CSE 421/521 - Operating Systems
Fall 2011

Lecture - XXVII

Final Review

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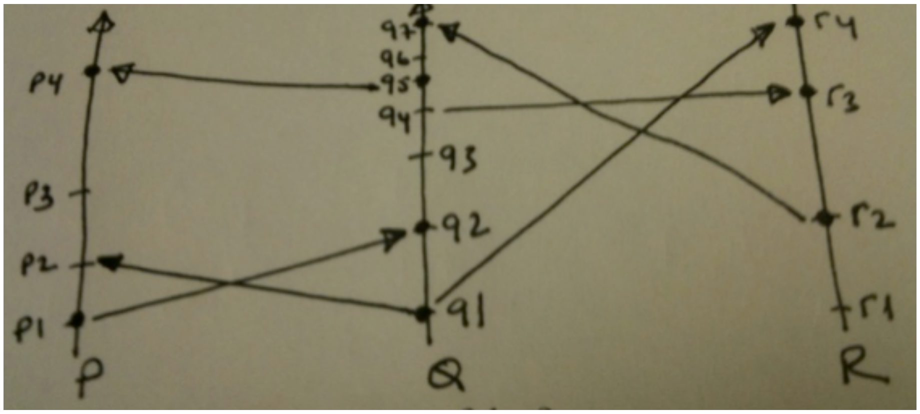
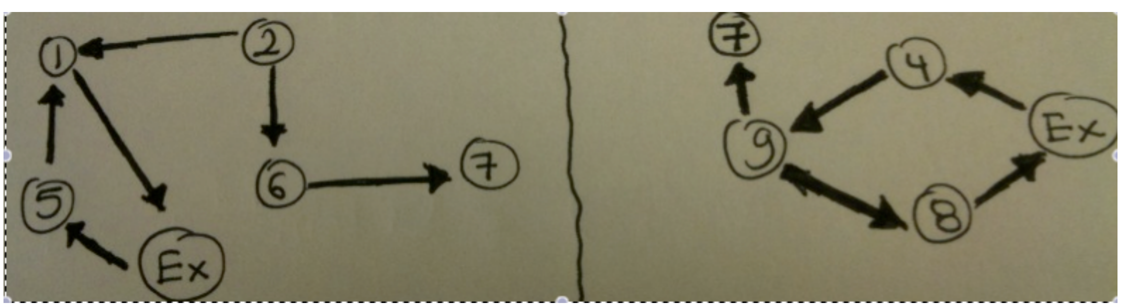
University at Buffalo
December 8th, 2011

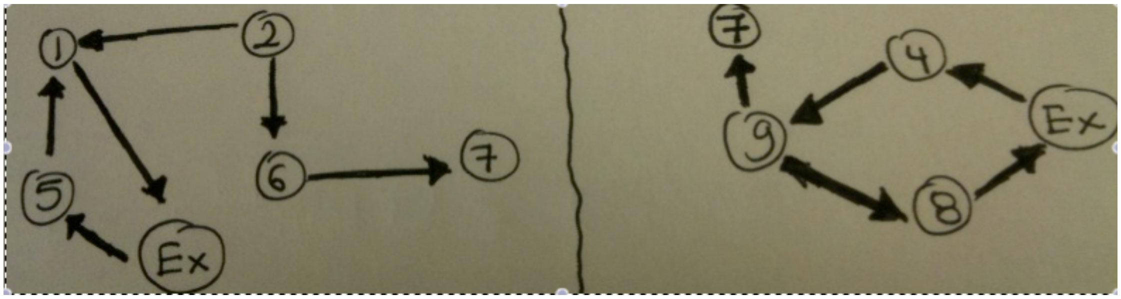
Quiz-5 Solutions



a) r2 happens before p4 :
b) p1 happens before r3 :
c) p2 happens before r4 :
d) p1 and r4 are concurrent processes :
e) r1 and p4 are concurrent processes :



Considering the above local wait-for graphs at sites S1 and S2, is the system D in a deadlocked state? If so, which processes are involved in the deadlock? Show how you would check the existence of a deadlock.



