

МИНИСТЕРСТВО НАУКИ И ВЫСШЕГО ОБРАЗОВАНИЯ
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Федеральное государственное автономное образовательное
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Кафедра компьютерной инженерии и моделирования

ОТЧЕТ ПО ПРАКТИЧЕСКОМУ ЗАДАНИЮ № 7
«Ядро ОС Linux. Сборка и установка.»

Практическая работа по дисциплине
«Операционные системы»
студента 1 курса группы ПИ-б-о-231(2)
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Цель: Изучить понятие ядра операционной системы, принципы его конфигурации, компиляции и установки на примере ядра Linux. Ознакомиться с методикой сборки новой версии ядра Linux из исходных кодов. Получить и распаковать свежие исходные коды ядра Linux. Выполнить их конфигурацию, скомпилировать и установить новое ядро. Проверить работоспособность системы с новым ядром.

Ход работы:

1. Для последующей сборки ядра необходимо установить дополнительные пакеты, например для дистрибутивов семейства Debian GNU/Linux:

```
ubuntu@ubuntu:~$ sudo apt install fakeroot build-essential libncurses-dev xz-utils libssl-dev flex libelf-dev bison bzip2 wget
[sudo] пароль для maxim:
Чтение списков пакетов... Готово
Построение дерева зависимостей... Готово
Чтение информации о состоянии... Готово
Уже установлен пакет bison самой новой версии (2:3.8.2+dfsg-1build1).
Уже установлен пакет build-essential самой новой версии (12.9ubuntu3).
Уже установлен пакет bzip2 самой новой версии (1.0.8-5build1).
Уже установлен пакет fakeroot самой новой версии (1.28-1ubuntu1).
Уже установлен пакет flex самой новой версии (2.6.4-8build2).
Уже установлен пакет libelf-dev самой новой версии (0.186-1build1).
Уже установлен пакет wget самой новой версии (1.21.2-2ubuntu1).
Уже установлен пакет xz-utils самой новой версии (5.2.5-2ubuntu1).
Уже установлен пакет libncurses-dev самой новой версии (6.3-2ubuntu0.1).
Уже установлен пакет libssl-dev самой новой версии (3.0.2-0ubuntu1.15).
Обновлено 0 пакетов, установлено 0 новых пакетов, для удаления отмечено 0 пакетов, и 78 пакетов не обновлено.
ubuntu@ubuntu:~$
```

2. Скачайте с сайта <https://kernel.org/> свежую копию исходных кодов ядра

```
ubuntu@ubuntu:~$ wget https://cdn.kernel.org/pub/linux/kernel/v6.x/linux-6.8.9.tar.xz
--2024-06-28 19:26:18-- https://cdn.kernel.org/pub/linux/kernel/v6.x/linux-6.8.9.tar.xz
Распознаётся cdn.kernel.org (cdn.kernel.org)... 146.75.117.176, 2a04:4e42:8d::432
Подключение к cdn.kernel.org (cdn.kernel.org)[146.75.117.176]:443... соединение установлено.
HTTP-запрос отправлен. Ожидание ответа... 200 OK
Длина: 142582332 (136M) [application/x-xz]
Сохранение в: 'linux-6.8.9.tar.xz'

linux-6.8.9.tar.xz          100%[=====] 135,98M  11,0MB/s   за 28s
2024-06-28 23:46:17 (4,78 MB/s) - 'linux-6.8.9.tar.xz' сохранён [142582332/142582332]
```

3. Проверьте верность скачанного архива по *PGP* подписи:

```
ubuntu@ubuntu:~/src$ unxz linux-6.8.9.tar.xz
ubuntu@ubuntu:~/src$ gpg --verify linux-6.8.9.tar.sign linux-6.8.9.tar
gpg: Подпись сделана Ср 19 июня 2024 01:26:44 MSK
gpg:                ключом RSA с идентификатором 647F28654894E3BD457199BE38DBBDC86092693E
gpg: Действительная подпись пользователя "Greg Kroah-Hartman <gregkh@kernel.org>" [неизвестно]
gpg: Внимание: Данный ключ не заверен доверенной подписью!
gpg:                Нет указаний на то, что подпись принадлежит владельцу.
Отпечаток первичного ключа: 647F 2865 4894 E3BD 4571  99BE 38DB BDC8 6092 693E
ubuntu@ubuntu:~/src$
```

