

CSc 352 : Systems Programming and Unix

Fall 2002

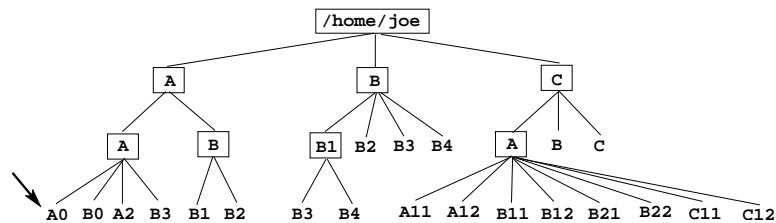
Midterm Exam: Thu. October 10 2002

Time : 75 mins

SOLUTIONS

1. Unix I [$4 \times 2.5 = 10$ points] :

The following illustrates the structure of the files within the home directory '/home/joe' of a user named joe. Directories are shown enclosed within boxes, e.g., A. Answer the following questions assuming that all the commands mentioned below execute normally, and there are no problems due to file permissions.



- (a) Give the full (i.e., absolute) file name of the file A0 indicated by the arrow in the picture above.

Answer: /home/joe/A/A/A0

- (b) Suppose a user starts at the directory A containing the file indicated by the arrow in the picture above, then executes the following commands:

```
cd ../../B
pwd
```

What will be printed as a result?

Answer: /home/joe/B

- (c) Suppose a user starts at the directory A containing the file indicated by the arrow in the picture above, then executes the following commands:

```
cp *0 ../B
cd ../../C/A
cd ../../A/B
ls
```

What will be printed out as a result?

Answer: A0 B0 B1 B2

- (d) Suppose a user executes the commands

```
rm /home/joe/C/A/[AB] [01]*
cd /home/joe/C/A
ls
```

What will be printed out as a result?

Answer: B21 B22 C11 C12

2. Unix II [2+8 = 10 points]

- (a) [2 points] You are in the process of writing a C program that writes some data into a file. You want to look up information about the system call that you might use for this. The command ‘man -k write’ produces the following:

```
write          write (1)      - write to another user
write          write (2)      - write on a file
```

However, when you execute the command ‘man write’, you only get information about writing to another user.

What command would you use to obtain information specific to the system call that writes to a file?

Answer: man -s 2 write

- (b) [4 × 2 = 8 points] Suppose that `ls -l` shows the following permissions for a directory `Foo`: `drwxr-x--`

- (i) What permissions does the owner of `Foo` have on the directory `Foo`?

Answer: read, write (i.e., modify), and enter the directory

- (ii) What permissions do members belonging to the group of the directory `Foo` have?

Answer: read and enter the directory

- (iii) What permissions do “other users” have on the directory `Foo`?

Answer: none

- (iv) What command should the owner of `Foo` execute if he wants to allow all users to read and enter the directory `Foo` but not create any files in it?

Answer: Either of the following will do:

```
chmod o+rx Foo
chmod a+rx Foo
```

3. Unix III [5+6+4 = 15 points]

A user executes the command ‘wc *’ in a directory and gets the following output:

```
30   152   700 file_1
11   121   406 file_2
10   107   360 file_3
51   380  1466 total
```

- (a) [2+3 = 5 points] Suppose the user now executes the following commands:

```
cat file_1 > file_4
cat file_2 >> file_4
wc file_4
```

(i) [2 points] What will be printed out?

Answer: 41 273 1106 file_4

(ii) [3 points] What can we conclude about the number of newline characters '\n' in file_4 after these commands have been executed?

Answer: There are 41 of them.

(b) [6 points] Instead of the commands given in part (a), suppose the user executes the commands

```
cat file_1 >& file_4
cat file_2 >>& file_4
wc file_4
```

Under what circumstances might the resulting file file_4 be different from that obtained in part (a)?

Answer: If an error occurs during the execution of these commands, the resulting error messages will now be written into file_4, which would not have been the case with the commands from (a). This can occur if the user does not have read permission on file_1 or file_2, or write permission in the directory containing these files (necessary to create file_4).

(c) [4 points] You want to extract the 5000th line (and only this line) from the end of a large file foo containing 20,000 lines. Show how you can do this using only the Unix commands head and tail.

Answer: tail -5000 foo | head -1

4. C Macros [2+5 = 7 points]

(a) [2 points] What will be printed out by the following program?

```
#include <stdio.h>
#define Prod(x,y)    x*y
int main()
{
    printf("%d\n", Prod(2*2, 2*2));
    return 0;
}
```

Answer: 16

(b) [5 points] What will be printed out by the following program?

```
#include <stdio.h>
#define Diff(x,y)    x-y
int main()
{
    printf("%d\n", Diff(2+2, 2+2));
    return 0;
}
```

Answer: 4

5. C Declarations [5 × 2 = 10 points]

Give C language declarations for the following:

- (a) Three integer variables named A, B, and C.

Answer: `int A, B, C;`

- (b) An array X of 10 integers.

Answer: `int X[10];`

- (c) An array of characters `str` that is big enough to hold a string of length 32.

Answer: `char str[33];`

- (d) A variable X that is a pointer to a character.

Answer: `char *X;`

- (e) A variable Y that is a pointer to a pointer to a pointer to an integer.

Answer: `int ***Y;`

6. C Strings [5+5 = 10 points]

- (a) [5 points] What is printed out by the following program?

```
char * foo_1(char *str)
{
    for ( ; *str != '\0'; str++) {
        if (*str == ' ') return str;
    }
    return NULL;
}

int main()
{
    printf("<%s>\n", foo_1("'Twas brillig, and the slithy toves"));
    return 0;
}
```

Answer: `< brillig, and the slithy toves>`

- (b) [5 points] What is printed out by the following program?

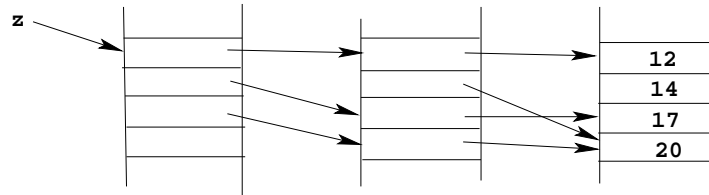
```
void foo_2(char *str)
{
    char *x;
    for (x=str; *x != ' '; x++) {
    }
    *(x+5) = '\0';
    printf("%s\n", str);
}

int main()
{
    foo_2("'Twas brillig, and the slithy toves");
    return 0;
}
```

Answer: `'Twas bril`

7. C Pointers [2+3+3+3+2 = 13 points]

Consider the following relationships between a set of `int` and pointer variables. An arrow from a variable to another indicates that the former is a pointer that points to the latter. The variable `z` has type `int ***`.



- (a) [2 points] What is printed out when we execute the following statement, given the pointer relationships shown in the figure above?

```
printf("%d\n", ***z);
```

Answer: 12

- (b) [3 points] What is printed out when we execute the following statement, given the pointer relationships shown in the figure above?

```
*z++; printf("%d\n", ***z);
```

Answer: 17

- (c) [3 points] What is printed out when we execute the following statement, given the pointer relationships shown in the figure above?

```
(*z)++; printf("%d\n", ***z);
```

Answer: 20

- (d) [3 points] What is printed out when we execute the following statement, given the pointer relationships shown in the figure above?

```
(**z)++; printf("%d\n", ***z);
```

Answer: 14

- (e) [2 points] What is printed out when we execute the following statement, given the pointer relationships shown in the figure above?

```
(***z)++; printf("%d\n", ***z);
```

Answer: 13