CSE 306 Operating Systems
Course Overview

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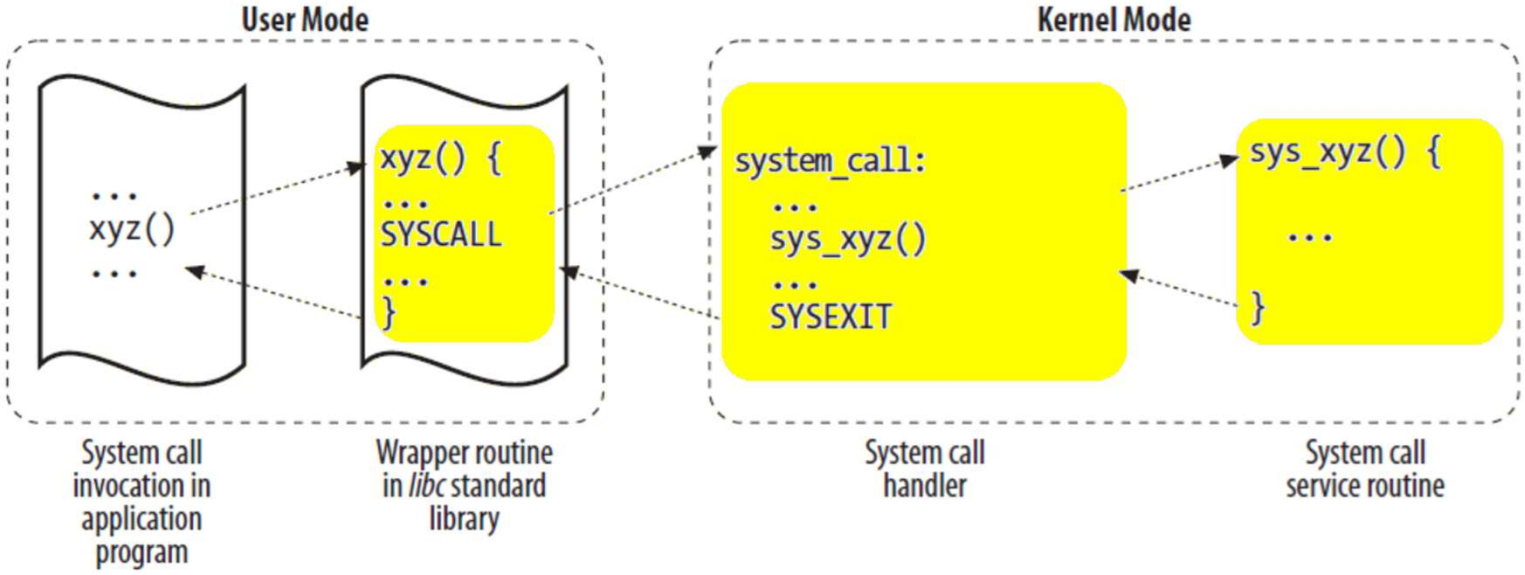
Topics

- System Calls
- Processes
- Threads / Synchronization / Deadlock
- Process scheduling
- Memory management
- File management

