# CSSE2310: 2013 ‘Practice’ exam answers

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**Q1) Write shell commands to do the following:**

**A) Delete all files with names beginning with A and ending in .c**
rm A*.c

**B) Show all lines in the file stuff which start with W**
grep ^W stuff

**C) A file nums consists of 4 space separated columns. Output columns 1, 3, 4 sorted by the last column**
cut -d ‘ ‘ -f1,3,4 nums | sort -k 3
OR
sort -k 4 nums | cut -d' ‘ -f1,3,4
OR
cat nums | cut -d' ‘ -f1,3,4 | sort -k 3

**D) Create a file c.c which is a copy of b.c**
cp b.c c.c

**E) For files f1, f2, f3, show all lines from any of them which contains all the words “song”, “river” and “terrible”**
cat f1 f2 f3 | grep song | grep river | grep terrible

**Q2) Write C to declare foo as:**

**A) An array of 12 integers**
int foo[12];

**B) A pointer to a positive integer**
unsigned int* foo;

**C) Another name for a small integer**
typedef short foo;

**D) A struct containing an integer called i and a string called s**

```
struct {
    int i;
    char* s;
} foo;
```

**NOTE: As question says a ‘struct’, it should be an instance of a struct, so foo goes at the end.**

**E) A pointer to a function which takes two floating point values and returns a string**
char* (*foo)(float, float);

**Q3)**

| | |
|---|---|
| **A.** | 2 |
| **B.** | 4 7 |
| **C.** | 3 6 |
| **D.** | 17 |
| **E.** | 9 |
| **F.** | 4 6 |
| **G.** | 8 2 |
| **H.** | 28 |
| **I.** | 8 9 |
| **J.** | 4 3 3 5 |
| **K.** | w ld |

**Q4) A system has 32bit virtual address, 4KB pages and page table entries are 4Bytes. It uses a two level page table.**

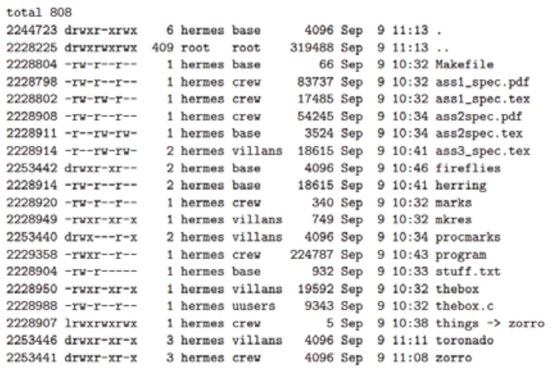
**A. Which pages do the following (decimal) addresses belong to?**
**11111, 22222, 9001, 404040**
2, 5, 2, 98

Eg.
4096 bytes in a page
Page = virtual address / page size
Page = 11111/4096 = 2.7
This means virtual address 11111 is on Page 2 (which is the third page, since numbering starts at 0).

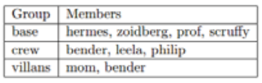
**B. what causes page faults?**
When an object/process/program is on disk and not in memory.

**C. What causes segmentation faults?**
-trying to access an invalid memory page
-writing to a read only page

**Q5) Consider the following directory listing:**



```
total 808
2244723 drwxr-xrwx    6 hermes base      4096 Sep  9 11:13 .
2228225 drwxrwxrwx  409 root   root    319488 Sep  9 11:13 ..
2228804 -rw-r--r--    1 hermes base        66 Sep  9 10:32 Makefile
2228798 -rw-r--r--    1 hermes crew     83737 Sep  9 10:32 ass1_spec.pdf
2228802 -rw-rw-r--    1 hermes crew     17485 Sep  9 10:32 ass1_spec.tex
2228908 -rw-r--r--    1 hermes crew     54245 Sep  9 10:34 ass2spec.pdf
2228911 -r--rw-rw-    1 hermes base      3524 Sep  9 10:34 ass2spec.tex
2228914 -r--rw-rw-    2 hermes villans  18615 Sep  9 10:41 ass3_spec.tex
2253442 drwxr-xr--    2 hermes base      4096 Sep  9 10:46 fireflies
2228914 -rw-r--r--    2 hermes base     18615 Sep  9 10:41 herring
2228920 -rw-r--r--    1 hermes crew       340 Sep  9 10:32 marks
2228949 -rwxr-xr-x    1 hermes villans    749 Sep  9 10:32 mkres
2253440 drwx---r-x    2 hermes villans   4096 Sep  9 10:34 procmarks
2229358 -rwxr--r--    1 hermes crew    224787 Sep  9 10:43 program
2228904 -rw-r-----    1 hermes base       932 Sep  9 10:33 stuff.txt
2228950 -rwxr-xr-x    1 hermes villans  19592 Sep  9 10:32 thebox
2228988 -rw-r--r--    1 hermes uusers    9343 Sep  9 10:32 thebox.c
2228907 lrwxrwxrwx    1 hermes crew         5 Sep  9 10:38 things -> zorro
2253446 drwxr-xr-x    3 hermes villans   4096 Sep  9 11:11 toronado
2253441 drwxr-xr-x    3 hermes crew      4096 Sep  9 11:08 zorro
```



