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Metamorphic Malware

Implementation of a Metamorphic
Engine

Obfuscation techniques

2. **Register usage exchange:** Different mutations of the malware will have the same code, but will use different registers. Signature based-detection is possible through wildcards. Win95.Regswap (December, 1998) used this technique.

Version 1

Binary Opcode	Assembly Code
5A	pop <u>edx</u>
BF04000000	mov <u>edi</u> , 0004h
8BF5	mov <u>esi</u> , <u>ebp</u>
B80C000000	mov <u>eax</u> , 000Ch
81C288000000	add <u>edx</u> , 0088h
8B1A	mov <u>ebx</u> , [<u>edx</u>]
899C8618110000	mov [<u>esi+eax*4+00001118</u>], <u>ebx</u>
String Signature:	
5ABF040000008BF5B80C00000081C2880000008B1A899C8618110000	

Version 2

Binary Opcode	Assembly Code
58	pop <u>eax</u>
BB04000000	mov <u>ebx</u> , 0004h
8BD5	mov <u>edx</u> , <u>ebp</u>
BF0C000000	mov <u>edi</u> , 000Ch
81C088000000	add <u>eax</u> , 0088h
8B30	mov <u>esi</u> , [<u>eax</u>]
89B4BA18110000	mov [<u>edx+edi*4+00001118</u>], <u>esi</u>
String Signature:	
58BB040000008BD5BF0C00000081C0880000008B3089B4BA18110000	

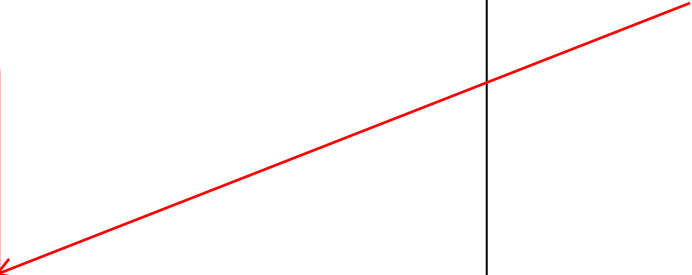
Exercise 2

- ▶ In the metamorphic engine implemented in the previous exercise, add a new method to perform Register Usage Exchange operations on the target code.
- ▶ The new method:
 1. Takes in input a file in assembly code (hello_mutation.s)
 2. Returns in output a new variant (hello_mutation2.s) of the input file obtained through operations of Register Usage Exchange (Each execution may produce a different variant of the original file)
- ▶ Recompile the resulting file and verify that the two executions (hello_mutation.s and hello_mutation2.s) are equivalent.

hello.s

```
.file "hello.c"
.def __main; .scl 2; .type 32; .endef
.section .rdata,"dr"
LC0:
.ascii "Hello world!\0"
.text
.globl __main
.def __main; .scl 2; .type 32; .endef
__main:
LFB7:
.cfi_startproc
pushl %ebp
.cfi_def_cfa_offset 8
.cfi_offset 5, -8
movl %esp, %ebp
.cfi_def_cfa_register 5
andl $-16, %esp
subl $16, %esp
call __main
movl $LC0, (%esp)
call _puts
leave
.cfi_restore 5
.cfi_def_cfa 4, 4
ret
.cfi_endproc
LFE7:
.ident "GCC: (GNU) 4.8.3"
.def _puts; .scl 2; .type 32; .endef
```

