

SHIVGAMI

Simplifying the titanlc blastx process using available Gathering of computational units

About SHIVGAMI

blastx is widely used program to annotate unknown nucleotide sequences. SHIVGAMI assemble the available CPU cores from LINUX machines and utilizes them to run blastx process. SHIVGAMI motivates those researchers/labs who have small computational units instead of high end computing facilities. SHIVGAMI assemble those small units, divide the blastx input queries amongst them and finally combine those results into a single output file. Additionally, the well-equipped labs, whose servers are loaded can also combined their other units with available CPU cores using SHIVGAMI.

1. Gathering of Linux computational units

Collecting information for those computational units which are having Linux Operating Systems(OS) User can include all types of Linux Machines like Normal PCs, High-config PCs and Servers. We have not tested SHIVGAMI on laptops, but user can include, if the laptop is LAN connected.

We have tested SHIVGAMI on Ubuntu and CentOS

Ubuntu

```
lab2@lab2-ThinkCentre-M93p: ~  
lab2@lab2-ThinkCentre-M93p:~$ cat /etc/lsb-release  
DISTRIB_ID=Ubuntu  
DISTRIB_RELEASE=16.04  
DISTRIB_CODENAME=xenial  
DISTRIB_DESCRIPTION="Ubuntu 16.04.6 LTS"  
lab2@lab2-ThinkCentre-M93p:~$
```

CentOS

```
user_132@localhost:~  
[user_132@localhost ~]$ cat /etc/redhat-release  
CentOS Linux release 7.5.1804 (Core)  
[user_132@localhost ~]$
```

2. Preparation

(I) Prerequisites

i. Perl

Below command will show you, which version of perl is installed `perl -v`

```
lab2@lab2-ThinkCentre-M93p: ~
lab2@lab2-ThinkCentre-M93p:~$ perl -v
This is perl 5, version 22, subversion 1 (v5.22.1) built for x86_64-linux-gnu-thread-multi
(with 73 registered patches, see perl -V for more detail)

Copyright 1987-2015, Larry Wall

Perl may be copied only under the terms of either the Artistic License or the
GNU General Public License, which may be found in the Perl 5 source kit.

Complete documentation for Perl, including FAQ lists, should be found on
this system using "man perl" or "perldoc perl".  If you have access to the
Internet, point your browser at http://www.perl.org/, the Perl Home Page.

lab2@lab2-ThinkCentre-M93p:~$
```

If, perl is not installed then, run the following commands:

Debian/Ubuntu

```
sudo apt-get install perl
```

RedHat/CentOS

```
yum install perl (run this as a root user)
```

ii. sshpass

Debian/Ubuntu

```
sudo apt-get install sshpass
```

RedHat/CentOS

```
yum install sshpass (run this as a root user)
```

user can re-check the installation using command:

```
sshpass -h
```

```
lab2@lab2-ThinkCentre-M93p: ~
lab2@lab2-ThinkCentre-M93p:~$ sshpass -h
Usage: sshpass [-f|-d|-p|-e] [-hV] command parameters
  -f filename  Take password to use from file
  -d number    Use number as file descriptor for getting password
  -p password  Provide password as argument (security unwise)
  -e          Password is passed as env-var "SSHPASS"
With no parameters - password will be taken from stdin

  -h          Show help (this screen)
  -V          Print version information
At most one of -f, -d, -p or -e should be used
lab2@lab2-ThinkCentre-M93p:~$
```

iii. OpenSSH Server

iv. OpenSSH Client

Ubuntu OS may have openssh-client, if not, it can be retrieved using commnd:

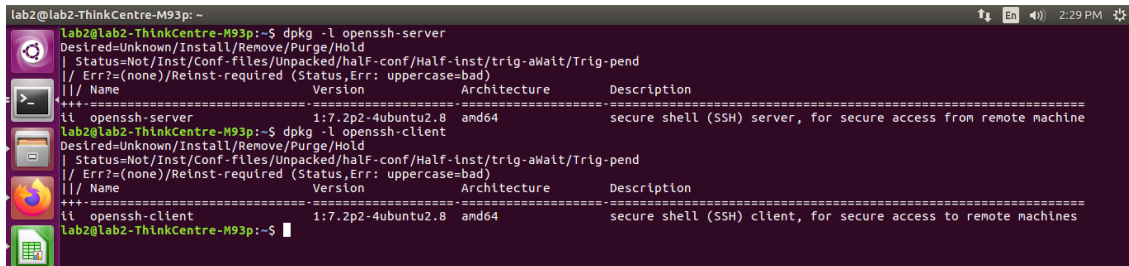
Debian/Ubuntu

sudo apt-get install openssh-server openssh-client

The installation can be verified using commands:

sudo dpkg -l openssh-server

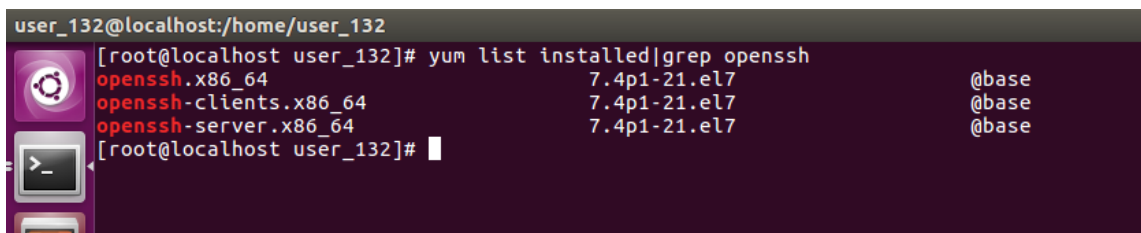
sudo dpkg -l openssh-client



```
lab2@lab2-ThinkCentre-M93p:~$ sudo dpkg -l openssh-server
Desired=Unknown/Install/Remove/Purge/Hold
| Status=Not/Inst/Conf-files/Unpacked/halF-conf/Half-inst/trig-aWait/Trig-pend
|/ Err?=(none)/Reinst-required (Status,Err: uppercase=bad)
++-----+
|/ Name          Version             Architecture         Description
++-----+
ii openssh-server 1:7.2p2-4ubuntu2.8 amd64                secure shell (SSH) server, for secure access from remote machine
lab2@lab2-ThinkCentre-M93p:~$ sudo dpkg -l openssh-client
Desired=Unknown/Install/Remove/Purge/Hold
| Status=Not/Inst/Conf-files/Unpacked/halF-conf/Half-inst/trig-aWait/Trig-pend
|/ Err?=(none)/Reinst-required (Status,Err: uppercase=bad)
++-----+
|/ Name          Version             Architecture         Description
++-----+
ii openssh-client 1:7.2p2-4ubuntu2.8 amd64                secure shell (SSH) client, for secure access to remote machines
lab2@lab2-ThinkCentre-M93p:~$
```

RedHat/CentOS

sudo apt-get install openssh-server openssh-client



```
user_132@localhost:/home/user_132
[root@localhost user_132]# yum list installed|grep openssh
openssh.x86_64                7.4p1-21.el7           @base
openssh-clients.x86_64      7.4p1-21.el7           @base
openssh-server.x86_64       7.4p1-21.el7           @base
[root@localhost user_132]#
```

v. Blast+

The latest Blast+ program can be obtained from NCBI ftp site, below are the steps

