Nachos_hw1

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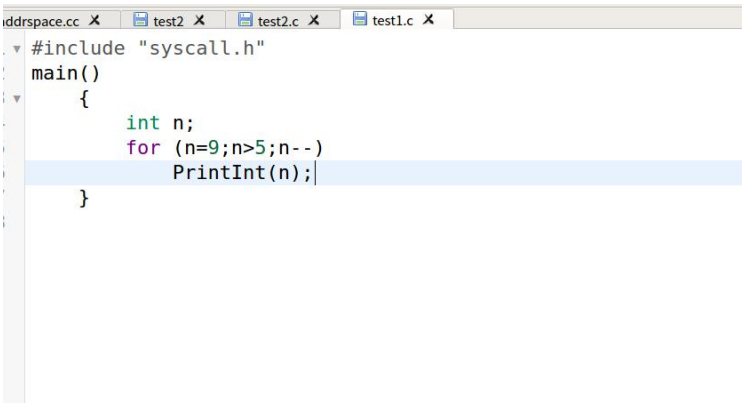
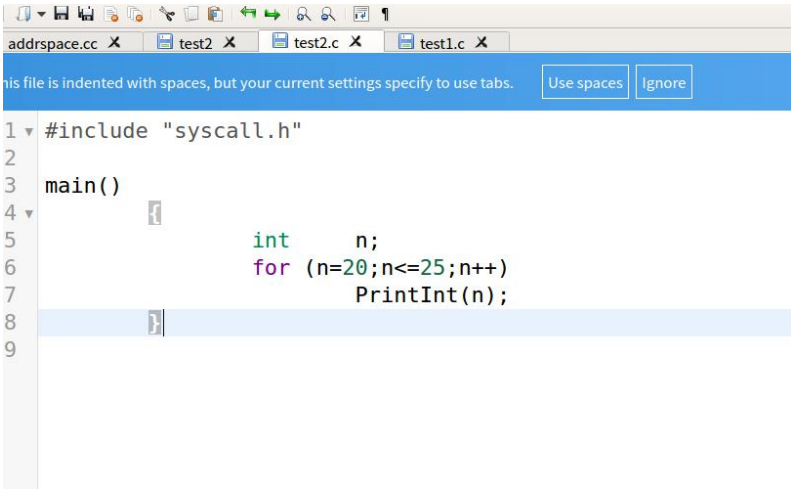
1. Motivation

觀察 test1 和 test2 的代碼:

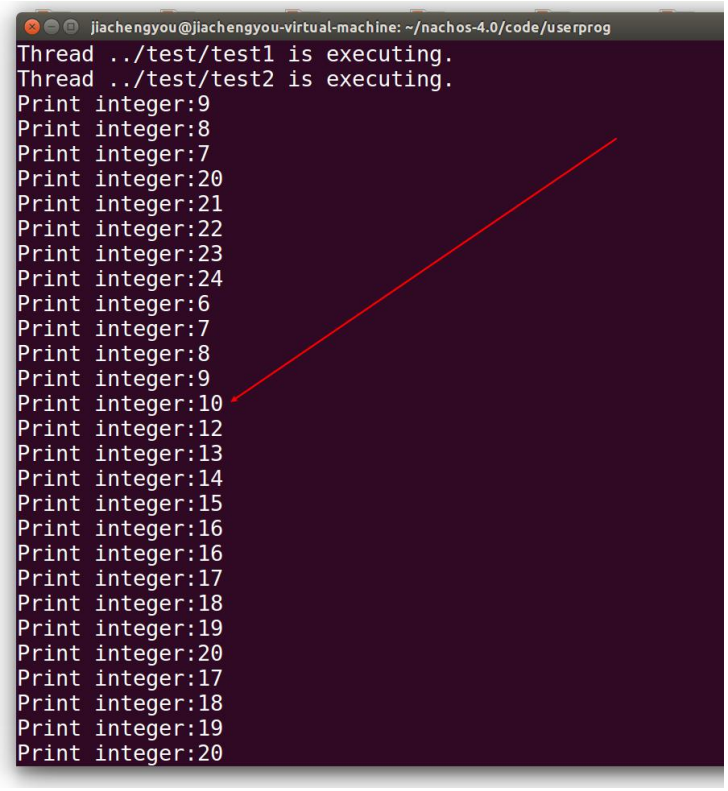
test1.c:



