Making Life Better With Software

Joelle Tori Maslak
(She/Her/Hers)

Perl and Raku
Conference in the Cloud 2021

Focus of Talk

- Will discuss three applications
  - Router CLI Colorization Script
  - Voice Training Assistant
  - “In a meeting” Indicator
- These meet a variety of needs - some neurodivergent, some social, some other types of needs
- Key Points:
  - Understanding your user is a must!
  - The process is iterative
  - Sometimes you’ll go down a wrong path
- These apply to any applications with users, not just assistive technology!

Who is Joelle?

- Developed in Perl for over 25 years
- Developed in Raku for 5 years
- Author of several Perl & Raku modules, most proud of Raku Net::BGP and Perl Parallel::WorkUnit
- Network Engineer @ Netflix
- Previously: Experience at government, telecom, and dotcom

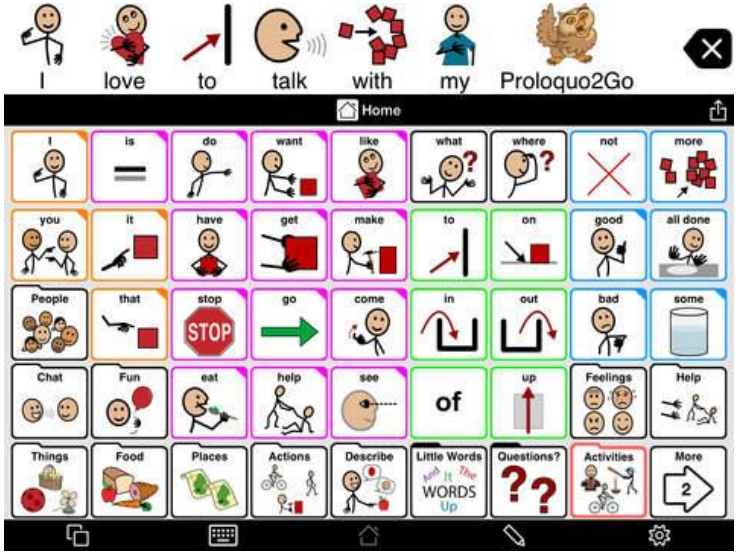
What Makes You Qualified?

- I’m Neurodivergent - and use software to help organize my life
- I’m Passionate about inclusion
- I’ve written numerous applications for myself and others, including assistive and augmentative communication software
- I’ve personally experienced what happens when software isn’t written with inclusion in mind

Problem #0
An Exercise: Communication

Communicating Without Speech

- What if someone with language skills wants to communicate without speech?
- Typical solution in 2021 is an iPad with special software, that emits audio based on user input.



But...is that always right?

- In a haunted house?
- In bed with an intimate partner?
- At a concert?
- For airport security?

Whitewater Rafting

- High likelihood of losing the device
- Loud, lots of movement make fine motor movements difficult
- Likely relatively few things need to be communicated
- Pointing and gestures likely useful
- Letterboard or symbol board can be cheaply made (just laminated sheet with letters to point at)
- But what about when you're *not* on the water?

In Bed with an Intimate Partner

- Might not want to break away from the action to use a device!
- Probably lots of non-verbal communication!
  - Gestures, pointing, guiding, vocalizations
- Motivated partners can be expected to learn another person’s communication methods
- Probably lots of communication in advance
- Small laminated cards with various activities/desires/etc

At a Concert

- LOUD!!!
- A different solution for being at seated classical orchestra performance vs. being in the mosh pit at a punk concert!
- Are there security restrictions?
- Concerns about breaking a device
- Probably want a backup method of communication (pencil and paper?)
- Again, might have pre-arranged communication methods with a willing partner, if accompanied

Airport Security

- Probably will have to surrender an electronic device for a short period
- Might want a note (just a piece of paper) that explains you need your device or a pencil & paper to communicate.
- Some conversations will be expected - a note that says you don’t speak, a note that says “this is my communication device, it’s a medical device, please be careful with it”.

Other Considerations

- If the person is seated most of the day vs. standing/walking, how might that change things?
- What if the person can type 140 WPM?
- What if the person finds it difficult to make voluntary motor movements with arms/hands?

Problem #1
Router Command Line Interfaces

Rethinking the CUI

- Text interfaces are industry-standard for routers
- My problems with text interfaces:
  - Seas of text w/o good hierarchy of information design
  - Prone to making transcription errors
  - Is 1000000 the same as 100000 or 1000000?
- What if I could redesign the router output?
- I kind of can redesign the output - I can pipe *ssh* to a filter script I write in Raku.

```
sw08#show ip bgp neighbors 192.168.153.17
BGP neighbor is 192.168.153.17, remote AS 65000, internal link
  BGP version 4, remote router ID 192.168.153.17, VRF default
  Last read 00:00:27, last write 00:00:03
  Hold time is 180, keepalive interval is 60 seconds
  Configured hold time is 180, keepalive interval is 60 seconds
  Hold timer is active, time left: 00:00:48
  Keepalive timer is active, time left: 00:00:50
  Connect timer is inactive
  Idle-restart timer is inactive
  BGP state is Established, up for 36d00h
  Number of transitions to established: 3
  Last state was OpenConfirm
  Last event was RecvKeepAlive
  Last sent socket-error:Connect (Network is unreachable), Last time 36d00h
  Last rcvd socket-error:Connection closed by peer, Last time 36d00h, First time
 124d03h, Repeats 1
  Types of communities advertised: none
  Neighbor Capabilities:
    Multiprotocol IPv4 Unicast: advertised and received and negotiated
    Four Octet ASN: advertised and received and negotiated
    Route Refresh: advertised and received and negotiated
    Enhanced route refresh: advertised
    Send End-of-RIB messages: advertised
    Additional-paths recv capability:
```

Locating info in a sea of text

What is the status of the BGP session?

What was the last error?