ftp://ftp.ncbi.nlm.nih.gov/

|

v

click on blast

|

v

click on executables

|

v

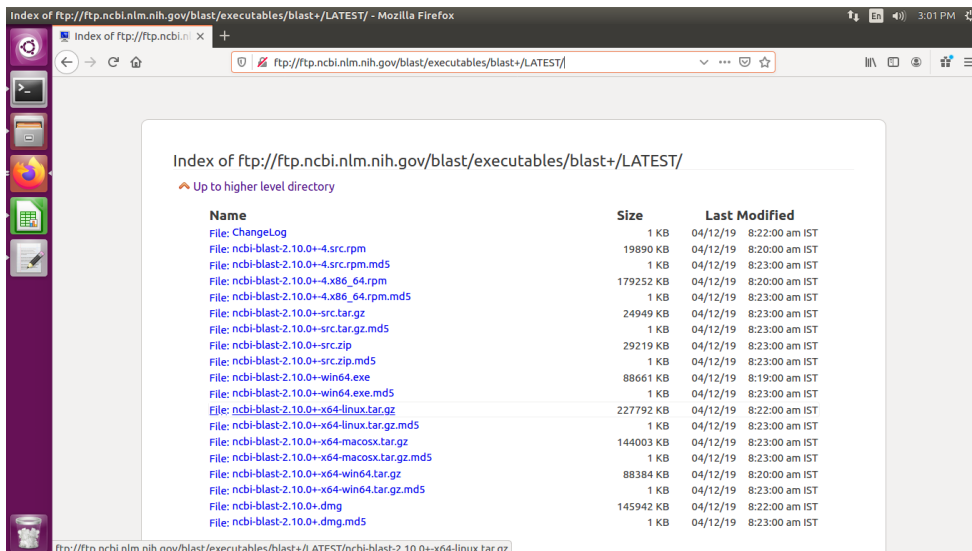
click on blast+

|

v

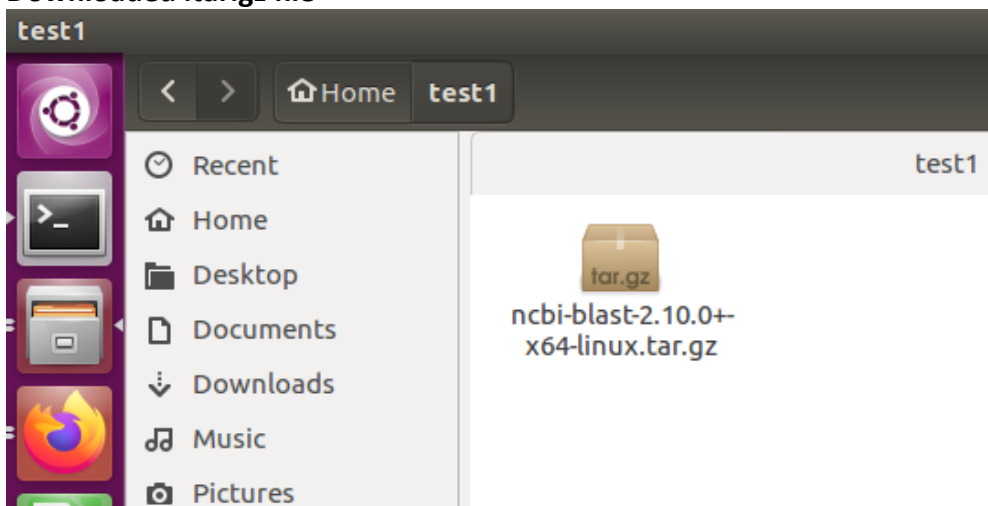
click on LATEST

(final link is: <ftp://ftp.ncbi.nlm.nih.gov/blast/executables/blast+/LATEST>)



There are various file types, but linux.tar.gz is an easy way to go!
Below is an illustration:

Downloaded .tar.gz file



tar command to extract:

```

lab2@lab2-ThinkCentre-M93p: ~/test1/ncbi-blast-2.10.0+/bin
lab2@lab2-ThinkCentre-M93p:~/test1$ ls
ncbi-blast-2.10.0+-x64-linux.tar.gz
lab2@lab2-ThinkCentre-M93p:~/test1$ tar -xzf ncbi-blast-2.10.0+-x64-linux.tar.gz
lab2@lab2-ThinkCentre-M93p:~/test1$ ls
ncbi-blast-2.10.0+  ncbi-blast-2.10.0+-x64-linux.tar.gz
lab2@lab2-ThinkCentre-M93p:~/test1$ cd ncbi-blast-2.10.0+/
lab2@lab2-ThinkCentre-M93p:~/test1/ncbi-blast-2.10.0+$ ls
bin  ChangeLog  doc  LICENSE  ncbi_package_info  README
lab2@lab2-ThinkCentre-M93p:~/test1/ncbi-blast-2.10.0+$ cd bin/
lab2@lab2-ThinkCentre-M93p:~/test1/ncbi-blast-2.10.0+/bin$ ls
blastdb_aliastool  blastn  convert2blastmask  legacy_blast.pl  psiblast  tblastn
blastdbcheck  blastp  deltablast  makeblastdb  rpsblast  tblastx
blastdbcmd  blastx  dustmasker  makembindex  rpstblastn  update_blastdb.pl
blast_formatter  cleanup_blastdb_volumes.py  get_species_taxids.sh  makeprofiledb  segmasker  windowmasker
lab2@lab2-ThinkCentre-M93p:~/test1/ncbi-blast-2.10.0+/bin$ pwd
/home/lab2/test1/ncbi-blast-2.10.0+/bin
lab2@lab2-ThinkCentre-M93p:~/test1/ncbi-blast-2.10.0+/bin$

```

vi. Protein database

A user can make a customized protein database as per the requirement, But to use it for blastx, the database must be formatted as per the NCBI blast+ package.

Suppose a user has a protein database fasta file called - protein.fasta
The command to format protein.fasta is:

```
/home/lab2/test1/ncbi-blast-2.10.0+/bin/makeblastdb -in  
protein.fasta -input_type fasta -dbtype prot
```

Where,

/home/lab2/test1/ncbi-blast-2.10.0+/bin/makeblastdb:
is a fullpath to the makeblastdb executable

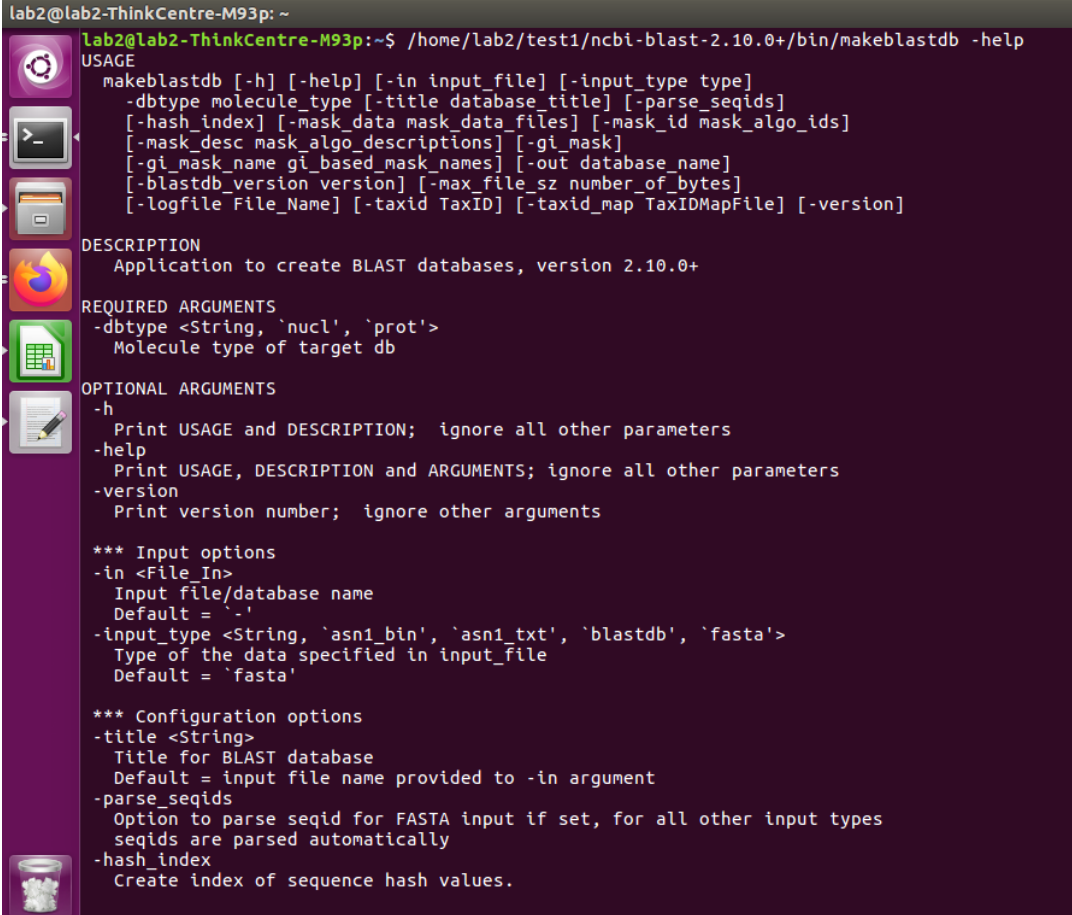
-in : input file

-input_type : input file type

-dbtype : molecule type (String OR nucl(nucleotide) OR prot(protein))

The same can be seen in detail with makeblastdb help

Long Help



```
lab2@lab2-ThinkCentre-M93p: ~  
lab2@lab2-ThinkCentre-M93p:~$ /home/lab2/test1/ncbi-blast-2.10.0+/bin/makeblastdb -help  
USAGE  
makeblastdb [-h] [-help] [-in input_file] [-input_type type]  
-dbtype molecule_type [-title database_title] [-parse_seqids]  
[-hash_index] [-mask_data mask_data_files] [-mask_id mask_algo_ids]  
[-mask_desc mask_algo_descriptions] [-gi_mask]  
[-gi_mask_name gi_based_mask_names] [-out database_name]  
[-blastdb_version version] [-max_file_sz number_of_bytes]  
[-logfile File_Name] [-taxid TaxID] [-taxid_map TaxIDMapFile] [-version]  
  
DESCRIPTION  
Application to create BLAST databases, version 2.10.0+  
  
REQUIRED ARGUMENTS  
-dbtype <String, 'nucl', 'prot'>  
Molecule type of target db  
  
OPTIONAL ARGUMENTS  
-h  
Print USAGE and DESCRIPTION; ignore all other parameters  
-help  
Print USAGE, DESCRIPTION and ARGUMENTS; ignore all other parameters  
-version  
Print version number; ignore other arguments  
  
*** Input options  
-in <File_In>  
Input file/database name  
Default = '-'  
-input_type <String, 'asn1_bin', 'asn1_txt', 'blastdb', 'fasta'>  
Type of the data specified in input_file  
Default = 'fasta'  
  
*** Configuration options  
-title <String>  
Title for BLAST database  
Default = input file name provided to -in argument  
-parse_seqids  
Option to parse seqid for FASTA input if set, for all other input types  
seqids are parsed automatically  
-hash_index  
Create index of sequence hash values.
```

