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A case study  
In partial fulfillment of the requirements  
for the course Operating Systems

Implementation of the Page Replacement Algorithms  
(FIFO, LRU and Optimal Algorithm)

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<https://github.com/Aron-Arboleda/PageReplacementAlgorithms>

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I. DOCUMENTATION

1. First Sample Input

Reference String: 7,0,1,2,0,3,0,4,2,3,0,3,2,1,2,0,1,7,0,1

Number of Page Frames: 3

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Page Replacement Algorithms

Inputs

Reference String  
7,0,1,2,0,3,0,4,2,3,0,3,2,1,2,0,1,7,0,1

Number of Frames  
3

Calculate

Output

Reference String: 7,0,1,2,0,3,0,4,2,3,0,3,2,1,2,0,1,7,0,1

Number of Frames: 3

First-In-First-Out (FIFO) Algorithm

7	0	1	2	0	3	0	4	2	3	0	3	2	1	2	0	1	7	0	1
7	7	7	2		2	2	4	4	0			0	0				7	7	7
	0	0	0		3	3	3	2	2	2			1	1			1	0	0
		1	1		1	0	0	0	3	3			3	2			2	2	1

Total Page Faults: 15

Optimal Algorithm

7	0	1	2	0	3	0	4	2	3	0	3	2	1	2	0	1	7	0	1
7	7	7	2		2		2		2			2					7		
	0	0	0		0		4			0			0				0		
		1	1		3		3		3			1					1		

Total Page Faults: 9

Least Recently Used (LRU) Algorithm

7	0	1	2	0	3	0	4	2	3	0	3	2	1	2	0	1	7	0	1
7	7	7	2		2		4	4	0				1				1		
	0	0	0		0		0	0	3	3			3		0		0		
		1	1		3		3	2	2	2			2		2		7		

Total Page Faults: 12

Q Analysis

Algorithm	Page Faults
First-In-First-Out (FIFO)	15
Optimal (OPT)	9
Least Recently Used (LRU)	12

Algorithm(s) in this scenario with least total page faults:  
**Optimal Algorithm**

Info about Optimal Algorithm:

- The Optimal Page Replacement Algorithm (OPT) is a theoretical page replacement algorithm that replaces the page that will not be used for the longest period of time in the future.
- It is considered the best page replacement algorithm in terms of page faults, but it is impractical to implement in real systems because it requires future knowledge of page references.
- The optimal algorithm is often used as a benchmark to compare the performance of other page replacement algorithms.

Algorithm	Page Faults
First-In-First-Out (FIFO)	15
Optimal (OPT)	9
Least Recently Used (LRU)	12

Table 1: First Input Results

In this scenario, the Optimal Algorithm had the least page faults. The Least Recently Used (LRU) Algorithm had slightly more page faults, while the First-In-First-Out (FIFO) Algorithm ended up with the most page faults overall.

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2. Second Sample Input

Reference String: 8,0,6,9,8,8,1,6,4,8,1,3,5,3,3,6,8,9,7,3,8

Number of Page Frames: 4

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Inputs

Reference String  
8,0,6,9,8,8,1,6,4,8,1,3,5,3,3,6,8,9,7,3,8

Number of Frames  
4

Calculate

Output

Reference String: 8,0,6,9,8,8,1,6,4,8,1,3,5,3,3,6,8,9,7,3,8

Number of Frames: 4

First-In-First-Out (FIFO) Algorithm

8	0	6	9	8	8	1	6	4	8	1	3	5	3	3	6	8	9	7	3	8
8	8	8	8			1			1			1	5			5		5	3	3
	0	0	0			0		4	4			4	4			6		6	6	8
		6	6			6		6	8			8	8			8		9	9	9
			9			9		9	9			3	3			3		3	7	7

Total Page Faults: 14

Optimal Algorithm

8	0	6	9	8	8	1	6	4	8	1	3	5	3	3	6	8	9	7	3	8
8	8	8	8			8		8			8	8					8	8		
	0	0	0			1		1			3	3					3	3		
		6	6			6		6			6	6					6	7		
			9			9		4			4	5					9	9		

