WRITEUP EKOPARTY PRECTF 2016 by @fz

BACKDOOR

- Con 7z descomprimi el archivo que resulto ser un binario de vsftpd
- Haciendo `strings` sobre el archivo me entere que era la version 3.0.3 por lo que busque el codigo fuente, lo compile e hice un diff entre los strings de los dos binarios; una cosa que salto inmediatamente es que el backdoor tenia `execl`.
- Usando radare2 busque las referencias de donde se usaba excel y comparando con el binario original me di cuenta que estaba reemplazando la funcion `str_contains_space` que se ejecuta en el chequeo del comando `USER` informacion que resulto ser util para debuggear con gdb.
- Leyendo el ASM de esta nueva funcion deduje que el string se esperaba que sea de 18 chars (cmp eax, 0x12) y que el string era validado con la regla:

#13 + #14 = 0xcb
#13 + #12 = 0xcf
#10 + #11 = 0xc3
#8 + #9 = 0xd4
#12 + #11 = 0xc9
#0 = 'E'
#15 + #14 = 0xd7
#5 + #6 = 0xd9
#10 + #9 = 0xc3
#4 + #5 = 0xe9
#3 + #4 = 0xf1
#16 + #17 = 0xf2
#1 + #2 = 0x9a
#3 + #2 = 0xca
#1 = 'K'
#7 + #6 = 0xda
#7 + #8 = 0xe4
#16 + #15 = 0xeb

Luego corri el script que adjunto (backdoor.py) y obtuve la bandera

```
$ 7z x backdoor
$ radare2 vsftpd
$ strings vsftpd-3.0.3/vsftpd > 1
$ strings vsftpd > 2
$ diff -Nru 1 2

(...)
@@ -11,6 +11,7 @@
 chroot
 socket
 fchmod
+execl
 stand
(...)

$ radare2 vftpd
[0x...] V
```

p
p (para ver asm)
_ (para buscar el symbol)
execl

```
> exe|
 - 0x00221fb0  reloc.execl_176
   0x00000000  sym.imp.execl
   0x00003fd8  sub.execl_176_fd8
```

Despues segui a ver quien llamaba a la función que tiene un xref a execl y era:

```
[0x00015ce4 62% 171 vsftpd]> pd $r @ fcn.00015c20+196 # 0x15ce4
|      ||   0x00015ce4      e867e0feff     call sub.dup2_24_d50
|      ||   0x00015ce9      89df           mov edi, ebx
|      ||   0x00015ceb      be01000000     mov esi, 1
|      ||   0x00015cf0      e85be0feff     call sub.dup2_24_d50
|      ||   0x00015cf5      89df           mov edi, ebx
|      ||   0x00015cf7      be02000000     mov esi, 2
|      ||   0x00015cfc      e84fe0feff     call sub.dup2_24_d50
|      ||   0x00015d01      31d2           xor edx, edx
|      ||   0x00015d03      4c89ee         mov rsi, r13
|      ||   0x00015d06      4c89e7         mov rdi, r12
|      ||   0x00015d09      31c0           xor eax, eax
|      ||   0x00015d0b      c644241573     mov byte [rsp + local_15h]
|      ||   0x00015d10      c64424136e     mov byte [rsp + local_13h]
|      ||   0x00015d15      c644241162     mov byte [rsp + local_11h]
|      ||   0x00015d1a      c644241700     mov byte [rsp + local_17h]
|      ||   0x00015d1f      c644241668     mov byte [rsp + local_16h]
|      ||   0x00015d24      c64424142f     mov byte [rsp + local_14h]
|      ||   0x00015d29      c644241269     mov byte [rsp + local_12h]
|      ||   0x00015d2e      c64424102f     mov byte [rsp + local_10h]
|      ||   0x00015d33      c6042473       mov byte [rsp], 0x73
|      ||   0x00015d37      c644240168     mov byte [rsp + local_1h],
|      ||   0x00015d3c      c644240200     mov byte [rsp + local_2h],
|      ||   0x00015d41      e892e2feff     call sub.execl_176_fd8
|      `==< 0x00015d46      e96dffffff     jmp 0x15cb8
|        |  0x00015d4b      bf01000000     mov edi, 1
|        |  0x00015d50      e863e2feff     call sub.exit_136_fb8
|        |  0x00015d55      90             nop
\        |  0x00015d56      662e0f1f8400.  nop word cs:[rax + rax]
/ (fcn) fcn.00015d60 15
|        |  ; CALL XREF from 0x000045ec (main)
|        |  ; CALL XREF from 0x0000f57b (fcn.0000f530)
|        |  0x00015d60      4889fe         mov rsi, rdi
|        |  0x00015d63      488d3d66dc20.  lea rdi, [rip + 0x20dc66]
```

