ECU178 Computer Science:
207SE Operating Systems, Security and Networks
Portfolio

Due on Monday, December 15th, 2014

Dr Mark Elshaw

Robert Rigler : 4939377

Contents

Item 1 - Linux Command Line **3**
1. Logfile containing evidence of activities . . . 3

Item 2 - Assembly Code **4**

Item 3 - Bootloader **5**

Item 4 - Inside Proc **6**
1. List the CPU Information using the Cat Command . . . 6
2. Show a table of the interrupts on the system . . . 7
3. Show number of CPUs, the producer of the CPUs and the CPU Model. . . . 7
4. How the parameters that are passed to the kernel when starting up linux. . . . 8
5. Show the name of the output devices and the number of megabytes read per second during the second sampled interval. . . . 8
6. Menu based shell script. . . . 9

Item 5 - Buffer tutorial **10**
1. Commented version of the rovided code . . . 10
2. Evidence of compiled code . . . 11
3. Code adaptation to show how many cahracters were read in total and how many times the buffer was filled . . . 12

3a Evidence . . . 13
4. Altering the buffer size . . . 13
5. Adapt the code so that it is possible to compare if two files are the same. . . . 14

5a. Evidence of comparison between review.txt and argo.txt . . . 15
5b. Evidence of comaprison between argo.txt and reviewobserver.txt . . . 15

Item 6 - Cache tutorial **16**
1. Complete the cr_read_byte function . . . 16
2. Prove the file is being buffered . . . 16
3. Provide some statistics . . . 16

Item 7 - Kernell **20**

Item 1 - Linux Command Line

1. Logfile containing evidence of activities

Item 2 - Assembly Code

Item 3 - Bootloader

Item 4 - Inside Proc

1. List the CPU Information using the Cat Command

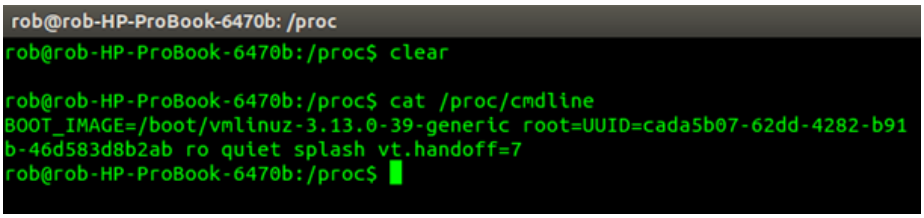
2. Show a table of the interrupts on the system

```
rob@rob-HP-ProBook-6470b: /proc
rob@rob-HP-ProBook-6470b:/proc$ cat /proc/interrupts
           CPU0       CPU1       CPU2       CPU3
  0:         17          0          0          0   IO-APIC-edge      timer
  1:        127        965         84        114   IO-APIC-edge      i8042
  5:          1          0          0          0   IO-APIC-edge      parpor
t0
  8:          0          0          0          1   IO-APIC-edge      rtc0
  9:        161        666         69         45   IO-APIC-fasteoi   acpi
 12:      17919     140293      11353      10149   IO-APIC-edge      i8042
 16:        156        160         13         16   IO-APIC-fasteoi   ehci_h
cd:usb1, ehci_hcd:usb2
 18:          2          0          0          0   IO-APIC-fasteoi   firewi
re_ohci, mmc0
 23:          0          0          0          0   IO-APIC-edge      lis3lv
02d
 40:          0          0          0          0   PCI-MSI-edge      PCIe P
ME
 41:          0          0          0          0   PCI-MSI-edge      PCIe P
ME, pciehp
 42:          0          0          0          0   PCI-MSI-edge      PCIe P
ME
 43:          0          0          0          0   PCI-MSI-edge      PCIe P
ME
 44:          0          0          0          0   PCI-MSI-edge      xhci_h
cd
 46:      13082       7835       8087       8869   PCI-MSI-edge      ahci
 47:         11          0          1          3   PCI-MSI-edge      mei_me
 48:        137        253      45647         54   PCI-MSI-edge      iwlwif
i
 49:       4755      31559       2541       2296   PCI-MSI-edge      i915
 50:       1179         80         17         57   PCI-MSI-edge      snd_hd
a_intel
NMI:          0          0          0          0   Non-maskable interrupts
LOC:      45464      43595      48260      38011   Local timer interrupts
SPU:          0          0          0          0   Spurious interrupts
PMI:          0          0          0          0   Performance monitoring i
nterrupts
IWI:       2279       1883       1820       1826   IRQ work interrupts
RTR:          2          0          0          0   APIC ICR read retries
RES:      20170      18531      19566      18119   Rescheduling interrupts
CAL:        494        594        574        529   Function call interrupts
```

