FRAPL

Next Generation Reverse Engineering Framework

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ruxcon

Who we are

Alex Hude

- Melbourne, Australia
- Blackmagic Design
- Hardware, XNU
- Fried Apple team

Max Bazaliy

- Kyiv, Ukraine
- Lookout
- XNU, Linux, LLVM
- Fried Apple team

Modern Reverse Engineering

Static approach

- Disassemblers
- Code analyzers
- Decompilers
- IDA as a choice

Dynamic approach

- Code instrumentation
- Dynamic analyzers
- Debuggers
- Frida as a choice

Static analysis challenges

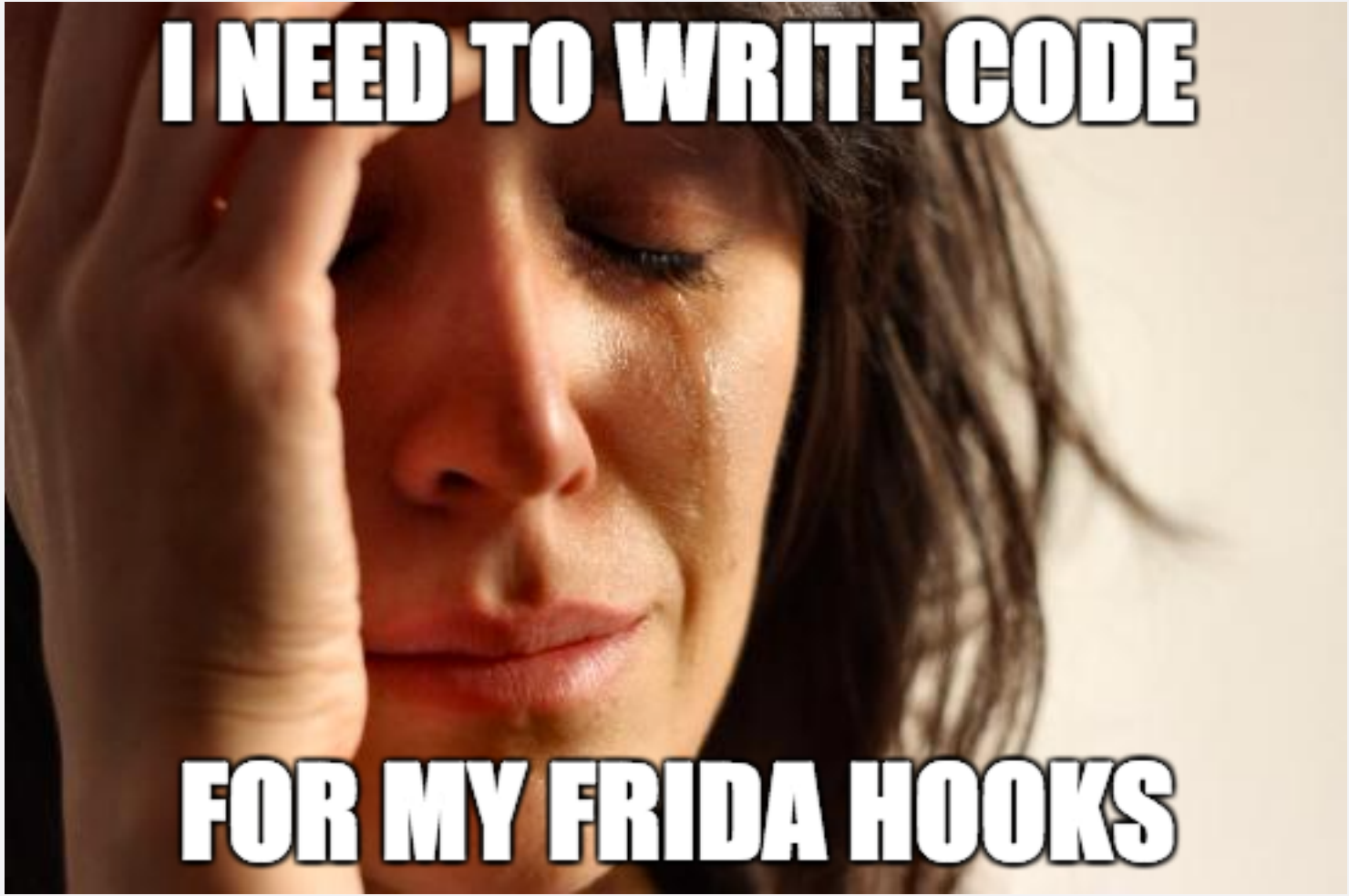
- Missed context (CPU registers, stack, memory)
- Hard to follow code execution flow (obfuscation)
- Hard to follow data flow (encryption)
- Hard to follow indirect function calls

Debugging challenges

- Anti debugging tricks
- Data loss during restarts
- Execution flow may be changed under debugging
- No way to hook/replace existing code easily

Dynamic instrumentation challenges

- Code disassembly still missed
- High learning curve
- Usually requires to write a lot of code
- Hard to maintain multiple things at a time


I NEED TO WRITE CODE
FOR MY FRIDA HOOKS


FRAPL

What is FRAPL ?

