操作系统作业五

姓名范翔宇，学号 PB18000006

1. Explain the following terms：
   Segmentation fault
   TLB
   Page fault
   Demand paging
   Thrashing

答：Segmentation fault：当访问不允许访问的内存时，操作系统会返回一个错误，这个错误就称为分段错误；

TLB：Translation lookaside buffer即转译后备缓冲器，是一个内存管理单元用于改进虚拟地址到物理地址转换速度的缓存，里面存放的是一些页表文件,文件记录了虚拟地址到物理地址的转换表。如果没有TLB，则每次取数据都需要两次访问内存，即查页表获得物理地址和取数据；

Page fault：页错误指的是当试图访问已映射在虚拟地址空间中，但是目前并未被加载在物理内存中的一个分页时，由中央处理器的内存管理单元所发出的中断；

Demand paging：内存不会立即被分配，操作系统仅说已分配内存，直到访问它才会真正分配，这就是按需分配；

Thrashing：如果一个进程没有足够的物理页框，那么会导致频繁的页错误，替换马上会需要再次使用的页面，这称为颠簸，会花费比执行更多的时间

2. Consider a paging system with the page table stored in memory.
   a. If a memory reference takes 50 nanoseconds, how long does a paged memory reference take?
   b. If we add TLBs, and 75 percent of all page-table references are found in the TLBs, what is the effective memory reference time? (Assume that finding a page-table entry in the TLBs takes 2 nanoseconds, if the entry is present.)

答：a.100ns。页表在内存中，也就是说需要50ns的时间；而从页表中找到物理地址后，再去找到数据，又需要访问一次内存，也就是需要50ns的时间，总共为50+50=100ns。

b.如果TLB命中，就只需要一次内存访问的时间，50ns；如果TLB不命中，那么需要对页表进行访问，再通过物理地址去找数据，需要100ns，此时，我们可以得到公式：$50 \times 75\% + 100 \times 25\% = 62.5ns$。

3. Assume a program has just referenced an address in virtual memory. Describe a scenario how each of the following can occur: (If a scenario cannot occur, explain why.)
   - TLB miss with no page fault
   - TLB miss and page fault
   - TLB hit and no page fault
   - TLB hit and page fault

答：TLB miss with no page fault: page has been brought into memory, but has been removed from the TLB；

TLB miss and page fault: page fault has occurred；

TLB hit and no page fault: page is in memory and in the TLB. Most likely a recent reference；

TLB hit and page fault cannot occur.The TLB is a cache of the page table.If an entry is not in the page table, it will not be in the TLB.

4. Assume we have a demand-paged memory. The page table is held in registers. It takes 8 milliseconds to service a page fault if an empty page is available or the replaced page is not modified, and 20 milliseconds if the replaced page is modified. Memory access time is 100 nanoseconds. Assume that the page to be replaced is modified 70 percent of the time. What is the maximum acceptable page-fault rate for an effective access time of no more than 200 nanoseconds?

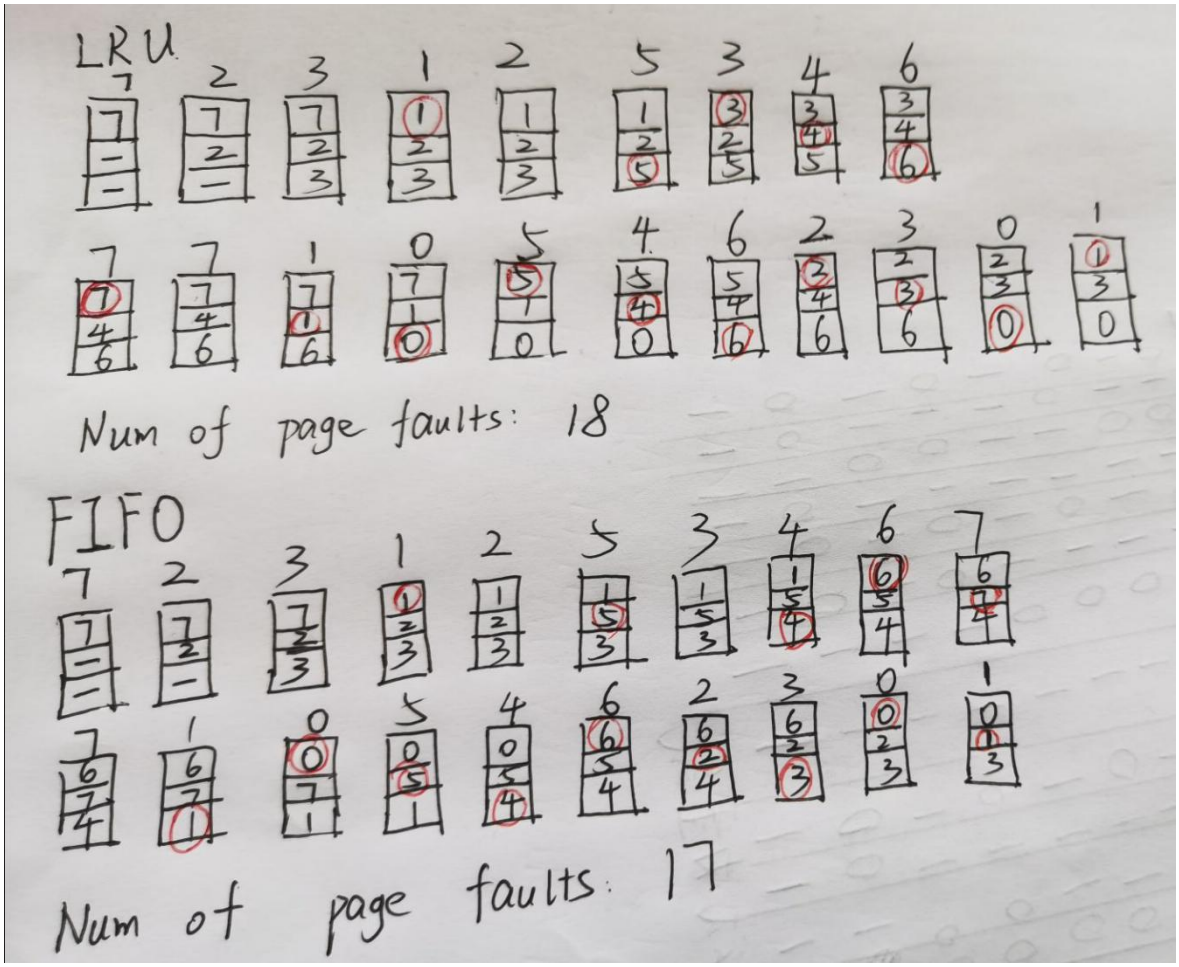
答：如果用p表示缺页率，则有效访问时间不超过0.2μs可表示为：$(1 - p) \times 0.1$

