OS_Assignment12

Assign	
tag	homework
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1. We consider a program which has the two segments shown below consisting of instructions in segment 0, and read/write data in segment 1. Segment 0 has read/execute protection, and segment 1 has just read/write protection. The memory system is a demand-paged virtual memory system with virtual addresses that have a 4-bit page number, and a 10-bit offset. The page tables and protection are as follows (all numbers in the table are in decimal):

Segment 0		Segment 1	
Read/Execute		Read/Write	
Virtual Page #	Page frame #	Virtual Page #	Page frame #
0	2	0	On Disk
1	On Disk	1	14
2	11	2	9
3	5	3	6
4	On Disk	4	On Disk
5	On Disk	5	13
6	4	6	8
7	3	7	12

For each of the following cases, either give the real (actual) memory address which results from dynamic address translation or identify the type of fault which occurs (either page or protection fault).

(a) Fetch from segment 1, page 1, offset 3
(b) Store into segment 0, page 0, offset 16
(c) Fetch from segment 1, page 4, offset 28
(d) Jump to location in segment 1, page 3, offset 32

a. 物理页号是14，偏移量是3，故其物理地址为0x3803

b. 段0不可写，因此发生protection fault

c. 第4页在disk上，会发生page fault进行换页

d. 段1不可执行，不能作为跳转目标，因此会发生protection fault

2. 请在 Linux 环境下实现如下功能，提交程序和执行结果:

   a. 申请一个 uint32_t 类型 65536(64K)项的数组(4B * 64K = 256KB, 我们相信各位同学的笔
   记本使用的页大小为 4KB，而没有使用 linux 的大页机制)。

   b. 使用 mprotect 函数对申请的页设置只读。

   c. 连续将数组中随机的 100 项元素设置为 1-100。

   d. 注册 SIGSEGV 信号处理函数，在数据访问发生错误时，让程序继续执行，并且打印
   这 100 次访存的 trace。

   提示: siginfo_t 包含了地址信息

```
#include <unistd.h>
#include <signal.h>
#include <stdio.h>
#include <stdlib.h>
#include <errno.h>
#include <sys/mman.h>
#include <setjmp.h>
#define ARRAYNUM 65536
#define PAGESIZE 4096
jmp_buf env;
static void handler(int sig, siginfo_t * si, void *unused)
{
  printf("Got SIGSEGV at address: 0x%lx\n", (long)si->si_addr);
  longjmp(env, 1);
}

int main()
{
  void *mem_ptr;
  struct sigaction sa;
  sa.sa_flags = SA_SIGINFO;
  sigemptyset(&sa.sa_mask);
  sa.sa_sigaction = handler;
  //task3
  sigaction(SIGSEGV, &sa, NULL);
  //task1
  size_t array_size = ARRAYNUM * sizeof(u_int32_t);
  posix_memalign(&mem_ptr, PAGESIZE, array_size);
  u_int32_t *array = (u_int32_t) mem_ptr;
  //task2
  mprotect(array, array_size, PROT_READ);
  //task4
  for (int i = 1; i <= 100; i++) {
    int pos = rand() % ARRAYNUM;
    if (setjmp(env) == 0) {
      array[pos] = i;
    }
  }
```

```
  free(mem_ptr);
  return 0;
}
```

