

Operatsion tizimlarning ichki tuzilishi.

OT tuzilishi, POSIX, jarayonlar, oqimlar, xotira va kiritish-chiqarish

Zamonaviy operatsion tizim - murakkab dasturlar majmuasi

u bir vaqtning o'zida:

- protsessorni boshqarishi;
- operativ xotirani taqsimlashi;
- dasturlarni ishga tushirishi va yakunlashi;
- fayllarni boshqarishi;
- qurilmalar bilan o'zaro aloqa qilishi;
- tarmoq ishini ta'minlashi;
- xavfsizlikni nazorat qilishi;
- ilovalarga standartlashtirilgan interfeyslarni taqdim etishi kerak.

Kompyuterning OT darajasida qanday ishlashini tushunish uchun quyidagi tushunchalarni o'rganish zarur:

- yadro;
- tizimli chaqiruv;
- foydalanuvchi va imtiyozli (previleged) rejim;
- jarayon (process);
- oqim (thread);
- virtual xotira;
- manzil fazosi;
- kiritish-chiqarish amallari;
- POSIX.



Memory
Management



Resource
Management



Device
Management



Error
Handling

Function Of Kernel



Task
Scheduling



Load
Balancing



Process
Management

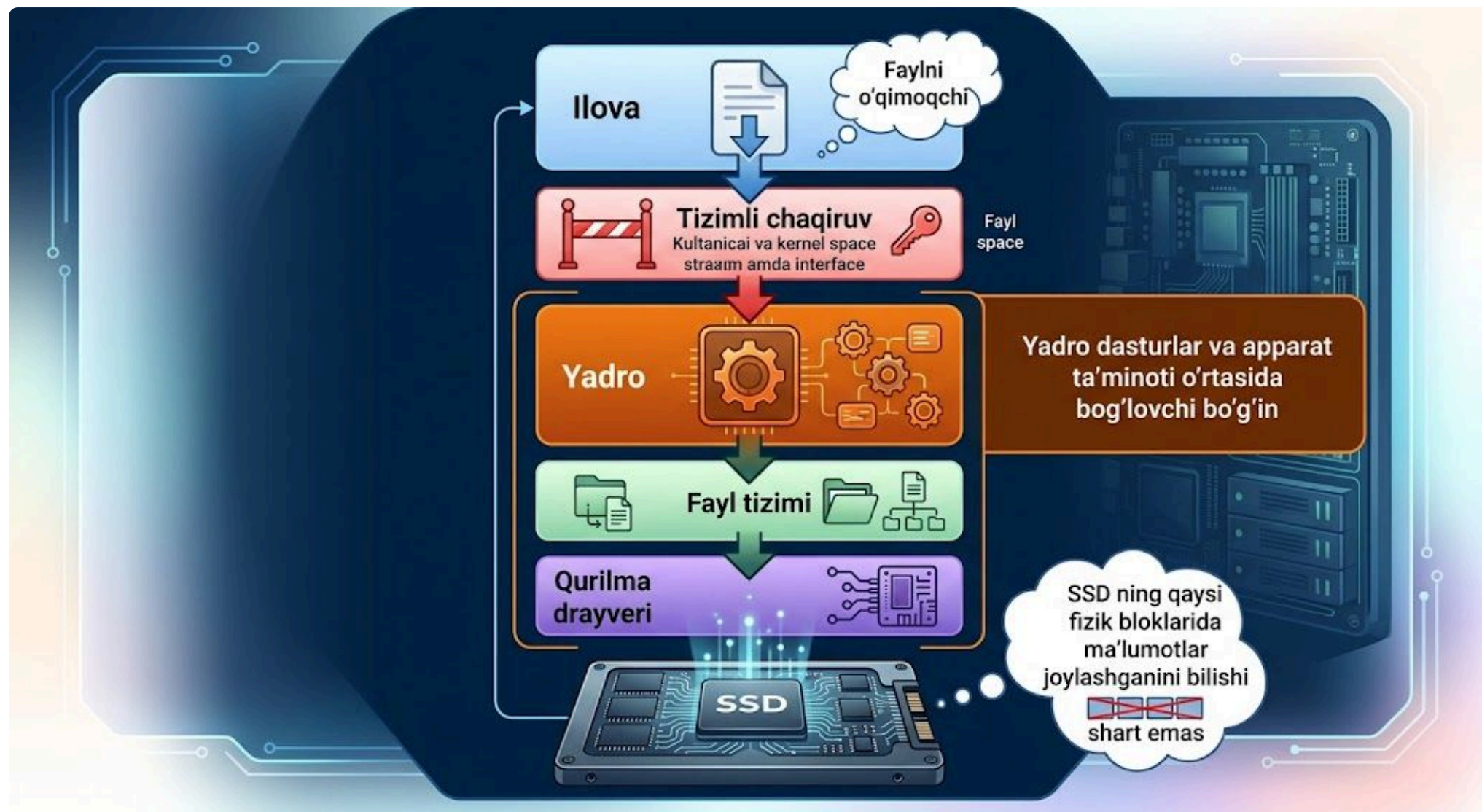
Operatsion tizimning yadrosi

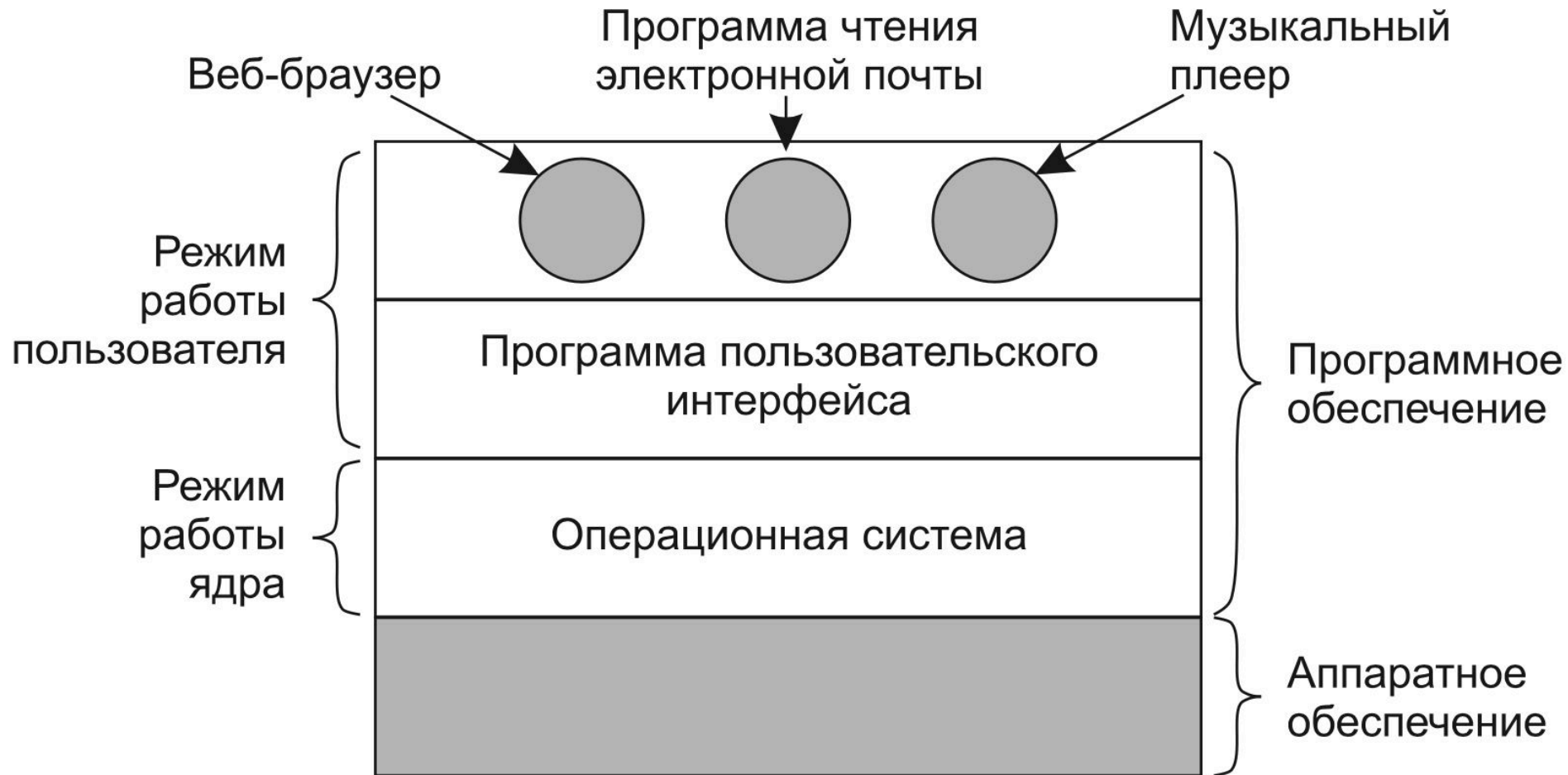
Yadro (Kernel) — operatsion tizimning markaziy qismi bo'lib, u eng yuqori imtiyozli apparat resurslari bilan ishlaydi.

