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«КПІ» імені Ігоря Сікорського
Кафедра обчислювальної техніки ФІОТ

лабораторна робота 5
з навчальної дисципліни «Архітектура комп'ютерів-2. Процесори»

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Київ 2021

```
karolina@karolina-Swift-SF314-41: ~/repos/busybox
File Edit View Search Terminal Help
karolina@karolina-Swift-SF314-41:~/lab5$ export PATH=/opt/gcc-arm-8.3-2019.03-x86_64-arm-eabi/bin:$PATH
karolina@karolina-Swift-SF314-41:~/lab5$ export CROSS_COMPILE='ccache arm-eabi-'
karolina@karolina-Swift-SF314-41:~/lab5$ export ARCH=arm
karolina@karolina-Swift-SF314-41:~/lab5$ make
make -C /home/karolina/repos/linux-stable M=$PWD
make[1]: Entering directory '/home/karolina/repos/linux-stable'
CC [M] /home/karolina/lab5/hello.o
Building modules, stage 2.
MODPOST 1 modules
CC /home/karolina/lab5/hello.mod.o
LD [M] /home/karolina/lab5/hello.ko
make[1]: Leaving directory '/home/karolina/repos/linux-stable'
karolina@karolina-Swift-SF314-41:~/lab5$ make
make -C /home/karolina/repos/linux-stable M=$PWD
make[1]: Entering directory '/home/karolina/repos/linux-stable'
CC [M] /home/karolina/lab5/hello.o
Building modules, stage 2.
MODPOST 1 modules
LD [M] /home/karolina/lab5/hello.ko
make[1]: Leaving directory '/home/karolina/repos/linux-stable'
karolina@karolina-Swift-SF314-41:~/lab5$ cd ../
karolina@karolina-Swift-SF314-41:~$ cd repos
karolina@karolina-Swift-SF314-41:~/repos$ cd busybox
karolina@karolina-Swift-SF314-41:~/repos/busybox$ cd _install
karolina@karolina-Swift-SF314-41:~/repos/busybox/_install$ find . | cpio -o -H newc | gzip > ../rootfs.cpio.gz
118785 blocks
```

```
karolina@karolina-Swift-SF314-41: ~/repos/busybox
File Edit View Search Terminal Help
karolina@karolina-Swift-SF314-41:~/repos/busybox$ qemu-system-arm -kernel _install/boot/zImage -initrd rootfs.cpio.gz -machine virt -nographic -m 512 --append "root=/dev/ram rw console=ttyAMA0,115200 mem=512M"
[ 0.000000] Booting Linux on physical CPU 0x0
[ 0.000000] Linux version 4.19.223 (karolina@karolina-Swift-SF314-41) (gcc version 8.3.0 (GNU Toolchain for the A-profile Architecture 8.3-2019.03 (arm-rel-8.36))) #1 SMP Sun Jan 2 05:30:52 EST 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
[ 0.000000] percpu: Embedded 16 pages/cpu s36620 r8192 d20724 u65536
[ 0.000000] Built 1 zonelists, mobility grouping on. Total pages: 130048
[ 0.000000] Kernel command line: root=/dev/ram rw console=ttyAMA0,115200 mem=
```

```
modinfo hello.ko
insmod hello.ko amount=7
insmod hello.ko amount=8
insmod hello.ko amount=12
cat sys/module/hello/parameters/amount
rmmod hello.ko
```

```
karolina@karolina-Swift-SF314-41: ~/repos/busybox
File Edit View Search Terminal Help
/ # modinfo hello.ko
filename:      hello.ko
author:        Tribunskaya Karolina
description:    Lab5
license:        Dual BSD/GPL
parm:          times:Amount of outputting Hello worlds
depends:
vermagic:      4.19.223 SMP mod_unload ARMv7 p2v8
/ # insmod hello.ko amount=7
[ 1082.817445] Entered parameter is between 5 and 10
[ 1082.817496] Hello, world!
[ 1082.817910] Hello, world!
[ 1082.818019] Hello, world!
[ 1082.818135] Hello, world!
[ 1082.818256] Hello, world!
[ 1082.818411] Hello, world!
[ 1082.818766] Hello, world!
[ 1082.818944] Amount: 7
/ # rmmod hello.ko
/ # insmod hello.ko amount=12
insmod: can't insert 'hello.ko': invalid parameter
/ # rmmod hello.ko
rmmod: remove 'hello': No such file or directory
/ # insmod hello.ko amount=8
[ 1239.858360] Entered parameter is bigger than 10
[ 1292.804865] Entered parameter is between 5 and 10
[ 1292.805114] Hello, world!
[ 1292.805404] Hello, world!
[ 1292.805518] Hello, world!
[ 1292.805640] Hello, world!
[ 1292.805764] Hello, world!
[ 1292.805883] Hello, world!
[ 1292.806005] Hello, world!
[ 1292.806126] Hello, world!
[ 1292.806269] Amount: 8
/ # cat sys/module/hello/parameters/amount
8
/ #
```

hello.c

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

MODULE_AUTHOR("Tribunskaya Karolina");
MODULE_DESCRIPTION("Lab5");
MODULE_LICENSE("Dual BSD/GPL");

static int amount = 1;
module_param(amount, uint, S_IRUGO);
MODULE_PARM_DESC(times, "Amount of outputting Hello worlds");

static int __init hello_init(void)
{
    uint i = 0;

    if(amount == 0)
    {
        printk(KERN_WARNING "Entered parameter equals 0");
    }
    else if(amount >= 5 && amount <= 10)
    {
        printk(KERN_WARNING "Entered parameter is between 5 and 10");
    }
    else if(amount > 10)
    {
        printk(KERN_ERR "Entered parameter is bigger than 10");
        return -EINVAL;
    }

    for(i=0; i<amount; i++)
    {
        printk(KERN_EMERG "Hello, world!\n");
    }

    printk(KERN_INFO "Amount: %d\n", amount);

    return 0;
}

static void __exit hello_exit(void)
{
    /* Do nothing here right now */
}

module_init(hello_init);
module_exit(hello_exit);
```