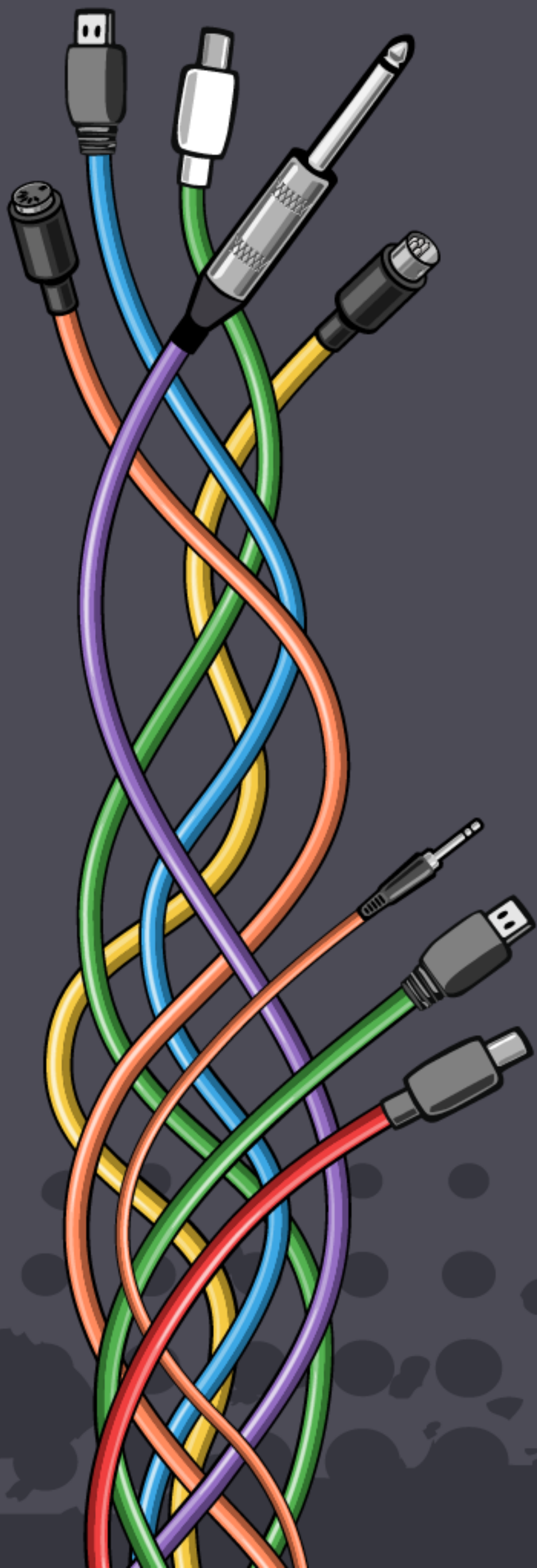




PEEKING INSIDE AUDIO UNITS

*A PRACTICAL REVERSE
ENGINEERING JOURNEY*

JOSIP CAVAR

ADC²⁵
Bristol



foone
@Foone



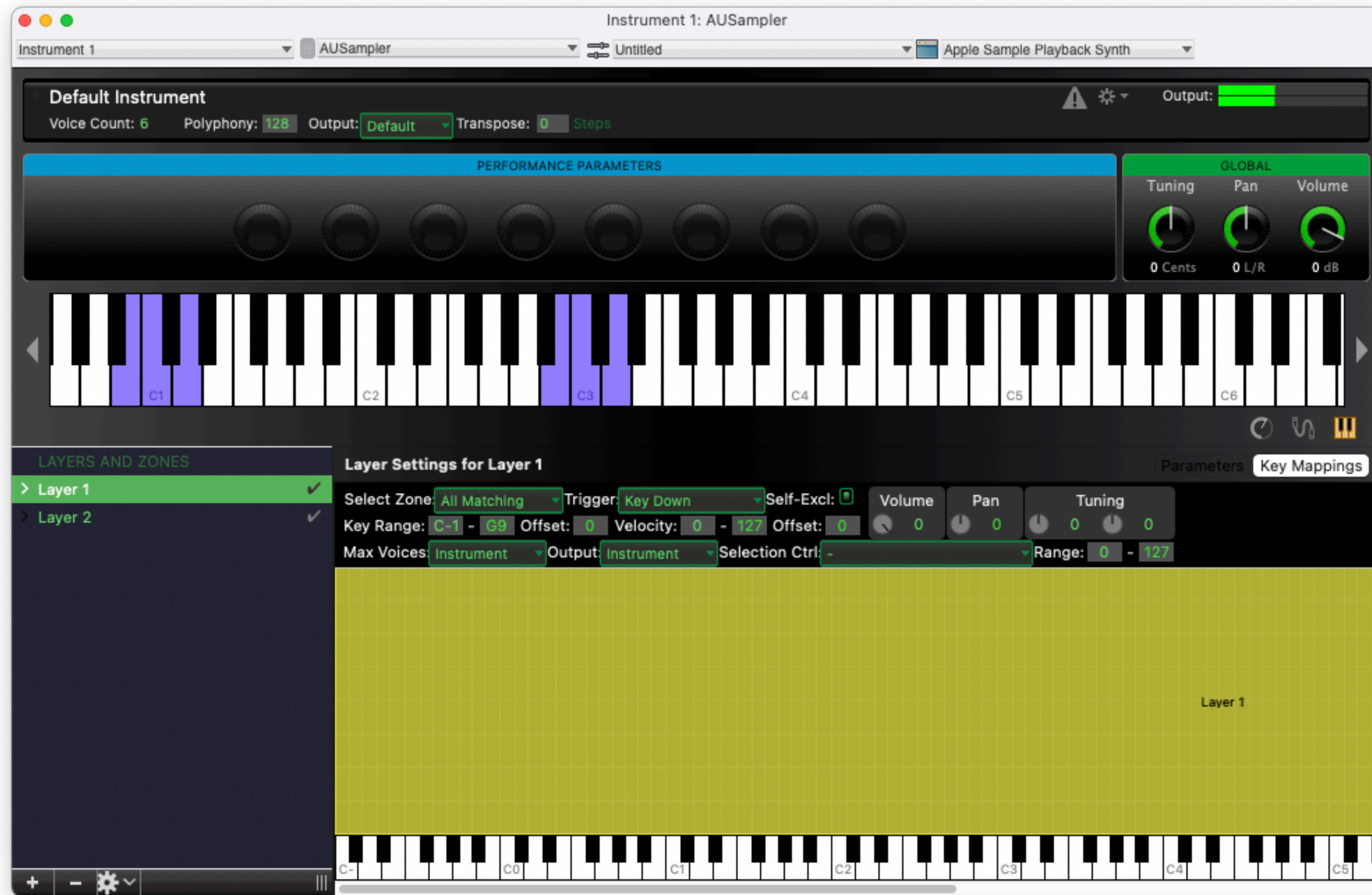
Replying to [@mjg59](#)

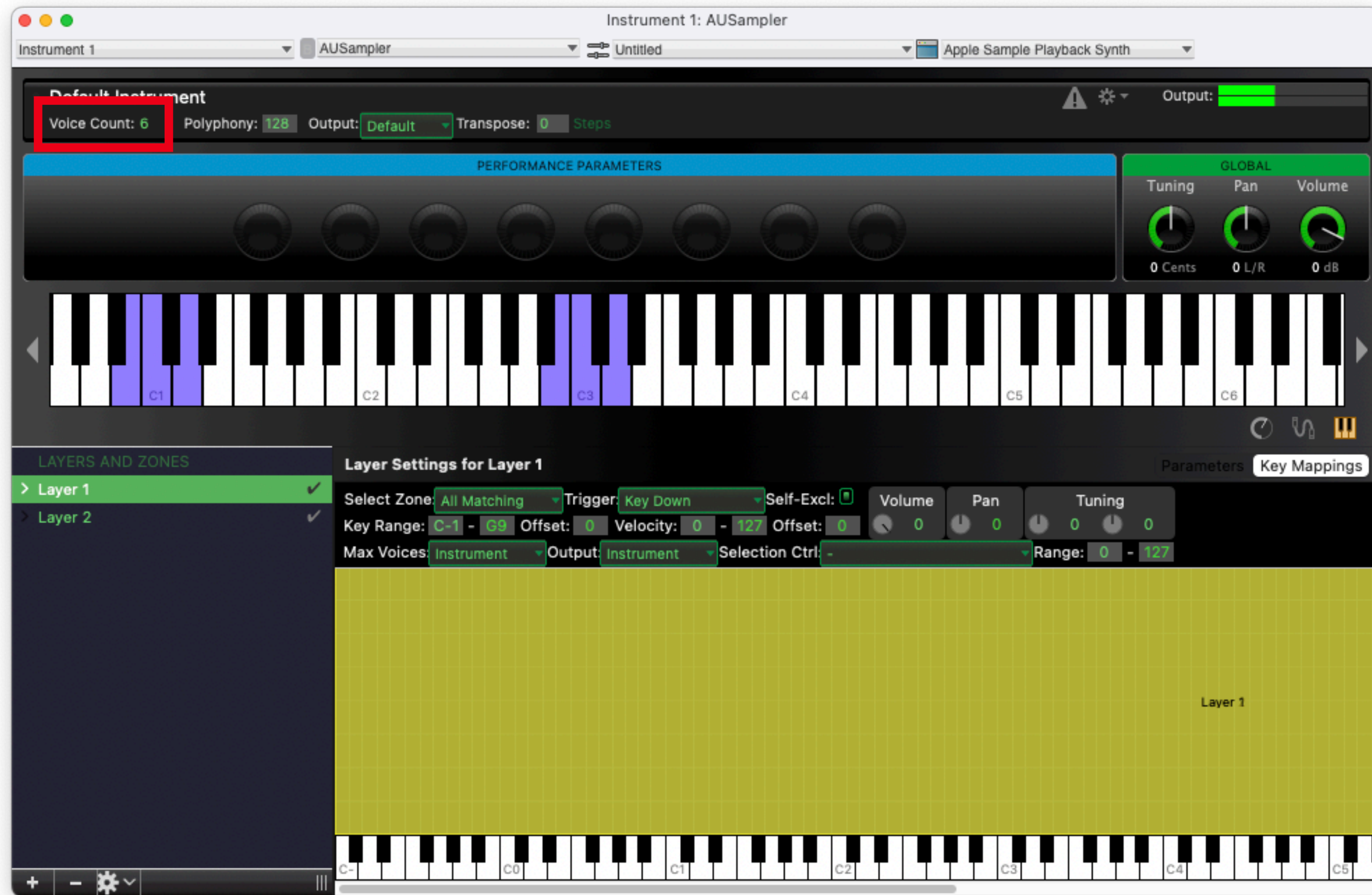
All software is open source if you get good enough at reverse engineering

9:25 PM · Jul 31, 2021 · Twitter for Android

77 Retweets **11** Quote Tweets **447** Likes







Agenda

Agenda

1. Problem

Agenda

1. Problem
2. Debugging process

Agenda

1. Problem
2. Debugging process
3. Results

01

Problem

Digital synth

Digital synth

- AUSampler as a basic building block

Digital synth

- AUSampler as a basic building block
- AudioUnit plugin



Digital synth

- AUSampler as a basic building block
- AudioUnit plugin
- Programmatic interface



```
let sampler = AVAudioUnitSampler()

let preset = Bundle.main.url(
    forResource: "Instrument",
    withExtension: "aupreset"
)

try sampler.loadPreset(at: preset)
```

Digital synth

- AUSampler as a basic building block
- AudioUnit plugin
- Programmatic interface

```
let sampler = AVAudioUnitSampler()

let preset = Bundle.main.url(
    forResource: "Instrument",
    withExtension: "aupreset"
)

try sampler.loadPreset(at: preset)
```




