

Міністерство освіти і науки України
Національний технічний університет України «КПІ» імені Ігоря Сікорського
Кафедра обчислювальної техніки ФІОТ

ЗВІТ
з лабораторної роботи №5
з навчальної дисципліни «Архітектура комп'ютерів-2. Процесори»

Виконала:

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Островська Богдана

Перевірів:

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Київ 2021

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danka@danka-Aspire-A315-23: ~/repos/busybox
File Edit View Search Terminal Help
danka@danka-Aspire-A315-23:~$ 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"
qemu-system-arm: could not load kernel '_install/boot/zImage'
danka@danka-Aspire-A315-23:~$ cd ~/repos/busybox
danka@danka-Aspire-A315-23:~/repos/busybox$ cd _install
danka@danka-Aspire-A315-23:~/repos/busybox/_install$ cd ..
CD: command not found
danka@danka-Aspire-A315-23:~/repos/busybox/_install$ cd ..
danka@danka-Aspire-A315-23:~/repos/busybox$ qemu-system-arm -kernel _install/boot/zImage -initrd rootfs.cpio.gz -mach
ne 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 4.19.220 (danka@danka-Aspire-A315-23) (gcc version 8.3.0 (GNU Toolchain for the A-profile
Architecture 8.3-2019.03 (arm-rel-8.36))) #1 SMP Thu Dec 9 03:23:02 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] 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/0x47c 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: 8815904053
14 ns
[ 0.000233] sched_clock: 56 bits at 62MHz, resolution 16ns, wraps every 4398046511096ns
[ 0.000466] Switching to timer-based delay loop, resolution 16ns
[ 0.005251] Console: colour dummy device 80x30
```

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danka@danka-Aspire-A315-23: ~/repos/busybox
File Edit View Search Terminal Help
[ 0.007228] Calibrating delay loop (skipped), value calculated using timer frequency.. 125.00 BogoMIPS (lpj=625000)
[ 0.007427] pid_max: default: 32768 minimum: 301
[ 0.013143] Mount-cache hash table entries: 1024 (order: 0, 4096 bytes)
[ 0.013203] Mountpoint-cache hash table entries: 1024 (order: 0, 4096 bytes)
[ 0.027519] CPU: Testing write buffer coherency: ok
[ 0.028932] CPU0: Spectre v2: firmware did not set auxiliary control register IBE bit, system vulnerable
[ 0.041029] /cpus/cpu@0 missing clock-frequency property
[ 0.041387] CPU0: thread -1, cpu 0, socket 0, mpidr 80000000
[ 0.048257] Setting up static identity map for 0x40300000 - 0x403000a0
[ 0.050692] rcu: Hierarchical SRCU implementation.
[ 0.057715] EFI services will not be available.
[ 0.059038] smp: Bringing up secondary CPUs ...
[ 0.059154] smp: Brought up 1 node, 1 CPU
[ 0.059254] SMP: Total of 1 processors activated (125.00 BogoMIPS).
[ 0.059337] CPU: All CPU(s) started in SVC mode.
[ 0.125816] devtmpfs: initialized
[ 0.136929] VFP support v0.3: implementor 41 architecture 4 part 30 variant f rev 0
[ 0.158717] clocksource: jiffies: mask: 0xffffffff max_cycles: 0xffffffff, max_idle_ns: 19112604462750000 ns
[ 0.159779] futex hash table entries: 256 (order: 2, 16384 bytes)
[ 0.167731] pinctrl core: initialized pinctrl subsystem
[ 0.185823] DMI not present or invalid.
[ 0.193669] NET: Registered protocol family 16
[ 0.218402] DMA: preallocated 256 KiB pool for atomic coherent allocations
[ 0.226126] cpuidle: using governor menu
[ 0.227030] No ATAGs?
[ 0.228887] hw-breakpoint: found 5 (+1 reserved) breakpoint and 4 watchpoint registers.
[ 0.228980] hw-breakpoint: maximum watchpoint size is 8 bytes.
[ 0.234061] Serial: AMBA PL011 UART driver
[ 0.275544] 9000000.pl011: ttyAMA0 at MMIO 0x9000000 (irq = 54, base_baud = 0) is a PL011 rev1
[ 0.294644] console [ttyAMA0] enabled
[ 0.352798] vgaarb: loaded
[ 0.356000] SCSI subsystem initialized
[ 0.358666] usbcore: registered new interface driver usbfs
[ 0.359097] usbcore: registered new interface driver hub
[ 0.359479] usbcore: registered new device driver usb
[ 0.362817] pps_core: LinuxPPS API ver. 1 registered
[ 0.363153] pps_core: Software ver. 5.3.6 - Copyright 2005-2007 Rodolfo Giometti <giometti@linux.it>
[ 0.363714] PTP clock support registered
[ 0.364606] EDAC MC: Ver: 3.0.0
[ 0.393939] clocksource: Switched to clocksource arch_sys_counter
[ 0.556309] NET: Registered protocol family 2
[ 0.558354] IP idents hash table entries: 8192 (order: 4, 65536 bytes)
[ 0.563480] tcp_listen_portaddr hash hash table entries: 512 (order: 0, 6144 bytes)
[ 0.563809] TCP established hash table entries: 4096 (order: 2, 16384 bytes)
[ 0.564229] TCP bind hash table entries: 4096 (order: 3, 32768 bytes)
[ 0.564728] TCP: Hash tables configured (established 4096 bind 4096)
[ 0.566819] UDP hash table entries: 256 (order: 1, 8192 bytes)
[ 0.567238] UDP-Lite hash table entries: 256 (order: 1, 8192 bytes)
[ 0.569621] NET: Registered protocol family 1
[ 0.574313] RPC: Registered named UNIX socket transport module.
[ 0.574630] RPC: Registered udp transport module.
[ 0.574785] RPC: Registered tcp transport module.
[ 0.574970] RPC: Registered tcp NFSv4.1 backchannel transport module.
[ 0.583274] Trying to unpack rootfs image as initramfs...
[ 2.919671] Freeing initrd memory: 25092K
[ 2.924862] Initialise system trusted keyrings
[ 2.926944] workingset: timestamp bits=30 max order=17 bucket_order=0
[ 2.941542] squashfs: version 4.0 (2009/01/31) Phillip Lougher
```



