

Міністерство освіти і науки України
Національний технічний університет України
“Київський політехнічний інститут ім. Ігоря Сікорського”
Факультет інформатики та обчислювальної техніки
Кафедра обчислювальної техніки

ЛАБОРАТОРНА РОБОТА №6

З дисципліни “Архітектура комп’ютерів 2”

Виконав:
студент 3 курсу ФІОТ
групи ІВ-91
Дерачиц В.В.

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Код

```
#include <linux/init.h>
#include <linux/module.h>
#include <linux/printk.h>
#include <linux/ktime.h>
#include <linux/slab.h>

struct head_list {
    struct head_list *next;
    ktime_t time;
};

MODULE_AUTHOR("Derachyts Vitalii IV-91");
MODULE_DESCRIPTION("Lab6");
MODULE_LICENSE("Dual BSD/GPL");

static struct head_list *head;

static int amount = 1;
module_param(amount, uint, 0444);
MODULE_PARM_DESC(amount, "Amount Hello worlds");

static int __init helloinit(void)
{
    uint i;

    struct head_list *var_1, *var_2;

    head = kmalloc(sizeof(struct head_list *), GFP_KERNEL);
```

```
var_1 = head;
if (amount == 0) {
    pr_warn("Entered parameter equals 0");
} else if (amount >= 5 && amount <= 10) {
    pr_warn("Entered parameter is between 5 and 10");
} else if (amount > 10) {
    BUG_ON(amount > 10);
    pr_warn("Entered parameter is bigger than 10");
    return -EINVAL;
}
```

```
for (i = 0; i < amount; i++) {
    var_1->next = kmalloc(sizeof(struct head_list), GFP_KERNEL);
    var_1->time = ktime_get();
}
```

```
if (i == 7){
    var_1 = NULL;
}
```

```
BUG_ON(!var_1);
pr_info("Hello World!");
var_2 = var_1;
var_1 = var_1->next;
}
```

```
if (amount != 0) {
    kfree(var_2->next);
    var_2->next = NULL;
}
```

```
}
```

```
pr_info("Amount: %d\n", amount);
```

```
return 0;
```

```
}
```

```
static void __exit helloexit(void)
```

```
{
```

```
struct head_list *var;
```

```
while (head != NULL && amount != 0) {
```

```
    var = head;
```

```
    pr_info("Time: %lld", var->time);
```

```
    head = var->next;
```

```
    kfree(var);
```

```
}
```

```
pr_info("");
```

```
}
```

```
module_init(helloinit);
```

```
module_exit(helloexit);
```

```
vide@vide-VirtualBox: ~/repos/lab6
vide@vide-VirtualBox:~/repos/lab6$ export ARCH=arm; export PATH=/opt/gcc-arm-8.3-2019.03-x86_64-arm-linux-gnueabi/bin:$PATH; export CROSS_COMPILE="ccache arm-linux-gnueabi-"; export KDIR=$HOME/repos/linux-stable
vide@vide-VirtualBox:~/repos/lab6$ make
make -C /home/vide/repos/linux-stable M=$PWD
make[1]: Entering directory '/home/vide/repos/linux-stable'
  CC [M]  /home/vide/repos/lab6/hello2.o
  Building modules, stage 2.
  MODPOST 1 modules
  CC      /home/vide/repos/lab6/hello2.mod.o
  LD [M]  /home/vide/repos/lab6/hello2.ko
make[1]: Leaving directory '/home/vide/repos/linux-stable'
cp hello2.ko hello2.ko.unstripped
ccache arm-linux-gnueabi-strip -g hello2.ko
vide@vide-VirtualBox:~/repos/lab6$
```

```
vide@vide-VirtualBox: ~/repos/busybox

Please press Enter to activate this console.
/ # modinfo hello2.ko
filename:      hello2.ko
author:       Derachyts Vitalii IV-91
description:   Lab6
license:      Dual BSD/GPL
parm:         amount:Amount Hello worlds
depends:
vermagic:     4.19.224 SMP mod_unload ARMv7 p2v8
/ # insmod hello2.ko amount=8
[ 39.862498] hello2: loading out-of-tree module taints kernel.
[ 39.874041] Entered parameter is between 5 and 10
[ 39.874116] Hello World!
[ 39.874556] Hello World!
[ 39.874701] Hello World!
[ 39.874821] Hello World!
[ 39.874902] Hello World!
[ 39.874971] Hello World!
[ 39.875039] Hello World!
[ 39.875914] -----[ cut here ]-----