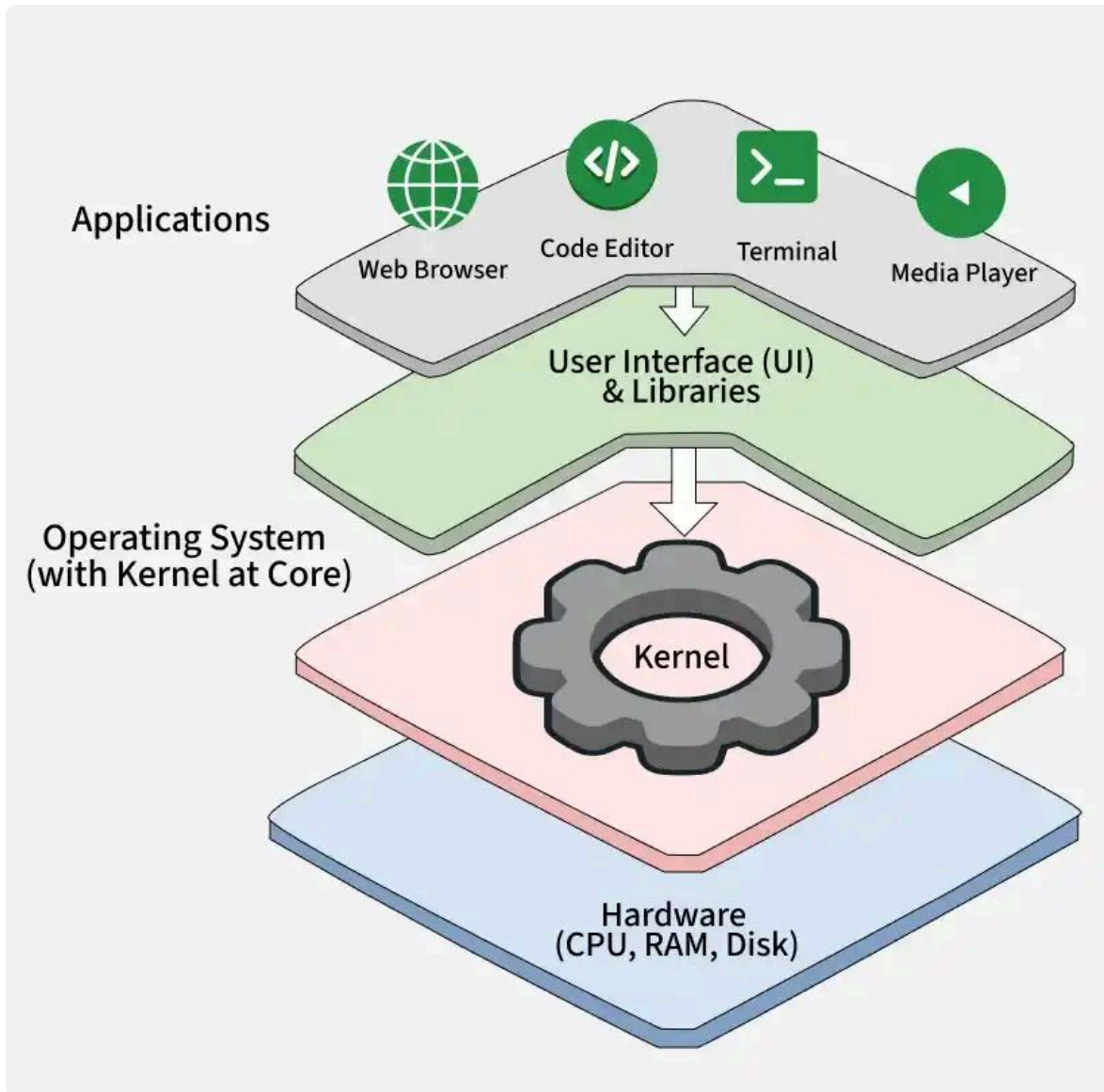
Yadro ko'plab vazifalarni bajaradi:

- jarayonlarni yaratadi va yakunlaydi;
- jarayonlarni bajarilishini rejalashtiradi;
- oqimlarni boshqaradi;
- xotirani taqsimlaydi;
- fayl tizimlari bilan ishlaydi;
- qurilmalarni boshqaradi;
- apparat uzilishlarini qayta ishlaydi;
- tarmoq o'zaro aloqasini ta'minlaydi;
- xavfsizlik mexanizmlarini amalga oshiradi.

Yadro dasturlar va apparat ta'minoti o'rtasida bog'lovchi bo'g'in hisoblanadi.

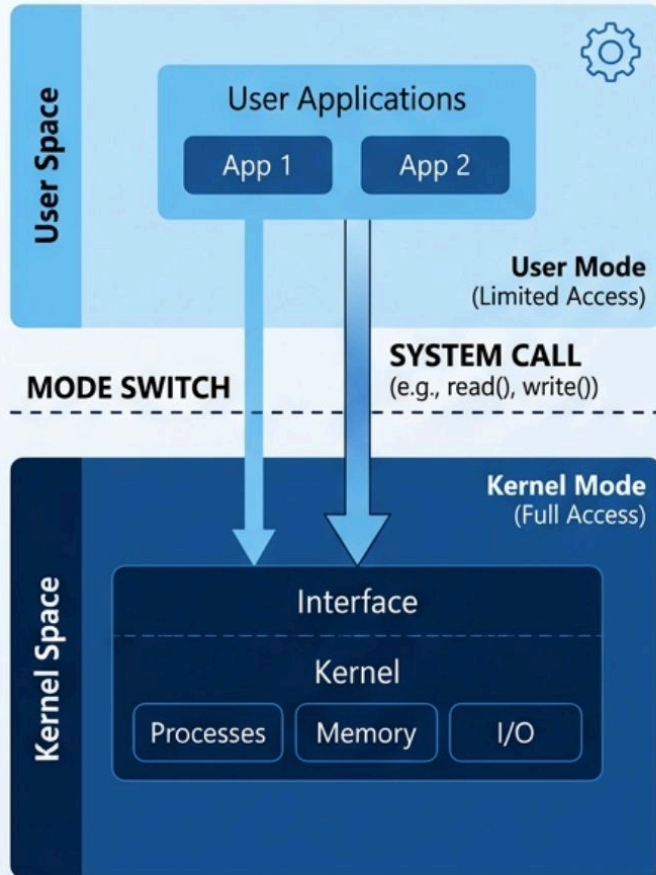






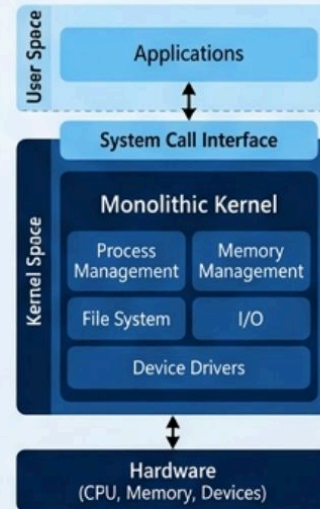
OPERATING SYSTEM KERNEL ARCHITECTURE

USER MODE vs. KERNEL MODE



KERNEL ARCHITECTURES

MONOLITHIC KERNEL



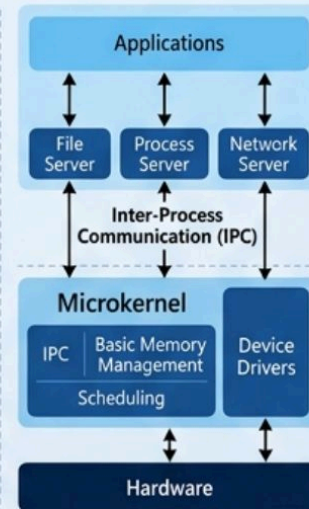
Features:

