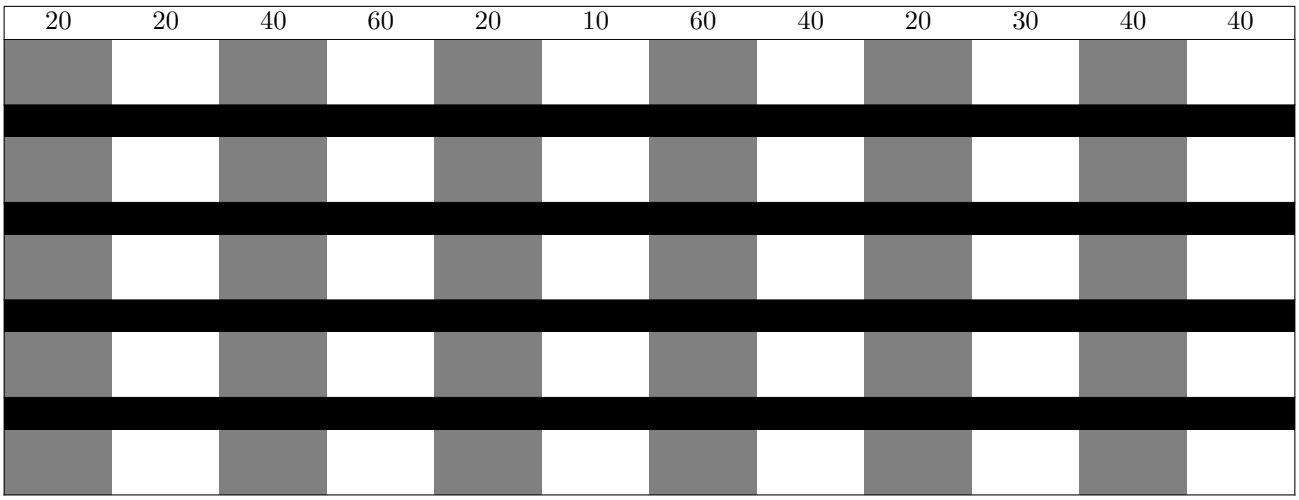
Exam Review

1 Memory Partitioning

The following diagram shows a partition of memory. If three separate requests for memory of 40M, 20M, and 10M are made, determine the spots in memory where the requests will each be placed, and indicate the beginning address of the request based on the following policies:

1. First Fit
2. Best Fit
3. Next Fit
4. Worst Fit

The grey blocks represent already filled spaces in memory.



2 Memory Allocation

A 1Mb block of memory is allocated using the buddy method. Show the resulting partitions in the following diagram if they recieve the following memory requests:

$$A = 70K \qquad B = 35K \qquad C = 80K \qquad D = 60K$$

The memory is requested/released as follows:

1. Request A
2. Request B
3. Request C
4. Return A
5. Request D
6. Return B
7. Return D
8. Return C

<table>
<tr><td colspan="6">1024</td><td>Initial</td></tr>
<tr><td colspan="2">A</td><td colspan="2">128</td><td colspan="2">256</td><td>512</td><td>Request A</td></tr>
<tr><td colspan="2">A</td><td>B</td><td>64</td><td colspan="2">256</td><td>512</td><td>Request B</td></tr>
<tr><td colspan="2">A</td><td>B</td><td>64</td><td>C</td><td>128</td><td>512</td><td>Request C</td></tr>
<tr><td colspan="2">128</td><td>B</td><td>64</td><td>C</td><td>128</td><td>512</td><td>Return A</td></tr>
<tr><td>D</td><td>64</td><td>B</td><td>64</td><td>C</td><td>128</td><td>512</td><td>Request D</td></tr>
<tr><td>D</td><td>64</td><td colspan="2">128</td><td>C</td><td>128</td><td>512</td><td>Return B</td></tr>
<tr><td colspan="4">256</td><td>C</td><td>128</td><td>512</td><td>Return D</td></tr>
<tr><td colspan="6">1024</td><td>Return C</td></tr>
</table>

3 Paging I

Given the following table, determine which physical address, if any, the following virtual address would correspond.