| Group | Members |
|---|---|
| base | hermes, zoidberg, prof, scruffy |
| crew | bender, leela, philip |
| villans | mom, bender |

**A) what can `zoidberg` do to the following:**
**`>stuff.txt`**
read
**`>procmarks`**
read, execute

**B) Which users can modify all of the `.tex` files (without changing permissions)?**
the crew (bender, leela, philip)

**C)What command(s) could `mom` type to execute `program`?**
Copy program to home directory and then run it (mom can read program)
cp program ~/program
~/program

**D) What would change in the directory listing after hermes executed `rmdir toronado` (and why?)**
No change, since toronado is not an empty directory. rmdir does nothing.

**E) What command was used to create `things`?**
ln -s zorro things
**F) Given the following commands and their output:**

```
prompt> ls -l zorro/transport
lrwxrwxrwx 1 hermes base 21 Sep 9 11:20 zorro/transport -> ../fireflies/serenity

prompt> ls -l fireflies/serenity
-rwx--x--x 1 hermes base 1072966 Sep 9 10:46 fireflies/serenity
```

**Can bender run `./things/transport` ? (Why?)**
No because the fireflies directory doesn't give bender permissions to execute it (in other words access stuff in the folder)

**Q6) Network stuff**

**A)**

| | **Network Address** | **Subnet Mask** | **Broadcast Address** |
|---|---|---|---|
| **X1** | 10.10.96.0 | 255.255.254.0 | 10.10.97.255 |
| **X3** | 10.10.144.0 | 255.255.248.0 | 10.10.151.255 |
| **X4** | 10.11.64.32 ~~10.11.64.40.0~~ | 255.255.255.240 ~~Shouldn't this be 255.255.252 since only the last three bits differ?~~ | 10.11.64.47 ~~10.11.64.40.3~~ |

**B) What does the `bind()` function perform?**
bind(): After a socket has been created, it attaches a local address to it.

**C) X2 performs NAT for this network. What is NAT and why is it necessary?**
Network address translation: Needed when the number of IPs assigned to you is less than the total number of computers trying to access the internet. It assigns an entity/organisation a single IP

Wouldn't a safer answer be that some IPs are non -routable (http://jeff.nieusma.com/docs/network/non-routable-ip.html). If any machines with these IPs want to communicate with the rest of the internet, their address must be converted by the NAT.

**D) to which layers do the following belong:**

| **Term** | **Layer** |
|---|---|
| **MAC address** | link |
| **socket** | application |
| **IP Address** | network |
| **port** | transport |
| **UDP** | transport |
| **URL** | application |

**E) What is the purpose of a `network gateway`?**
Router interface connected to the local network. It's purpose is to send packets out of and receive to the local network.

**Q7) Consider a "unix" filesystem where:**
**>i-nodes have 10-direct pointers, 1 indirect pointer and 1 double indirect pointer.**
**>Blocks are 8KB**
**>Block pointers are 4Bytes**
**>blocks are numbered from 0.**

**A)Why is fragmentation a problem for linked filesystems but not for indexed filesystems?**
Indexed filesystems are sequential so adjacent blocks store data "in order". Linked filesystems hold pointers to data, so the data can be spread (physically) across the disk.

**B) How many blocks (in total) must be accessed to read the following blocks from a file: 9, 2053, 2057**
1 for 9, 2 for 2053, and 1 for 2057 (the pointer is stored from the 2053 read)
total of 4

**C)What is the maximum possible file size for this file system?**
total size = (10*8192) + (1*2048*8192) + (1*2048^2 * 8192) = 33,570,896 kB

**D) If an additional 2 double indirect pointers were added to the i-nodes on this system, what would be the increase in maximum file size?**
Increase is 2*2048^2 * 8192 = 67,108,864 kB