4. Распакуйте архив с кодами в папку предназначенную для хранения исходных кодов ПО в GNU/Linux:

```
linux-6.8.9/virt/lib/
linux-6.8.9/virt/lib/Kconfig
linux-6.8.9/virt/lib/Makefile
linux-6.8.9/virt/lib/irqbypass.c
ubuntu@ubuntu:~/usr/src$ tar -vxf linux-6.8.9.tar
```

5. В данной папке сделайте ссылку linux указывающую на распакованную вами директорию.

```
ubuntu@ubuntu:~/usr/src$ ln -s linux-6.8.9 linux
```

6. Перейдите в распакованную директорию и запустите процесс конфигурации:

```
ubuntu@ubuntu:~/usr/src/linux$ make menuconfig
HOSTCC  scripts/basic/fixdep
HOSTCC  scripts/kconfig/mconf.o
HOSTCC  scripts/kconfig/lxdialog/checklist.o
HOSTCC  scripts/kconfig/lxdialog/inputbox.o
HOSTCC  scripts/kconfig/lxdialog/menubox.o
HOSTCC  scripts/kconfig/lxdialog/textbox.o
HOSTCC  scripts/kconfig/lxdialog/util.o
HOSTCC  scripts/kconfig/lxdialog/yesno.o
HOSTCC  scripts/kconfig/mnconf-common.o
HOSTCC  scripts/kconfig/confdata.o
HOSTCC  scripts/kconfig/expr.o
LEX      scripts/kconfig/lexer.lex.c
YACC     scripts/kconfig/parser.tab.[ch]
HOSTCC  scripts/kconfig/lexer.lex.o
HOSTCC  scripts/kconfig/menu.o
HOSTCC  scripts/kconfig/parser.tab.o
HOSTCC  scripts/kconfig/preprocess.o
HOSTCC  scripts/kconfig/symbol.o
HOSTCC  scripts/kconfig/util.o
HOSTLD  scripts/kconfig/mconf

#
# using defaults found in /boot/config-6.5.0-35-generic
#
.config:10580:warning: symbol value 'm' invalid for ANDROID_BINDER_IPC
.config:10581:warning: symbol value 'm' invalid for ANDROID_BINDERFS
.config:10807:warning: symbol value 'm' invalid for FSCACHE

*** End of the configuration.
*** Execute 'make' to start the build or try 'make help'.
```

включение поддержки виртуализации KVM и Xen полная поддержка ядром cgroups

```
.config - Linux/x86 6.8.9 Kernel Configuration
> General setup > Control Group support

Control Group support
Arrow keys navigate the menu. <Enter> selects submenus ---> (or empty submenus ----).
Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes
features. Press <Esc><Esc> to exit, <?> for Help, </> for Search. Legend: [*] built-in
[ ] excluded <M> module < > module capable

--- Control Group support
[*] Favor dynamic modification latency reduction by default
[*] Memory controller
[*] IO controller
-* CPU controller --->
[*] Utilization clamping per group of tasks
[*] PIDs controller
[*] RDMA controller
[*] Freezer controller
[*] HugeTLB controller
[*] Cpuset controller
[*] Include legacy /proc/<pid>/cpuset file
[*] Device controller
[*] Simple CPU accounting controller
[*] Perf controller
[*] Support for eBPF programs attached to cgroups
[*] Misc resource controller
[*] Debug controller
```