Single Binary
Fast (Low Overhead)
Efficient

Drawbacks:

Hard to maintain, Unstable
(One bug crash)

MICROKERNEL



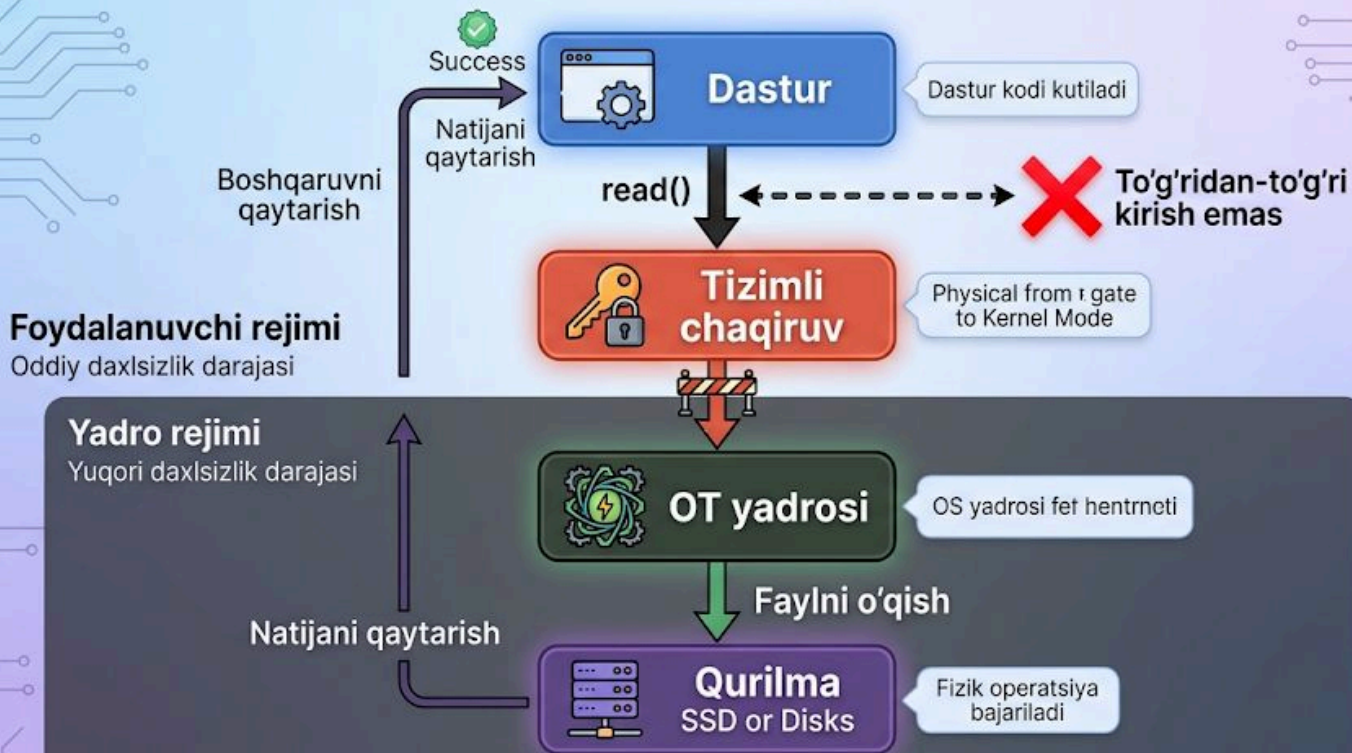
Features:

Modular
Stable (Isolation)
Reliable

Drawbacks:

Higher Overhead (IPC latency)
Slower

Imtiyozli operatsiyalarni bajarish tartibi



POSIX standarti

POSIX (Portable Operating System Interface) — operatsion tizimlarning mosligini ta'minlash uchun interfeyslar, xatti-harakatlar va kelishuvlarni belgilaydigan standartlar oilasi.

POSIX dasturlarni Unix-ga o'xshash tizimlar o'rtasida osonroq ko'chirish uchun ishlab chiqilgan.

Asosiy g'oya:

standart POSIX-interfeyslaridan foydalanib yozilgan dastur mos keluvchi tizimlar o'rtasida kamroq o'zgartirishlar bilan ko'chirilishi kerak.

POSIX nima uchun kerak?

Umumiy standartlar paydo bo'lishidan oldin **Unix-ga o'xshash** tizimlar sezilarli darajada farqlanishi mumkin edi.

- Dasturchi quyidagilarni hisobga olishi kerak edi:



- turli tizimli chaqiruvlar;



- turli kutubxonalar;



- turli funktsiya nomlari;



- tizim xatti-harakatlaridagi farqlar.



POSIXning
paydo bo'lishi
→
Yagona yechim

POSIX: Umumiy Qoidalar To'plami

POSIX umumiy qoidalar to'plamini shakllantirdi.



- Masalan, tanish funksiyalar:



`open()`



`read()`



`write()`



`close()`



`fork()`



`exec()`



`wait()`

an'anaviy Unix/POSIX-dasturlashtirishning
bir qismi hisoblanadi.

Fayllar bilan ishlash

open()

read()

write()

close()

Jarayonlar

fork()

exec()

wait()

exit()

Signallar

```
signal()  
sigaction()
```

Oqimlar

POSIX Threads:

```
pthread_create()  
pthread_join()  
pthread_mutex_lock()  
pthread_mutex_unlock()
```

Tarmoq funksiyalari

Unix/POSIX-muhitida standart soket mexanizmlari ishlatiladi:

```
socket()  
bind()  
listen()  
accept()  
connect()
```

Yadro Arxitekturalari: Boshqaruvchini Loyihalash



Monolitik Yadro

Misol: Linux, UNIX.

Tuzilishi: Barcha xizmatlar yagona katta blokda, yadro rejimida ishlaydi.

Xususiyati: Tezkor va samarali, lekin bitta xato butun tizimni qulatishi mumkin.

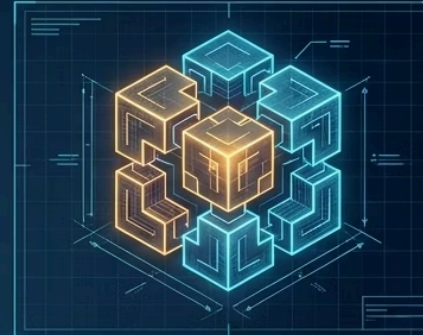


Mikroyadro

Misol: MINIX 3, QNX.

Tuzilishi: Faqat eng zarur funksiyalar yadroda; qolganlari foydalanuvchi rejimida serverlar sifatida ishlaydi.

Xususliiyati: O'ta ishonchli va xavfsiz, lekin xabarlar almashinuvi (IPC) sababli sekinroq.



