# 第 10 次作业

## Log Creative

## 2021 年 6 月 15 日

**10.5** Consider the page table for a system with 12-bit virtual and physical addresses and 256-byte pages.

| Page | Page Frame |
|------|------------|
| 0 | - |
| 1 | 2 |
| 2 | C |
| 3 | A |
| 4 | - |
| 5 | 4 |
| 6 | 3 |
| 7 | - |
| 8 | B |
| 9 | 0 |

The list of free page frames is $D, E, F$ (that is, $D$ is at the head of the list, $E$ is second, and $F$ is last). A dash for a page frame indicates that thepage is not in memory.

Convert the following virtual addresses to their equivalent physical addresses in hexadecimal. All numbers are given in hexadecimal.

- 9EF
- 111
- 700
- 0FF

**解**. $256\text{B} = 2^8\text{B}$，所以第一个十六进制位为虚拟页码。

- 9EF → 0EF
- 111 → 211
- 700 → D00 缺页错误，需要引入新的 D 帧。
- 0FF → EFF 缺页错误，需要按照顺序引入 E 帧。

**10.7** Consider the two-dimensional array A:

$$\mathrm{int}\ A[\,]\,[\,]\ =\ \mathrm{new}\ \mathrm{int}\,[\,1\,0\,0\,]\,[\,1\,0\,0\,];$$

where `A[0][0]` is at location 200 in a paged memory system with pages of size 200. A small process that manipulates the matrix resides in page0 (locations 0 to 199). Thus, every instruction fetch will be from page 0.

For three page frames, how many page faults are generated by the following array-initialization loops? Use LRU replacement, and assume that page frame 1 contains the process and the other two are initially empty.

a.
```
for (int j = 0; j < 100; j++)
    for (int i = 0; i < 100; i++)
        A[i][j] = 0;
```

b.
```
for (int i = 0; i < 100; i++)
    for (int j = 0; j < 100; j++)
        A[i][j] = 0;
```

解.

1. $10000/2 = 5000$ 由于页大小是200，所以相邻的两次访问是在同一页的。因为只有两个可用页帧，所以每两次都会导致缺页错误，LRU 在这里会替换最先进入的，100次访问才会访问同一行，大于页帧数 2。

2. $100/2 = 50$ 因为按照行访问都在页帧内，所以100次内不会出现缺页错误。由于一页可以存储2行，所以两行内不会出现缺页错误。

**10.8** Consider the following page reference string:

$$1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6$$

How many page faults would occur for the following replacement algorithms, assuming one, two, three, four, five, six, and seven frames?Remember that all frames are initially empty, so your first unique pages will cost one fault each.

- LRU replacement
- FIFO replacement
- Optimal replacement

解.

| Method | one | two | three | four | five | six | seven |
|---|---|---|---|---|---|---|---|
| LRU | 20 | 18 | 15 | 10 | 8 | 7 | 7 |
| FIFO | 20 | 18 | 16 | 14 | 10 | 10 | 7 |
| Optimal | 20 | 15 | 11 | 8 | 7 | 7 | 7 |

**10.9** Consider the following page reference string:

$$7, 2, 3, 1, 2, 5, 3, 4, 6, 7, 7, 1, 0, 5, 4, 6, 2, 3, 0 , 1$$

Assuming demand paging with three frames, how many page faults would occur for the following replacement algorithms?

- LRU replacement
- FIFO replacement
- Optimal replacement

解.

- LRU 共 18 次。

  | 7 | | 1 | | | 3 | | 7 | 7 | | 5 | | 2 | | 1 |
  |---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
  | | 2 | | | 2 | | 4 | | | 1 | | 4 | | 3 | |
  | | | 3 | 5 | | | 6 | | | 0 | | 6 | | 0 | |

- FIFO 共 17 次。

  | 7 | | 1 | | | 4 | | | 1 | | 4 | | 3 | |
  |---|---|---|---|---|---|---|---|---|---|---|---|---|---|
  | | 2 | | 2 | 5 | | 6 | | | 0 | | 6 | | 0 |
  | | | 3 | | 3 | | 7 | 7 | | 5 | | 2 | | 1 |

- Optimal 共 13 次。

  | 7 | | 1 | | | | | | 1 | | | | | | 1 |
  |---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
  | | 2 | | 2 | 5 | | | | | 5 | 4 | 6 | 2 | 3 | |
  | | | 3 | 3 | 4 | 6 | 7 | 7 | | 0 | | | | 0 | |