Short Help

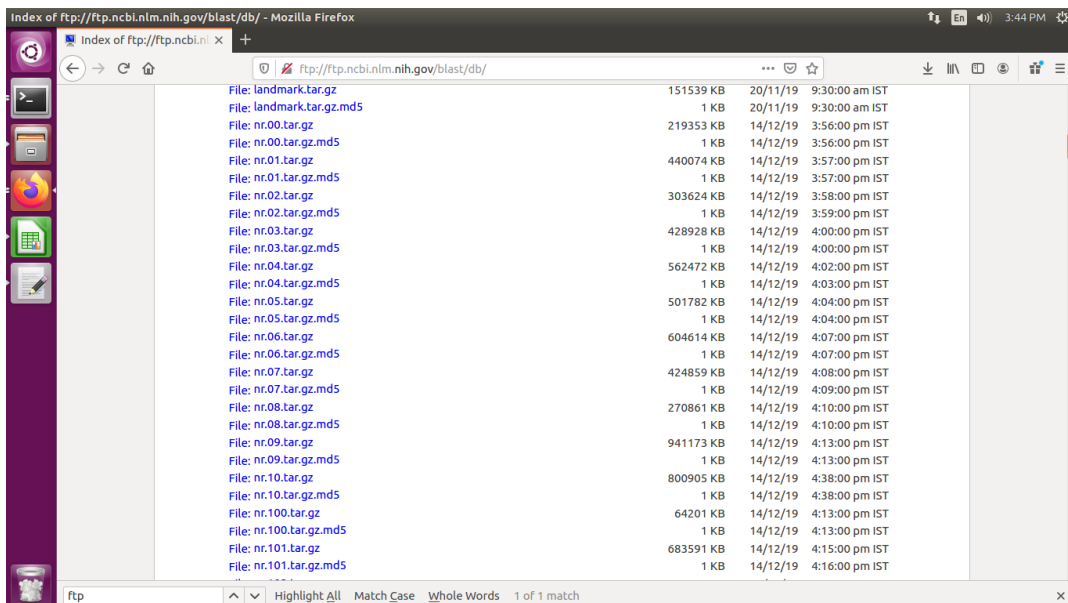
```
lab2@lab2-ThinkCentre-M93p: ~
Lab2@Lab2-ThinkCentre-M93p:~$ /home/lab2/test1/ncbi-blast-2.10.0+/bin/makeblastdb -h
USAGE
makeblastdb [-h] [-help] [-in input_file] [-input_type type]
             [-dbtype molecule_type] [-title database_title] [-parse_seqids]
             [-hash_index] [-mask_data mask_data_files] [-mask_id mask_algo_ids]
             [-mask_desc mask_algo_descriptions] [-gi_mask]
             [-gi_mask_name gi_based_mask_names] [-out database_name]
             [-blastdb_version version] [-max_file_sz number_of_bytes]
             [-logfile File_Name] [-taxid TaxID] [-taxid_map TaxIDMapFile] [-version]

DESCRIPTION
Application to create BLAST databases, version 2.10.0+

Use '-help' to print detailed descriptions of command line arguments
Lab2@Lab2-ThinkCentre-M93p:~$
```

If a user wanted to run blastx against NCBI-NR database, then the advantage is, it can be obtained as preformatted and can be downloaded from:

<ftp://ftp.ncbi.nlm.nih.gov/blast/db/>



File Name	Size	Timestamp
File: landmark.tar.gz	151539 KB	20/11/19 9:30:00 am IST
File: landmark.tar.gz.mds	1 KB	20/11/19 9:30:00 am IST
File: nr.00.tar.gz	219353 KB	14/12/19 3:56:00 pm IST
File: nr.00.tar.gz.mds	1 KB	14/12/19 3:56:00 pm IST
File: nr.01.tar.gz	440074 KB	14/12/19 3:57:00 pm IST
File: nr.01.tar.gz.mds	1 KB	14/12/19 3:57:00 pm IST
File: nr.02.tar.gz	303624 KB	14/12/19 3:58:00 pm IST
File: nr.02.tar.gz.mds	1 KB	14/12/19 3:59:00 pm IST
File: nr.03.tar.gz	428928 KB	14/12/19 4:00:00 pm IST
File: nr.03.tar.gz.mds	1 KB	14/12/19 4:00:00 pm IST
File: nr.04.tar.gz	562472 KB	14/12/19 4:02:00 pm IST
File: nr.04.tar.gz.mds	1 KB	14/12/19 4:03:00 pm IST
File: nr.05.tar.gz	501782 KB	14/12/19 4:04:00 pm IST
File: nr.05.tar.gz.mds	1 KB	14/12/19 4:04:00 pm IST
File: nr.06.tar.gz	604614 KB	14/12/19 4:07:00 pm IST
File: nr.06.tar.gz.mds	1 KB	14/12/19 4:07:00 pm IST
File: nr.07.tar.gz	424859 KB	14/12/19 4:08:00 pm IST
File: nr.07.tar.gz.mds	1 KB	14/12/19 4:09:00 pm IST
File: nr.08.tar.gz	270861 KB	14/12/19 4:10:00 pm IST
File: nr.08.tar.gz.mds	1 KB	14/12/19 4:10:00 pm IST
File: nr.09.tar.gz	941173 KB	14/12/19 4:13:00 pm IST
File: nr.09.tar.gz.mds	1 KB	14/12/19 4:13:00 pm IST
File: nr.10.tar.gz	800905 KB	14/12/19 4:38:00 pm IST
File: nr.10.tar.gz.mds	1 KB	14/12/19 4:38:00 pm IST
File: nr.100.tar.gz	64201 KB	14/12/19 4:13:00 pm IST
File: nr.100.tar.gz.mds	1 KB	14/12/19 4:13:00 pm IST
File: nr.101.tar.gz	683591 KB	14/12/19 4:15:00 pm IST
File: nr.101.tar.gz.mds	1 KB	14/12/19 4:16:00 pm IST

A user must download all files with prefix "nr." (nr.00 to nr.142 as on 13-Jan-2020 3:43 IST)

vii. SSH connection

SSH (Secure Shell) connection is must to run this software.

(II) Master node

A master node is a computational unit with Linux OS, which distributes the process amongst the child nodes, but do not take part in the blastx process.

Master node can be a simple computer or a server or a high-end pc.

(III) Child node system information

Child nodes are all computational units with Linux OS, except master node.

A text file "child_node_system_info.txt" (user can rename it, if required) creation is required, which must has all child nodes' information with below mentioned 7 entities:

i. Serial no.

This is just a serial number like 1,2,3..

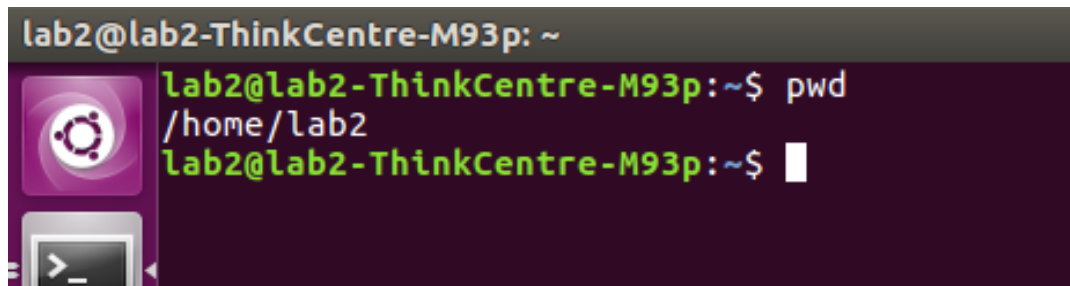
ii. User

Username of a current login

Ex. ram.