настройка межсетевого экрана iptables

```
.config - Linux/x86 6.8.9 Kernel Configuration
> Virtualization

Virtualization
Arrow keys navigate the menu. <Enter> selects submenus ---> (or empty submenus ----).
Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes
features. Press <Esc><Esc> to exit, <?> for Help, </> for Search. Legend: [*] built-in
[ ] excluded <M> module < > module capable

--- Virtualization
<*> Kernel-based Virtual Machine (KVM) support
[*] Compile KVM with -Werror
[ ] Enable support for KVM software-protected VMs
<*> KVM for Intel (and compatible) processors support
[ ] Software Guard extensions (SGX) Virtualization
< > KVM for AMD processors support
[ ] System Management Mode emulation
[ ] Support for Microsoft Hyper-V emulation
[*] Support for Xen hypercall interface
[ ] Prove KVM MMU correctness
(4096) Maximum number of vCPUs per KVM guest
```



```
.config - Linux/x86 6.8.9 Kernel Configuration
[...] King options > Network packet filtering framework (Netfilter) > Core Netfilter Configuration
Core Netfilter Configuration
Arrow keys navigate the menu. <Enter> selects submenus ---> (or empty submenus ----).
Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes
features. Press <Esc><Esc> to exit, <?> for Help, </> for Search. Legend: [*] built-in
[ ] excluded <M> module < > module capable

^(-)
-* Network Address Translation support
<Y> Netfilter nf_tables support
[*] Netfilter nf_tables mixed IPv4/IPv6 tables support
[*] Netfilter nf_tables netdev tables support
<Y> Netfilter nf_tables number generator module
<Y> Netfilter nf_tables conntrack module
<Y> Netfilter nf_tables hardware flow offload module
<Y> Netfilter nf_tables connlimit module
<Y> Netfilter nf_tables log module
<Y> Netfilter nf_tables limit module
<Y> Netfilter nf_tables masquerade support
<Y> Netfilter nf_tables redirect support
<Y> Netfilter nf_tables nat module
<Y> Netfilter nf_tables tunnel module
<Y> Netfilter nf_tables queue module
<Y> Netfilter nf_tables quota module
<Y> Netfilter nf_tables reject support
<Y> Netfilter x_tables over nf_tables module
<Y> Netfilter nf_tables hash module
<Y> Netfilter nf_tables fib inet support
<Y> Netfilter nf_tables xfrm/IPSec security association matching
<Y> Netfilter nf_tables socket match support
<Y> Netfilter nf_tables passive OS fingerprint support
<Y> Netfilter nf_tables tproxy support
<Y> Netfilter nf_tables SYNPROXY expression support
-* Netfilter packet duplication support
<Y> Netfilter nf_tables netdev packet duplication support
<Y> Netfilter nf_tables netdev packet forwarding support
<Y> Netfilter nf_tables netdev fib lookups support
<Y> Netfilter nf_tables netdev REJECT support
<Y> Netfilter flow table mixed IPv4/IPv6 module
<Y> Netfilter flow table module
[ ] Supply flow table statistics in procfs
-* Netfilter Xtables support (required for ip_tables)
[*] Netfilter Xtables 32bit support
*** Xtables combined modules ***
{M} nfmark target and match support
{M} ctmark target and match support
<M> set target and match support
*** Xtables targets ***
<M> AUDIT target support
v(+)

<Select> < Exit > < Help > < Save > < Load >
```

поддержка initrd

.config - Linux/x86 6.8.9 Kernel Configuration

> General setup

General setup

Arrow keys navigate the menu. <Enter> selects submenus ---> (or empty submenus ----). Highlighted letters are hotkeys. Pressing <Y> includes, <N> excludes, <M> modularizes features. Press <Esc><Esc> to exit, <?> for Help, </> for Search. Legend: [*] built-in [] excluded <M> module < > module capable

```
^(-)
[*] Auditing support
    IRQ subsystem --->
    Timers subsystem --->
    BPF subsystem --->
    Preemption Model (Voluntary Kernel Preemption (Desktop)) --->
[*] Preemption behaviour defined on boot
[*] Core Scheduling for SMT
    CPU/Task time and stats accounting --->
[*] CPU isolation
    RCU Subsystem --->
< > Kernel .config support
<M> Enable kernel headers through /sys/kernel/kheaders.tar.xz
(18) Kernel log buffer size (16 => 64KB, 17 => 128KB)
(12) CPU kernel log buffer size contribution (13 => 8 KB, 17 => 128KB)
[ ] Printk indexing debugfs interface
    Scheduler features --->
[*] Memory placement aware NUMA scheduler
[*] Automatically enable NUMA aware memory/task placement
--* Control Group support --->
[*] Namespaces support --->
[*] Checkpoint/restore support
[*] Automatic process group scheduling
--* Kernel->user space relay support (formerly relayfs)
--* Initial RAM filesystem and RAM disk (initramfs/initrd) support
    () Initramfs source file(s)
    [*] Support initial ramdisk/ramfs compressed using gzip
    [*] Support initial ramdisk/ramfs compressed using bzip2
    [*] Support initial ramdisk/ramfs compressed using LZMA
    [*] Support initial ramdisk/ramfs compressed using XZ
    [*] Support initial ramdisk/ramfs compressed using LZ0
    [*] Support initial ramdisk/ramfs compressed using LZ4
    [*] Support initial ramdisk/ramfs compressed using ZSTD
[*] Boot config support
    [ ] Force unconditional bootconfig processing
    [ ] Embed bootconfig file in the kernel
[*] Preserve cpio archive mtimes in initramfs
    Compiler optimization level (Optimize for performance (-O2)) --->
[*] Configure standard kernel features (expert users) --->
    Kernel Performance Events And Counters --->
[*] Profiling support
    Kexec and crash features --->
```