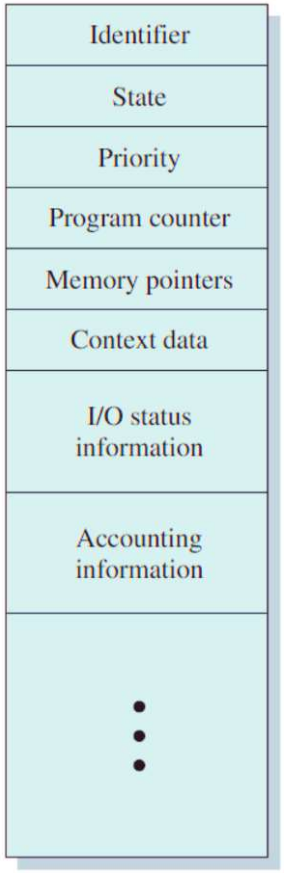
System Calls

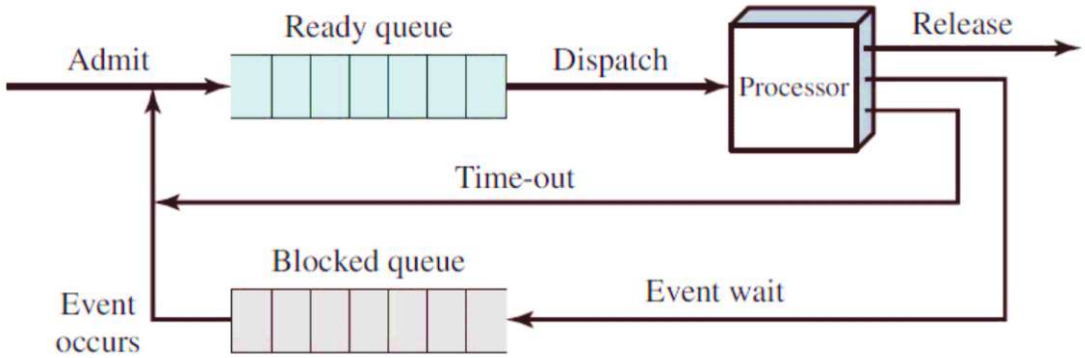
- System calls are a way for user processes to communicate with the kernel
  - open, read, write, close
  - getpid, fork, exec, …



Processes

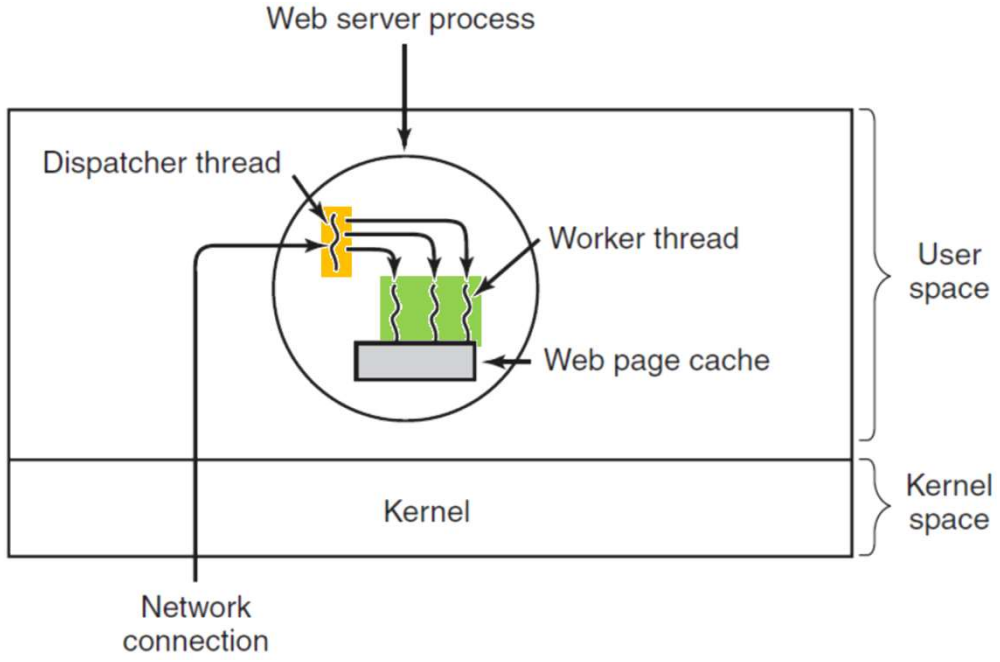
- A process is an instance of a running program
  - Composed of code, data, Process Control Block …





Threads

- Thread: a logical flow that runs in the context of a process
  - Process: the unit of resource ownership
  - Thread: the unit of dispatching



Synchronization

- Critical section
  - Dekker's algorithm, Peterson's algorithm
  - Atomic operations
  - Spin Locks
  - Semaphores