test2.c:



test1 程序應該在 9-6 遞減輸出，而 test2 程序應該會在 20-25 遞增輸出。而實際運行結果在應該結束時遞增，結果如下：



問題分析：

為什麼會出現後面的遞增？

應該操作到了兩個程式相同區域的代碼段。並且發現輸出 n 的結果錯誤，可以想到應該是 context-switch 上發生問題。

解決方案：

為地址做標記，每一個 process 都會有一個 AddrSpace，紀錄 logical address 所對應在 physical address，也就是 pageTable 對應到 pageTable[i].physicalPage。

在作業一開始給的代碼中，所有程序的 physicalPage 都共用，如此一來當然會執行到同一份 code。

改進後當要執行某一頁的程序，則將會去找 pageTable 所對應的 physicalPage，然後去運行。

2. Implementation

（1）做全局標記

```
14  #define ADDRSPACE_H
15
16  #include "copyright.h"
17  #include "filesys.h"
18  #include <string.h>
19
20  #define UserStackSize       1024    // increase this as necessary
21
22  class AddrSpace {
23    public:
24      AddrSpace();            // Create an address space.
25      ~AddrSpace();           // De-allocate an address space
26
27      void Execute(char *fileName);   // Run the the program
28                      // stored in the file "executable"
29
30      void SaveState();           // Save/restore address space-spe
31      void RestoreState();        // info on a context switch
32      //add
33      static bool usedPhyPage[NumPhysPages];
34    private:
35      TranslationEntry *pageTable;    // Assume linear page table t
36                      // for now!
37      unsigned int numPages;      // Number of pages in the virtual
38                      // address space
39
```

（2）初始化為 0。同時當 process 執行成功後，把標記使用的 page 設回未使用

```
20  #include "addrspace.h"
21  #include "machine.h"
22  #include "noff.h"
23
24  //----------------------------------------------------------------------
25  // SwapHeader
26  //  Do little endian to big endian conversion on the bytes i
27  //  object file header, in case the file was generated on a
28  //  endian machine, and we're now running on a big endian ma
29  //----------------------------------------------------------------------
30  //add
31  bool AddrSpace::usedPhyPage[NumPhysPages] = {0};
32  static void
```

```
2
3   //----------------------------------------------------------------------
4   // AddrSpace::~AddrSpace
5   //  Dealloate an address space.
6   //----------------------------------------------------------------------
7
8   AddrSpace::~AddrSpace()
9   {
0       for(int i = 0; i < numPages; i++)
1           AddrSpace::usedPhyPage[pageTable[i].physicalPage] = false;
2       delete pageTable;
3   }
4
5
6   //----------------------------------------------------------------------
7   // AddrSpace::Load
8   //  Load a user program into memory from a file.
9   //
0   //  Assumes that the page table has been initialized, and that
```