Usually, it's parent directory is /home

Below, the user is "lab2"



```
lab2@lab2-ThinkCentre-M93p: ~  
lab2@lab2-ThinkCentre-M93p:~$ pwd  
/home/lab2  
lab2@lab2-ThinkCentre-M93p:~$
```

iii. IP Address

It is an Internet Protocol address, can be displayed using 'ifconfig' command

Ubuntu

```
lab2@lab2-ThinkCentre-M93p: ~  
lab2@lab2-ThinkCentre-M93p:~$ ifconfig  
eno1    Link encap:Ethernet  HWaddr 6c:0b:84:94:d9:ca  
        inet addr:172.16.29.127  Bcast:172.16.29.255  Mask:255.255.255.0  
        inet6 addr: fe80::d970:f66:a858:ac3c/64  Scope:Link  
        UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1  
        RX packets:249579  errors:0  dropped:0  overruns:0  frame:0  
        TX packets:75740  errors:0  dropped:0  overruns:0  carrier:0  
        collisions:0  txqueuelen:1000  
        RX bytes:280446551 (280.4 MB)  TX bytes:7349035 (7.3 MB)  
        Interrupt:20  Memory:f7c00000-f7c20000  
  
lo      Link encap:Local Loopback  
        inet addr:127.0.0.1  Mask:255.0.0.0  
        inet6 addr: ::1/128  Scope:Host  
        UP LOOPBACK RUNNING  MTU:65536  Metric:1  
        RX packets:5586  errors:0  dropped:0  overruns:0  frame:0  
        TX packets:5586  errors:0  dropped:0  overruns:0  carrier:0  
        collisions:0  txqueuelen:1000  
        RX bytes:569783 (569.7 KB)  TX bytes:569783 (569.7 KB)  
  
lab2@lab2-ThinkCentre-M93p:~$
```

CentOS

```
user_132@localhost:~  
[user_132@localhost ~]$ ifconfig  
eno1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500  
        inet 172.16.29.132  netmask 255.255.255.0  broadcast 172.16.29.255  
        inet6 fe80::3e5b:fbdb:c3fd:1998  prefixlen 64  scopeid 0x20<link>  
        ether 6c:0b:84:94:da:41  txqueuelen 1000  (Ethernet)  
        RX packets 67402  bytes 8726427 (8.3 MiB)  
        RX errors 0  dropped 1  overruns 0  frame 0  
        TX packets 9937  bytes 1145185 (1.0 MiB)  
        TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0  
        device interrupt 20  memory 0xf7c00000-f7c20000  
  
lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536  
        inet 127.0.0.1  netmask 255.0.0.0  
        inet6 ::1  prefixlen 128  scopeid 0x10<host>  
        loop txqueuelen 1000  (Local Loopback)  
        RX packets 1092  bytes 95544 (93.3 KiB)  
        RX errors 0  dropped 0  overruns 0  frame 0  
        TX packets 1092  bytes 95544 (93.3 KiB)  
        TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0  
  
virbr0: flags=4099<UP,BROADCAST,MULTICAST>  mtu 1500  
        inet 192.168.122.1  netmask 255.255.255.0  broadcast 192.168.122.255  
        ether 52:54:00:4a:9f:30  txqueuelen 1000  (Ethernet)  
        RX packets 0  bytes 0 (0.0 B)  
        RX errors 0  dropped 0  overruns 0  frame 0  
        TX packets 0  bytes 0 (0.0 B)  
        TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0  
  
[user_132@localhost ~]$
```


iv. Password

A password for the child node system

Ex. lab2_123

v. Process path

A path or location where the process will run

Ex: /home/lab2/Naman

```
lab2@lab2-ThinkCentre-M93p: ~/Naman
Lab2@lab2-ThinkCentre-M93p:~/Naman$ pwd
/home/lab2/Naman
Lab2@lab2-ThinkCentre-M93p:~/Naman$
```

vi. Blast path

A path where blast+ executable is located

Ex: /home/lab2/test1/ncbi-blast-2.10.0+/bin

```
lab2@lab2-ThinkCentre-M93p: ~/test1/ncbi-blast-2.10.0+/bin
Lab2@lab2-ThinkCentre-M93p:~/test1/ncbi-blast-2.10.0+/bin$ pwd
/home/lab2/test1/ncbi-blast-2.10.0+/bin
Lab2@lab2-ThinkCentre-M93p:~/test1/ncbi-blast-2.10.0+/bin$
```

vii. Database path

A path where protein database is located

Ex: /home/lab2/test1/database

```
lab2@lab2-ThinkCentre-M93p: ~/test1/database
Lab2@lab2-ThinkCentre-M93p:~/test1/database$ ls
protefn.fasta
Lab2@lab2-ThinkCentre-M93p:~/test1/database$ /home/lab2/test1/ncbi-blast-2.10.0+/bin/makeblastdb -in protefn.fasta -input_type fasta -dbtype pr
ot
Building a new DB, current time: 01/13/2020 15:54:24
New DB name: /home/lab2/test1/database/protefn.fasta
New DB title: protefn.fasta
Sequence type: Protein
Keep MBits: T
Maximum file size: 1000000000B
Adding sequences from FASTA; added 20 sequences in 0.00278807 seconds.
Lab2@lab2-ThinkCentre-M93p:~/test1/database$ ls
protefn.fasta protefn.fasta.phr protefn.fasta.pot protefn.fasta.ptf
protefn.fasta.pdb protefn.fasta.pin protefn.fasta.psq protefn.fasta.pto
Lab2@lab2-ThinkCentre-M93p:~/test1/database$
```

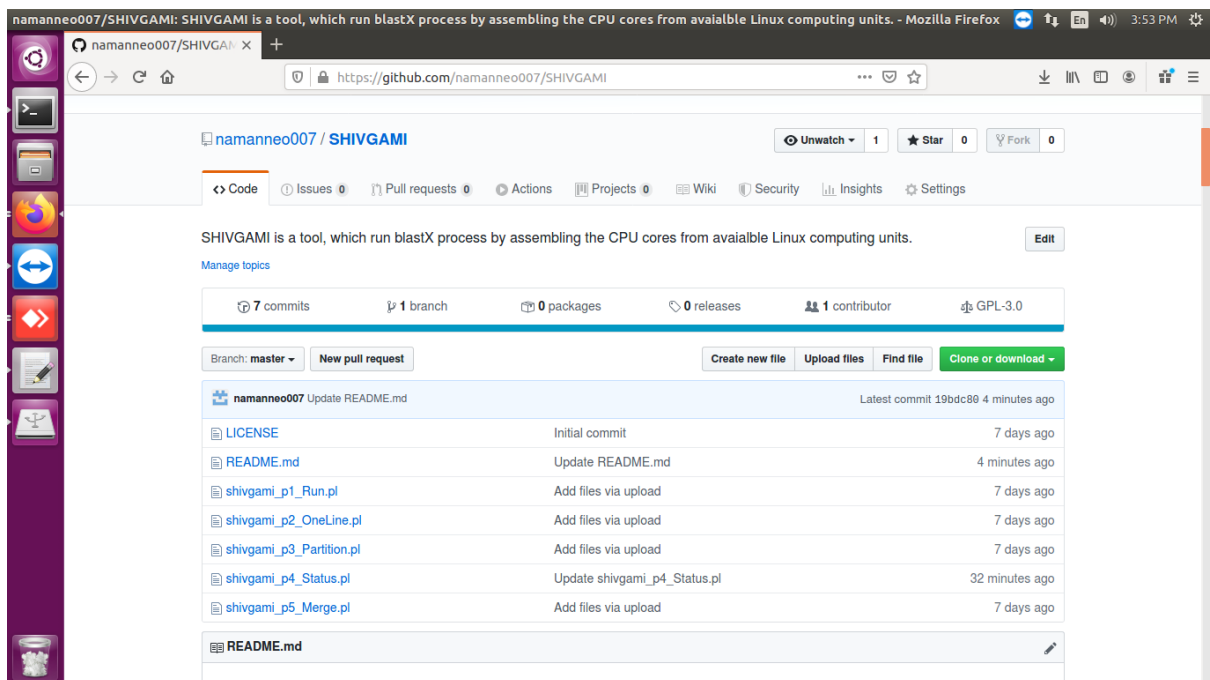
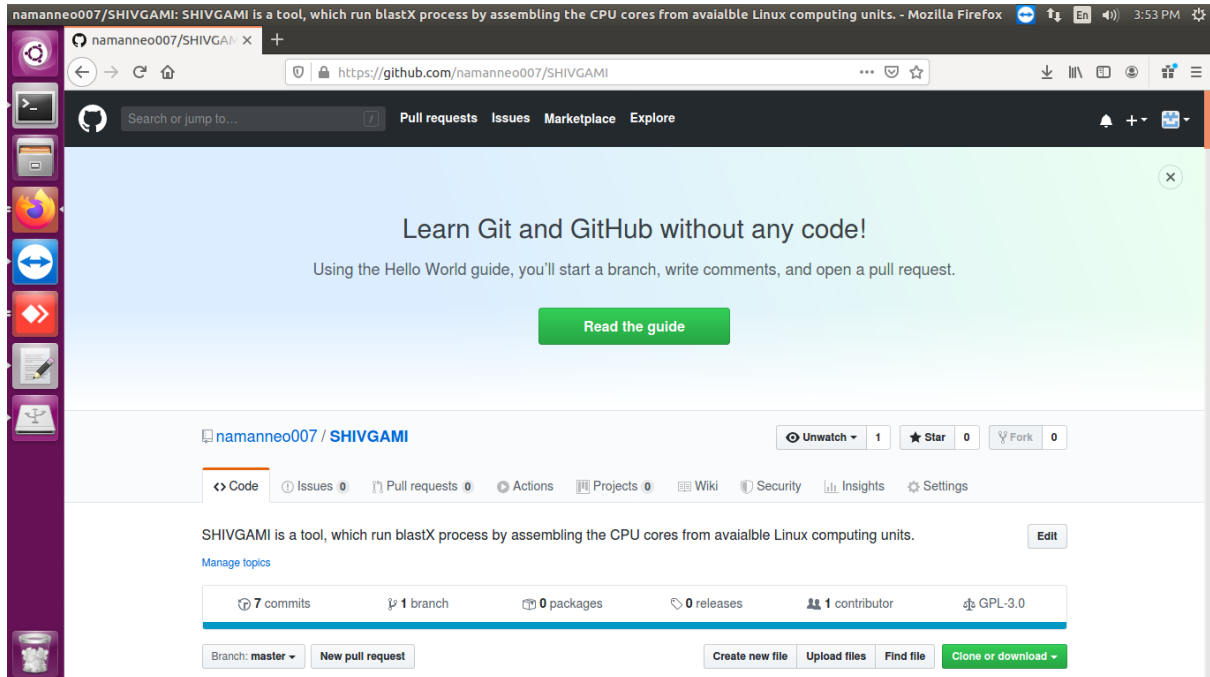
The child_node_system_info.txt will look like:

```
childnodes_info.txt (-/Naman/work/2_sh/test10_snap) - gedit
Open  Save
1 NO USER IP Password process_PATH blast_program_PATH Database_PATH
2 1 lab3 172.16.29.122 123 /home/lab3/Naman /home/lab3/Naman/blast_2p9p0plus/bin/blastx /home/lab3/Naman/New_NR/nr
3 2 lab11 172.16.29.123 123 /home/lab11/Naman /home/lab11/Naman/blast_2p9p0plus/bin/blastx /home/lab11/Naman/New_NR/nr
4 3 lab14 172.16.29.124 123 /home/lab14/Naman /home/lab14/Naman/blast_2p9p0plus/bin/blastx /home/lab14/Naman/New_NR/nr
5 4 lab15 172.16.29.125 123 /home/lab15/Naman /home/lab15/Naman/blast_2p9p0plus/bin/blastx /home/lab15/Naman/New_NR/nr
6 5 user_132 172.16.29.132 123 /home/user_132/Naman /home/user_132/Naman/blast_2p9p0plus/bin/blastx /home/user_132/Naman/
New_NR/nr
7 6 lab6 172.16.29.35 123 /home/lab6/Naman /home/lab6/Naman/blast_2p9p0plus/bin/blastx /home/lab6/Naman/New_NR/nr
```