1103 2325 5544

VPN	Valid Bit	Reference Bit	Modify Bit	PFN
0	1	1	0	4
1	1	1	1	7
2	0	0	0	-
3	1	0	0	2
4	0	0	0	-
5	1	0	1	0

$1103 = (1 * 1024) + 79$
$\implies$ PFN: 7
Address $= (7 * 1024) + 79$
$= 7247$

$2325 = (2 * 1024) + 277$
$\implies$ PFN: -
$\implies$ PAGE FAULT

$5544 = (5 * 1024) + 424$
$\implies$ PFN: 0
Address $= (0 * 1024) + 424$
$= 79$

4 Paging II

Given the following table, assume there is a page fault at 4. Determine which page will be replaced using the following policies:

1. FIFO
2. LRU
3. Clock
4. Optimal (Assume the remaning sequence is 4, 0, 0, 0, 2, 4, 2, 1, 0, 3, 2)

VPN	Time Loaded	Reference Time	R-Bit	M-Bit
2	60	161	0	1
1	130	160	1	0
0	26	162	1	0
3	20	163	1	1

VPN	3	0	2	1	···	1	2	0	3	4
VPN In Memory	3	3	3	3	···	3	3	3	3	4
		0	0	0		0	0	0	0	0
			2	2		2	2	2	2	2
				1		1	1	1	1	1
Time	20	26	60	130	···	160	161	162	163	164

VPN	3	0	2	1	···	1	2	0	3	4
VPN In Memory	3	3	3	3	···	3	3	3	3	3
		0	0	0		0	0	0	0	0
			2	2		2	2	2	2	2
				1		1	1	1	1	4
Time	20	26	60	130	···	160	161	162	163	164

VPN	3	0	2	1	···	1	2	0	3	4
VPN In Memory	3	3	3	3	···	3	3	3	3	3
		0	0	0		0	0	0	0	0
			2	2		2	2	2	2	4*
				1		1	1	1	1	1*
Time	20	26	60	130	···	160	161	162	163	164

VPN	1	2	0	3	4	0 0 0 2 4 2 1 0 3 2 ...
VPN In Memory	3	3	3	3	4	
	0	0	0	0	0	
	2	2	2	2	2	
	1	1	1	1	1	
Time	160	161	162	163	164	...

5 Processor Scheduling

Example: Determine the processor scheduling times of the following policies:

1. First Come First Serve
2. Round Robin (q = 1)
3. Round Robin (q = 4)

Process Number	Arrival Time	Service Time
1	0	6
2	1	2
3	4	5
4	5	7

Process Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	■	■	■	■	■	■														
2							■	■												
3									■	■	■	■	■							
4														■	■	■	■	■	■	■
1	■		■		■			■			■			■						
2		■		■																
3						■			■			■			■		■			
4							■			■			■			■		■	■	■
1	■	■	■	■							■	■								
2					■	■														
3							■	■	■	■							■			
4													■	■	■	■		■	■	■

1. First Come First Serve
2. Round Robin (q = 1)
3. Round Robin (q = 4)
4. Shortest Process Next
5. Shortest Remaining Time
6. Highest Response Ratio Next (Response Ratio = $\frac{\text{wait time+service time}}{\text{service time}}$)
7. Feedback (q = 1)
8. Feedback (q = 2^i)

Process Name	Arrival Time	Service Time
1	0	3
2	1	5
3	3	2
4	9	5
5	12	5

Process Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	■	■	■																	
2				■	■	■	■	■												
3									■	■										
4											■	■	■	■	■					
5																■	■	■	■	■
1	■		■			■														
2		■		■			■		■		■									
3					■			■												
4										■		■		■		■		■		
5													■		■		■		■	■
1	■	■	■																	
2				■	■	■	■			■										
3								■	■											
4											■	■	■	■					■	
5															■	■	■	■		■
1	■	■	■																	
2						■	■	■	■	■										
3				■	■															
4											■	■	■	■	■					
5																■	■	■	■	■
1	■	■	■																	
2						■	■	■	■	■										
3				■	■															
4											■	■	■	■	■					
5																■	■	■	■	■

Process Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	■	■	■																	
2				■	■	■	■	■												
3									■	■										
4											■	■	■	■	■					
5																■	■	■	■	■
1	■		■				■													
2		■			■			■	■									■		
3				■		■														
4										■	■	■				■			■	
5													■	■	■		■			■
1	■		■	■																
2		■				■	■		■	■										
3					■			■												
4											■	■	■		■	■				
5														■			■	■	■	■

6 Multiprocessor Scheduling I

Determine the runtimes of the following processes based on the Fixed Priority ($A \to B \to C$), and Earliest Deadline policies.