C code for thread i

```
for (i = 0; i < niters; i++)
    cnt++;
```

Asm code for thread i

```
    movq   (%rdi), %rcx
    testq  %rcx,%rcx
    jle    .L2
    movl   $0, %eax
.L3:
    movq   cnt(%rip),%rdx
    addq   $1, %rdx
    movq   %rdx, cnt(%rip)
    addq   $1, %rax
    cmpq   %rcx, %rax
    jne    .L3
.L2:
```

H_i : Head

L_i : Load cnt

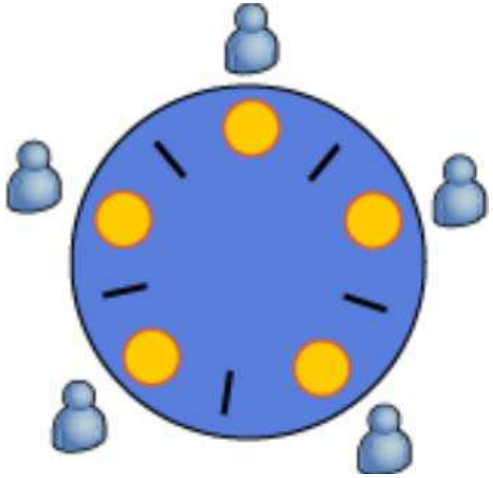
U_i : Update cnt

S_i : Store cnt

T_i : Tail

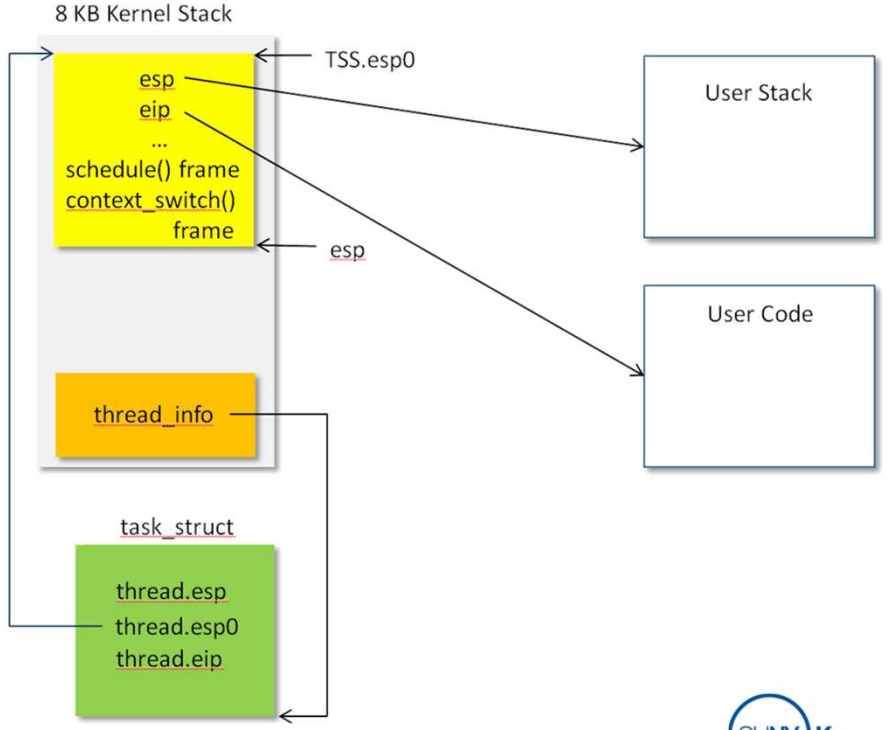
Deadlock

- Deadlock
  - In a set of processes, each process is waiting for an event that can be triggered only from the set
  - Four deadlock conditions
- Deadlock prevention
- Deadlock avoidance
- Deadlock detection and recovery