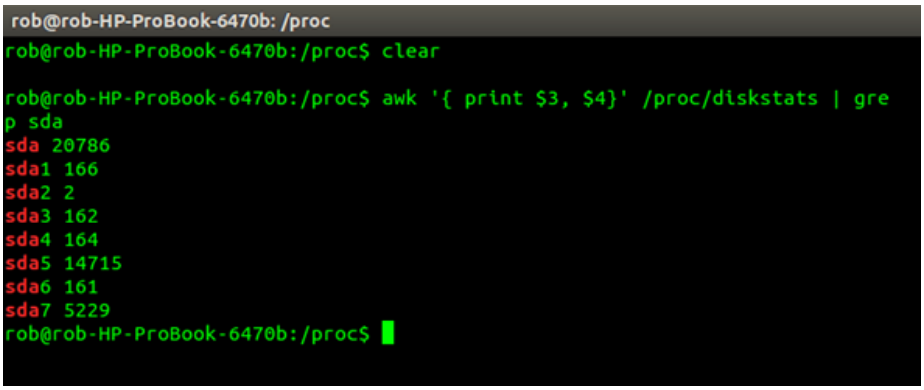
3. Show number of CPUs, the producer of the CPUs and the CPU Model.

```
rob@rob-HP-ProBook-6470b: /proc
rob@rob-HP-ProBook-6470b:/proc$ clear

rob@rob-HP-ProBook-6470b:/proc$ grep model /proc/cpuinfo
model           : 58
model name      : Intel(R) Core(TM) i5-3340M CPU @ 2.70GHz
model           : 58
model name      : Intel(R) Core(TM) i5-3340M CPU @ 2.70GHz
model           : 58
model name      : Intel(R) Core(TM) i5-3340M CPU @ 2.70GHz
model           : 58
model name      : Intel(R) Core(TM) i5-3340M CPU @ 2.70GHz
rob@rob-HP-ProBook-6470b:/proc$
```

4. How the parameters that are passed to the kernel when starting up linux.



5. Show the name of the output devices and the number of megabytes read per second during the second sampled interval.



6. Menu based shell script.

Listing 1: Bash Script

```
#!/bin/bash

 # DISPLAYS A MENU

while true;
do
echo "1. Display information about the CPU. "
echo "2. Display the interrupts system. "
echo "3. Display a process PID for a process on the system and its status. "
echo "4. exit. "

read input_variable
#STORES THE INPUT INTO A VARAIBLE CALLED "input_variable"

echo "Your choice was $input_variable"

#CASE STATEMENT TO DIFFERENTIATE OUTPUT RESPECTIVE TO THE USER'S CHOICE.

case "$input_variable" in

1)    #Display CPU info
      echo Displaying CPU information
      grep model /proc/cpuinf
      ;;
2)    #Display the interrupts info
      echo Displaying interrupts
      cat /proc/interrupts
      ;;
3)    #Display the PID and its status.
      echo Enter PID
      read input2
      ps -p "$input2"
      ;;
4)    #stop the script
      break
      ;;
#END CASE STATEMENT
esac
#END OF WHILE LOOP
done

echo "Exiting"
```