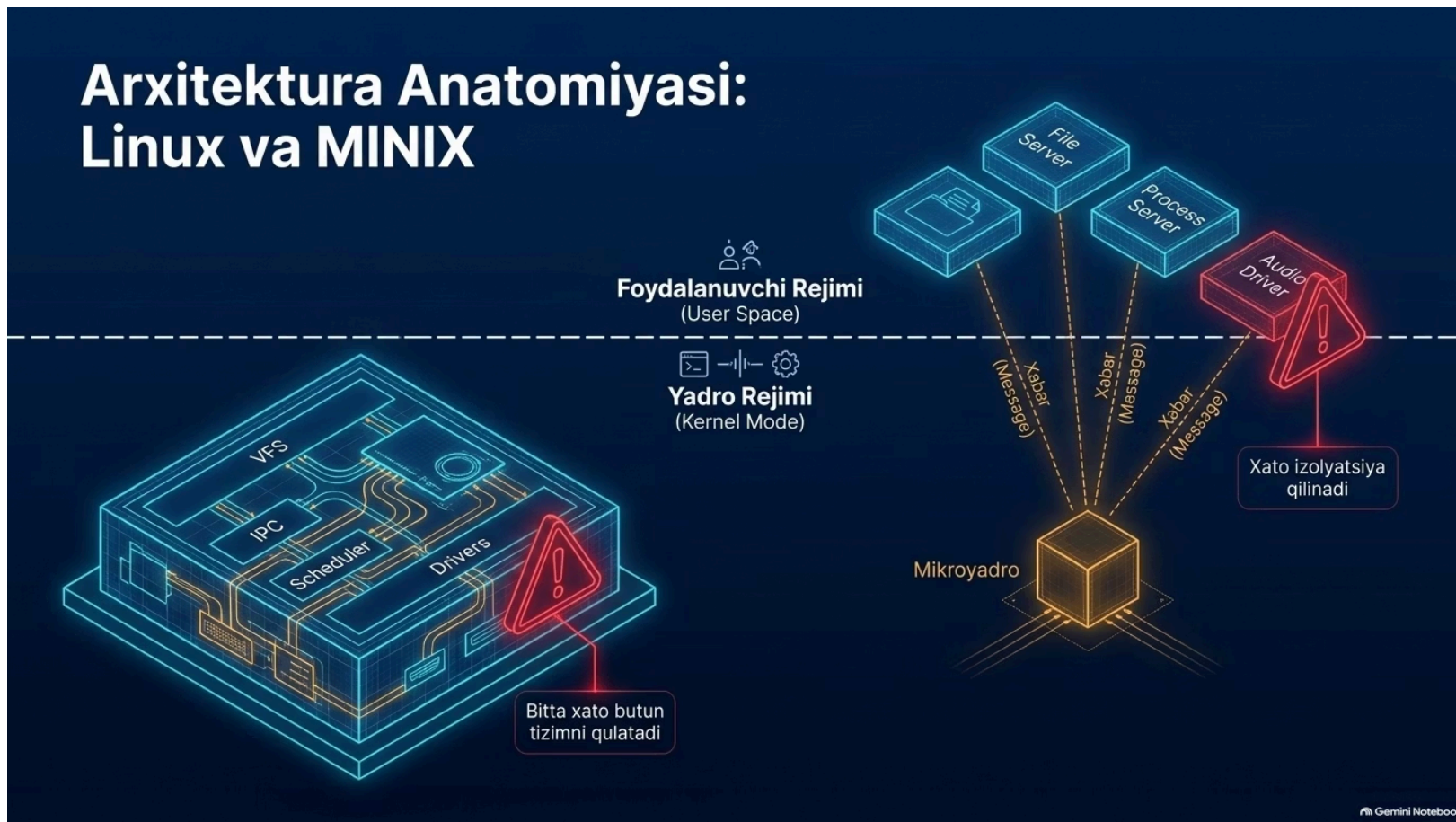
Gibrid Yadro

Misol: Windows 11, macOS.

Tuzilishi: Monolitik tezlik va mikroyadro barqarorligini birlashtirishga harakat qiladi.

Xususiyati: Asosiy xizmatlar yadroda saqlanib, ba'zi qismlar modullashtiriladi.

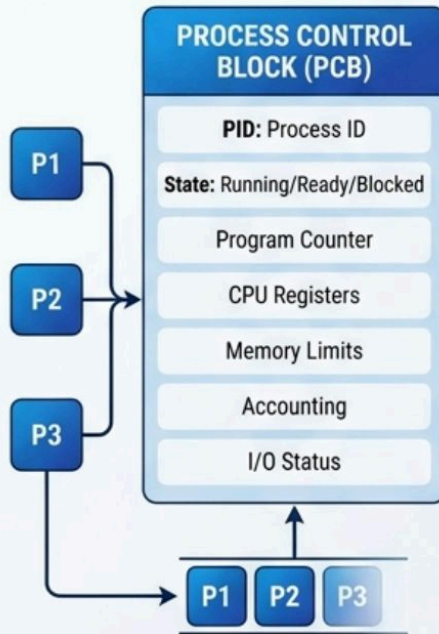
Arxitektura Anatomiyasi: Linux va MINIX



OS PROCESS AND THREAD MANAGEMENT



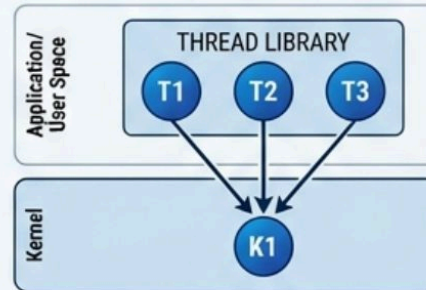
PROCESS MANAGEMENT & PCB



THREAD MANAGEMENT MODELS



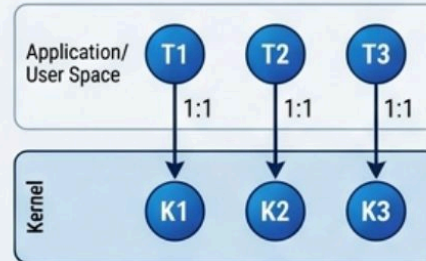
USER-LEVEL THREADS (ULT)



Many-to-One Model
Managed by library, kernel unaware



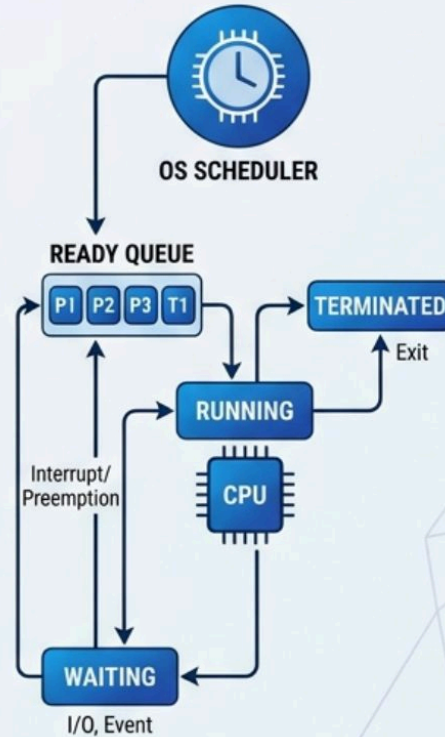
KERNEL-LEVEL THREADS (KLT)



One-to-One Model
Managed by OS Kernel, visible to OS



TASK SCHEDULING



Vaqtning Boshqarish: Jarayonlar (Processes)

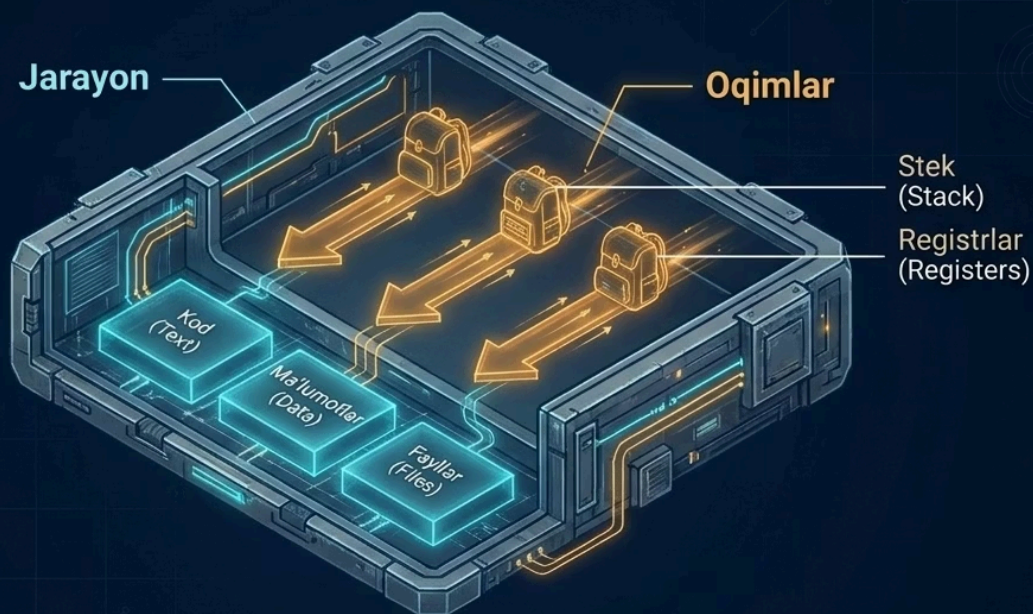
Operatsion tizim bitta protsessorda ko'plab jarayonlarni navbatma-navbat (Time Multiplexing) ishga tushirish orqali parallelizm illyuziyasini yaratadi.



