



Operating Systems

Review

Questions

- What are two functions of an OS?
- What “layer” is above the OS?
- What “layer” is below the OS?



Questions

- What causes OS to change?
 - Or, why aren't we still running MS-DOS?
- What is a *process*?
- What is a *file*?



True or False

- Unix is a “simple structure” OS
- Micro Kernels are faster than other OSes
- Virtual Machines are faster than other OSes



Questions

- Name 3 operating system structures
- Give one advantage of each
- Give one disadvantage of each



Questions

- How does a shell work? Or ... arrange the commands in order:

```
wait()  
pid = fork()  
exec()  
gets()  
while(1) {  
}
```



Review

- What is a PCB?
- Usually the PCB is in OS memory only. Assume we put the PCB into a processes address space. What problems might this cause?



Review

- List steps that occur during *interrupt*
- True or False:
 - Context switch times happen every 5-10 seconds
 - Most processes have long CPU burst times



Review

- What is (average) waiting time?
- Explain how SJF works
- True or False:
 - FCFS is optimal in terms of avg waiting time
 - Most processes are CPU bound
 - The shorter the time quantum, the better



Questions

- How does Windows NT/2000 avoid process starvation?



Review

- What is a “race condition”?
- What are 3 properties necessary for a correct “critical region” solution?
- What is Peterson’s Solution?



Possible Outputs?

```
int main() {  
    int *num, shm_id  
  
    shm_id = shmget(502)  
    num = (int *) shmat(shm_id)  
    fork()  
    *num = *num + 1  
    printf("%d\n", *num)  
}
```

(Assume shm is
0 when first
Created)



Possible Outputs?

```
int num = 0;
int main() {
    fork();
    num = num + 1
    printf("%d\n", *num)
}
```

What if `fork()` was `spawn()`?



Review

- What does *Test_and_Set* do?
- What is one major advantage of *semaphores* over the *Test_and_Set* or *Peterson's* solution?



Review

- What is the Memory Management Unit?
- What is a relocation register?
- What happens to it during a context switch?



Review

- What are some of the sections in an object module?
- What are some of the steps that occur during linking?



Review

- What is internal fragmentation?
- What is external fragmentation?
- What is compaction?



True or False

- With paging, a process' logical address spaces is contiguous
- With paging, a process' physical address spaces is contiguous
- Paging reduces the size of the possible address space used by a process



Review

- Does paging have fragmentation?
 - No? Then why not?
 - Yes? Then what kind?
- What are the overheads associated with paging?



Another Paging Example

- Consider:
 - 8 bits in an address
 - 3 bits for the frame/page number
- How many bytes (words) of physical memory?
- How many frames are there?
- How many bytes is a page?
- How many bits for page offset?
- If a process' page table is 12 bits, how many logical pages does it have?



Review

- What is run-time, dynamic linking?



Review

- True or False:
 - a) The logical address space cannot be bigger than the physical address space
 - b) Processes have big address spaces because they always need them
- Demand paging:
 - a) Is unrelated to basic paging
 - b) Brings logical pages into physical memory when requested by a process
 - c) Increases memory requirements for a system
 - d) All of the above
 - e) None of the above



First-In-First-Out (FIFO)

1,2,3,4,1,2,5,1,2,3,4,5

3 Frames / Process

1	4	5
2	1	3
3	2	4

9 Page Faults

How many page faults would we have if we had
4 Frames/Process?



Review

- Page faults
 - What is a page fault?
 - What does an OS do during a page fault?
- What is a Page Replacement Algorithm?
 - What is “Belady’s Anomaly”?
 - How does the Optimal algorithm work?
 - How does Enhanced Second Chance work?
- What is thrashing?
 - How do we fix it?



Page Replacement Algorithms: Counting

- Keep a counter of number of references
 - LFU - replace page with smallest count
 - + Can decay values by shift
 - MFU - replace page with largest count
 - + smallest count just brought in and will probably be used
- Problems?



Review

- What is a file descriptor?
 - What information must it contain?
 - What information might it contain?



Linked-List with Index

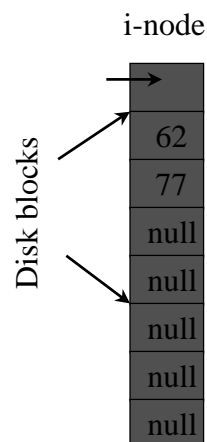
Physical
Block

0	
1	
2	null
3	null
4	7
5	
6	3
7	2

- How many files are there?
- How large are they?
- How many free blocks are there?



I-Node



- How many data blocks are there?
- If you added 3 more data blocks to the file, what would happen?



Review

- Directories:
 - In what way is a directory different than a file?
 - In what way is a directory similar to a file?
- Aliases:
 - Describe a hard-link
 - Describe a soft-link
- Free space management:
 - What are two common methods of keeping track of free blocks?



Flo00

- What is *journaling*? How is it used in modern file systems?
- How do large disks cause problems for some file systems? How are those problems addressed in modern file systems?

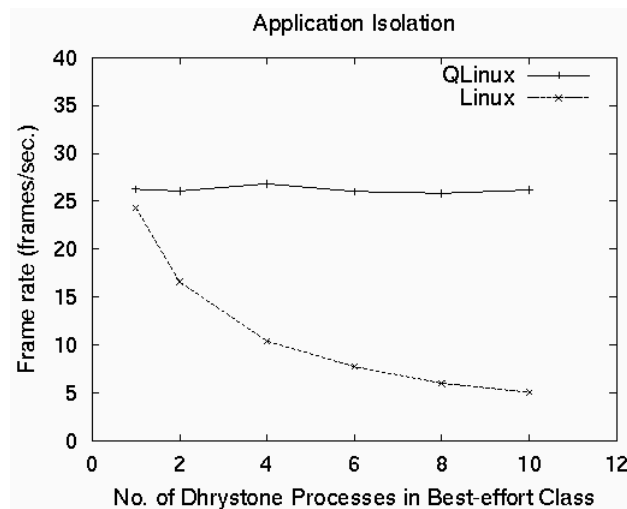


SCG+00

- What are three classes of applications handled by typical OSes?
- What components does QLinux provide?



SCG+00



- What are the two classes used in this test?
- Draw conclusions from the graph