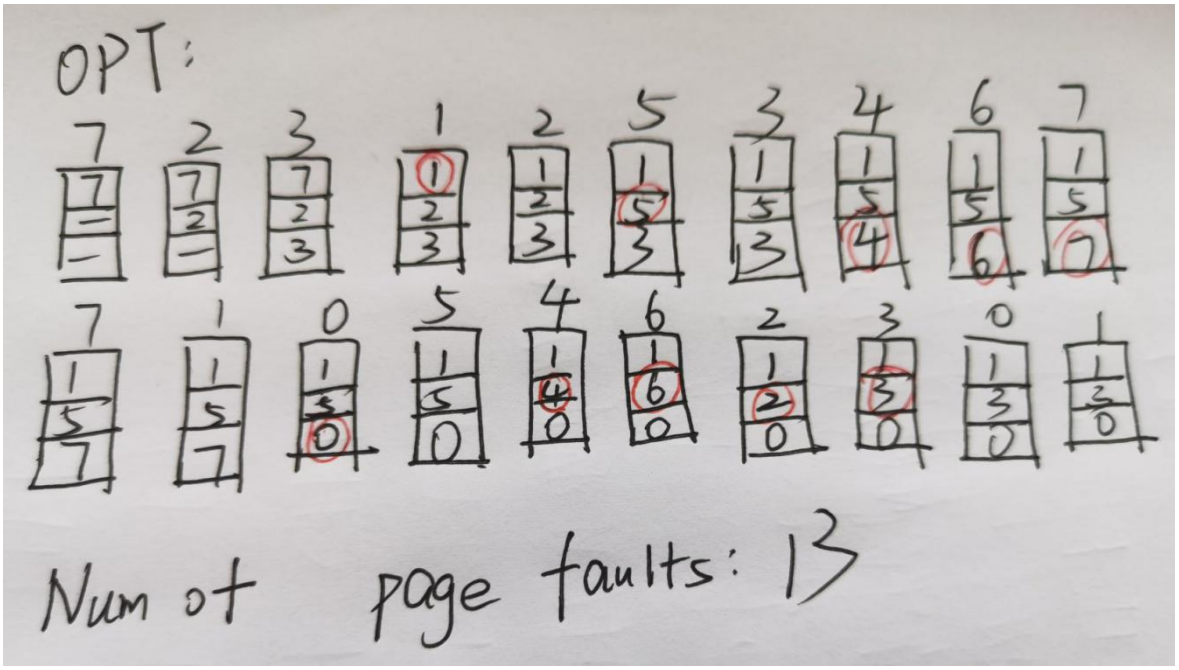
＋ p × (0.7 × 20000 ＋ 0.3 × 8000) ≤ 0.2 因此可计算出： p ≤ 1 / 16400 ≈ 0.000006.

5. 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

答：（图在下一页）





6. Suppose that a disk drive has 5,000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 2150, and the previous request was at cylinder 1805. The queue of pending requests, in FIFO order, is: 2069, 1212, 2296, 2800, 544, 1618, 356, 1523, 4965, 3681 Starting from the current head position, what is the total distance (in cylinders) that the disk armmoves to satisfy all the pending requests for each of the following disk-scheduling algorithms?
   a. FCFS
   b. SSTF
   c. SCAN
   d. LOOK
   e. C-SCAN
   f. C-LOOK

答：a.FCFS：2150, 2069, 1212, 2296, 2800, 544, 1618, 356, 1523, 4965, 3681.

total seek distance is 13011.

b.SSTF：2150, 2069, 2296, 2800, 3681, 4965, 1618, 1523, 1212, 544, 356.

total seek distance is 7586.

c.SCAN：2150, 2296, 2800, 3681, 4965, (4999), 2069, 1618, 1523, 1212, 544, 356.Suppose the head is moving from 2150 to 4999.total seek distance is 7492.

d.LOOK：2150, 2296, 2800, 3681, 4965, 2069, 1618, 1523, 1212, 544, 356.

total seek distance is 7424.

e.C-SCAN： 2150, 2296, 2800, 3681, 4965, (4999), (0), 356, 544, 1212, 1523 ,1618, 2069.total seek distance is 9917.

f.C-LOOK：2150, 2296, 2800, 3681, 4965, 356, 544, 1212, 1523 ,1618, 2069.

total seek distance is 9137.