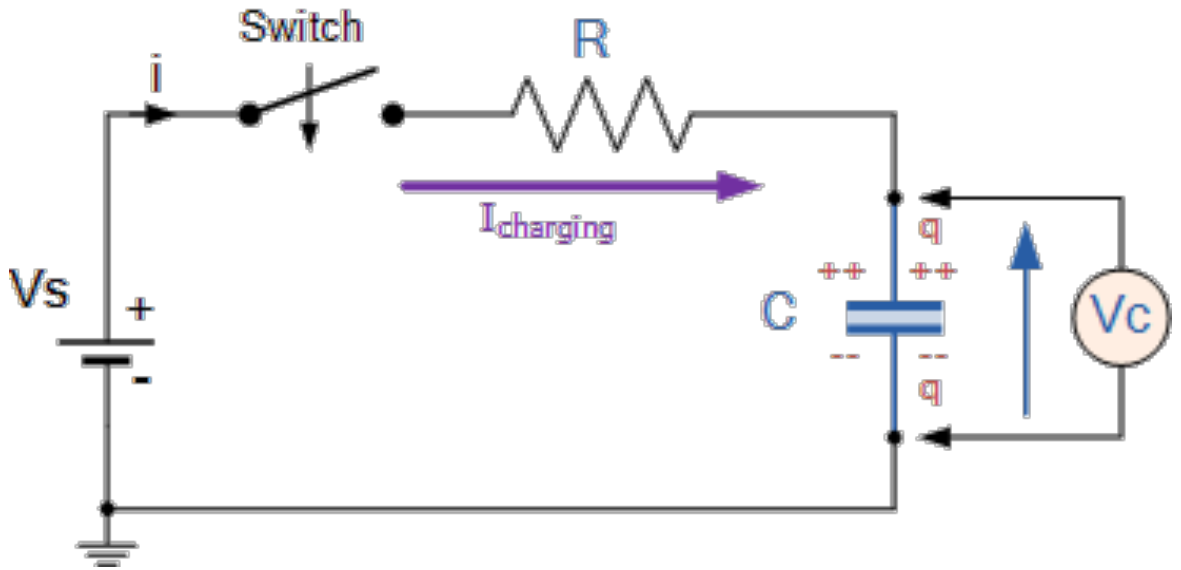
# Kondenzátor



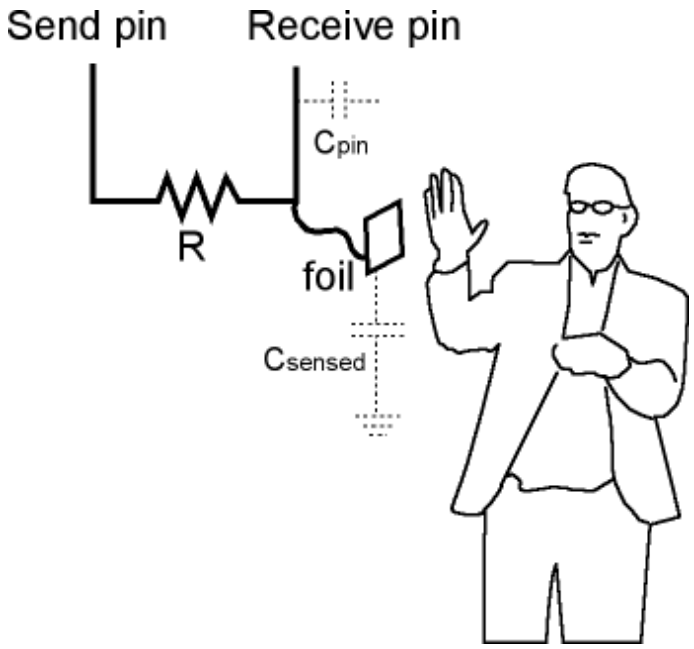
# Nabíjanie RC článku

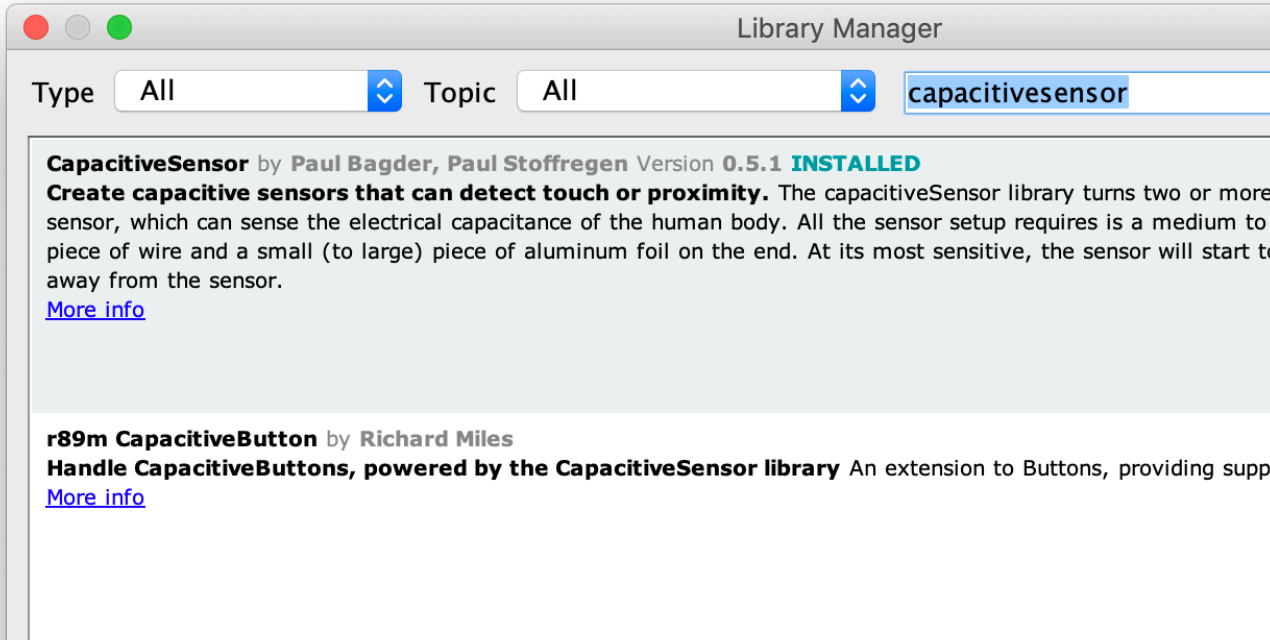


# U07: Knižnica CapacitiveSensor

- 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

# U11: Midi USB

- Posielať midi eventy cez USB a otestovať so softwarovým syntezátorom
- http://www.multiplayerpiano.com
- Play alone

# U12: Midi keyboard

- Posielať midi eventy cez UART

# U12: Midi keyboard

- Preposielať midi eventy zo susedného arduina
- Nastaviť oktávu

# Ďakujem!

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