OS_Assignment10

Assign	
tag	homework
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1. Consider the following C program:

```
int    X[N];
int step = M;      /* M is some predefined constant */
for (int i = 0; i < N; i += step) X[i] = X[i] + 1;
```

(a) If this program is run on a machine with a 4-KB page size and 64-entry TLB, what values of *M* and *N* will cause a TLB miss for every execution of the inner loop?
(b) Would your answer in part (a) be different if the loop were repeated many times? Explain.

a. 由于是要在**每次**inner loop中产生miss，因此其与循环的次数N没有关系
   - 对于4-KB大小的页表，一页中能存储1K个int类型的数据
   - 也就是说，如果要保证每次都跨页，则应确保每次对数组下标增加的数值大于1K
   - 即M至少为1024

b. M同上

   考虑到TLB有64项，若TLB替换采取随机算法，则不能保证每次都TLBmiss。若TLB替换采取LRU算法，则需要N ≥ 64*M（其中1个TLB项存放代码所在的页表项）。

2. Suppose that a machine has 48-bit virtual addresses and 32-bit physical addresses.

(a) If pages are 4 KB, how many entries are in the page table if it has only a single level? Explain.
(b) Suppose this same system has a TLB (Translation Lookaside Buffer) with 32 entries. Furthermore, suppose that a program contains instructions that fit into one page and it sequentially reads long integer elements from an array that spans thousands of pages. How effective will the TLB be for this case?

a. 4KB为2^{12}，即12位，而虚存地址为48位，故有$2^{48-12} = 2^{36}$个页表项

b. 程序代码页面只在刚开始时换入TLB。设长整型为4B，则每访问1K个数据会发生一次TLBmiss。

3. A computer whose processes have 1024 pages in their address spaces keeps its page tables in memory. The overhead required for reading a word from the page table is 5 nsec. To reduce this overhead, the computer has a TLB, which holds 32 (virtual page, physical page frame) pairs, and can do a lookup in 1 nsec. What hit rate is needed to reduce the mean overhead to 2 nsec?

不妨假设命中概率为p，则自然有如下公式：

$$1 \times p + 5 \times (1 - p) < 2$$

故有$p \geq 0.8$

4. A computer has 32-bit virtual addresses and 4-KB pages. The program and data together fit in the lowest page (0–4095) The stack fits in the highest page. How many entries are needed in the page table if traditional (one-level) paging is used? How many page table entries are needed for two-level paging, with 10 bits in each part?

4KB即需要12位，故若为一级页表，则需要1M（20位）个页表项

使用二级页表时，由于每级虚页号分别占用 10 bit，所以一级页表项数为 2^{10} ，代码–数据段与栈 分别占用最低和最高的一页，所以只需记录两个二级页表，即$2^{10} \times 2$项。共有3×2^{10}项