Jarayonlarni Boshqarish Bloki (PCB)

1. ID
2. Holat
3. Registrlar
4. Xotira ko'rsatkichlari

Ijro Anatomiyasi: Jarayon va Oqim (Process vs. Thread)



Jarayon - bu resurslar konteyneri. **Oqim** - bu yengil, mustaqil ijro birligi. Ular bir xotirani ulashib, samaradorlikni oshiradi.

Gemini Notebook

Sinxronizatsiya: Poygalar va Qulflar

Oqimlar umumiy xotiraga bir vaqtda kiringanda **Poyga holati** (Race Condition) yuzaga keladi. OS buni tartibga solishi kerak.



Gemini Notebook

Apparat uzilishlari

Operatsion tizim kompyuterda sodir bo'layotgan hodisalarga javob berishi kerak.

Buning uchun **uzilishlar (interrupts)** ishlatiladi.

Masalan:

- klaviatura tugma bosilganligi haqida xabar beradi;
- tarmoq adapteri paket oldi;
- taymer hodisa generatsiya qiladi;
- disk operatsiyani yakunladi.

Apparat uzilishlari

Operatsion tizim kompyuterda sodir bo'layotgan hodisalarga javob berishi kerak.

Buning uchun **uzilishlarlar (interrupts)** ishlatiladi.

UZILISHMANBALARI



OPERATSION TIZIM
JAVOB

Klaviatura tugma bosilganligi
haqida xabar beradi



Klaviatura
uzilishi



Tarmoq adapteri paket oldi



Tarmoq
uzilishi



Taymer hodisa generatsiya qiladi



Taymer
uzilishi



Disk operatsiyani yakunladi



Disk
uzilishi

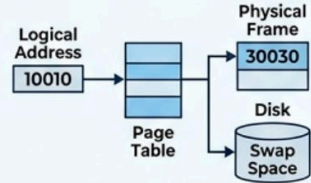


OPERATING SYSTEM: MEMORY MANAGEMENT

Key Concepts & Techniques

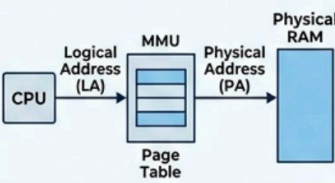
 **VIRTUAL MEMORY**

Decouples Logical Address Space from Physical Memory. Enables programs to run that are larger than Physical RAM.



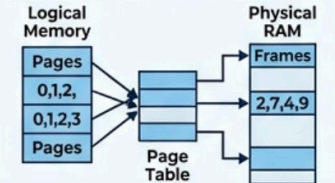
 **MEMORY MANAGEMENT UNIT (MMU)**

Hardware component translates Logical Addresses (CPU) to Physical Addresses (RAM) using Page Tables.



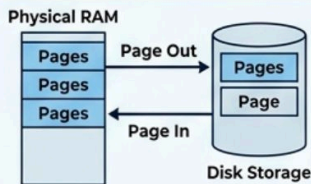
 **PAGING**

Divides Logical Memory into Pages and Physical Memory into Frames. Efficiently manages and allocates non-contiguous memory.



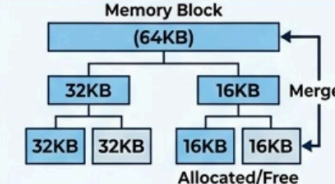
 **SWAP / PAGINATION**

Moves inactive Memory Pages (Page Out) to secondary storage (Disk Swap Space) to free up Physical RAM (Page In).



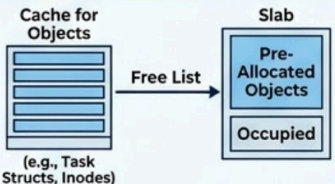
 **BUDDY ALGORITHM**

Binary Memory Allocation. Splits blocks into 'buddies' (powers of two) and merges adjacent free buddies to minimize fragmentation.



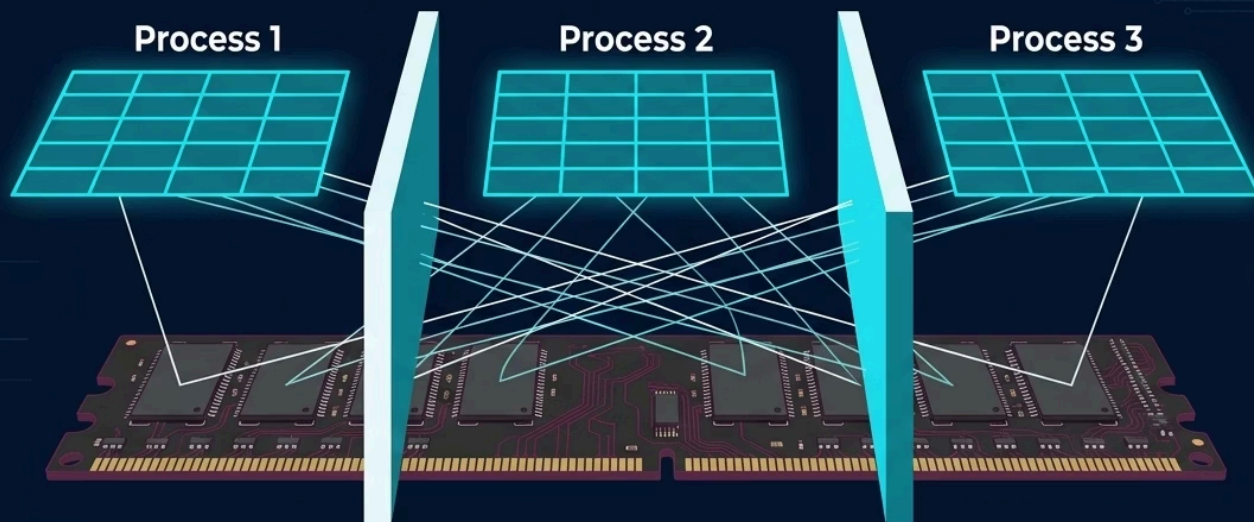
 **SLAB ALLOCATOR**

Efficient Memory Allocation for Kernel Objects. Groups objects by size in caches, reusing memory to avoid frequent allocation overhead.



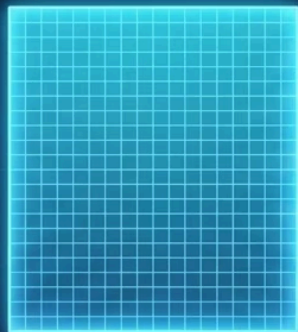
Makonni Boshqarish: Xotira Abstraktsiyasi

OS jismoniy xotirani (RAM) har bir dastur uchun izolyatsiya qilingan, xavfsiz **Manzillar Makoniga (Address Space)** aylantiradi.



Buyuk Illyuziya: Virtual Xotira va Sahifalash

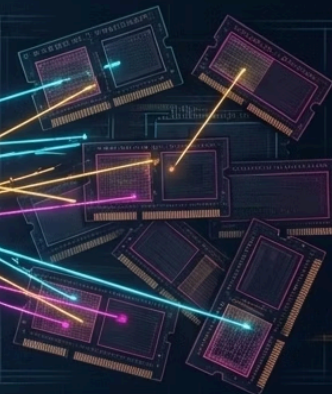
Virtual Xotira
(0 dan 4GB gacha)



