Numerical Methods Lesson 1

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Course page: http://jfbenitez.ddns.net:8080/Courses/MetodosNumericos

Goals for this Lesson

- Connect to a Linux Operating System

- Execute Bash commands

- Explore directory structure

- Edit and move files

- View results via Web Browser

Requirements

- Computer with Linux or Windows

- Terminal

- Internet connection

- Web Browser

- Linux account in Dr. Benitez home computer

System and User info

- **In the following slides we will connect to Dr. Benitez home network:**

- Server(IP): `jfbenitez.ddns.net`

- SSH Port to internal host "higgs": `1022`

- Operating system: CERN CentOS 8

- user id: `benitezj` , must be replaced by your own account id

- Your account id is set to your email name. Your initial password is set your full email path. Example for jose.benitez@unison.mx:
  - user id : jose.benitez
  - Password: jose.benitez@unison.mx

- View results published using the Web Browser address:
  http://jfbenitez.ddns.net:8080/Courses/MetodosNumericos

Secure Shell connection (SSH)

- From your computer Terminal connect using the following ssh command:
  `ssh benitezj@jfbenitez.ddns.net -p 1022`

- First time connected change your initial password:
  `passwd`

- Exit the system:
  `exit`

```
[benitezj@lxplus772:0] ~ >ssh benitezj@189.173.164.46 -p 1022
benitezj@189.173.164.46's password:
Web console: https://higgs:9090/ or https://192.168.1.73:9090/

Last login: Thu Jan 21 11:08:49 2021 from 188.185.121.19
[benitezj@higgs ~]$ passwd
Changing password for user benitezj.
Current password:
[benitezj@higgs ~]$ exit
logout
Connection to 189.173.164.46 closed.
[benitezj@lxplus772:0] ~ >
```

pwd, ls , cd

- Which directory you are located at:
  `pwd`

- Contents of current directory:
  `ls`

- Move to a different directory:
  `cd /tmp/`

- Move back to previous directory
  `cd –`

- Move home:
  `cd ~`

- Move one directory up :
  `cd ..`

```
[benitezj@higgs ~]$ pwd
/home/benitezj
[benitezj@higgs ~]$ ls
Desktop  Documents  Downloads  Music  Pictures  Public  scripts  Templates  Videos
[benitezj@higgs ~]$ cd /tmp/
[benitezj@higgs tmp]$ cd -
/home/benitezj
[benitezj@higgs ~]$ cd ~
[benitezj@higgs ~]$ █
```

mkdir, echo, cat, less, cp, chmod

- Create a new directory in your home area:
  ```
  cd ~
  mkdir MetodosNumericos
  cd MetodosNumericos
  ```

- Create a file with echo:
  ```
  echo "test" > file.txt
  ```

- View the file contents with cat and less:
  ```
  cat file.txt
  less file.txt
  ```

- Make a directory in your web area:
  ```
  mkdir /var/www/html/Courses/MetodosNumericos/2021-1/Lesson1/Results/benitezj
  ```

- Copy the file to another location:
  ```
  cp file.txt /var/www/html/Courses/MetodosNumericos/2021-1/Lesson1/Results/benitezj/
  ```

- Fix permissions on the file so that everyone can read it:
  ```
  ls -l /var/www/html/Courses/MetodosNumericos/2021-1/Lesson1/Results/benitezj/file.txt

  chmod a+r /var/www/html/Courses/MetodosNumericos/2021-1/Lesson1/Results/benitezj/file.txt

  ls -l /var/www/html/Courses/MetodosNumericos/2021-1/Lesson1/Results/benitezj/file.txt
  ```

After these commands you can view the new file on your web browser (see slide 4).

Index of /Courses/MetodosNumericos/2021-1/Lesson1/Results/benitezj

Name	Last modified	Size	Description
Parent Directory		-	
file.txt	2021-01-21 11:32	5	

Editing files (Emacs)

- The recommended file editor is Emacs
  https://www.gnu.org/software/emacs/manual/emacs.html

- Emacs is very powerful, but for now we need only basic commands:
  https://www.gnu.org/software/emacs/manual/html_node/emacs/Basic.html#Basic

- It takes some practice to learn all the editing commands

- Examples:
  - Create and edit a new file:
    ```
    cd ~
    emacs file.txt
    ```
  - Inside emacs:
    save edits: `Ctrl-x , Ctrl-s`
    exit emacs: `Ctrl-x , Ctrl-c`

Bash scripts

- Commands that can be executed in the command line can be made into bash script with multiple commands and logic.