[ 39.876372] kernel BUG at /home/vide/repos/lab6/hello2.c:49!
[ 39.876572] Internal error: Oops - BUG: 0 [#1] SMP ARM
[ 39.877080] Modules linked in: hello2(0+)
[ 39.877940] CPU: 0 PID: 63 Comm: insmod Tainted: G      0      4.19.224 #1
[ 39.878250] Hardware name: Generic DT based system
[ 39.879094] PC is at helloinit+0xdc/0x1000 [hello2]
[ 39.879378] LR is at 0x17
[ 39.879521] pc : [bf0050dc]   lr : [<00000017>]   psr: 600f0013
[ 39.879787] sp : c8b95db8 ip : 80000000 fp : 00000000
[ 39.880035] r10: 006000c0 r9 : bf0010dc r8 : c8bb0540
[ 39.880298] r7 : c135a34c r6 : c8bb0580 r5 : bf002000 r4 : 00000007
[ 39.880580] r3 : 00000009 r2 : 20000000 r1 : 00000009 r0 : 4769a220
[ 39.880922] Flags: nZCv IRQs on FIQs on Mode SVC_32 ISA ARM Segment none
[ 39.881262] Control: 10c5387d Table: 48b0806a DAC: 00000051
[ 39.881663] Process insmod (pid: 63, stack limit = 0x(ptrval))
[ 39.881982] Stack: (0xc8b95db8 to 0xc8b96000)
[ 39.882437] 5da0:                                     c1788300 c1604c48
[ 39.882955] 5dc0: fffff000 bf005000 00000000 c1604c48 bf002040 c0302d4c c8bb02c0 c04f0c10
[ 39.883632] 5de0: 00210d00 00000002 c1604c48 c8b33400 8040003f c04f1604 00000000 6dc6448d
[ 39.884539] 5e00: ffe00000 c8b33600 8040003e e0968000 c8b33600 6dc6448d e0968000 c8b33400
[ 39.885463] 5e20: bf002040 6dc6448d bf002040 00000002 c8bb0380 00000002 c8bb02c0 c03d1c08
[ 39.885868] 5e40: 00000001 c03d3f64 c8b95f30 c8b95f30 00000002 c8bb0280 00000002 c03d3f80
[ 39.886512] 5e60: bf00204c 00007fff bf002040 c03d0e40 c8ba0818 bf002088 c8ba0a9c bf002234
[ 39.887014] 5e80: bf002170 c1358940 00000000 c121f2e8 c121f358 c1604c48 c1608f04 c8b33600
[ 39.887971] 5ea0: fffff000 e0800000 c8b33600 c8b33400 00000000 00000000 00000000 00000000
[ 39.888669] 5ec0: 00000000 00000000 6e72656b 00006c65 00000000 00000000 00000000 00000000
[ 39.889269] 5ee0: 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
[ 39.889745] 5f00: 00000000 6dc6448d 00000000 0000157c 00000000 e096957c 0011c7cc c1604c48
[ 39.890309] 5f20: 0011b1f8 fffff000 00000051 c03d43e0 e09682c6 e09683c0 e0968000 0000157c
[ 39.890685] 5f40: e096902c e0968ed4 e0968ba4 00003000 00003040 00000000 00000000 00000000
[ 39.891266] 5f60: 00001678 0000001f 00000020 00000017 00000000 00000010 00000000 6dc6448d
[ 39.891616] 5f80: 000f411e 0011b1f8 b6f75950 0000157c 00000080 c0301204 c8b94000 00000080
[ 39.891986] 5fa0: 000f411e c0301000 0011b1f8 b6f75950 0011b250 0000157c 0011b1f8 00000000
[ 39.892326] 5fc0: 0011b1f8 b6f75950 0000157c 00000080 00000001 bec23ea0 001086c4 000f411e
[ 39.892661] 5fe0: bec23b58 bec23b48 0003b270 b6e2f1b0 600f0010 0011b250 00000000 00000000
[ 39.894159] [<bf0050dc>] (helloinit [hello2]) from [<c0302d4c>] (do_one_initcall+0x54/0x208)
[ 39.894638] [<c0302d4c>] (do_one_initcall) from [<c03d1c08>] (do_init_module+0x64/0x224)
[ 39.894895] [<c03d1c08>] (do_init_module) from [<c03d3f80>] (load_module+0x2150/0x2458)
[ 39.895138] [<c03d3f80>] (load_module) from [<c03d43e0>] (sys_init_module+0x158/0x18c)
[ 39.895337] [<c03d43e0>] (sys_init_module) from [<c0301000>] (ret_fast_syscall+0x0/0x54)
[ 39.895544] Exception stack(0xc8b95fa8 to 0xc8b95ff0)
[ 39.895795] 5fa0:                                0011b1f8 b6f75950 0011b250 0000157c 0011b1f8 00000000
[ 39.896282] 5fc0: 0011b1f8 b6f75950 0000157c 00000080 00000001 bec23ea0 001086c4 000f411e
[ 39.896578] 5fe0: bec23b58 bec23b48 0003b270 b6e2f1b0
[ 39.897137] Code: e3560000 13540007 e1c600f8 1afffffd (e7f001f2)
[ 39.898032] ---[ end trace 3b1e361a335647a5 ]---
Segmentation fault
```

