Exercise Sheet 5

Exercise 1 (Memory Management)

1.	With which men	mory managemen	nt methods do i	nternal fragmentation occur?		
	☐ Static partition ☐ Dynamic par ☐ Buddy memor	titioning				
2.	With which men	mory managemen	nt methods do e	external fragmentation occur?		
	☐ Static partitic ☐ Dynamic par ☐ Buddy memo	titioning				
3.	. How can external fragmentation be fixed?					
4.	. Which memory management method searches for the block, which fits best?					
	\square First Fit	\square Next Fit	\square Best fit	\square Random		
5.	. Which memory management concept searches for a free block, starting from the beginning of the address space?					
	\square First Fit	\square Next Fit	\square Best fit	\square Random		
6.		management con l of the address s		quickly the large area of free		
	\square First Fit	\square Next Fit	\square Best fit	\square Random		
7.	Which memory block?	management co	ncept selects ra	andom a free and appropriate		
	☐ First Fit	\square Next Fit	\square Best fit	\square Random		
8.	Which memory the latest alloca	~	ncept searches f	for a free block, starting from		
	\square First Fit	\square Next Fit	\square Best fit	\square Random		
9.	Which memory slow?	management co	ncept produces	many mini-fragments and is		
	\square First Fit	\square Next Fit	\square Best fit	\square Random		

Content: Topics of slide set 5 Page 1 of 8

Exercise 2 (Buddy Memory Allocation)

The Buddy method for allocating memory to processes shall be used for a memory with a capacity of 1024 kB. Perform the provided operations and give the occupancy state of the memory after each operation.

	0	128	256	384	512	640	768	896	1024
Initial state					1024 KB				
65 KB request => A									
30 KB request => B									
90 KB request => C									
34 KB request => D									
130 KB request => E									
Free C									
Free B									
275 KB request => F									
145 KB request => G									
Free D									
Free A									
Free G									
Free E									

Exercise 3 (Real Mode and Protected Mode)

- 1. Describe the functioning of the real mode.
- 2. Why is it impossible to use real mode for multitasking operation mode?
- 3. Describe the functioning of the protected mode.
- 4. What is virtual memory?
- 5. Explain, why virtual memory helps to better utilize the main memory.
- 6. What is mapping?
- 7. What is swapping?
- 8. Which component of the CPU is used to implement virtual memory?
- 9. Describe the function of the component from subtask 8.
- 10. Name a virtual memory concept.
- 11. What sort of fragmentation does occur with the concept of subtask 10?
- 12. What causes a page fault exception to occur?

- 13. What is the reaction of the operating system, when a page fault exception occurs?
- 14. What causes an access violation exception or general protection fault exception to occur?
- 15. What is the consequence (effect) of an access violation exception or general protection fault exception?
- 16. What contains the kernelspace?
- 17. What contains the userspace?

Exercise 4 (Memory Management)

Please mark for each one of the following statements, whether the statement is true or false.

1.	Real mode is	suited for multitasking systems.
	\square True	☐ False
2.	-	mode, each process is executed in its own copy of the physical which is protected from other processes.
	\square True	☐ False
3.	When static p	partitioning is used, internal fragmentation occurs.
	\square True	☐ False
4.	When dynami	c partitioning is used, external fragmentation cannot occur.
	\square True	☐ False
5.	With paging,	all pages have the same length.
	\square True	☐ False
6.	One advantag	e of long pages is little internal fragmentation.
	\square True	☐ False
7.	A drawback o	f short pages is that the page table gets bigger.
	\square True	☐ False
8.	When paging physical memory	is used, the MMU translates the logical memory addresses into ory addresses.

Content: Topics of slide set 5

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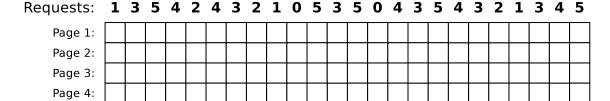
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	\square True	☐ False
9.	Modern opera paging.	ting systems (for x86) operate in protected mode and use only
	\square True	☐ False

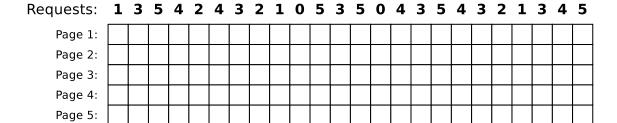
Exercise 5 (Page Replacement Strategies)

- 1. Why is it impossible to implement the optimal replacement strategy OPT?
- 2. Perform the access sequence with the replacement strategies Optimal, LRU, LFU and FIFO once with a cache with a capacity of 4 pages and once with 5 pages. Also calculate the hit rate and the miss rate for all scenarios.