（2）當將程序載入 momory 時，要去填入 pageTable[] 對應的 physicalPage，搜索第一

個未使用的 page 進行填入。

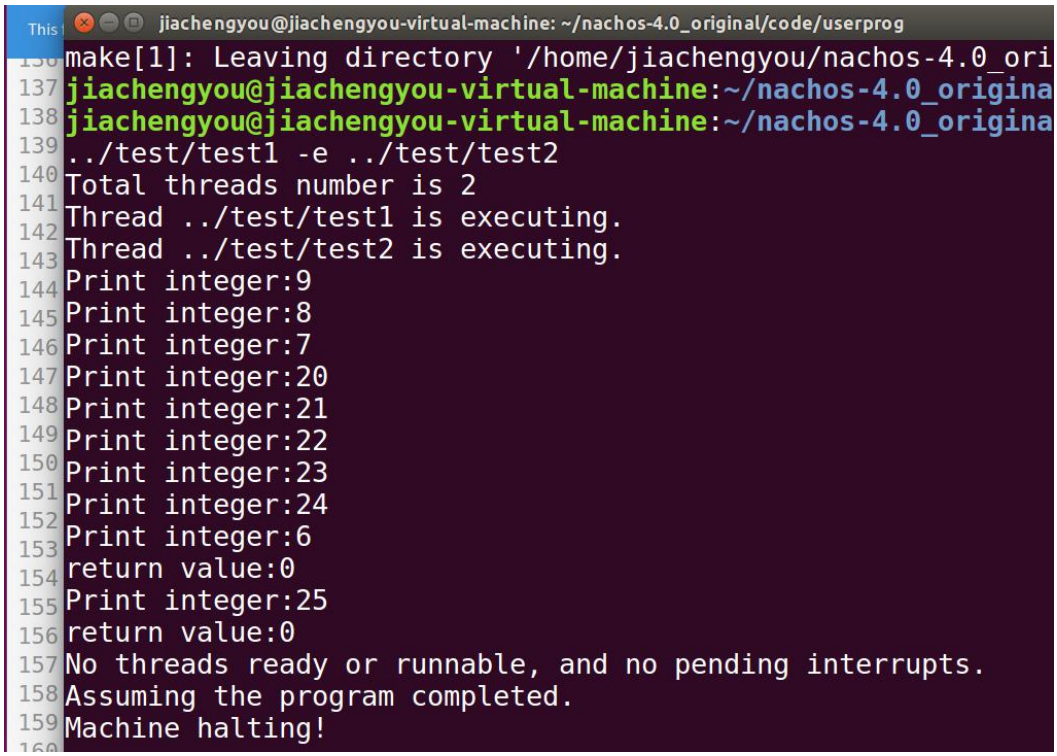
```
// how big is address space?
    size = noffH.code.size + noffH.initData.size + noffH.uninitData.size
            + UserStackSize;    // we need to increase the size
                        // to leave room for the stack
    numPages = divRoundUp(size, PageSize);
//  cout << "number of pages of " << fileName<< " is "<<numPages<<endl;
    // add
    pageTable = new TranslationEntry[numPages];
    for(unsigned int i = 0, j = 0; i < numPages; i++) {
        pageTable[i].virtualPage = i;
        while(j < NumPhysPages && AddrSpace::usedPhyPage[j] == true)
            j++;
        AddrSpace::usedPhyPage[j] = true;
        pageTable[i].physicalPage = j;
        pageTable[i].valid = true;
        pageTable[i].use = false;
        pageTable[i].dirty = false;
        pageTable[i].readOnly = false;
    }
// end add
    size = numPages * PageSize;

    ASSERT(numPages <= NumPhysPages);       // check we're not trying
                        // to run anything too big --
```

（3）載入確定後，開始執行，去算程序進入點，進入點的位置即是記憶體地址。首先算出第幾頁，然後乘上 PageSize 就是 page base，而 page offset 則是 code.address % PageSize。page base + page offset 就是我們所需要的程序進入點。

```
142 // then, copy in the code and data segments into memory
143     if (noffH.code.size > 0) {
144         DEBUG(dbgAddr, "Initializing code segment.");
145     DEBUG(dbgAddr, noffH.code.virtualAddr << ", " << noffH.code.size);
146
147 //add
148             executable->ReadAt(
149         &(kernel->machine->mainMemory[pageTable[noffH.code.virtualAddr/PageSize].physicalPage * PageSize + (noffH.code.virtualAddr
150             noffH.code.size, noffH.code.inFileAddr);
151 // end add
152     }
153     if (noffH.initData.size > 0) {
154         DEBUG(dbgAddr, "Initializing data segment.");
155     DEBUG(dbgAddr, noffH.initData.virtualAddr << ", " << noffH.initData.size);
156 // add
157         executable->ReadAt(
158         &(kernel->machine->mainMemory[pageTable[noffH.initData.virtualAddr/PageSize].physicalPage * PageSize + (noffH.code.virtual
159             noffH.initData.size, noffH.initData.inFileAddr);
160 // end  add
161     }
162
163     delete executable;          // close file
164     return TRUE;            // success
165 }
```

3. Result

實驗結果：



額外的觀察：

輸出的結果仍然穿插，詢問助教後，知道了這跟 scheduling 有關導致他們的輸出的確會穿插。

Reference：https://morris821028.github.io/2014/05/24/lesson