OS

- Intro 1
  - Kernel DS
    - linked list → clean
    - BST → dir
    - hash → username/pwd
  - Computing env
    - traditional, mobile, client server, P2P, cloud, real time, embedded
    - internet centric
      - ? goals, components
    - foss
- Protection & security — virtualization vs emulation
- Resource mgmt
  - pcs
  - Filesys
  - mem
    - cache
- Csys arch
  - chemistry: asym/sym
  - multiprocessor / multicore OS
    - asymmetric
    - NUMA
    - symmetric
    - dual core
  - operations
    - multi prog family (batch)
      - scheduler
    - multitasking (time sharing)
    - swapping
- Storage struct
  - NVM
    - flash memory, SSD, ROMs
  - HDD
  - hierarchy
    - caching
- I/O structure
  - buffer, cache, spool
  - DMA
    - 1 per block
  - programmed I/O, Interrupt driven
    - (polling)
- Mass 14 storage sys
  - disk structure — addr mapping
  - err detection & correction
  - extensions
    - traditional vs pooled
    - obj
  - storage attachments
    - host
    - storage NAS
    - cloud storage array, SAN } RAID
      - redundant array of inexpensive disks
        - how its independent
      - lvls
  - disk scheduling
    - FCFS
    - SCAN — CSCAN
      - elevator
    - uniform wait time
    - starvation
  - volatile vs NVM scheduling
    - RAM, cache
- Internals
  - consistency semantics — NFS
  - partitions & mounting
  - Sharing — virtual filesys — remote — client server model — distributed
- File sys 13 intro
  - file attr
  - file op
  - access
    - multiple
      - seq
      - direct
      - other index ref
  - disk struct
  - protection
    - access ctrl
  - dir org
    - acyclic graph
    - tree
    - 2 lvl
    - style
    - user
    - group?
- impl
  - log recovery
  - cache
  - performance
  - free spc mgmt
    - extent
  - structure
    - FCB
      - layered
      - shrink, shrink into abt file
  - dir — allocation meth
    - contiguous
    - linked
    - FAT
      - indexed
      - disk blocks allocation per file
- Synchronization 5 tools
  - motivate?
  - pre conditions → critical section problem
    - dekker's algo, peterson's algo (interrupt based) → mem barrier
    - mutual exclusion
    - deadlock
      - livelock → priority inversion
    - starvation
    - absence of contention
  - Shared resources
    - mechanisms
      - locks
      - mutexes
        - busy wait spin lock
      - semaphore
        - down: block, wait, 0, s−
        - up: release, signal, >0, s++
    - patterns
      - producer consumer
        - bdd buffer
        - reader/writer prob
        - dining philosophers
        - sleeping barber
- deadlock 7
  - dealing
    - ignore — [ostrich]
    - prevention — proactive [banker's algo]
    - avoidance
    - detection & recovery — reactive
  - resource allocation graph (RAG)
  - conditions for deadlock
    - mutual exclusion
    - hold & wait
    - No preemption
    - Circular wait
- Process 3 ?
  - Multi OS archi → browser
  - mem layout
  - status
  - PCB (id → ...)
  - OS
    - fork
    - exec
    - wait
    - exit
    - kill
    - create
    - del
  - IPC models
    - shared mem [producer consumer prob]
    - message
      - pipes
      - client/server
      - sockets
      - remote procedure call / RPC
  - Scheduling
    - ready/wait queue / queue / (context switch) / PCB switch
  - process
    - physical
    - logical
      - mmu/mmkmu
      - block
      - synchronization
      - blocking
      - send/receive
    - parent
    - child
    - wait/abort
    - zombie
    - orphan
    - init
    - fork
    - exec
    - wait
    - exit
- Services 2
  - resource allocation
    - logging
    - protection and security
  - Syscalls
    - types
    - OS specific apps
  - UI
  - prog exec
    - linker / loader
  - I/O
  - file
  - design & impl
  - policy & mechanism
  - OS structure
    - Hybrid
    - Micro kernel
    - layered
    - simple
    - complex
    - monolithic
    - err detect
    - mag
    - proc spec
    - ret mem
    - time mem
    - stats
- CPU Scheduling 8
  - CPU/I/O burst
    - +
  - CPU scheduler
    - ready queue
    - preempt (race condition) → conditions
      - dispatcher
      - ready (run) preemptive
  - Algo
    - FCFS → very long time
    - SJF → optimal, hard
      - optimal (CPU burst) → preemptive, starvation, t.f
    - RR → simple
      - time slice
      - optimal (system) > context switch
      - some priority → PQ
    - + priority scheduling → MLFQ → most ideal general for priority
      - int
  - scheduler criteria
    - utilization
    - throughput
    - turnaround
    - waiting
    - response
    - t
- Thread 4
  - eg
  - multicore/multi prog
    - parallelism
    - concurrency
      - //ism
      - data
      - task
  - benefits?
  - models
    - #:1
      - user → kernel
      - block
      - solaris (obj)
    - 1:1
      - win
      - linux
    - #:#
      - thread fiber (not common)
    - 2 lvl
      - M + 1:1
  - single vs multi
  - motivation?
  - libs
    - primary
      - Java
    - only
      - specify
    - user vs kernel thread
  - Amdahl's law
  - implicit threading
    - Thread pools
    - fork-join // lib
    - compile/runtime libs
      - intel TBB
      - grand central (iOS) dispatch
      - open MP
      - identify // parts
      - create OS # mode OS cores
  - issues
    - semantics
    - signal handling
    - thread cancellation
    - scheduler activation
    - TLS (thread local storage) → static data
- Multi processor scheduling 9
  - Symmetric SMP
    - multi threaded
    - multi core cpu
      - load balancing
      - processor affinity
        - cache size
          - if switching new core
            - cost
            - hard
  - NUMA CPU scheduling
  - priority mode, mean, EDF, proportional share
  - real-time CPU
    - interrupt latency
    - dispatch latency
    - soft
    - hard
    - cache miss closer
  - Thread scheduling
  - Pthread
- Real time systems 10
  - impl
    - ?
    - types
      - hard critical
      - soft
      - safety-critical
    - requirements
      - soft real time (priority)
      - real time embedded
      - SOC
      - Bus overload
  - functions
  - response time factors
  - transparent real time OS requirements
  - Applications
    - mp (media stream)
    - priority inversion
    - scheduling critical access (interface protocol)
    - relay
  - characteristics → system clock
  - rate monotonic algo
  - context switch = timelines
- Virtual 12 memory
  - code space
  - how implemented
  - demand paging
    - page fault
    - page replacement
      - FIFO
      - LRU
- Main 11 memory
  - swapping + context switch time
  - protection
    - HW address
    - address bdg
  - logical vs physical addr space
    - translation
      - MMU
        - hierarchical page tables (N/W page)
        - shared pages
        - protection, valid/invalid bit
  - dynamic loading → linking
  - paging (table)
    - EAT no effective access time
    - address translation
    - TLB translation look aside buffers
    - variable partition
      - contiguous allocation
    - dynamic storage allocation problem
      - first fit
      - best
      - worst
    - fragmentation
      - internal vs ext
- I/O sys 15
  - protection
    - sys calls
  - err handling
  - choice of device
    - block
    - character
    - network
    - clocks & timers
  - Application I/O interf
  - kernel I/O subsys — kernel DS
    - non blocking / asynchronous
    - vectored
  - power mgmt
  - Streams
    - read/write queue
  - HW
  - techniques
    - polling (programmed)
    - interrupt
    - DMA