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USCSP301-USCS303: Operating System(OS) Practical-09

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Practical – 09: Page Replacement Algorithm: LRU

- **Content:**
  - In LRU page replacement algorithm, the page that has not been used for the longest period of the time is chosen and replaced.
- **Process:**
  - Implement LRU Algorithm and find out page hits and page faults.
- **Prior Knowledge:**
  - Page Replacement Algorithm.

Page Replacement Algorithm

- In demand paging memory management technique, if a page demanded for execution is not present in main memory, then a page fault occurs.
- To load the page in demand into main memory, a free page frame is searched in main memory and allocated.
- If no page frame is free, memory manager has to free a frame by swapping its contents to secondary storage and thus make room for the required page.
- To swap pages, many schemes or strategies are used.

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Least Recently Used (LRU)

- The **Least Recently used (LRU) algorithm** replaces the page that has not been used for the longest period of time.
- It is based on the observation that pages that have not been used for long time will probably remain unused for the longest time and are to be replaced.

Example

- Apply the LRU replacement algorithm for the following page-reference strings: 7,0,1,2,0,3,0,4,2,3,0,3,2.
- Indicate the number paging with four frames.
- Find the number of hits, number of faults and hit ratio.

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

Demand Paging or Number of Frames: 4

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

7	0	1	2	0	3	0	4	2	3	0	3	2
✗	✗	✗	✗	✓	✗	✓	✗	✓	✓	✓	✓	✓

Number of Hits: count of no replacements = 7 ✓

Number of Faults: count of replacements = 6 ✗

Hit Ratio: Number of Hits/Len(Ref String) = 7/13 = 0.53846157

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Question:

Write a Java program that implements the LRU page-replacement algorithm.

Source Code:

```
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//BATCH: B1

//PRN: 2020016400773862

//DATE: 30th  Aug, 2021

//PRAC-08: PAGE REPLACEMENT ALGORITHM


import java.io.*;

import java.util.*;

public class P8_PR_FIFO_SS

{

  public static void main(String[] args) throws IOException

 {

  Scanner scan = new Scanner(System.in);

  int frames, pointer = 0, hit =0, fault = 0, ref_len;

  int buffer[];

  int reference[];

  int mem_layout[][];

  System.out.print("Please enter the number of Frames: ");

  frames = scan.nextInt();

  System.out.print("Please enter the length of the Reference string: ");

  ref_len = scan.nextInt();
```

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```
 reference = new int[ref_len];
 mem_layout = new int[ref_len][frames];
 buffer = new int[frames];
 for(int j = 0; j<frames; j++)
  buffer[j] = -1;
System.out.println("Please enter the reference string: ");
for(int i=0; i<ref_len; i++)
{
 reference[i] = scan.nextInt();
}
System.out.println();
for(int i=0; i< ref_len; i++)
{
 int search =-1;
for(int j=0; j<frames; j++)
{
if(buffer[j] ==reference[i])
{
 search = j;
 hit++;
break;
}
}
if (search==-1)
```

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```
{
  buffer[pointer]= reference[i];
  fault++;
  pointer++;
  if(pointer==frames)
    pointer = 0;
 }
for(int j=0; j<frames; j++)
  mem_layout[i][j]=buffer[j];
}
for(int i=0; i<frames; i++)
 {
  for(int j =0; j<ref_len; j++)
   System.out.printf("%3d" , mem_layout[j][i]);
 System.out.println();
}
System.out.println("The number of Hits: "+hit);
System.out.println("Hit Ratio: " +(float)((float)hit/ref_len));
System.out.println("The number of Faults: "+fault);
}
}
```

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Input:

```
Please enter the number of Frames: 4
Please enter the length of the Reference string: 13
Please enter the reference string:
7 0 1 2 0 3 0 4 2 3 0 3 2
```

Output:

```
  7  7  7  7  7  3  3  3  3  3  3  3  3
 -1  0  0  0  0  0  0  0  0  0  0  0  0
 -1 -1  1  1  1  1  4  4  4  4  4  4  4
 -1 -1 -1  2  2  2  2  2  2  2  2  2  2
The number of Hits: 7
Hit Ratio: 0.53846157
Thne number of Faults: 6
```

Sample Output – 01:

```
D:\OS Pract\Batch 01\USCSP301_USCS303_OS\Prac_09_SS_30_08_2021>javac P9_PR_LRU_S
S.java

D:\OS Pract\Batch 01\USCSP301_USCS303_OS\Prac_09_SS_30_08_2021>java P9_PR_LRU_SS

Please enter the number of Frames: 4
Please enter the length of the Reference string: 13
Please enter the reference string:
7 0 1 2 0 3 0 4 2 3 0 3 2

  7  7  7  7  7  3  3  3  3  3  3  3  3
 -1  0  0  0  0  0  0  0  0  0  0  0  0
 -1 -1  1  1  1  1  1  4  4  4  4  4  4
 -1 -1 -1  2  2  2  2  2  2  2  2  2  2
The number of Hits: 7
Hit Ratio: 0.53846157
Thne number of Faults: 6

D:\OS Pract\Batch 01\USCSP301_USCS303_OS\Prac_09_SS_30_08_2021>
```

Sample Output – 02:

```
D:\OS Pract\Batch 01\USCSP301_USCS303_OS\Prac_09_SS_30_08_2021>java P9_PR_LRU_SS

Please enter the number of Frames: 3
Please enter the length of the Reference string: 7
Please enter the reference string:
1 3 0 3 5 6 3

  1  1  1  1  5  5  5
 -1  3  3  3  3  3  3
 -1 -1  0  0  0  6  6
The number of Hits: 2
Hit Ratio: 0.2857143
Thne number of Faults: 5
```

Sample Output – 03:

```
D:\OS Pract\Batch 01\USCSP301_USCS303_OS\Prac_09_SS_30_08_2021>java P9_PR_LRU_SS

Please enter the number of Frames: 3
Please enter the length of the Reference string: 20
Please enter the reference string:
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  4  4  4  0  0  0  1  1  1  1  1  1  1
 -1  0  0  0  0  0  0  0  0  3  3  3  3  3  3  0  0  0  0  0
 -1 -1  1  1  1  3  3  3  2  2  2  2  2  2  2  2  2  7  7  7
The number of Hits: 8
Hit Ratio: 0.4
Thne number of Faults: 12
```

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