∞ INFINUM

neverstop



∞ INFINUM

neverstop



∞ INFINUM

neverstop



∞ INFINUM

neverstop



∞ INFINUM

neverstop

Investigation process

Investigation process

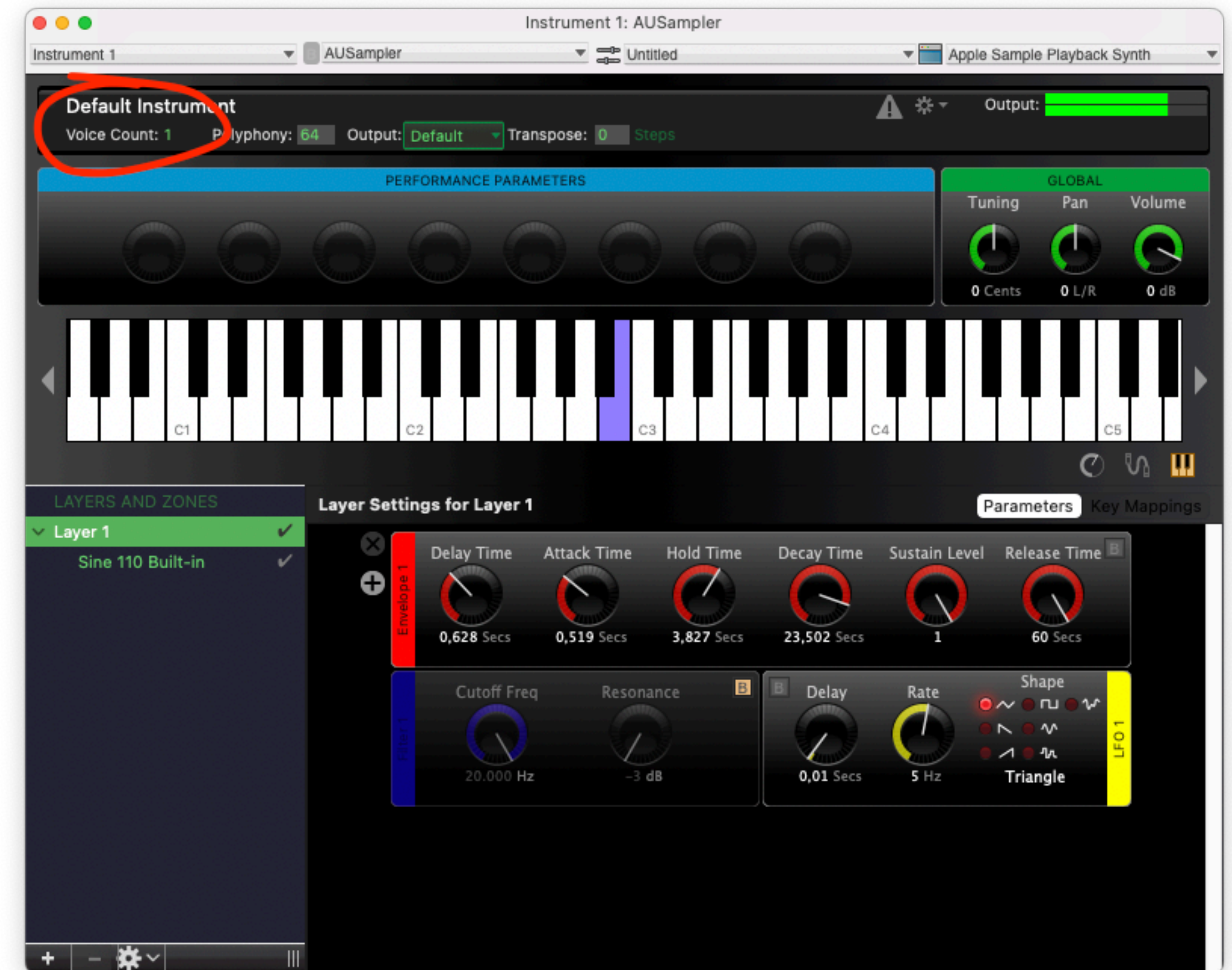
- Debugging in the app was limiting

Investigation process

- Debugging in the app was limiting
- AUSampler plugin

Investigation process

- Debugging in the app was limiting
- AUSampler plugin

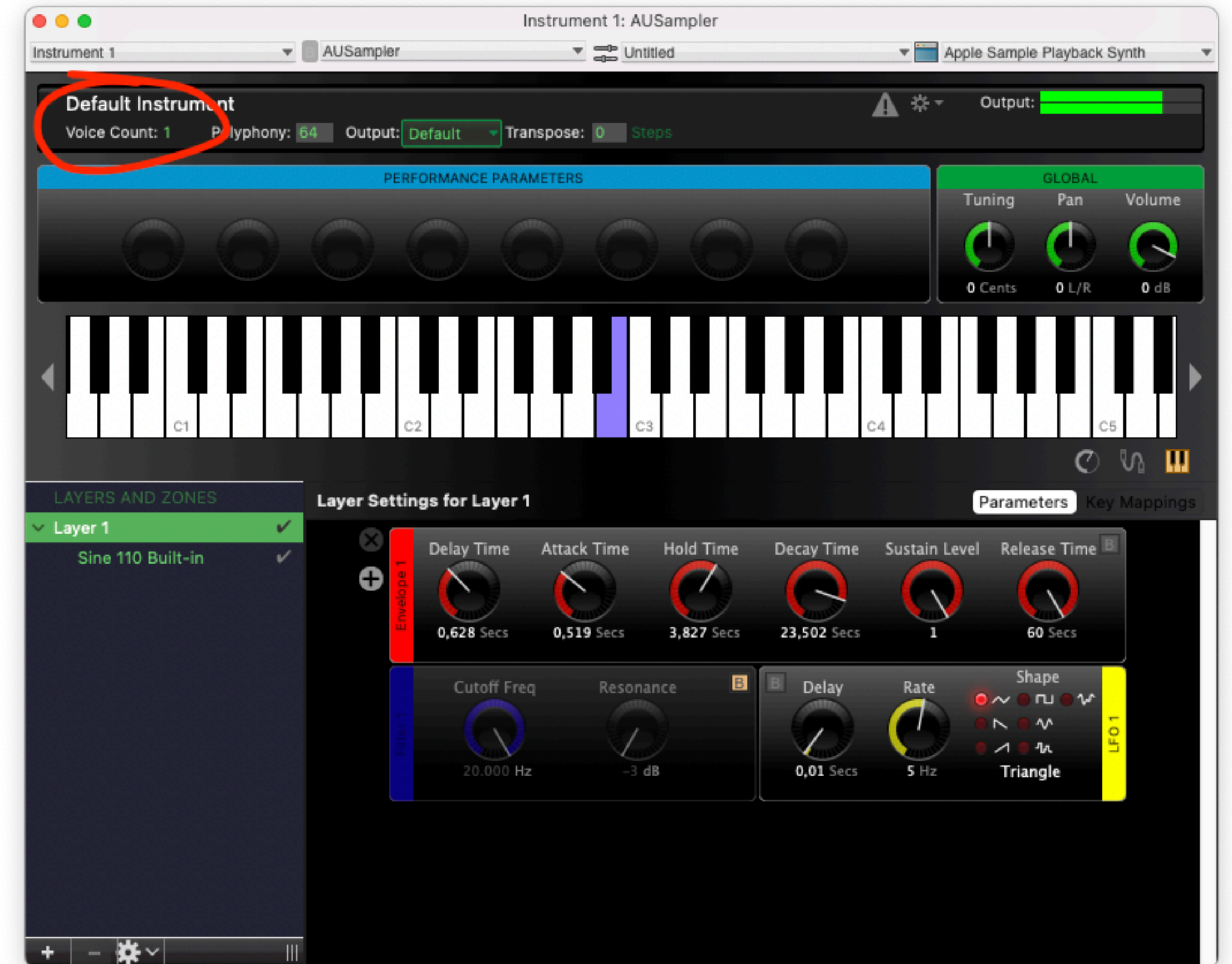


Investigation process

- Debugging in the app was limiting
- AUSampler plugin
- Hosted in AU Lab

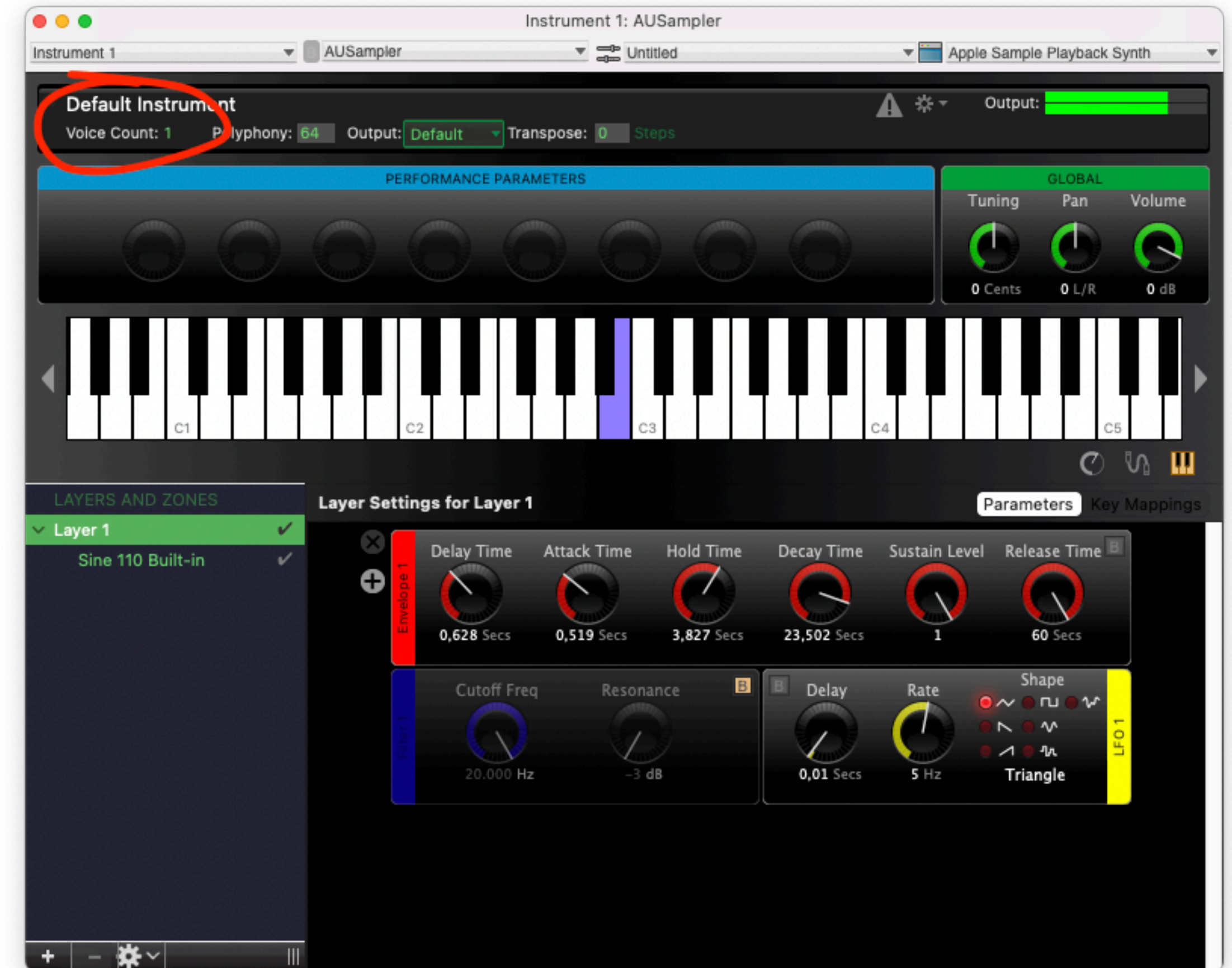


Results



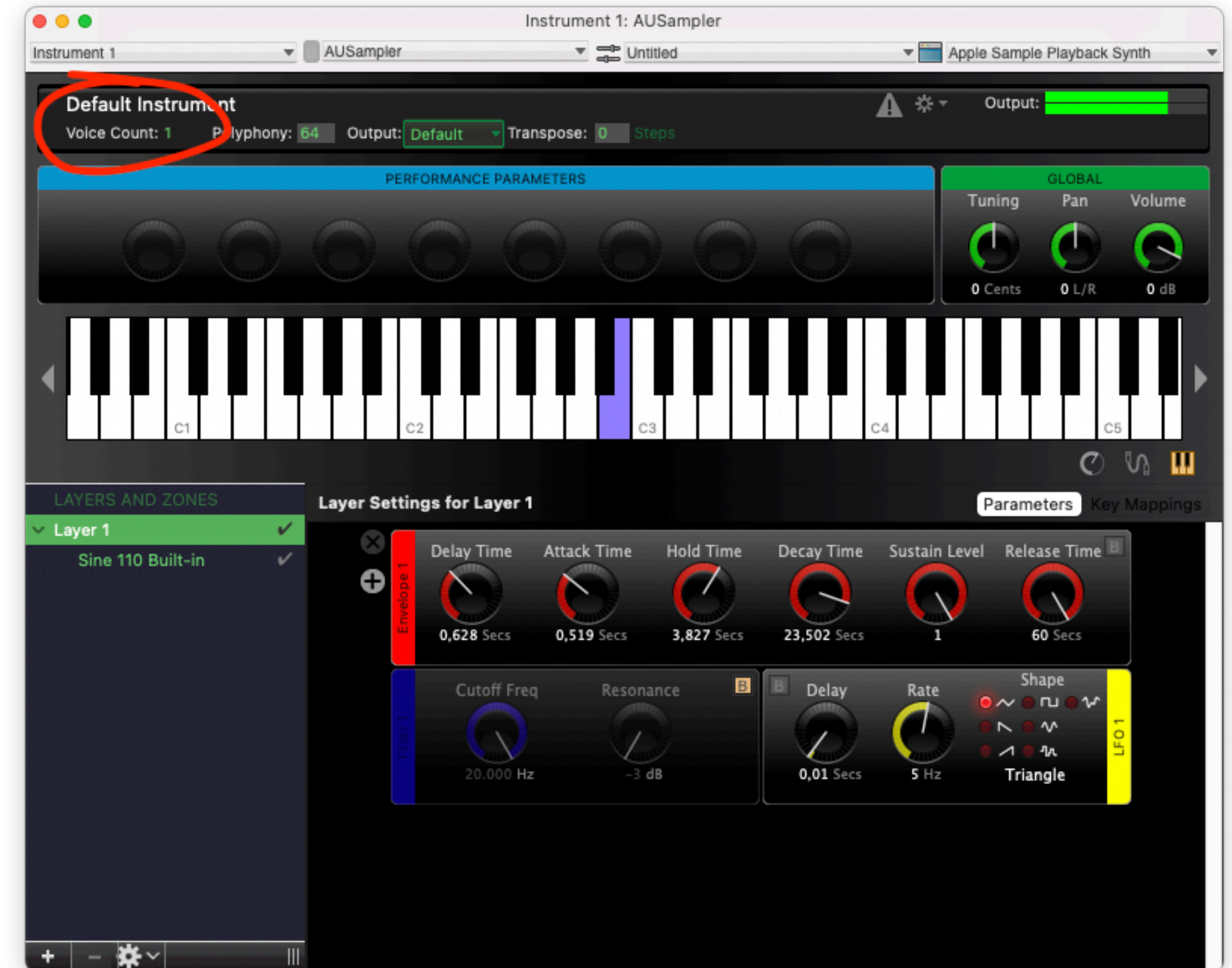
Results

- AUSampler has a limit of 256 audio samples



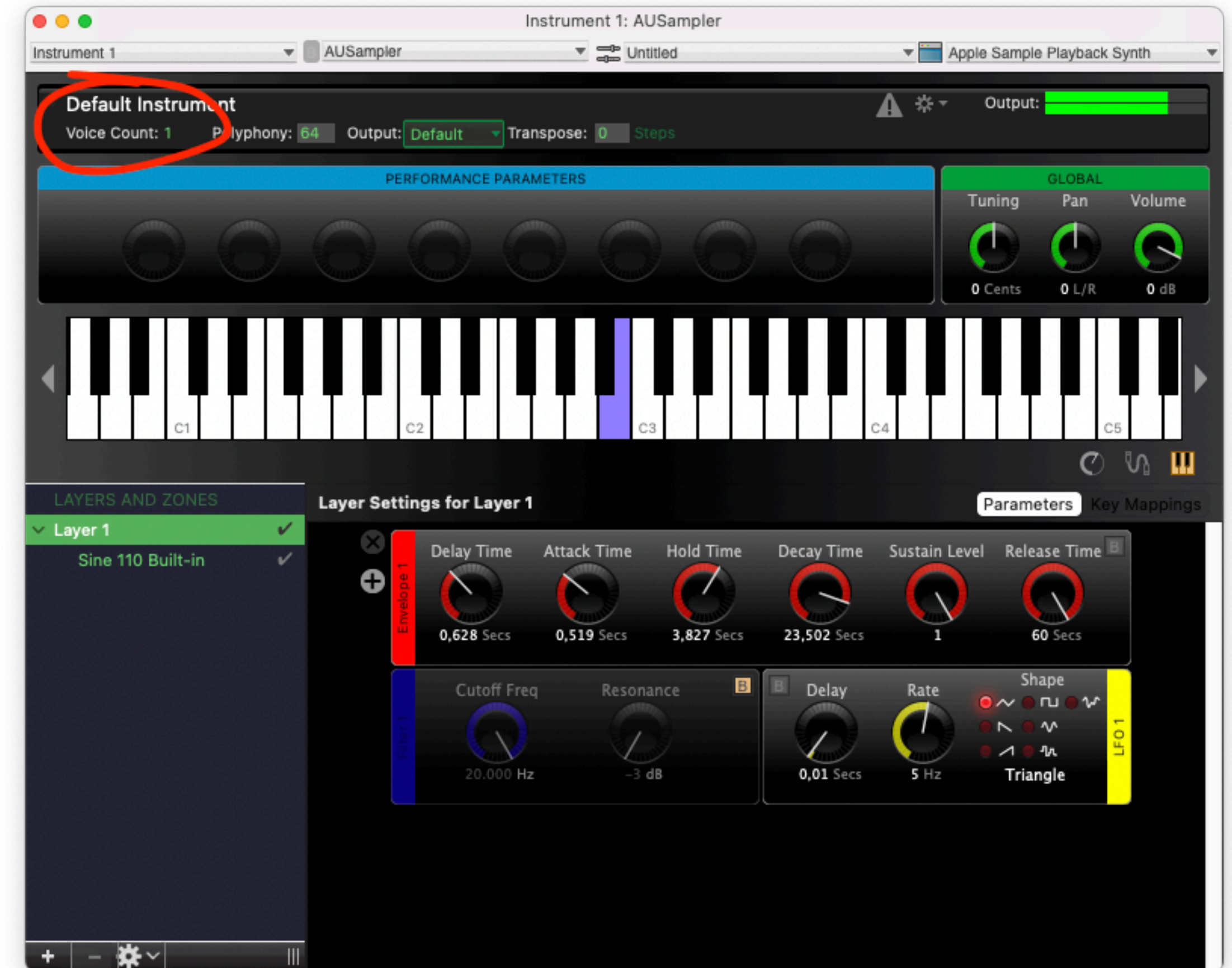
Results

- AUSampler has a limit of 256 audio samples
- We had to work with this limitation



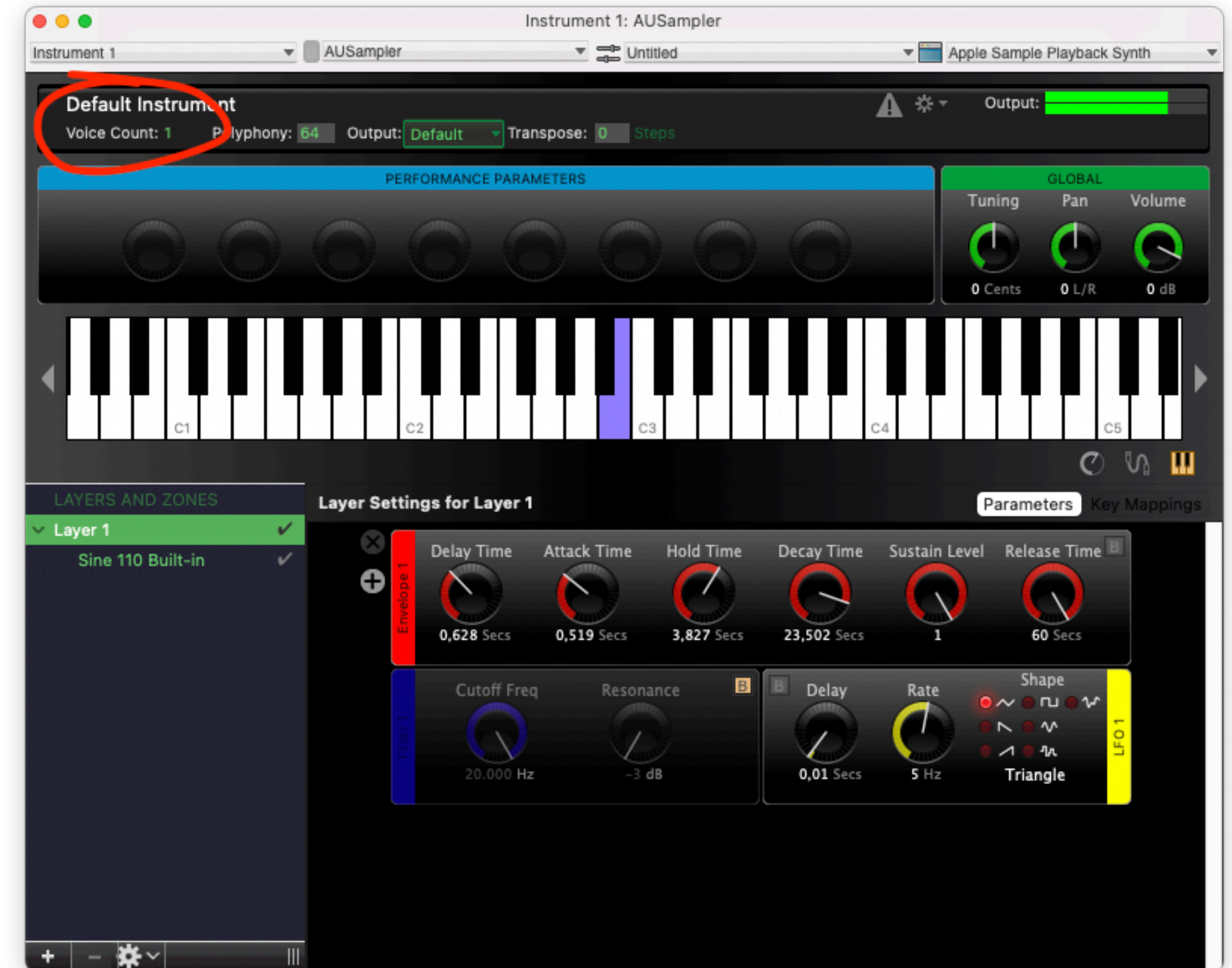
Results

- AUSampler has a limit of 256 audio samples
- We had to work with this limitation
- The app was not showing the same limit



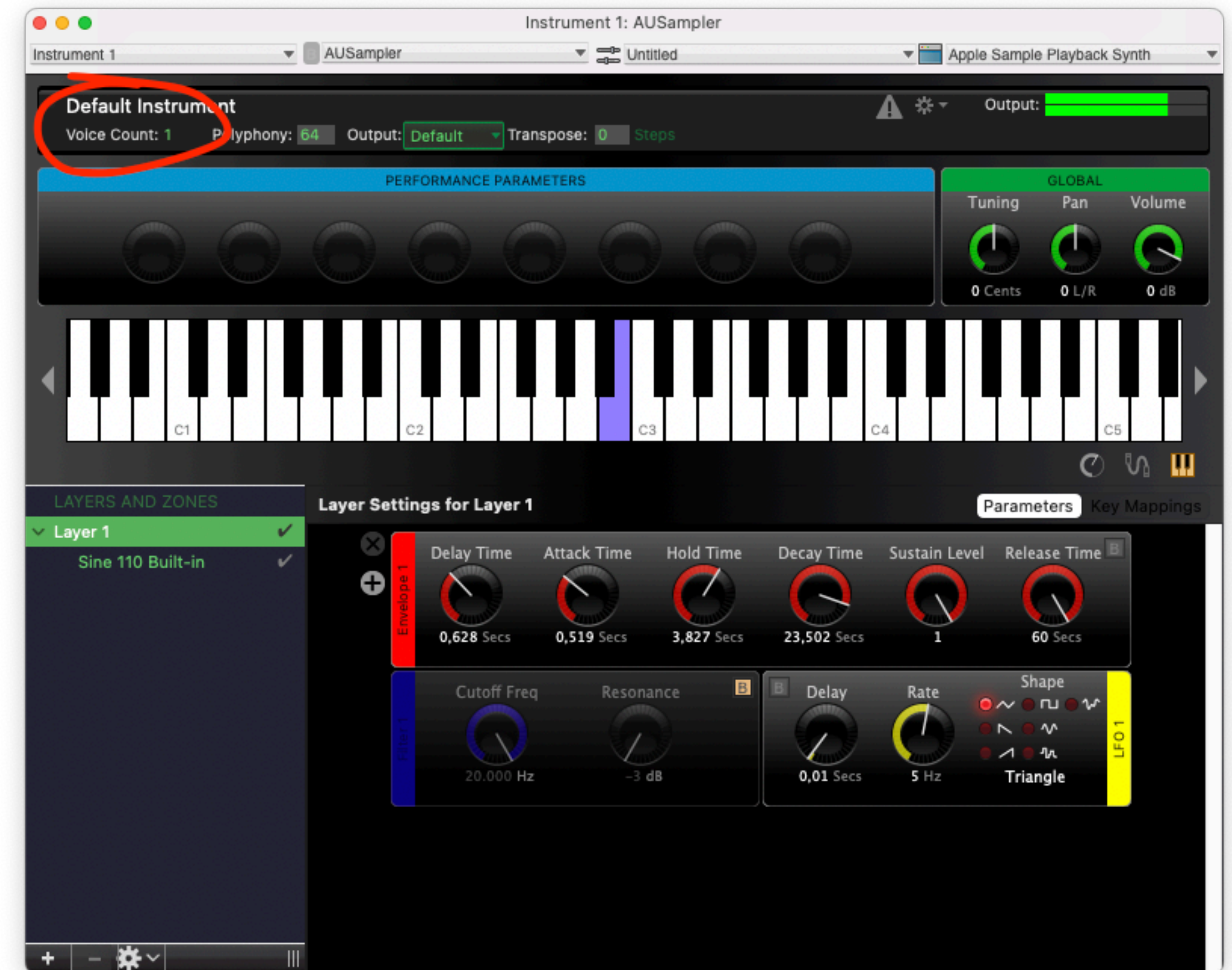
Results

- AUSampler has a limit of 256 audio samples
- We had to work with this limitation
- The app was not showing the same limit
- The app uses multiple AUSampler instances



Results

- AUSampler has a limit of 256 audio samples
- We had to work with this limitation
- The app was not showing the same limit
- The app uses multiple AUSampler instances
- I became interested if we can get a voice count metric to our app



02

Debugging

- Conventional methods didn't work

High level plan

- Conventional methods didn't work

High level plan

- Conventional methods didn't work
- AUSampler is a black box

High level plan

- Conventional methods didn't work
- AUSampler is a black box
- Start from UI

High level plan

- Conventional methods didn't work
- AUSampler is a black box
- Start from UI
- Add a breakpoint to the element that displays it

High level plan

- Conventional methods didn't work
- AUSampler is a black box
- Start from UI
- Add a breakpoint to the element that displays it
- Navigate the stack trace and find something interesting



```
> open -a "AU Lab"  
> lladb --attach-name "AU Lab"
```



```
> open -a "AU Lab"
```

```
> lldb --attach-name "AU Lab"
```

```
error: attach failed: attach failed (Not allowed to attach to process.
```




```
> cp "/Applications/AU Lab.app" ~/Applications  
> codesign -fv -s "Apple Development: Josip Cavar" ~/Applications/AU\ Lab.app
```



```
> cp "/Applications/AU Lab.app" ~/Applications  
> codesign -fv -s "Apple Development: Josip Cavar" ~/Applications/AU\ Lab.app  
> open ~/Applications/AU\ Lab.app  
> lldb --attach-name "AU Lab"
```



