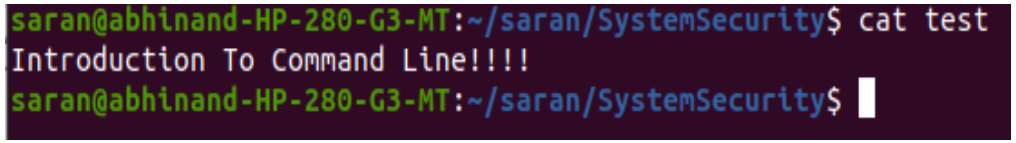
Linux Command Line

Command Line

- The command line (aka "shell") is a powerful interface to a computer
  - You type a command.
  - The system executes it and outputs the results.

Typically, a command will contain a program name and arguments to that program, separated by spaces.



1. Run the program cat with the argument test
2. The shell found the cat program file and launched it into a cat process with a test argument.
3. cat is a program that outputs files. It reads the test argument and knows to output the test file, which contains "Introduction To Command Line!!!!".

Process

- A process is a running program.
- A program is a file on your computer.
- Your web browser, your command line interpreter ("shell"), your text editor, all start out as files on the filesystem and become processes when they are executed.

The File System

- Files are organized into file systems.
- Unlike Windows (which traditionally has different file systems at different anchor points C:\, D:\, E:\, etc.), Linux presents a unified file system view.

/	The "anchor" of the filesystem. Pronounced "root".
/usr	The **U**nix **S**ystem **R**esource. Contains all the system files.
/usr/bin	Executable files for programs installed on the computer.
/usr/lib	Shared libraries for use by programs on the computer
/usr/share	Program resources (icons, art assets, etc)
/etc	System configuration
/var	Logs, caches, etc
/home	User-owned data
/proc	Runtime process data
/tmp	Temporary data storage

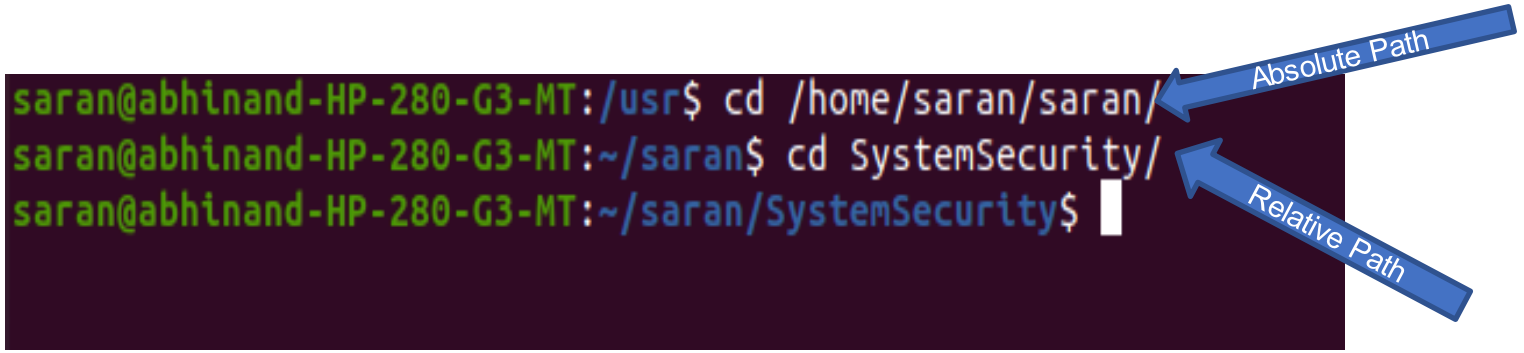
Directories

- Files are stored in **directories** in the filesystem. Each directory has several files.
- Each process has a "current working directory". You can view it with the **pwd** builtin (and it usually shows in your prompt) and change it with the **cd** builtin.
- You can *list* the files in a directory using the **ls** command. With no arguments, it will list the files in the current directory.

```
saran@abhinand-HP-280-G3-MT:~/saran$ pwd
/home/saran/saran
saran@abhinand-HP-280-G3-MT:~/saran$ ls
SystemSecurity  WebApp
saran@abhinand-HP-280-G3-MT:~/saran$ cd /usr
saran@abhinand-HP-280-G3-MT:/usr$ ls
bin     include  lib32  libexec  local  share
games   lib      lib64  libx32   sbin   src
saran@abhinand-HP-280-G3-MT:/usr$ pwd
/usr
saran@abhinand-HP-280-G3-MT:/usr$ cd /home/saran/saran/
saran@abhinand-HP-280-G3-MT:~/saran$
```

Specifying paths

- There are two ways to specify paths:
  - **Absolute Paths** start with /, such as /usr, /home/saran/saran, etc.
  - **Relative Paths** *don't* start with / and are relative to the current working directory.



Path

- A "path" contains:
  - Possible leading "/" to specify that the path is absolute (starts at the root).
  - Directory names, followed by "/" to reference resources "inside" a directory.
  - A ".", signifying "current directory".
  - A "..", signifying "the directory that the current directory lives in".
  - A file name at the end of the path, referencing a file with that name.