FRAPL

=

Frida scripts + FridaLink

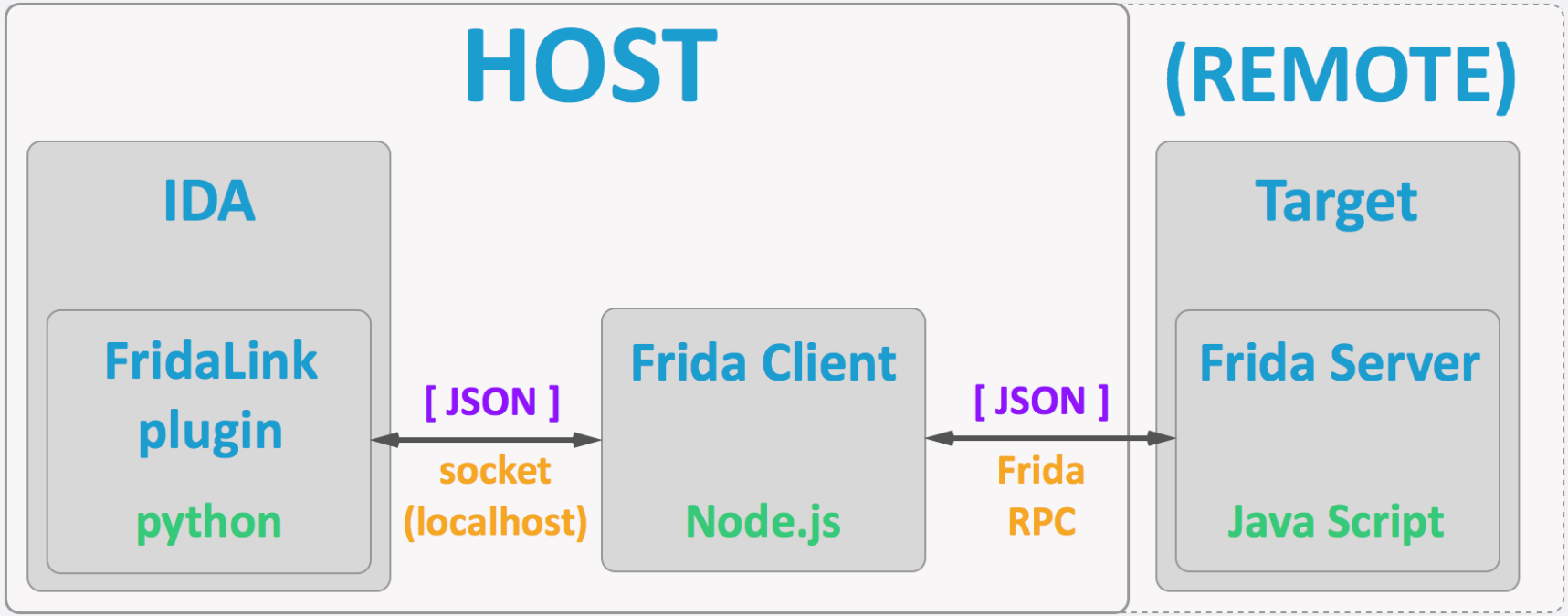
Frida Scripts

- Node.js client (attach, spawn, RPC, script loading)
- Node.js server script (RPC, GCD, iOS/macOS bindings)
- Common operations wrappers (objc hooks etc)
- Utility functions (memory dumps, logging)

FridaLink

- IDA plugin that implements UI controls to Frida
- Socket protocol between IDA & Frida Client (JSON)
- RPC protocol for between Frida Client Server (JSON)
- FridaLink.js (Frida script)

FridaLink architecture



FridaLink goals

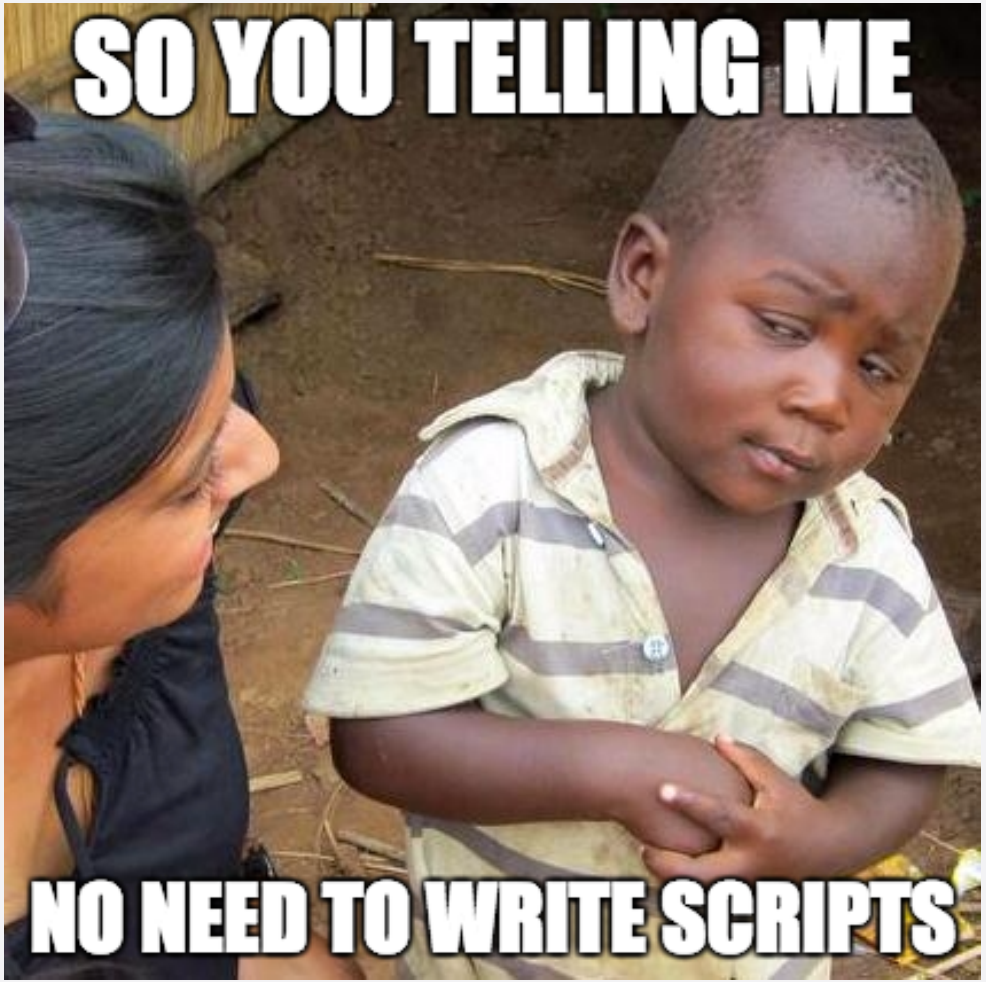
- Bring static analysis info from IDA to Frida
- Use dynamic info from Frida for IDA analysis
- Monitor runtime state directly from IDA
- Control Frida agent directly from IDA