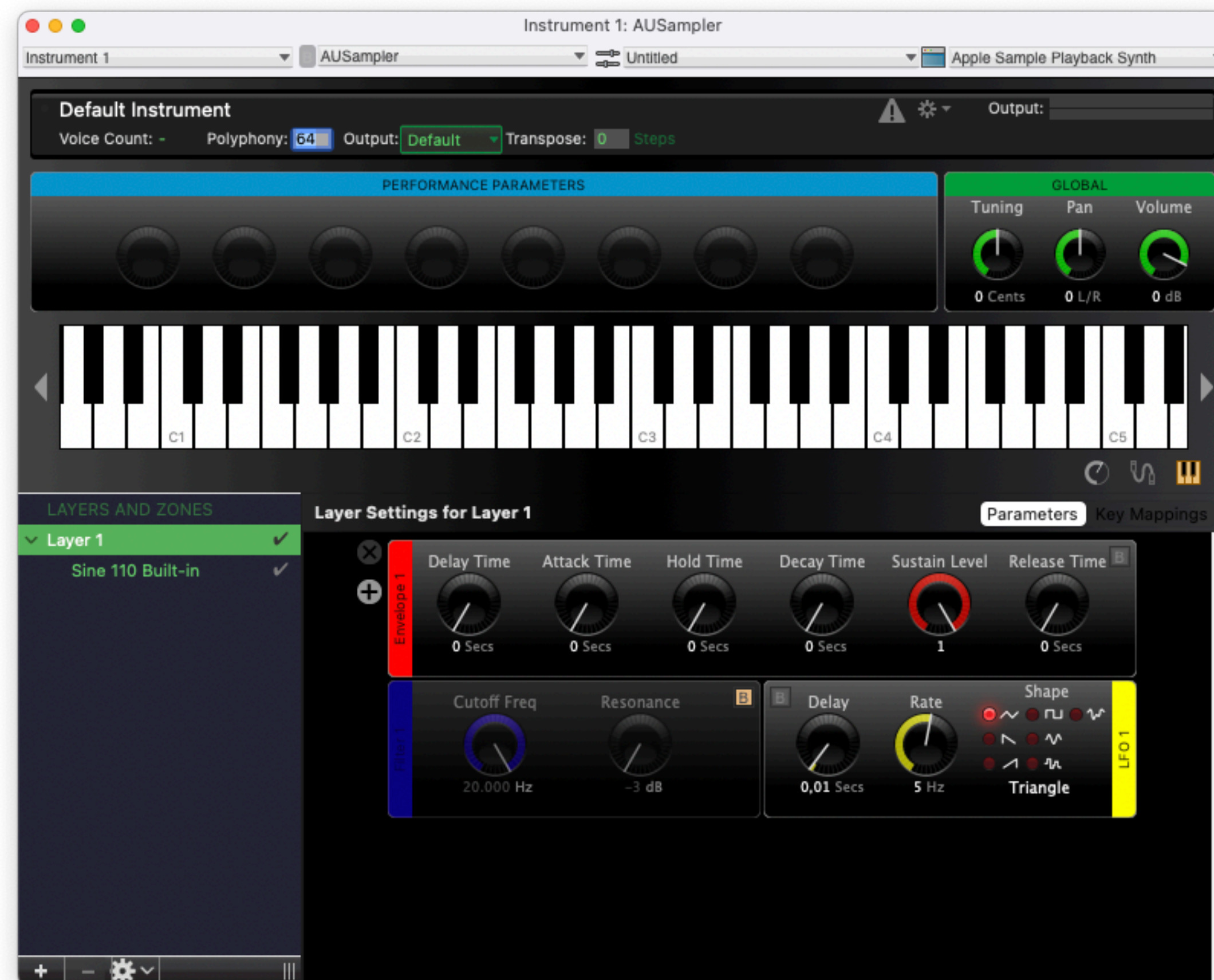
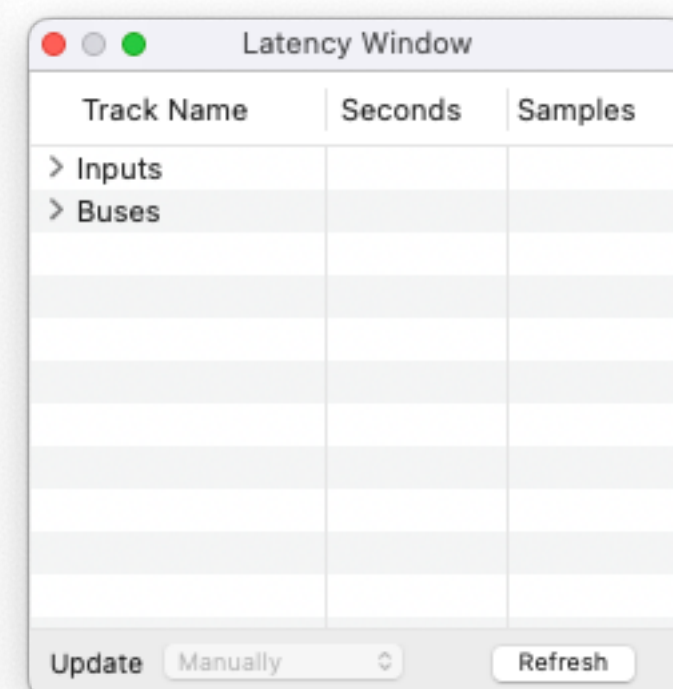
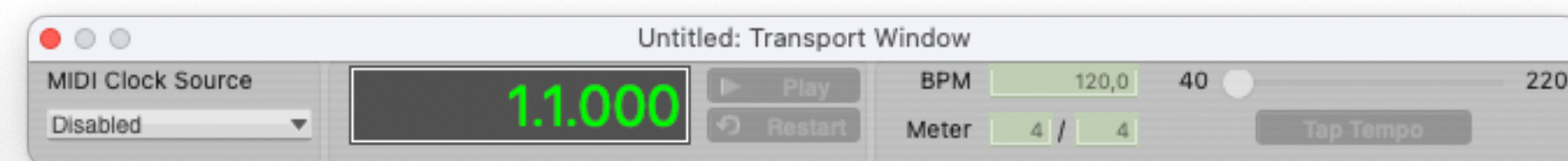
```
> cp "/Applications/AU Lab.app" ~/Applications  
> codesign -fv -s "Apple Development: Josip Cavar" ~/Applications/AU\ Lab.app  
> open ~/Applications/AU\ Lab.app  
> lldb --attach-name "AU Lab"
```

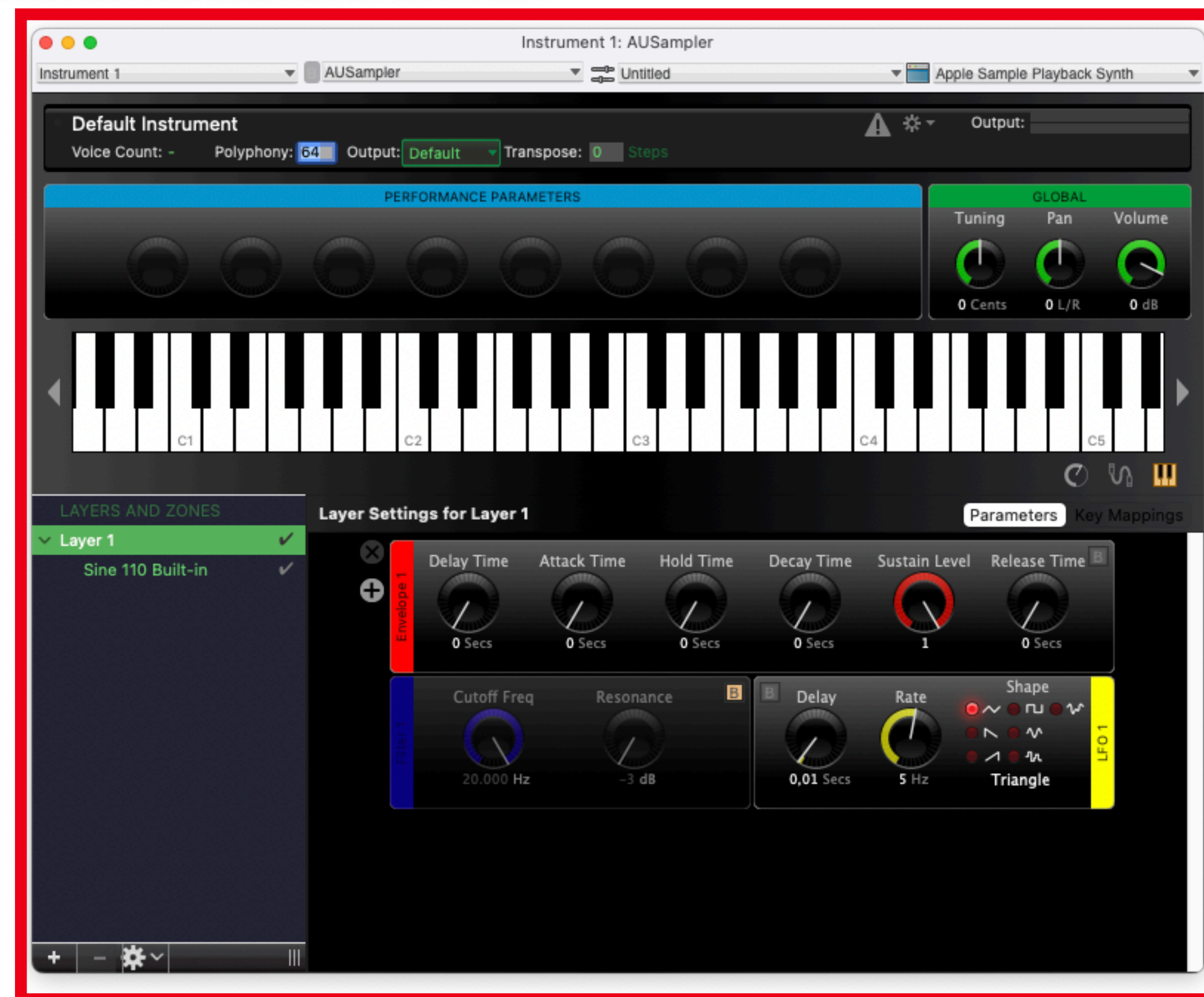
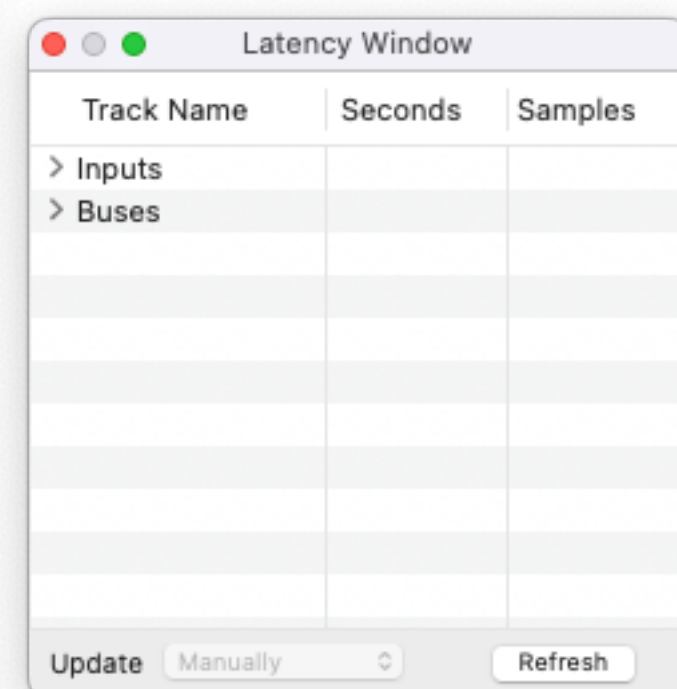
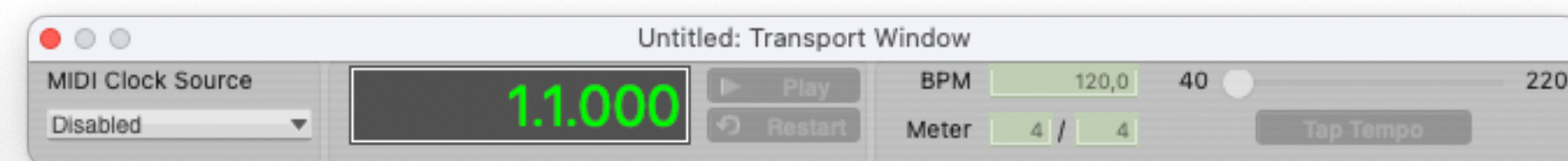
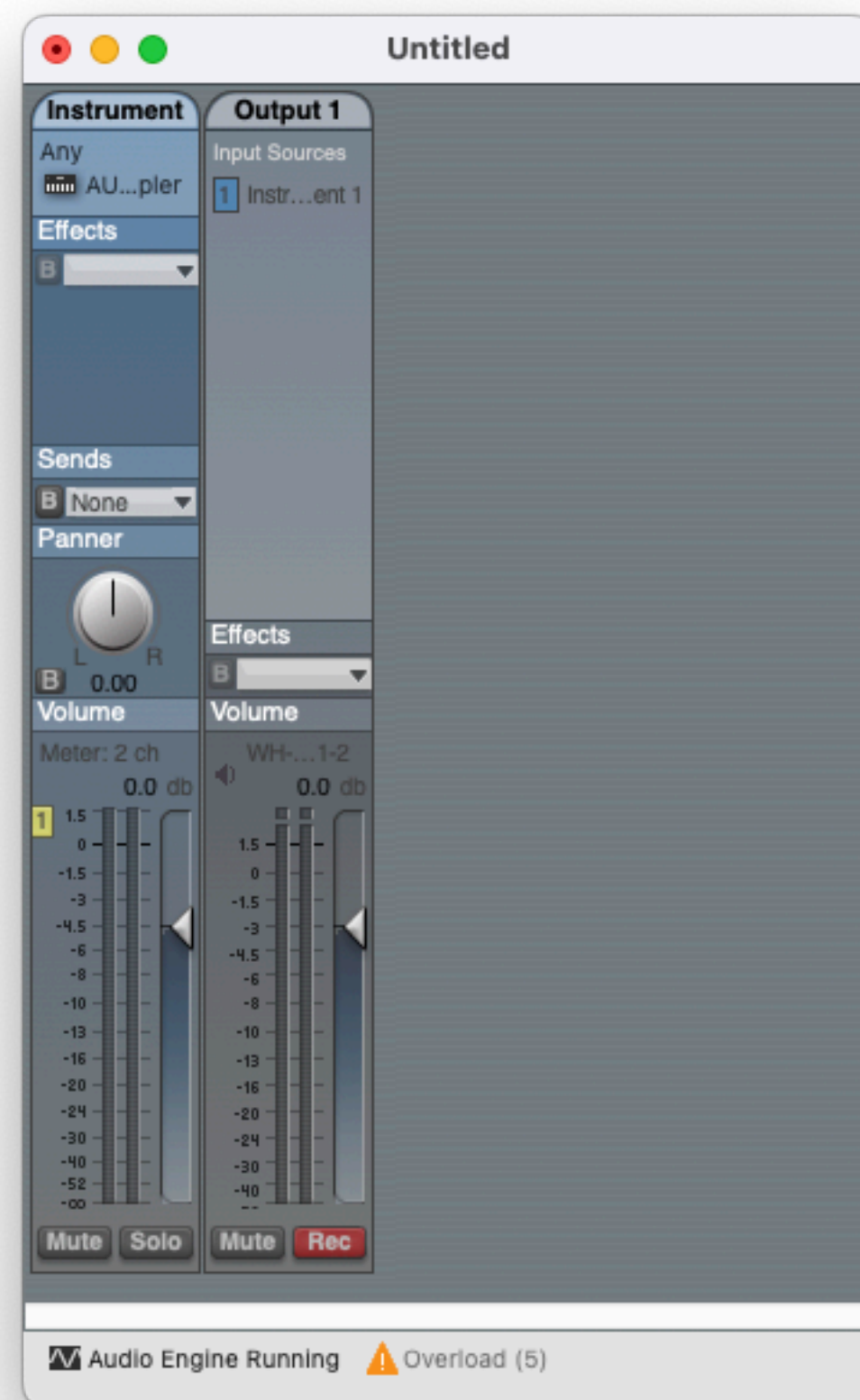
```
(lldb) process attach --name "AU Lab"
```

```
Process 66646 stopped
```

```
Target 0: (AU Lab) stopped.
```

```
Executable binary set to "~/Applications/AU Lab.app/Contents/MacOS/AU Lab".
```





```
(lldb) po
```



```
(lldb) po [UIApplication sharedApplication]
```



```
(lldb) po [[NSApplication sharedApplication] keyWindow]
```




```
(lldb) po [[NSApplication sharedApplication] keyWindow]  
<InspectorPanel: 0x15c0aa4d0>
```



```
(lldb) po [[NSApplication sharedApplication] keyWindow]  
<InspectorPanel: 0x15c0aa4d0>
```

```
(lldb) po [[[NSApplication sharedApplication] keyWindow] title]  
Instrument 1: AUSampler
```




```
(lldb) po [[NSApplication sharedApplication] keyWindow]  
<InspectorPanel: 0x15c0aa4d0>
```

```
(lldb) po [[[NSApplication sharedApplication] keyWindow] title]  
Instrument 1: AUSampler
```

```
(lldb) e -- (NSWindow *)[NSApplication sharedApplication] keyWindow]
```



```
(lldb) po [[NSApplication sharedApplication] keyWindow]  
<InspectorPanel: 0x15c0aa4d0>
```

```
(lldb) po [[[NSApplication sharedApplication] keyWindow] title]  
Instrument 1: AUSampler
```

```
(lldb) e -- (NSWindow *)[NSApplication sharedApplication] keyWindow  
(InspectorPanel *) $8 = 0x000000015c0aa4d0
```

