操作系统作业 4

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问题 1.

Segmentation Fault When you access a memory that is not allowed (e.g., write to read-only segments and access unused or unallocated segments), the OS returns you segmentation fault.

TLB The TLB is a special, small, fast-lookup hardware called translation look-aside buffer. It is associative, high-speed memory. It is used to boost the performance of page table.

Page Fault If a page marked invalid is accessed, the CPU generates an interrupt called page fault, causing the page fault handling routine to be called.

Demand Paging Demand paging is a technique that pages are loaded only as they are needed.

问题 2.

Thrashing refers to an instance of high paging activity. A process is thrashing means it is spending more time paging than executing. It results in severe performance problem.

When the total demand for frames is greater than the total number of available frames, thrashing will occur, because some processes will not have enough frames. Thus, the process will replace pages that will be needed again right away, causing frequent page faults.

问题 3.

(a) It takes $50 + 50 = 100$ nanoseconds.

(b) The effective memory reference time is $75\% \times (2 + 50) + 25\% \times 100 = 64$ nanoseconds.

问题 4.

TLB miss with no page fault The page is in the memory but the page table entry is not cached in the TLB.

TLB miss and page fault The page is not in the memory and of course the page table entry is not cached in the TLB.

TLB hit and no page fault The page is in the memory and the page table entry is cached in the TLB.

TLB hit and page fault It cannot occur, since if the page table entry is cached in the TLB, the page must be in the memory, causing no page fault.

问题 5.

Assume the page fault rate is p, the effective access time is

$$(1-p)\times 100\text{ns} + p \times (30\% \times 8\text{ms} + 70\% \times 20\text{ms}) = (100 + 16399900p)\text{ns} \le 200\text{ns}$$

Which means the maximum acceptable page-fault rate is

$$\max p = \frac{1}{163999} \approx 6.098 \times 10^{-6}$$

问题 6.

The execution of each algorithm is shown in the tables below. The cell with a '-' represents an empty page. And the cell with a boxed number represents a page replacement, i.e., a page fault.

表 1: LRU algorithm

Page reference	7	2	3	1	2	5	3	4	6	7	7	1	0	5	4	6	2	3	0	1
Page #1	$\boxed{7}$	7	7	$\boxed{1}$	1	1	$\boxed{3}$	3	3	$\boxed{7}$	7	7	7	$\boxed{5}$	5	5	$\boxed{2}$	2	2	$\boxed{1}$
Page #2	-	$\boxed{2}$	2	2	2	2	2	$\boxed{4}$	4	4	4	$\boxed{1}$	1	1	$\boxed{4}$	4	4	$\boxed{3}$	3	3
Page #3	-	-	$\boxed{3}$	3	3	$\boxed{5}$	5	5	$\boxed{6}$	6	6	6	$\boxed{0}$	0	0	$\boxed{6}$	6	6	$\boxed{0}$	0

表 2: FIFO algorithm

Page reference	7	2	3	1	2	5	3	4	6	7	7	1	0	5	4	6	2	3	0	1
Page #1	$\boxed{7}$	7	7	$\boxed{1}$	1	1	1	1	$\boxed{6}$	6	6	6	$\boxed{0}$	0	0	$\boxed{6}$	6	6	$\boxed{0}$	0
Page #2	-	$\boxed{2}$	2	2	2	$\boxed{5}$	5	5	5	$\boxed{7}$	7	7	7	$\boxed{5}$	5	5	$\boxed{2}$	2	2	$\boxed{1}$
Page #3	-	-	$\boxed{3}$	3	3	3	3	$\boxed{4}$	4	4	4	$\boxed{1}$	1	1	$\boxed{4}$	4	4	$\boxed{3}$	3	3

表 3: Optimal algorithm

Page reference	7	2	3	1	2	5	3	4	6	7	7	1	0	5	4	6	2	3	0	1
Page #1	$\boxed{7}$	7	7	$\boxed{1}$	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Page #2	-	$\boxed{2}$	2	2	2	$\boxed{5}$	5	5	5	5	5	5	5	5	$\boxed{4}$	$\boxed{6}$	$\boxed{2}$	$\boxed{3}$	3	3
Page #3	-	-	$\boxed{3}$	3	3	3	3	$\boxed{4}$	$\boxed{6}$	$\boxed{7}$	7	7	$\boxed{0}$	0	0	0	0	0	0	0

The number of page fault is:

LRU 18 page faults.

FIFO 17 page faults.

Optimal 13 page faults.

问题 7.

The Belady's anomaly is: for some page-replacement algorithms, the page fault rate may increase as the number of frames increases.

The feature of stack algorithms which never exhibit is: the set of pages in memory for n frames is always a subset of the set of pages in memory for $n+1$ frames.