Consider the asymmetric encryption algorithm. You are given two prime numbers:

p= 5 , q = 7

and assume the public key is given for you: Public key, *ke* = 5

Suppose we want to send the message, M=27 to you over the network.

a) How do we calculate the encrypted message (cyphertext)?

b) How would you calculate your private key?

c) How do you calculate the decrypted message (cleartext) from the cyphertext?

Final Exam

December 15th, Thursday

8:00am - 11:00am

@NSC 215

Chapters included in Final

• Ch. 3.2-3.4	(Processes)	
• Ch. 4.2-4.4	(Threads)	
• Ch. 5.2-5.3	(CPU Scheduling)	~ 20%
• Ch. 6.2-6.7	(Synchronization)	
• Ch. 7-2-7.6	(Deadlocks)	
• Ch. 8.1-8.6	(Main Memory)	
• Ch. 9.1-9.6	(Virtual Memory)	
• Ch. 11.1-11.5, 11.8	(File Systems)	~ 80%
• Ch. 12.1-12.7	(Mass Storage & IO)	
• Ch. 15.1-15.5	(Security)	
• Ch. 17.1-17.6	(Distr. File Systems)	
• Ch. 18.1,18.2,18.5	(Distr. Coordination)	

8. Main Memory

- Contiguous Allocation
- Dynamic Allocation Algorithms
- Fragmentation
- Address Binding
- Address Protection
- Paging
- Segmentation

9. Virtual Memory

- Demand Paging
- Page Faults
- Page Replacement
- Page Replacement Algorithms (FIFO, LRU, SC, LFU, MFU, Optimal)
- Performance of Demand Paging

11. File Systems

- Directory structure & implementation
- File allocation methods
  - contiguous, linked, indexed
- Free space management
  - bit vectors, linked lists, grouping, counting

12. Mass Storage & I/O

- Disk Mechanism & Structure
- Disk Scheduling Algorithms
  - FCFS, SSTF, SCAN, LOOK, C-SCAN, C-LOOK
- Hierarchical Storage Management
- RAID Architectures
  - RAID 0-6, RAID 0+1, RAID 1+0

15. Security

- Security Violation Categories
- Security Violation Methods
- Program & Network Threats
- Cryptography
- Symmetric & Asymmetric Encryption
- Key distribution

18. Distributed Coordination

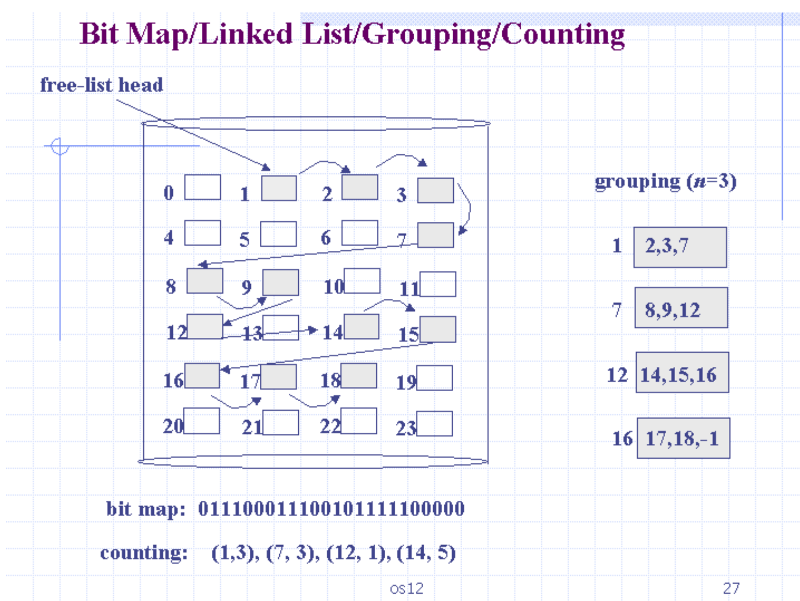
- Event Ordering
  - Happened before relationship
- Distributed Mutual Exclusion
  - Centralized & Fully Distributed Approaches
- Distributed Deadlock Prevention
  - Resource Ordering
  - Timestamp Ordering (Wait-die & Wound-wait)
- Distributed Deadlock Detection
  - Centralized & Fully Distributed Approaches