Paths to commands

If the first word of the command has no / characters, the shell will search for it in either its builtins or a set of directories specified in the PATH environment variable.

Environment Variables?

- Set of Key/Value pairs passed into every process when it is launched.
- Critical variables:

PATH: a list of directories to search for programs in.
PWD: the current working directory (same as the pwd command)
HOME: the path to your home directory
HOSTNAME: the name of your system

```
USER=saran
GNOME_TERMINAL_SERVICE=:1.96
DISPLAY=:0
SHLVL=1
QT_IM_MODULE=ibus
XDG_RUNTIME_DIR=/run/user/1001
JOURNAL_STREAM=8:43066
XDG_DATA_DIRS=/usr/share/ubuntu:/usr/local/share/:/usr/share/:/var/lib/snapd/desktop
PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin:/usr/games:/usr/local/games:/snap/bin
GDMSESSION=ubuntu
```

Path

- To know what program file ends up becoming our cat process after it's found using the PATH variable, use which.

```
saran@abhinand-HP-280-G3-MT:~$ cat saran/SystemSecurity/test
Introduction To Command Line!!!!
saran@abhinand-HP-280-G3-MT:~$ which cat
/usr/bin/cat
saran@abhinand-HP-280-G3-MT:~$ /usr/bin/cat saran/SystemSecurity/test
Introduction To Command Line!!!!
saran@abhinand-HP-280-G3-MT:~$
```

Files

```
saran@abhinand-HP-280-G3-MT:~$ ls -ld saran/SystemSecurity/
drwxrwxr-x 2 saran saran 4096 Jul  5 14:03 saran/SystemSecurity/
saran@abhinand-HP-280-G3-MT:~$ ls -ld saran/SystemSecurity/test
-rw-rw-r-- 1 saran saran 33 Jul  5 14:03 saran/SystemSecurity/test
saran@abhinand-HP-280-G3-MT:~$
```

- Types
  - \- is a **regular file**
  - **d** is a **directory** (yes, directories are actually just special files!)
  - l is a **symbolic link** (a file that transparently points to another file or directory)
  - p is a **named pipe** (also known as a FIFO. You will get very familiar with these this module!)
  - c is a **character device file** (i.e., backed by a hardware device that produces or receives data streams, such as a microphone)
  - b is a **block device file** (i.e., backed by a hardware device that stores and loads blocks of data, such as a hard drive)
  - s is a **unix socket** (essentially a local network connection encapsulated in a file)

Symbolic Links

- A symbolic/soft link is a special type of file that references another file.
- They are created ln -s (-s stands for symbolic)
- Aka Soft links

```
saran@abhinand-HP-280-G3-MT:~$ ln -s saran/SystemSecurity/test link_to_the_testFile
saran@abhinand-HP-280-G3-MT:~$ ls
Desktop  Documents  Downloads  link_to_the_testFile  Music  Pictures  Public  saran  snap  Templates  Videos
saran@abhinand-HP-280-G3-MT:~$ cat ./link_to_the_testFile
Introduction To Command Line!!!!
saran@abhinand-HP-280-G3-MT:~$ ln -s saran/SystemSecurity/ link_to_the_dir
saran@abhinand-HP-280-G3-MT:~$ ls
Desktop  Documents  Downloads  link_to_the_dir  link_to_the_testFile  Music  Pictures  Public  saran  snap  Templates  Videos
saran@abhinand-HP-280-G3-MT:~$ cat link_to_the_dir/test
Introduction To Command Line!!!!
saran@abhinand-HP-280-G3-MT:~$ cat link_to_the_testFile
Introduction To Command Line!!!!
saran@abhinand-HP-280-G3-MT:~$
```

Symbolic link

- symbolic links to relative paths are relative to the directory containing the link!

Relative Path

```
saran@abhinand-HP-280-G3-MT:~$ ls -l link_to_the_testFile
lrwxrwxrwx 1 saran saran 25 Jul  5 15:59 link_to_the_testFile -> saran/SystemSecurity/test
saran@abhinand-HP-280-G3-MT:~$ mv link_to_the_testFile /tmp
saran@abhinand-HP-280-G3-MT:~$ ls -l /tmp
total 44
-rw------- 1 saran saran    0 Jul  5 13:39 config-err-uxbuxN
lrwxrwxrwx 1 saran saran   25 Jul  5 15:59 link_to_the_testFile -> saran/SystemSecurity/test
drwx------ 3 root  root  4096 Jul  5 13:39 snap.snap-store
drwx------ 2 saran saran 4096 Jul  5 13:39 ssh-wkr1CYn0ngrk
drwx------ 3 root  root  4096 Jul  5 13:39 systemd-private-5ef921568be84720b64003cf8eb9b137-colord.service-eTzfKh
drwx------ 3 root  root  4096 Jul  5 13:38 systemd-private-5ef921568be84720b64003cf8eb9b137-ModemManager.service-jURtih
drwx------ 3 root  root  4096 Jul  5 13:38 systemd-private-5ef921568be84720b64003cf8eb9b137-switcheroo-control.service-CwFXkg
drwx------ 3 root  root  4096 Jul  5 13:38 systemd-private-5ef921568be84720b64003cf8eb9b137-systemd-logind.service-SwoWai
drwx------ 3 root  root  4096 Jul  5 13:38 systemd-private-5ef921568be84720b64003cf8eb9b137-systemd-resolved.service-EaTnug
drwx------ 3 root  root  4096 Jul  5 13:39 systemd-private-5ef921568be84720b64003cf8eb9b137-upower.service-CzJWdh
drwx------ 2 saran saran 4096 Jul  5 13:40 Temp-0e12183b-081d-4314-8359-6e1274e94093
drwx------ 2 saran saran 4096 Jul  5 13:39 tracker-extract-files.1001
drwx------ 2 gdm   gdm   4096 Jul  5 13:39 tracker-extract-files.125
saran@abhinand-HP-280-G3-MT:~$ cat /tmp/link_to_the_testFile
cat: /tmp/link_to_the_testFile: No such file or directory
saran@abhinand-HP-280-G3-MT:~$
```