<Select>

< Exit >

< Help >

< Save >

< Load >

Выключение хранения конфигурации в ядре

```
config - Linux/x86 6.8.9 Kernel Configuration
General setup

General setup
Arrow keys navigate the menu. <Enter> selects submenus ---> (or empty
submenus ----). Highlighted letters are hotkeys. Pressing <Y>
includes, <N> excludes, <M> modularizes features. Press <Esc><Esc> to
exit, <?> for Help, </> for Search. Legend: [*] built-in [ ]

[*] Preemption Model (Voluntary Kernel Preemption (Desktop)) ---
[*] Preemption behaviour defined on boot
[*] Core Scheduling for SMT
CPU/Task time and stats accounting --->
[*] CPU isolation
RCU Subsystem --->
< > Kernel .config support
<M> Enable kernel headers through /sys/kernel/kheaders.tar.xz
(18) Kernel log buffer size (16 => 64KB, 17 => 128KB)
(12) CPU kernel log buffer size contribution (13 => 8 KB, 17 => 1
[ ] Printk indexing debugfs interface
Scheduler features --->
--* Control Group support --->
[*] Namespaces support --->
[ ] Checkpoint/restore support
[*] Automatic process group scheduling
--* Kernel->user space relay support (formerly relayfs)
--* Initial RAM filesystem and RAM disk (initramfs/initrd) support
( ) Initramfs source file(s)
[*] Support initial ramdisk/ramfs compressed using gzip
[*] Support initial ramdisk/ramfs compressed using bzip2
[*] Support initial ramdisk/ramfs compressed using LZMA
[*] Support initial ramdisk/ramfs compressed using XZ
[*] Support initial ramdisk/ramfs compressed using LZO
[*] Support initial ramdisk/ramfs compressed using LZ4
[*] Support initial ramdisk/ramfs compressed using ZSTD
[*] Boot config support
[ ] Force unconditional bootconfig processing

v(+)
```