**Question 8: multiprocess/fork stuff**

**A)**
**Lower diagram shows a process being reaped by a process who isn't its parent (or init). This is impossible.**

**B)**
**wait(), with WNOHANG set.**

**C)**
**kill(pid_t pid, int sig)**

**D)**
**pthread_exit(void* value_ptr)**

**pthread_join(pthread_t thread, void** value_ptr)**

**E)**
**pthread_mutex_lock**
**pthread_mutex_unlock**

**F)**
~~**The down arrow indicates reaping of the child. So the top left, top right and bottom right are possible but not bottom left, for the same reason as (A).**~~

**JEA: Down arrow indicates a thread being joined. All of them are possible. Threads do not follow the same rules as processes, because they are different.**

**Isn't it that a thread cannot join a thread who isn't its child? So the bottom left is not correct**

**Question 9) code**
**Note: As the question states, the #includes aren't necessary in your answer. I put them in so I could run the code. Copy/Paste all 5 functions and play around with it for fun.**

```
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <stdbool.h>
#include <unistd.h>
#include <sys/types.h>
#include <sys/wait.h>

bool matchingLines(const char* string, const char* filename) {

       FILE *file;
       char line[81];

       if ((file = fopen(filename, "r")) == NULL) {
              return false;
       }

       while(fgets(line, 81, file) != NULL) {
              if (strstr(line, string) != NULL) {
                     printf("%s", line);
              }
       }

       return true;
}
```

**B)**
```
bool grepSearch(const char* string, const char* filename) {

       if (fork()) {       /* Parent */

              int status;
              wait(&status);

              if (WIFEXITED(status)) {
                     if (WEXITSTATUS(status) == 2) {
                            return false;
                     } else {
                            return true;
                     }
              }

       } else {      /* Child */

              execlp("grep", "grep", string, filename, NULL);
              exit(0);

       }

       return true;
}
```

**C)**
```
bool matchingLinesMany(const char* string, const char** filenames, int numfiles) {

       int i = 0;
       int status;
       bool result = true;

       for(i = 0; i < numfiles; i++) {
              if (fork() == 0) {/* Child */
                     if (matchingLines(string, filenames[i])) {
                            exit(0);
                     } else {
                            exit(2);
                     }
              }
       }
       for(i = 0; i < numfiles; i++) {
              wait(&status);
              if (WIFEXITED(status)) {
                     if (WEXITSTATUS(status) == 2) {
                            result = false;
                     }
              }
       }

       return result;
}


With threads (see next page):
```

```c
struct SearchData {
    char *string;
    char *filename;
};

void *match(void* arg) {
    struct SearchData* data = (struct SearchData*) arg;
    bool res = matchingLines(data->string, data->filename);
    pthread_exit((void*) res);
}

bool matchingLinesMany(const char* string, const char** filenames, int numfiles) {
    pthread_t* threads = malloc(numfiles * sizeof(pthread_t));
    struct SearchData* searches = malloc(numfiles * sizeof(SearchData));
    bool result = true;

    for (int i = 0; i < numfiles; ++i) {
        searches[i] = malloc(sizeof(struct SearchData));
        data->string = string;
        data->filename = filenames[i];
        pthread_create(&threads[i], NULL, match, (void*) data);
    }
    for (int i = 0; i < numfiles; ++i) {
        bool res;
        pthread_join(threads[i], (void**) &res);
        if (!res) {
            result = false;
        }
        free(threads[i]);
        free(searches[i]);
    }
    return result;
}
```

**D)**

```c
bool grepSearchMany(const char* string, const char** filenames, int numfiles) {

        int i = 0;
        int status;
        bool result = true;

        for(i = 0; i < numfiles; i++) {
                if (fork() == 0) { /* Child */
                        execlp("grep", "grep", string, filenames[i], NULL);
                        //should this line not be
                        result = grepsearch(string, filenames[i]);
                        exit(result);
                        exit(0);
                }
        }
        for(i = 0; i < numfiles; i++) {
                wait(&status);
                if (WIFEXITED(status)) {
                        if (WEXITSTATUS(status) == 2) {
                                result = false;
                        }
                }
        }
        return result;
}
```

**E)**

```c
int main(int argc, const char **argv) {

        if (argc < 4 || ((strcmp(argv[1], "M") != 0) &&
                    (strcmp(argv[1], "G") != 0))) {
                fprintf(stderr, "Bad params.\n");
                exit(1);
        }

        int i = 0;
        int (*func)(char*, char*, int); // function pointer avoids code duplication

        if (argv[1][0] == 'M') {
                func = matchingLinesMany;
        } else {
                func = grepSearchMany;
        }
        if (!func(argv[2], argv+3, argc - 3)) {
                fprintf(stderr, "Bad file.\n");
                exit(2);
        }
        return 0;
}
```