Target Code. In this code block we can apply obfuscation techniques



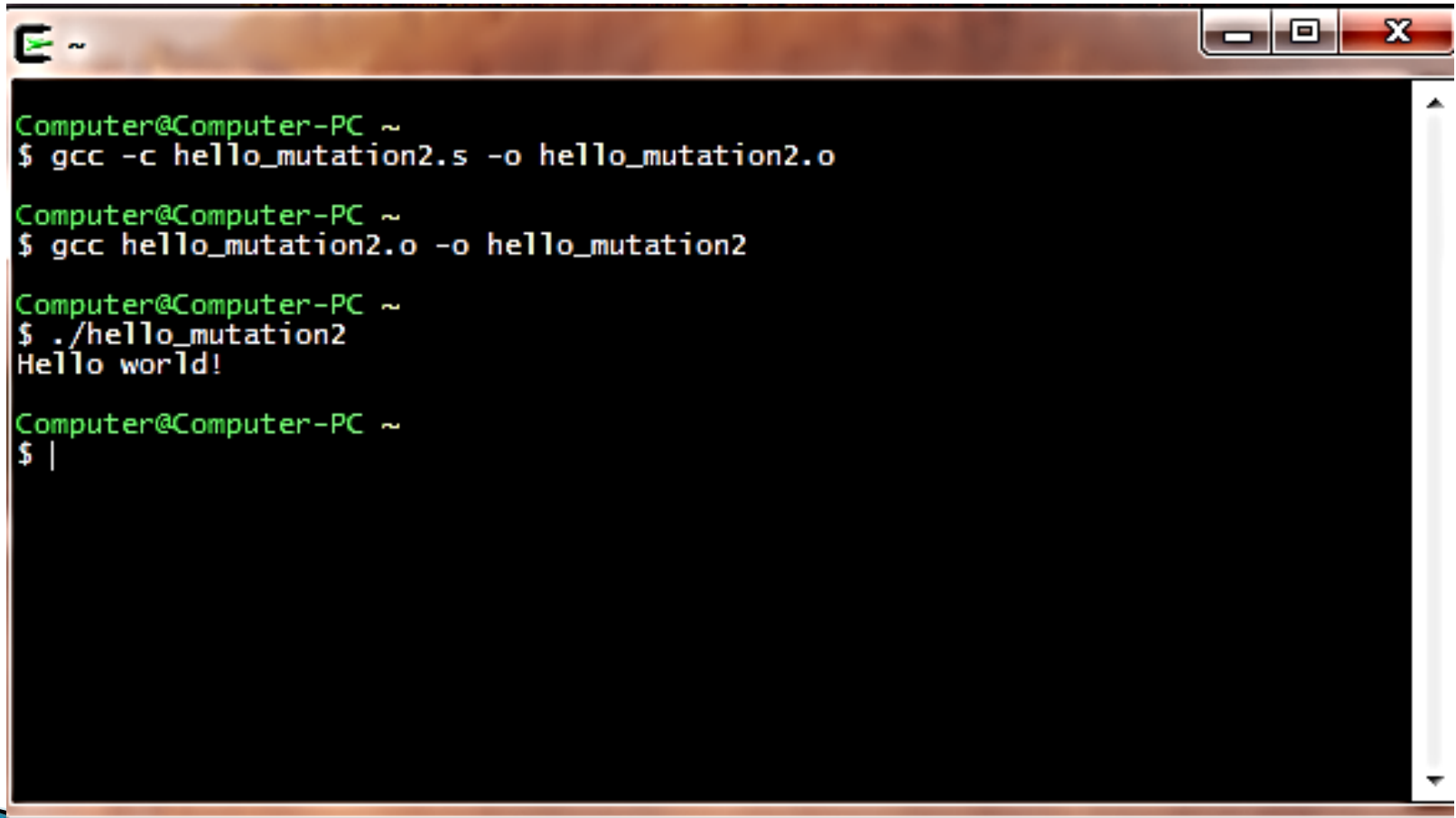
hello_mutation2.s

hello_mutation.s

hello_mutation2.s

<pre>_main: movl %eax, %eax # garbage instruction LFB7: movl %edi, %edi # garbage instruction .cfi_startproc pushl %ebp movl %edi, %edi # garbage instruction .cfi_def_cfa_offset 8 .cfi_offset 5, -8 movl %esp, %ebp .cfi_def_cfa_register 5 andl \$-16, %esp subl \$16, %esp call __main andl \$1, %esi # garbage instruction movl \$LC0, (%esp) orl %ecx, %ecx # garbage instruction call _puts orl %ecx, %ecx # garbage instruction leave .cfi_restore 5 .cfi_def_cfa 4, 4 ret .cfi_endproc LFE7: .ident "GCC: (GNU) 4.8.3" .def _puts; .scl 2; .type 32; .endif</pre>	<p>%eax -> %edi</p> <p>%edi -> %eax</p> <p>%edi -> %eax</p> <p>%esi -> %ecx</p> <p>%ecx -> %ebx</p> <p>%ecx -> %ebx</p>	<pre>_main: movl %edi, %edi # register swapped LFB7: movl %eax, %eax # register swapped .cfi_startproc pushl %ebp movl %eax, %eax # register swapped .cfi_def_cfa_offset 8 .cfi_offset 5, -8 movl %esp, %ebp .cfi_def_cfa_register 5 andl \$-16, %esp subl \$16, %esp call __main andl \$1, %ecx # register swapped movl \$LC0, (%esp) orl %ebx, %ebx # register swapped call _puts orl %ebx, %ebx # register swapped leave .cfi_restore 5 .cfi_def_cfa 4, 4 ret .cfi_endproc LFE7: .ident "GCC: (GNU) 4.8.3" .def _puts; .scl 2; .type 32; .endif</pre>
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Recompiling and executing hello_mutation2.s



```
Computer@Computer-PC ~  
$ gcc -c hello_mutation2.s -o hello_mutation2.o  
  
Computer@Computer-PC ~  
$ gcc hello_mutation2.o -o hello_mutation2  
  
Computer@Computer-PC ~  
$ ./hello_mutation2  
Hello world!  
  
Computer@Computer-PC ~  
$ |
```

Some useful tips

- ▶ A static swap (e.g., %eax is always substituted by %edi), would produce at each iteration the same code.
- ▶ The substitutions should be established in a random manner at each iteration.
- ▶ Designed substitutions should be applied for all the instructions of the target code, (e.g. if %ebx \rightarrow %eax, %eax should be replaced by %ebx every time it appears in the code).
- ▶ A designed register may replace only one other register (e.g., %eax and %ecx cannot be both replaced by %ebx)

Some useful tips

- ▶ Through a data structure you can keep track of the substitutions.
- ▶ Stack pointer (%esp) and base pointer (%ebp) registers should not be replaced

Register	Replaced by
%eax	%edi
%ebx	%esi
%ecx	%ebx
%edx	%edx
%edi	%eax
%esi	%ecx

```
_main:
    movl %edi, %edi # register swapped
LEB7:
    movl %eax, %eax # register swapped
    .cfi_startproc
    pushl %ebp
    movl %eax, %eax # register swapped
    .cfi_def_cfa_offset 8
    .cfi_offset 5, -8
    movl %esp, %ebp
    .cfi_def_cfa_register 5
    andl $-16, %esp
    subl $16, %esp
    call __main
    andl $1, %ecx # register swapped
    movl $LC0, (%esp)
    orl %ebx, %ebx # register swapped
    call _puts
    orl %ebx, %ebx # register swapped
    leave
    .cfi_restore 5
    .cfi_def_cfa 4, 4
    ret
    .cfi_endproc
```