Лабораторна робота №3

з дисципліни «мережеві технології»

«Компіляція ядра ОС FreeBSD UNIX»

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Контрольні запитання:

1. З якою метою виконується процедура збірки кастомного ядра ОС FreeBSD Unix?
   Для отримання кращої ефективності, так як кастомне ядро буде більше заточене під апаратне забезпечення системи, ніж ядро загального призначення.
2. Які способи визначення складу встановленого обладнання є у FreeBSD?
   - `man 8 pciconf`
   - `man 8 usbconfig`
   - `sysctl hw.model`
   - https://www.freebsd.org/doc/handbook/kernelconfig-devices.html
3. Процедура вибору ядра в засобі завантаження при старті системи.
   За замовчуванням вибирається останнє ядро (те, дата створення якого найбільша). Є опція перейти в меню, де можна обрати, яке саме ядро завантажувати
4. До якого типу архітектури відноситься ядро ОС FreeBSD Unix?
   Монолітне з модульною архітектурою
5. Вирішення проблем при збірці кастомного ядра.
   - Прямі руки не із жопи
   - https://www.freebsd.org/doc/handbook/kernelconfig-trouble.html
6. Чому рекомендується окремо зберегти ядро generic?
   - Щоб у випадку криворукості мати змогу забутатися в робочу систему і спробувати зібрати кастомне ядро ще раз.
7. Які функції виконує ядро операційної системи?
   - керування пам'яттю,
   - керування процесами введення-виведення,
   - керування файловою системою,
   - організація взаємодії та диспетчеризація процесів,
   - облік використання ресурсів,
   - оброблення команд і т.д.

Процедура збірки кастомного ядра в умовах обмеженого дискового простору віртуальної машини із лабораторних робіт 1 та 2.

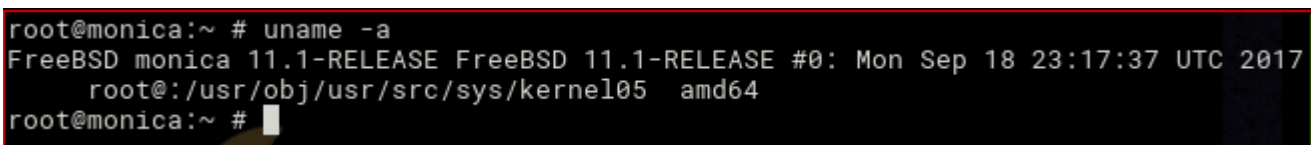
```
# Download kernel sources
# ======================
cd /
fetch ftp://ftp.freebsd.org/pub/FreeBSD/releases/amd64/11.1-RELEASE/src.txz
tar -xjpf src.txz
rm src.txz

# We will need a lot of free space to compile kernel, so clean it up
# ==================================================================

# Move everything possible out of /usr disk
# In order to preserve the system work, mount it back via nullfs
mkdir /tmp/usr/
cp -r /usr/lib /tmp/usr/lib
rm -rf /usr/lib/*
mount -t nullfs /tmp/usr/lib/ /usr/lib

mkdir -p /var/tmp/usr/
cp -r /usr/bin /var/tmp/usr/bin
rm -rf /usr/bin/*
mount -t nullfs /var/tmp/usr/bin/ /usr/bin/

mkdir -p /root/usr/share/
mv /usr/share/i18n/ /root/usr/share/i18n
mv /usr/share/locale/ /root/usr/share/locale
mv /usr/share/misc /root/usr/share/misc
mv /usr/share/dict /root/usr/share/dict
mv /usr/share/doc /root/usr/share/doc
mv /usr/share/groff_font/ /root/usr/share/groff_font
mv /usr/share/games /root/usr/share/games
mv /usr/share/examples /root/usr/share/examples
mv /usr/share/zoneinfo /root/usr/share/zoneinfo
mv /usr/share/openssl /root/usr/share/openssl
mv /usr/share/syscons /root/usr/share/syscons
mv /usr/share/nls /root/usr/share/nls
mv /usr/share/vt /root/usr/share/vt
mv /usr/share/sendmail /root/usr/share/sendmail

mkdir   /usr/share/i18n   /usr/share/locale   /usr/share/misc   /usr/share/dict
/usr/share/doc   /usr/share/groff_font   /usr/share/games   /usr/share/examples
/usr/share/zoneinfo   /usr/share/openssl   /usr/share/syscons   /usr/share/nls
/usr/share/vt /usr/share/sendmail
mount -t nullfs /root/usr/share/dict/ /usr/share/dict
mount -t nullfs /root/usr/share/doc/ /usr/share/doc/
mount -t nullfs /root/usr/share/examples/ /usr/share/examples/
mount -t nullfs /root/usr/share/games/ /usr/share/examples/
```