Total Page Faults: 10

Least Recently Used (LRU) Algorithm

8	0	6	9	8	8	1	6	4	8	1	3	5	3	3	6	8	9	7	3	8
8	8	8	8			8		8			8	8				6	6	6	6	3
	0	0	0			1		1			1	1				1	8	8	8	8
		6	6			6		6			3	3				3	3	3	7	7
			9			9		4			4	5				5	5	9	9	9

Total Page Faults: 13

Analysis

Algorithm	Page Faults
First-In-First-Out (FIFO)	14
Optimal (OPT)	10
Least Recently Used (LRU)	13

Algorithm(s) in this scenario with least total page faults:

Optimal Algorithm

Info about Optimal Algorithm:

- The Optimal Page Replacement Algorithm (OPT) is a theoretical page replacement algorithm that replaces the page that will not be used for the longest period of time in the future.
- It is considered the best page replacement algorithm in terms of page faults, but it is impractical to implement in real systems because it requires future knowledge of page references.
- The optimal algorithm is often used as a benchmark to compare the performance of other page replacement algorithms.

Algorithm	Page Faults
First-In-First-Out (FIFO)	14
Optimal (OPT)	10
Least Recently Used (LRU)	13

Table 2: Second Input Results

In this scenario, the Optimal Algorithm had the least page faults again. The Least Recently Used (LRU) Algorithm comes in second, and the First-In-First-Out (FIFO) Algorithm had the largest total of page faults.



3. Third Sample Input

Reference String: 0,6,4,1,7,0,6,6,8,4,8,7,8,0,9,8,7,7,4,5,7,3,0,4

Number of Page Frames: 5

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Page Replacement Algorithms

Inputs

Reference String  
0,6,4,1,7,0,6,6,8,4,8,7,8,0,9,8,7,7,4,5,7,3,0,4

Number of Frames  
5

Calculate

Output

Reference String: 0,6,4,1,7,0,6,6,8,4,8,7,8,0,9,8,7,7,4,5,7,3,0,4

Number of Frames: 5

First-In-First-Out (FIFO) Algorithm

0	6	4	1	7	0	6	6	8	4	8	7	8	0	9	8	7	7	4	5	7	3	0	4
0	0	0	0	0				8					8	8			8	8	7	7	7		
	6	6	6	6				6					0	0			0	0	0	3	3		
		4	4	4				4					4	9			9	9	9	0			
			1	1				1					1	1			4	4	4	4	4		
								7					7	7			7	5	5	5	5		

Total Page Faults: 13

Optimal Algorithm

0	6	4	1	7	0	6	6	8	4	8	7	8	0	9	8	7	7	4	5	7	3	0	4
0	0	0	0	0				0					0				0		0	8			
	6	6	6	6				8					8				8		8				
		4	4	4				4					4				4		4				
			1	1				1					9				5		3				
								7					7				7		7				

Total Page Faults: 9

Least Recently Used (LRU) Algorithm

0	6	4	1	7	0	6	6	8	4	8	7	8	0	9	8	7	7	4	5	7	3	0	4
0	0	0	0	0				0	0				0				5		5	5			
	6	6	6	6				6	6				9				9		3	3			
		4	4	4				8	8				8				8		8	0			
			1	1				1	4				4				4		4	4	4		
								7	7	7			7				7		7	7			

Total Page Faults: 11

Q Analysis

Algorithm	Page Faults
First-In-First-Out (FIFO)	13
Optimal (OPT)	9
Least Recently Used (LRU)	11

Algorithm(s) in this scenario with least total page faults:

Optimal Algorithm

Info about Optimal Algorithm:

- The Optimal Page Replacement Algorithm (OPT) is a theoretical page replacement algorithm that replaces the page that will not be used for the longest period of time in the future.
- It is considered the best page replacement algorithm in terms of page faults, but it is impractical to implement in real systems because it requires future knowledge of page references.
- The optimal algorithm is often used as a benchmark to compare the performance of other page replacement algorithms.

Algorithm	Page Faults
First-In-First-Out (FIFO)	13
Optimal (OPT)	9
Least Recently Used (LRU)	11

Table 3: Third Input Results

In the third scenario, the Optimal Algorithm wins with the least number of page faults (9). The Least Recently Used (LRU) Algorithm comes next with 11 total page faults, and the First-In-First-Out (FIFO) Algorithm comes in last with 13 total page faults.

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