- Example:
    - create a file:
      ```
      emacs test.sh
      ```

    - inside test.sh file put following contents:
      ```
      #This is just a comment
      echo "Hello World"
      echo "Hello World again"
      ```

    - execute the script:
      ```
      bash test.sh
      ```

```
[benitezj@higgs ~]$ emacs test.sh
[benitezj@higgs ~]$ bash test.sh
Hello World
Hello World again
[benitezj@higgs ~]$ ▮
```

Data storage and transfer (scp)

- Data will be stored in the following directory:
  `/home/DATA/MetodosNumericos`

- It will be readable and writable by all users so PLEASE BECAREFUL NOT TO REMOVE THE CONTENTS

- Data files can be transferred from external machines using scp if you have access to the external machine.

- Example: transfer `Lesson1.dat` file from a CERN machine `lxplus.cern.ch` using `scp` command:
  `scp benitezj@lxplus.cern.ch:public/Teaching/MetodosNumericos/Lesson1/Lesson1.dat /home/DATA/MetodosNumericos/`

```
[benitezj@higgs Results]$ scp benitezj@lxplus.cern.ch:/afs/cern.ch/user/b/benitezj/public/Teaching/MetodosNumericos/Lesson1/Lesson1.dat /home/DATA/MetodosNumericos/.
Warning: Permanently added the ECDSA host key for IP address '2001:1458:d00:4c::100:41c' to the list of known hosts.
Password:
Lesson1.dat                                                                    100%  847
[benitezj@higgs Results]$ ls /home/DATA/MetodosNumericos/.
Lesson1.dat
[benitezj@higgs Results]$ less /home/DATA/MetodosNumericos/Lesson1.dat
[benitezj@higgs Results]$ ls -l /home/DATA/MetodosNumericos/Lesson1.dat
-rw-r--r--. 1 benitezj benitezj 847 Jan 21 18:37 /home/DATA/MetodosNumericos/Lesson1.dat
```

ROOT

- ROOT is a general c/c++ based data analysis framework.

- Documentation containing the list of all ROOT classes can be found here:
  https://root.cern.ch
  Some examples and tutorials for each object can be found there or by searching in google.

- ROOT is an executable, see the following image how to start and do some basic commands.

```
[benitezj@higgs Results]$ root
   ----------------------------------------------------------------
  | Welcome to ROOT 6.22/06                         https://root.cern |
  | (c) 1995-2020, The ROOT Team; conception: R. Brun, F. Rademakers |
  | Built for linuxx8664gcc on Nov 27 2020, 15:14:08                 |
  | From tags/v6-22-06@v6-22-06                                      |
  | Try '.help', '.demo', '.license', '.credits', '.quit'/'.q'       |
   ----------------------------------------------------------------

root [0] float x=1.0
(float) 1.00000f
root [1] float y=2.0
(float) 2.00000f
root [2] x*y
(float) 2.00000f
root [3] .q
```

ROOT Example 1

- ROOT can execute scripts written in c/c++.

- These files do not need compilation

- Example: Create a file called example1.C with the following contents
  ```
  void example1(){
  std::cout<<"Hello World"<<std::endl;
  }
  ```

- NOTE: the name of the function: `void example1()` must be same as the name of the file: `example1.C`

- Run the script:
  ```
  root -q example1.C
  ```



```
[benitezj@higgs Results]$ root -q example1.C
   --------------------------------------------------------------
  | Welcome to ROOT 6.22/06                      https://root.cern |
  | (c) 1995-2020, The ROOT Team; conception: R. Brun, F. Rademakers |
  | Built for linuxx8664gcc on Nov 27 2020, 15:14:08              |
  | From tags/v6-22-06@v6-22-06                                   |
  | Try '.help', '.demo', '.license', '.credits', '.quit'/'.q'    |
   --------------------------------------------------------------


Processing example1.C...
Hello World
[benitezj@higgs Results]$
```

ROOT Example 2

- In this example we generate a data from a Gaussian distribution:
  ```
  root -q /home/DATA/MetodosNumericos/example2.C
  ```

ROOT Example 3

- In this example we read the data generated in Example 2 and print it on the terminal:
  ```
  root -q /home/DATA/MetodosNumericos/example3.C
  ```

```
[benitezj@higgs Results]$ root -q /home/DATA/MetodosNumericos/example3.C
   ------------------------------------------------------------
  | Welcome to ROOT 6.22/06                      https://root.cern |
  | (c) 1995-2020, The ROOT Team; conception: R. Brun, F. Rademakers |
  | Built for linuxx8664gcc on Nov 27 2020, 15:14:08             |
  | From tags/v6-22-06@v6-22-06                                  |
  | Try '.help', '.demo', '.license', '.credits', '.quit'/'.q'   |
   ------------------------------------------------------------


Processing /home/DATA/MetodosNumericos/example3.C...
1 1.34725
2 0.901742
3 0.942488
```