

# CSc 3320: Systems Programming

Fall 2021

Homework

# 1: Total points 100

## Submission instructions:

1. Create a Google doc for each homework assignment submission.
2. Start your responses from page 2 of the document and copy these instructions on page 1.
3. Fill in your name, campus ID and panther # in the fields provided. If this information is missing in your document TWO POINTS WILL BE DEDUCTED per submission.
4. Keep this page 1 intact on all your submissions. If this *submissions instructions* page is missing in your submission TWO POINTS WILL BE DEDUCTED per submission.
5. Each homework will typically have 2-3 PARTS, where each PART focuses on specific topic(s).
6. Start your responses to each PART on a new page.
7. If you are being asked to write code copy the code into a separate txt file and submit that as well.
8. If you are being asked to test code or run specific commands or scripts, provide the evidence of your outputs through a screenshot and copy the same into the document.
9. Upon completion, download a .PDF version of the document and submit the same.

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## **PART 1**

**Answer the following questions briefly. Provide clear and succinct reasoning.**

**Points per question = 5**

**1. Tell the differences between Unix and Linux. Then please list some operating systems (at least three) which belong to Unix but not Linux.**

*Ans.* UNIX is the name of a popular family of operating systems created by AT&T Bell Labs and then iterated upon by different manufacturers and UC Berkeley. Most UNIX-based operating systems make an effort to be compliant with a common standard known as the Portable Operating System Interface (POSIX). Linux is an Open Source version of the UNIX operating system, created by Linus Torvalds, which shares the interface of UNIX but not the code, allowing the code to be freely modified and distributed.

Three non-Linux operating systems that are in the UNIX family are

1. Apple's MacOS (previously known as OSX)
2. Berkeley Software Distribution family (like FreeBSD, OpenBSD, etc.)
3. IBM's AIX

**2. What is the pipe mechanism in UNIX? And show one command using a pipe and explain how the pipe works in it?**

*Ans.* The pipe mechanism in UNIX allows for the standard output of one command process as the input for another command using the pipe (|) metacharacter. This allows complex tasks to be broken down into a set of simpler ones.

One command using a pipe is `ls -lR | cat > permissions.txt`. The `ls` command gets the names of the entire filesystem hierarchy and permissions for each of the files and folders under the folder where the command was given, and this output is fed to the `cat` command with the `|` pipe operator which stores this output in a file called `permissions.txt` because of the `>`

redirection operator.

**3. In a Linux system, you can issue the command `ls /` to check the sub directories under root. Please describe the meanings of directory `/bin`, `/dev`, `/boot`, `/usr`, `/etc`, `/mnt`, `/sbin`, `/var` separately. For example, you can say that `/bin` contains binary executable files.**

*Ans.* UNIX systems share a common set of subdirectories under root where different files and programs necessary for the operation of the system are stored. These are:

- `/bin`: stores binaries of commands like `ls`, `cp`, `mkdir` etc.
- `/dev`: stores drivers to devices like the monitor, keyboard, GPU etc.
- `/boot`: stores the files from which the OS boots, like the kernel
- `/usr`: a read-only directory that holds utilities and applications for users
- `/etc`: stores configuration files
- `/mnt`: access point for mounted filesystems from hard drives, flash drives, CDs etc.
- `/sbin`: stores essential system binaries
- `/var`: variable files like application data and temporary files

**4. What is the meaning of Multitask and Multi-user in a Unix system?**

*Ans.* Multitask means that multiple programs can run at the same time in an UNIX system. Multiuser means that multiple users can use the same Unix system by the use of shared processing time and distributed computing systems.

**5. What does `-rwxr-xr-x` mean in terms of permissions for a file? What is the exact unix command (with the octal representation) for changing the permissions to this setting?**

*Ans.* the first - means that the item is a file. The first `rwx` means that the

owner of the file can read, write and execute the file. The second two r-x means that users in the group as well as other global users can only read and execute the file and cannot write to it. The UNIX command for changing permissions to this string is `chmod 755 <filename>`

**6. In class, you have learned the meaning of read, write and execute permission for regular files. However, these permissions are also applied to directories. So please describe the meaning of read, write, and execute permission for directory.**

*Ans.* The meaning of permissions differs for files and directories. For directories

- Read (r) means that users can list the files in the directory
- Write (w) means that users can move files into the directory and delete files from it
- Execute (x) means that users can access the files in the directory if they also have permissions for those files.

## Part II-a

### Regular Expression

Find outcomes for each given basic/extended regular expression (maybe multiple correct answers)

Points per question: 2.5

*Example:*

*'ab+a' (extended regex)*

**Answer:** *aba , abba ; Pattern : The matched string should begin and end with 'a' and 'b' occurs at least once between leading and ending 'a'*

Note: 7) to 10) are basic regexes; Note: 11) to 18) are extended regexes.