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  BGP version 4, remote router ID 192.168.153.17, VRF default
  Last read 00:00:43, last write 00:00:16
  Hold time is 180, keepalive interval is 60 seconds
  Configured hold time is 180, keepalive interval is 60 seconds
  Hold timer is active, time left: 00:01:20
  Keepalive timer is active, time left: 00:00:41
  Connect timer is inactive
  Idle-restart timer is inactive
  BGP state is Established, up for 36d00h
  Number of transitions to established: 3
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  Keepalive timer is active, time left: 00:00:41
  Connect timer is inactive
  Idle-restart timer is inactive
  BGP state is Established, up for 36d00h
  Number of transitions to established: 2
  Last state was OpenConfirm
  Last event was RecvKeepAlive
  Last sent socket-error:Connect (Network is unreachable), Last time 36d00h
  Last rcvd socket-error:Connection closed by peer, Last time 36d00h, First tim
 124d03h, Repeats 1
  Types of communities advertised: none
  Neighbor Capabilities:
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    Additional-paths recv capability:
```

Highlight Errors

```
sw08#show int et49/1-12 transceiver
If device is externally calibrated, only calibrated values are printed.
N/A: not applicable, Tx: transmit, Rx: receive.
mA: milliamperes, dBm: decibels (milliwatts).
                                Bias      Optical   Optical
           Temp       Voltage   Current   Tx Power  Rx Power
Port       (Celsius)  (Volts)   (mA)      (dBm)     (dBm)     Last Update
---------  ---------  --------  --------  --------  --------  -------------------
Et49/1      41.71      3.29      5.49      0.83      -4.05     0:00:05 ago
Et49/2      41.71      3.29      5.47      0.52      -3.80     0:00:05 ago
Et49/3      41.71      3.29      5.47      0.76      -2.46     0:00:05 ago
Et49/4      41.71      3.29      5.62      0.75      -5.71     0:00:05 ago
Et49/5      41.71      3.29      5.87      0.74      -4.86     0:00:05 ago
Et49/6      41.71      3.29      5.83      1.04      -4.21     0:00:05 ago
Et49/7      41.71      3.29      5.86      0.90      -4.55     0:00:05 ago
Et49/8      41.71      3.29      5.46      0.93      -30.00    0:00:05 ago
Et49/9      41.71      3.29      5.69      1.11      -30.00    0:00:05 ago
Et49/10     41.71      3.29      5.50      0.80      -30.00    0:00:05 ago
Et49/11     41.71      3.29      5.78      0.95      -30.00    0:00:05 ago
Et49/12     41.71      3.29      5.77      0.50      -1.33     0:00:05 ago
```

```
sw08#show int et49/1-12 transceiver
If device is externally calibrated, only calibrated values are printed.
N/A: not applicable, Tx: transmit, Rx: receive.
mA: milliamperes, dBm: decibels (milliwatts).
                                 Bias      Optical   Optical
          Temp       Voltage     Current   Tx Power  Rx Power
Port      (Celsius)  (Volts)     (mA)      (dBm)     (dBm)     Last Update
-----     ---------  --------    --------  --------  --------  -------------------
Et49/1     41.71      3.29        5.49     0.82      -4.05     0:00:04 ago
Et49/2     41.71      3.29        5.52     0.37      -3.80     0:00:04 ago
Et49/3     41.71      3.29        5.42     0.76      -2.46     0:00:04 ago
Et49/4     41.71      3.29        5.62     0.75      -6.09     0:00:04 ago
Et49/5     41.71      3.29        5.40     0.71      -4.86     0:00:04 ago
Et49/6     41.71      3.29        5.87     1.04      -4.21     0:00:04 ago
Et49/7     41.71      3.29        5.86     0.91      -4.59     0:00:04 ago
Et49/8     41.71      3.29        5.46     0.93      -30.00    0:00:04 ago
Et49/9     41.71      3.29        5.69     1.08      -30.00    0:00:04 ago
Et49/10    41.71      3.29        5.50     0.69      -30.00    0:00:04 ago
Et49/11    41.71      3.29        5.78     0.96      -30.00    0:00:04 ago
Et49/12    41.71      3.29        5.77     0.55      -1.33     0:00:04 ago
```

Preventing Trancsription Errors

```
jmaslak@fw1.den1:~$ show ip bgp 192.168.149.2
BGP routing table entry for 192.168.149.2/32
Paths: (3 available, best #3, table default)
  Advertised to non peer-group peers:
  192.168.152.174 192.168.152.210 192.168.79.2
  65000 65000 4200149002
    192.168.152.210 from 192.168.152.210 (192.168.153.17)
      Origin IGP, valid, external
      Community: 65000:1000
      Last update: Sun May 30 03:26:15 2021
  65000 4200149002
    192.168.152.174 from 192.168.152.174 (192.168.153.17)
      Origin IGP, valid, external
      Community: 65000:1000
      Last update: Wed May 26 10:11:40 2021
  4200149002
    192.168.65.10 from 192.168.65.10 (192.168.65.10)
      Origin IGP, valid, external, best (AS Path)
      Community: 65000:1000
      Last update: Fri May  7 06:57:52 2021
```

```
jmaslak@fw1.den1:~$ show ip bgp 192.168.149.2
BGP routing table entry for 192.168.149.2/32
Paths: (3 available, best #3, table default)
  Advertised to non peer-group peers:
  192.168.152.174 192.168.152.210 192.168.79.2
  65000 65000 4200149002
    192.168.152.210 from 192.168.152.210 (192.168.153.17)
      Origin IGP, valid, external
      Community: 65000:1000
      Last update: Sun May 30 03:26:15 2021
  65000 4200149002
    192.168.152.174 from 192.168.152.174 (192.168.153.17)
      Origin IGP, valid, external
      Community: 65000:1000
      Last update: Wed May 26 10:11:40 2021
  4200149002
    192.168.65.10 from 192.168.65.10 (192.168.65.10)
      Origin IGP, valid, external, best (AS Path)
      Community: 65000:1000
      Last update: Fri May  7 06:57:52 2021
```

Is 1000000 equivalent to 1,000,000 or 100,000?