Que tiene un xref a 0xccc0 con la logica mencionada anteriormente:

```
  |||||||   0x0000cd19      0f1f80000000.  nop dword [rax]
| |||||||   0x0000cd20      488b07         mov rax, qword [rdi]
| |||||||   0x0000cd23      0fbe480d       movsx ecx, byte [rax + 0xd
| |||||||   0x0000cd27      0fbe500e       movsx edx, byte [rax + 0xe
| |||||||   0x0000cd2b      8d3411         lea esi, [rcx + rdx]
| |||||||   0x0000cd2e      81fecb000000   cmp esi, 0xcb
| `=======< 0x0000cd34      75a3           jne 0xccd9
|  ||||||   0x0000cd36      0fbe700a       movsx esi, byte [rax + 0xa
|  ||||||   0x0000cd3a      0fbe780b       movsx edi, byte [rax + 0xb
|  ||||||   0x0000cd3e      448d043e       lea r8d, [rsi + rdi]
|  ||||||   0x0000cd42      4181f8c30000.  cmp r8d, 0xc3
|  `======< 0x0000cd49      758e           jne 0xccd9
|   |||||   0x0000cd4b      440fbe480c     movsx r9d, byte [rax + 0xc
|   |||||   0x0000cd50      4401c9         add ecx, r9d
|   |||||   0x0000cd53      81f9cf000000   cmp ecx, 0xcf
|   `=====< 0x0000cd59      0f857affffff   jne 0xccd9
|    ||||   0x0000cd5f      440fbe4008     movsx r8d, byte [rax + 8]
|    ||||   0x0000cd64      440fbe5009     movsx r10d, byte [rax + 9]
|    ||||   0x0000cd69      438d0c10       lea ecx, [r8 + r10]
|    ||||   0x0000cd6d      81f9d4000000   cmp ecx, 0xd4
|    `====< 0x0000cd73      0f8560ffffff   jne 0xccd9
|     |||   0x0000cd79      4401cf         add edi, r9d
|     |||   0x0000cd7c      81ffc9000000   cmp edi, 0xc9
|     `===< 0x0000cd82      0f8551ffffff   jne 0xccd9
|      ||   0x0000cd88      803845         cmp byte [rax], 0x45
|      `==< 0x0000cd8b      0f8548ffffff   jne 0xccd9
|        |  0x0000cd91      0fbe480f       movsx ecx, byte [rax + 0xf
|        |  0x0000cd95      01ca           add edx, ecx
|        |  0x0000cd97      81fad7000000   cmp edx, 0xd7
|        `=< 0x0000cd9d      0f8536ffffff   jne 0xccd9
```