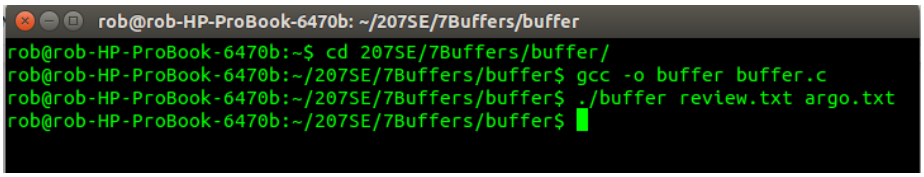
Item 5 - Buffer tutorial

1. Commented version of the rovided code

Listing 2: Commented Buffer Code

```
#include <fcntl.h>
#include <stdlib.h>
#include <unistd.h>  //Define header files
#include <stdio.h>

#define BUF_SIZE 500     //Define Buffer size as 500.
#define OUTPUT_MODE 0700 //Define file permission.

int main(int argc, char *argv[])
{
  int in_fd, out_fd;
  int rd_size = 1, wr_size;
  char buf[BUF_SIZE];              //Declare buffer.

  if (argc != 3)
     exit(1);

  in_fd = open(argv[1], O_RDONLY);           //Open input file.
  if (in_fd < 0)
     exit(2);

  out_fd = creat(argv[2], OUTPUT_MODE); //Create output file.
  if (out_fd < 0)
     exit(3);

  while (rd_size > 0) {

     rd_size = read(in_fd, buf, BUF_SIZE); // Continuously read from input file
                                           //into buffer.
     if (rd_size <0)
     exit(4);

     wr_size = write(out_fd, buf, rd_size); // Continuously write from buffer into
                                             //the output file.
     if (wr_size<=0){
        close(in_fd);                        //Close both of the files.
  close(out_fd);
exit(5);
}
  }
}
```

2. Evidence of compiled code



Argo.txt contains the exact same text that was in review.txt

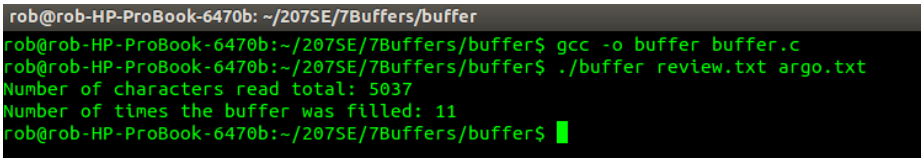
3. Code adaptation to show how many cahracters were read in total and how many times the buffer was filled

Listing 3: Adpated Code

```
#include <fcntl.h>
#include <stdlib.h>
#include <unistd.h>
#include <stdio.h>
//Define header files

#define BUF_SIZE 500     //Define Buffer size as 500.
#define OUTPUT_MODE 0700 //Define file permission.

int main(int argc, char *argv[])
{
  int in_fd, out_fd;
  int buf_count=0,rd_count=0;
  int rd_size = 1, wr_size;
  char buf[BUF_SIZE];                              //Declare buffer.

  if (argc != 3)
     exit(1);

  in_fd = open(argv[1], O_RDONLY);                 //Open input file.
  if (in_fd < 0)
     exit(2);

  out_fd = creat(argv[2], OUTPUT_MODE);       //Create output file.
  if (out_fd < 0)
     exit(3);

  while (rd_size > 0) {

     rd_size = read(in_fd, buf, BUF_SIZE);//Continuously read from input file
                                          //into buffer.
    rd_count+= rd_size;
      if(rd_size > 0)
      buf_count +=1;//Counts the number of times the buffer
                    //is filled (only if rd_size is > 0
     exit(4);

     wr_size = write(out_fd, buf, rd_size);//Continuously write from buffer into
                                           //output file.
     if (wr_size<=0){
        close(in_fd);                             //Close input file.
  close(out_fd);                                  //Close output file


    printf("Number of characters read total: %d\n",rd_count -1 );
    //Prints how many Characters were read.
printf("Number of times the buffer was filled: %d\n",buf_count);
     //Prints how many times the buffer was filled
```

```
50  exit(5);
    }
      }
    }
```

3a Evidence



4. Altering the buffer size

- Doubling the buffer size to 1000, the program filled the buffer 6 times. This is half of the original value + 1.
- Doubling the buffer size again to 2000 , the program filled the buffer 3 times which is half of 6.
- Raising the the buffer size to 10000, the program filled the buffer 1 time, indicating that the entire text was placed into the buffer.