Absolute Path

```
saran@abhinand-HP-280-G3-MT:~$ ln -s /home/saran/saran/SystemSecurity/test link_to_the_testFile
saran@abhinand-HP-280-G3-MT:~$ ls -l link_to_the_testFile
lrwxrwxrwx 1 saran saran 37 Jul  5 16:18 link_to_the_testFile -> /home/saran/saran/SystemSecurity/test
saran@abhinand-HP-280-G3-MT:~$ mv link_to_the_testFile /tmp
saran@abhinand-HP-280-G3-MT:~$ ls -l /tmp
total 44
-rw------- 1 saran saran    0 Jul  5 13:39 config-err-uxbuxN
lrwxrwxrwx 1 saran saran   37 Jul  5 16:18 link_to_the_testFile -> /home/saran/saran/SystemSecurity/test
drwx------ 3 root  root  4096 Jul  5 13:39 snap.snap-store
drwx------ 2 saran saran 4096 Jul  5 13:39 ssh-wkr1CYn0ngrk
drwx------ 3 root  root  4096 Jul  5 13:39 systemd-private-5ef921568be84720b64003cf8eb9b137-colord.service-eTzfKh
drwx------ 3 root  root  4096 Jul  5 13:38 systemd-private-5ef921568be84720b64003cf8eb9b137-ModemManager.service-jURtih
drwx------ 3 root  root  4096 Jul  5 13:38 systemd-private-5ef921568be84720b64003cf8eb9b137-switcheroo-control.service-CwFXkg
drwx------ 3 root  root  4096 Jul  5 13:38 systemd-private-5ef921568be84720b64003cf8eb9b137-systemd-logind.service-SwoWai
drwx------ 3 root  root  4096 Jul  5 13:38 systemd-private-5ef921568be84720b64003cf8eb9b137-systemd-resolved.service-EaTnug
drwx------ 3 root  root  4096 Jul  5 13:39 systemd-private-5ef921568be84720b64003cf8eb9b137-upower.service-CzJWdh
drwx------ 2 saran saran 4096 Jul  5 13:40 Temp-0e12183b-081d-4314-8359-6e1274e94093
drwx------ 2 saran saran 4096 Jul  5 13:39 tracker-extract-files.1001
drwx------ 2 gdm   gdm   4096 Jul  5 13:39 tracker-extract-files.125
saran@abhinand-HP-280-G3-MT:~$ cat /tmp/link_to_the_testFile
Introduction To Command Line!!!!
```

Hard Links

- The existence of soft links implies a hard link.
- Hard links (created with ln without the -s argument) reference the original file directly
- A hard link is an equally "valid" reference to the original file as the original file itself. It is a file that happens to be backed by the same data as the original.

```
saran@abhinand-HP-280-G3-MT:~$ ln saran/SystemSecurity/test link_to_the_testFile
saran@abhinand-HP-280-G3-MT:~$ ls -l link_to_the_testFile
-rw-rw-r-- 2 saran saran 33 Jul  5 14:03 link_to_the_testFile
saran@abhinand-HP-280-G3-MT:~$ cat link_to_the_testFile
Introduction To Command Line!!!!
```

Pipes

- Pipes facilitate a unidirectional flow of information.
- Most commonly used to direct data from one command to another.

```
saran@abhinand-HP-280-G3-MT:~$ md5sum < link_to_the_testFile
dd359f96bde40b74e67605bafda6efd2  -
saran@abhinand-HP-280-G3-MT:~$ md5sum < link_to_the_testFile >outputFile
saran@abhinand-HP-280-G3-MT:~$ cat outputFile
dd359f96bde40b74e67605bafda6efd2  -
saran@abhinand-HP-280-G3-MT:~$ md5sum < link_to_the_testFile >>outputFile
saran@abhinand-HP-280-G3-MT:~$ cat outputFile
dd359f96bde40b74e67605bafda6efd2  -
dd359f96bde40b74e67605bafda6efd2  -
```