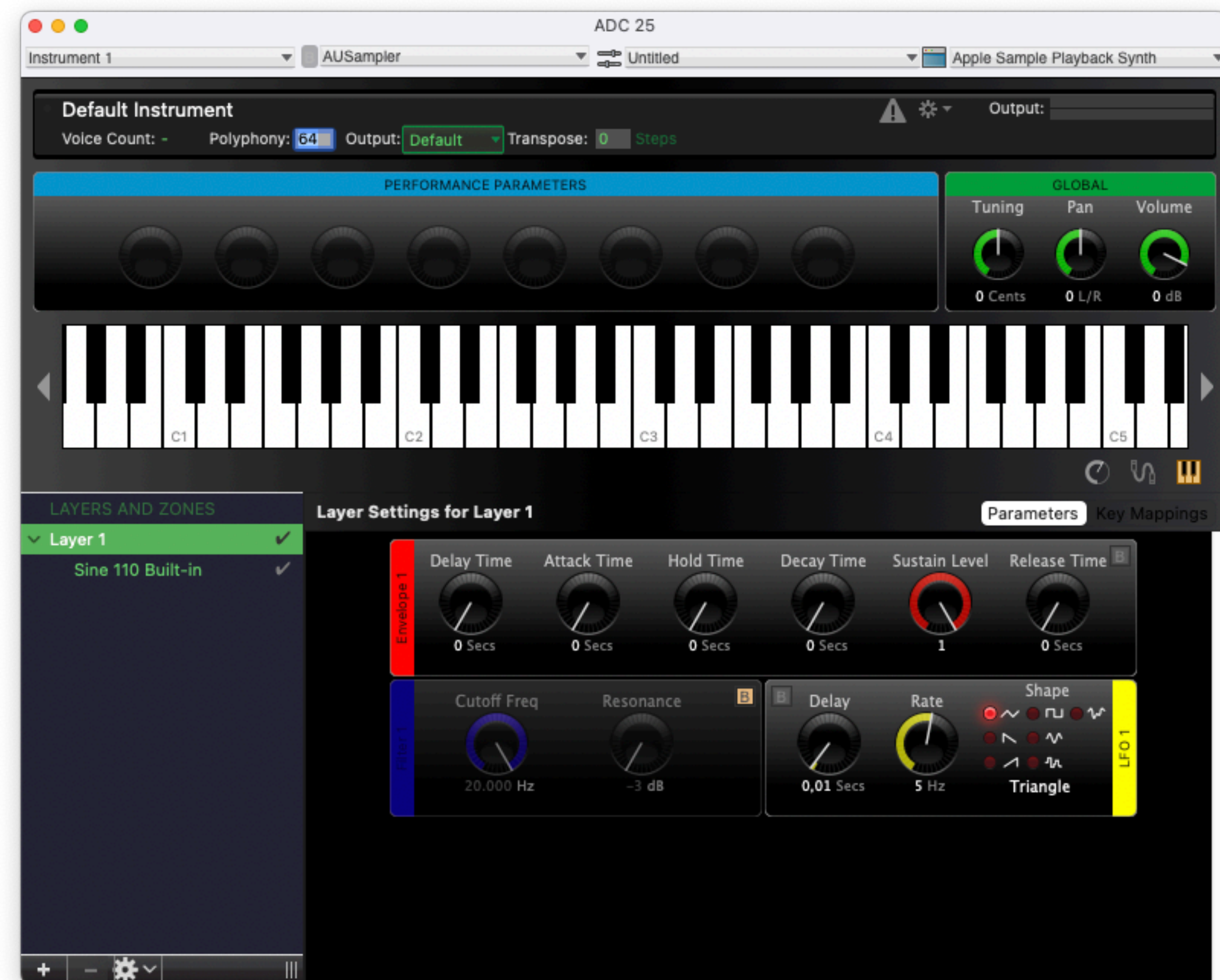


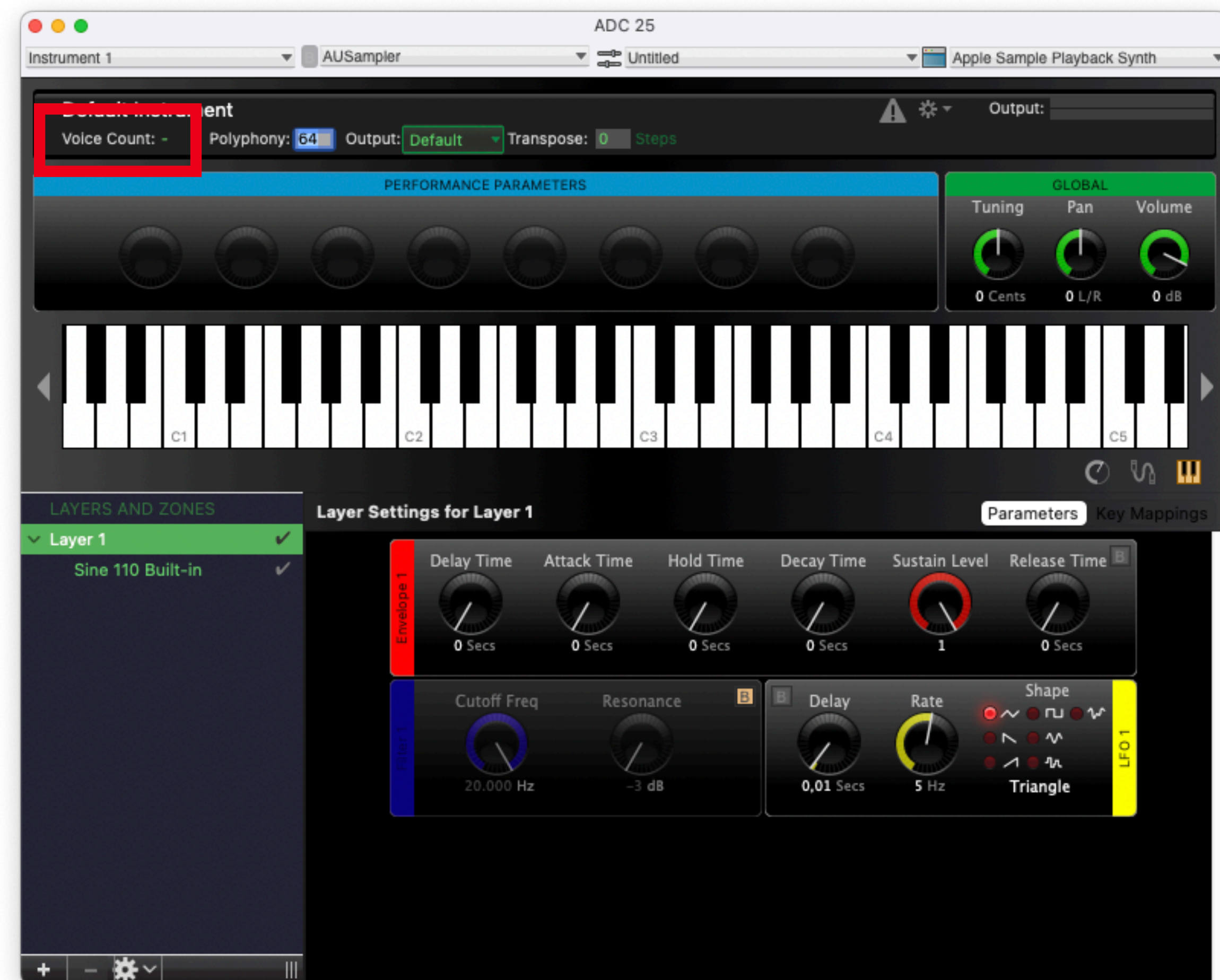
```
(lldb) po [[NSApplication sharedApplication] keyWindow]  
<InspectorPanel: 0x15c0aa4d0>
```

```
(lldb) po [[[NSApplication sharedApplication] keyWindow] title]  
Instrument 1: AUSampler
```

```
(lldb) e -- (NSWindow *)[NSApplication sharedApplication] keyWindow  
(InspectorPanel *) $8 = 0x000000015c0aa4d0
```

```
(lldb) po $8  
<InspectorPanel: 0x15c0aa4d0>
```



 master [Apple-Runtime-Headers](#) / [macOS](#) / [Frameworks](#) / [AppKit.framework](#) / [NSView.h](#)

Code

Blame

1628 lines (1620 loc) · 81.8 KB

```
878     - (BOOL)_isContainedInMenu;
879     @property(readonly) NSMenuItem *enclosingMenuItem;
880     - (id)_enclosingMenuItem;
881     @property(retain) NSPressureConfiguration *pressureConfiguration;
882     - (void)_debug_showKeyboardUILoop;
883     - (void)_drawMetricsOverlays;
884     - (void)_updateLayerMetricsOverlays;
885     - (void)_showAllDrawingDrawRect:(struct CGRect)arg1;
886     - (id)loggingDescription;
887     - (id)_subtreeDescriptionForLogging:(BOOL)arg1;
888     - (id)_subtreeDescription;
889     - (id)_subtreeDescriptionWithDepth:(long long)arg1 forLogging:(BOOL)arg2;
890     - (id)_briefDescriptionForLogging:(BOOL)arg1;
891     - (id)_briefDescription;
892     - (id)_layerTreeDescription;
893     - (void)_setOpenGLContext:(id)arg1;
894     - (id)_openGLContext;
895     - (id)_openGLContextForCurrentLayerBackingState;
896     - (void)_setSurfaceBackedOpenGLContext:(id)arg1;
897     - (id)_surfaceBackedOpenGLContext;
898     - (void)_setLayerBackedOpenGLContext:(id)arg1;
899     - (id)_layerBackedOpenGLContext;
900     @property BOOL wantsExtendedDynamicRangeOpenGLSurface;
901     @property(setter=_setProxyLayer:) CAProxyLayer *_proxyLayer;
902     @property(setter=_setWindowBackdrop:) NSCGSWindowBackdrop *_windowBackdrop;
903     - (void)_removeVibrantBlendingMimicBackdropOrProxyLayerIfNeeded;
904     - (void)_updateVibrantBlendingMimicBackdropOrProxyLayerWithBlendMode:(int)arg1;
```

🔍 master Apple-Runtime-Headers / macOS / Frameworks / AppKit.framework / NSView.h

Code Blame 1628 lines (1620 loc) · 81.8 KB

```
878 - (BOOL)_isContainedInMenu;
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887 - (id) subtreeDescriptionForLogging:(BOOL)arg1;
888 - (id)_subtreeDescription;
889 - (id)_subtreeDescriptionWithDepth:(long long)arg1 forLogging:(BOOL)arg2;
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```



```
(lldb) po [[$8 contentView] _subtreeDescription]
```




```
(lldb) po [[$8 contentView] _subtreeDescription]
NSView 0x15c097440 f=(0,0,793,596)
  NSScrollView 0x15c997800 f=(0,0,793,596)
    NSClipView 0x15c0d8080 f=(0,0,793,596)
      AUSynthCustomView 0x112278500 f=(0,0,793,596)
        CASynthHeaderView 0x1122995a0 f=(8,542,776,46)
          NSTextField 0x15c1ed890 "Default Instrument" f=(17,25,117.5,16)
            NSView 0x1122cdf80 f=(551,19,58,26)
              NSButton 0x15c1ec760 f=(0,4,26,18)
                NSButtonImageView 0x15c44b410 f=(4,0,18,18)
              NSPopUpButton 0x15c1eb500 f=(25,5,33,18)
            NSView 0x1122bebd0 f=(0,0,776,26)
              NSTextField 0x15c1ead30 "-" f=(81.5,6.5,29,13)
              NSTextField 0x15c1ea8e0 "Polyphony:" f=(112.5,6.5,57.5,13)
```



```
(lldb) po [[$8 contentView] _subtreeDescription]
NSView 0x15c097440 f=(0,0,793,596)
  NSScrollView 0x15c997800 f=(0,0,793,596)
    NSClipView 0x15c0d8080 f=(0,0,793,596)
      AUSynthCustomView 0x112278500 f=(0,0,793,596)
        CASynthHeaderView 0x1122995a0 f=(8,542,776,46)
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            NSView 0x1122cdf80 f=(551,19,58,26)
              NSButton 0x15c1ec760 f=(0,4,26,18)
                NSButtonImageView 0x15c44b410 f=(4,0,18,18)
                NSPopUpButton 0x15c1eb500 f=(25,5,33,18)
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              NSTextField 0x15c1ea8e0 "Polyphony:" f=(112.5,6.5,57.5,13)
```



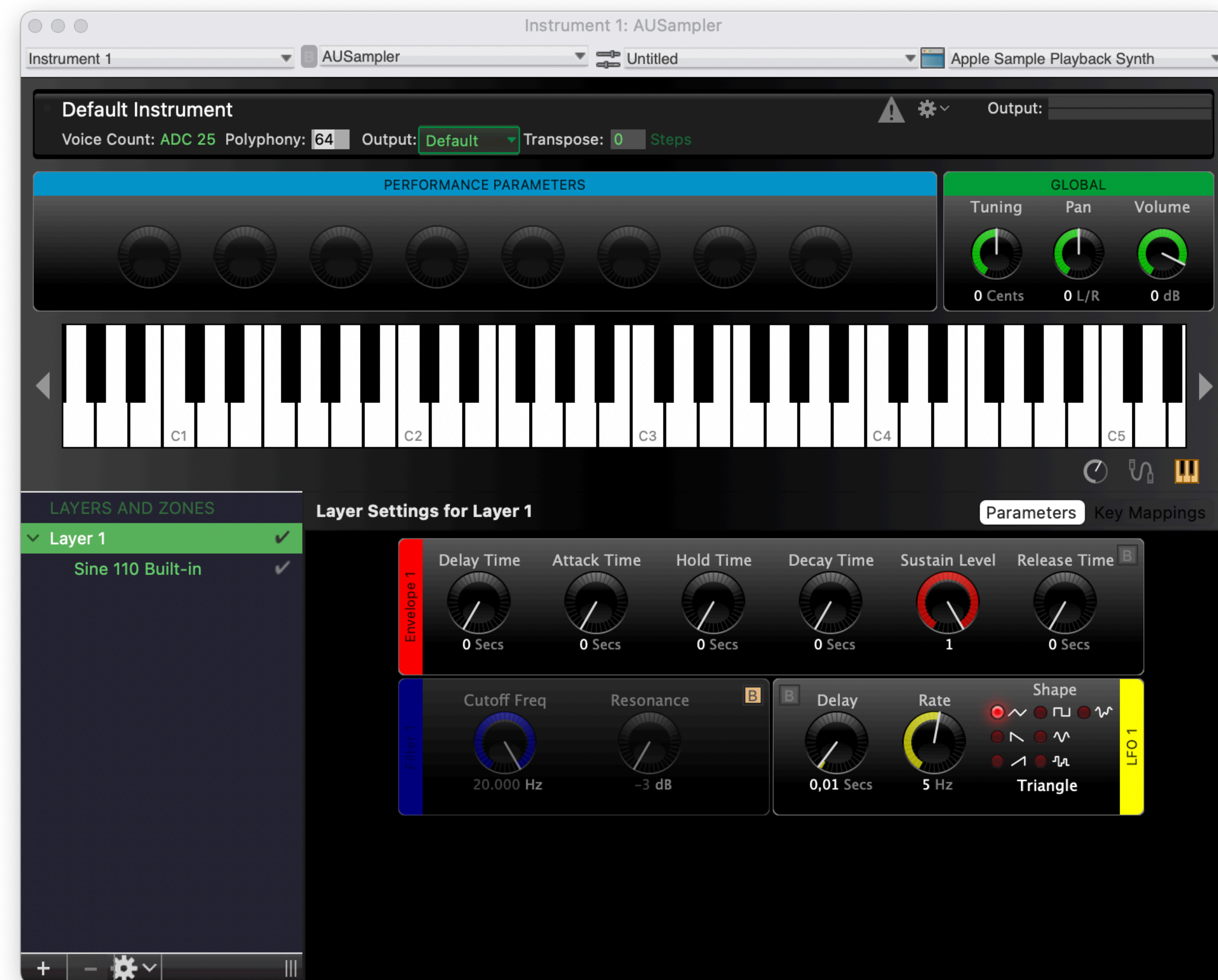

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  NSScrollView 0x15c997800 f=(0,0,793,596)
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              NSTextField 0x15c1ead30 "-" f=(81.5,6.5,29,13)
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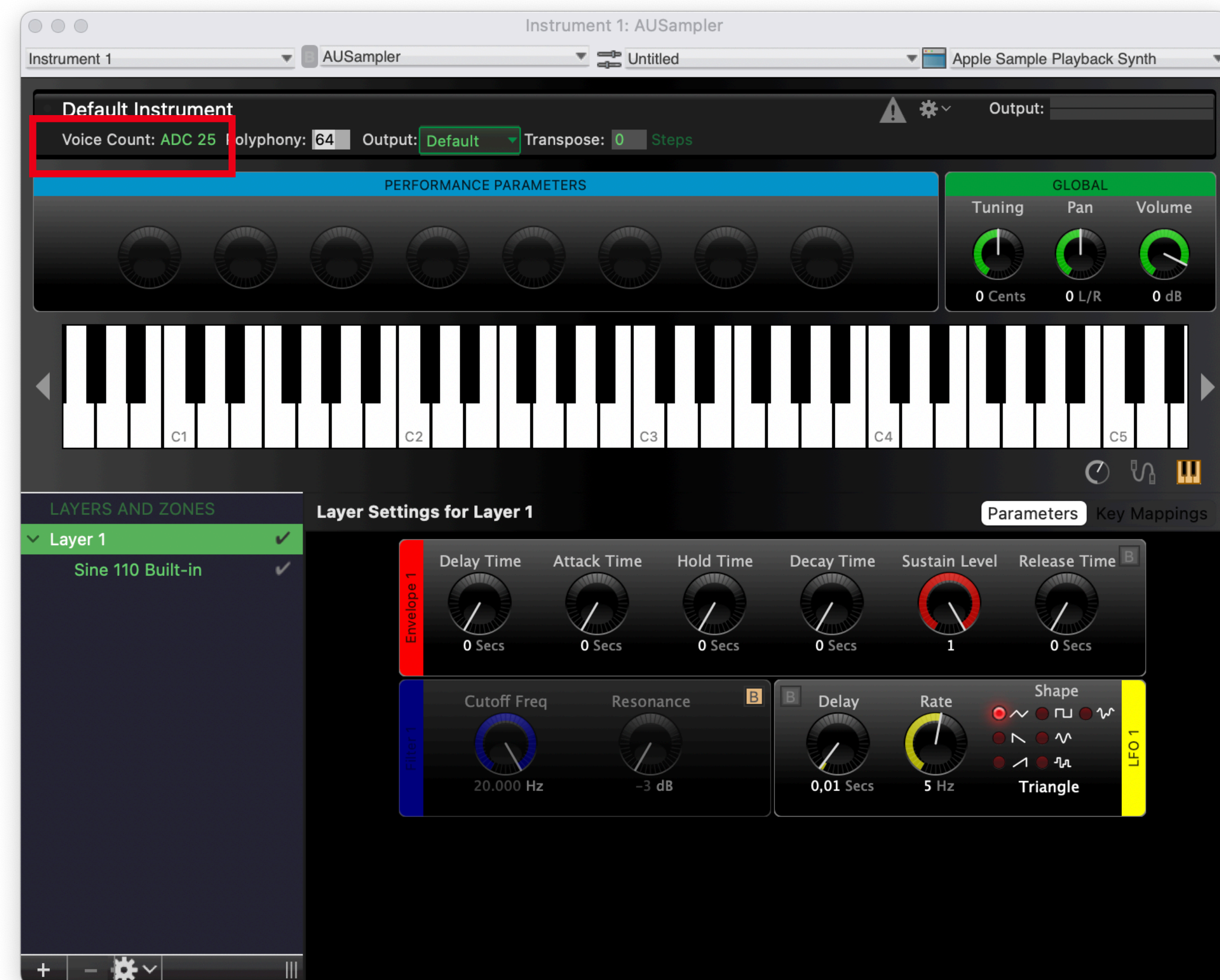
(lldb) e -- [(NSTextField *)0x15c1ead30 setStringValue:@"ADC 25"]
```

```
(lldb) po [[$8 contentView] _subtreeDescription]
NSView 0x15c097440 f=(0,0,793,596)
  NSScrollView 0x15c997800 f=(0,0,793,596)
    NSClipView 0x15c0d8080 f=(0,0,793,596)
      AUSynthCustomView 0x112278500 f=(0,0,793,596)
        CASynthHeaderView 0x1122995a0 f=(8,542,776,46)
          NSTextField 0x15c1ed890 "Default Instrument" f=(17,25,117.5,16)
            NSView 0x1122cdf80 f=(551,19,58,26)
              NSButton 0x15c1ec760 f=(0,4,26,18)
                NSButtonImageView 0x15c44b410 f=(4,0,18,18)
              NSPopUpButton 0x15c1eb500 f=(25,5,33,18)
            NSView 0x1122bebd0 f=(0,0,776,26)
              NSTextField 0x15c1ead30 "-" f=(81.5,6.5,29,13)
              NSTextField 0x15c1ea8e0 "Polyphony:" f=(112.5,6.5,57.5,13)

(lldb) e -- [(NSTextField *)0x15c1ead30 setStringValue:@"ADC 25"]

(lldb) c
Process 54980 resuming
```







```
(lldb) breakpoint set -F "-[NSTextField setStringValue:]"  
Breakpoint 3: where = AppKit`-[NSTextField setStringValue:]`
```




```
(lldb) breakpoint set -F "-[NSTextField setStringValue:]"  
Breakpoint 3: where = AppKit`-[NSTextField setStringValue:]`
```

```
(lldb) c  
Process 54980 resuming
```

```
(lldb) breakpoint set -F "-[NSTextField setStringValue:]"
Breakpoint 3: where = AppKit`-[NSTextField setStringValue:]`

(lldb) c
Process 54980 resuming
Process 54980 stopped
* thread #1, queue = 'com.apple.main-thread', stop reason = breakpoint 3.1
  frame #0: 0x000000019cac38e8 AppKit`-[NSTextField setStringValue:]`
-> 0x19cac38e8 <+0>:  pacibsp
    0x19cac38ec <+4>:  sub     sp, sp, #0x30
    0x19cac38f0 <+8>:  stp     x20, x19, [sp, #0x10]
    0x19cac38f4 <+12>: stp     x29, x30, [sp, #0x20]
    0x19cac38f8 <+16>: add     x29, sp, #0x20
    0x19cac38fc <+20>: mov     x19, x0
    0x19cac3900 <+24>: adrp    x8, 406078
    0x19cac3904 <+28>: ldr     x8, [x8, #0xe70]
Target 0: (AU Lab) stopped.

(lldb)
```



```
(lldb) bt
```




(lldb) bt

```
* thread #1, queue = 'com.apple.main-thread', stop reason = breakpoint 3.1
* frame #0: AppKit`-[NSTextField setStringValue:]
  frame #1: CoreAudioAUUI`___lldb_unnamed_symbol11659 + 112
  frame #2: Foundation`___NSFireTimer + 104
  frame #3: CoreFoundation`___CFRUNLOOP_IS_CALLING__CALLBACK_FUNCTION__ + 32
  frame #4: CoreFoundation`___CFRunLoopDoTimer + 980
  frame #5: CoreFoundation`___CFRunLoopDoTimers + 332
  frame #6: CoreFoundation`___CFRunLoopRun + 1848
  frame #7: CoreFoundation`CFRunLoopRunSpecific + 572
  frame #8: HIToolbox`RunCurrentEventLoopInMode + 324
  frame #9: HIToolbox`ReceiveNextEventCommon + 676
  frame #10: HIToolbox`_BlockUntilNextEventMatchingListInModeWithFilter + 76
  frame #11: AppKit`_DPSNextEvent + 684
  frame #12: AppKit`-[NSApplication next:untilDate:inMode:dequeue:] + 688
  frame #13: AppKit`-[NSApplication run] + 480
  frame #14: AppKit`NSApplicationMain + 880
  frame #15: dyld`start + 6076
```


(lldb) bt

* thread #1, queue = 'com.apple.main-thread', stop reason = breakpoint 3.1

* frame #0: AppKit`-[NSTextField setStringValue:]

frame #1: CoreAudioAUUI`___lldb_unnamed_symbol11659 + 112

frame #2: Foundation`___NSFireTimer + 104

frame #3: CoreFoundation`___CFRunLoop_IS_CALLING__CALLBACK_FUNCTION__ + 32

frame #4: CoreFoundation`___CFRunLoopDoTimer + 980

frame #5: CoreFoundation`___CFRunLoopDoTimers + 332

frame #6: CoreFoundation`___CFRunLoopRun + 1848

frame #7: CoreFoundation`CFRunLoopRunSpecific + 572

frame #8: HIToolbox`RunCurrentEventLoopInMode + 324

frame #9: HIToolbox`ReceiveNextEventCommon + 676

frame #10: HIToolbox`_BlockUntilNextEventMatchingListInModeWithFilter + 76

frame #11: AppKit`_DPSNextEvent + 684

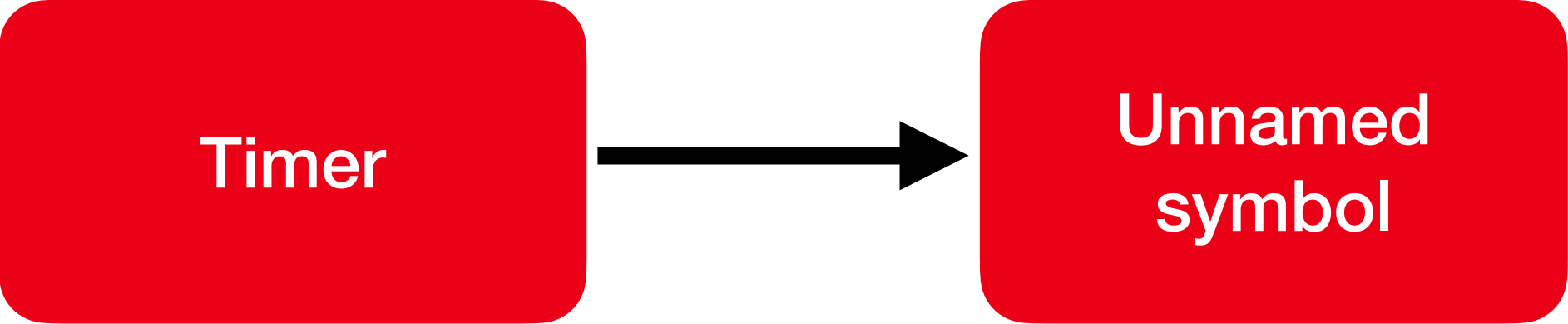
frame #12: AppKit`-[NSApplication next:untilDate:inMode:dequeue:] + 688