Virtual Memory Funnel



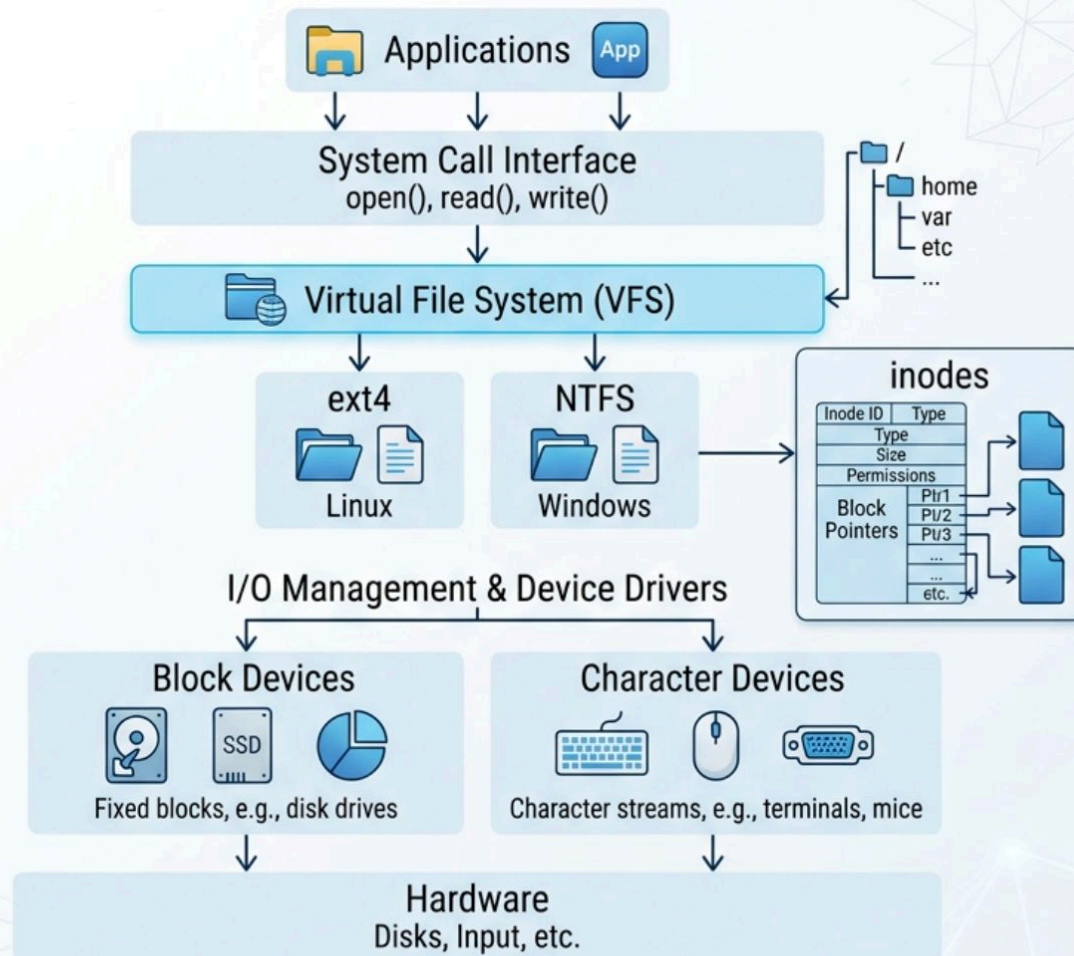
Jismoniy RAM
(Parchalangan Sahifalar)



Dastur o'zini cheksiz va uzluksiz xotiraga ega deb o'ylaydi.
Aslida sahifalar (pages) jismoniy xotiraga parchalanib joylashadi.

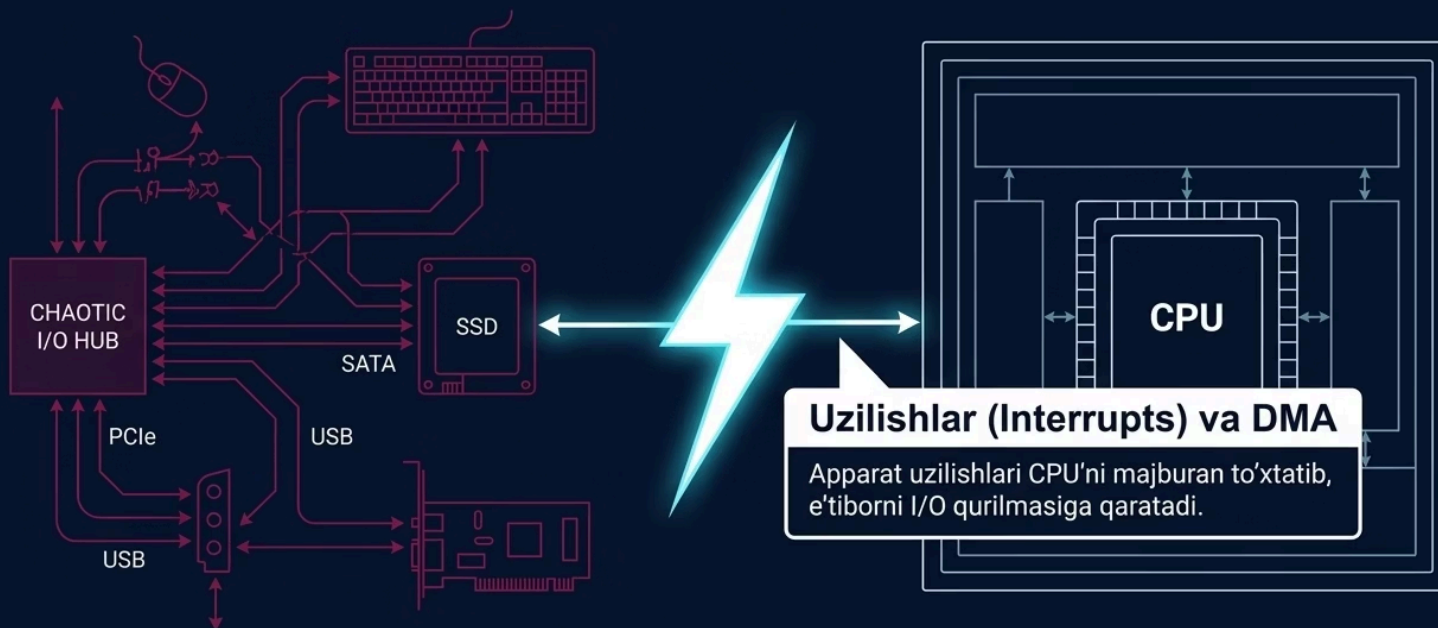
Gemini Notebook

Operating System: I/O & File Systems



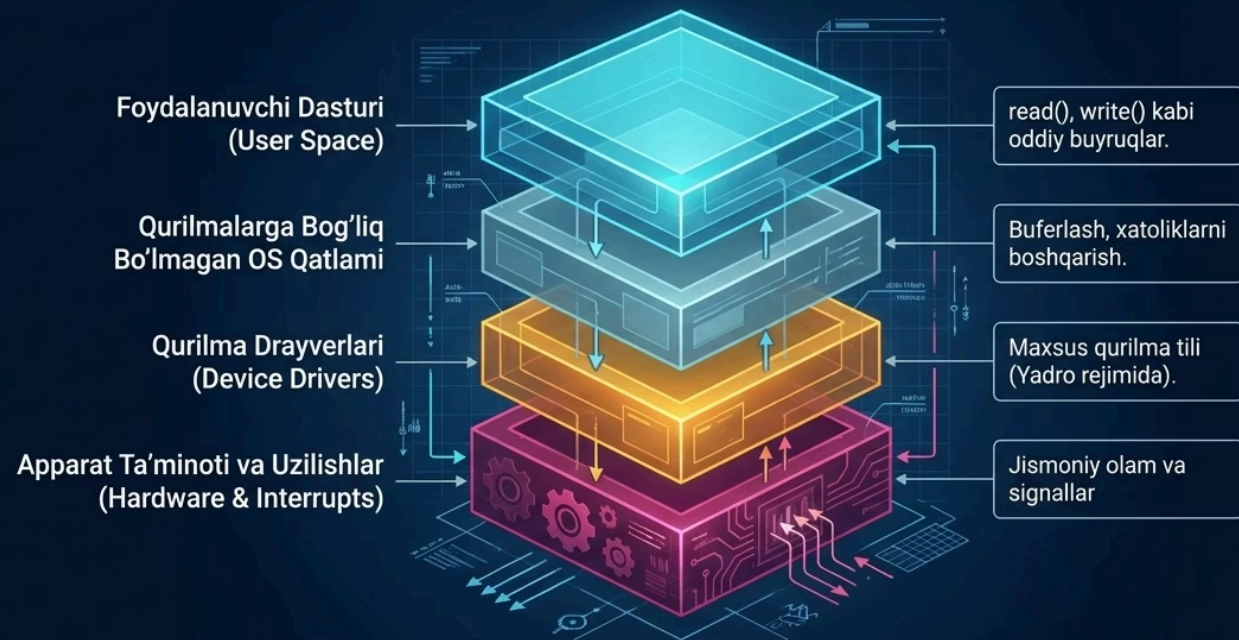
Jismoniy Olam: Kirish-Chiqish (I/O) Xaosi

Har bir qurilma (klaviatura, SSD, tarmoq kartasi) o'ziga xos tilda gapiradi. OS ularni yagona standartga keltirishi shart.