FridaLink features

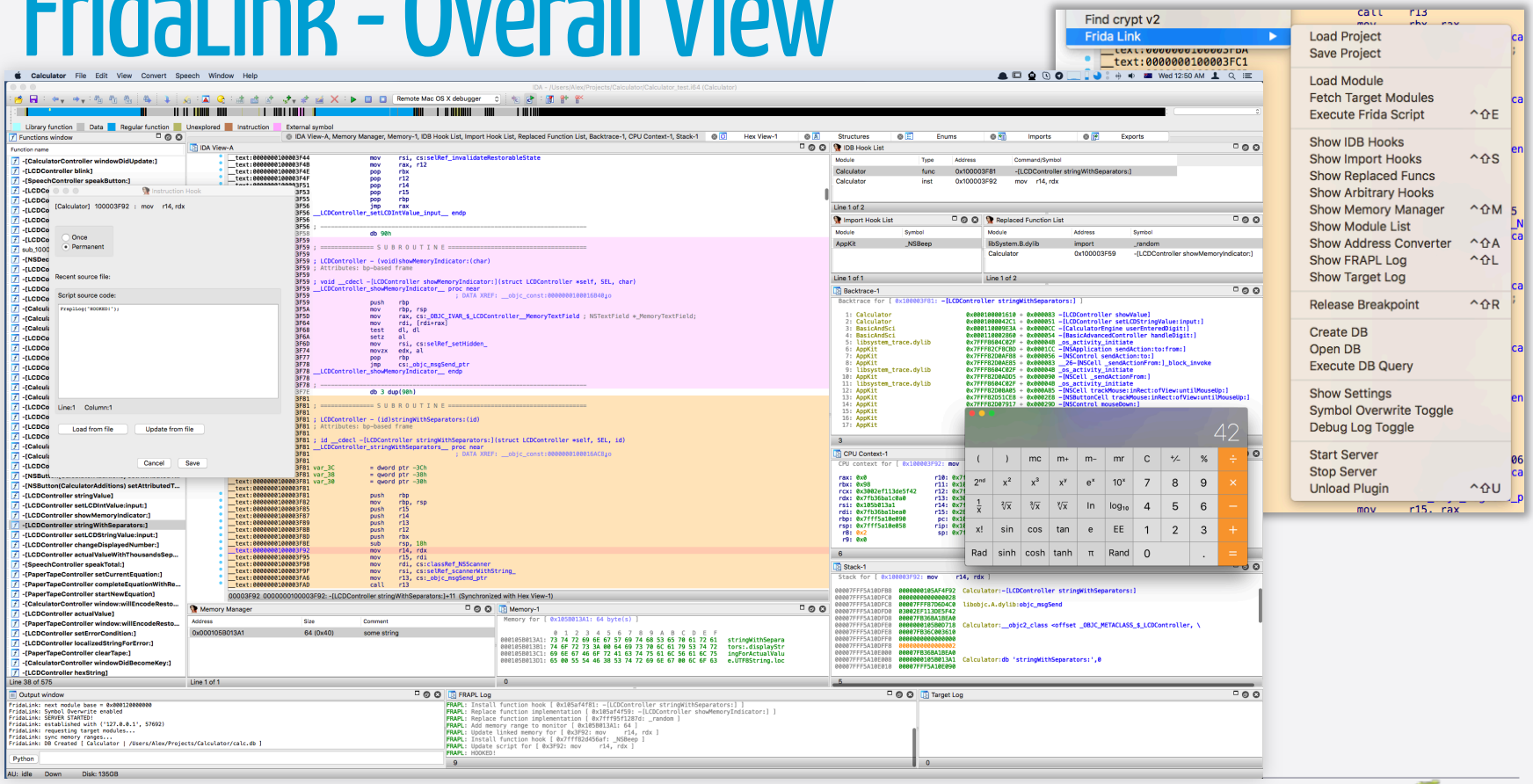
- Direct function hooks made easy
- Function replacement made easy
- Module loading made easy
- Custom scripts support

FridaLink features

- CPU context monitoring
- Memory monitoring
- SQLite database support
- Helpers and project save/restore