Backdoor.py

```
known = {
    0: 'E',
    1: 'K',
    2: 'O',
    3: '{',
    17: '}',
}

equation = [
    (13, 14, 0xcb),
    (13, 12, 0xcf),
    (10, 11, 0xc3),
    (8, 9, 0xd4),
    (12, 11, 0xc9),
    (15, 14, 0xd7),
    (5, 6, 0xd9),
    (10, 9, 0xc3),
    (4, 5, 0xe9),
    (3, 4, 0xf1),
    (16, 17, 0xf2),
    (1, 2, 0x9a),
    (3, 2, 0xca),
    (7, 6, 0xda),
    (7, 8, 0xe4),
    (16, 15, 0xeb),
]

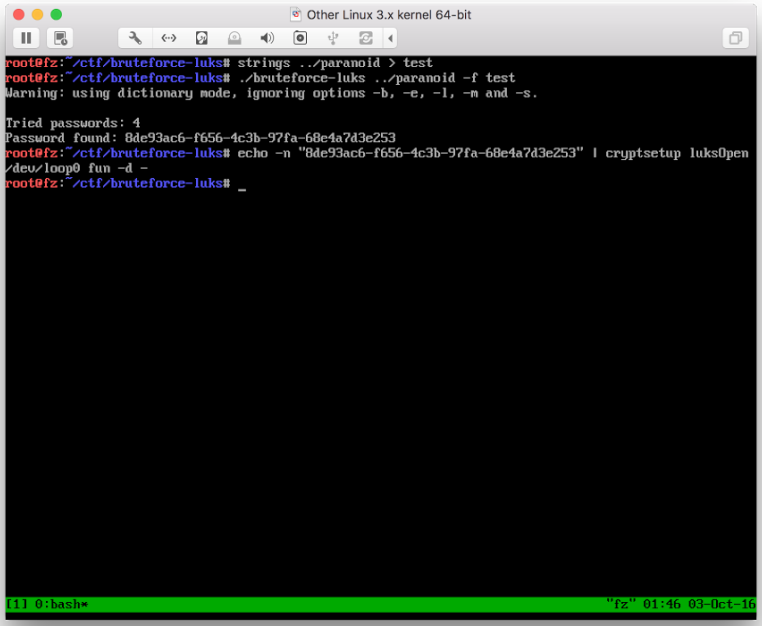
while len(known) < 17:
    for a, b, total in equation:
        if a in known and b in known:
            continue

        if a in known:
            known[b] = chr(total - ord(known[a]))
        elif b in known:
            known[a] = chr(total - ord(known[b]))

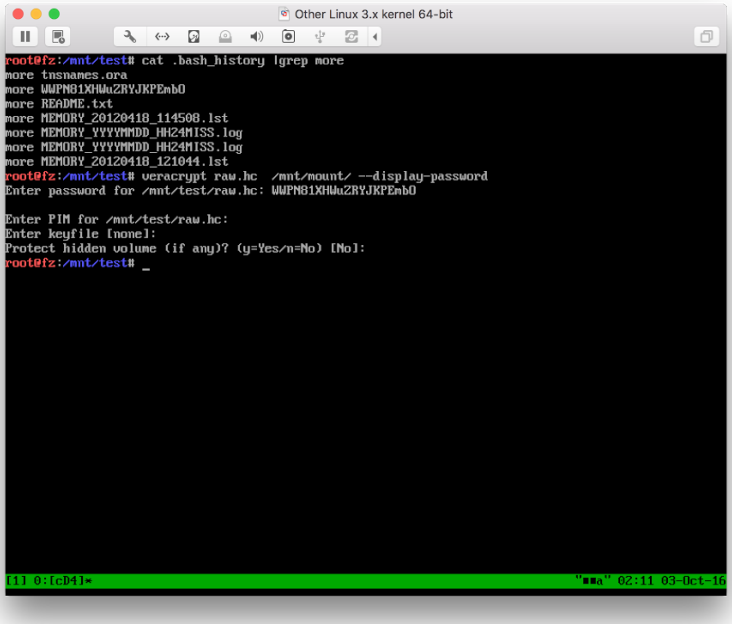
print "".join(c for i, c in sorted(known.items()))
```

PARANOID

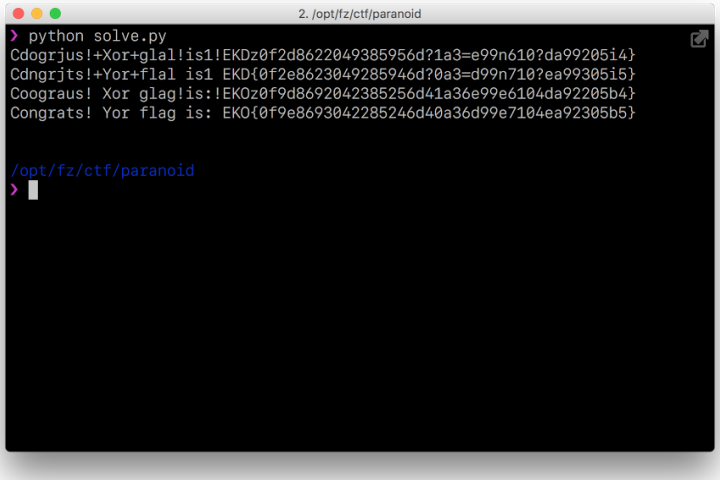
- Primero hice un brute force en el archivo luks usando como diccionario el output del comando `strings paranoid`