Process	Arrival Time	Execution Time	Ending Deadline
A_1	0	10	20
A_2	20	10	40
A_3	40	10	60
A_4	60	10	80
A_5	80	10	100
B_1	0	10	50
B_2	50	10	100
C_1	0	15	50
C_2	50	15	100

		10		20		30		40		50		60		70		80		90		100
FP	A_1	A_1	B_1	B_1	A_2	A_2	C_1	C_1	A_3	A_3	B_2	B_2	A_4	A_4	C_2	C_2	A_5	A_5	C_2	
ED	A_1	A_1	B_1	B_1	A_2	A_2	C_1	C_1	C_1	A_3	A_3	B_2	B_2	A_4	A_4	C_2	C_2	C_2	A_4	A_4

7 Multiprocessor Scheduling II

Display the result of the following periodic tasks under the Earliest Starting Deadline, First Come First Serve, and Earliest Starting Deadline with Unenforced Idle Times policies.

Process	Arrival Time	Execution Time	Starting Deadline
A	10	20	100
B	20	20	20
C	40	20	60
D	50	20	80
E	60	20	70

	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120
ESD		A	A	A	A		C	C	C	C	E	E	E	E	D	D	D	D						
ESDU					B	B	B	B	C	C	C	C	E	E	E	E	D	D	D	D	A	A	A	A
FCFS			A	A	A	A		C	C	C	C	D	D	D	D									

8 I/O Operations

Perform a FIFO, SSTF, SCAN, and C-SCAN on the following sequence of disk track requests in order to calculate the average seek length:

27, 129, 110, 186, 147, 41, 10, 64, 120

Assume that the disk starts at address 100, and the head is moving in the direction of decreasing track number.

FIFO:

	100
27	73
129	102
110	19
186	76
147	39
41	106
10	31
64	54
120	56
Average:	61.8

SSTF:

	100
110	10
120	10
129	9
147	18
186	39
64	122
41	23
27	14
10	17
Average:	29.1

SCAN:

	100
64	36
41	23
27	14
10	17
110	100
120	10
129	9
147	18
186	39
Average:	29.6

C-SCAN:

	100
64	36
41	23
27	14
10	17
186	176
147	39
129	18
120	9
110	10
Average:	38

9 UNIX Inodes

Consider a UNIX file system represented by Inodes. Assume that there are 12 direct block pointers and a singly, doubly, and triply indirect pointer in each Inode. Further, assume that the system block size is and the disk sector size are both 8 Kb. If the disk block pointer is 32 bits, with 8 bits to identify the physical disk and 24 bits to identify the physical block, then

1. What is the max file size supported by the system?

   Since there are 12 block pointers in the inode, and each block is 8 Kb, we have 12 * 8 Kb, or 96 Kb, directly addressable. The indirect pointer points to an entire block of pointers. Since each block is 8 Kb, and each pointer is 32 bits, there are 1024 pointers in the block; each pointer points to an 8 Kb block. This means the single pointers take up 1024 * 8 Kb, or 8192 Kb. The double pointer points to a pointer that points to a block. There are 1024 of those, so we have 1024 * 1024 * 8 Kb, or 8,388,608 Kb. The triple pointer will yield 1024 * 1024 * 1024 * 3 Kb, or 8,589,934,592 Kb. This yields a total size of 8,598,331,488 Kb.

2. What is the max file system partition supported by the system?

   There are 24 bits assigned to idetify the physical block, so the max file system partition supported is $2^{24} * 8$, or 134,217,728 Kb.

3. How many disk accesses are required to access the byte in position 13,423,956?

   The location in question is located in the third pointer, so it would take 4 disk accesses to access the location.