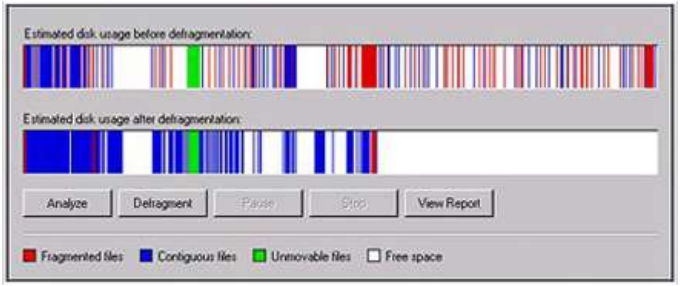
Process Scheduling

- Scheduling policies
  - First Come First Served, Round Robin, Real-time, …
- Next process selection
  - pick_next_task()
- Context switch
  - switch_mm()
  - switch_to()



Memory Management

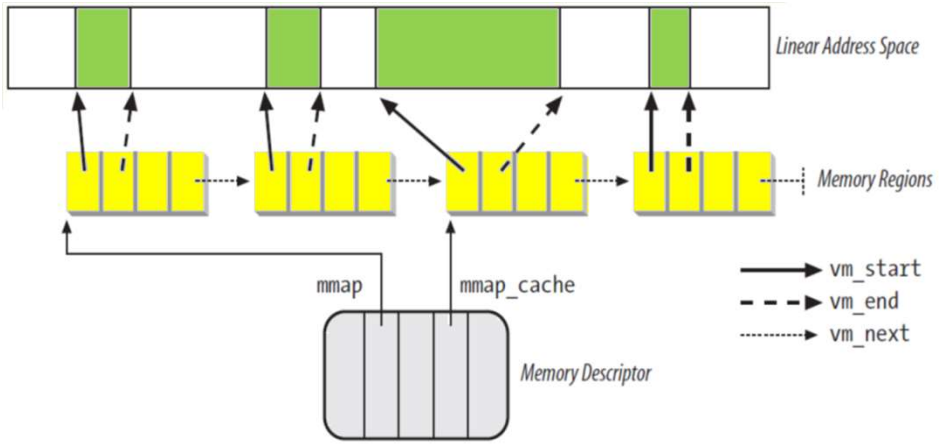
- Memory management for Kernel
  - Page descriptors for page frame states
  - Buddy system
  - Slab allocator

