Exercise 5: Writing to an SSD

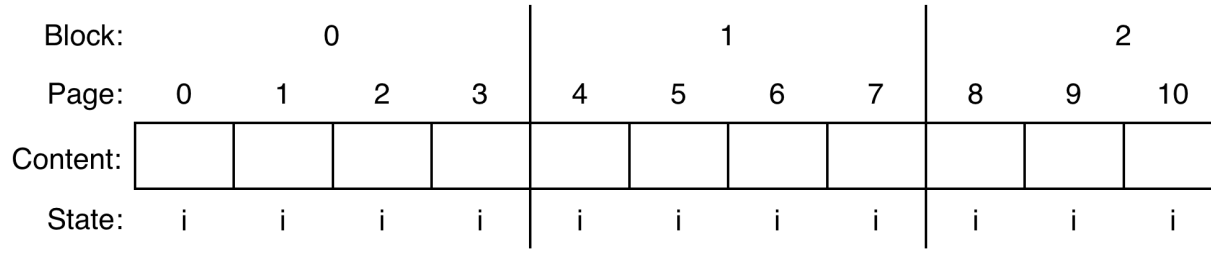
Started: Oct 14 at 11:37am

Quiz Instructions

Consider a very simple Solid State Drive (SSD) with 16 KiB sized blocks, each divided into 4 KiB pages.

The OS issues writes to logical blocks and the drive needs to keep a mapping of logical blocks to actual page number

Here is the initial state:



No data is stored on the disk, and the pages are all in their initial state.

A page can be in one of 4 states:

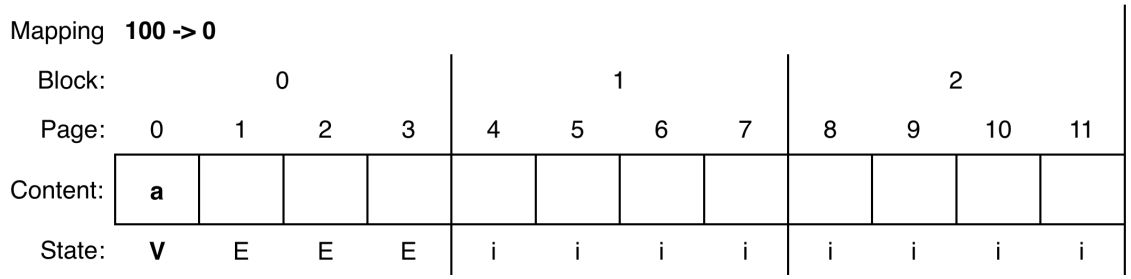
- i - initial state
- E - erased (an erased page can be written to)
- V - valid (a valid page has a mapping from logical block to page number)
- + - trim (the page no longer has a mapping from logical block to page number)

Question 1 1 pts

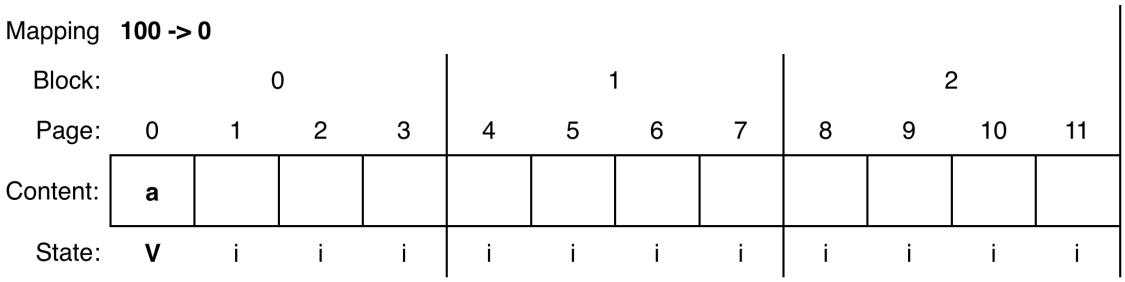
What happens when the following operation is carried out on the initial state above?

write(100, a) - Write the contents (a) of logical block 100 to the drive.