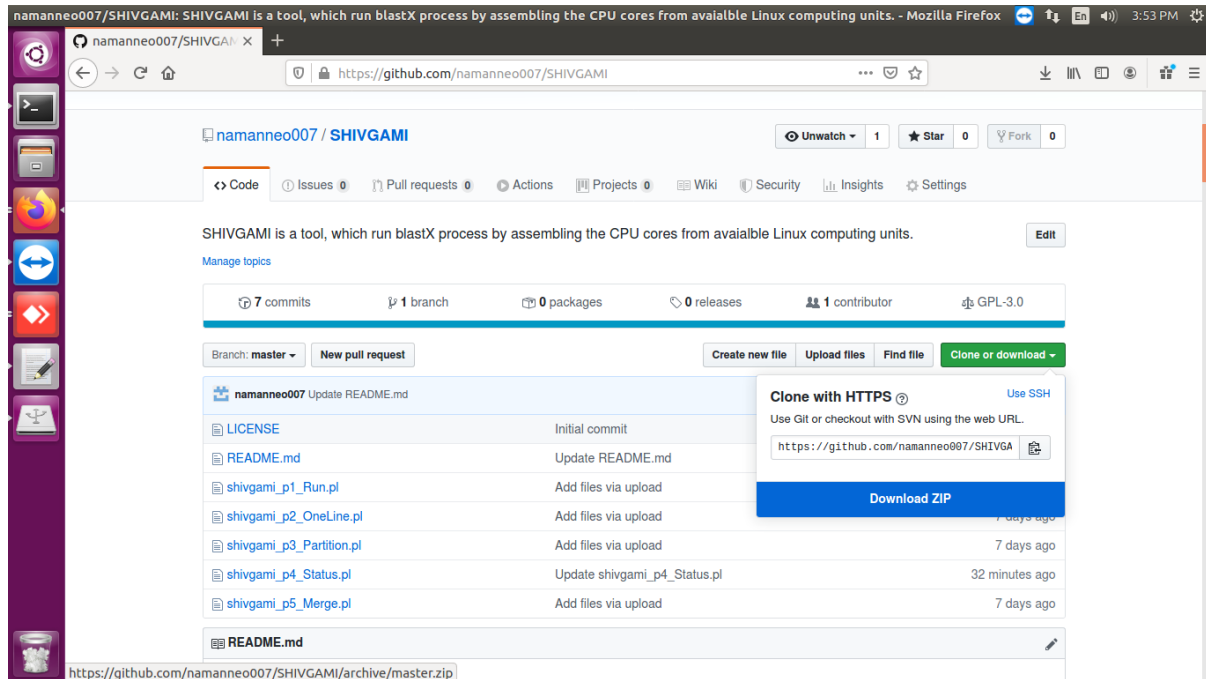
3. Download

User can download SHIVGAMI from website www.shivgami.net and Github. Here, we are giving illustration for github

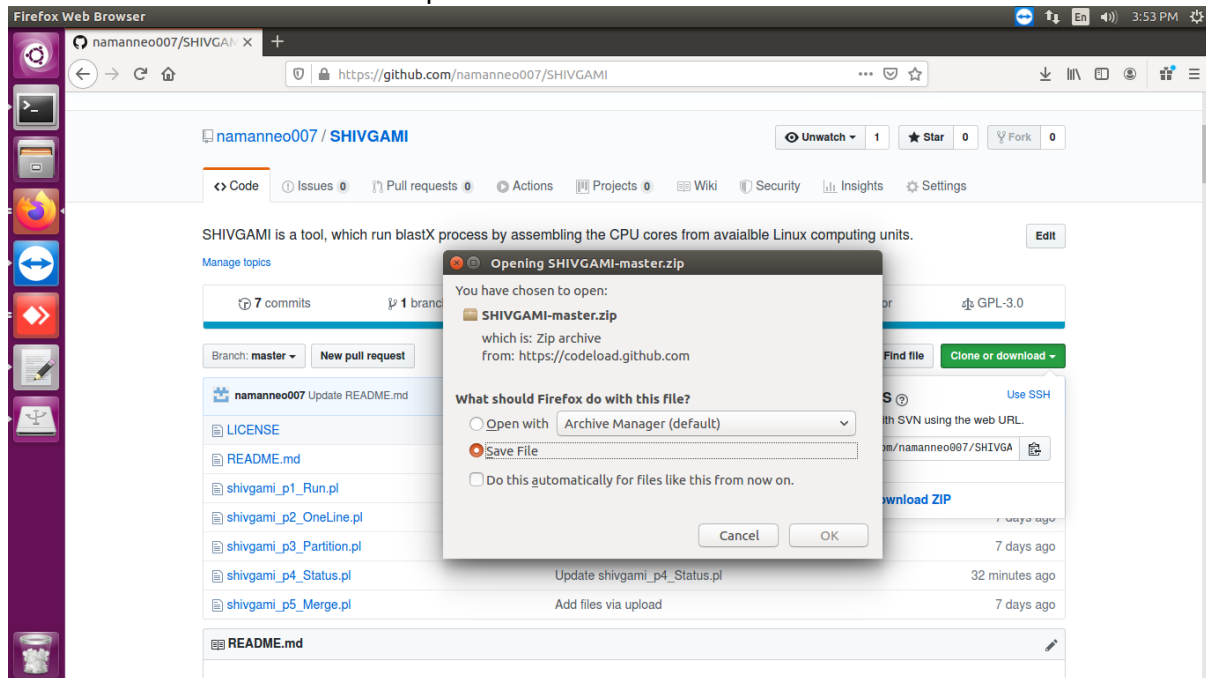
Open a link : <https://github.com/namanneo007/SHIVGAMI>



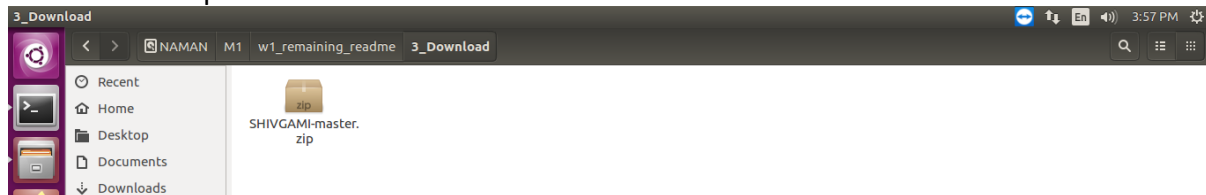
Click on "Clone or download"