Exercise Questions

Question 1

- In terms of reliability and performance, compare bit vector implementation of a free block list with keeping a list of free blocks where the first few bytes of each free block provide the logical sector number of the next free block.

Remember



Question 2

Consider a demand-paged computer system where the degree of multi-programming is currently fixed at four. The system was recently measured to determine utilization of CPU and the paging disk. The results are one of the following alternatives. For each case, what is happening (in one phrase)? Can you increase the degree of multiprogramming to increase the CPU utilization?

a) CPU utilization 86 percent; disk utilization 4 percent.

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a) CPU utilization 86 percent; disk utilization 4 percent.

Answer: CPU utilization is sufficiently high to leave things alone (there are already sufficient processes running to keep the CPU busy); increasing the degree of multiprogramming may decrease the CPU utilization.

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b) CPU utilization 10 percent; disk utilization 95 percent.

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b) CPU utilization 10 percent; disk utilization 95 percent.

Answer: thrashing is occurring. We cannot increase the CPU utilization

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Consider a demand-paged computer system where the degree of multi-programming is currently fixed at four. The system was recently measured to determine utilization of CPU and the paging disk. The results are one of the following alternatives. For each case, what is happening (in one phrase)? Can you increase the degree of multiprogramming to increase the CPU utilization?

c) CPU utilization 12 percent; disk utilization 2 percent.

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c) CPU utilization 12 percent; disk utilization 2 percent.

Answer: both CPU and disk utilization are low, and CPU is obviously underutilized. We should increase the degree of multiprogramming to increase CPU utilization.

Question 3

- Consider a demand-paging system with the following time-measured utilization:

  CPU utilization 18%
  Paging disk 96%
  Other I/O devices 6%

For each of the following, say whether it will (or is likely to) improve CPU utilization. Answer with YES or NO or LIKELY, and justify your answers.

(a) Install a faster CPU.

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  CPU utilization 18%
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For each of the following, say whether it will (or is likely to) improve CPU utilization. Answer with YES or NO or LIKELY, and justify your answers.

(a) Install a faster CPU.

NO. a faster CPU reduces the CPU utilization further since the CPU will spend more time waiting for a process to enter in the ready queue.

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(b) Install a bigger paging disk.

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(b) Install a bigger paging disk.

NO. the size of the paging disk does not affect the amount of memory that is needed to reduce the page faults.

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(c) Decrease the degree of multiprogramming.

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YES. by suspending some of the processes, the other processes will have more frames in order to bring their pages in them, hence reducing the page faults.

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  CPU utilization 18%
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For each of the following, say whether it will (or is likely to) improve CPU utilization. Answer with YES or NO or LIKELY, and justify your answers.

(d) Install more main memory.

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- Consider a demand-paging system with the following time-measured utilization:

  CPU utilization 18%
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For each of the following, say whether it will (or is likely to) improve CPU utilization. Answer with YES or NO or LIKELY, and justify your answers.

(d) Install more main memory.

Likely. more pages can remain resident and do not require paging to or from the disks.

Question 4

- Given the following memory partitions (in kilobytes): 200, 600, 500, 800, 400, 300 (in order); how would each of the first-fit, best-fit, and worst-fit algorithms place processes of 292, 522, 138, 770, 162, 418 (in order).
- Which algorithm makes the most efficient usage of memory?