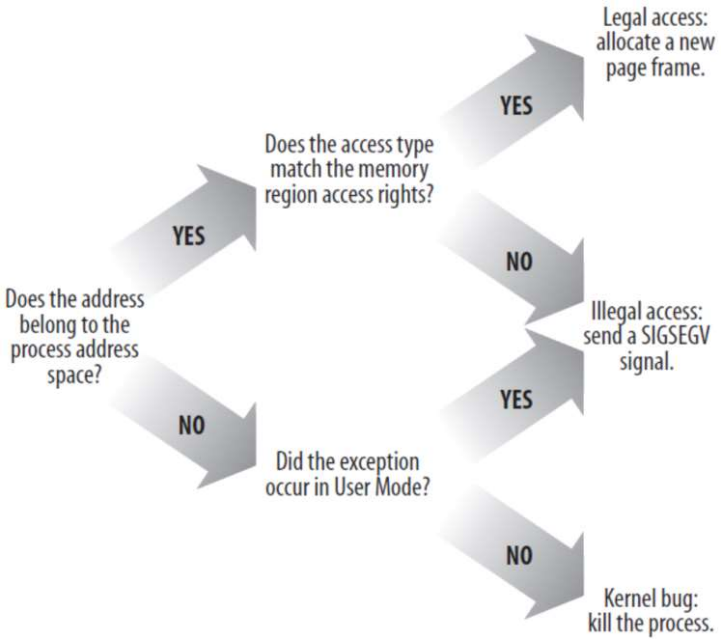


External fragmentation

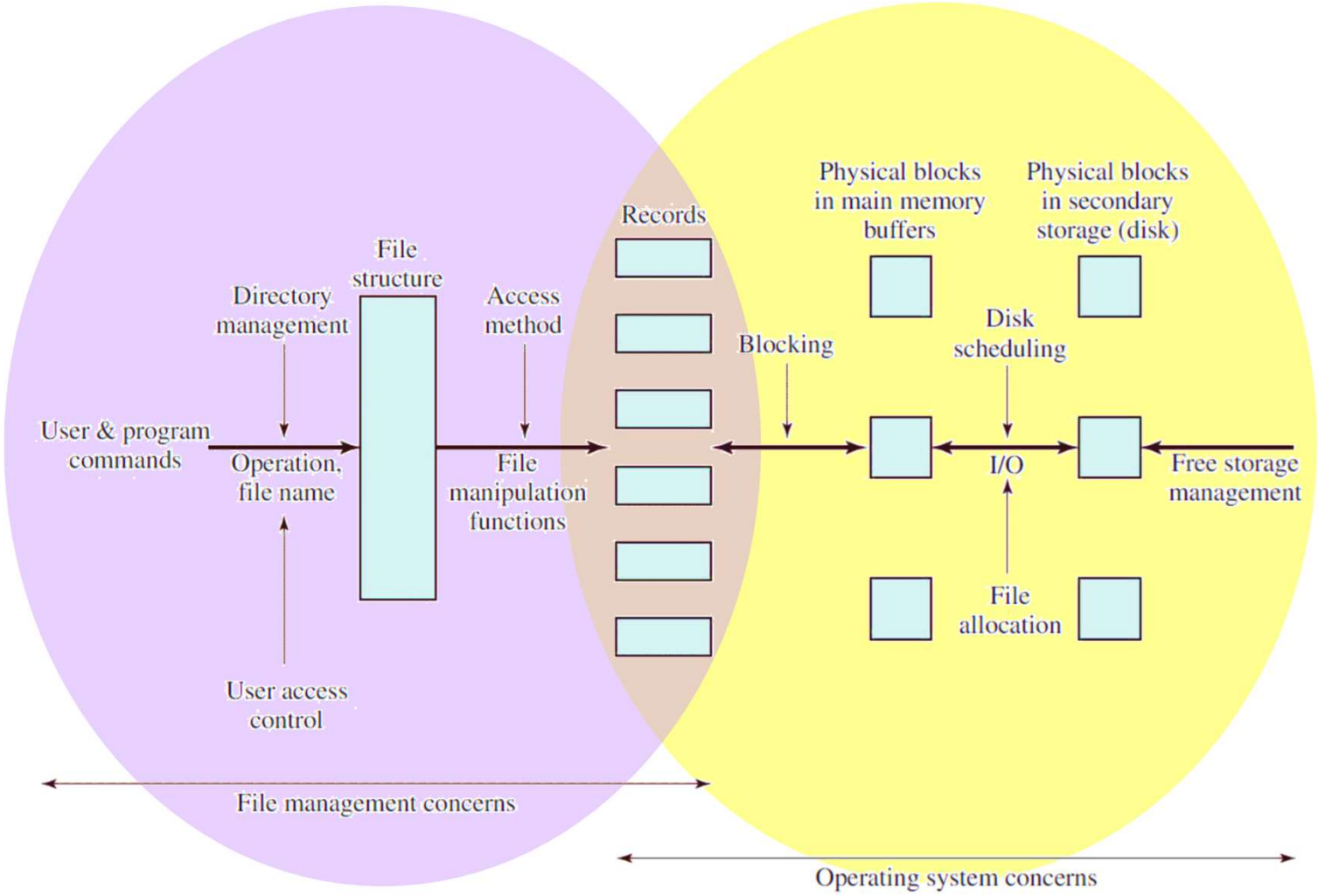
Memory Management

- Memory management for User processes
  - Process address space
  - Page fault handler





File Management



Filesystem

- Filesystem
  - A hierarchical storage of data
  - Filesystem controls the flow of data