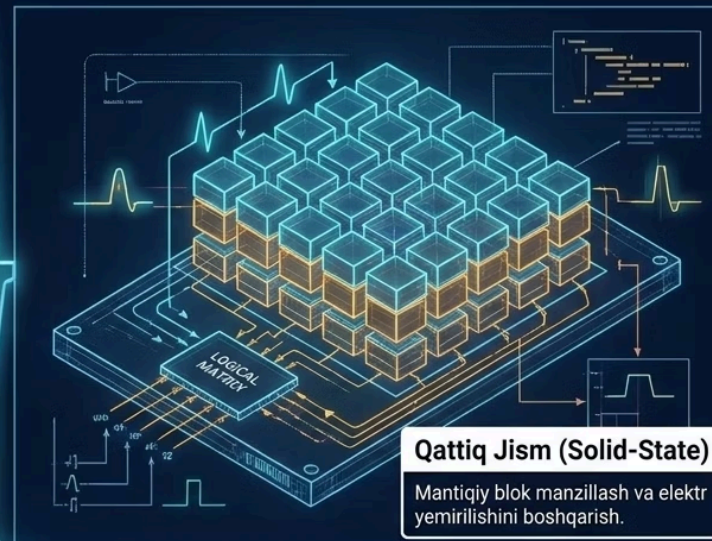
Gemini Notebook

I/O Dasturiy Ta'minoti: Qatlamli Kek (Layer Cake)



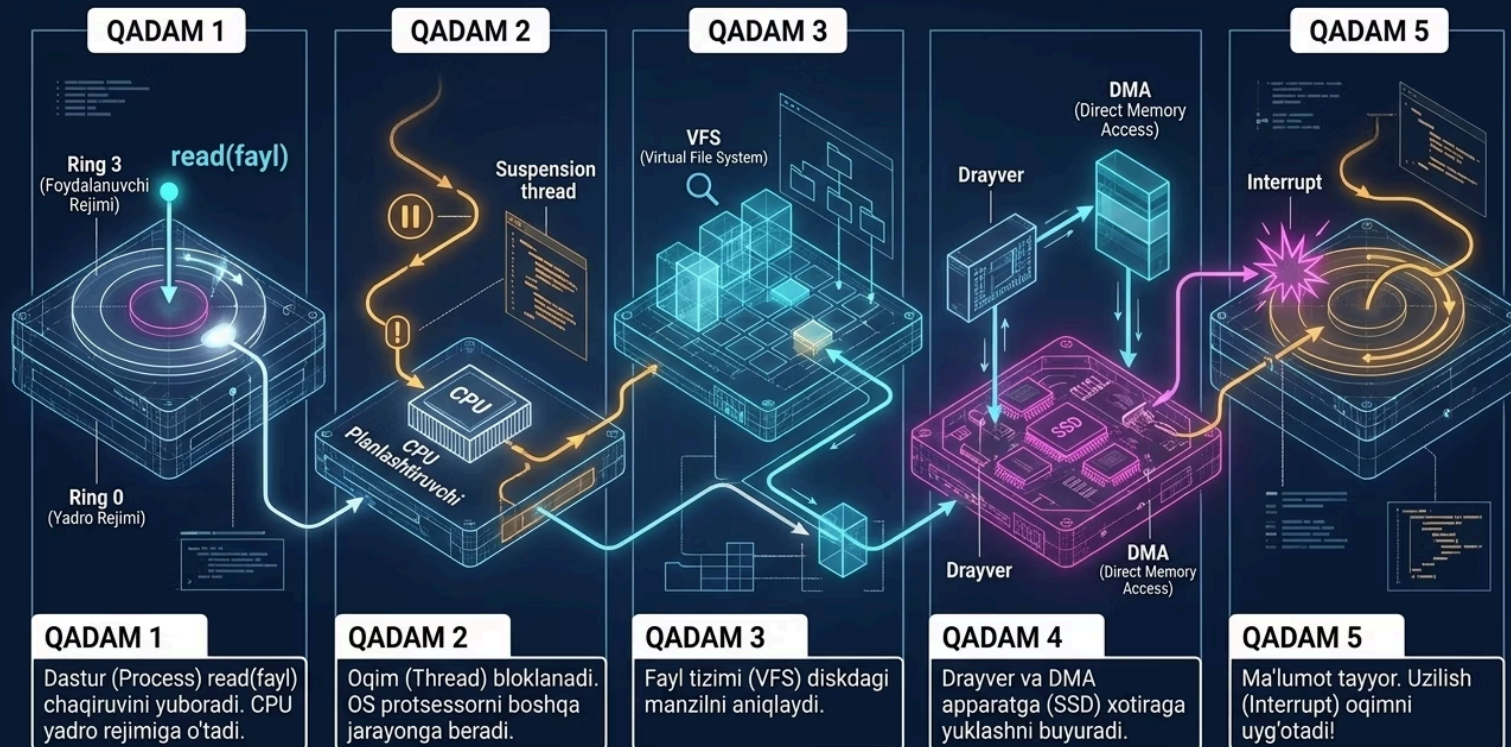
Har bir qatlam o'zidan pastdagi xaosni yashiradi.

Saqlash Evolyutsiyasi: Magnit Disklar (HDD) va SSD



OS bu mutlaqo farq qiluvchi jismoniy qurilmalarni yagona sodda abstraktsiya — Fayl orqali birlashtiradi.

Tizim Chaqiruvi Hayoti: Sinfoniya Ijrosi



Gemini Notebook

1. Operatsion tizimning markaziy qismi nima deb ataladi?

- A) Tizimli chaqiruv
- B) Yadro (Kernel)
- C) Foydalanuvchi rejimi
- D) POSIX

Javob: B (Yadro (Kernel))

Izoh: Yadro operatsion tizimning yuragi va eng muhim qismi bo'lib, u bevosita apparat resurslarini boshqaradi va dasturlar hamda uskunalar o'rtasida ko'prik vazifasini o'taydi.

2. Qaysi arxitekturada OTning asosiy xizmatlari (xotirani boshqarish, fayl tizimi, tarmoq steki, drayverlar) bitta yadro ichida ishlaydi?

- A) Mikroyadro
- B) Gibril yadro
- C) Monolit yadro
- D) Ekzoyadro

Javob: C (Monolit yadro)

Izoh: Monolit arxitekturada OTning barcha asosiy qismlari (fayl tizimi, xotira boshqaruvi, tarmoq steki, drayverlar) bitta yirik yadro ichida birlashtiriladi (masalan, Linux). Bu unumdorlikni oshiradi, lekin tizim xavfsizligi biroz zaiflashadi.

3. Foydalanuvchi rejimida (User Mode) ishlovchi dasturlar (brauzerlar, o'yinlar) apparat resurslariga qanday murojaat qiladi?

A) To'g'ridan-to'g'ri fizik xotiraga yozish orqali

B) BIOS orqali

C) Tizimli chaqiruvlar (System calls) orqali

D) Hech qachon murojaat qila olmaydi

Javob: C (Tizimli chaqiruvlar (System calls) orqali)

Izoh: Foydalanuvchi rejimidagi dasturlar xavfsizlik nuqtai nazaridan apparatga yoki xotiraga o'zboshimchalik bilan to'g'ridan-to'g'ri kira olmaydi. Har qanday muhim vazifa (fayl ochish, tarmoqqa ulanish) maxsus interfeys — tizimli chaqiruvlar orqali OT yadrosidan so'raladi.

4. Mikroyadro arxitekturasining asosiy afzalligi nimada?

- A) Maksimal unumdorlik va tezlik
- B) Barcha xizmatlarning yadroda ishlashi
- C) Komponentlarning yuqori darajada izolyatsiya qilinganligi (bitta xizmat ishdan chiqsa, butun tizim qulamaydi)
- D) Monolit yadroga qaraganda dasturlashning ancha soddaligi

Javob: C (Komponentlarning yuqori darajada izolyatsiya qilinganligi)

Izoh: Mikroyadro (Microkernel) arxitekturasida yadro ichida faqatgina eng asosiy va kichik qismlar qoldiriladi. Qolgan barcha xizmatlar (drayverlar, fayl tizimi va hk) foydalanuvchi rejimida alohida dastur kabi ishlaydi. Bu orqali, masalan, biron drayver qulasa ham, butun kompyuter qotib qolmaydi.