- En el archivo montado encontré un `.bash_history` con un more medio raro; probando me di cuenta que era la clave del veracrypt (por la extension del archivo me di cuenta que era un veracrypt)



- Ahi se encontraba un flag.cipher que depuse de _MUCHO_ probar me di cuenta que era un XOR (en realidad me costo un huevo porque asumi siempre que empezaba con EKO{)... Use el script que adjunto para brute forcearlo:



Paranoid.py

```
import itertools
import string

from collections import defaultdict

cipher = open("flag.cipher").read()


def xor(key, cipher):
    content = ""
    key_iter = itertools.cycle(key)
    for letter in cipher:
        k = key_iter.next()
        content += chr(ord(k) ^ ord(letter))

    return content


def valid(decrypted):
    alphabet = string.ascii_letters + string.digits + "=+/\n\r \t\"%'{}!?:"
    return all(x in alphabet for x in decrypted)


def check(position, key, cipher):
    decrypted = xor(key, cipher)
    parts = [decrypted[i:i + len(key)]
             for i in xrange(0, len(decrypted), len(key))]

    return all(valid(p[position:position + 1]) for p in parts)

key = ["\x00", "\x00", "\x00", "\x00"]
possible = defaultdict(list)
for i in xrange(len(key)):
    for c in map(chr, xrange(255)):
        key[i] = c
        if check(i, key, cipher):
            possible[i].append(c)

for f in possible[0]:
    for s in possible[1]:
        for t in possible[2]:
            for c in possible[3]:
                print xor(f + s + t + c, cipher)
```

CODEOP

- Primero traduje los opcodes de python que están en el archivo a un script mas o menos legible (ver constructed.py).

```
1. /opt/fz/ctf/opc
❯ python constructed.py > my_opc


/opt/fz/ctf/opc master*
❯ diff -Nrbu my_opc opc
--- my_opc      2016-10-02 12:09:56.000000000 -0700
+++ opc 2016-10-02 11:44:14.000000000 -0700
@@ -121,4 +121,3 @@
             182 LOAD_FAST                4 (OOOOOOOOOOOOOOOOOO)
             185 COMPARE_OP               2 (==)
             188 RETURN_VALUE
-


/opt/fz/ctf/opc master*
❯
```

- Segundo limpie un poco el código para que se entienda mas fácil (ver solve.py - método checkpass).

```
diff --git a/solve.py b/solve.py
index 13dbfa9..9f9acf5 100644
--- a/solve.py
+++ b/solve.py
@@ -6,7 +6,7 @@ class Checker(object):
             738095, 525756, 1332298, 1274390, 1926028, 1462800, 157737,
             1144861, 460670, 411631, 1531994, 1992766, 197800, 349871,
             2033064, 852423, 23667, 1211575, 1771461, 1727029, 86621, 805407,
-            616682, 279968, 67548
+            616682, 279968, 675489
         ]

     def checkpass(self, password):
```

- Tercero arme un script que hace brute force de todo el campo de las posibilidades utilizadas en las partes aleatorias, osea:
  - El indice que usa del string => (0, 32)
  - La parte del algoritmo que usa un entero entre (1, 255)
  - Con el indice el algoritmo accede a esa parte del string que recibe la función por lo cual también hice brute force de esas letras (que finalmente me dieron la flag) => Para esta parte use string.printable

```
1. /opt/fz/ctf/opc
❯ python solve.py
Key is EKO{We1c0me_2_Th3_ek0party_2016}

/opt/fz/ctf/opc master*  14s
❯
```

