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ЗВІТ

з лабораторної роботи №5
з навчальної дисципліни «Архітектура комп'ютерів-2. Процесори»
Підготовка та налаштування плати BBB

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Навчальної групи ІВ-93

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Лістинг програми:

hello.c

```
#include <linux/init.h>
#include <linux/module.h>
#include <linux/kernel.h>
#include <linux/proc_fs.h>
#include <linux/uaccess.h>

MODULE_AUTHOR("Dromashko Artem IV-93");
MODULE_DESCRIPTION("AK 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);
```

Makefile

```
ifneq ($(KERNELRELEASE),)
# kbuild part of makefile
obj-m := hello.o

else
# normal makefile
KDIR ?= /lib/modules/`uname -r`/build

default:
$(MAKE) -C $(KDIR) M=$$PWD

clean:
$(MAKE) -C $(KDIR) M=$$PWD clean

endif
```

```
Терминал
Ср, 22 декабря 20:15
bebra@bebra-VirtualBox: ~/repos/busybox

bebra@bebra-VirtualBox:~/repos/busybox$ qemu-system-arm -kernel _install/boot/zImage -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 4.19.221 (bebra@bebra-VirtualBox) (gcc version 8.3.0 (GNU Toolchain for the A-profile Architecture 8.3-2019.03 (arm-rel-8.36))) #1 SMP Wed Dec 22 01:20:25 EET 2021
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] psct: probing for conduit method from DT.
0.000000] psct: PSCTv0.2 detected in firmware.
0.000000] psct: Using standard PSCT v0.2 function IDs
0.000000] psct: 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/ram0 rw console=ttyAMA0,115200 mem=512M
0.000000] Dentry cache hash table entries: 65536 (order: 6, 262144 bytes)
0.000000] Inode-cache hash table entries: 32768 (order: 5, 131072 bytes)
0.000000] Memory: 406428K/524288K available (12288K kernel code, 1619K rwdata, 4784K rodata, 2048K init, 393K bss, 52324K reserved, 65536K cma-reserved, 0K highmem)
0.000000] Virtual kernel memory layout:
0.000000]   vector : 0xffff0000 - 0xffff1000   ( 4 kB)
0.000000]   fixmap : 0xffc00000 - 0xffff0000   (3072 kB)
0.000000]   vmalloc : 0xe0800000 - 0xff800000   ( 496 MB)
0.000000]   lowmem  : 0xc0000000 - 0xe0000000   ( 512 MB)
0.000000]   pkmap   : 0xbfe00000 - 0xc0000000   ( 2 MB)
0.000000]   modules : 0xbf000000 - 0xbfe00000   ( 14 MB)
0.000000]   .text : 0x(ptrval) - 0x(ptrval)   (13280 kB)
0.000000]   .init : 0x(ptrval) - 0x(ptrval)   (2048 kB)
0.000000]   .data : 0x(ptrval) - 0x(ptrval)   (1620 kB)
0.000000]   .bss : 0x(ptrval) - 0x(ptrval)   ( 394 kB)
0.000000] SLUB: HWalign=64, Order=0-3, MinObjects=0, CPUs=1, Nodes=1
0.000000] rcu: Hierarchical RCU implementation.
0.000000] rcu: RCU event tracing is enabled.
0.000000] rcu: RCU restricting CPUs from NR_CPUS=16 to nr_cpu_ids=1.
0.000000] rcu: Adjusting geometry for rcu_fanout_leaf=16, nr_cpu_ids=1
0.000000] NR_IRQS: 16, nr_irqs: 16, preallocated irqs: 16
0.000000] GICv2m: range[mem 0x08020000-0x08020fff], SPI[80:143]
0.000000] arch_timer: cp15 timer(s) running at 62.50MHz (virt).
0.000000] clocksource: arch_sys_counter: mask: 0xffffffffffffff max_cycles: 0x1cd42e208c, max_idle_ns: 881590405314 ns
0.002222] sched_clock: 56 bits at 62MHz, resolution 16ns, wraps every 4398046511096ns
0.005223] Switching to timer-based delay loop, resolution 16ns
0.005699] Console: colour dummy device 80x30
0.007950] Calibrating delay loop (skipped), value calculated using timer frequency.. 125.00 BogoMIPS (lpj=625000)
0.012855] pid_max: default: 32768 minimum: 301
0.014348] Mount-cache hash table entries: 1024 (order: 0, 4096 bytes)
0.014348] Mountpoint-cache hash table entries: 1024 (order: 0, 4096 bytes)
```

Rovyshyn Andrii

Rovyshyn Andrii

```
[ 4.418128] i2c /dev entries driver
[ 4.486829] sdhci: Secure Digital Host Controller Interface driver
[ 4.492422] sdhci: Copyright(c) Pierre Ossman
[ 4.496834] Synopsys Designware Multimedia Card Interface Driver
[ 4.508781] sdhci-pltfm: SDHCI platform and OF driver helper
[ 4.522149] ledtrig-cpu: registered to indicate activity on CPUs
[ 4.534700] usbcore: registered new interface driver usbhid
[ 4.539829] usbhid: USB HID core driver
[ 4.569129] NET: Registered protocol family 10
[ 4.596996] Segment Routing with IPv6
[ 4.598603] sit: IPv6, IPv4 and MPLS over IPv4 tunneling driver
[ 4.609783] NET: Registered protocol family 17
[ 4.624433] can: controller area network core (rev 20170425 abt 9)
[ 4.627055] NET: Registered protocol family 29
[ 4.628463] can: raw protocol (rev 20170425)
[ 4.632131] can: broadcast manager protocol (rev 20170425 t)
[ 4.634108] can: netlink gateway (rev 20170425) max_hops=1
[ 4.638107] Key type dns_resolver registered
[ 4.640233] ThumbEE CPU extension supported.
[ 4.649610] Registering SWP/SMPB emulation handler
[ 4.659824] Loading compiled-in X.509 certificates
[ 4.699018] input: gpio-keys as /devices/platform/gpio-keys/input/input0
[ 4.716390] rtc-pl031 9010000.pl031: setting system clock to 2021-12-22 17:49:39 UTC (1640195379)
[ 4.736997] uart-pl011 9000000.pl011: no DMA platform data
[ 5.167927] Freeing unused kernel memory: 2048K
[ 5.183658] Run /init as init process
```

Please press Enter to activate this console.

```
/ # modinfo hello.ko
filename:      hello.ko
author:        Rovyshyn Andrii IV-93
description:    AK Lab5
license:        Dual BSD/GPL
parm:          times:Amount of outputting Hello worlds
depends:
vermagic:      4.19.221 SMP mod_unload ARMv7 p2v8
/ # insmod hello.ko
[ 1672.995202] hello: loading out-of-tree module taints kernel.
[ 1673.015705] Hello, world!
[ 1673.016461] Amount: 1
/ # rmmod hello.ko
/ # insmod hello.ko amount=4
[ 1711.344265] Hello, world!
[ 1711.346659] Hello, world!
[ 1711.347499] Hello, world!
[ 1711.348198] Hello, world!
[ 1711.348885] Amount: 4
/ #
```