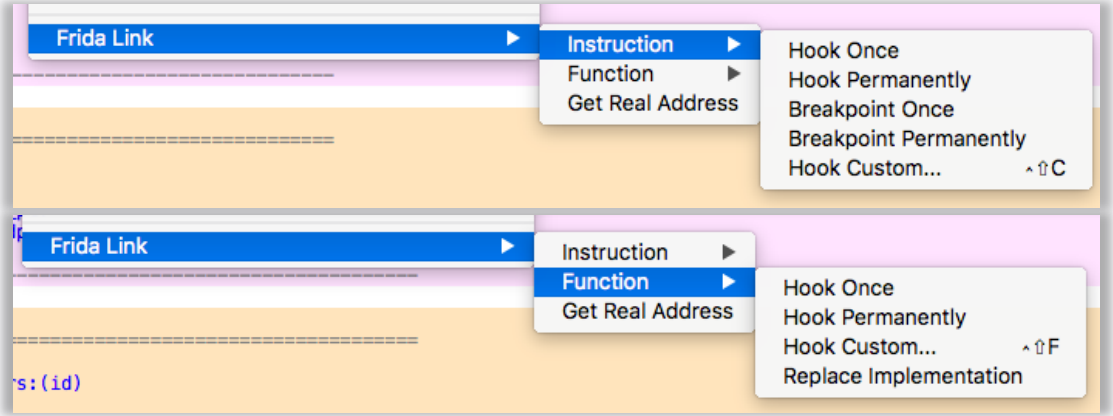

SO YOU TELLING ME
NO NEED TO WRITE SCRIPTS

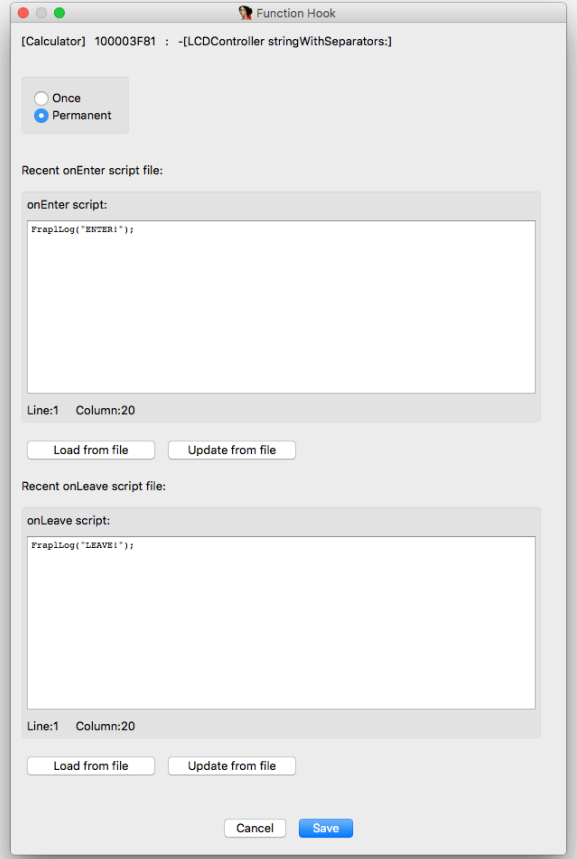
FridaLink - Overall View



FridaLink – Hooks

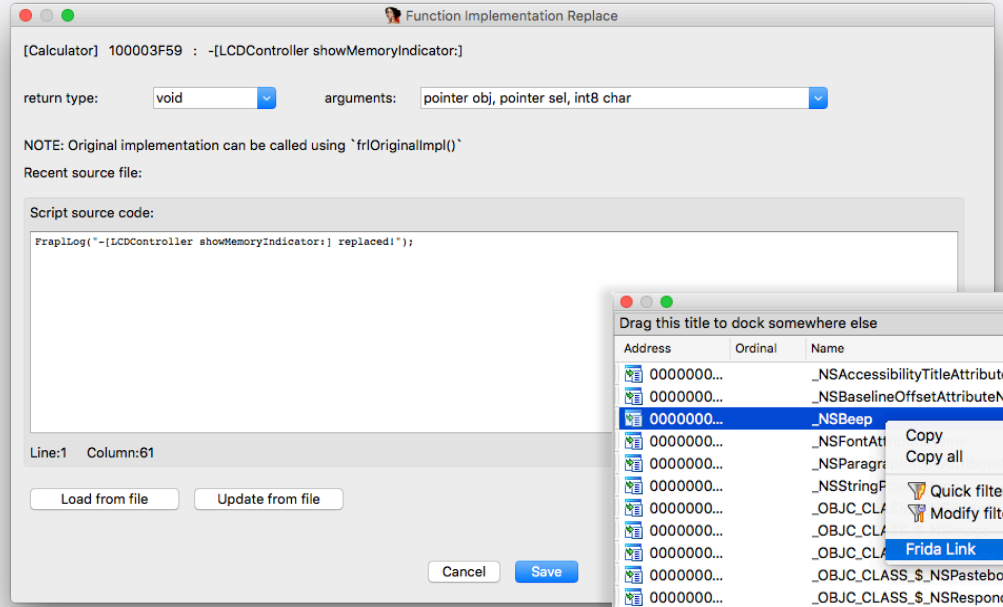
- Instruction hooks
- Instruction breakpoints (hook with wait)
- IDB (local) function hooks
- Import function hooks