Codeop.py

```
class Checker(object):

    def __init__(self):
        self.password = [
            919161, 1859495, 985017, 1377995, 1659485, 1068148, 1599708,
            738095, 525756, 1332298, 1274390, 1926028, 1462800, 157737,
            1144861, 460670, 411631, 1531994, 1992766, 197800, 349871,
            2033064, 852423, 23667, 1211575, 1771461, 1727029, 86621, 805407,
            616682, 279968, 675489
        ]

    def checkpass(self, password):
        from random import shuffle
        from random import randint

        result = []
        indices = [i for i in range(len(password))]
        shuffle(indices)

        for i in indices:
            letter = (i ^ 19) << 16
            letter += (ord(password[i]) ^ 55) << 8
            letter += randint(1, 255)
            result.append(letter)

        return self.password == result

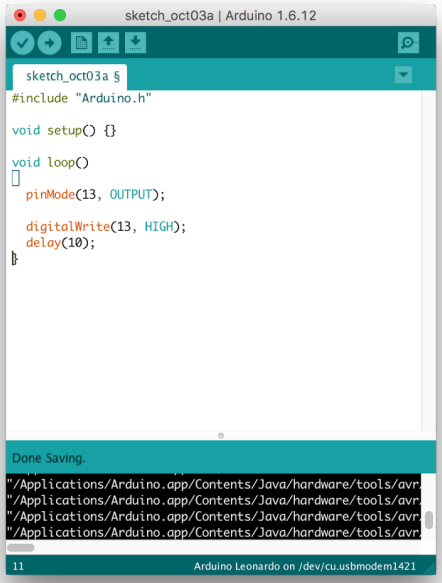
    def bruteforce(self):
        import string
        answer = ["?"] * len(self.password)
        for right in self.password:
            for idx in xrange(len(self.password)):
                for letter_ord in xrange(255):
                    for i in xrange(1, 255):
                        n = (idx ^ 19) << 16
                        n += (letter_ord ^ 55) << 8
                        n += i
                        if n == right:
                            answer[idx] = chr(letter_ord)

        return "".join(answer)

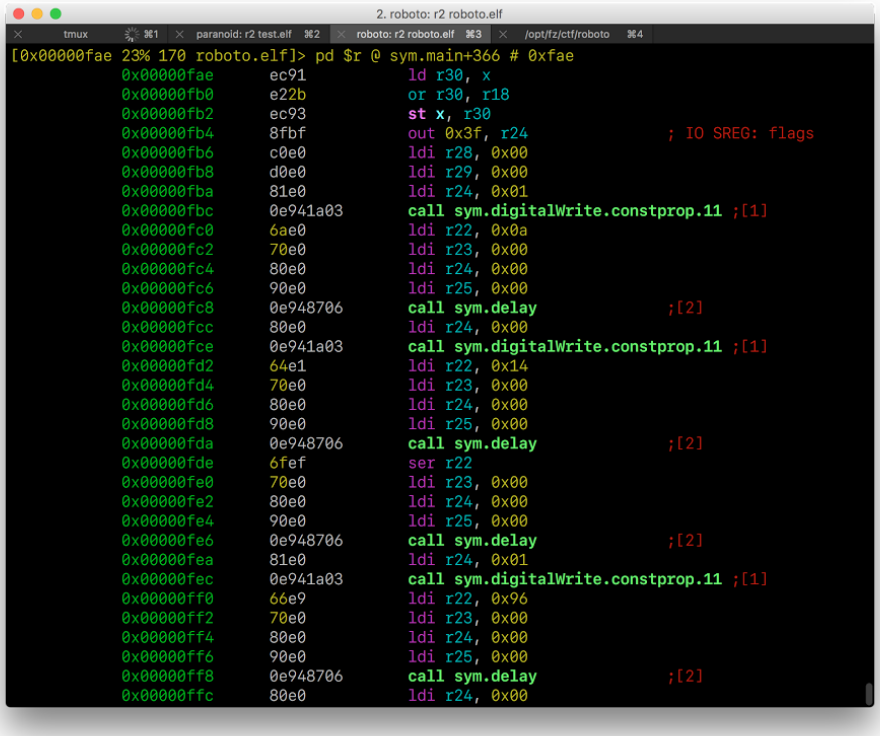
if __name__ == "__main__":
    checker = Checker()
    print "Key is", checker.bruteforce()
```

ROBOTO

- Usando strings me di cuenta que el elf/ihex eran un programa de arduino corriendo en la version Leonardo
- Con arduino IDE compile un main chiquito con un delay/write para ver como se veía el asm.