7) *'a[ab]\*a'*

**Answer:** *aa, aba , abaa; Pattern : The matched string should begin and end with 'a' and 'a' or 'b' occurs zero or more times between leading and ending 'a'*

8) *'a(bc)?'*

**Answer:** *a, abc; Pattern : The matched string should begin with 'a' and 'bc' occurs a maximum of once after 'a'*

9) *'.[ind]\*'*

**Answer:** *a, b, c, rind, win; Pattern : The matched string can begin with any character and 'i', 'n' or 'd' occurs zero or more times after the first character*

10) *'[a-z]+[a-z]'*

**Answer:** *hello, water , air, go; Pattern : The matched string should end with lowercase letters a-z and should have at least one lowercase letter before the ending letter*

11) '[a-z] (\+[a-z])+'

**Answer:** *b +c, k +d+r, u +n+i+x; Pattern: The matched string should begin with a lowercase letter, then a space, and then the pattern '+<lowercase letter>' occurs at least once after the first letter.*

12) 'a.[bc]+'

**Answer:** *abb , alccb ; Pattern : The matched string should begin with 'a', have any one character after 'a', and 'b' and 'c' occurs at least once after 'a' and any character*

13) 'a.[0-9]'

**Answer:** *ab0, a\$5, ak4 ; Pattern : The matched string should begin with 'a', have any one character after 'a', and end with any digit character (0 - 9)*

14) '[a-z]+[\. \?!]'

**Answer:** *water. air! fire?; Pattern: The matched string should contain one or more lowercase letters and should end with a period (.), question mark (?), or exclamation mark (!).*

15) '[a-z]+[\. \?!] \s\*[A-Z]'

**Answer:** *water. T, hello! \nT, this?W; Pattern: The matched string should contain one or more lowercase letters, then a period (.), question mark (?), or exclamation mark (!), then zero or more whitespace characters like spaces, tabs or line breaks, and must end with an uppercase letter*

16) '(very )+(cool )?(good|bad) weather'

**Answer:** *very cool good weather, very very bad weather*

**Pattern:** *The matched string should begin with the word 'very' with a space after it one or more times, then can contain the word 'cool' and a space upto one time, then can contain either 'good' or 'bad', then a space and end with the word 'weather'*

17) '-?[0-9]+'

**Answer:** 70, -50, 4; **Pattern :** The matched string can begin with the character '-' zero or one times, and then have at least one numeric character after.

18) '-?[0-9]\*\.[0-9]\*'

**Answer:** ., 70, -50, 4.2, -.09; **Pattern :** The matched string can begin with the character '-' zero or one times, and then have zero or more numeric characters after, then may have a single dot (.) character or not, then can have zero or more numeric characters after the dot.

## Part II-b

### Regular Expression

Write down the extended regular expression for following questions.

E.g. Social security number in the format of 999-99-9999. **Answer:**

**[0-9]{3}-[0-9]{2}-[0-9]{4}**

**Points per question: 5**

19) Valid URL beginning with "http://" and ending with ".edu" (e.g. <http://cs.gsu.edu>, <http://gsu.edu>)

**Answer:** http:\\\\[\\w.]+(\\.edu)

20) Non-negative integers. (e.g. 0, +1, 3320)

**Answer:** \\+?[0-9]+'

21) A valid absolute pathname in Unix (e.g. /home/ylong4, /test/try.c)

**Answer:** (\\S+)+

22) Identifiers which can be between 1 and 10 characters long, must start with a letter or an underscore. The following characters can be letters or underscores or digits. (e.g. number, \_name1, isOK).

**Answer:** `[A-Za-z_][\w_]{0,9}`

23) Phone number in any of the following format: 9999999999,999-999-9999, (999)-999-9999. (Note: all of these formats should be matched by a single regular expression)

**Answer:** `\(?\d{3}\)?-?\d{3}-?\d{4}`

### **Part III**

#### **Programming**

##### **Points per question: 15**

24. Create a file named `homework_instructions.txt` using VI editor and type in it all the submission instructions from page1 of this document. Save the file in a directory named *homeworks* that you would have created. Set the permissions for this file such that only you can edit the file while anybody can only read. Find and list (on the command prompt) all the statements that contain the word POINTS. Submit your answer as a description of what you did in a sequential manner (e.g. Step1 ... Step 2... and so on..). Add a screenshot to your answer as a proof of evidence.