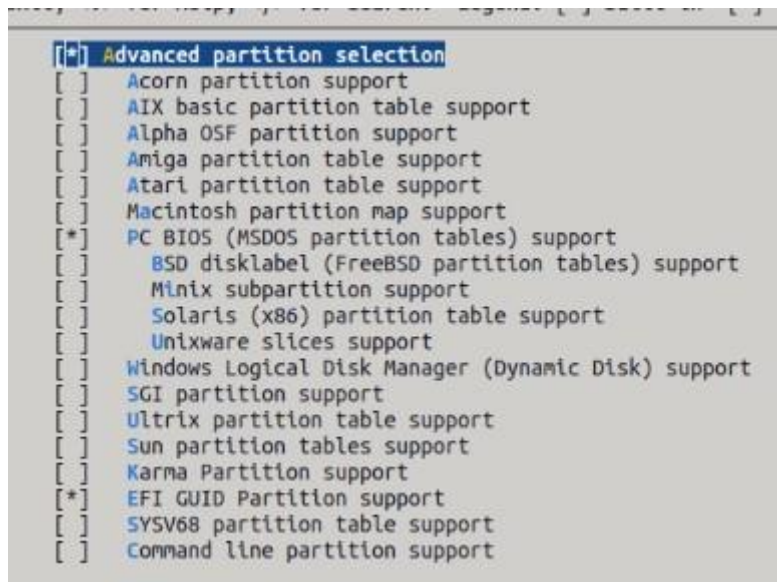
<Select> <Exit> <Help> <Save> <Load>

поддержка загрузки/выгрузки модулей

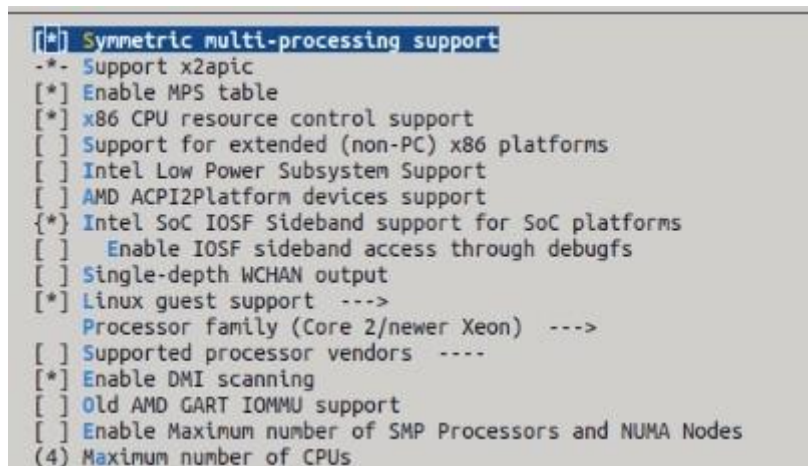
```
Arrow keys navigate the menu. <Enter> selects submenus ---> (or emp
submenus ----). Highlighted letters are hotkeys. Pressing <Y>
includes, <N> excludes, <M> modularizes features. Press <Esc><Esc>
exit, <?> for Help, </> for Search. Legend: [*] built-in [ ]

--* Enable loadable module support
[ ] Module debugging
[ ] Forced module loading
[*] Module unloading
[ ] Forced module unloading
[ ] Tainted module unload tracking
[ ] Module versioning support
[ ] Source checksum for all modules
[ ] Module signature verification
Module compression mode (ZSTD) --->
[*] Support in-kernel module decompression
[ ] Allow loading of modules with missing namespace imports
(/sbin/modprobe) Path to modprobe binary
[ ] Trim unused exported kernel symbols
```

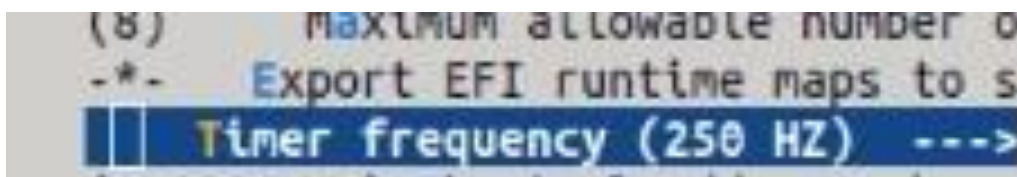
поддержка таблиц разделов только PC-BIOS и EFI GUID



поддержка SMP и максимальное количество CPU — 4



выставленная частота таймера (250 Hz)



поддержка PCI

```
.config - Linux/x86 6.8.9 Kernel Configuration
> Device Drivers

Device Drivers
Arrow keys navigate the menu. <Enter> selects submenus ---> (or empty
submenus ----). Highlighted letters are hotkeys. Pressing <Y>
includes, <N> excludes, <M> modularizes features. Press <Esc><Esc> to
exit, <?> for Help, </> for Search. Legend: [*] built-in [ ]

[*] EISA support --->
[*] PCI support --->
<M> PCCard (PCMCIA/CardBus) support --->
<*> RapidIO support --->
    Generic Driver Options --->
    Bus devices --->
    Cache Drivers ----
[*] Connector - unified userspace <-> kernelspace linker --->
    Firmware Drivers --->
< > GNSS receiver support ----
< > Memory Technology Device (MTD) support ----
[ ] Device Tree and Open Firmware support ----
<M> Parallel port support --->
-* Plug and Play support --->
[*] Block devices --->
    NVME Support --->
    Misc devices --->
    SCSI device support --->
<*> Serial ATA and Parallel ATA drivers (libata) --->
[*] Multiple devices driver support (RAID and LVM) --->
< > Generic Target Core Mod (TCM) and ConfigFS Infrastructure --
[*] Fusion MPT device support --->
    IEEE 1394 (FireWire) support --->
[*] Macintosh device drivers --->
-* Network device support --->
    Input device support --->
    Character devices --->
    I2C support --->
<M> I3C support --->
v(+)
```