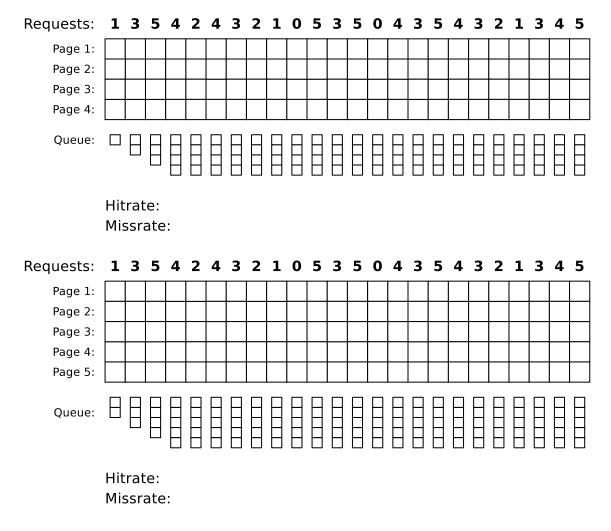
Optimal replacement strategy (OPT):



Hit rate: Miss rate:

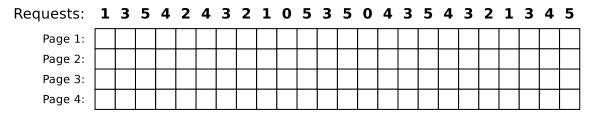


Hit rate: Miss rate: Replacement strategy Least Recently Used (LRU):



Content: Topics of slide set 5 Page 5 of 8

Replacement strategy Least Frequently Used (LFU):



Hit rate: Miss rate:

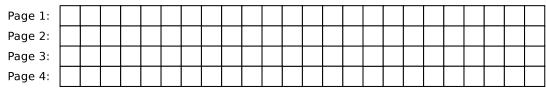
1 3 5 4 2 4 3 2 1 0 5 3 5 0 4 3 5 4 3 2 1 3 4 5 Requests: Page 1: Page 2:

Page 3: Page 4: Page 5:

> Hit rate: Miss rate:

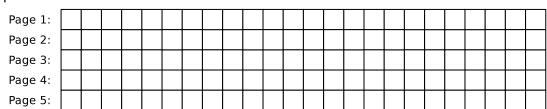
Replacement strategy FIFO:

Requests: 1 3 5 4 2 4 3 2 1 0 5 3 5 0 4 3 5 4 3 2 1 3 4 5



Hit rate: Miss rate:

1 3 5 4 2 4 3 2 1 0 5 3 5 0 4 3 5 4 3 2 1 3 4 5 Requests:



Hit rate: Miss rate:

3. What is the key message of Laszlo Belady's anomaly?

Content: Topics of slide set 5 Page 6 of 8 4. Show Belady's anomaly by performing the access sequence with the replacement strategy FIFO once with a cache with a capacity of 3 pages and once with 4 pages. Also calculate the hit rate and the miss rate for both scenarios.

Hit rate:

Miss rate:

Requests: 3 2 1 0 3 2 4 3 2 1 0 4

Hit rate:

Miss rate:

Exercise 6 (Time-based Command Execution, Sorting, Environment Variables)

1. Create in your home directory a directory NotImportant and write a cron job, which erases the content of the directory NotImportant every Tuesday at 1:25 clock am.

The output of the command should be appended to a file EraseLog.txt in your home directory.

2. Write a cron job, which appends a line at a file Datum.txt with the following format (but with the current values) every 3 minutes between 14:00 to 15:00 clock on every Tuesday in the month of November:

3. Write an at-job, which outputs at 17:23 today a list of the running processes.

```
You may have to install the command line tool at first.
With Debian/Ubuntu this works with:
$ sudo apt update && sudo apt install at
With CentOS/Fedora/RedHat this works with:
$ sudo yum install at
```

- 4. Write an at-job, which outputs at December 24th at 8:15 am the text "It's christmas!"
- 5. Create in your home directory a file Kanzler.txt with the following content:

Willy	Brandt	1969
Angela	Merkel	2005
Gerhard	Schröder	1998
KurtGeorg	Kiesinger	1966
Helmut	Kohl	1982
Konrad	Adenauer	1949
Helmut	Schmidt	1974
Ludwig	Erhard	1963

- 6. Print out the file Kanzler.txt sorted by the first names.
- 7. Print out the file Kanzler.txt sorted by the third letter of the last names.
- 8. Print out the file Kanzler.txt sorted by the year of the inauguration.
- 9. Print out the file Kanzler.txt backward reverse sorted by the year of the inauguration and redirect the output into a file Kanzlerdaten.txt.
- 10. Create with the command export an environment variable VAR1 and assign it the value Testvariable.
- 11. Print out the value of VAR1 in the shell.
- 12. Erase the environment variable VAR1.