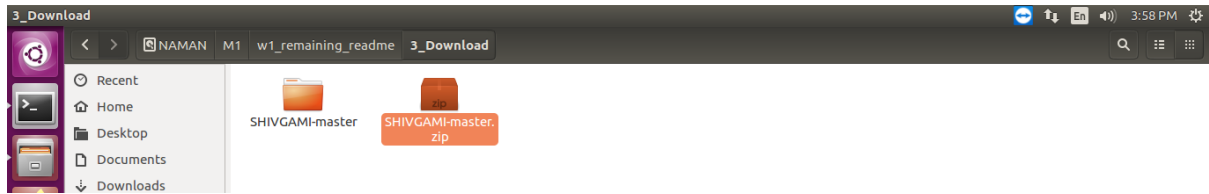
Download "SHIVGAMI-master.zip"



Download completion



Extraction



Exploring SHIVGAMI folder



steps:

Put all these programs in a folder of a Master-node, from where you want to initiate the process.

4. Run

Initiate SHIVGAMI by running program-1:shivgami_p1_Run.pl and providing 2 arguments <input-fasta-file> and <child-nodes-information> respectively. Here, we have taken a sample input fasta file comprising 6 nucleotide sequences to search against NR database (Alias created-05/15/2019 23:58:27, NSEQ 203058027, LENGTH 73894506806) using blastx program (ncbi-blast-2.9.0+).

```
lab2@lab2-ThinkCentre-M93p: ~/Naman/work/2_sh/test10_snap
lab2@lab2-ThinkCentre-M93p:~/Naman/work/2_sh/test10_snap$ perl shivgami_p1_Run.pl input.fasta childnodes_info.txt

You have given total 5 cores but possible partitions are 4 cores
So, please enter the cores in such a manner that a sum-total is LESS THAN OR EQUAL TO 4 (<=4)

Do not provide any of your file name with
'seq', 'outfile' and 'time' word
It may conflict with resulting file names

#####
# SHIVGAMI 1.0                                     #
# Simplifying the titanIC blastx process using available GATHERING of computational units #
#####

PROGRAM-1 : shivgami_p1_Run.pl
=====
(c) 2020, Software written by: Naman Mangukia
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If you use this software please cite:
Mangukia N, Raval S, Pandya H and Rawal R (2020)
(Publication is in process)

SHIVGAMI comes with ABSOLUTELY NO WARRANTY and is a free software to use.

SHIVGAMI assemble the computational power of CPUs from available
LINUX machines and uses them to run blastX process.

-----
| SYSTEM Information From User |
-----
USER      IP
lab3      172.16.29.122
lab11     172.16.29.123
```

```
lab2@lab2-ThinkCentre-M93p: ~/Naman/work/2_sh/test10_snap
lab2@lab2-ThinkCentre-M93p:~/Naman/work/2_sh/test10_snap$ perl shivgami_p1_Run.pl input.fasta childnodes_info.txt

SHIVGAMI assemble the computational power of CPUs from available
LINUX machines and uses them to run blastX process.

-----
| SYSTEM Information From User |
-----
USER      IP
lab3      172.16.29.122
lab11     172.16.29.123
lab14     172.16.29.124
lab15     172.16.29.125
user_132  172.16.29.132
lab6      172.16.29.35

-----
| Connected System Information |
-----
System:      lab3@172.16.29.122
Connected:   Yes
Cores_available: 8

System:      lab11@172.16.29.123
Connected:   Yes
Cores_available: 8

System:      lab14@172.16.29.124
Connected:   Yes
Cores_available: 8

System:      lab15@172.16.29.125
Connected:   Yes
Cores_available: 8

System:      user_132@172.16.29.132
Connected:   Yes
Cores_available: 8

System:      lab6@172.16.29.35
```

Then program shows the TOTAL NUMBER of CORES comprised by the connected system:

```
lab2@lab2-ThinkCentre-M93p: ~/Naman/work/2_sh/test10_snap
lab2@lab2-ThinkC... x lab3@lab3-ThinkC... x lab2@lab2-ThinkC... x lab2@lab2-ThinkC... x lab15@lab15-Thin... x lab2@lab2-ThinkC... x lab2@lab2-ThinkC... x
lab6 172.16.29.35
-----
| Connected System Information |
-----
System: lab3@172.16.29.122
Connected: Yes
Cores_available: 8

System: lab11@172.16.29.123
Connected: Yes
Cores_available: 8

System: lab14@172.16.29.124
Connected: Yes
Cores_available: 8

System: lab15@172.16.29.125
Connected: Yes
Cores_available: 8

System: user_132@172.16.29.132
Connected: Yes
Cores_available: 8

System: lab6@172.16.29.35
Connected: Yes
Cores_available: 8

Total 6 Systems are connected

-----
| USER_INPUT |
-----
=====
PLEASE ENTER THE AVAILABLE CORES FOR EACH SYSTEM
=====
(
```

Now, program asks for USER-INPUT, Like how many cores user want to use. Here, in example, 1 core is used for all 6 systems.

```
lab2@lab2-ThinkCentre-M93p: ~/Naman/work/2_sh/test10_snap
lab2@lab2-ThinkC... x lab3@lab3-ThinkC... x lab2@lab2-ThinkC... x lab2@lab2-ThinkC... x lab15@lab15-Thin... x lab2@lab2-ThinkC... x lab2@lab2-ThinkC... x
Total 6 Systems are connected

-----
| USER_INPUT |
-----
=====
PLEASE ENTER THE AVAILABLE CORES FOR EACH SYSTEM
=====
(
It is wise to select N-1 cores for your system, instead of using full N cores
Where N = Total numbers of cores.
For Example, If a system has total 8 cores then use maxinum upto 7 cores (N=8, hence N-1=7)
)
Enter the cores for system=> lab3@172.16.29.122: 1
Enter the cores for system=> lab11@172.16.29.123: 1
Enter the cores for system=> lab14@172.16.29.124: 1
Enter the cores for system=> lab15@172.16.29.125: 1
Enter the cores for system=> user_132@172.16.29.132: 1
Enter the cores for system=> lab6@172.16.29.35: 1

-----
| shivgami_p2_OneLine.pl |
-----
conversion into 1-line.....

-----
| shivgami_p3_Partition.pl |
-----
Partition.....

-----
| USER_INPUT for CORES |
-----
```

Then, program send partitioned sequences to the respective child-nodes.

```

lab2@lab2-ThinkCentre-M93p: ~/Naman/work/2_sh/test10_snap
-----
shivgami_p3_Partition.pl
-----
Partition.....
-----
USER_INPUT for CORES
-----
Merge1.fasta generated.....
Merge2.fasta generated.....
Merge3.fasta generated.....
Merge4.fasta generated.....
Merge5.fasta generated.....
Merge6.fasta generated.....
-----
SENDING FILES TO CHILD NODES
-----
Sending to Child_Node-1:      lab3@172.16.29.122
Sending to Child_Node-2:      lab11@172.16.29.123
Sending to Child_Node-3:      lab14@172.16.29.124
Sending to Child_Node-4:      lab15@172.16.29.125
Sending to Child_Node-5:      user_132@172.16.29.132
Sending to Child_Node-6:      lab6@172.16.29.35
lab2@lab2-ThinkCentre-M93p:~/Naman/work/2_sh/test10_snap$

```

Checking the blastx on PC-1:

```

lab3@lab3-ThinkCentre-M93p: ~/Naman/shiv_pc1_1580195635
lab2@lab2-ThinkCentre-M93p:~$ ssh -X lab3@172.16.29.122
lab3@172.16.29.122's password:
Welcome to Ubuntu 16.04.6 LTS (GNU/Linux 4.15.0-74-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:    https://landscape.canonical.com
 * Support:       https://ubuntu.com/advantage

2 packages can be updated.
1 update is a security update.

Last login: Tue Jan 28 12:47:36 2020 from 172.16.29.127
lab3@lab3-ThinkCentre-M93p:~$ cd Naman/
lab3@lab3-ThinkCentre-M93p:~/Naman$ ls
0_readme.txt          New_NR                previous_r1            shiv_pc1_1576824994    shiv_pc1_1579518331    test_lab3
14n15_Wp5p6_Linux_PC2.Fasta  out_blastX_14n15_Wp5p6_Linux_PC2.xml  shiv_pc1_1575454628    shiv_pc1_1578051962    shiv_pc1_1579519254
1_info.txt            out_blastX_p2_Lpc2.xml  shiv_pc1_1575882760    shiv_pc1_1578137993    shiv_pc1_1579519924
blast_2p9p0plus      p2_Lpc2.fasta          shiv_pc1_1576582976    shiv_pc1_1579502860    shiv_pc1_1580195635
lab3@lab3-ThinkCentre-M93p:~/Naman$ cd shiv_pc1_1580195635
lab3@lab3-ThinkCentre-M93p:~/Naman/shiv_pc1_1580195635$