<Select> < Exit > < Help > < Save > < Load >

поддержка драйверов VIRTIO

```
-- Virtio drivers
<*> PCI driver for virtio devices
[*] Support for legacy virtio draft 0.9.X and older devices
<*> vDPA driver for virtio devices
<*> Support for virtio pmem driver
<*> Virtio balloon driver
<*> Virtio input driver
<*> Platform bus driver for memory mapped virtio devices
[*] Memory mapped virtio devices parameter parsing
```

Отключение звуковой карты

```
Config - Linux/x86 0.8.9 Kernel Configuration
Device Drivers

Device Drivers
Arrow keys navigate the menu. <Enter> selects submenus
submenus ----). Highlighted letters are hotkeys. Press
includes, <N> excludes, <M> modularizes features. Press
exit, <?> for Help, </> for Search. Legend: [*] built-i

[*] GPIO Support --->
{M} Dallas's 1-wire support --->
[*] Board level reset or power off --->
-* Power supply class support --->
[*] Hardware Monitoring support --->
-* Thermal drivers --->
[*] Watchdog Timer Support --->
{M} Sonics Silicon Backplane support --->
{M} Broadcom specific AMBA --->
Multifunction device drivers --->
-* Voltage and Current Regulator Support --->
< > Remote Controller support ----
CEC support --->
<M> Multimedia support --->
Graphics support --->
[*] Compute Acceleration Framework --->
< > Sound card support ----
[*] HID bus support --->
[*] USB support --->
<*> MMC/SD/SDIO card support --->
<M> Universal Flash Storage Controller --->
<M> Sony MemoryStick card support --->
-* LED Support --->
[*] Accessibility support --->
<M> InfiniBand support --->
<*> EDAC (Error Detection And Correction) reporting
[*] Real Time Clock --->
[*] DMA Engine support --->
DMABUF options --->
```

включенная поддержка файловых систем NFS, FUSE,
Quota, Inotify/Dnotify


```

.config - Linux/x86 6.8.9 Kernel Configuration
> File systems
File systems
Arrow keys navigate the menu. <Enter> selects submenus ---> (or
submenus ----). Highlighted letters are hotkeys. Pressing <Y>
includes, <N> excludes, <M> modularizes features. Press <Esc><E
exit, <?> for Help, </> for Search. Legend: [*] built-in [ ]
^(-)
[*] FS Verity builtin signature support
[*] Dnotify support
[*] Inotify support for userspace
[*] Filesystem wide access notification
[*] Quota support
[*] Report quota messages through netlink interface
[ ] Additional quota sanity checks
< > Old quota format support
< > Quota format vfstv0 and vfstv1 support
<M> Kernel automounter support (supports v3, v4 and v5)
<M> FUSE (Filesystem in Userspace) support
<M> Character device in Userspace support
<M> Virtio Filesystem
[*] Virtio Filesystem Direct Host Memory Access support
<M> Overlay filesystem support
[ ] Overlayfs: turn on redirect directory feature by default
[*] Overlayfs: follow redirects even if redirects are turn
[ ] Overlayfs: turn on inodes index feature by default
[*] Overlayfs: auto enable inode number mapping
[ ] Overlayfs: turn on metadata only copy up feature by de
[ ] Overlayfs: turn on extra debugging checks
Caches --->
CD-ROM/DVD Filesystems --->
DOS/FAT/EXFAT/NT Filesystems --->
Pseudo filesystems --->
*- Miscellaneous filesystems --->
[*] Network File Systems --->
*- Native language support --->
<M> Distributed Lock Manager (DLM) --->
v(+)