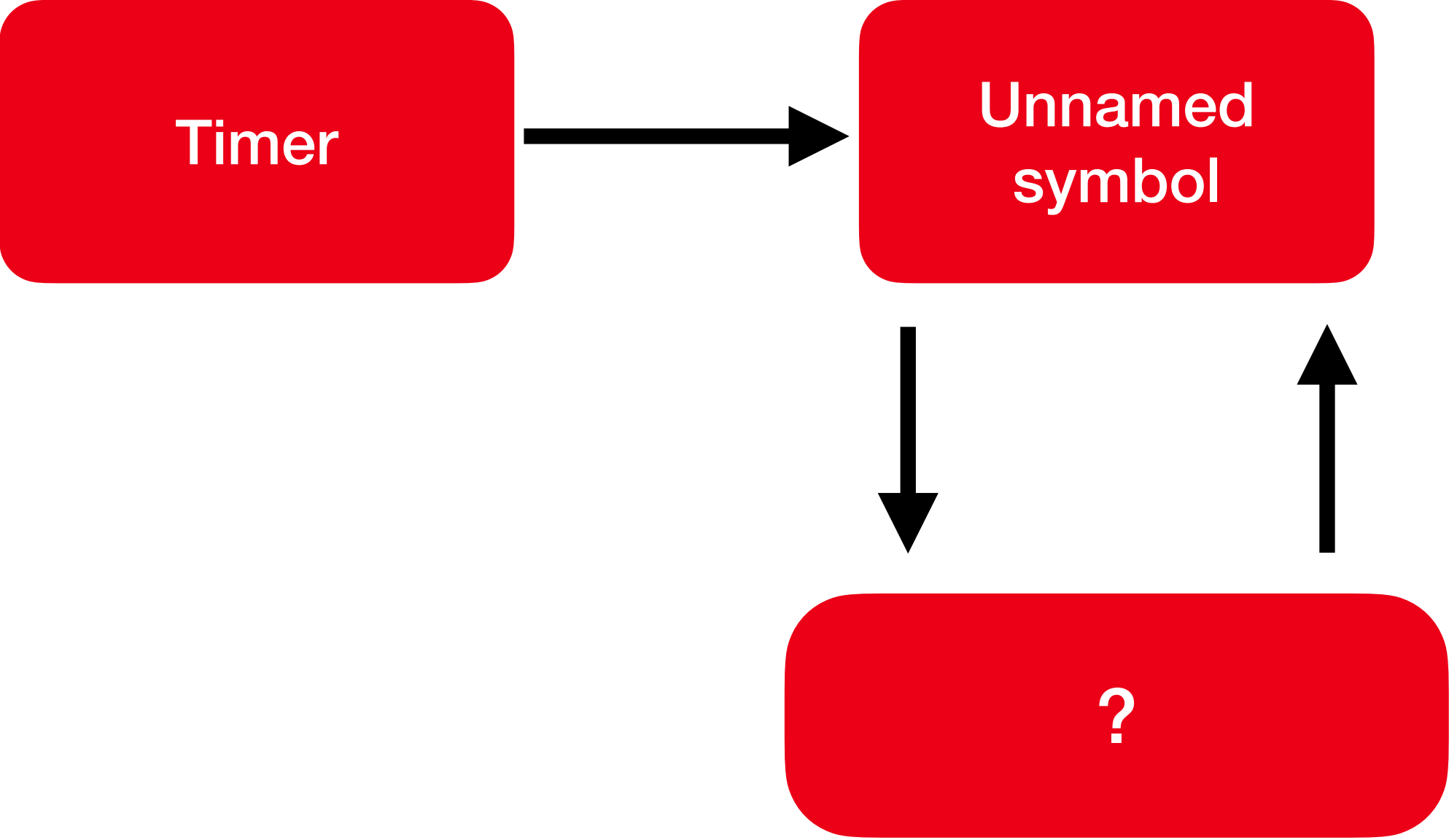
frame #13: AppKit`-[NSApplication run] + 480

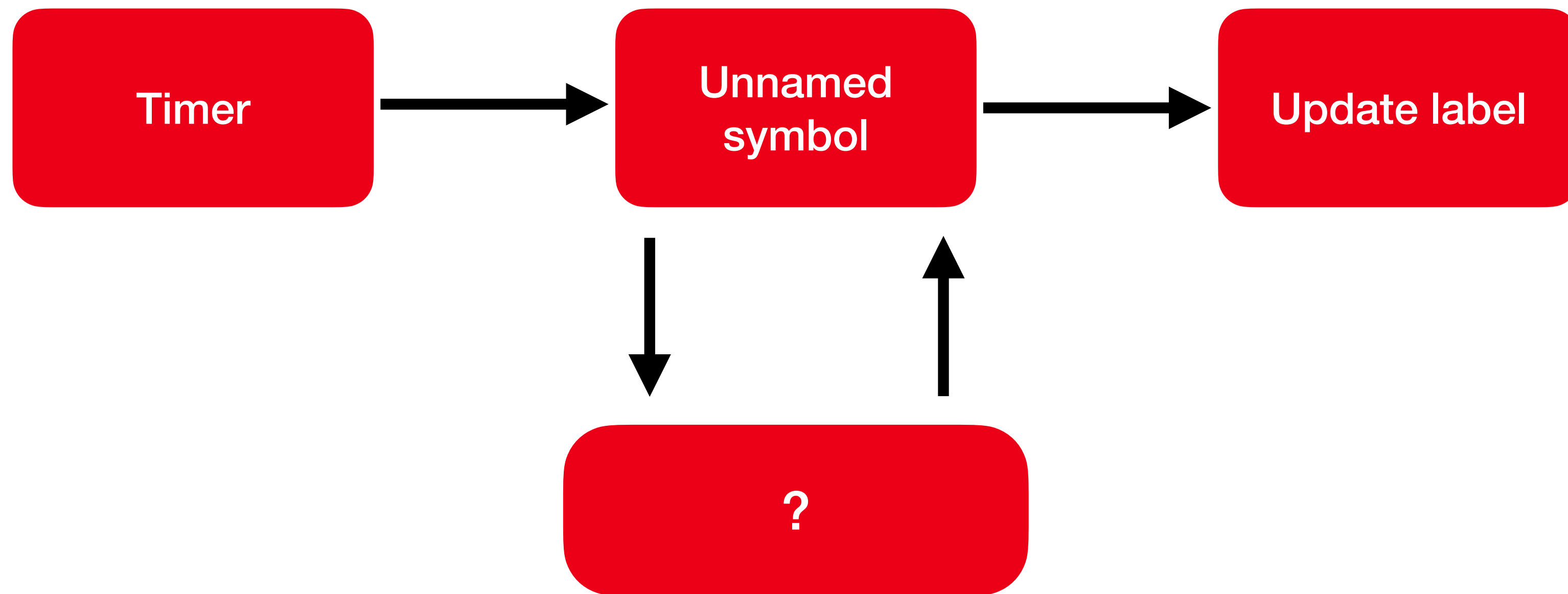
frame #14: AppKit`NSApplicationMain + 880

frame #15: dyld`start + 6076

Timer









```
(lldb) bt
* thread #1, queue = 'com.apple.main-thread', stop reason = breakpoint 3.1
* frame #0: AppKit`-[NSTextField setStringValue:]
frame #1: CoreAudioAUUI`___lldb_unnamed_symbol11659 + 112
frame #2: Foundation`___NSFireTimer + 104
frame #3: CoreFoundation`___CFRUNLOOP_IS_CALLING__CALLBACK_FUNCTION__ + 32
frame #4: CoreFoundation`___CFRunLoopDoTimer + 980
frame #5: CoreFoundation`___CFRunLoopDoTimers + 332
frame #6: CoreFoundation`___CFRunLoopRun + 1848
frame #7: CoreFoundation`CFRunLoopRunSpecific + 572
frame #8: HIToolbox`RunCurrentEventLoopInMode + 324
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frame #11: AppKit`_DPSNextEvent + 684
frame #12: AppKit`-[NSApplication next:untilDate:inMode:dequeue:] + 688
frame #13: AppKit`-[NSApplication run] + 480
frame #14: AppKit`NSApplicationMain + 880
frame #15: dyld`start + 6076
```




```
[ (NSTextField *)0x15c1ead30 setStringValue:@"ADC 25" ]
```



```
[ (NSTextField *)0x15c1ead30 setStringValue:@"ADC 25" ]
```

Receiver



```
[ (NSTextField *)0x15c1ead30 setStringValue:@"ADC 25" ]
```

Receiver

Message



```
[ (NSTextField *)0x15c1ead30 setStringValue:@"ADC 25" ]
```

Receiver

Message

Argument



```
[ (NSTextField *)0x15c1ead30 setStringValue:@"ADC 25" ]
```

Receiver

Message

Argument



```
objc_msgSend(0x15c1ead30, "setStringValue", "ADC 25")
```


Calling convention

Calling convention

- The caller and callee need to agree on how arguments are passed

Calling convention

- The caller and callee need to agree on how arguments are passed
- arm
 - x0, x1, x2



```
[ (NSTextField *)0x15c1ead30 setStringValue:@"ADC 25" ]
```



```
objc_msgSend(0x15c1ead30, "setStringValue", "ADC 25")
```

x0

x1

x2



```
(lldb) b 0x11a221b20
```

```
Breakpoint 3: where = CoreAudioAUUI`____lldb_unnamed_symbol11659`
```




```
(lldb) b 0x11a221b20
Breakpoint 3: where = CoreAudioAUUI`____lldb_unnamed_symbol11659`

(lldb) c
Process 15111 resuming
Process 15111 stopped
* thread #1, queue = 'com.apple.main-thread', stop reason = breakpoint 3.1
   frame #0: 0x000000011a221b20 CoreAudioAUUI`____lldb_unnamed_symbol11659
-> 0x11a221b20 <+0>:  pacibsp
    0x11a221b24 <+4>:  stp     x24, x23, [sp, #-0x40]!
    0x11a221b28 <+8>:  stp     x22, x21, [sp, #0x10]
    0x11a221b2c <+12>: stp     x20, x19, [sp, #0x20]
    0x11a221b30 <+16>: stp     x29, x30, [sp, #0x30]
    0x11a221b34 <+20>: add     x29, sp, #0x30
    0x11a221b38 <+24>: mov     x19, x0
    0x11a221b3c <+28>: adrp    x8, 125
Target 0: (AU Lab) stopped.
```



```
(lldb) b 0x11a221b20
Breakpoint 3: where = CoreAudioAUUI`____lldb_unnamed_symbol11659`

(lldb) c
Process 15111 resuming
Process 15111 stopped
* thread #1, queue = 'com.apple.main-thread', stop reason = breakpoint 3.1
   frame #0: 0x000000011a221b20 CoreAudioAUUI`____lldb_unnamed_symbol11659
-> 0x11a221b20 <+0>:  pacibsp
    0x11a221b24 <+4>:  stp     x24, x23, [sp, #-0x40]!
    0x11a221b28 <+8>:  stp     x22, x21, [sp, #0x10]
    0x11a221b2c <+12>: stp     x20, x19, [sp, #0x20]
    0x11a221b30 <+16>: stp     x29, x30, [sp, #0x30]
    0x11a221b34 <+20>: add     x29, sp, #0x30
    0x11a221b38 <+24>: mov     x19, x0
    0x11a221b3c <+28>: adrp    x8, 125
Target 0: (AU Lab) stopped.

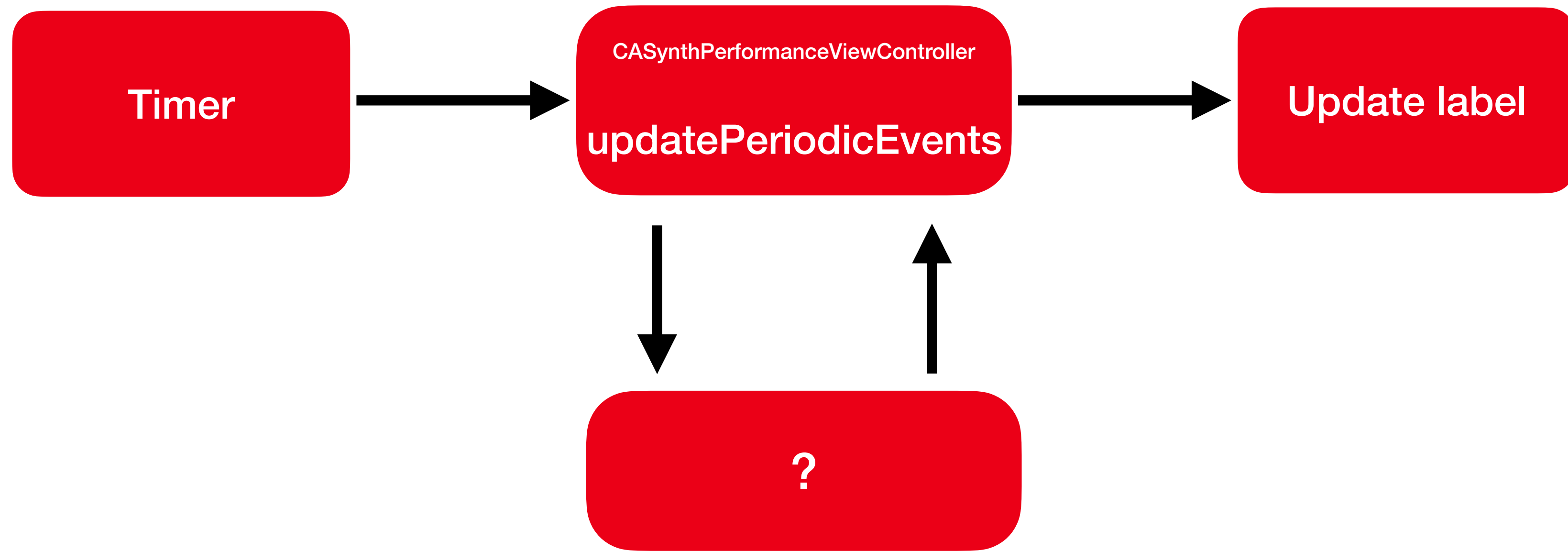
(lldb) po $x0
<CASynthPerformanceViewController: 0x1191b4e80>
```

```
(lldb) b 0x11a221b20
Breakpoint 3: where = CoreAudioAUUI`____lldb_unnamed_symbol11659`

(lldb) c
Process 15111 resuming
Process 15111 stopped
* thread #1, queue = 'com.apple.main-thread', stop reason = breakpoint 3.1
   frame #0: 0x000000011a221b20 CoreAudioAUUI`____lldb_unnamed_symbol11659
-> 0x11a221b20 <+0>:  pacibsp
    0x11a221b24 <+4>:  stp     x24, x23, [sp, #-0x40]!
    0x11a221b28 <+8>:  stp     x22, x21, [sp, #0x10]
    0x11a221b2c <+12>: stp     x20, x19, [sp, #0x20]
    0x11a221b30 <+16>: stp     x29, x30, [sp, #0x30]
    0x11a221b34 <+20>: add     x29, sp, #0x30
    0x11a221b38 <+24>: mov     x19, x0
    0x11a221b3c <+28>: adrp    x8, 125
Target 0: (AU Lab) stopped.

(lldb) po $x0
<CASynthPerformanceViewController: 0x1191b4e80>

(lldb) x/s $x1
0x600002961e80: "updatePeriodicEvents:"
```



```
(lldb) dd
```

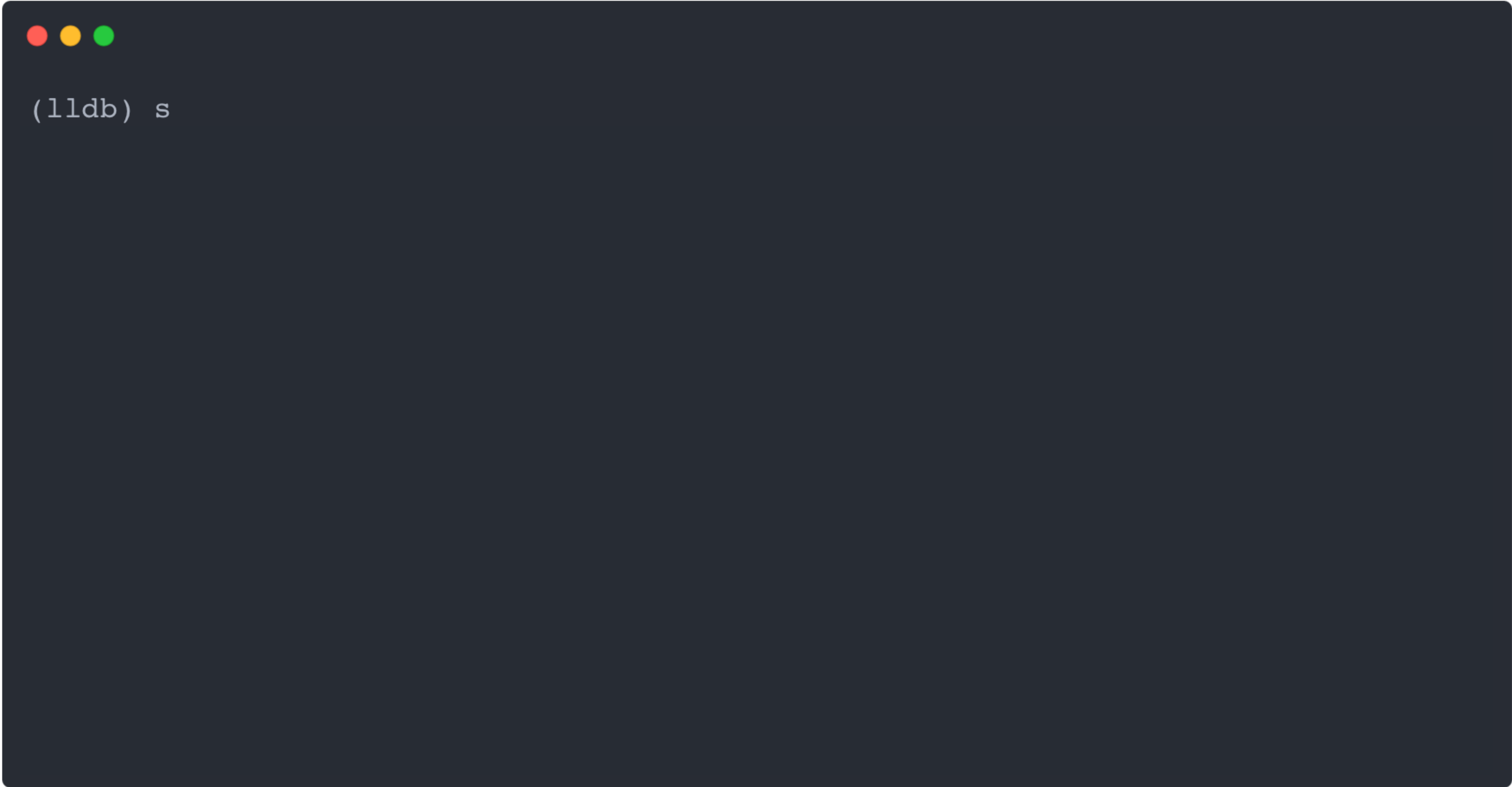


```

(lldb) dd
CoreAudioAUUI, ___lldb_unnamed_symbol1659
-> 0      0x11a221b20 <+0>:      pacibsp
    1      0x11a221b24 <+4>:      stp    x24,  x23
    2      0x11a221b28 <+8>:      stp    x22,  x21
    3      0x11a221b2c <+12>:     stp    x20,  x19
    4      0x11a221b30 <+16>:     stp    x29,  x30
    5      0x11a221b34 <+20>:     add    x29,  sp
    6      0x11a221b38 <+24>:     mov    x19,  x0
    7      0x11a221b3c <+28>:     adrp   x8,   125
    8      0x11a221b40 <+32>:     add    x8,   x8
    9      0x11a221b44 <+36>:     ldrrsw x23,  [x8]
   10      0x11a221b48 <+40>:     ldr    x0,   [x0
*11      0x11a221b4c <+44>:     bl     0x11a257100
   12      0x11a221b50 <+48>:     adrp   x8,   126
   13      0x11a221b54 <+52>:     ldrrsw x22,  [x8
   14      0x11a221b58 <+56>:     ldr    w8,   [x19
   15      0x11a221b5c <+60>:     cmp    w0,   w8
*16      0x11a221b60 <+64>:     b.eq   0x11a221bb4 <+148>
   17      0x11a221b64 <+68>:     mov    x20,  x0
   18      0x11a221b68 <+72>:     adrp   x8,   126
   19      0x11a221b6c <+76>:     ldrrsw x8,   [x8
   20      0x11a221b70 <+80>:     ldr    x0,   [x19
*21      0x11a221b74 <+84>:     cbz    w20,  0x11a221b84 <+100>
   22      0x11a221b78 <+88>:     mov    x2,   x20
*23      0x11a221b7c <+92>:     bl     0x11a25a280