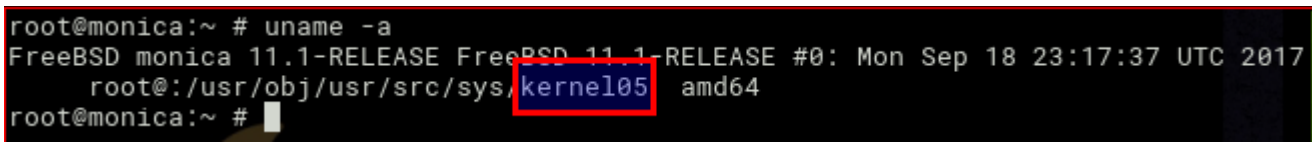
```
mount -t nullfs /root/usr/share/groff_font/ /usr/share/groff_font/
mount -t nullfs /root/usr/share/i18n/ /usr/share/i18n/
mount -t nullfs /root/usr/share/locale/ /usr/share/locale/
mount -t nullfs /root/usr/share/misc /usr/share/misc/
mount -t nullfs /root/usr/share/nls /usr/share/nls
mount -t nullfs /root/usr/share/openssl /usr/share/openssl
mount -t nullfs /root/usr/share/sendmail/ /usr/share/sendmail/
mount -t nullfs /root/usr/share/syscons/ /usr/share/syscons/
mount -t nullfs /root/usr/share/vt /usr/share/vt/
mount -t nullfs /root/usr/share/zoneinfo/ /usr/share/zoneinfo/

# Man is too big. Remove all locales except en.UTF-8
cd /usr/share/man/
rm -rf ./en.ISO8859-1 ./en.ISO8859-15
cp -r /usr/share/man/ /tmp/usr/share/man/
rm -rf /usr/share/man/*
mount -t nullfs /tmp/usr/share/man/ /usr/share/man

# Delete sources for architectures we will not need
cd /usr/src/sys/
rm -rf arm64/ arm mips pc98/ powerpc/ sparc64/

# Configure and compile kernel
# ============================
cd /usr/src/
cat >/usr/src/sys/amd64/conf/kernel05 <<EOF
cpu     HAMMER
ident       kernel05

makeoptions WITH_CTF=1                  # Run ctfconvert(1) for DTrace support

options     SCHED_ULE                   # ULE scheduler
options     PREEMPTION                  # Enable kernel thread preemption
options     INET                        # InterNETworking
options     INET6                       # IPv6 communications protocols
options     IPSEC                       # IP (v4/v6) security
options     TCP_OFFLOAD                 # TCP offload
options     SCTP                        # Stream Control Transmission Protocol
options     FFS                         # Berkeley Fast Filesystem
options     SOFTUPDATES                 # Enable FFS soft updates support
options     UFS_ACL                     # Support for access control lists
options       UFS_DIRHASH                         # Improve performance on big
directories
options     UFS_GJOURNAL                # Enable gjournal-based UFS journaling
options     QUOTA                       # Enable disk quotas for UFS
options     MD_ROOT                     # MD is a potential root device
options       PROCFS                              # Process filesystem (requires
PSEUDOFS)
options     PSEUDOFS                    # Pseudo-filesystem framework
options     GEOM_PART_GPT               # GUID Partition Tables.
options     GEOM_LABEL                  # Provides labelization
options     SCSI_DELAY=5000             # Delay (in ms) before probing SCSI
options     KTRACE                      # ktrace(1) support
options     STACK                       # stack(9) support
options     SYSVSHM                     # SYSV-style shared memory
```

```
options     SYSVMSG                     # SYSV-style message queues
options     SYSVSEM                     # SYSV-style semaphores
options     _KPOSIX_PRIORITY_SCHEDULING # POSIX P1003_1B real-time extensions
options        PRINTF_BUFR_SIZE=128           #  Prevent  printf  output  being
interspersed.
options     KBD_INSTALL_CDEV            # install a CDEV entry in /dev
options     HWPMC_HOOKS                 # Necessary kernel hooks for hwpmc(4)
options     AUDIT                       # Security event auditing
options     CAPABILITY_MODE             # Capsicum capability mode
options     CAPABILITIES                # Capsicum capabilities
options     MAC                         # TrustedBSD MAC Framework
options     KDTRACE_FRAME               # Ensure frames are compiled in
options     KDTRACE_HOOKS               # Kernel DTrace hooks
options     DDB_CTF                     # Kernel ELF linker loads CTF data
options     INCLUDE_CONFIG_FILE         # Include this file in kernel
options     RACCT                       # Resource accounting framework
options     RACCT_DEFAULT_TO_DISABLED   # Set kern.racct.enable=0 by default
options     RCTL                        # Resource limits

# Debugging support.  Always need this:
options     KDB                         # Enable kernel debugger support.
options     KDB_TRACE                   # Print a stack trace for a panic.

# Make an SMP-capable kernel by default
options     SMP                         # Symmetric MultiProcessor Kernel
options     DEVICE_NUMA                 # I/O Device Affinity
options     EARLY_AP_STARTUP

# CPU frequency control
device      cpufreq

# Bus support.
device      acpi
options     ACPI_DMAR