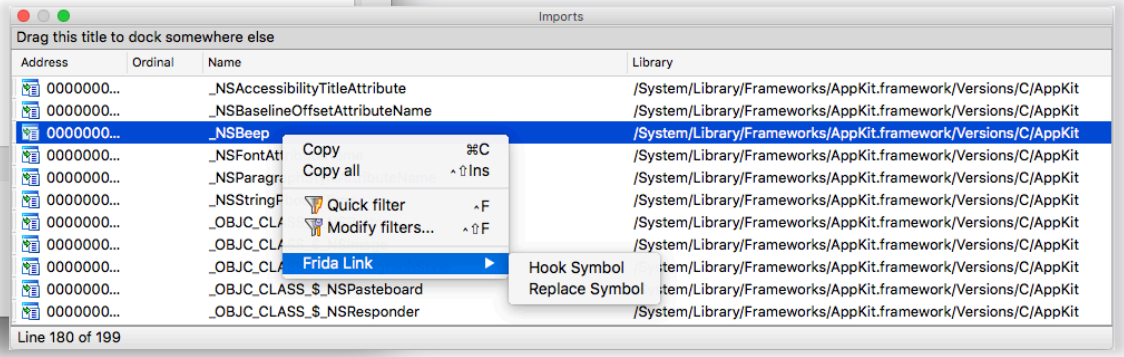


FridaLink – Function Replacement

Replace local function

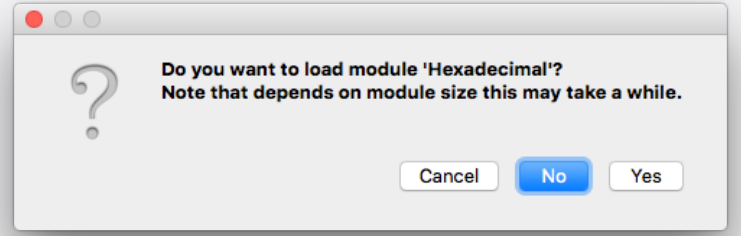


Replace Import function



FridaLink – Module Loading

- Automatic (on backtrace)
- Manual

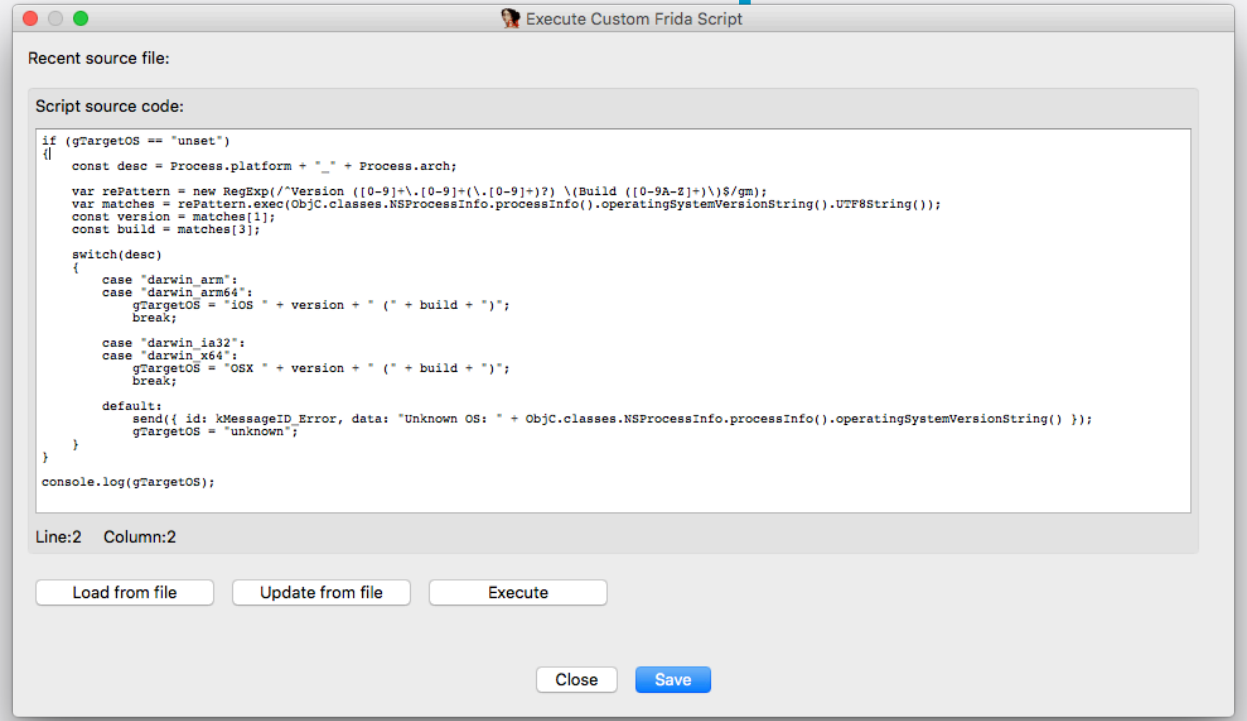


Target Module List

Module	Base	Path	Size
Calculator	0x10dfe1000	/Users/Alex/Projects/Calculator/Calculator.app/Contents/MacOS/Calculator	86016 (0x15000)
Cocoa	0x7fff9ea95000	/System/Library/Frameworks/Cocoa.framework/Versions/A/Cocoa	4096 (0x1000)
SpeechDictionary	0x10e008000	/System/Library/PrivateFrameworks/SpeechDictionary.framework/Versions/A/SpeechDictionary	569344 (0x8B000)
SpeechObjects	0x10e0cd000	/System/Library/PrivateFrameworks/SpeechObjects.framework/Versions/A/SpeechObjects	139264 (0x22000)
Calculate	0x7fff9117c000	/System/Library/PrivateFrameworks/Calculate.framework/Versions/A/Calculate	77824 (0x13000)
ApplicationServices	0x7fff93d77000	/System/Library/Frameworks/ApplicationServices.framework/Versions/A/ApplicationServices	4096 (0x1000)
QuartzCore	0x7fff8f1ae000	/System/Library/Frameworks/QuartzCore.framework/Versions/A/QuartzCore	1896448 (0x1CF000)
Foundation	0x7fff9c67d000	/System/Library/Frameworks/Foundation.framework/Versions/C/Foundation	3493888 (0x355000)
libobjc.A.dylib	0x7fff962ed000	/usr/lib/libobjc.A.dylib	3588096 (0x36C000)
libSystem.B.dylib	0x7fff9ccc4000	/usr/lib/libSystem.B.dylib	8192 (0x2000)

Line 1 of 223

FridaLink – Custom Scripts



Execute custom script dialog

FridaLink – CPU Context Monitoring

Stack

Stack-1

```
Stack for [ 0x100003F92: mov     r14, rdx ]

00007FFF5A10DFB8  0000000105AF4F92  Calculator:-[LCDController stringWithSeparators:]
00007FFF5A10DFC0  0000000000000028
00007FFF5A10DFC8  00007FFF87D6D4C0  libobjc.A.dylib:objc_msgSend
00007FFF5A10DFD0  03002EF113DE5F42
00007FFF5A10DFD8  00007FB36BA1BEA0
00007FFF5A10DFE0  0000000105B0D718  Calculator:__objc2_class <offset _OBJC_METACLASS_$_LCDController, \
00007FFF5A10DFE8  00007FB36E8EFA10
00007FFF5A10DFF0  0000000000000000
00007FFF5A10DFF8  0000000000000002
00007FFF5A10E000  00007FB36BA1BEA0
00007FFF5A10E008  0000000105B013A1  Calculator:db 'stringWithSeparators:',0
00007FFF5A10E010  00007FFF5A10E090
00007FFF5A10E018  00007FFF5A10E058
00007FFF5A10E020  0000000000000098
00007FFF5A10E028  00007FB36BA1C0A0
00007FFF5A10E030  03002EF113DE5F42
00007FFF5A10E038  0000000000000000
00007FFF5A10E040  0000000000000206
00007FFF5A10E048  00007FB36E856700
00007FFF5A10E050  0000000105B013A1  Calculator:db 'stringWithSeparators:',0
00007FFF5A10E058  00007FFF5A10E0F0
00007FFF5A10E060  00007FFF5A10E0A0
00007FFF5A10E068  0000000000000098
00007FFF5A10E070  00007FB36BA1BEA0
00007FFF5A10E078  03002EF113DE5F42
00007FFF5A10E080  00007FFF87D6D4C0  libobjc.A.dylib:objc_msgSend
00007FFF5A10E088  0000000000000028
00007FFF5A10E090  00007FFF5A10E0F0
00007FFF5A10E098  000000010D5CA413
00007FFF5A10E0A0  00007FFF87D6D4C0  libobjc.A.dylib:objc_msgSend
00007FFF5A10E0A8  0000000000000030
00007FFF5A10E0B0  00007FFF966E9BAD  CoreFoundation:CreateStringFromFileSystemRepresentationByAdding
00007FFF5A10E0B8  00007FB36A592A30
00007FFF5A10E0C0  03002EF113DE5F42
00007FFF5A10E0C8  00007FB36BA1BEA0
00007FFF5A10E0D0  00007FFF87D6D4C0  libobjc.A.dylib:objc_msgSend
00007FFF5A10E0D8  0000000000000030
00007FFF5A10E0E0  00007FFF87D6D4C0  libobjc.A.dylib:objc_msgSend
00007FFF5A10E0E8  0000000000000028
00007FFF5A10E0F0  00007FFF5A10E110
00007FFF5A10E0F8  0000000105AF5312  Calculator:-[LCDController setLCDStringValue:input:]
12
```