```

```
(lldb) dd
CoreAudioAUUI, ___lldb_unnamed_symbol1659
-> 0      0x11a221b20 <+0>:      pacibsp
    1      0x11a221b24 <+4>:      stp    x24,  x23
    2      0x11a221b28 <+8>:      stp    x22,  x21
    3      0x11a221b2c <+12>:     stp    x20,  x19
    4      0x11a221b30 <+16>:     stp    x29,  x30
    5      0x11a221b34 <+20>:     add    x29,  sp
    6      0x11a221b38 <+24>:     mov    x19,  x0
    7      0x11a221b3c <+28>:     adrp   x8,   125
    8      0x11a221b40 <+32>:     add    x8,   x8
    9      0x11a221b44 <+36>:     ldrrsw x23,  [x8]
   10      0x11a221b48 <+40>:     ldr    x0,   [x0]
   *11     0x11a221b4c <+44>:     bl     0x11a257100
   12      0x11a221b50 <+48>:     adrp   x8,   126
   13      0x11a221b54 <+52>:     ldrrsw x22,  [x8]
   14      0x11a221b58 <+56>:     ldr    w8,   [x19]
   15      0x11a221b5c <+60>:     cmp    w0,   w8
   *16     0x11a221b60 <+64>:     b.eq   0x11a221bb4 <+148>
   17      0x11a221b64 <+68>:     mov    x20,  x0
   18      0x11a221b68 <+72>:     adrp   x8,   126
   19      0x11a221b6c <+76>:     ldrrsw x8,   [x8]
   20      0x11a221b70 <+80>:     ldr    x0,   [x19]
   *21     0x11a221b74 <+84>:     cbz    w20,  0x11a221b84 <+100>
   22      0x11a221b78 <+88>:     mov    x2,   x20
   *23     0x11a221b7c <+92>:     bl     0x11a25a280
```





```
(lldb) s
```

```
Process 15111 stopped
```

```
* thread #1, queue = 'com.apple.main-thread', stop reason = instruction step into  
frame #0: 0x000000011a219428 CoreAudioAUUI`___lldb_unnamed_symbol1361:``
```

```
-> 0x11a219428 <+4>:  add    x8, x8, #0x0  
0x11a21942c <+8>:  ldr     x2, [x0, #0x8]  
0x11a219430 <+12>: mov     x0, x8  
0x11a219434 <+16>: mov     w3, #0x1008 ; =4104  
0x11a219438 <+20>: mov     w4, #0x0 ; =0  
0x11a21943c <+24>: mov     w5, #0x0 ; =0  
0x11a219440 <+28>: b       0x11a255140
```


(lldb) s

Process 15111 stopped

* thread #1, queue = 'com.apple.main-thread', stop reason = instruction step into
frame #0: 0x000000011a219428 CoreAudioAUUI`____lldb_unnamed_symbol11361:``

```
-> 0x11a219428 <+4>:  add    x8, x8, #0x0
    0x11a21942c <+8>:  ldr     x2, [x0, #0x8]
    0x11a219430 <+12>: mov     x0, x8
    0x11a219434 <+16>: mov     w3, #0x1008 ; =4104
    0x11a219438 <+20>: mov     w4, #0x0 ; =0
    0x11a21943c <+24>: mov     w5, #0x0 ; =0
    0x11a219440 <+28>: b       0x11a255140
```

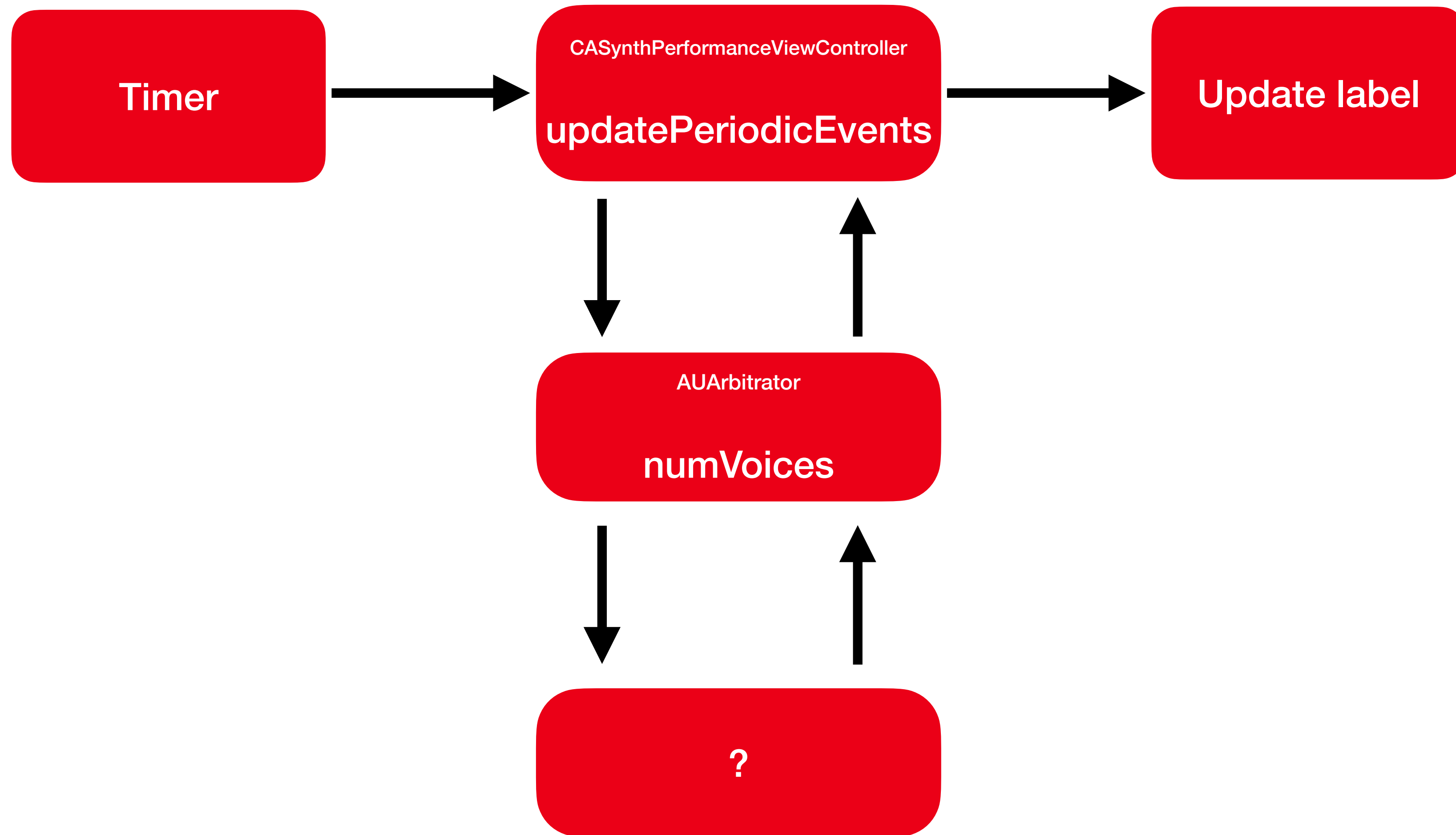
(lldb) po \$x0

<AUArbitrator: 0x6000026c8120>


```
(lldb) s
Process 15111 stopped
* thread #1, queue = 'com.apple.main-thread', stop reason = instruction step into
  frame #0: 0x000000011a219428 CoreAudioAUUI`___lldb_unnamed_symbol1361:``
-> 0x11a219428 <+4>:  add    x8, x8, #0x0
    0x11a21942c <+8>:  ldr    x2, [x0, #0x8]
    0x11a219430 <+12>: mov    x0, x8
    0x11a219434 <+16>: mov    w3, #0x1008 ; =4104
    0x11a219438 <+20>: mov    w4, #0x0 ; =0
    0x11a21943c <+24>: mov    w5, #0x0 ; =0
    0x11a219440 <+28>: b      0x11a255140

(lldb) po $x0
<AUArbitrator: 0x6000026c8120>

(lldb) x/s $x1
0x600002bf4a10: "numVoices"
```





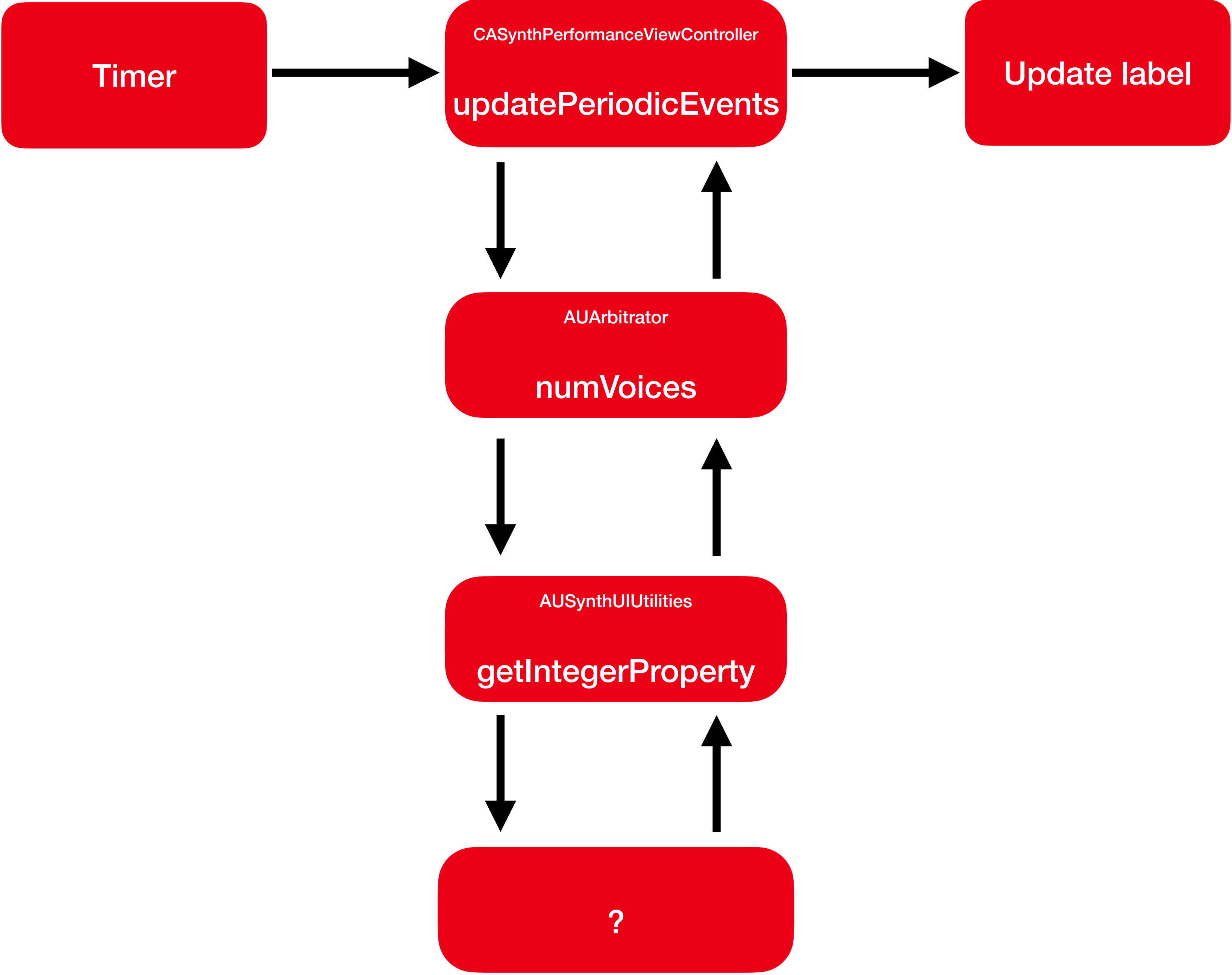
(11db) s


```
(lldb) s
Process 15111 stopped
* thread #1, queue = 'com.apple.main-thread', stop reason = instruction step into
    frame #0: 0x000000011a21e9ec CoreAudioAUUI`____lldb_unnamed_symbol11590 + 8
CoreAudioAUUI`____lldb_unnamed_symbol11590`:
-> 0x11a21e9ec <+8>: stp    x22, x21, [sp, #0x20]
    0x11a21e9f0 <+12>: stp    x20, x19, [sp, #0x30]
    0x11a21e9f4 <+16>: stp    x29, x30, [sp, #0x40]
    0x11a21e9f8 <+20>: add    x29, sp, #0x40
    0x11a21e9fc <+24>: mov    x20, x5
    0x11a21ea00 <+28>: mov    x21, x4
    0x11a21ea04 <+32>: mov    x19, x3
    0x11a21ea08 <+36>: mov    x22, x2
Target 0: (AU Lab) stopped.
```

```
(lldb) s
Process 15111 stopped
* thread #1, queue = 'com.apple.main-thread', stop reason = instruction step into
    frame #0: 0x000000011a21e9ec CoreAudioAUUI`____lldb_unnamed_symbol11590 + 8
CoreAudioAUUI`____lldb_unnamed_symbol11590`:
-> 0x11a21e9ec <+8>: stp    x22, x21, [sp, #0x20]
    0x11a21e9f0 <+12>: stp    x20, x19, [sp, #0x30]
    0x11a21e9f4 <+16>: stp    x29, x30, [sp, #0x40]
    0x11a21e9f8 <+20>: add    x29, sp, #0x40
    0x11a21e9fc <+24>: mov    x20, x5
    0x11a21ea00 <+28>: mov    x21, x4
    0x11a21ea04 <+32>: mov    x19, x3
    0x11a21ea08 <+36>: mov    x22, x2
Target 0: (AU Lab) stopped.

(lldb) po $x0
AUSynthUIUtilities

(lldb) x/s $x1
0x600003c7b240: "getIntegerPropertyForAU:propertyID:scope:element:"
```



```
(lldb) dd
```

```

(lldb) dd
CoreAudioAUUI, ___lldb_unnamed_symbol1590
    17  0x11a21ea28 <+68>:  mov    x3,  x20
    *18 0x11a21ea2c <+72>:  bl     0x11a251888 symbol stub for: AudioUnitGetPropertyInfo
    *19 0x11a21ea30 <+76>:  cbnz   w0,  0x11a21ea6c <+136>
    20  0x11a21ea34 <+80>:  ldr     w8,  [sp
    *21 0x11a21ea38 <+84>:  cbz     w8,  0x11a21ea6c <+136>
    22  0x11a21ea3c <+88>:  add     x4,  sp
    23  0x11a21ea40 <+92>:  add     x5,  sp
    24  0x11a21ea44 <+96>:  mov     x0,  x22
    25  0x11a21ea48 <+100>: mov     x1,  x19
    26  0x11a21ea4c <+104>: mov     x2,  x21
    27  0x11a21ea50 <+108>: mov     x3,  x20
    *28 0x11a21ea54 <+112>: bl      0x11a251878 symbol stub for: AudioUnitGetProperty
    *29 0x11a21ea58 <+116>: cbz     w0,  0x11a21ea6c <+136>
    30  0x11a21ea5c <+120>: stp     x19, x0
    31  0x11a21ea60 <+124>: adrp    x0,  102
    32  0x11a21ea64 <+128>: add     x0,  x0 @"Error getting integer property %d: %d"x19
    37  0x11a21ea78 <+148>: ldp     x22, x21
    38  0x11a21ea7c <+152>: add     sp,  sp
    *39 0x11a21ea80 <+156>: retab

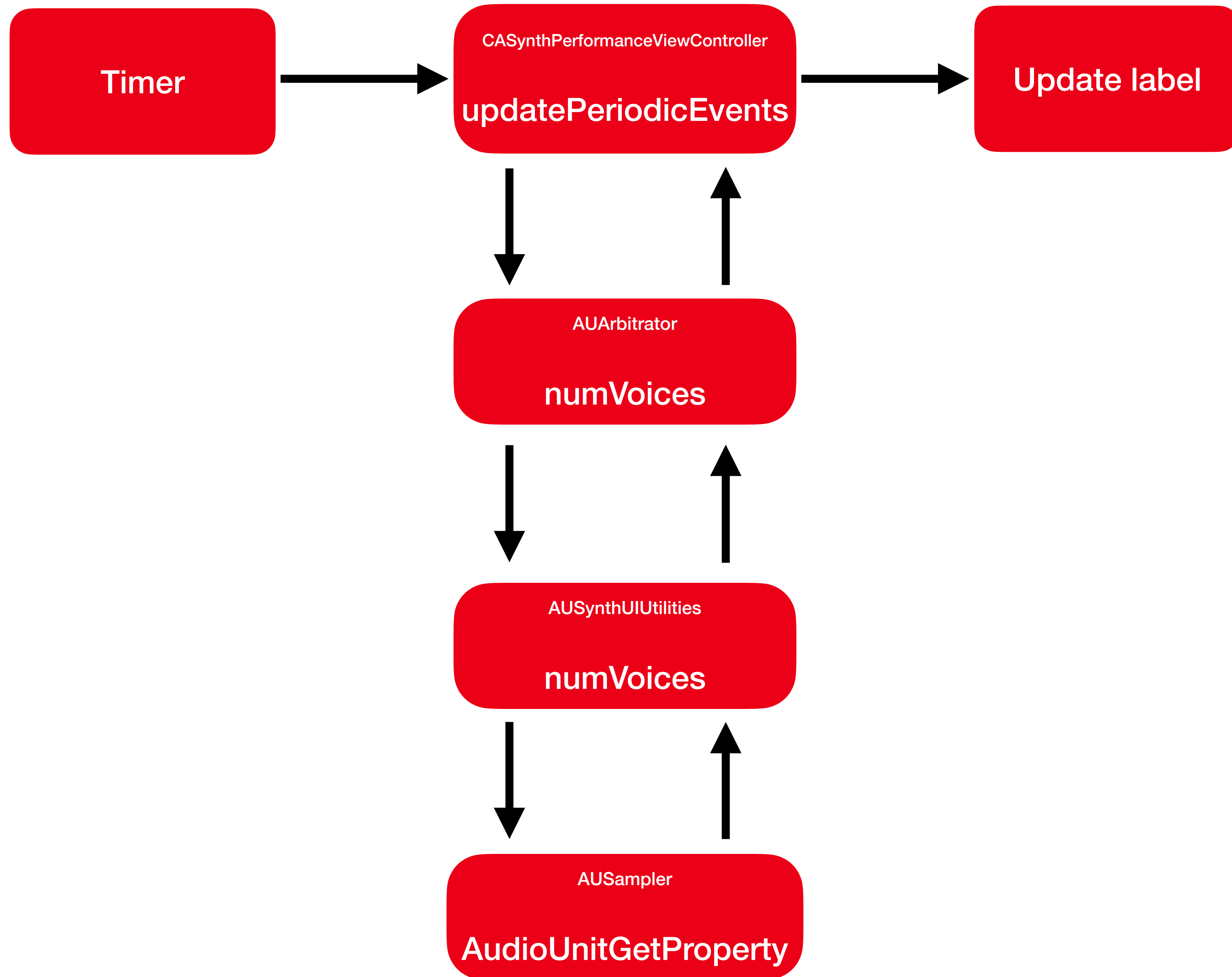
```



```

(lldb) dd
CoreAudioAUUI, ___lldb_unnamed_symbol1590
  17  0x11a21ea28 <+68>:  mov    x3,  x20
*18  0x11a21ea2c <+72>:  bl     0x11a251888 symbol stub for: AudioUnitGetPropertyInfo
*19  0x11a21ea30 <+76>:  cbnz   w0,  0x11a21ea6c <+136>
  20  0x11a21ea34 <+80>:  ldr     w8,  [sp
*21  0x11a21ea38 <+84>:  cbz     w8,  0x11a21ea6c <+136>
  22  0x11a21ea3c <+88>:  add     x4,  sp
  23  0x11a21ea40 <+92>:  add     x5,  sp
  24  0x11a21ea44 <+96>:  mov     x0,  x22
  25  0x11a21ea48 <+100>: mov     x1,  x19
  26  0x11a21ea4c <+104>: mov     x2,  x21
  27  0x11a21ea50 <+108>: mov     x3,  x20
*28  0x11a21ea54 <+112>: bl     0x11a251878 symbol stub for: AudioUnitGetProperty
*29  0x11a21ea58 <+116>: cbz     w0,  0x11a21ea6c <+136>
  30  0x11a21ea5c <+120>: stp     x19, x0
  31  0x11a21ea60 <+124>: adrp    x0,  102
  32  0x11a21ea64 <+128>: add     x0,  x0 @"Error getting integer property %d: %d"x19
  37  0x11a21ea78 <+148>: ldp     x22, x21
  38  0x11a21ea7c <+152>: add     sp,  sp
*39  0x11a21ea80 <+156>: retab

```



Function

AudioUnitGetProperty(_:_:_:_:_:_)

Gets the value of an audio unit property.

iOS 2.0+ | iPadOS 2.0+ | Mac Catalyst 13.1+ | macOS 10.0+ | tvOS 9.0+ | visionOS 1.0+

```
func AudioUnitGetProperty(  
    _ inUnit: AudioUnit,  
    _ inID: AudioUnitPropertyID,  
    _ inScope: AudioUnitScope,  
    _ inElement: AudioUnitElement,  
    _ outData: UnsafeMutableRawPointer,  
    _ ioDataSize: UnsafeMutablePointer<UInt32>  
) -> OSStatus
```

Parameters

inUnit

The audio unit that you want to get a property value from.

inID

The identifier for the property.

inScope

The audio unit scope for the property.

inElement

The audio unit element for the property.

outData

On successful output, the current value for the specified audio unit property. Set this parameter to NULL when calling this function if you only want to determine how much memory to allocate for a variable size property.

ioDataSize

On input, the expected size of the property value, as pointed to by the `outData` parameter. On output, the size of the data that was returned.

