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## ЛАБОРАТОРНА РОБОТА №6

З дисципліни “Архітектура комп’ютерів 2”

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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");
} BUG_ON(amount > 10);

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
[ # insmod hello2.ko amount=10
[ 122.218364] Entered parameter is bigger than 10
[ 177.214912] Entered parameter is between 5 and 10
[ 177.215244] Hello World!
[ 177.215816] Hello World!
[ 177.215945] Hello World!
[ 177.216089] Hello World!
[ 177.216215] Hello World!
[ 177.216345] Hello World!
[ 177.216462] Hello World!
[ 177.217809] -----[ cut here ]-----
[ 177.218398] kernel BUG at /home/vide/repos/lab6/hello2.c:45!
[ 177.218752] Internal error: Oops - BUG: 0 [#1] SMP ARM
[ 177.219191] Modules linked in: hello2(0+) [last unloaded: hello]
[ 177.220366] CPU: 0 PID: 80 Comm: insmod Tainted: G 0 4.19.224 #1
[ 177.220586] Hardware name: Generic DT based system
[ 177.221543] PC is at helloinit+0xc8/0x1000 [hello2]
[ 177.221905] LR is at 0x17
[ 177.222007] pc : [<bf02d0c8>] lr : [<00000017>] psr: 600f0013
[ 177.222196] sp : c8b85db8 ip : 00000000 fp : 00000000
[ 177.222356] r10: 006000c0 r9 : bf0290dc r8 : c135a34c
[ 177.222495] r7 : c8b2ad00 r6 : c8b2acc0 r5 : bf02a000 r4 : 00000007
[ 177.222656] r3 : 00000029 r2 : 28000000 r1 : 00000029 r0 : 41285840
[ 177.222867] Flags: nZCv IRQs on FIQs on Mode SVC_32 ISA ARM Segment none
[ 177.223070] Control: 10c5387d Table: 48b4c06a DAC: 00000051
[ 177.223414] Process insmod (pid: 80, stack limit = 0x(ptrval))
[ 177.223721] Stack: (0xc8b85db8 to 0xc8b86000)
[ 177.223990] 5da0: c1788300 c1604c48
[ 177.224365] 5dc0: fffffe00 bf02d000 00000000 c1604c48 bf02a040 c0302d4c c8b2a800 c04f0c10
[ 177.224694] 5de0: 00210d00 00000002 c1604c48 c8b827c0 8040003f c04f1604 00000000 6dc6448d
[ 177.225018] 5e00: ffe00000 c8b823c0 8040003e e0977000 c8b823c0 6dc6448d e0977000 c8b827c0
[ 177.225401] 5e20: bf02a040 6dc6448d bf02a040 00000002 c8b2a900 00000002 c8b2a7c0 c03d1c08
[ 177.225730] 5e40: 00000001 c03d3f64 c8b85f30 c8b85f30 00000002 c8b2a780 00000002 c03d3f80
[ 177.226069] 5e60: bf02a04c 00007fff bf02a040 c03d0e40 c8b6a818 bf02a088 c8b6aa9c bf02a234
[ 177.226404] 5e80: bf02a170 c1358940 00000000 c121f2e8 c121f358 c1604c48 c1608f04 c8b823c0
[ 177.226866] 5ea0: ffffff00 e0800000 c8b823c0 c8b827c0 00000000 00000000 00000000 00000000
[ 177.227278] 5ec0: 00000000 00000000 6e72656b 00006c65 00000000 00000000 00000000 00000000
[ 177.227662] 5ee0: 00000000 00000000 00000000 00000000 00000000 00000000 00000000 00000000
[ 177.228001] 5f00: 00000000 6dc6448d 00000080 0000157c 00000000 e097857c 0011c7d4 c1604c48
[ 177.228362] 5f20: 0011b1f8 fffffe00 00000051 c03d43e0 e09772ca e09773c0 e0977000 0000157c
[ 177.228826] 5f40: e097802c e0977ed4 e0977ba4 00003000 00003040 00000000 00000000 00000000
[ 177.229338] 5f60: 00001678 0000001f 00000020 00000017 00000000 00000010 00000000 6dc6448d
[ 177.229676] 5f80: 000f411e 0011b1f8 b6fa5950 0000157c 00000080 c0301204 c8b84000 00000080
[ 177.230070] 5fa0: 000f411e c0301000 0011b1f8 b6fa5950 0011b258 0000157c 0011b1f8 00000000
[ 177.230422] 5fc0: 0011b1f8 b6fa5950 0000157c 00000080 00000001 bed55ea0 001086c4 000f411e
[ 177.230751] 5fe0: bed55b58 bed55b48 0003b270 b6e5f1b0 600f0010 0011b258 00000000 00000000
[ 177.232120] [<bf02d0c8>] (helloinit [hello2]) from [<c0302d4c>] (do_one_initcall+0x54/0x208)
[ 177.232770] [<c0302d4c>] (do_one_initcall) from [<c03d1c08>] (do_init_module+0x64/0x224)
[ 177.233221] [<c03d1c08>] (do_init_module) from [<c03d3f80>] (load_module+0x2150/0x2458)
[ 177.233647] [<c03d3f80>] (load_module) from [<c03d43e0>] (sys_init_module+0x158/0x18c)
[ 177.233938] [<c03d43e0>] (sys_init_module) from [<c0301000>] (ret_fast_syscall+0x0/0x54)
[ 177.234258] Exception stack(0xc8b85fa8 to 0xc8b85ff0)
[ 177.234518] 5fa0: 0011b1f8 b6fa5950 0011b258 0000157c 0011b1f8 00000000
[ 177.234956] 5fc0: 0011b1f8 b6fa5950 0000157c 00000080 00000001 bed55ea0 001086c4 000f411e
[ 177.235331] 5fe0: bed55b58 bed55b48 0003b270 b6e5f1b0
[ 177.236014] Code: e3540007 13560000 e1c600f8 1a000000 (e7f001f2)
[ 177.236919] ---[ end trace 4a6e36a10e65865f ]---
Segmentation fault
```

`${CROSS_COMPILE}objdump -dS hello2.ko.unstripped | less`