`${CROSS_COMPILE}objdump -dS lab6.ko.unstripped | less`

```
vide@vide-VirtualBox: ~/repos/lab6
var_1 = var_1->next;
a8: e5960000 ldr r6, [r6]
for (i = 0; i < amount; i++) {
a4: e2844001 add r4, r4, #1
a8: e5953000 ldr r3, [r5]
ac: e1530004 cmp r3, r4
b0: 9a00000a bls e0 <init_module+0xe0>
b4: e3a02010 mov r2, #16
b8: e1a0100a mov r1, sl
bc: e5970018 ldr r0, [r7, #24]
c0: ebffffff bl 0 <kmem_cache_alloc_traces>
var_1->next = kcalloc(sizeof(struct head_list), GFP_KERNEL);
c4: e5860000 str r0, [r6]
var_1->time = ktime_get();
c8: ebffffff bl 0 <ktime_get>
BUG_ON(!var_1);
cc: e3560000 cmp r6, #0
d0: 13540007 cmpne r4, #7
var_1->time = ktime_get();
d4: e1c600f8 strd r0, [r6, #8]
BUG_ON(!var_1);
d8: 1afffffd bne 94 <init_module+0x94>
dc: e7f001f2 .word 0xe7f001f2
}

if (amount != 0) {
e0: e3530000 cmp r3, #0
e4: 0a000003 beq f8 <init_module+0xf8>
kfree(var_2->next);
e8: e5980000 ldr r0, [r8]
ec: ebffffff bl 0 <kfree>
var_2->next = NULL;
f0: e3a03000 mov r3, #0
f4: e5883000 str r3, [r8]
}

pr_info("Amount: %d\n", amount);
f8: e5951000 ldr r1, [r5]
fc: e3000000 movw r0, #0
100: e3400000 movt r0, #0
104: ebffffff bl 0 <prinfo>

return 0;
}
```