```

```

lab3@lab3-ThinkCentre-M93p: ~/Naman/shiv_pc1_1580195635
top - 13:17:34 up 32 mIn, 1 User, load average: 1.04, 1.02, 0.98
Tasks: 182 total, 2 running, 116 sleeping, 0 stopped, 0 zombie
%Cpu(s): 11.2 us, 0.1 sy, 0.0 ni, 87.1 id, 1.6 wa, 0.0 hi, 0.0 si, 0.0 st
KiB Mem : 3830072 total, 123540 free, 227144 used, 3479388 buff/cache
KiB Swap: 998396 total, 998396 free, 0 used, 3296552 avail Mem

  PID USER      PR  NI   VIRT   RES   SHR  S  %CPU  %MEM     TIME+ COMMAND
 1745 lab3      20   0 35.355g 2.951g 2.947g R 41.9 80.8 28:59.54 blastx
   1 root      20   0 185168   5736 3960 S  0.0  0.1  0:01.07 systemd
   2 root      20   0   0       0     0 S  0.0  0.0  0:00.00 kthreadd
   4 root      20  -20   0       0     0 I  0.0  0.0  0:00.00 kworker/0:0H
   6 root      20  -20   0       0     0 I  0.0  0.0  0:00.00 mm_percpu_wq
   7 root      20   0   0       0     0 S  0.0  0.0  0:00.00 ksoftirqd/0
   8 root      20   0   0       0     0 I  0.0  0.0  0:00.15 rcu_sched
   9 root      20   0   0       0     0 I  0.0  0.0  0:00.00 rcu_bh
  10 root      rt    0   0       0     0 S  0.0  0.0  0:00.00 migration/0
  11 root      rt    0   0       0     0 S  0.0  0.0  0:00.00 watchdog/0
  12 root      20   0   0       0     0 S  0.0  0.0  0:00.00 cpuhp/0
  13 root      20   0   0       0     0 S  0.0  0.0  0:00.00 cpuhp/1
  14 root      rt    0   0       0     0 S  0.0  0.0  0:00.00 watchdog/1
  15 root      rt    0   0       0     0 S  0.0  0.0  0:00.00 migration/1
  16 root      20   0   0       0     0 S  0.0  0.0  0:00.00 ksoftirqd/1
  18 root      20  -20   0       0     0 I  0.0  0.0  0:00.00 kworker/1:0H
  19 root      20   0   0       0     0 S  0.0  0.0  0:00.00 cpuhp/2
  20 root      rt    0   0       0     0 S  0.0  0.0  0:00.00 watchdog/2
  21 root      rt    0   0       0     0 S  0.0  0.0  0:00.00 migration/2
  22 root      20   0   0       0     0 S  0.0  0.0  0:00.00 ksoftirqd/2
  24 root      20  -20   0       0     0 I  0.0  0.0  0:00.00 kworker/2:0H

```

Checking the blastx on PC-2:

```
lab2@lab2-ThinkCentre-M93p: ~/test1/database
lab2@lab2-ThinkCentre-M93p:~/test1/database$ ssh -X lab11@172.16.29.123
lab11@172.16.29.123's password:
Welcome to Ubuntu 16.04.5 LTS (GNU/Linux 4.15.0-74-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:    https://landscape.canonical.com
 * Support:       https://ubuntu.com/advantage

104 packages can be updated.
0 updates are security updates.

Last login: Tue Jan 28 13:09:07 2020 from 172.16.29.127
lab11@lab11-ThinkCentre-M93p:~$ cd Naman/
lab11@lab11-ThinkCentre-M93p:~/Naman$ ls
0_readme.txt          copy                p2_Lpc3.fasta      shlv_pc2_1576582976  shlv_pc2_1579502860  test_lab1
16n17_Wp7p8_Linux_PC3.fasta  New_NR             p_r1               shlv_pc2_1576824994  shlv_pc2_1579518331
1_info.txt           out_blastx_16n17_Wp7p8_Linux_PC3.xml  p_r1              shlv_pc2_1575454628  shlv_pc2_1579519924
blast_zppppPlus     out_blastx_p2_Lpc3.xml                shlv_pc2_1575882760  shlv_pc2_1578137993  shlv_pc2_1580195635
lab11@lab11-ThinkCentre-M93p:~/Naman$ cd shlv_pc2_1580195635
lab11@lab11-ThinkCentre-M93p:~/Naman/shlv_pc2_1580195635$ ls
Merge2.fasta  pc2_blastx_outfile.xml  pc2_runNback_shfile.pl  pc2_time_1580195635.txt
lab11@lab11-ThinkCentre-M93p:~/Naman/shlv_pc2_1580195635$
```

```
lab2@lab2-ThinkCentre-M93p: ~/test1/database
top - 13:15:47 up 1:37, 2 users, load average: 1.02, 1.04, 0.97
Tasks: 231 total, 2 running, 164 sleeping, 0 stopped, 0 zombie
%Cpu(s): 4.9 us, 0.2 sy, 0.0 ni, 93.5 id, 1.4 wa, 0.0 hi, 0.0 si, 0.0 st
Mem: 3830072 total, 101116 free, 2466960 used, 1261996 buff/cache
Mem Swap: 998396 total, 859388 free, 139008 used, 897872 avail Mem

  PID USER      PR  NI   VIRT   RES   SHR  S  %CPU  %MEM    TIME+  COMMAND
 5670 lab11    20   0 36.591g 814964 810564 R  93.3 21.3  30:12.98 blastx
   1 root      20   0 185244   4164  2800 S   0.0  0.1   0:01.26 systemd
   2 root      20   0   0       0       0 S   0.0  0.0   0:00.00 kthreadd
   4 root      0 -20   0       0       0 I   0.0  0.0   0:00.00 kworker/0:0H
   6 root      0 -20   0       0       0 I   0.0  0.0   0:00.00 mm_percpu_wg
```

Checking the blastx on PC-3:

```
lab14@lab14-ThinkCentre-M93p: ~/Naman/shlv_pc3_1580195635
lab2@lab2-ThinkCentre-M93p:~/test1/database$ ssh -X lab14@172.16.29.124
lab14@172.16.29.124's password:
Welcome to Ubuntu 16.04.5 LTS (GNU/Linux 4.15.0-72-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:    https://landscape.canonical.com
 * Support:       https://ubuntu.com/advantage

136 packages can be updated.
20 updates are security updates.

Last login: Wed Jan 22 16:17:37 2020 from 172.16.29.35
lab14@lab14-ThinkCentre-M93p:~$ cd Naman/
lab14@lab14-ThinkCentre-M93p:~/Naman$ ls
0_readme.txt          New_NR             p_r1               shlv_pc3_1576582976  shlv_pc3_1579502860  temp1
18n19_Wp9p10_Linux_PC4.fasta  out_blastx_18n19_Wp9p10_Linux_PC4.xml  shlv_pc3_1579519254  shlv_pc3_1576824994  shlv_pc3_1579518331
1_info.txt           out_blastx_p2_Lpc4.xml                shlv_pc3_1575454628  shlv_pc3_1578051962  shlv_pc3_1579519924
blast_zppppPlus     p2_Lpc4.fasta     shlv_pc3_1575882760  shlv_pc3_1578137993  shlv_pc3_1580195635
lab14@lab14-ThinkCentre-M93p:~/Naman$ cd shlv_pc3_1580195635
lab14@lab14-ThinkCentre-M93p:~/Naman/shlv_pc3_1580195635$ ls
Merge3.fasta  pc3_blastx_outfile.xml  pc3_runNback_shfile.pl  pc3_time_1580195635.txt
lab14@lab14-ThinkCentre-M93p:~/Naman/shlv_pc3_1580195635$
```

```
lab14@lab14-ThinkCentre-M93p: ~/Naman/shlv_pc3_1580195635
Tasks: 231 total, 3 running, 163 sleeping, 0 stopped, 0 zombie
%Cpu(s): 12.5 us, 0.5 sy, 0.0 ni, 80.5 id, 6.3 wa, 0.0 hi, 0.1 si, 0.0 st
Mem: 3830384 total, 123256 free, 1803072 used, 1904056 buff/cache
Mem Swap: 998396 total, 854012 free, 144384 used, 1529856 avail Mem

  PID USER      PR  NI   VIRT   RES   SHR  S  %CPU  %MEM    TIME+  COMMAND
19774 lab14    20   0 34.579g 1.266g 1.262g R  76.7 34.7  28:34.12 blastx
1335 root      20   0 414772 108908 86988 S   7.0  2.8   9:49.72 Xorg
20372 lab14    20   0 665328 38804 28428 S   6.0  1.0   0:01.05 gedit
1993 lab14    20   0 1277928 76528 28320 S   4.0  2.0   9:27.48 compiz
1937 lab14    20   0 2676580 1.099g 68948 S   1.7 30.1   8:09.87 nautilus
1766 lab14    20   0 705784 68588 10300 S   1.0  1.8   0:40.21 hud-service
5444 lab14    20   0 1927572 198496 60156 S   1.0  5.2   0:50.81 soffice.bin
  83 root      20   0   0       0       0 S   0.7  0.0   0:12.79 kswapd0
1663 lab14    20   0 426844 6928 4812 S   0.7  0.2   0:13.08 ibus-daemon
13587 lab14    20   0 519120 21316 16728 S   0.7  0.6   0:05.74 gvfsd-recent
   8 root      20   0   0       0       0 I   0.3  0.0   3:01.30 rcu_sched
  889 root      0 -20   0       0       0 I   0.3  0.0   0:04.45 kworker/5:1H
1675 lab14    20   0 39860 120 0 S   0.3  0.0   0:04.99 upstart-dbus-br
1707 lab14    20   0 484488 14144 11712 S   0.3  0.4   0:03.59 ibus-ut-gtk3
1727 lab14    20   0 195456 4948 4764 S   0.3  0.1   0:03.23 ibus-engine-sln
1768 lab14    20   0 934656 15592 12424 S   0.3  0.4   0:06.35 unity-settings-
1790 lab14    20   0 579440 28748 13864 S   0.3  0.8   0:38.95 unity-panel-ser
2172 lab14    20   0 618444 11960 7980 D   0.3  0.3   0:21.60 zeitgeist-datat
19267 root      20   0   0       0       0 D   0.3  0.0   0:01.07 kworker/u16:0
```