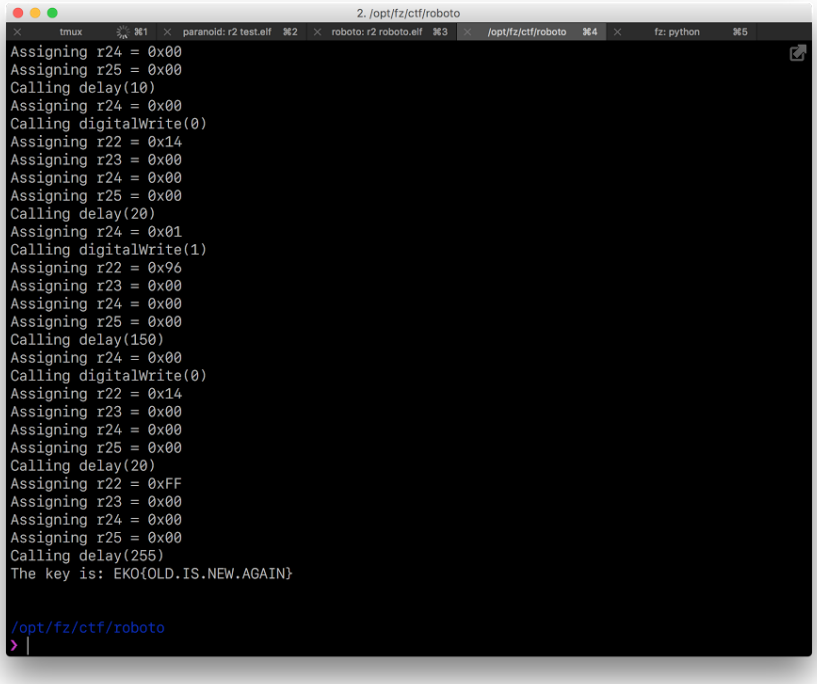
- Usando radare2 desensamble roboto.elf y con mi programa de referencia encontré donde empezaba el código (que parte de sym.main).



- Usando avr-objdump dumpie el asm del elf y manualmente removi todo excepto por todos los delay/write que se estaban haciendo (ver sequence.asm).
- Escribi un script en python que "emula" los write/delays y dibuje un PNG como si fuera un osciloscopio:

Esta fue la imagen (sorry tiene 6000px de ancho):

- Me di cuenta que era morse y agregue al script la traducción de timing a morse y de morse a ascii.



Roboto.py

```
from operator import itemgetter
from PIL import Image

calls = {
    "0x634": ("digitalWrite", ("r24", )),
    "0xd0e": ("delay", ("r22", "r23", "r24", "r25")),
}

registers = {
    "r22": 0x0,
    "r23": 0x0,
    "r24": 0x0,
    "r25": 0x0,
}

MORSE = {
    (0, 150): "-",
    (0, 10): ".",
    (99, 255): " "
}

ALPHABET = {
    ".-": "A", "-...": "B", "-.-.": "C", "-..": "D", ".": "E", "..-.": "F",
    "--.": "G", "....": "H", "..": "I", ".---": "J", "-.-": "K", ".-..": "L",
    "--": "M", "-.": "N", "---": "O", ".--.": "P", "--.-": "Q", ".-.": "R",
    "...": "S", "-": "T", "..-": "U", "...-": "V", ".--": "W", "-..-": "X",
    "-.--": "Y", "--..": "Z", "-.--.": "{", "-.--.-": "}", ".-.-.-": ".",
    " ": " "
}


class Plot(object):

    def __init__(self, height=100):
        self._height = height
        self._cursor = (0, height - 1)
        self._img = Image.new('RGB', (6024, height), "black")
        self._pixels = self._img.load()
        self._morse = ""

    def digitalWrite(self, bit):
        x, y = self._cursor
        y_dest = -1 if bit else self._height
        for y in xrange(y, y_dest, -1 if bit else 1):
            self._pixels[x, y] = (0xFF, 0x00, 0x00)
            self._cursor = (x, y)

    def delay(self, ms):
        x, y = self._cursor
        x_dest = x + (ms / 2)

        if (y, ms) in MORSE:
            self._morse += MORSE[(y, ms)]

        for x in xrange(x, x_dest):
            self._pixels[x, y] = (0xFF, 0x00, 0x00)
            self._cursor = (x, y)

    def draw(self):
```

```
        self._img.save("whatever.png")

    def morse(self):
        words = map(ALPHABET.__getitem__, self._morse.strip().split(" "))
        return "".join(words)


plot = Plot()
for instruction in open("sequence.asm"):
    opcode, args = instruction.strip().split("\t")
    args = args.split(", ")
    if opcode == "call":
        address = args[0]
        function, arg_regs = calls[address]

        value = 0
        for i, arg_reg in enumerate(arg_regs):
            reg = registers[arg_reg]
            value |= (reg << (i * 8))

        print "Calling %s(%d)" % (function, value)
        getattr(plot, function)(value)

    elif opcode == "ldi":
        register, value = args
        if register not in registers:
            raise ValueError("Invalid register %s" % register)

        registers[register] = int(value[2:], 16)
        print "Assigning %s = %s" % (register, value)

plot.draw()
print "The key is:", plot.morse()
```