```

включенная поддержка файловых систем MSDOS
и VFAT

```

.config - Linux/x86 6.8.9 Kernel Configuration
File systems > DOS/FAT/EXFAT/NT Filesystems
DOS/FAT/EXFAT/NT Filesystems
Arrow keys navigate the menu. <Enter> selects submenus ---> (or er
submenus ----). Highlighted letters are hotkeys. Pressing <Y>
includes, <N> excludes, <M> modularizes features. Press <Esc><Esc>
exit, <?> for Help, </> for Search. Legend: [*] built-in [ ]
<M> MSDOS fs support
<M> VFAT (Windows-95) fs support
(437) Default codepage for FAT
(iso8859-1) Default iocharset for FAT
[ ] Enable FAT UTF-8 option by default
<M> exFAT filesystem support
(utf8) Default iocharset for exFAT
<M> NTFS file system support
[ ] NTFS debugging support
[ ] NTFS write support
<M> NTFS Read-Write file system support
[ ] 64 bits per NTFS clusters
[*] activate support of external compressions lzx/xpress
[*] NTFS POSIX Access Control Lists

```


Кодировки UTF-8 и все кириллические
кодировки русского языка

```
.config - Linux/x86 6.8.9 Kernel Configuration
> File systems > Native language support

Native language support
Arrow keys navigate the menu. <Enter> selects submenus ---> (or empty
submenus ----). Highlighted letters are hotkeys. Pressing <Y>
includes, <N> excludes, <M> modularizes features. Press <Esc><Esc> to
exit, <?> for Help, </> for Search. Legend: [*] built-in [ ]

--- Native language support
(utf8) Default NLS Option
<*> Codepage 437 (United States, Canada)
< > Codepage 737 (Greek)
< > Codepage 775 (Baltic Rim)
<M> Codepage 850 (Europe)
<*> Codepage 852 (Central/Eastern Europe)
<*> Codepage 855 (Cyrillic)
< > Codepage 857 (Turkish)
< > Codepage 860 (Portuguese)
< > Codepage 861 (Icelandic)
< > Codepage 862 (Hebrew)
< > Codepage 863 (Canadian French)
< > Codepage 864 (Arabic)
< > Codepage 865 (Norwegian, Danish)
<*> Codepage 866 (Cyrillic/Russian)
< > Codepage 869 (Greek)
< > Simplified Chinese charset (CP936, GB2312)
< > Traditional Chinese charset (Big5)
< > Japanese charsets (Shift-JIS, EUC-JP)
< > Korean charset (CP949, EUC-KR)
< > Thai charset (CP874, TIS-620)
< > Hebrew charsets (ISO-8859-8, CP1255)
<*> Windows CP1250 (Slavic/Central European Languages)
<*> Windows CP1251 (Bulgarian, Belarusian)
<M> ASCII (United States)
<M> NLS ISO 8859-1 (Latin 1; Western European Languages)
<*> NLS ISO 8859-2 (Latin 2; Slavic/Central European Languages)
< > NLS ISO 8859-3 (Latin 3; Esperanto, Galician, Maltese, Tur
v(+)
```

команда для начала сборки ядра

```
ubuntu@ubuntu:/usr/src/linux$ nproc
12
ubuntu@ubuntu:/usr/src/linux$ make -j12
```