Function

AudioUnitGetProperty(_:_:_:_:_:_)

Gets the value of an audio unit property.

iOS 2.0+ | iPadOS 2.0+ | Mac Catalyst 13.1+ | macOS 10.0+ | tvOS 9.0+ | visionOS 1.0+

```
func AudioUnitGetProperty(  
    _ inUnit: AudioUnit,  
    _ inID: AudioUnitPropertyID,  
    _ inScope: AudioUnitScope,  
    _ inElement: AudioUnitElement,  
    _ outData: UnsafeMutableRawPointer,  
    _ ioDataSize: UnsafeMutablePointer<UInt32>  
) -> OSStatus
```

Parameters

inUnit

The audio unit that you want to get a property value from.

inID

The identifier for the property.

inScope

The audio unit scope for the property.

inElement

The audio unit element for the property.

outData

On successful output, the current value for the specified audio unit property. Set this parameter to NULL when calling this function if you only want to determine how much memory to allocate for a variable size property.

ioDataSize

On input, the expected size of the property value, as pointed to by the `outData` parameter. On output, the size of the data that was returned.

Function

AudioUnitGetProperty(_:_:_:_:_:_)

Gets the value of an audio unit property.

iOS 2.0+ | iPadOS 2.0+ | Mac Catalyst 13.1+ | macOS 10.0+ | tvOS 9.0+ | visionOS 1.0+

```
func AudioUnitGetProperty(
    _ inUnit: AudioUnit,
    _ inID: AudioUnitPropertyID,
    _ inScope: AudioUnitScope,
    _ inElement: AudioUnitElement,
    _ outData: UnsafeMutableRawPointer,
    _ ioDataSize: UnsafeMutablePointer<UInt32>
) -> OSStatus
```

Parameters

inUnit

The audio unit that you want to get a property value from.

inID

The identifier for the property.

inScope

The audio unit scope for the property.

inElement

The audio unit element for the property.

outData

On successful output, the current value for the specified audio unit property. Set this parameter to NULL when calling this function if you only want to determine how much memory to allocate for a variable size property.

ioDataSize

On input, the expected size of the property value, as pointed to by the outData parameter. On output, the size of the data that was returned.

Function

AudioUnitGetProperty(_:_:_:_:_:_)

Gets the value of an audio unit property.

iOS 2.0+ | iPadOS 2.0+ | Mac Catalyst 13.1+ | macOS 10.0+ | tvOS 9.0+ | visionOS 1.0+

```
func AudioUnitGetProperty(
    _ inUnit: AudioUnit,
    _ inID: AudioUnitPropertyID,  x1
    _ inScope: AudioUnitScope,
    _ inElement: AudioUnitElement,
    _ outData: UnsafeMutableRawPointer,
    _ ioDataSize: UnsafeMutablePointer<UInt32>
) -> OSStatus
```

Parameters

inUnit

The audio unit that you want to get a property value from.

inID

The identifier for the property.

inScope

The audio unit scope for the property.

inElement

The audio unit element for the property.

outData

On successful output, the current value for the specified audio unit property. Set this parameter to NULL when calling this function if you only want to determine how much memory to allocate for a variable size property.

ioDataSize

On input, the expected size of the property value, as pointed to by the outData parameter. On output, the size of the data that was returned.



```
(lldb) dd
CoreAudioAUUI, ___lldb_unnamed_symbol1590
  17  0x11a21ea28 <+68>:  mov    x3,  x20
*18  0x11a21ea2c <+72>:  bl     0x11a251888 symbol stub for: AudioUnitGetPropertyInfo
*19  0x11a21ea30 <+76>:  cbnz   w0,  0x11a21ea6c <+136>
  20  0x11a21ea34 <+80>:  ldr     w8,  [sp
*21  0x11a21ea38 <+84>:  cbz     w8,  0x11a21ea6c <+136>
  22  0x11a21ea3c <+88>:  add     x4,  sp
  23  0x11a21ea40 <+92>:  add     x5,  sp
  24  0x11a21ea44 <+96>:  mov     x0,  x22
  25  0x11a21ea48 <+100>: mov     x1,  x19
  26  0x11a21ea4c <+104>: mov     x2,  x21
  27  0x11a21ea50 <+108>: mov     x3,  x20
*28  0x11a21ea54 <+112>: bl     0x11a251878 symbol stub for: AudioUnitGetProperty
*29  0x11a21ea58 <+116>: cbz     w0,  0x11a21ea6c <+136>
  30  0x11a21ea5c <+120>: stp     x19, x0
  31  0x11a21ea60 <+124>: adrp    x0,  102
  32  0x11a21ea64 <+128>: add     x0,  x0 @"Error getting integer property %d: %d"x19
  37  0x11a21ea78 <+148>: ldp     x22, x21
  38  0x11a21ea7c <+152>: add     sp,  sp
*39  0x11a21ea80 <+156>: retab
(lldb)
```



```

(lldb) dd
CoreAudioAUUI, ___lldb_unnamed_symbol1590
    17  0x11a21ea28 <+68>:  mov    x3,  x20
    *18 0x11a21ea2c <+72>:  bl     0x11a251888 symbol stub for: AudioUnitGetPropertyInfo
    *19 0x11a21ea30 <+76>:  cbnz   w0,  0x11a21ea6c <+136>
    20  0x11a21ea34 <+80>:  ldr     w8,  [sp
    *21 0x11a21ea38 <+84>:  cbz     w8,  0x11a21ea6c <+136>
    22  0x11a21ea3c <+88>:  add     x4,  sp
    23  0x11a21ea40 <+92>:  add     x5,  sp
    24  0x11a21ea44 <+96>:  mov     x0,  x22
    25  0x11a21ea48 <+100>: mov     x1,  x19
    26  0x11a21ea4c <+104>: mov     x2,  x21
    27  0x11a21ea50 <+108>: mov     x3,  x20
    *28 0x11a21ea54 <+112>: bl      0x11a251878 symbol stub for: AudioUnitGetProperty
    *29 0x11a21ea58 <+116>: cbz     w0,  0x11a21ea6c <+136>
    30  0x11a21ea5c <+120>: stp     x19, x0
    31  0x11a21ea60 <+124>: adrp    x0,  102
    32  0x11a21ea64 <+128>: add     x0,  x0 @"Error getting integer property %d: %d"x19
    37  0x11a21ea78 <+148>: ldp     x22, x21
    38  0x11a21ea7c <+152>: add     sp,  sp
    *39 0x11a21ea80 <+156>: retab
(lldb)

```



```
(lldb) b 0x11a21ea54
```

```
Breakpoint 4: where = CoreAudioAUUI`____lldb_unnamed_symbol11590 + 112`
```

"

```
(lldb) b 0x11a21ea54
Breakpoint 4: where = CoreAudioAUUI`____lldb_unnamed_symbol11590 + 112`

(lldb) c
Process 15111 resuming
Process 15111 stopped
* thread #1, queue = 'com.apple.main-thread', stop reason = breakpoint 4.1
  frame #0: 0x000000011a21ea54 CoreAudioAUUI`____lldb_unnamed_symbol11590 + 112`
CoreAudioAUUI`____lldb_unnamed_symbol11590`:
-> 0x11a21ea54 <+112>: bl      0x11a251878      ; symbol stub for: AudioUnitGetProperty
    0x11a21ea58 <+116>: cbz     w0, 0x11a21ea6c ; <+136>
    0x11a21ea5c <+120>: stp     x19, x0, [sp]
    0x11a21ea60 <+124>: adrp    x0, 102
    0x11a21ea64 <+128>: add     x0, x0, #0x170 ; @"Error getting integer property %d: %d"
    0x11a21ea68 <+132>: bl      0x11a251bc8      ; symbol stub for: NSLog
    0x11a21ea6c <+136>: ldr     w0, [sp, #0x18]
    0x11a21ea70 <+140>: ldp     x29, x30, [sp, #0x40]
Target 0: (AU Lab) stopped.
```



```
(lldb) b 0x11a21ea54
Breakpoint 4: where = CoreAudioAUUI`____lldb_unnamed_symbol11590 + 112`

(lldb) c
Process 15111 resuming
Process 15111 stopped
* thread #1, queue = 'com.apple.main-thread', stop reason = breakpoint 4.1
  frame #0: 0x000000011a21ea54 CoreAudioAUUI`____lldb_unnamed_symbol11590 + 112`
CoreAudioAUUI`____lldb_unnamed_symbol11590`:
-> 0x11a21ea54 <+112>: bl      0x11a251878      ; symbol stub for: AudioUnitGetProperty
    0x11a21ea58 <+116>: cbz     w0, 0x11a21ea6c ; <+136>
    0x11a21ea5c <+120>: stp     x19, x0, [sp]
    0x11a21ea60 <+124>: adrp    x0, 102
    0x11a21ea64 <+128>: add     x0, x0, #0x170 ; @"Error getting integer property %d: %d"
    0x11a21ea68 <+132>: bl      0x11a251bc8      ; symbol stub for: NSLog
    0x11a21ea6c <+136>: ldr     w0, [sp, #0x18]
    0x11a21ea70 <+140>: ldp     x29, x30, [sp, #0x40]
Target 0: (AU Lab) stopped.

(lldb) po $x1
4104
```

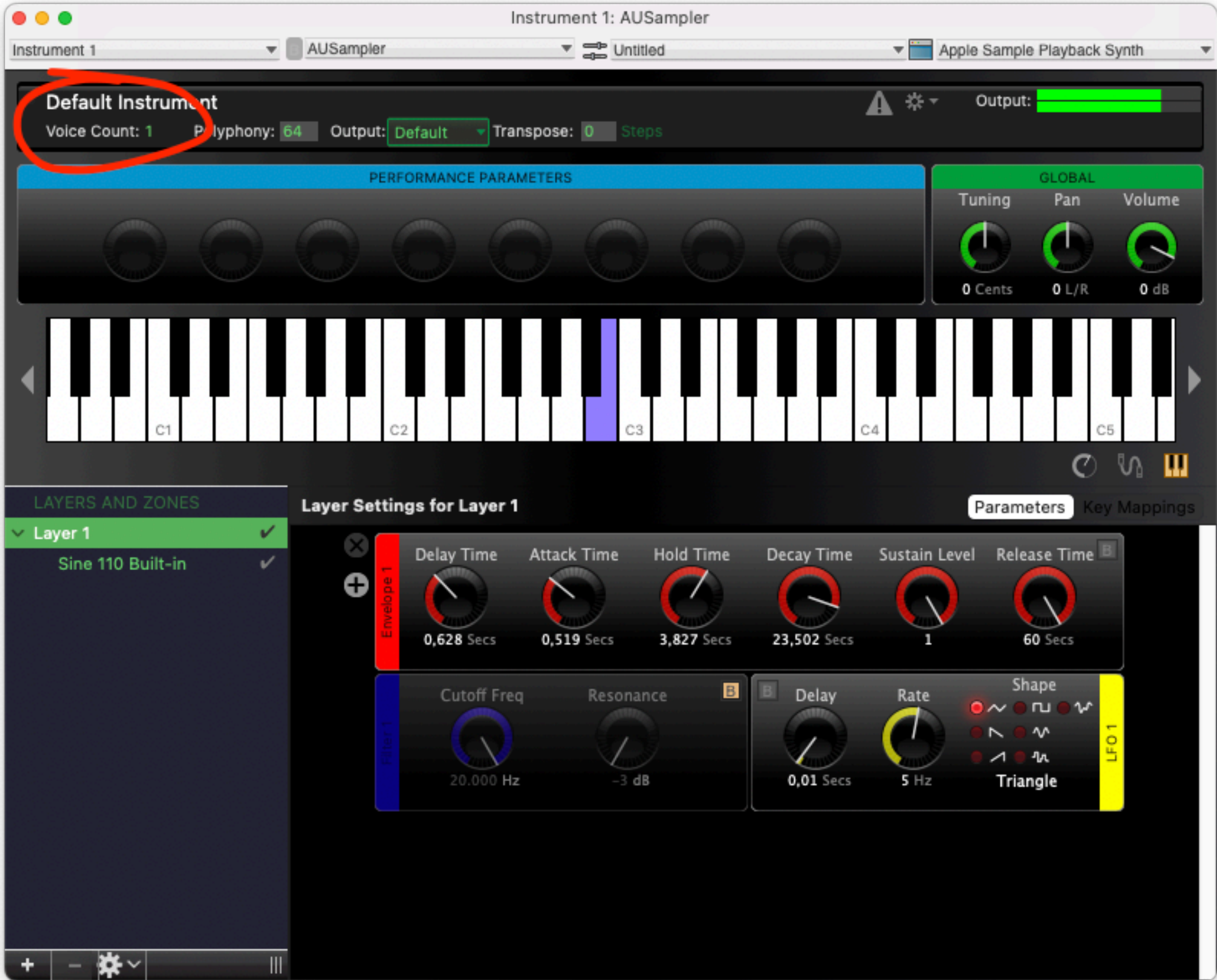



```
extension AVAudioUnit {  
    func activeVoiceCount() -> UInt32 {  
        var current: UInt32 = 0  
        var currentSize: UInt32 = UInt32(MemoryLayout<UInt32>.size)  
        AudioUnitGetProperty(  
            self.audioUnit,  
            4104,  
            kAudioUnitScope_Global,  
            0,  
            &current,  
            &currentSize  
        )  
        return current  
    }  
}
```



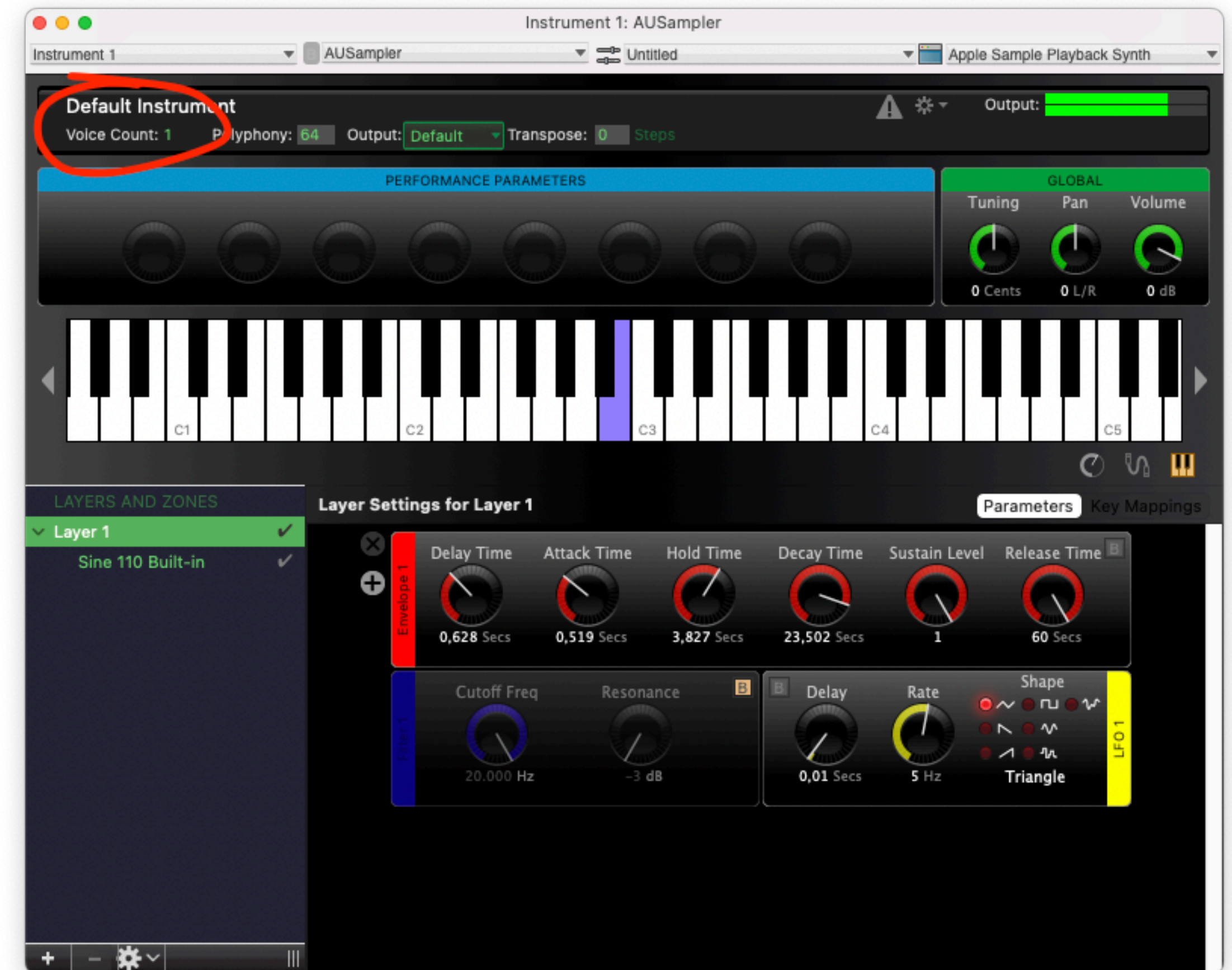

```
extension AVAudioUnit {  
    func activeVoiceCount() -> UInt32 {  
        var current: UInt32 = 0  
        var currentSize: UInt32 = UInt32(MemoryLayout<UInt32>.size)  
        AudioUnitGetProperty(  
            self.audioUnit,  
            → 4104,  
            kAudioUnitScope_Global,  
            0,  
            &current,  
            &currentSize  
        )  
        return current  
    }  
}
```