```
sw08#show int et49/3
Ethernet49/3 is up, line protocol is up (connected)
  Hardware is Ethernet, address is 001c.739c.8146 (bia 001c.739c.8146)
  Description: Joelle Desktop
  Ethernet MTU 9214 bytes, BW 10000000 kbit
  Full-duplex, 10Gb/s, auto negotiation: off, uni-link: n/a
  Up 4 hours, 56 minutes, 24 seconds
  Loopback Mode : None
  300 link status changes since last clear
  Last clearing of "show interface" counters 130 days, 0:42:55 ago
  30 seconds input rate 20.9 Mbps (0.2% with framing overhead), 16257 packets/sec
  30 seconds output rate 527 Mbps (5.3% with framing overhead), 44068 packets/sec
     613002040 packets input, 269247233616 bytes
     Received 97141 broadcasts, 798342 multicast
     0 runts, 0 giants
     0 input errors, 0 CRC, 0 alignment, 0 symbol, 0 input discards
     99406 PAUSE input
     1125627991 packets output, 958959625324 bytes
     Sent 5109261 broadcasts, 107010337 multicast
     0 output errors, 0 collisions
     0 late collision, 0 deferred, 0 output discards
     0 PAUSE output
```

The Script Turns

10000000

Into This

10000000

```
sw08#show int et49/3
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```

```
sw08#show int et49/3
Ethernet49/3 is up, line protocol is up (connected)
  Hardware is Ethernet, address is 001c.739c.8146 (bia 001c.739c.8146)
  Description: Joelle Desktop
  Ethernet MTU 9214 bytes, BW 10000000 kbit
  Full-duplex, 10Gb/s, auto negotiation: off, uni-link: n/a
  Up 4 hours, 56 minutes, 26 seconds
  Loopback Mode : None
  300 link status changes since last clear
  Last clearing of "show interface" counters 130 days, 0:42:57 ago
  30 seconds input rate 20.5 Mbps (0.2% with framing overhead), 16885 packets/sec
  30 seconds output rate 540 Mbps (5.5% with framing overhead), 45091 packets/sec
     613054136 packets input, 269250845035 bytes
     Received 97141 broadcasts, 798342 multicast
     0 runts, 0 giants
     0 input errors, 0 CRC, 0 alignment, 0 symbol, 0 input discards
     99510 PAUSE input
     1125747853 packets output, 959140857601 bytes
     Sent 5109262 broadcasts, 107010341 multicast
     0 output errors, 0 collisions
     0 late collision, 0 deferred, 0 output discards
     0 PAUSE output
```

How Did I Do It?

- Raku & Regexes. Lots of regexes.
- A bash function in my .bashrc similar to:

```
# SSH w/ color
ssh() {
    SSH=$(which ssh)
    echo | raku ~/bin/sshr.raku 2>/dev/null >/dev/null
    if [ $? -ne 0 ] ; then
        $SSH "$@"
        return
    fi

    # Only filter if connecting to a router
    if [[ " $* " =~ " edge[0-9]" ]] ; then
        $SSH "$@" | ~/bin/sshr.raku
    else
        $SSH "$@"
    fi
}
```

```
220     # Interfaces ("show int transceiver")
221     my regex lowlight { [ "-30." <[0..9]>**2 ] || [ "-2" <[5..9]> "." <[0..9]>**2 ] };
222     my regex light    { "N/A" || <num> };
223
224     $str ~~ s/^ ( <[A..Z]><[a..z]><[0..9]> \S* [ \s+ <light> ]**4 \s+ <lowlight> \s+ \S+ " ago" ) $ /{colored($0, $red)}/;
225     $str ~~ s/^ ( <[A..Z]><[a..z]><[0..9]> \S* [ \s+ <light> ]**5               \s+ \S+ " ago" ) $ /{colored($0, $info)}/;
226     $str ~~ s/^ ( <[A..Z]><[a..z]><[0..9]> \S* [ \s+ 'N/A' ]**6 \s*                          ) $ /{colored($0, $orange)}/;
227
```

Would it Work for Everyone?

- What if someone was red/green color blind?
- What if someone used a screen reader or similar?
- What if colorization was distracting?
- What if I cared about *different* parts of the router output?
- What if I was used to a different number grouping technique? I.E. what if I grew up using 10,00,00,000?

That said, I'd love to see an "enhanced readability" mode when I'm on a router! (Cisco's "*human-readable*" option at least adds commas to numbers!

Lessons Learned

- Raku regexes are fantastic!
- Raku grammars are even more fantastic!
- Both make me way more efficient.
- But I’m not thrilled with performance.

Problem #2
Voice Training

Voice Training Assistant

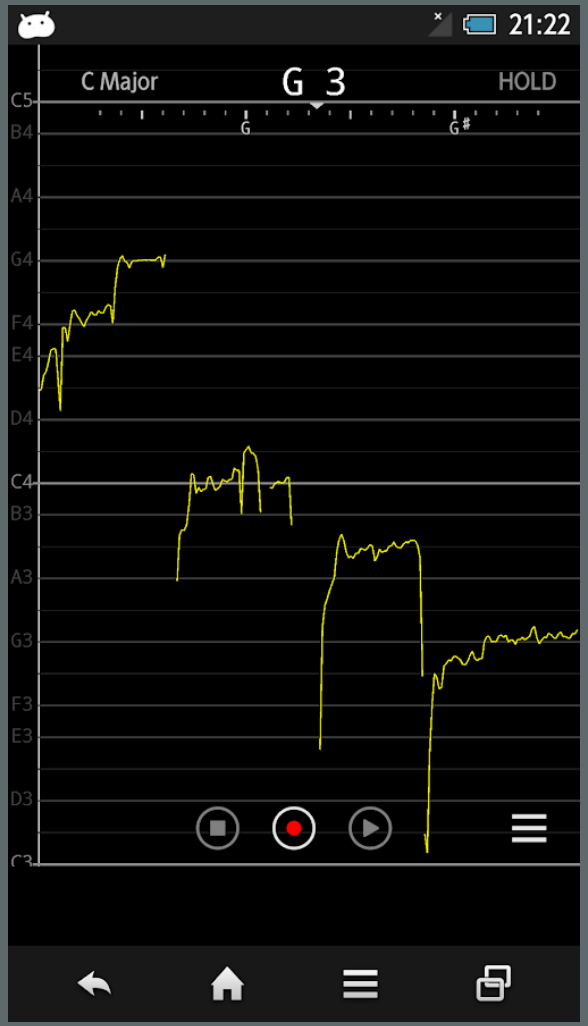
- I would like my voice to be somewhat different
- I’m in front of a computer most of the day
- A lot of the day, I’m making video calls from my PC
- What if my computer gave me hints?
  - But I need them in a non-distracting way!
  - I’ll bet someone figured out all the hard audio analysis, right?
- Needs to be cross-platform (Windows, Linux, maybe Mac)

My Goals

- Focus on pitch
- Anything < 160hz is lower than I want
- Anything > 180hz is good
- Between 160hz and 180hz is acceptable
- I want to know when I’m not doing what I want
- I also need to know when I’m doing things “right” so I can note what I was doing then.

