

Theoretical Exercises 4

Memory Management

Please submit solutions on Blackboard by Thursday, 11.03.2021 12:00h

4.1 Buddy algorithm (4 points)

A memory management system is allocated using the *Buddy algorithm* for a memory with a total size of 512 kB and a minimum block size of 64 kB.

The following tables each describe an initial scenario at time $t = 1$ before an allocation (A) or a release (R) of a data block. For each of the memory blocks, the current allocation for $t = 1$ is given – either an allocation a, b, c, \dots or the assignment of the given 64 kB blocks to a free memory area of given size.

At time $t = 2$, the given allocation or release is requested. For an allocation, the size of the memory block to allocate is given.

Enter the resulting memory layout at $t = 2$ in the table. If an allocation or release cannot be performed, indicate this in the respective table.

a. Scenario 1:

t	Operation	Block	Size	64 kB	64 kB	64 kB	64 kB	64 kB	64 kB	64 kB	64 kB	
1	Initial →			128 kB		a	b	256 kB				
2	R	b	—									

b. Scenario 2:

t	Operation	Block	Size	64 kB	64 kB	64 kB	64 kB	64 kB	64 kB	64 kB	64 kB
1	Initial →			512 kB							
2	A	x	121 kB								

c. Scenario 3:

t	Operation	Block	Size	64 kB	64 kB	64 kB	64 kB	64 kB	64 kB	64 kB	64 kB
1	Initial →			128 kB		64 kB	y	a			
2	R	y	—								

d. Scenario 4:

t	Operation	Block	Size	64 kB	64 kB	64 kB	64 kB	64 kB	64 kB	64 kB	64 kB
1	Initial →			128 kB		64 kB	a	b	64 kB	128 kB	
2	A	z	180 kB								

4.2 First fit algorithm (3 points)

Use the *first fit* strategy to implement the following sequence of memory requests. Note your results by completing the following table. Each field of the table stands for 1 MB of memory and there are 32 MB of memory available altogether:

- a. release *A*, (already shown)
- b. allocate 4 MB for *F*, (already shown)
- c. allocate 2 MB for *A*,
- d. release *B*,
- e. release *E*,
- f. allocate 7 MB for *E*,
- g. release *E*,
- h. allocate 4 MB for *E*

Initial layout	A	A	A	B	B	B				C	C	C	C	C	C							D	D	D	D	D	E	E	E	E				
Release A				B	B	B				C	C	C	C	C	C							D	D	D	D	D	E	E	E	E				
Alloc. F (4 MB)				B	B	B				C	C	C	C	C	C	F	F	F	F			D	D	D	D	D	E	E	E	E				
Alloc. A (2 MB)																																		
Release B																																		
Release E																																		
Alloc. E (7 MB)																																		
Release E																																		
Alloc. E (4 MB)																																		

4.3 Page replacement (3 points)

Complete the given table using the *first-in first-out* (FIFO) approach. The age of each page frame is given as support information, you don't have to fill it in.

Allocation sequence →	1	2	3	4	5	6	1	2	3	2
Page frame	1	1	1	1						
Page frame 2		2	2	2						
Page frame 3			3	3						
Page frame 4				4						
Age of page frame 1 (optional)	0	1	2	3						
Age of page frame 2 (optional)	>	0	1	2						
Age of page frame 3 (optional)	>	>	0	1						
Age of page frame 4 (optional)	>	>	>	0						