

CS333 - Lab4

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February 2, 2016

1 Question 01

Process ID of bash was found to be 4090 (Found using ps command). Branch of the process tree which leads to the bash shell is as shown:

```
init --- lightdm ---- lightdm ---- init ---- gnome-terminal ---- bash
```

The above was found using

```
pstree -H <pid_of_bash>
```

2 Question 02

'cd' and 'history' are implemented in the bash shell code, and the others are exec'd. This was found using the 'help', which lists the commands implemented in bash.

3 Question 03

File descriptors 0 and 2 are pointing to /dev/pts/2 which correspond to standard input and standard error output, both being the terminal. File descriptor 1 points to /tmp/tmp.txt. Thus, IO redirection in bash is implemented by making standard file descriptors point to locations where the IO needs to be redirected to/from. 'readlink' command can be used to find where the file descriptors point to.

4 Question 04

The file descriptors (1 for cpulprint and 0 for grep) point to the same pipe (determined by pipe id from readlink output). Thus, pipe is implemented in bash by pointing to std out file desc(1) of the left side process of the pipe to a pipe buffer and the std in file desc(0) of the right side of the pipe to the same pipe buffer.