What is the “typical” solution?

VoicePitchMonitor
iOS Phone Appliation



Why do I want something different?

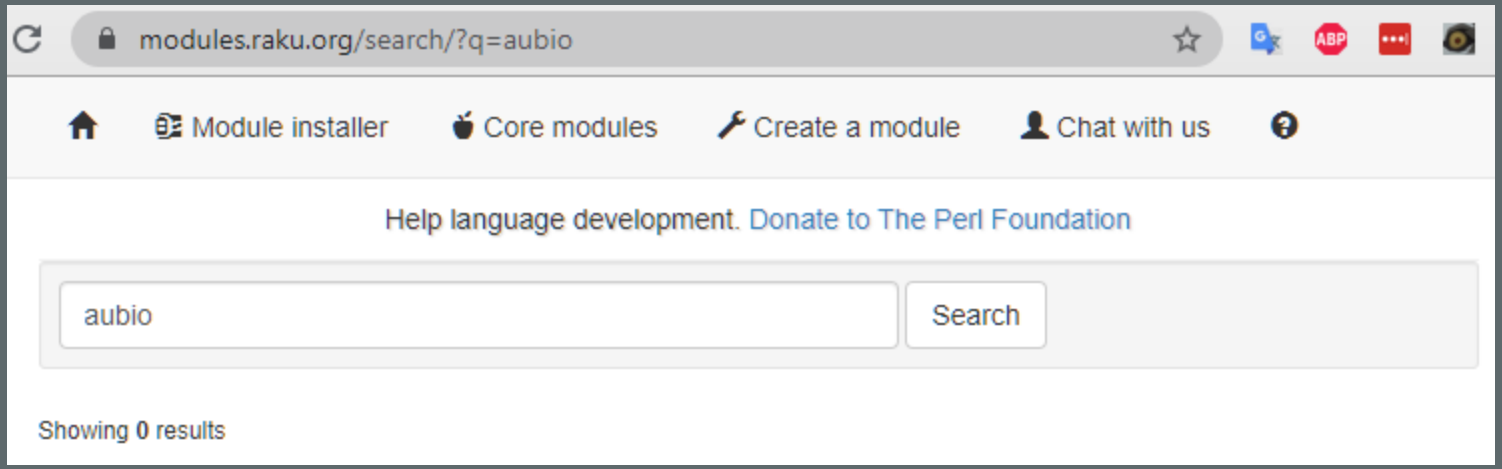
- I don’t want another screen in front of me!
- I want it running all the time.
- I’m not using this for dedicated voice training. I need to be able to focus on other tasks while doing this.
- I want a “traffic light” - SIMPLE to interpret!
- Background noise can be a problem with these apps.

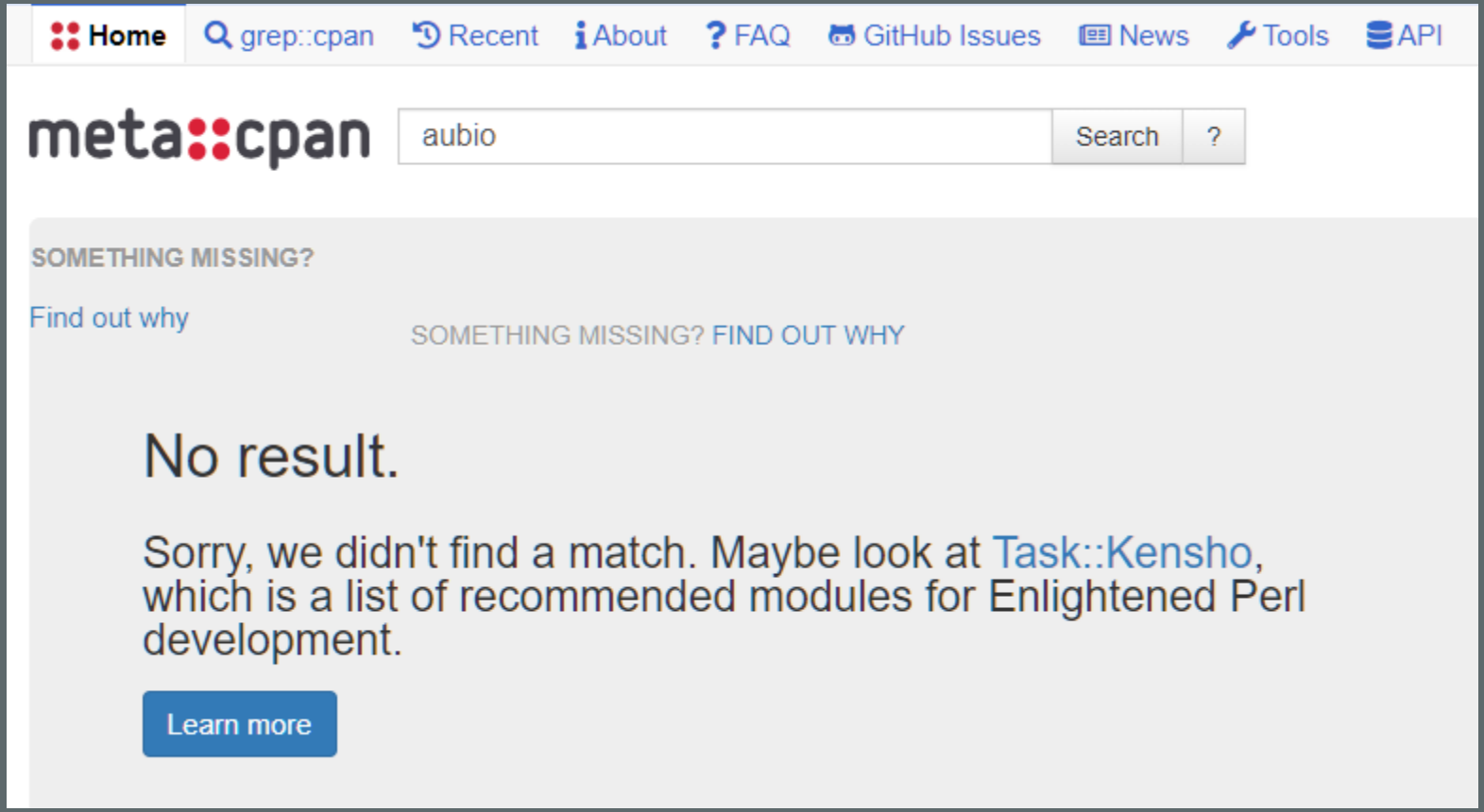
So, what language?