CPU context

CPU Context-1

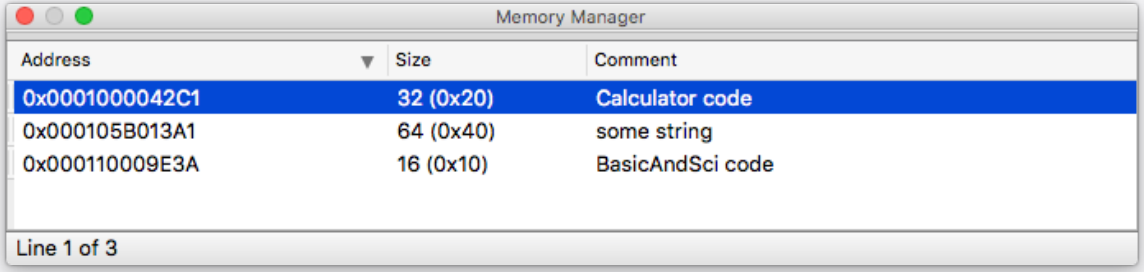
```
Drag this title to dock somewhere else
CPU context for [ 0x100003F92: mov     r14, rdx ]

rax: 0x0                  r10: 0x7fb36c003610
rbx: 0x98                 r11: 0x105b0d718
rcx: 0x3002ef113de5f42    r12: 0x7fb36ba1bea0
rdx: 0x7fb36ba1c0a0       r13: 0x3002ef113de5f42
rsi: 0x105b013a1          r14: 0x7fff87d6d4c0
rdi: 0x7fb36ba1bea0       r15: 0x28
rbp: 0x7fff5a10e090        pc: 0x105af4f92
rsp: 0x7fff5a10e058       rip: 0x105af4f92
 r8: 0x2                   sp: 0x7fff5a10e058
 r9: 0x0

Synchronize with ▶
1 Column
2 Columns
3 Columns

4
```

Backtrace

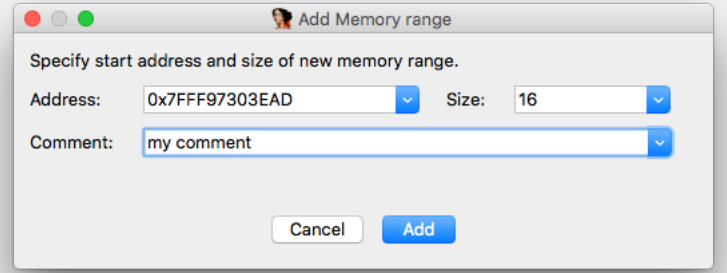
Backtrace-1

```
Backtrace for [ 0x100003F81: -[LCDController stringWithSeparators:] ]

 1: Calculator                0x000100001610 + 0x000083 -[LCDController showValue]
 2: Calculator                0x0001000042C1 + 0x000051 -[LCDController setLCDStringValue:input:]
 3: BasicAndSci               0x000110009E3A + 0x0000CC -[CalculatorEngine userEnteredDigit:]
 4: BasicAndSci               0x000110002860 + 0x000054 -[BasicAdvancedController handleDigit:]
 5: libsystem_trace.dylib     0x7FFF8604C02F + 0x00004B _os_activity_initiate
 6: AppKit                    0x7FFF82CF8CBD + 0x0001CC -[NSApplication sendAction:to:from:]
 7: AppKit                    0x7FFF82D0AF88 + 0x000056 -[NSControl sendAction:to:]
 8: AppKit                    0x7FFF82D0AE85 + 0x000083 __26-[NSCell _sendActionFrom:]_block_invoke
 9: libsystem_trace.dylib     0x7FFF8604C02F + 0x00004B _os_activity_initiate
10: AppKit                    0x7FFF82D0ADD5 + 0x000090 -[NSCell _sendActionFrom:]
11: libsystem_trace.dylib     0x7FFF8604C02F + 0x00004B _os_activity_initiate
12: AppKit                    0x7FFF82D08A05 + 0x000A85 -[NSCell trackMouse:inRect:ofView:untilMouseUp:]
13: AppKit                    0x7FFF82D51CE8 + 0x0002E8 -[NSButtonCell trackMouse:inRect:ofView:untilMouseUp:]
14: AppKit                    0x7FFF82D07917 + 0x00029D -[NSControl mouseDown:]
15: AppKit                    0x7FFF8325ABB7 + 0x0018B2 -[NSWindow _handleMouseDownEvent:isDelayedEvent:]
16: AppKit                    0x7FFF8325D379 + 0x0000D4 -[NSWindow _reallySendEvent:isDelayedEvent:]
17: AppKit                    0x7FFF82C9C438 + 0x000205 -[NSWindow sendEvent:]

3
```