Sequence.asm

```
ldi     r24, 0x01
call    0x634
ldi     r22, 0x0A
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r22, 0xFF
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x96
ldi     r23, 0x00
```

```
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x0A
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x96
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r22, 0xFF
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x96
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x96
ldi     r23, 0x00
ldi     r24, 0x00
```

```
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x96
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r22, 0xFF
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x96
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x0A
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x96
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
```

```
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x96
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x0A
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r22, 0xFF
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x96
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x96
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
```

```
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x96
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r22, 0xFF
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x0A
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x96
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
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ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x0A
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
```

```
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x0A
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r22, 0xFF
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x96
ldi     r23, 0x00
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ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
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call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x0A
ldi     r23, 0x00
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ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
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ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x0A
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
```

```
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r22, 0xFF
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x0A
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ldi     r25, 0x00
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ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
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call    0xd0e
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call    0x634
ldi     r22, 0x96
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call    0xd0e
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call    0xd0e
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call    0x634
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call    0x634
ldi     r22, 0x96
ldi     r23, 0x00
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ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
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ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x0A
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call    0xd0e
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call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
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ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r22, 0xFF
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
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ldi     r24, 0x00
call    0x634
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ldi     r24, 0x00
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call    0xd0e
ldi     r24, 0x00
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ldi     r25, 0x00
call    0xd0e
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call    0x634
ldi     r22, 0x0A
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
```

```
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
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call    0xd0e
ldi     r24, 0x00
call    0x634
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call    0xd0e
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call    0x634
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call    0xd0e
ldi     r24, 0x00
call    0x634
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call    0x634
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call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
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```

```
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x96
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
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call    0xd0e
ldi     r22, 0xFF
ldi     r23, 0x00
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call    0xd0e
ldi     r24, 0x01
call    0x634
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call    0xd0e
ldi     r24, 0x00
call    0x634
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call    0xd0e
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call    0x634
ldi     r22, 0x0A
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call    0xd0e
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call    0x634
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call    0xd0e
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call    0xd0e
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call    0x634
ldi     r22, 0x0A
ldi     r23, 0x00
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ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
```

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ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
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call    0xd0e
ldi     r22, 0xFF
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call    0xd0e
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call    0x634
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ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
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call    0xd0e
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call    0x634
ldi     r22, 0x96
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call    0xd0e
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call    0xd0e
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call    0xd0e
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call    0x634
ldi     r22, 0x0A
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```

```
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
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call    0xd0e
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call    0x634
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call    0xd0e
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call    0x634
ldi     r22, 0x14
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ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x96
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call    0xd0e
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ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
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ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r22, 0xFF
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x96
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x0A
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x96
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x96
ldi     r23, 0x00
ldi     r24, 0x00
```

```
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x0A
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x01
call    0x634
ldi     r22, 0x96
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r24, 0x00
call    0x634
ldi     r22, 0x14
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
ldi     r22, 0xFF
ldi     r23, 0x00
ldi     r24, 0x00
ldi     r25, 0x00
call    0xd0e
```