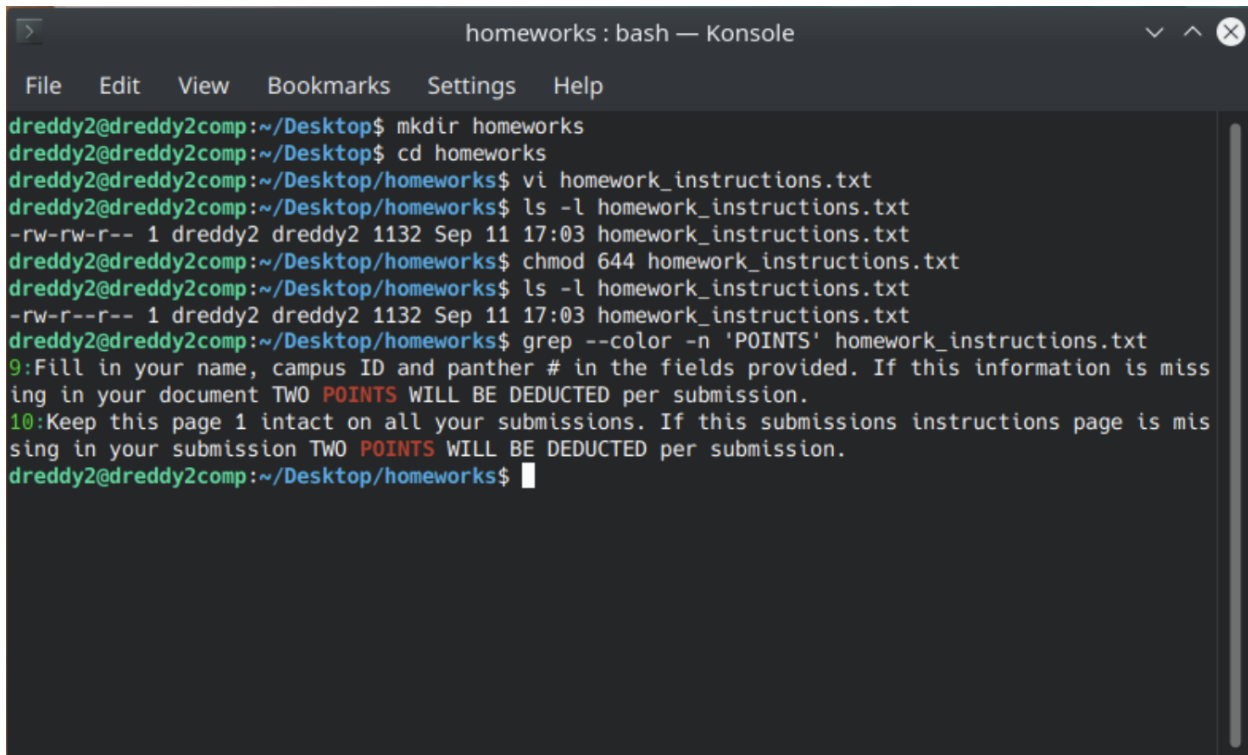
##### **Answer in Steps:**

1. Created a directory called 'homeworks' using the command `mkdir homeworks`
2. Changed to this directory with the command `cd homeworks`
3. Created a file called `homework_instructions.txt` using VI editor with the command `vi homework_instructions.txt`
4. Entered insert mode in the file by pressing the `i` key
5. Typed out the submission instructions
6. Saved the file and quit by entering command mode by pressing the `ESC` key and then typing `:wq`
7. Checked the current permissions of the file with the command `ls -l homework_instructions.txt`



8. Changed the instruction so that only the owner can edit it and other users can only read it with the command `chmod 644 homework_instructions.txt`
9. Checked the changed permissions of the file with the command `ls -l homework_instructions.txt`
10. Found and displayed the lines in the file with the word 'POINTS' with the command `grep --color -n 'POINTS' homework_instructions.txt` (the options `-n` to show the line numbers where the word occurs and `--color` to highlight the word found)

## Screenshot



```
homeworks : bash — Konsole
File Edit View Bookmarks Settings Help
dreddy2@dreddy2comp:~/Desktop$ mkdir homeworks
dreddy2@dreddy2comp:~/Desktop$ cd homeworks
dreddy2@dreddy2comp:~/Desktop/homeworks$ vi homework_instructions.txt
dreddy2@dreddy2comp:~/Desktop/homeworks$ ls -l homework_instructions.txt
-rw-rw-r-- 1 dreddy2 dreddy2 1132 Sep 11 17:03 homework_instructions.txt
dreddy2@dreddy2comp:~/Desktop/homeworks$ chmod 644 homework_instructions.txt
dreddy2@dreddy2comp:~/Desktop/homeworks$ ls -l homework_instructions.txt
-rw-r--r-- 1 dreddy2 dreddy2 1132 Sep 11 17:03 homework_instructions.txt
dreddy2@dreddy2comp:~/Desktop/homeworks$ grep --color -n 'POINTS' homework_instructions.txt
9:Fill in your name, campus ID and panther # in the fields provided. If this information is missing in your document TWO POINTS WILL BE DEDUCTED per submission.
10:Keep this page 1 intact on all your submissions. If this submissions instructions page is missing in your submission TWO POINTS WILL BE DEDUCTED per submission.
dreddy2@dreddy2comp:~/Desktop/homeworks$
```