Raku?
Perl?

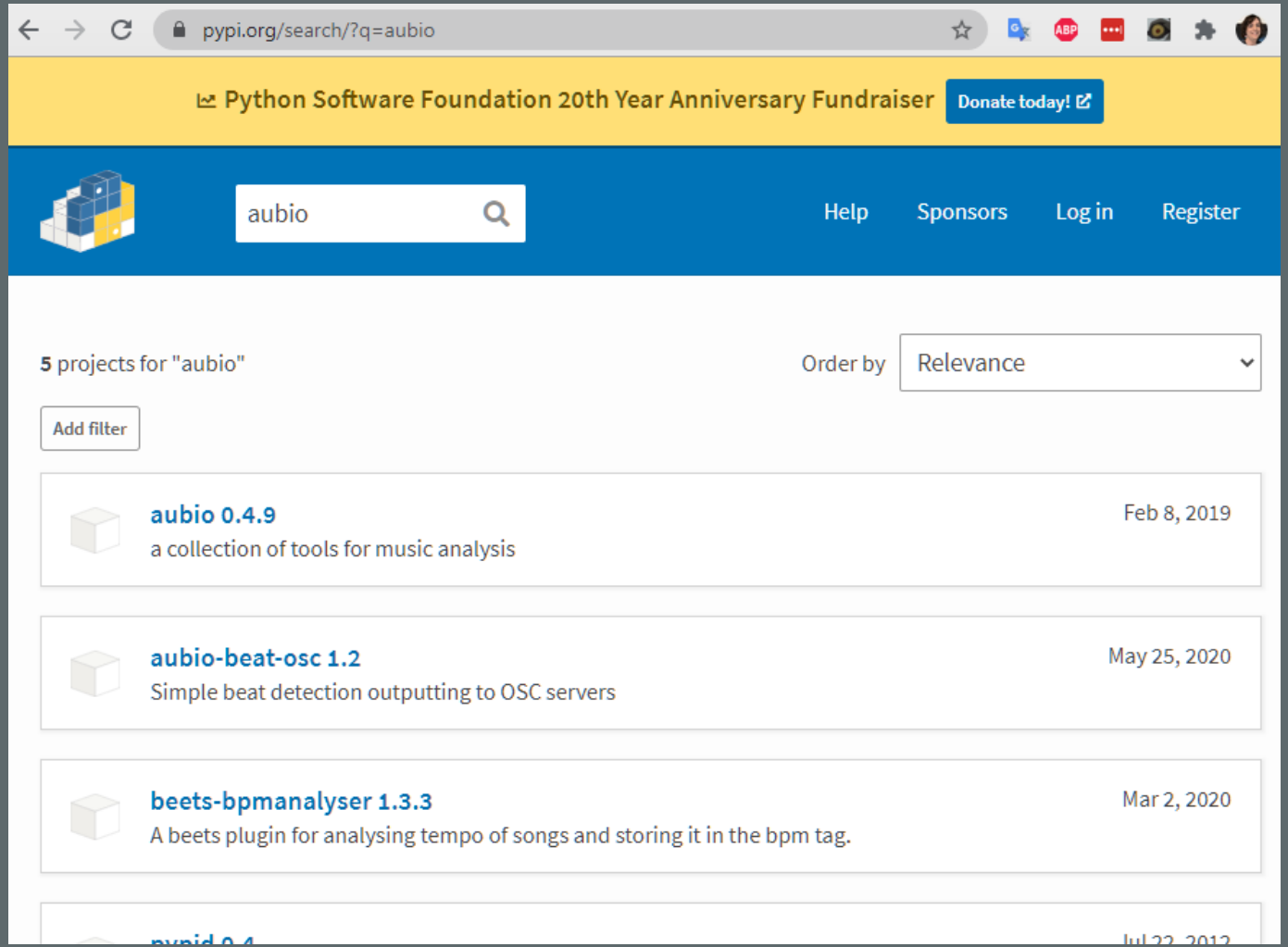
Aubio!

- A cross-platform library that can do pitch detection exists: *aubio*
- Usage is pretty simple:
  - Open an audio stream
  - Set up a pitch detector
  - Loop over stream, calling pitch detector for each sample


modules.raku.org/search/?q=aubio
Module installer
Core modules
Create a module
Chat with us
Help language development. Donate to The Perl Foundation
aubio
Search
Showing 0 results


Home
grep::cpan
Recent
About
FAQ
GitHub Issues
News
Tools
API
metacpan
aubio
Search
?
SOMETHING MISSING?
Find out why
SOMETHING MISSING? FIND OUT WHY
No result.
Sorry, we didn't find a match. Maybe look at Task::Kensho, which is a list of recommended modules for Enlightened Perl development.
Learn more

Hmmm, what about...


pypi.org/search/?q=aubio
Python Software Foundation 20th Year Anniversary Fundraiser
Donate today!
aubio
Help
Sponsors
Log in
Register
5 projects for "aubio"
Order by
Relevance
Add filter
aubio 0.4.9
a collection of tools for music analysis
Feb 8, 2019
aubio-beat-osc 1.2
Simple beat detection outputting to OSC servers
May 25, 2020
beets-bpmanalyser 1.3.3
A beets plugin for analysing tempo of songs and storing it in the bpm tag.
Mar 2, 2020

Operating System

- MacOS :: MacOS X
- Microsoft :: Windows
- POSIX

Guess What I Used...