There is a direct linear correlation between the buffer size and the amount of times that the buffer was filled.

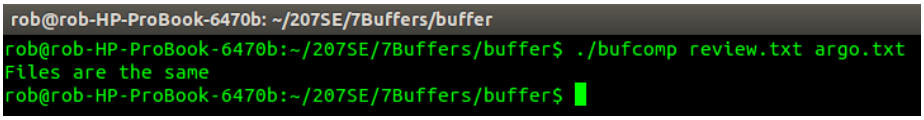
5. Adapt the code so that it is possible to compare if two files are the same.

Listing 4: Adapted code

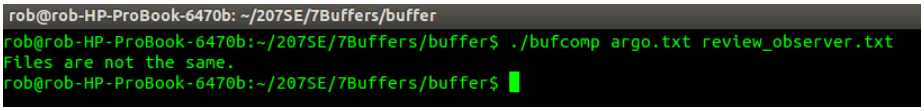
```
#include <fcntl.h>
#include <stdlib.h>
#include <unistd.h>
#include <stdio.h>
//Define header files

#define BUF_SIZE 500          //Define Buffer size as 500.
#define OUTPUT_MODE 0700 //Define file permission.

int main(int argc, char *argv[])
{
  int in_fd, in0_fd; // Create integers to hold file handles.
  int rd_size = 1;  // Create integer to hold the amount of bytes in the buffer.
  char buf[BUF_SIZE]; //Declare 1st buffer.
  char buf0[BUF_SIZE]; //Declare 2nd buffer.

  if (argc != 3)
     exit(1);



  in_fd = open(argv[1], O_RDONLY); //Open 1st file.
  if (in_fd < 0)
     exit(2);

  in0_fd = open(argv[2], O_RDONLY); //Open 2nd file.
  if (in0_fd < 0)
     exit(3);

  while (rd_size > 0) {

    int i;
     rd_size = read(in_fd, buf, BUF_SIZE); // Read From 1st file into 1st buffer

     if (rd_size <0)
     exit(4);
     rd_size = read(in0_fd, buf0, rd_size); //Read from 2nd file into 2nd buffer

    for (i =0; i < BUF_SIZE; i++){//Loop through the contents of each buffer.

    if (buf[i] == buf0[i])// If buffer contents are equal, go to next buffer element.
      continue;
    else {//If buffer contets are not the same,
          //close the files and display a message
            //and exit the program.

    close(in_fd);                                  //Close input file.
      close(in0_fd);                               //Close output file
    printf("Files are not the same. \n");
    exit(5);
```

```
            } //end else
        } //end for
        } //end while

55
printf("Files are the same \n");// Display this message if the files are the same

}//end main
```

5a. Evidence of comparison between review.txt and argo.txt



5b. Evidence of comaprison between argo.txt and reviewobserver.txt



Item 6 - Cache tutorial

1. Complete the cr_read_byte function

Please see the provided code in cache_reader.c

2. Prove the file is being buffered

To prove the code is being buffered. I included *printf(" \n");* on line 58 in the cache_reader.c file . The program now starts a new line every time it reaches the end of the buffer (in this example 20).

3. Provide some statistics

To count the number of bytes read, I created a variable called *byte_tot* in the *cr_file* structure (line12) in the cache_reader.h file. This variable is used in the *Refill()* method (line 15). Every time the *Refill()* method is called, it adds the value of *len* (which contains the number of bytes currently being read) to itself.
The amount of times the buffer was refilled, was calculated by dividing the number of bytes read from the text by the size of the buffer.

