Exercise Sheet 5

Exercise 1 (Memory Management)

1.	1. Mark memory management methods that cause internal fragmentation to cur.									
	☐ Static partiti	ioning \square Dynan	nic partitioning	\square Buddy memory allocation						
2.	Mark memory management methods that cause external fragmentation to occur.									
	☐ Static partiti	ioning Dynan	nic partitioning	\square Buddy memory allocation						
3.	Explain how external fragmentation can be fixed.									
4.	. Mark the memory management method that searches in the entire address space for the block, which fits best to satisfy the request.									
	\square First Fit	☐ Next Fit	\square Best fit	\square Random						
5.	6. Mark the memory management concept that searches for the first free block that satisfies the request, starting from the beginning of the address space.									
	\square First Fit	☐ Next Fit	\square Best fit	\square Random						
6.		ory management the end of the a	-	agments quickly the large area						
	\square First Fit	\square Next Fit	\square Best fit	☐ Random						
7.	Mark the memory propriate block		concept that se	elects randomly a free and ap-						
	☐ First Fit	\square Next Fit	\square Best fit	\square Random						
8.	. Mark the memory management concept that searches for a free block, starting from the latest allocation.									
	\square First Fit	\square Next Fit	\square Best fit	☐ Random						
9.	Mark the memorand is slow.	ory management	concept that p	produces many mini-fragments						
	☐ First Fit	☐ Next Fit	\square Best fit	Random						

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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. Explain why it is impossible to use real mode for multitasking operation mode.
- 3. Describe the functioning of the protected mode.
- 4. Describe what virtual memory is.
- 5. Explain, why virtual memory helps to better utilize the main memory.
- 6. Describe what mapping is.
- 7. Describe what swapping is.
- 8. Name the component of the CPU that is used to implement virtual memory.
- 9. Describe the function of the component from subtask 8.
- 10. Name a virtual memory concept.
- 11. Name the sort of fragmentation that does occur with the concept of subtask 10.
- 12. Explain the purpose of the Page-Table Base Register (PTBS).

- 13. Explain the purpose of the Page-Table Length Register (PTLR).
- 14. Explain the event that causes a page fault exception.
- 15. Describe the reaction of the operating system when a page fault exception occurs.
- 16. Explain what an access violation exception or general protection fault exception causes to occur.
- 17. Describe the consequence (effect) of an access violation exception or general protection fault exception.
- 18. Describe the content of the kernelspace.
- 19. Describe the content of 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	\square False
2.	-	mode, each process is executed in its own copy of the physical which is protected from other processes.
	\square True	\square False
3.	When static p	partitioning is used, internal fragmentation occurs.
	\square True	\square False
4.	When dynami	c partitioning is used, external fragmentation cannot occur.
	\square True	\square False
5.	With paging,	all pages have the same length.
	\square True	\square False
6.	One advantag	e of long pages is little internal fragmentation.
	\square True	\square False
7.	A drawback o	f short pages is that the page table gets bigger.
	\square True	\square False

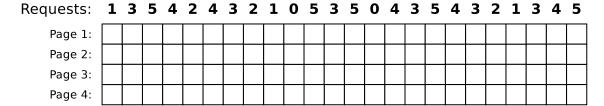
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8.	When paging is used, the MMU translates the logical memory addresses into physical memory addresses.					
	\square True	\square False				
9.	Modern paging.	operating systems (for x86) operate in protected mode and use only				
	\square True	\square 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:

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

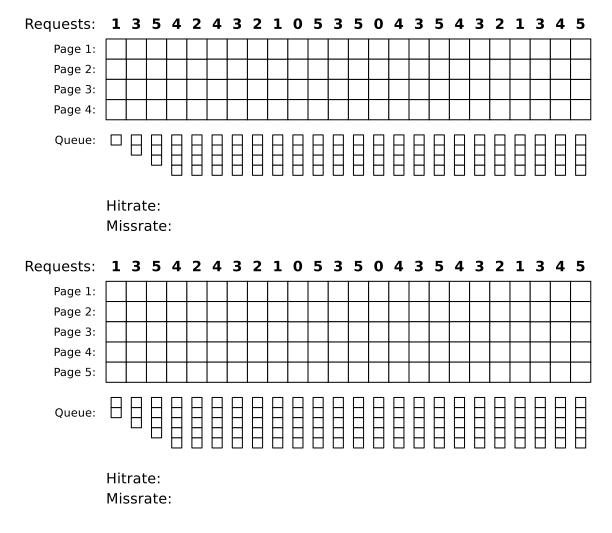
Page 1: Page 2:

 Page 3:
 | | | | | | |

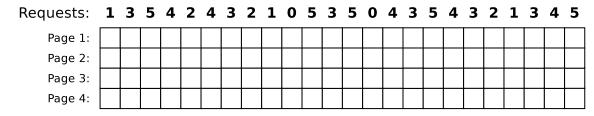
 Page 4:
 | | | | | |

 Page 5:
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Hit rate: Miss rate: Replacement strategy Least Recently Used (LRU):



Replacement strategy Least Frequently Used (LFU):



Hit rate: Miss rate:

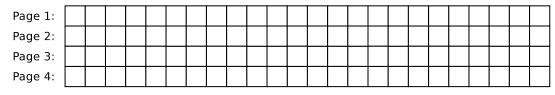
Requests: 1 3 5 4 2 4 3 2 1 0 5 3 5 0 4 3 5 4 3 2 1 3 4 5

Page 5:

Hit rate: Miss rate:

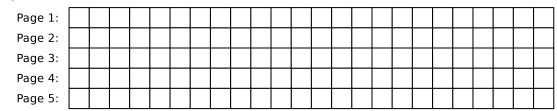
Replacement strategy FIFO:

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:

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

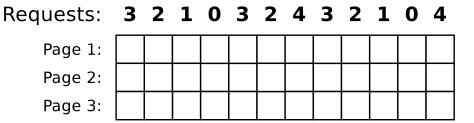


Hit rate: Miss rate:

3. Describe the key message of Laszlo Belady's anomaly.

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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
Page 1:												
Page 2:												
Page 3:												
Page 1.												

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.