Results



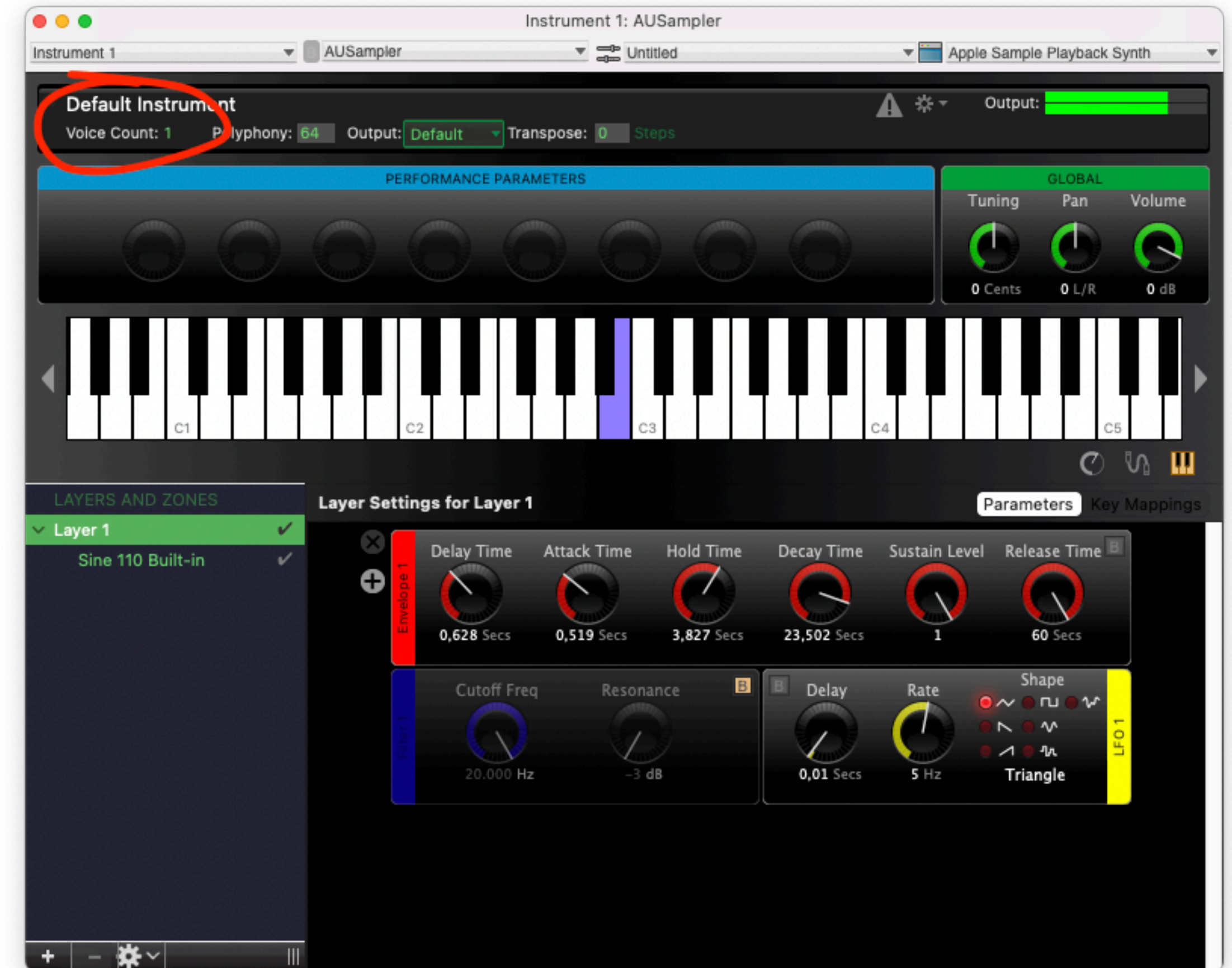
Results

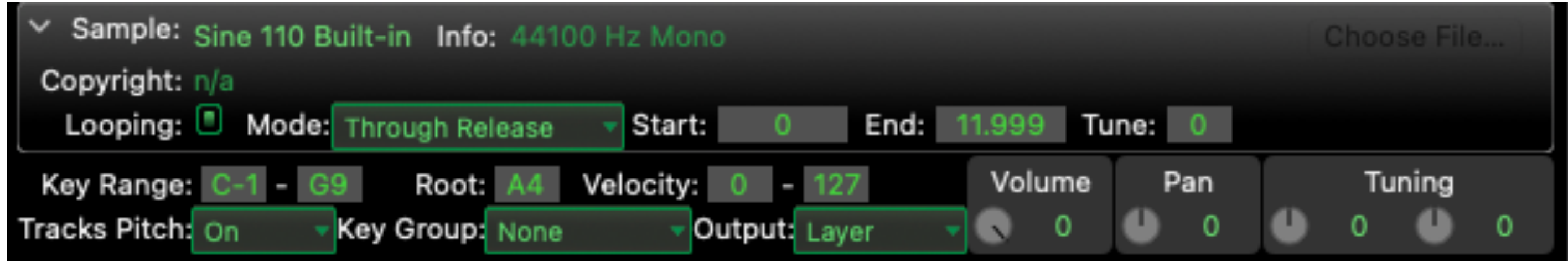
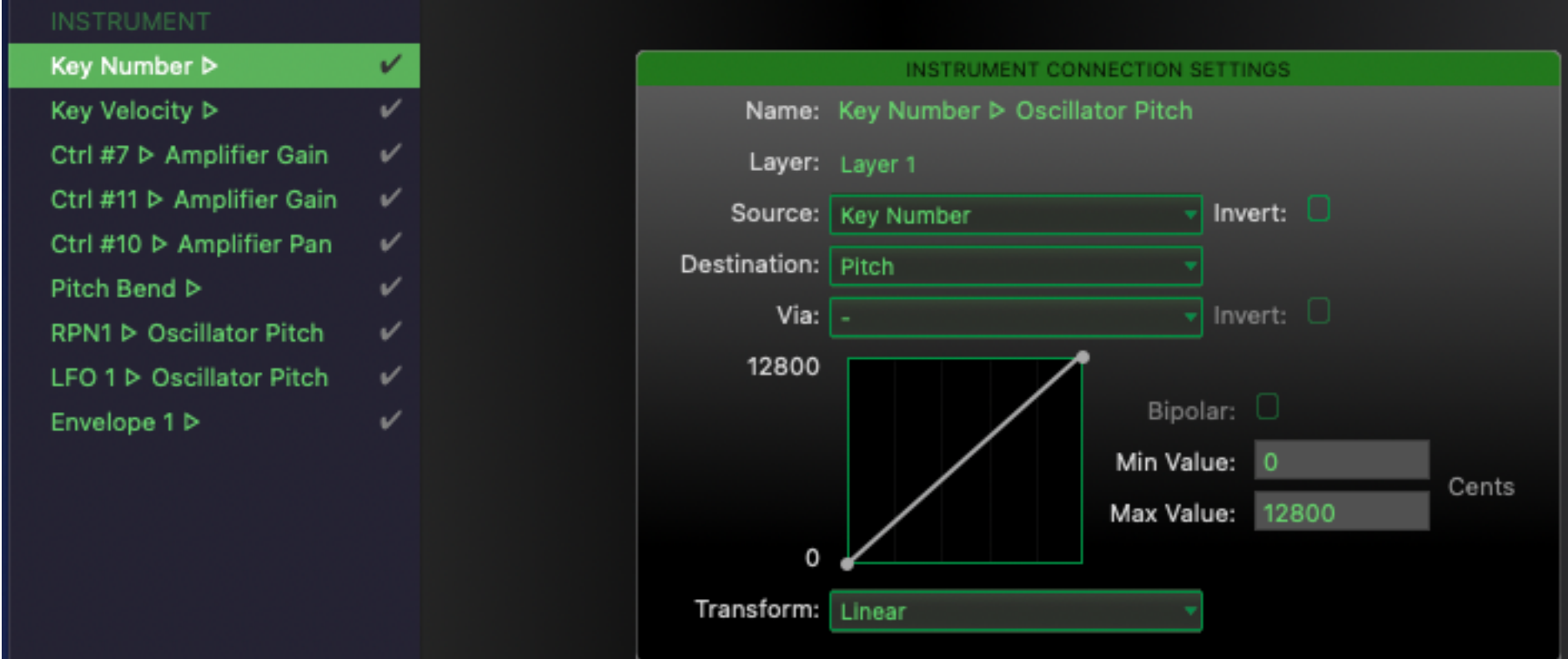
- AUSampler has a limit of 128 audio samples on iOS



Results

- AUSampler has a limit of 128 audio samples on iOS
- It is a global limit across all sampler instances





Function

AudioUnitSetProperty(_:_:_:_:_:_)

Sets the value of an audio unit property.

iOS 2.0+ | iPadOS 2.0+ | Mac Catalyst 13.1+ | macOS 10.0+ | tvOS 9.0+ | visionOS 1.0+

```
func AudioUnitSetProperty(
    _ inUnit: AudioUnit,
    _ inID: AudioUnitPropertyID,
    _ inScope: AudioUnitScope,
    _ inElement: AudioUnitElement,
    _ inData: UnsafeRawPointer?,
    _ inDataSize: UInt32
) -> OSStatus
```

Parameters

inUnit

The audio unit that you want to set a property value for.

inID

The audio unit property identifier.

inScope

The audio unit scope for the property.

inElement

The audio unit element for the property.

inData

The value that you want to apply to the property. May be NULL (see Discussion).

Always pass property values by reference. For example, for a property value of type `CFStringRef`, pass it as `&myCFString`.

Fishhook

Fishhook

“fishhook is a very simple library that enables dynamically rebinding symbols in Mach-O binaries”

FISHOOH README

Rebind

AudioUnitSetProperty

MySetProperty (print id)

Rebind

AudioUnitSetProperty

MySetProperty (print id)



Rebind

AudioUnitSetProperty

MySetProperty (print id)





```
@interface HookLoader : NSObject

@end

@implementation HookLoader

+ (void)load {
    NSLog(@"hook did load\n");

    rebind_symbols(
        (struct rebinding[1]){
            {
                "AudioUnitSetProperty",
                my_set_property,
                (void *)&orig_set_property
            }
        },
        1
    );
}

@end
```



```
OSStatus
my_set_property(AudioUnit inUnit,
                AudioUnitPropertyID inID,
                AudioUnitScope inScope,
                AudioUnitElement inElement,
                const void * __nullable inData,
                UInt32 ioDataSize) {

    printf("set property - inId: %-10d inScope: %-10d inElement: %-10d inDataF: %-10f inDataI: %-10d
dataSize: %-10d\n", inID, inScope, inElement, *(float *)inData, *(int *)inData, ioDataSize);
    orig_set_property(inUnit, inID, inScope, inElement, inData, ioDataSize)
    return result;
}

static OSStatus (*orig_set_property)(AudioUnit inUnit,
                                     AudioUnitPropertyID inID,
                                     AudioUnitScope inScope,
                                     AudioUnitElement inElement,
                                     const void * __nullable inData,
                                     UInt32 ioDataSize);
```




```
> DYLD_INSERT_LIBRARIES=hook.framework/hook /Applications/AU\ Lab\ Resigned.app/Contents/MacOS/AU\ Lab
```



```
> DYLD_INSERT_LIBRARIES=hook.framework/hook /Applications/AU\ Lab\ Resigned.app/Contents/MacOS/AU\ Lab
```

```
2025-10-12 18:00:11.310 AU Lab[63973:102339928] hook did load
```






```
> DYLD_INSERT_LIBRARIES=hook.framework/hook /Applications/AU\ Lab\ Resigned.app/Contents/MacOS/AU\ Lab
```

```
2025-10-12 18:00:11.310 AU Lab[63973:102339928] hook did load
```

```
set - inId: 4171 inScope: 7 inElement: 536870912 inDataF: 0.444234 inDataI: 1055093410 dataSize: 4
```



```
> DYLD_INSERT_LIBRARIES=hook.framework/hook /Applications/AU\ Lab\ Resigned.app/Contents/MacOS/AU\ Lab
```

```
2025-10-12 18:00:11.310 AU Lab[63973:102339928] hook did load
```

```
set - inId: 4171 inScope: 7 inElement: 536870912 inDataF: 0.444234 inDataI: 1055093410 dataSize: 4  
set - inId: 4171 inScope: 7 inElement: 536870912 inDataF: 0.519012 inDataI: 1057283579 dataSize: 4  
set - inId: 4171 inScope: 7 inElement: 536870912 inDataF: 0.539383 inDataI: 1057625352 dataSize: 4  
set - inId: 4171 inScope: 7 inElement: 536870912 inDataF: 0.604910 inDataI: 1058724701 dataSize: 4  
set - inId: 4171 inScope: 7 inElement: 536870912 inDataF: 0.703580 inDataI: 1060380115 dataSize: 4  
set - inId: 4171 inScope: 7 inElement: 536870912 inDataF: 0.787097 inDataI: 1061781302 dataSize: 4
```



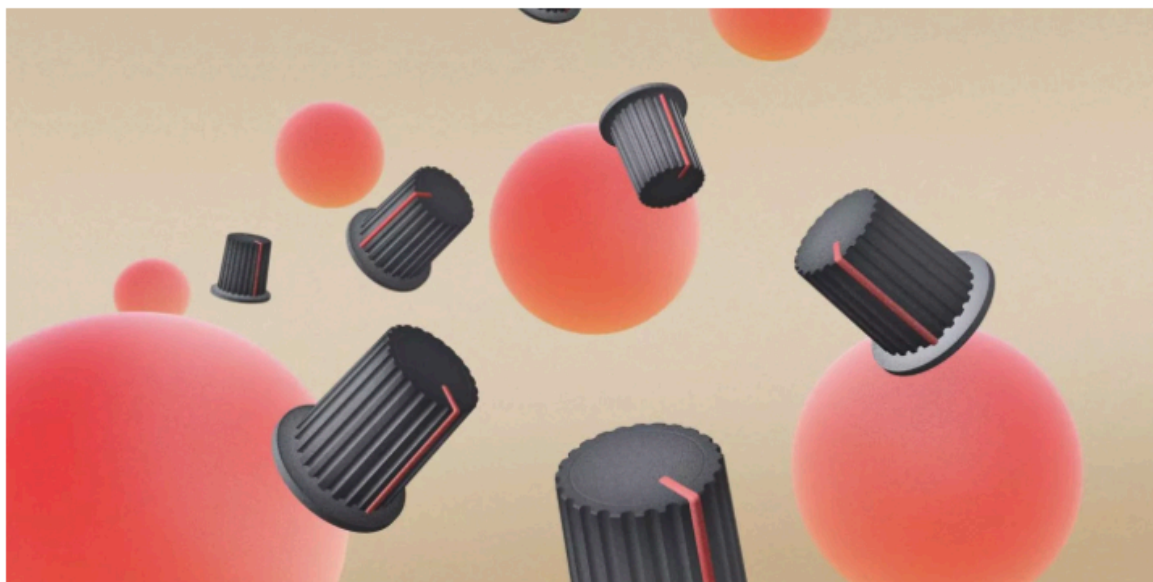

```
> DYLD_INSERT_LIBRARIES=hook.framework/hook /Applications/AU\ Lab\ Resigned.app/Contents/MacOS/AU\ Lab
```

```
2025-10-12 18:00:11.310 AU Lab[63973:102339928] hook did load
```

set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 0.444234	inDataI: 1055093410	dataSize: 4
set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 0.519012	inDataI: 1057283579	dataSize: 4
set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 0.539383	inDataI: 1057625352	dataSize: 4
set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 0.604910	inDataI: 1058724701	dataSize: 4
set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 0.703580	inDataI: 1060380115	dataSize: 4
set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 0.787097	inDataI: 1061781302	dataSize: 4
set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 0.912859	inDataI: 1063891228	dataSize: 4
set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 1.057321	inDataI: 1065834056	dataSize: 4
set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 1.268470	inDataI: 1067605309	dataSize: 4
set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 1.632846	inDataI: 1070661910	dataSize: 4
set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 1.952889	inDataI: 1073346626	dataSize: 4
set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 2.173292	inDataI: 1074468663	dataSize: 4
set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 2.417845	inDataI: 1075494391	dataSize: 4
set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 2.689193	inDataI: 1076632508	dataSize: 4
set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 3.097793	inDataI: 1078346300	dataSize: 4
set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 3.567151	inDataI: 1080314930	dataSize: 4
set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 4.253178	inDataI: 1082661385	dataSize: 4
set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 6.254236	inDataI: 1086857908	dataSize: 4
set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 11.320334	inDataI: 1094000663	dataSize: 4
set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 16.601160	inDataI: 1099222829	dataSize: 4
set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 33.260971	inDataI: 1107626812	dataSize: 4
set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 57.954182	inDataI: 1114099989	dataSize: 4
set - inId: 4171	inScope: 7	inElement: 536870912	inDataF: 60.000000	inDataI: 1114636288	dataSize: 4

03

Results



ENGINEERING

Uncovering the Secrets of AUSampler’s Missing Documentation

We explain the ways of controlling Apple’s AUSampler and discover its hidden secrets – the essential features missing from the official documentation.

JOSIP ČAVAR



ENGINEERING

Can AU Sampler Survive Dynamic Chain Changes?

Continuing our exploration of Apple's AUSampler, we’ve tested it to see if the promise of AVAAudioEngine's dynamic connection abilities holds true.

JOSIP ČAVAR



ENGINEERING

Exploring AU Sampler – Apple’s Mysterious Sampler Audio Unit

Getting acquainted with Apple's powerful, yet underexplored sampler audio unit. We set the stage and learn how to use a simple toolbox.

JOSIP ČAVAR

Scope	Property Name	Property ID (decimal number)	AUPreset Path	Data type	Description
kAudioUnitScope_Global	Voice Count Set	4131	Instrument.voice count	int	Set instrument polyphony
	Transpose	4123	Instrument.coarse tune	int	Set transpose (semitones)
	Voice Count Get	4104	Instrument.voice count	int	Retreives current instrument's voice count
	Panic	4111	N/A	int	Kill all playing notes
kAudioUnitScope_Part	Output	4122	N/A	int	Change output. -1 is a default output.
	Add sample	4144	file-references	custom	Dynamically add a sample to a running sampler instance // Sampler accents 72 byte data structure that
kAudioUnitScope_Layer	Enabled	4121	Instrument.Layers[index].enabled	int	1 to enable or 0 to disable a layer. AudioUnitElement is an index of a layer.
	Add connection	4271	Instrument.Layers[index].Connections	custom	The data type for adding a connection is some private data type
	Remove connection	4134	Instrument.Layers[index].Connections	custom	The data type for removing a connection is some private data type
kAudioUnitScope_LayerItem					
Filter Base ID: 0x40000000	Enabled	4121	Instrument.Layers.Filters.enabled	int	Enable or disable a layer's filter
	Resonance	4162	Instrument.Layers.Filters.resonance	float	Resonance in dB. Range (-3,- 40)
	Cutoff	4161		float	Cutoff frequency in Hz. Range (20,20000)
	Type	N/A	Instrument.Layers.Filters.type	int	Not available in AU Lab. Range: (40,46)
Envelope Base ID: 0x20000000	Enabled	4121	Instrument.Layers.Envelopes[index].enabled		Enable or disable envelope
	Delay	4171	Instrument.Layers.Envelopes[index].Stages[0].time	float	Delay time in seconds. Range (0,60)
	Attack	4172	Instrument.Layers.Envelopes[index].Stages[1].time	float	Attack time in seconds. Range (0,60)
	Hold	4173	Instrument.Layers.Envelopes[index].Stages[2].time	float	Hold time in seconds. Range (0,60)
	Decay	4174	Instrument.Layers.Envelopes[index].Stages[3].time	float	Decay time in seconds. Range (0,60)
	Sustain	4176	Instrument.Layers.Envelopes[index].Stages[4].time	float	Sutsain level. Range (0,1)
	Release	4175	Instrument.Layers.Envelopes[index].Stages[5].time	float	Release time in seconds. Range (0,60)
LFO Base ID: 0x10000000	Enabled	4121	Instrument.Layers.LFOs[index].enabled	int	Enable or disable LFO
					25 - sine 26 - sawtooth 27 - triangle 28 - square 29 - reverse saw 75 - random hold 76 - Rnd interpolated
	Shape	4180	Instrument.Layers.LFOs[index].waveform	int	
	Delay	4181	Instrument.Layers.LFOs[index].delay	float	Delay time in seconds. Range (0,60)
	Rate	4182	Instrument.Layers.LFOs[index].rate	float	Rate in Hz. Range (0.008, 128)

Open Radar

Community bug reports

My Radars

	Number	Created	Status	Product	Title
Modify	rdar://FB15975190	2024-11-27	Open	macOS	Showing Audio Unit view controller twice crashes the app
Modify	rdar://FB13997359	2024-06-21	Open	iPadOS	Error when decoding more then 256 audio files
Modify	rdar://FB12275009	2023-06-08	Open	iOS and macOS	Publicly expose hidden AUSampler parameters and properties
Modify	rdar://FB12234908	2023-06-06	Open	ioS and macOS	AVAudioUnitSampler dropping new notes instead of old notes when max voice count is reached
Modify	rdar://FB12036500	2023-03-06	Open	iOS	RefillBuffer crash when sending a lot of notes to sampler
Modify	rdar://FB11656684	2022-10-06	Open	Documentation	Tech note incorrectly states Sampler search paths
Modify	rdar://FB11331022	2022-08-21	Open	iOS, macOS	AVAudioUnitSampler's preset cleaned up when chain is reconnected
Modify	rdar://FB11292481	2022-08-17	Open	iOS, macOS	Internal splitter audio unit not detached from the graph
Modify	rdar://FB9835828	2022-06-10	Closed	iOS and macOS	AVAudioUnitSampler ignoring new notes when an unknown limit is reached
Modify	rdar://FB10136468	2022-06-10	Closed	iOS and macOS	AVAudioUnitSampler crashes on dealloc
Modify	rdar://FB10136628	2022-06-10	Open	iOS	Resonance connection not working on iOS

iOS 16 limit relaxed to 1024



Conclusion

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- Not everything is open source if you know reverse engineering

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- You can learn a lot

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- And get lucky sometimes

Conclusion

- Not everything is open source if you know reverse engineering
- You can learn a lot
- And get lucky sometimes
- <https://gist.github.com/jcavar/deba97c9bfb05fc29fe1402aabd2f97d>