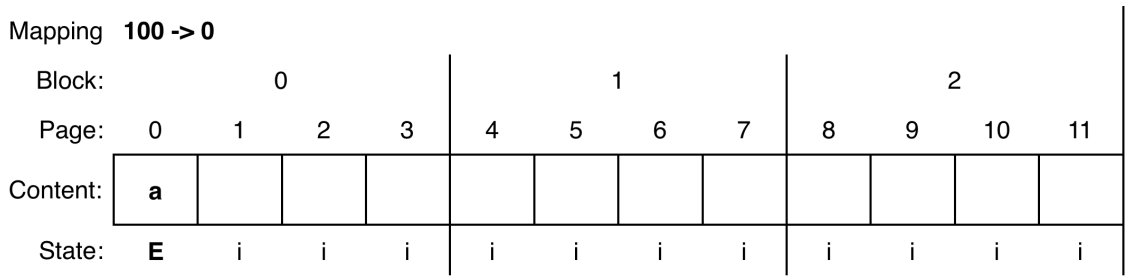
○ Mapping **100 -> 0**



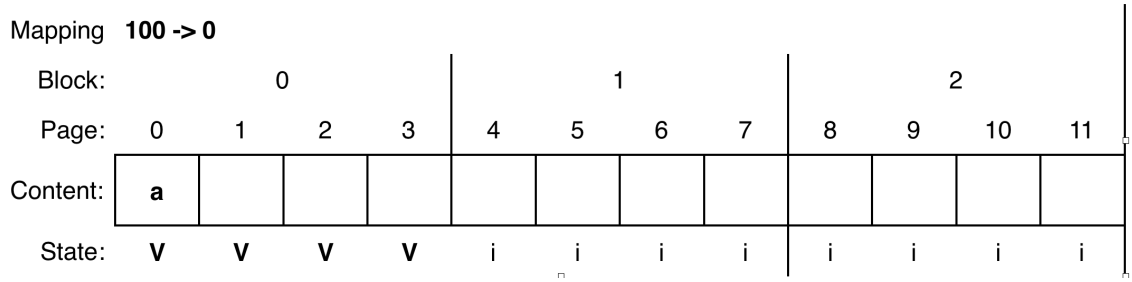
○ Mapping **100 -> 0**



○ Mapping **100 -> 0**



○ Mapping **100 -> 0**



Question 2

1 pts

Suppose the SSD is in the following state:

Mapping **100 -> 0**

Block:	0				1				2			
Page:	0	1	2	3	4	5	6	7	8	9	10	11
Content:	**a**											
State:	**V**	E	E	E	i	i	i	i	i	i	i	i

What would the new state be if we performed the following operation?

write(101, b) -- Write logical block 101 with the contents "b"

○ Mapping 100 -> 0, 101 -> 4

Block:	0				1				2			
Page:	0	1	2	3	4	5	6	7	8	9	10	11
Content:	**a**				**b**							
State:	**V**	**E**	**E**	**E**	**V**	**E**	**E**	**E**	i	i	i	i

○ Mapping 100 -> 0, 101 ->1

Block:	0				1				2			
Page:	0	1	2	3	4	5	6	7	8	9	10	11
Content:	**a**	**b**										
State:	**V**	**V**	**E**	**E**	i	i	i	i	i	i	i	i

Question 3

1 pts

Suppose additional write calls have taken place so that the current state is:

Mapping 100 -> 0, 101 ->1, 102 -> 2, 103 -> 3

Block:	0				1				2			
Page:	0	1	2	3	4	5	6	7	8	9	10	11
Content:	**a**	b	c	d								
State:	**V**	V	V	V	i	i	i	i	i	i	i	i

Block 102 is no longer needed, so we call "trim(102)". How does the state change as a result of this operation?

Mapping 100 -> 0, 101 ->1, 103 -> 3

Block:	0				1				2			
Page:	0	1	2	3	4	5	6	7	8	9	10	11
Content:	**a**	b		d								
State:	**V**	V	E	V	i	i	i	i	i	i	i	i

Mapping 100 -> 0, 101 ->1, 103 -> 3

Block:	0				1				2			
Page:	0	1	2	3	4	5	6	7	8	9	10	11
Content:	**a**	b	c	d								
State:	**V**	V	+	V	i	i	i	i	i	i	i	i

Mapping 100 -> 0, 101 ->1, 103 -> 3

Block:	0				1				2			
Page:	0	1	2	3	4	5	6	7	8	9	10	11
Content:	**a**	b	c	d								
State:	**V**	V	V	V	i	i	i	i	i	i	i	i

Question 4

1 pts

What is the state after the next two operations are performed?

write(100, e)

write(101, f)

Mapping 100 -> 4, 101 -> 5, 103 -> 3

Block:	0				1				2			
Page:	0	1	2	3	4	5	6	7	8	9	10	11
Content:	a	b	c	d	e	f						
State:	+	+	+	V	V	V	E	E	i	i	i	i

Mapping 100 -> 4, 101 -> 5, 103 -> 3

Block:	0				1				2			
Page:	0	1	2	3	4	5	6	7	8	9	10	11
Content:			c	d	e	f						
State:	E	E	+	V	V	V	E	E	i	i	i	i

○ Mapping 100 -> 4, 101 -> 5, 103 -> 3

Block:	0				1				2			
Page:	0	1	2	3	4	5	6	7	8	9	10	11
Content:	a	b	c	d	e	f						
State:	V	V	+	V	V	V	E	E	i	i	i	i

○ Mapping 100 -> 1, 101 -> 2, 103 -> 3

Block:	0				1				2			
Page:	0	1	2	3	4	5	6	7	8	9	10	11
Content:	e	f	c	d								
State:	V	V	+	V	i	i	i	i	i	i	i	i

Question 5

1 pts

Finally, suppose the garbage collector runs to free up Block 0. What is the new state of the drive?

○ Mapping 100 -> 4, 101 -> 5, 103 -> 6

Block:	0				1				2			
Page:	0	1	2	3	4	5	6	7	8	9	10	11
Content:					e	f	d					
State:	E	E	E	E	V	V	V	E	i	i	i	i

○

Mapping 100 -> 4, 101 -> 5

Block:	0				1				2			
Page:	0	1	2	3	4	5	6	7	8	9	10	11
Content:					e	f						
State:	E	E	E	E	V	V	E	E	i	i	i	i

Quiz saved at 12:37am

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