Local or global 实验报告

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1. 实验问题

Many language rules are checked by the compiler, and it is possible to bypass the rules using assembly language after compilation. Consider the following C program

```
include<stdio.h>
int x=3;

int main(void)
{
  int x=5;
  printf("x = %d\n", x);
}
```

1. Compile the program and generate its assembly code.
2. Understand the assembly code and modify it to let the program print the global variable `x` instead of the local variable `x`.

2. 实验过程

2.1 生成汇编

对上述代码进行编译得到汇编文件

```
gcc -S local.cpp
```

得到文件local.s

local.s内容为

```
    .file   "local.cpp"
    .globl  x
    .data
```

```
    .align 4
    .type   x, @object
    .size   x, 4
x:
    .long   3
    .section    .rodata
.LC0:
    .string "x = %d\n"
    .text
    .globl  main
    .type   main, @function
main:
.LFB0:
    .cfi_startproc
    pushq   %rbp
    .cfi_def_cfa_offset 16
    .cfi_offset 6, -16
    movq    %rsp, %rbp
    .cfi_def_cfa_register 6
    subq    $16, %rsp
    movl    $5, -4(%rbp)
    movl    -4(%rbp), %eax
    movl    %eax, %esi
    movl    $.LC0, %edi
    movl    $0, %eax
    call    printf
    movl    $0, %eax
    leave
    .cfi_def_cfa 7, 8
    ret
    .cfi_endproc
.LFE0:
    .size   main, .-main
    .ident  "GCC: (Ubuntu 5.4.0-6ubuntu1~16.04.11) 5.4.0 20160609"
    .section    .note.GNU-stack,"",@progbits
```

`gcc -c local.s` 得到local.o文件

```
jones@ubuntu:~/Desktop/csapp/hw3$ objdump -d local.o

local.o:     file format elf64-x86-64


Disassembly of section .text:

0000000000000000 <main>:
   0:   55                      push   %rbp
   1:   48 89 e5                mov    %rsp,%rbp
   4:   48 83 ec 10             sub    $0x10,%rsp
   8:   c7 45 fc 05 00 00 00    movl   $0x5,-0x4(%rbp)
   f:   8b 45 fc                mov    -0x4(%rbp),%eax
  12:   89 c6                   mov    %eax,%esi
```

```
  14:   bf 00 00 00 00          mov    $0x0,%edi
  19:   b8 00 00 00 00          mov    $0x0,%eax
  1e:   e8 00 00 00 00          callq  23 <main+0x23>
  23:   b8 00 00 00 00          mov    $0x0,%eax
  28:   c9                      leaveq
  29:   c3                      retq
```

下面代码用来保护堆栈

```
push   %rbp
mov    %rsp,%rbp
```

然后腾出栈空间

```
sub    $0x10,%rsp
```

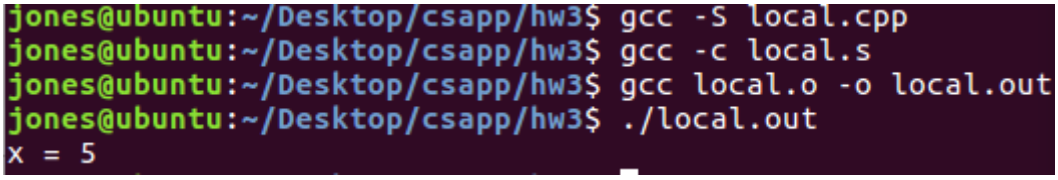
为调用printf函数，需要准备相关参数

```
movl   $0x5,-0x4(%rbp)
mov    -0x4(%rbp),%eax
mov    %eax,%esi
mov    $0x0,%edi
mov    $0x0,%eax
callq  23 <main+0x23>
```

从这段代码中可以看出：

调用printf函数之前，将参数放入`%edi`，`%esi`寄存器

`%esi`中放的是local variable x的值



2.2 输出global变量

修改local.s的代码

```
movl    $5, -4(%rbp)
movl    -4(%rbp), %eax
```

为

```
movl    x(%rip), %eax
```

global.s部分代码如下图所示

```
x:
        .long   3
        .section        .rodata
.LC0:
        .string "x = %d\n"
        .text
        .globl  main
        .type   main, @function
main:
.LFB0:
        .cfi_startproc
        pushq   %rbp
        .cfi_def_cfa_offset 16
        .cfi_offset 6, -16
        movq    %rsp, %rbp
        .cfi_def_cfa_register 6
        subq    $16, %rsp
        movl    x(%rip), %eax
        movl    %eax, %esi
        movl    $.LC0, %edi
        movl    $0, %eax
        call    printf
        movl    $0, %eax
        leave
        .cfi_def_cfa 7, 8
        ret
        .cfi_endproc
```

再来看一下代码的运行情况

```
jones@ubuntu:~/Desktop/csapp/hw3$ objdump -d global.o

global.o:     file format elf64-x86-64


Disassembly of section .text:

0000000000000000 <main>:
   0:   55                      push   %rbp
   1:   48 89 e5                mov    %rsp,%rbp
   4:   48 83 ec 10             sub    $0x10,%rsp
   8:   8b 05 00 00 00 00       mov    0x0(%rip),%eax        # e <main+0xe>
   e:   89 c6                   mov    %eax,%esi
  10:   bf 00 00 00 00          mov    $0x0,%edi
  15:   b8 00 00 00 00          mov    $0x0,%eax
  1a:   e8 00 00 00 00          callq  1f <main+0x1f>
  1f:   b8 00 00 00 00          mov    $0x0,%eax
  24:   c9                      leaveq
  25:   c3                      retq
```

```
jones@ubuntu:~/Desktop/csapp/hw3$ gcc local.o -o local.out
jones@ubuntu:~/Desktop/csapp/hw3$ ./local.out
x = 3
```