команда для запуска сборки модулей

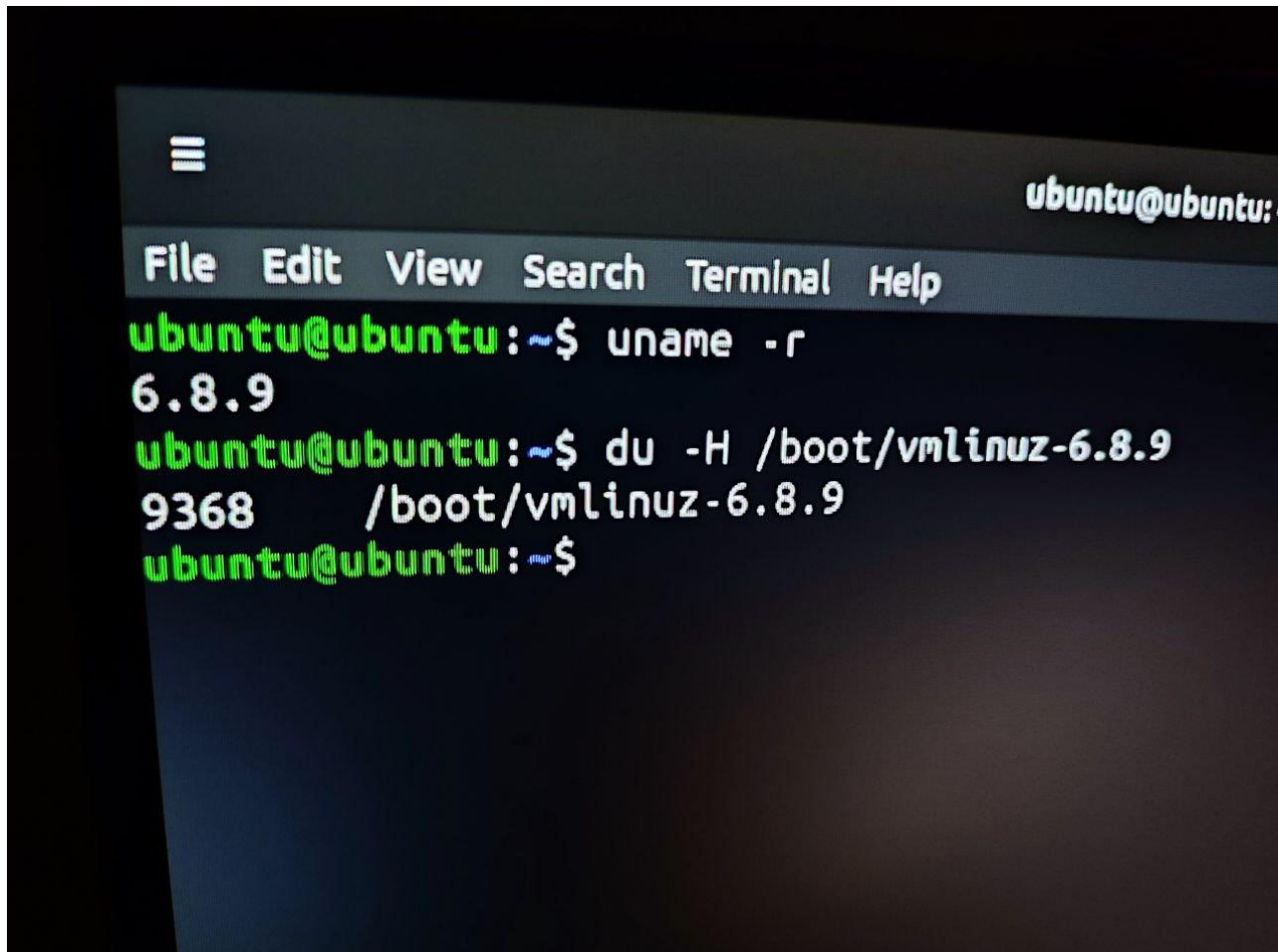
```
ubuntu@ubuntu:/usr/src/linux$ make modules
```

команда для запуска установки модулей ядра

```
ubuntu@ubuntu:/usr/src/linux$ make modules_install
```

команда для запуска установки ядра и автоматической
настройки GRUB для загрузки ядра

```
ubuntu@ubuntu:/usr/src/linux$ make install
```



The image shows a terminal window with a dark background. At the top left is a hamburger menu icon. At the top right, the text 'ubuntu@ubuntu:' is visible. Below the menu is a light blue header bar containing the menu items: 'File', 'Edit', 'View', 'Search', 'Terminal', and 'Help'. The terminal content shows the following commands and output:

```
ubuntu@ubuntu:~$ uname -r
6.8.9
ubuntu@ubuntu:~$ du -H /boot/vmlinuz-6.8.9
9368      /boot/vmlinuz-6.8.9
ubuntu@ubuntu:~$
```