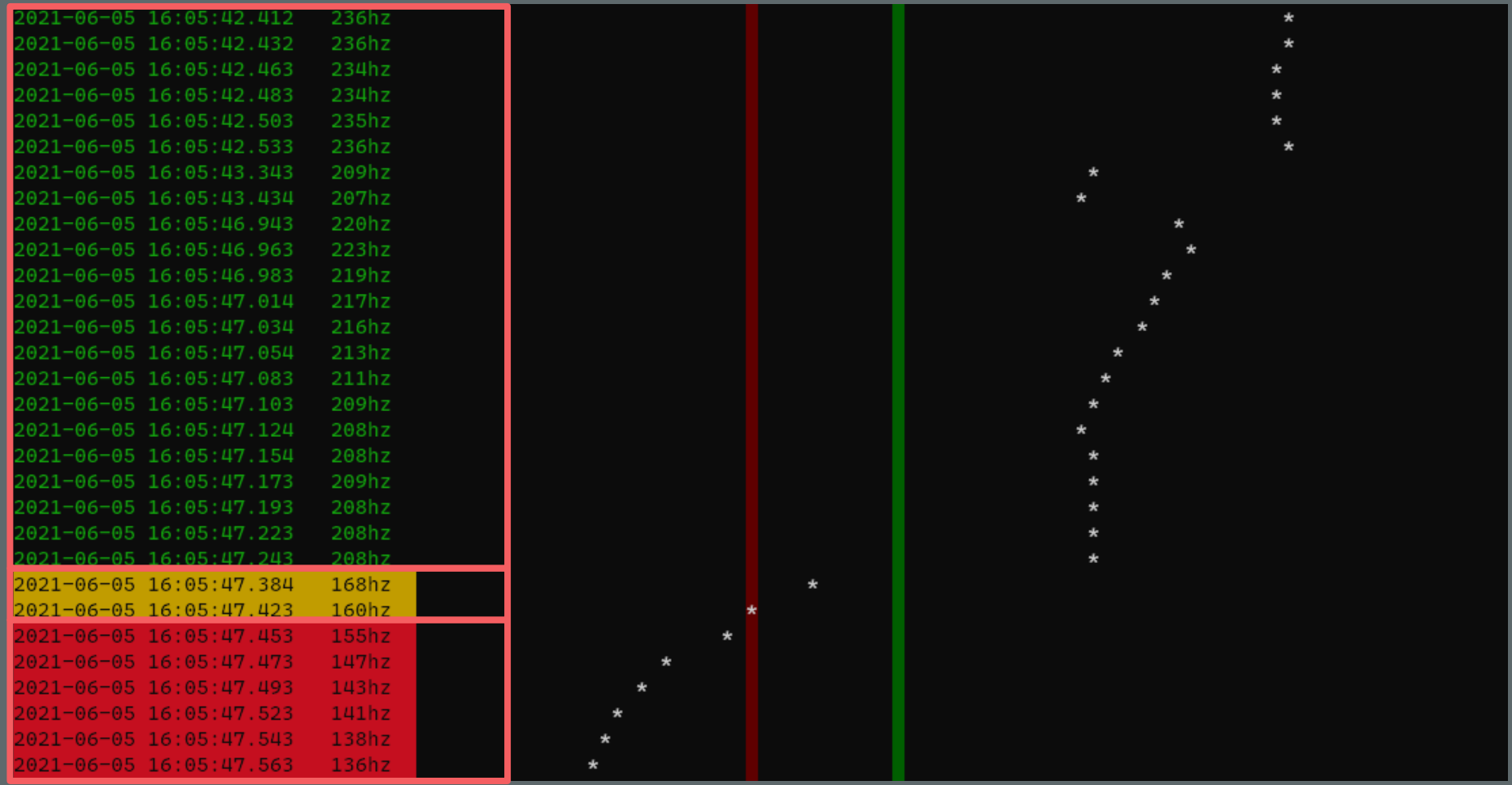
Discoveries

- Initial idea: traffic light visible to peripheral vision
- But it’s useful to know if my pitch is going up or down in real-time sometimes
  - What if I did a a sort of real-time graph?
- I really don’t want to learn cross-platform GUIs! And I don’t want a browser app.
- Sometimes I want to know exactly what pitch I’m at
- I don’t care that my air conditioner makes a 60hz noise
- I don’t care about silence

The Graph


OLDER
Too Low
GOOD!
NEWER ↓

The Traffic Light (Peripheral Vision)


2021-06-05 16:05:42.412 236hz
2021-06-05 16:05:42.432 236hz
2021-06-05 16:05:42.463 234hz
2021-06-05 16:05:42.483 234hz
2021-06-05 16:05:42.503 235hz
2021-06-05 16:05:42.533 236hz
2021-06-05 16:05:43.343 209hz
2021-06-05 16:05:43.434 207hz
2021-06-05 16:05:46.943 220hz
2021-06-05 16:05:46.963 223hz
2021-06-05 16:05:46.983 219hz
2021-06-05 16:05:47.014 217hz
2021-06-05 16:05:47.034 216hz
2021-06-05 16:05:47.054 213hz
2021-06-05 16:05:47.083 211hz
2021-06-05 16:05:47.103 209hz
2021-06-05 16:05:47.124 208hz
2021-06-05 16:05:47.154 208hz
2021-06-05 16:05:47.173 209hz
2021-06-05 16:05:47.193 208hz
2021-06-05 16:05:47.223 208hz
2021-06-05 16:05:47.243 208hz
2021-06-05 16:05:47.384 168hz
2021-06-05 16:05:47.423 160hz
2021-06-05 16:05:47.453 155hz
2021-06-05 16:05:47.473 147hz
2021-06-05 16:05:47.493 143hz
2021-06-05 16:05:47.523 141hz
2021-06-05 16:05:47.543 138hz
2021-06-05 16:05:47.563 136hz

Would it Work for Everyone?

- What if someone wanted to lower their voice?
- What if someone wanted to keep their voice inside a range (not just “higher” or “lower” than a point)?
- Color blindness
- Some people are intimidated by CLIs
- What if I needed to share my screen?
- What about other voice characteristics (resonance, range, etc)?
- What about a noisy environment or place with other voices?

Problem #3
Busy Indicator

Working From Home Problem

- I share a house with my wife (that isn’t a problem!)
- Sometimes I’m okay with interruptions
- Other times I’m not okay with interruptions
- My wife doesn’t like to appear on video unexpectedly
- I want this to be automatic

Defining the Solution

- Basically, I need an “on air” type of light
- Must work with Linux
- Must integrate with Google Calendar
- Should turn on when webcam is in use
- Should be controllable via the terminal

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LUXAFOR

How to Drive a USB Device?

- Raku is a great choice if I need computerized duct tape
- Travis Gibson did the hard work already!

  “USB Devices: How to Drive Your Own”

  Conference in the Cloud 2020

  (LibUSB from Raku)
- Yes, there were gotchas still…
  - What USB commands do I need?
  - There was a Python script available that did this!