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danka@danka-Aspire-A315-23: ~/repos/busybox
File Edit View Search Terminal Help

Please press Enter to activate this console.
/ # poweroff
/ # umount: can't unmount /: Invalid argument
swapon: can't open '/etc/fstab': No such file or directory
The system is going down NOW!
Sent SIGTERM to all processes
Sent SIGKILL to all processes
Requesting system poweroff
[ 20.274231] reboot: Power down
danka@danka-Aspire-A315-23:~/repos/busybox$ cd ~
danka@danka-Aspire-A315-23:~$ cd lab5/
danka@danka-Aspire-A315-23:~/lab5$ export ARCH=arm; export PATH=/opt/gcc-arm-8.3-2019.03-x86_64-arm-linux-gnueabi/hf/bin:$PATH; export CROSS_COMPILE="ccache arm-linux-gnueabi/hf-"; export KDIR=$HOME/repos/linux-stable
danka@danka-Aspire-A315-23:~/lab5$ make
make: *** No targets. Stop.
danka@danka-Aspire-A315-23:~/lab5$ make
Makefile:1: *** missing separator. Stop.
danka@danka-Aspire-A315-23:~/lab5$ export ARCH=arm; export PATH=/opt/gcc-arm-8.3-2019.03-x86_64-arm-linux-gnueabi/hf/bin:$PATH; export CROSS_COMPILE="ccache arm-linux-gnueabi/hf-"; export KDIR=$HOME/repos/linux-stable
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Makefile:1: *** missing separator. Stop.
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danka@danka-Aspire-A315-23:~/lab5$ make
make -C /home/danka/repos/linux-stable M=$PWD
make[1]: Entering directory '/home/danka/repos/linux-stable'
  CC [M] /home/danka/lab5/hello.o
  Building modules, stage 2.
  MODPOST 1 modules
  CC /home/danka/lab5/hello.mod.o
  LD [M] /home/danka/lab5/hello.ko
make[1]: Leaving directory '/home/danka/repos/linux-stable'
danka@danka-Aspire-A315-23:~/lab5$ cd ..
danka@danka-Aspire-A315-23:~$ cd repos
danka@danka-Aspire-A315-23:~/repos$ cd busybox/
danka@danka-Aspire-A315-23:~/repos/busybox$ cd _install/
danka@danka-Aspire-A315-23:~/repos/busybox/_install$ find . | cpio -o -H newc | gzip > ../rootfs.cpio.gz; cd ..
118784 blocks
danka@danka-Aspire-A315-23:~/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"
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[ 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/0x47c with crng_init=0
[ 0.000000] percpu: Embedded 16 pages/cpu s36620 r8192 d20724 u65536