Listing 5: cache_example.c

```
#include "cache_reader.h"

//Simple file display to show how easy it is to use the cached reader functions

int main(){
  char c;
  int refill_count=0;
  int byte_count=0;
  //Open a file
  cr_file* f = cr_open("text",20);

  //While there are useful bytes coming from it
  while((c=cr_read_byte(f))!=EOF){
    //Print them
    printf("%c",c);

  }


  //Then close the file
  printf("\nByte Count: %d",f->byte_tot);
// Displaying the total number of bytes read.

  printf("\nRefill Count: %d\n",f->byte_tot/f->bufferlength);
//Displaying the total number of times the buffer was filled.
//(No_of_bytes / buffersize).
  cr_close(f);

  //And finish
  return 0;
}
```

Listing 6: cache_reader.h

```
#include <stdio.h>
#include <stdlib.h>

//The internals of this struct aren't important
//from the user's point of view
typedef struct{
  FILE* file;         //File being read
  int bufferlength;   //Fixed buffer length
  int usedbuffer;     //Current point in the buffer
  char* buffer;       //A pointer to a piece of memory
                      //  same length as "bufferlength"
  int byte_tot;      //Integer to store the total amount of bytes that were read
                     //from the file.
} cr_file;



//Open a file with a given size of buffer to cache with
cr_file* cr_open(char* filename, int buffersize);


//Close an open file
void cr_close(cr_file* f);

//Read a byte.  Will return EOF if empty.
char cr_read_byte(cr_file* f);



//-------------------------------------------------------

//Refill an empty buffer.  Not intended for users
int refill(cr_file* buff);
```

Listing 7: cache_reader.c

```
#include "cache_reader.h"

int refill(cr_file* buff){
  //Refills a buffer
  //Only works when completely used buffer
  if(buff->usedbuffer!=buff->bufferlength)
    return 0;
  else{
    buff->usedbuffer=0;
    int len=fread(buff->buffer, sizeof(char), buff->bufferlength, buff->file);
    //If we didn't fill the buffer, fill up with EOF
    if(len<buff->bufferlength)
      for(int i=len;i<buff->bufferlength;i++)
     buff->buffer[i]=EOF;  //Accessing like an array!
     buff->byte_tot +=len; //Adding len to the byte total.
    return len;
  }

}









void cr_close(cr_file* f){
  free(f->buffer);
  fclose(f->file);
}


cr_file* cr_open(char * filename, int buffersize){

  //Info on malloc
  //http://www.space.unibe.ch/comp_doc/c_manual/C/FUNCTIONS/malloc.html
  FILE* f;
  if ((f = fopen(filename, "r")) == NULL){
    fprintf(stderr, "Cannot open %s\n", filename);
    return 0;
  }

  cr_file* a=(cr_file*)malloc(sizeof(cr_file));
  a->file=f;
  a->bufferlength=buffersize;
  a->usedbuffer=buffersize; //Start off with no characters,
              // so refill will work as expected
  a->buffer=(char*)malloc(sizeof(char)*buffersize);
  a->byte_tot =0;
  refill(a);
  return a;
}
```

```
//-------------------------------------------------------------------
char cr_read_byte(cr_file* f){

  char btoRet; // byte to hold the character to return.
  if (f->usedbuffer >= f->bufferlength){ // if the buffer is all used, refill()
    printf(" \n "); // starts a new line very time the buffer needs to be refilled.
    refill(f);

  }
    else{ // If buffer hasn't been fully used, return the chracter and increase
     // the usedBuffer position by 1.

       btoRet = f->buffer[f->usedbuffer]; //Place next character in the
                         //btoRet variable.
        f->usedbuffer +=1; //Move the buffer position up by 1.
       return btoRet; //return the varibale.

    }

}
```

Item 7 - Kernell