SYNACKTIV

Strings deobfuscation in pseudocode with microcode manipulation

04/07/2023

Case Study

- **Triangle DB**
  - iOS malware
- **Analysis**
  - https://securelist.com/triangledb-triangulation-implant/110050/
- **Sample**
  - fd9e97cfb55f9cfb5d3e1388f712edd952d902f23a583826ebe55e9e322f730f

Case Study


```
id __cdecl -[CRConfig getBuildArchitecture](CRConfig *self, SEL a2)
{
  return +[CRConfig unmungeHexString:](&OBJC_CLASS___CRConfig, "unmungeHexString:", CFSTR("61137e487c19"));
}
```

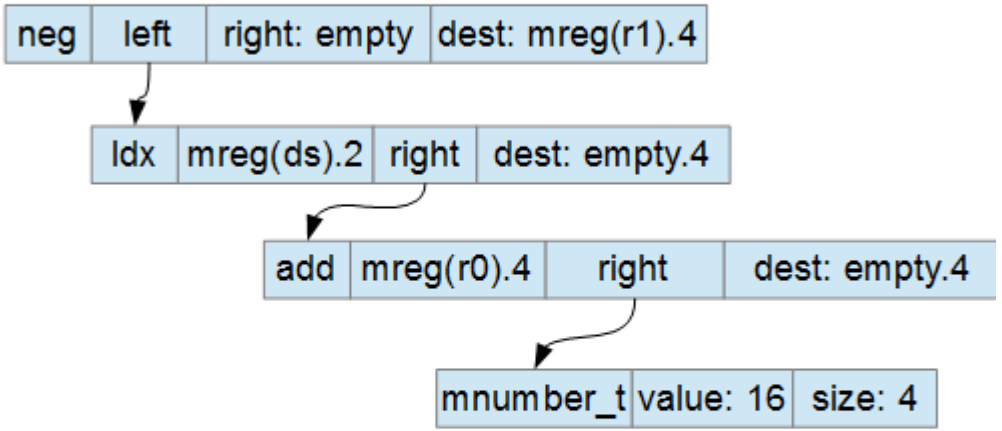
arm64e

Microcode manipulation

- **Intermediate representation between assembly and C**
  - Write 1 assembly → microcode per architecture
  - Apply the same optimizations to microcode for all architectures
- **Called pcode in Ghidra**
  - Java API :(

Micro-instruction in IDA

- **1 opcode, multiple operands**
  - Instructions can also be operands



Writing the plugin

- optinsn_t plugin to optimize individual instructions
- Wait for maturity MMAT_CALLS
- Check if the instruction is a call to unmungeHexString
- Fetch the string
- Decode it
- Replace the microcode

Finding the call

- **Objective-C calls are done with objc_msgSend and a string**
  - IDA is smart enough to replace it with the direct function call
  - But we are before this optimization pass

```
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Putting it all together

```
objc_msgSend = ida_name.get_name_ea(idaapi.BADADDR, "_objc_msgSend")
unmunge = b'unmungeHexString:'
```

```
objc_msgSend = ida_name.get_name_ea(idaapi.BADADDR, "_objc_msgSend")
unmunge = b'unmungeHexString:'

class UnmungeHexStrings(optinsn_t):
    def func(self, blk: mblock_t, ins: minsn_t) -> bool:
        if blk.mba.maturity == MMAT_CALLS:
            call, mop = ins.find_ins_op()
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        if blk.mba.maturity == MMAT_CALLS:
            call, mop = ins.find_ins_op()

            # Check that we have a call to objc_msgSend
            if not call: return 0
            if not call.l.t == mop_v: return 0
            if not call.l.g == objc_msgSend: return 0
```

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            # Check that we have a call to objc_msgSend
            if not call: return 0
            if not call.l.t == mop_v: return 0
            if not call.l.g == objc_msgSend: return 0

            # Check args type and that it is unmungeHexString
            f = call.d.f
            if not len(f.args) == 3: return 0
            if not f.args[1].t == mop_a or not f.args[2].t == mop_a: return 0
            if not get_strlit_contents(f.args[1].a.g) == unmunge: return 0
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            # Get string data from CFSTR
            addr = get_qword(f.args[2].a.g + 16)
            h = bytes.fromhex(get_strlit_contents(addr).decode("ascii"))

            # Decode the string
            s = decode(h)
```

```
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        if blk.mba.maturity == MMAT_CALLS:
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            # Check that we have a call to objc_msgSend
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            # Check args type and that it is unmungeHexString
            f = call.d.f
            if not len(f.args) == 3: return 0
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            if not get_strlit_contents(f.args[1].a.g) == unmunge: return 0

            # Get string data from CFSTR
            addr = get_qword(f.args[2].a.g + 16)
            h = bytes.fromhex(get_strlit_contents(addr).decode("ascii"))

            # Decode the string
            s = decode(h)

            # Replace the string
            ins.l._make_strlit(s)
            return 1
        return 0
```

Result


```
id __cdecl -[CRConfig getBuildArchitecture](CRConfig *self, SEL a2)
{
  return "arm64e";
}
```

More examples

- **Hexrays vs Obfuscating compiler**
  - https://hex-rays.com/blog/hex-rays-microcode-api-vs-obfuscating-compiler/
- **7 days to lift**
  - https://blog.ret2.io/2020/07/22/ida-pro-avx-decompiler/
- **d810**
  - https://eshard.com/posts/d810-deobfuscation-ida-pro
  - https://eshard.com/posts/D810-a-journey-into-control-flow-unflattening

IDA References

- **SDK Hexrays:**
  - https://hex-rays.com/products/decompiler/manual/sdk/index.shtml
- **VM used by microcode**
  - https://hex-rays.com/products/decompiler/manual/sdk/vmpage.shtml
- **Decompiler Internals**
  - https://i.blackhat.com/us-18/Thu-August-9/us-18-Guilfanov-Decompiler-Internals-Microcode-wp.pdf
  - https://www.youtube.com/watch?v=T-YkhNEIvng
- **Microcode in pictures:**
  - https://hex-rays.com/blog/microcode-in-pictures/

https://www.linkedin.com/company/synacktiv
https://twitter.com/synacktiv
Nos publications sur : https://synacktiv.com