Question 4

- Given the following memory partitions (in kilobytes): 200, 600, 500, 800, 400, 300 (in order); how would each of the first-fit, best-fit, and worst-fit algorithms place processes of 292, 522, 138, 770, 162, 418 (in order).
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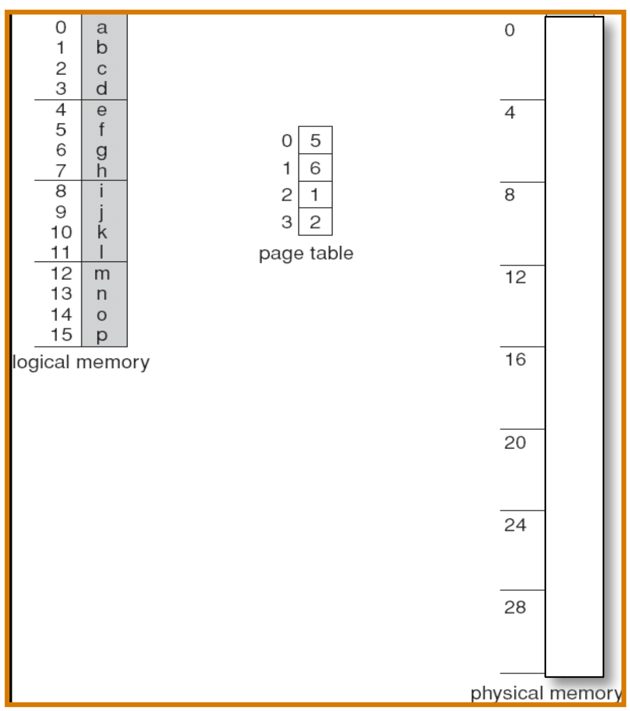
- Which algorithm makes the most efficient usage of memory?

Question 5

- Consider the paging table on the right. What are the physical addresses of the following logical addresses [p,d] and the words on them :
- a) 0,0
- b) 1,4
- c) 2,3



Question 6

- Consider the following segment table:

Segment	Base	Length
0	219	600
1	2300	14
2	90	100
3	1327	580
4	1952	96

What are the physical addresses for the following logical addresses?

a. 0, 100
b. 1, 100
c. 2, 100
d. 3, 0

Question 7

- Consider the following demand paging system:
  Memory access time = 1 microsecond
  Swap Page Time = 10 msec = 10,000 microsec

40% of the time the page that is being replaced has been modified and therefore does need to be swapped out

a) What is the Effective Access Time (EAT) if 1 out of 1000 memory accesses result in a page fault?

b) What if we only want 20% performance degradation?

Question 8

- Consider the following page-reference string:

1, 2, 3, 4, 4, 3, 2, 1, 5, 6, 2, 1, 2, 3, 7, 8, 3, 2, 1, 5

How many page faults, page hits, and page replacements would occur for the following replacement algorithms, assuming 4 memory frames? Show your page assignments to frames.

(a) Assuming LRU page replacement algorithm is used.

1	2	3	4	4	3	2	1	5	6	2	1	2	3	7	8	3	2	1	5

# of page faults:
# of page hits:
# of page replacements:

Question 8

(b) Assuming Optimal page replacement algorithm is used.

1	2	3	4	4	3	2	1	5	6	2	1	2	3	7	8	3	2	1	5

# of page faults:
# of page hits:
# of page replacements:

Question 9

Assume a disk with 500 cylinders is accessing cylinder 100 right now. Prior cylinder 100, the disk head accessed cylinder 101. Further assume that the FIFO queue of pending requests is 102, 20, 450, 60, 80, 220, 330, 250, 101, 190. What order will the pending requests be satisfied using the following scheduling algorithms?

(a) Circular Scan disk-scheduling policy?

(b) SSTF disk-scheduling policy?

(c) Which of the above algorithms is more efficient in this particular case, and why?