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danka@danka-Aspire-A315-23: ~/repos/busybox
File Edit View Search Terminal Help
[ 2.184927] usbserial: USB Serial support registered for google
[ 2.185350] usbserial: USB Serial support registered for libtransistor
[ 2.185804] usbserial: USB Serial support registered for vivopay
[ 2.186108] usbserial: USB Serial support registered for moto_modem
[ 2.186420] usbserial: USB Serial support registered for motorola_tetra
[ 2.186834] usbserial: USB Serial support registered for novatel_gps
[ 2.187349] usbserial: USB Serial support registered for hp4x
[ 2.187719] usbserial: USB Serial support registered for suunto
[ 2.188124] usbserial: USB Serial support registered for siemens_mpi
[ 2.200112] rtc-pl031 9010000.pl031: rtc core: registered pl031 as rtc0
[ 2.202979] i2c /dev entries driver
[ 2.221371] sdhci: Secure Digital Host Controller Interface driver
[ 2.221877] sdhci: Copyright(c) Pierre Ossman
[ 2.226227] Synopsys Designware Multimedia Card Interface Driver
[ 2.228115] sdhci-pltfm: SDHCI platform and OF driver helper
[ 2.231101] ledtrig-cpu: registered to indicate activity on CPUs
[ 2.232472] usbcore: registered new interface driver usbhid
[ 2.232668] usbhid: USB HID core driver
[ 2.238349] NET: Registered protocol family 10
[ 2.243985] Segment Routing with IPv6
[ 2.244434] sit: IPv6, IPv4 and MPLS over IPv4 tunneling driver
[ 2.246975] NET: Registered protocol family 17
[ 2.247662] can: controller area network core (rev 20170425 abi 9)
[ 2.248151] NET: Registered protocol family 29
[ 2.248321] can: raw protocol (rev 20170425)
[ 2.248538] can: broadcast manager protocol (rev 20170425 t)
[ 2.248770] can: netlink gateway (rev 20170425) max_hops=1
[ 2.249802] Key type dns_resolver registered
[ 2.250244] ThumbEE CPU extension supported.
[ 2.250413] Registering SWP/SWPB emulation handler
[ 2.251892] Loading compiled-in X.509 certificates
[ 2.267551] input: gpio-keys as /devices/platform/gpio-keys/input/input0
[ 2.274164] rtc-pl031 9010000.pl031: setting system clock to 2021-12-09 02:51:51 UTC (1639018311)
[ 2.280818] uart-pl011 9000000.pl011: no DMA platform data
[ 2.393793] Freeing unused kernel memory: 2048K
[ 2.399128] Run /init as init process

Please press Enter to activate this console.
/ # modinfo hello.ko
filename:      hello.ko
author:       Ostrovska Bohdana IV-93
description:   Hello world Lab5
license:      Dual BSD/GPL
parm:         times:Amount of outputting Hello worlds
depends:
vermagic:     4.19.220 SMP mod_unload ARMv7 p2v8
/ # insmod hello.ko amount=5
[ 65.716632] hello: loading out-of-tree module taints kernel.
[ 65.725355] Entered parameter is between 5 and 10
[ 65.725515] Hello, world!
[ 65.725775] Hello, world!
[ 65.725851] Hello, world!
[ 65.725920] Hello, world!
[ 65.725997] Hello, world!
[ 65.726084] Amount: 5
/ # rmmod hello.ko
/ #
```