Defining the Solution

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gcalcli

```
[0] sandbox:work$ gcalcli --nocolor --calendar "Test Calendar" agenda --military --tsv --nodeclined
2020-10-10      17:15   2020-10-10      19:00   Example Meeting
2020-10-10      19:00   2020-10-10      20:00   Example Meeting #2
```

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Webcam NOT in use:

```
[0] sandbox:work$ cat /proc/modules | egrep ^uvcvideo
uvcvideo 98304 0 - Live 0x0000000000000000
```

Webcam IS in use:

```
[0] sandbox:work$ cat /proc/modules | egrep ^uvcvideo
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Iterating on the Design

- What if I want the Luxafor on a different computer than the camera? (Network support!)
- Also, what if I wanted to control the indicator from the other computer?
- Can I remind *me* of meetings?

Basic Design

- “Main” Thread: Listens to a Raku *Channel*
- Other threads send messages to that channel
- Examples of other threads:
  - Clock Ticker (once a minute sends a tick)
  - Fetch updates to Google Calendar
  - Keyboard Reader
  - Camera Monitor
  - Later, Network Thread

Example Thread: Network Listener

```
159     # Remote Network monitor
160     if $port ≠ 0 {
161         start {
162             my $camera = False;
163             my $socket = IO::Socket::Async.bind-udp('::', $port);
164 
165             react {
166                 whenever $socket.Supply -> $v {
167                     if $v ~~ m/ ^ "CAMERA " [ON || OFF] $/ {
168                         my $new-camera = False;
169                         if $v eq "CAMERA ON" {
170                             $new-camera = True;
171                         }
172                         if $new-camera ≠ $camera {
173                             $camera = $new-camera;
174                             $channel.send: 'remote-camera ' ~ ( $camera ?? "on" !! "off" );
175                         }
176                     } elsif $v ~~ m/ ^ "KEY " (.) $/ {
177                         $channel.send($0.Str.fc);
178                     }
179                 }
180             }
181         }
182     }
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Putting Everything Together