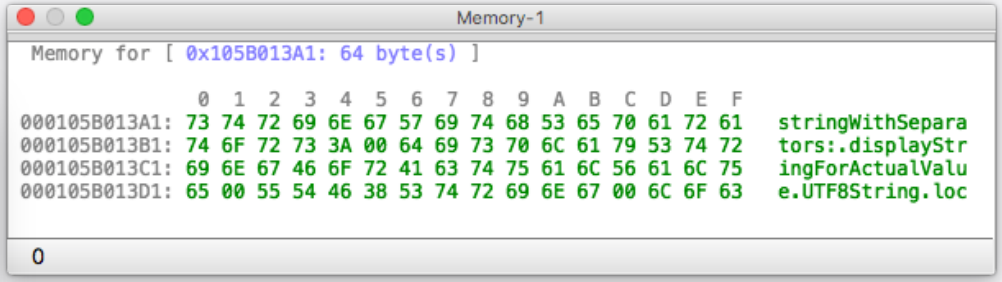
FridaLink – Memory Monitoring



Memory manger

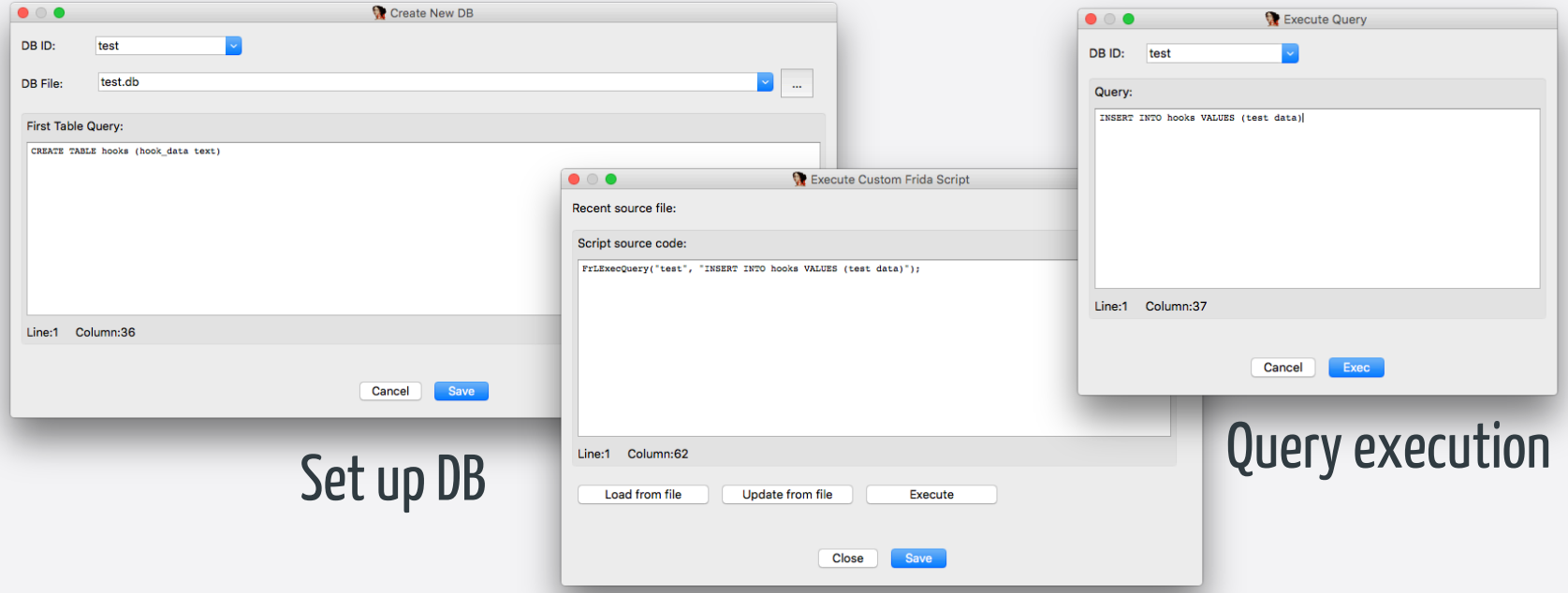


Add new memory watchpoint

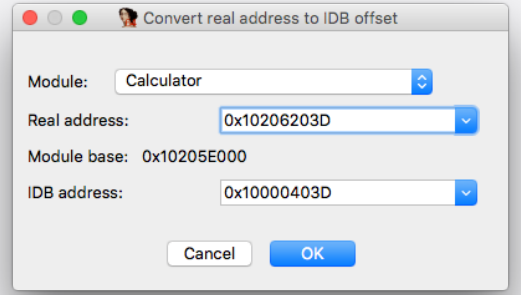


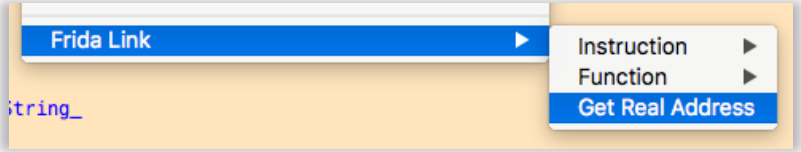
Memory content

FridaLink – SQLite Support

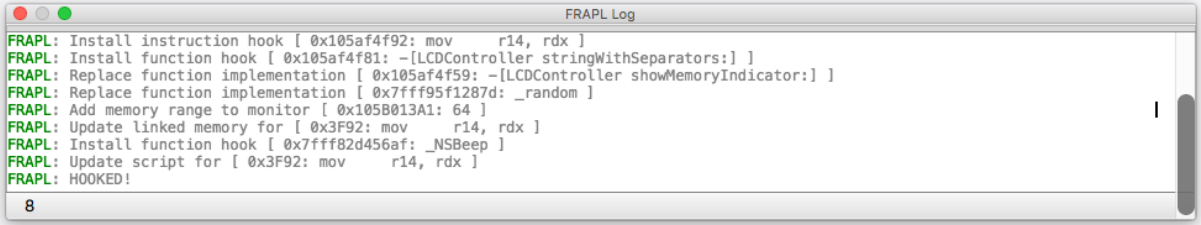


FridaLink – Helpers and more