5. Ilova faylni o'qimoqchi bo'lsa, jarayon qanday ketma-ketlikda amalga oshadi?

A) Ilova -> Yadro -> Tizimli chaqiruv -> SSD

B) Ilova -> Tizimli chaqiruv -> Yadro -> Fayl tizimi -> Qurilma drayveri -> SSD

C) Ilova -> Qurilma drayveri -> SSD

D) Ilova -> Fayl tizimi -> Tizimli chaqiruv -> SSD

Javob: B

(Ilova -> Tizimli chaqiruv -> Yadro -> Fayl tizimi -> Qurilma drayveri -> SSD)

Izoh: Bu ketma-ketlik OT ning turli qatlamlaridan o'tishni to'g'ri ko'rsatadi:

- > Ilova faylni so'raydi (Tizimli chaqiruv)
- > Yadro so'rovni qabul qiladi
- > Fayl tizimidan ma'lumot qayerdaligi aniqlanadi
- > Qurilma drayveri uskunaga buyruq beradi
- > SSD diskdan ma'lumot o'qiladi.

- 1. Linux System Monitor**
- 2. CPU Scheduling Simulator**
- 3. Process Manager**
- 4. Disk Space Analyzer**
- 5. File Manager**
- 6. Linux Security Audit Tool**
- 7. Client–Server Chat**
- 8. System Information Tool**
- 9. Backup Utility**

Operatsion tizimlar fanidan mustaqil ta'lim va loyiha mavzulari

1. Linux System Monitor — tizim resurslarini monitoring qilish

Loyiha mazmuni:

Linux operatsion tizimida kompyuter resurslarini kuzatuvchi dastur yaratish.

Talaba bajaradi:

- CPU yuklanishini aniqlaydi;
- RAM ishlatilishini ko'rsatadi;
- disk hajmi va bandligini ko'rsatadi;
- ishlayotgan jarayonlarni chiqaradi;
- tizimning ishlash vaqtini (uptime) ko'rsatadi.

Natija: terminal yoki oddiy web interfeysga ega tizim monitoring dasturi.

O'rganiladigan mavzular: CPU, RAM, disk, process, system monitoring.

2. CPU Scheduling Simulator — protsessorni rejalashtirish algoritmlari

Loyiha mazmuni:

Operatsion tizimda jarayonlarni protsessorga taqsimlash algoritmlarini modellashtiruvchi dastur yaratish.

Talaba bajaradi:

- FCFS algoritmini;
- SJF algoritmini;
- Priority Scheduling algoritmini;
- Round Robin algoritmini

amalgamaga oshiradi va ularni o'zaro taqqoslaydi.

Dastur:

- Waiting Time;
- Turnaround Time;
- Response Time;
- Average Waiting Time

ko'rsatkichlarini hisoblaydi.

Natija: algoritmlarni taqqoslovchi simulator va grafik/Gantt chart.

3. Process Manager — jarayonlarni boshqarish dasturi

Loyiha mazmuni:

Operatsion tizimdagi ishlayotgan jarayonlarni ko'rish va boshqarish uchun oddiy dastur yaratish.

Talaba bajaradi:

- ishlayotgan processlarni ko'rsatadi;
- PID bo'yicha processni topadi;
- CPU va RAM sarfini ko'rsatadi;
- processni to'xtatadi yoki terminate qiladi;
- processlar haqida asosiy ma'lumotlarni chiqaradi.

Natija: Task Manager yoki top dasturining soddalashtirilgan analogi.

O'rganiladigan mavzular: process, PID, parent/child process, signals, process states.

4. Disk Space Analyzer — disk xotirasini tahlil qilish

Loyiha mazmuni:

Diskdagi fayl va papkalar qancha joy egallayotganini aniqlovchi dastur yaratish.

Talaba bajaradi:

- papkalar hajmini hisoblaydi;
- katta hajmdagi fayllarni topadi;
- fayllarni hajmi bo'yicha saralaydi;
- diskning bo'sh va band qismini ko'rsatadi;
- kerak bo'lsa, natijani grafik ko'rinishda chiqaradi.

Natija: foydalanuvchiga diskdagi joyni boshqarishga yordam beruvchi utility.

O'rganiladigan mavzular: filesystem, files, directories, disk storage, file metadata.

5. File Manager — fayllarni boshqarish dasturi

Loyiha mazmuni:

Fayl va papkalar bilan ishlash imkonini beruvchi oddiy file manager yaratish.

Talaba bajaradi:

- yangi fayl yaratadi;
- papka yaratadi;
- faylni o'chiradi;
- fayl nomini o'zgartiradi;
- faylni nusxalaydi;
- faylni boshqa papkaga ko'chiradi;
- fayllarni qidiradi;
- fayl hajmi va boshqa ma'lumotlarni ko'rsatadi.

Natija: CLI yoki GUI ko'rinishidagi mini File Manager.

O'rganiladigan mavzular: files, directories, paths, permissions, filesystem operations.

6. Linux Security Audit Tool — Linux xavfsizligini tekshirish

Loyiha mazmuni:

Linux tizimining asosiy xavfsizlik holatini avtomatik tekshiruvchi dastur yaratish.

Talaba bajaradi:

- tizimdagi userlarni tekshiradi;
- file permissions holatini ko'rsatadi;
- ishlayotgan servislarni aniqlaydi;
- ochiq portlarni ko'rsatadi;
- SSH konfiguratsiyasini tekshiradi;
- firewall holatini aniqlaydi.

Natijani masalan quyidagicha chiqarish mumkin:

SYSTEM SECURITY AUDIT

- ✓ Firewall enabled
- ✓ SSH configuration checked
- ⚠ Port 8080 is open
- ✓ User permissions checked

Security Score: 85/100

Natija: Linux tizimi uchun oddiy security audit utility.

7. Client–Server Chat — oddiy tarmoq chat dasturi

Loyiha mazmuni:

Operatsion tizimning tarmoq imkoniyatlaridan foydalanib, client-server asosida ishlaydigan chat dasturi yaratish.

Talaba bajaradi:

- server yaratadi;
- client yaratadi;
- socket orqali aloqa o'rnatadi;
- xabar yuborish va qabul qilishni amalga oshiradi;
- bir nechta client bilan ishlash imkoniyatini qo'shadi.

Natija: ikki yoki undan ortiq foydalanuvchi ishlata oladigan oddiy terminal chat.

O'rganiladigan mavzular: network, socket, TCP/IP, port, client-server, process/thread.

8. System Information Tool — kompyuter haqida ma'lumot

Loyiha mazmuni:

Kompyuter va operatsion tizim haqida texnik ma'lumotlarni avtomatik chiqaruvchi dastur yaratish.

Talaba bajaradi:

- operatsion tizim nomini;
- kernel versiyasini;
- CPU modelini;
- CPU core sonini;
- RAM hajmini;
- disk hajmini;
- hostname;
- system uptime

ma'lumotlarini chiqaradi.

SYSTEM INFORMATION

OS: Ubuntu 24.04
Kernel: 6.8.0
CPU: Intel Core i5
CPU Cores: 8
RAM: 16 GB
Disk: 512 GB
Hostname: student-pc
Uptime: 3 hours 21 minutes

Natija: Windows yoki Linux uchun system information utility.

O'rganiladigan mavzular: OS, kernel, CPU, RAM, disk, system information, system commands.

9. Backup Utility — fayllarni zaxiralash dasturi

Loyiha mazmuni:

Muhim fayl va papkalarni avtomatik ravishda boshqa joyga nusxalovchi backup dasturini yaratish.

Talaba bajaradi:

- backup uchun source papkani tanlaydi;
- destination papkani belgilaydi;
- fayllarni nusxalaydi;
- backup sanasini saqlaydi;
- o'zgargan fayllarni aniqlaydi;
- backup natijasi haqida hisobot chiqaradi.

BACKUP STARTED

Files scanned: 125

Files copied: 17

Files unchanged: 108

Backup completed successfully.

Natija: oddiy, amaliy backup utility.

O'rganiladigan mavzular: filesystem, file operations, storage, automation, system utilities.