```
vide@vide-VirtualBox: ~/repos/lab6
98: e1530004    cmp     r3, r4
9c: 9a000010    bls     e4 <init_module+0xe4>
a0: e3a02010    mov     r2, #16
a4: e1a0100a    mov     r1, sl
a8: e5980018    ldr     r0, [r8, #24]
ac: ebfffffe    bl      0 <kmem_cache_alloc_trace>
var_1->next = kmalloc(sizeof(struct head_list), GFP_KERNEL);
b0: e5860000    str     r0, [r6]
var_1->time = ktime_get();
b4: ebfffffe    bl      0 <ktime_get>
BUG_ON(!var_1);
b8: e3540007    cmp     r4, #7
bc: 13560000    cmpne   r6, #0
var_1->time = ktime_get();
c0: e1c600f8    strd    r0, [r6, #8]
BUG_ON(!var_1);
c4: 1a000000    bne     cc <init_module+0xcc>
c8: e7f001f2    .word   0xe7f001f2
pr_info("Hello World!");
cc: e1a00009    mov     r0, r9
for (i = 0; i < amount; i++) {
d0: e1a07006    mov     r7, r6
pr_info("Hello World!");
d4: ebfffffe    bl      0 <printk>
for (i = 0; i < amount; i++) {
d8: e2844001    add     r4, r4, #1
var_2 = var_1;
var_1 = var_1->next;
dc: e5966000    ldr     r6, [r6]
e0: eaafffeb    b       94 <init_module+0x94>
}

if (amount != 0) {
e4: e3530000    cmp     r3, #0
e8: 0a000003    beq     fc <init_module+0xfc>
kfree(var_2->next);
ec: e5970000    ldr     r0, [r7]
f0: ebfffffe    bl      0 <kfree>
var_2->next = NULL;
f4: e3a03000    mov     r3, #0
f8: e5873000    str     r3, [r7]
}

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