运行结果为：

```
Got SIGSEGV at address: 0xa51069c
Got SIGSEGV at address: 0xa50ebc4
Got SIGSEGV at address: 0xa52b364
Got SIGSEGV at address: 0xa5030a8
Got SIGSEGV at address: 0xa52de08
Got SIGSEGV at address: 0xa536b20
Got SIGSEGV at address: 0xa523b60
Got SIGSEGV at address: 0xa5027f8
Got SIGSEGV at address: 0xa50bd0c
Got SIGSEGV at address: 0xa501134
Got SIGSEGV at address: 0xa526260
Got SIGSEGV at address: 0xa50f154
Got SIGSEGV at address: 0xa504a30
Got SIGSEGV at address: 0xa536f88
Got SIGSEGV at address: 0xa5352cc
Got SIGSEGV at address: 0xa50dd1c
Got SIGSEGV at address: 0xa50e45c
Got SIGSEGV at address: 0xa510444
Got SIGSEGV at address: 0xa530e60
Got SIGSEGV at address: 0xa512550
Got SIGSEGV at address: 0xa50b8bc
Got SIGSEGV at address: 0xa50ac44
Got SIGSEGV at address: 0xa5258b4
Got SIGSEGV at address: 0xa522c14
Got SIGSEGV at address: 0xa50c960
Got SIGSEGV at address: 0xa519bd4
Got SIGSEGV at address: 0xa5205ac
Got SIGSEGV at address: 0xa527758
Got SIGSEGV at address: 0xa51de20
Got SIGSEGV at address: 0xa52741c
Got SIGSEGV at address: 0xa519264
Got SIGSEGV at address: 0xa52d248
Got SIGSEGV at address: 0xa503d20
Got SIGSEGV at address: 0xa5144cc
Got SIGSEGV at address: 0xa53b988
Got SIGSEGV at address: 0xa525104
Got SIGSEGV at address: 0xa5133cc
Got SIGSEGV at address: 0xa503c34
Got SIGSEGV at address: 0xa51408c
Got SIGSEGV at address: 0xa51ab94
Got SIGSEGV at address: 0xa53e17c
Got SIGSEGV at address: 0xa50d4c0
Got SIGSEGV at address: 0xa508b44
Got SIGSEGV at address: 0xa53db20
Got SIGSEGV at address: 0xa53d7b4
Got SIGSEGV at address: 0xa531584
Got SIGSEGV at address: 0xa51a030
Got SIGSEGV at address: 0xa50552c
Got SIGSEGV at address: 0xa50a408
```

```
Got SIGSEGV at address: 0xa5150d4
Got SIGSEGV at address: 0xa5200e4
Got SIGSEGV at address: 0xa514204
Got SIGSEGV at address: 0xa519210
Got SIGSEGV at address: 0xa5096e0
Got SIGSEGV at address: 0xa519450
Got SIGSEGV at address: 0xa506e88
Got SIGSEGV at address: 0xa50ce70
Got SIGSEGV at address: 0xa519ad0
Got SIGSEGV at address: 0xa53b968
Got SIGSEGV at address: 0xa52499c
Got SIGSEGV at address: 0xa52b0a8
Got SIGSEGV at address: 0xa50d328
Got SIGSEGV at address: 0xa536b94
Got SIGSEGV at address: 0xa504920
Got SIGSEGV at address: 0xa5127a4
Got SIGSEGV at address: 0xa528314
Got SIGSEGV at address: 0xa5017c4
Got SIGSEGV at address: 0xa508ac0
Got SIGSEGV at address: 0xa515b10
Got SIGSEGV at address: 0xa527054
Got SIGSEGV at address: 0xa50ae28
Got SIGSEGV at address: 0xa524794
Got SIGSEGV at address: 0xa51aa6c
Got SIGSEGV at address: 0xa53e134
Got SIGSEGV at address: 0xa530ce4
Got SIGSEGV at address: 0xa53d7d8
Got SIGSEGV at address: 0xa501fdc
Got SIGSEGV at address: 0xa509ba0
Got SIGSEGV at address: 0xa513284
Got SIGSEGV at address: 0xa504014
Got SIGSEGV at address: 0xa53ab4c
Got SIGSEGV at address: 0xa53e3f8
Got SIGSEGV at address: 0xa53cfb4
Got SIGSEGV at address: 0xa513694
Got SIGSEGV at address: 0xa52e354
Got SIGSEGV at address: 0xa5383cc
Got SIGSEGV at address: 0xa526b64
Got SIGSEGV at address: 0xa513390
Got SIGSEGV at address: 0xa50f16c
Got SIGSEGV at address: 0xa52efe8
Got SIGSEGV at address: 0xa5151b0
Got SIGSEGV at address: 0xa52370c
Got SIGSEGV at address: 0xa504544
Got SIGSEGV at address: 0xa53cf88
Got SIGSEGV at address: 0xa527080
Got SIGSEGV at address: 0xa507eb8
Got SIGSEGV at address: 0xa504030
Got SIGSEGV at address: 0xa527b84
Got SIGSEGV at address: 0xa53f418
Got SIGSEGV at address: 0xa529a60
```