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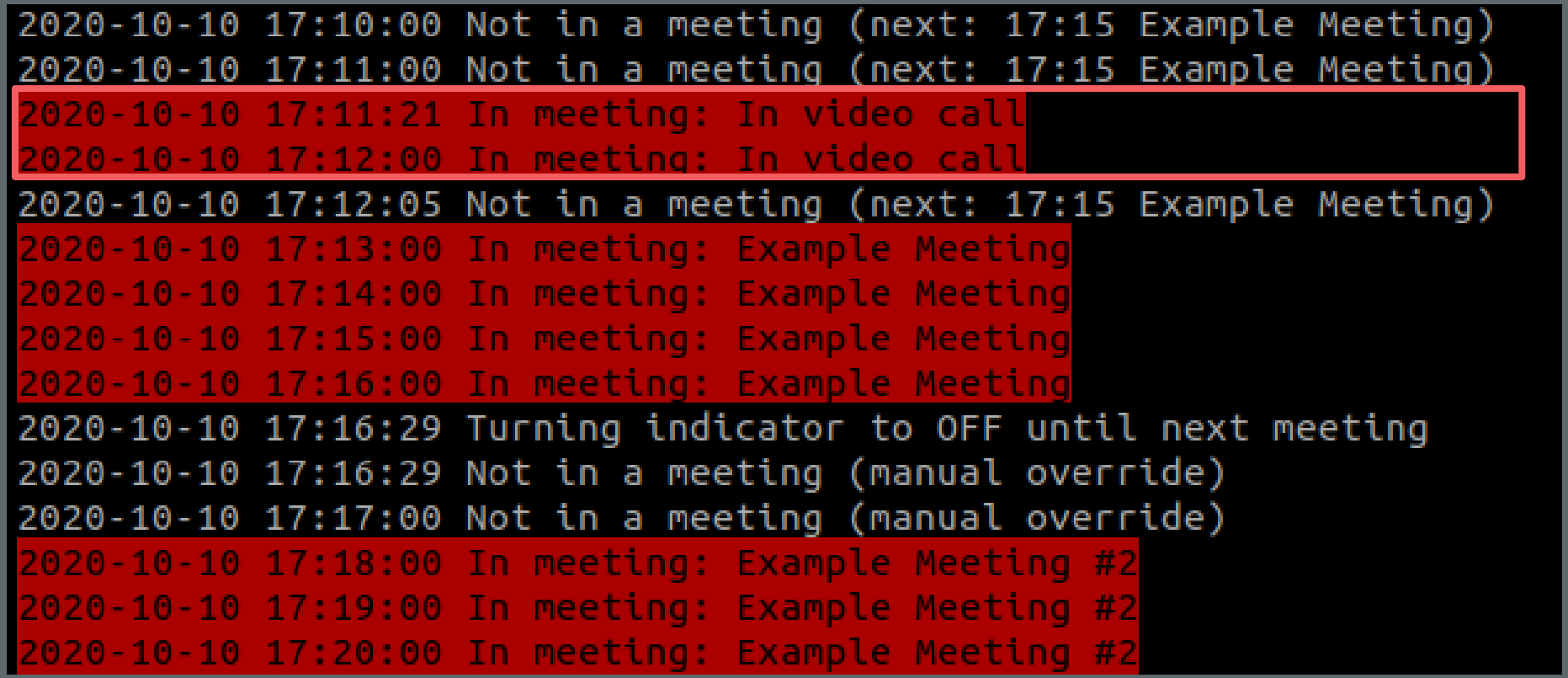
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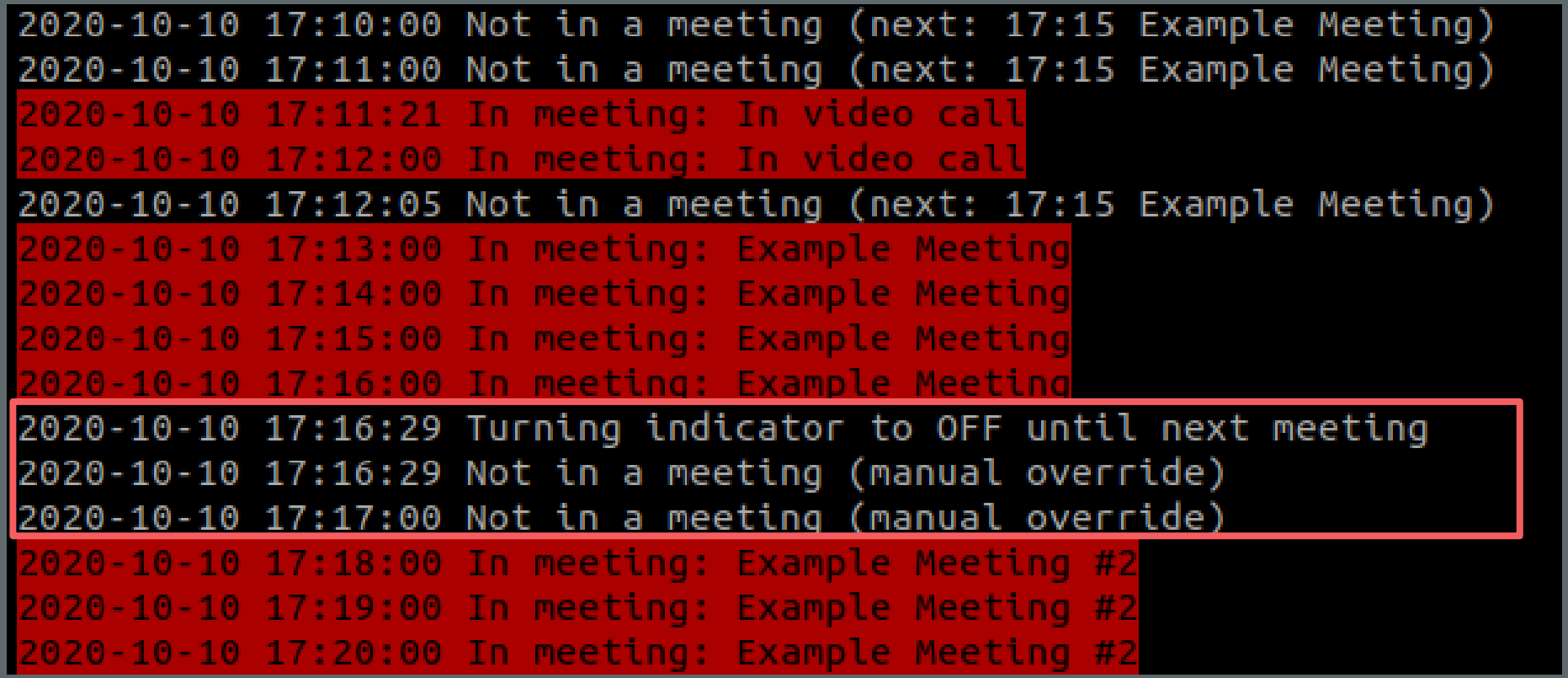
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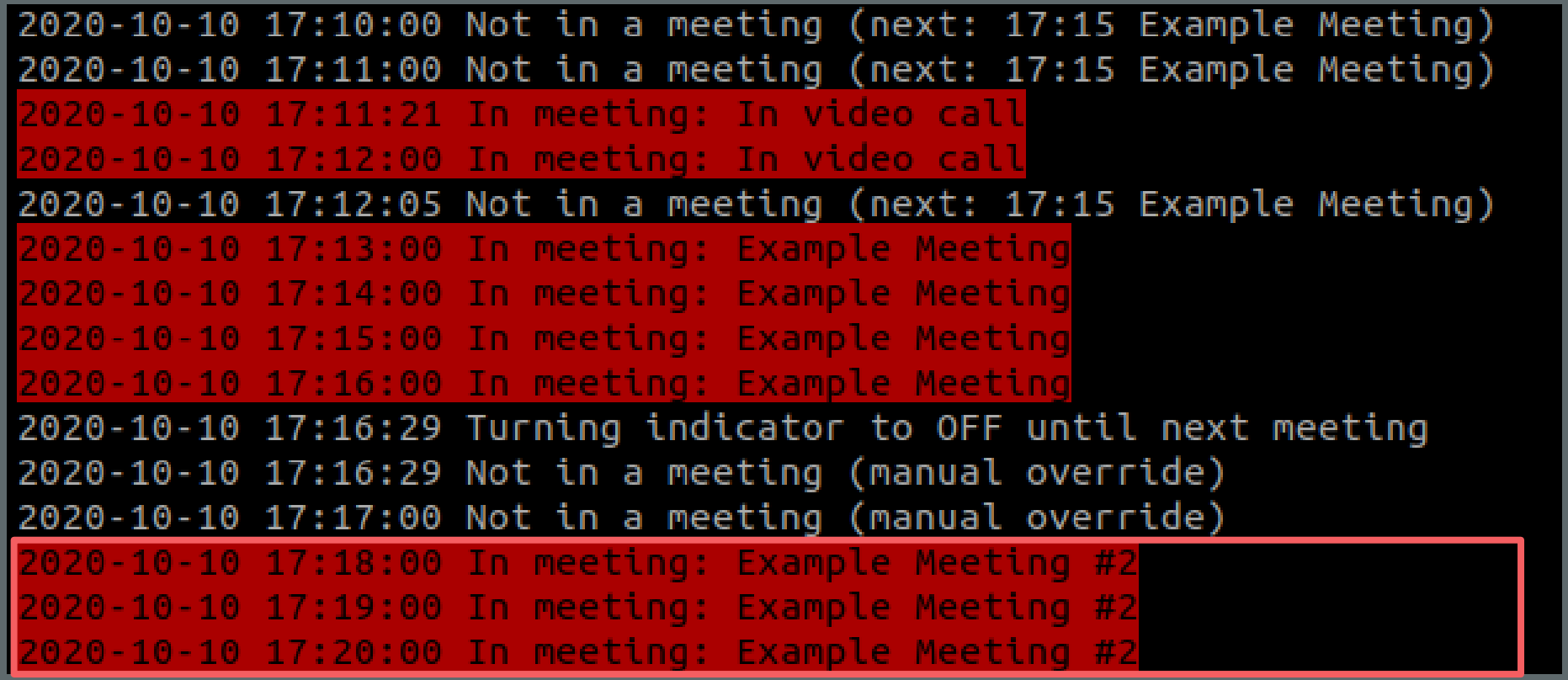
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Lessons Learned

- Linux-only
- Are there better ways to send context?
- I hate wireless!

Recap

- Know your user & the problem space!
- Iterate!
- Be willing to throw bad solutions away!

Questions?


HAPPY
PRIDE!