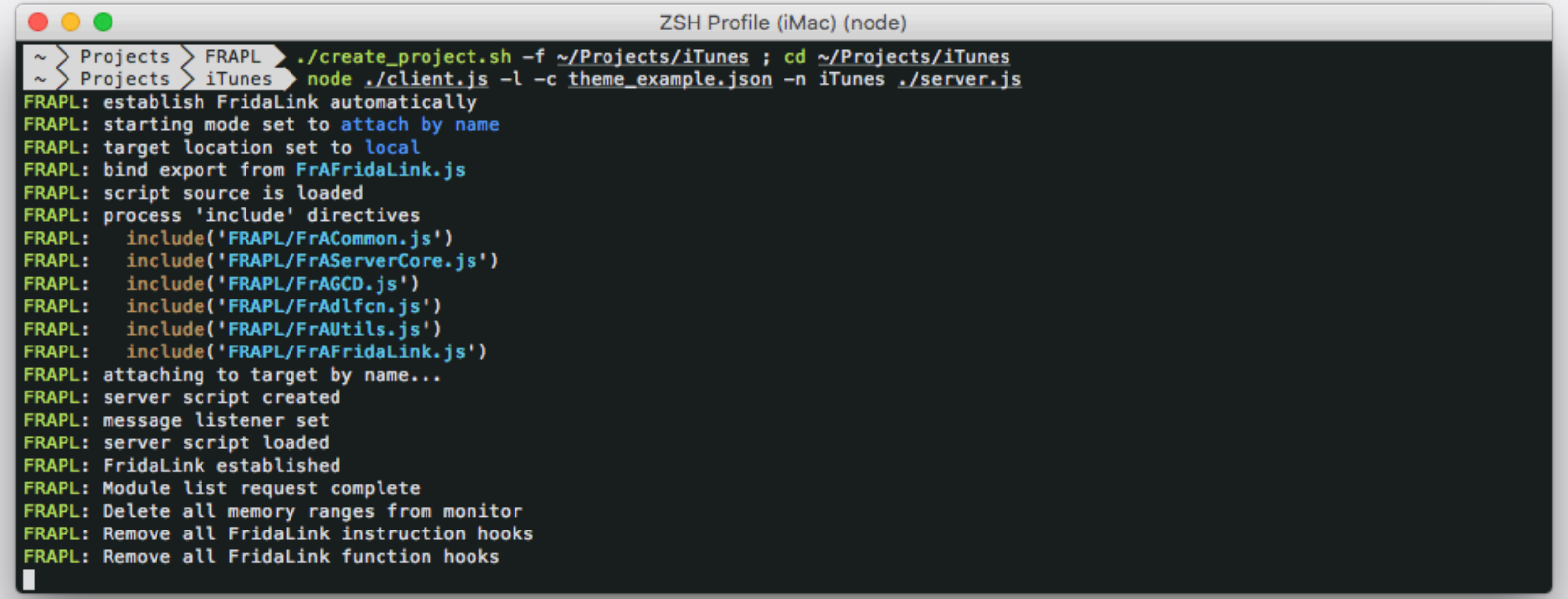


Address converter

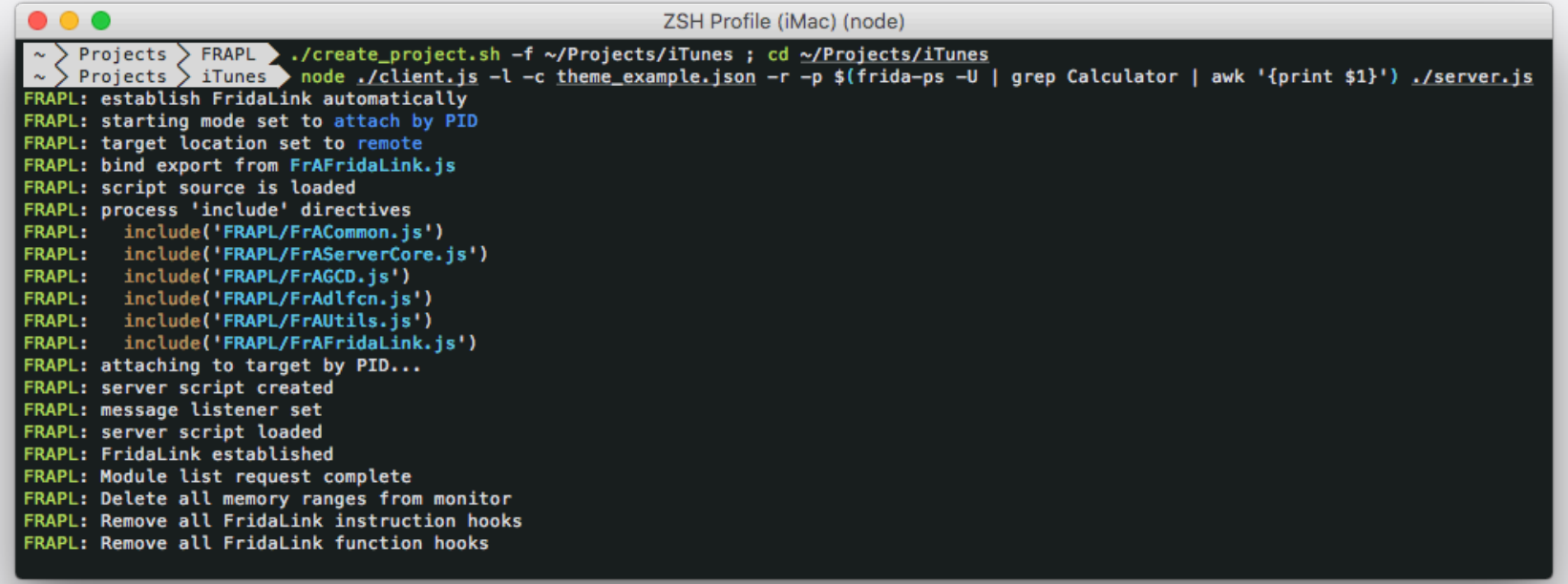


FRAPL logs

macOS Application Demo



iOS Application Demo




WEN ETA RELES ??

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Future plans

- Kernel support
- Windows support ?
- Android support ?
- Hack the planet!

@getorix

@mbazaliy