

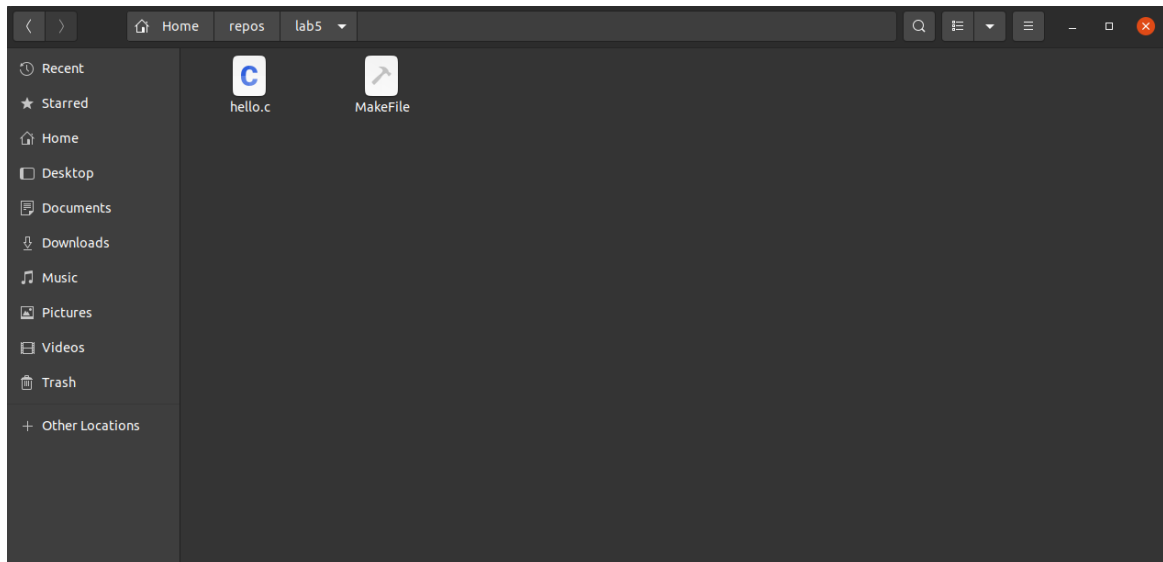
Міністерство освіти і науки України
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ЛАБОРАТОРНА РОБОТА №5

З дисципліни “Архітектура комп’ютерів 2”

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Код файла hello.c:

```
#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("Lab5");
```

```
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) {
```

```
        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();
```

```
        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/lab5
vide@vide-VirtualBox:~/repos/lab5$ 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/lab5$ make
make -C /home/vide/repos/linux-stable M=$PWD
make[1]: Entering directory '/home/vide/repos/linux-stable'
CC [M] /home/vide/repos/lab5/hello.o
Building modules, stage 2.
MODPOST 1 modules
CC /home/vide/repos/lab5/hello.mod.o
LD [M] /home/vide/repos/lab5/hello.ko
make[1]: Leaving directory '/home/vide/repos/linux-stable'
vide@vide-VirtualBox:~/repos/lab5$
```

Перевірка результатів:

```
vide@vide-VirtualBox: ~/repos/busybox
vide@vide-VirtualBox:~/repos/busybox/_install$ find . | cpio -o -H newc | gzip >
../rootfs.cpio.gz; cd ..
118785 blocks
vide@vide-VirtualBox:~/repos/busybox$ qemu-system-arm -kernel _install/boot/zImage
-i initrd rootfs.cpio.gz -machine virt -nographic -m 512 --append "root=/dev/ram0
rw console=ttyAMA0,115200 mem=512M"
[ 0.000000] Booting Linux on physical CPU 0x0
[ 0.000000] Linux version 4.19.224 (vide@vide-VirtualBox) (gcc version 8.3.0
(GNU Toolchain for the A-profile Architecture 8.3-2019.03 (arm-rel-8.36))) #1 SM
P Wed Jan 5 18:36:40 EET 2022
[ 0.000000] CPU: ARMv7 Processor [412fc0f1] revision 1 (ARMv7), cr=10c5387d
[ 0.000000] CPU: div instructions available: patching division code
[ 0.000000] CPU: PIPT / VIPT nonaliasing data cache, PIPT instruction cache
[ 0.000000] OF: fdt: Machine model: linux,dummy-virt
[ 0.000000] Memory policy: Data cache writealloc
[ 0.000000] efi: Getting EFI parameters from FDT:
[ 0.000000] efi: UEFI not found.
[ 0.000000] cma: Reserved 64 MiB at 0x5c000000
[ 0.000000] psci: probing for conduit method from DT.
[ 0.000000] psci: PSCIv0.2 detected in firmware.
[ 0.000000] psci: Using standard PSCI v0.2 function IDs
[ 0.000000] psci: Trusted OS migration not required
[ 0.000000] random: get_random_bytes called from start_kernel+0x9c/0x480 with
crng_init=0
```

```
vide@vide-VirtualBox: ~/repos/busybox
/ # modinfo hello.ko
filename:      hello.ko
author:        Derachyts Vitalii IV-91
description:    Lab5
license:        Dual BSD/GPL
parm:          amount:Amount Hello worlds
depends:
vermagic:      4.19.224 SMP mod_unload ARMv7 p2v8
/ # insmod hello.ko amount=5
[ 39.126395] hello: loading out-of-tree module taints kernel.
[ 39.135640] Entered parameter is between 5 and 10
[ 39.135689] Hello World!
[ 39.135892] Hello World!
[ 39.136049] Hello World!
[ 39.136242] Hello World!
[ 39.136414] Hello World!
[ 39.136615] Amount: 5
/ # rmmod hello.ko
[ 46.245689] Time: 39086674720
[ 46.245925] Time: 39086885744
[ 46.246091] Time: 39087045504
[ 46.246183] Time: 39087235072
[ 46.246276] Time: 39087410144
/ #
```

```
vide@vide-VirtualBox: ~/repos/busybox
/ # insmod hello.ko amount=0
[ 113.969553] Entered parameter equals 0
[ 113.969636] Amount: 0
/ # rmmod hello.ko
/ # insmod hello.ko amount=11
insmod: can't insert 'hello.ko': invalid parameter
/ #
```