device      pci

# ATA controllers
device      ahci                        # AHCI-compatible SATA controllers
device      ata                         # Legacy ATA/SATA controllers

# ATA/SCSI peripherals
device      scbus                       # SCSI bus (required for ATA/SCSI)
device      ch                          # SCSI media changers
device      da                          # Direct Access (disks)
device      cd                          # CD
device      pass                          # Passthrough device (direct ATA/SCSI
access)
device      ses                         # Enclosure Services (SES and SAF-TE)
#device     ctl                         # CAM Target Layer

# NVM Express (NVMe) support
device      nvme                        # base NVMe driver
device       nvd                            # expose NVMe namespaces as disks,
depends on nvme
```

```
# atkbdc0 controls both the keyboard and the PS/2 mouse
device      atkbdc                      # AT keyboard controller
device      atkbd                       # AT keyboard
device      psm                         # PS/2 mouse

device      kbdmux                      # keyboard multiplexer

device      vga                         # VGA video card driver
options     VESA                         # Add support for VESA BIOS Extensions
(VBE)

# TODO: can I remove this?
device       splash                           # Splash screen and screen saver
support

# syscons is the default console driver, resembling an SCO console
device      sc
options     SC_PIXEL_MODE               # add support for the raster text mode

# vt is the new video console driver
device      vt
device      vt_vga
device      vt_efifb

# TODO: can I remove this?
device      agp                         # support several AGP chipsets

# PCI Ethernet NICs.
device       em                               # Intel PRO/1000 Gigabit Ethernet
Family

# Pseudo devices.
device      loop                        # Network loopback
device      random                      # Entropy device
device      padlock_rng                 # VIA Padlock RNG
device      rdrand_rng                  # Intel Bull Mountain RNG
device      ether                       # Ethernet support
device      tun                         # Packet tunnel.
device      md                          # Memory "disks"
device      gif                         # IPv6 and IPv4 tunneling
device      firmware                    # firmware assist module

# The `bpf' device enables the Berkeley Packet Filter.
# Be aware of the administrative consequences of enabling this!
# Note that 'bpf' is required for DHCP.
device      bpf                         # Berkeley packet filter

# TODO: Can I remove this?
# VirtIO support
device      virtio                      # Generic VirtIO bus (required)
device      virtio_pci                  # VirtIO PCI device
device      vtnet                       # VirtIO Ethernet device
device      virtio_blk                  # VirtIO Block device
device      virtio_scsi                 # VirtIO SCSI device
device      virtio_balloon              # VirtIO Memory Balloon device
```

```
# Netmap provides direct access to TX/RX rings on supported NICs
device      netmap                      # netmap(4) support

# The crypto framework is required by IPSEC
device      crypto                      # Required by IPSEC
EOF

# Finally build the kernel.
# Do not forget to cross fingers
make buildkernel KERNCONF=kernel05

# Put moved content back to /usr
# ==============================
umount /root/usr/share/*
mv /root/usr/share/* /usr/share/
rm -rf /root/usr/
umount /tmp/usr/share/man/
mv /tmp/usr/share/man/ /usr/share/

# After we freed some space in root filesystem (/)
# we can install the built kernel
# ================================================

cd /usr/src/
make installkernel KERNCONF=kernel05

# Clean up build directories
# ==========================

make clean
make cleandepend
make cleandir
make cleanworld

# Finish putting things back where they belong
# ============================================

umount /tmp/usr/lib/
mv /tmp/usr/lib/* /usr/lib
rm -rf /tmp/usr

umount /var/tmp/usr/bin/
mv /var/tmp/usr/bin/* /usr/bin/
rm -rf /var/tmp/usr

# Reboot with the new kernel
# ==========================

reboot
```




root@monica:~ # uname -a
FreeBSD monica 11.1-RELEASE FreeBSD 11.1-RELEASE #0: Mon Sep 18 23:17:37 UTC 2017
root@:/usr/obj/usr/src/sys/kernel05 amd64
root@monica:~ #