Checking the blastx on PC-4:

```

lab15@lab15-ThinkCentre-M93p: ~/Naman/shiv_pc4_1580195635
lab2@lab2-ThinkCentre-M93p:~/test1/database$ cd
lab2@lab2-ThinkCentre-M93p:~$ ssh -X lab15@172.16.29.125
lab15@172.16.29.125's password:
Welcome to Ubuntu 16.04.5 LTS (GNU/Linux 4.15.0-55-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:    https://landscape.canonical.com
 * Support:       https://ubuntu.com/advantage

238 packages can be updated.
127 updates are security updates.

Last login: Mon Jan 20 11:21:54 2020 from 172.16.29.127
lab15@lab15-ThinkCentre-M93p:~$ cd Naman/
lab15@lab15-ThinkCentre-M93p:~/Naman$ ls
0_readme.txt      db.fasta.phr      p_r1              shiv_pc4_1575531025  shiv_pc4_1576824994  shiv_pc4_1579518331  test_lab15
1_info.txt        db.fasta.pln      save              shiv_pc4_1575454628  shiv_pc4_1578051962  shiv_pc4_1579519924  time5.txt
blast_zppoplus   db.fasta.psq      shiv_pc4_1575372449  shiv_pc4_1575882760  shiv_pc4_1578137993  shiv_pc4_1580195635
db.fasta          New_NR            shiv_pc4_1575372687  shiv_pc4_1576582976  shiv_pc4_1579502860  test1
lab15@lab15-ThinkCentre-M93p:~/Naman$ cd shiv_pc4_1580195635
lab15@lab15-ThinkCentre-M93p:~/Naman/shiv_pc4_1580195635$ ls
Merge4.fasta  pc4_blastx_outfile.xml  pc4_runNback_shfile.pl  pc4_time_1580195635.txt
lab15@lab15-ThinkCentre-M93p:~/Naman/shiv_pc4_1580195635$

```

```

lab15@lab15-ThinkCentre-M93p:~/Naman/shiv_pc4_1580195635
top - 13:24:01 up 55 days, 20:47, 2 users, load average: 1.19, 1.05, 0.95
Tasks: 221 total, 2 running, 157 sleeping, 0 stopped, 0 zombie
%Cpu(s): 0.9 us, 0.0 sy, 0.0 ni, 99.1 id, 0.0 wa, 0.0 hi, 0.0 si, 0.0 st
KiB Mem : 3830256 total, 109668 free, 819592 used, 2900996 buff/cache
KiB Swap: 998396 total, 998396 free, 0 used, 2452932 avail Mem

  PID USER      PR  NI   VIRT   RES   SHR  S  %CPU  %MEM     TIME+ COMMAND
 23257 lab15    20   0 37.680g 2.109g 2.105g R 40.0 57.7 31:48.18 blastx
    20 root      20   0 185188    5084 3284 S  0.0  0.1  0:19.49 systemd
    22 root      20   0     0     0     0 S  0.0  0.0  0:00.40 kthreadd
    42 root      0 -20    0     0     0 I  0.0  0.0  0:00.00 kworker/0:0H
    62 root      0 -20    0     0     0 I  0.0  0.0  0:00.00 mm_percpu_wq
    72 root      20   0     0     0     0 S  0.0  0.0  0:00.28 ksoftirqd/0
    82 root      20   0     0     0     0 I  0.0  0.0 15:39.77 rcu_sched
    92 root      20   0     0     0     0 I  0.0  0.0  0:00.00 rcu_bh
   102 root      rt    0     0     0     0 S  0.0  0.0  0:00.00 migration/0

```

Checking the blastx on PC-5:

```

user_132@localhost:~/Naman/shiv_pc5_1580195635
lab2@lab2-ThinkCentre-M93p:~/test1/database$ ssh -X user_132@172.16.29.132
user_132@172.16.29.132's password:
Last login: Mon Jan 27 11:35:29 2020
[user_132@localhost ~]$ cd Naman/
[user_132@localhost Naman]$ ls
9_Linux_PC12.fasta  out_blastX_9_Linux_PC12.xml  shiv_pc5_1575882760  shiv_pc5_1578051962  shiv_pc5_1579518331  time_Linux_pc12.txt
blast_zppoplus     shiv_pc3_1579519254          shiv_pc5_1576582976  shiv_pc5_1578137993  shiv_pc5_1579519924
New_NR             shiv_pc5_1575454628          shiv_pc5_1576824994  shiv_pc5_1579502860  shiv_pc5_1580195635
[user_132@localhost Naman]$ cd shiv_pc5_1580195635
[user_132@localhost shiv_pc5_1580195635]$ ls
Merge5.fasta  pc5_blastx_outfile.xml  pc5_runNback_shfile.pl  pc5_time_1580195635.txt
[user_132@localhost shiv_pc5_1580195635]$

```

```

user_132@localhost:~/Naman/shiv_pc5_1580195635
top - 13:41:13 up 1 day, 2:06, 2 users, load average: 1.12, 1.09, 1.16
Tasks: 247 total, 2 running, 245 sleeping, 0 stopped, 0 zombie
%Cpu(s): 9.2 us, 0.6 sy, 0.0 ni, 85.3 id, 4.9 wa, 0.0 hi, 0.0 si, 0.0 st
KiB Mem : 3671680 total, 111740 free, 2037680 used, 1522260 buff/cache
KiB Swap: 4706300 total, 4264956 free, 441344 used, 1084776 avail Mem

  PID USER      PR  NI   VIRT   RES   SHR  S  %CPU  %MEM     TIME+ COMMAND
 27959 user_132  20   0 38.77g 908372 903964 R 70.0 24.7 33:20.71 blastx
 32481 user_132  20   0 162160 2328 1520 R  5.0  0.1  0:00.01 top
    12 root      20   0 194056    6200 3184 S  0.0  0.2  0:12.97 systemd
    22 root      20   0     0     0     0 S  0.0  0.0  0:00.12 kthreadd
    32 root      20   0     0     0     0 S  0.0  0.0  0:00.12 ksoftirqd/0
    52 root      0 -20    0     0     0 S  0.0  0.0  0:00.00 kworker/0:0H
    72 root      rt    0     0     0     0 S  0.0  0.0  0:00.02 migration/0
    82 root      20   0     0     0     0 S  0.0  0.0  0:00.00 rcu_bh
    92 root      20   0     0     0     0 S  0.0  0.0  0:37.76 rcu_sched
   102 root      0 -20    0     0     0 S  0.0  0.0  0:00.00 lru-add-drain
   112 root      rt    0     0     0     0 S  0.0  0.0  0:00.45 watchdog/0
   122 root      rt    0     0     0     0 S  0.0  0.0  0:00.45 watchdog/1
   132 root      rt    0     0     0     0 S  0.0  0.0  0:00.03 migration/1
   142 root      20   0     0     0     0 S  0.0  0.0  0:00.05 ksoftirqd/1
   162 root      0 -20    0     0     0 S  0.0  0.0  0:00.00 kworker/1:0H
   172 root      rt    0     0     0     0 S  0.0  0.0  0:00.43 watchdog/2

```

Checking the blastx on PC-6:

```
lab6@lab6-ThinkCentre-M93p: ~/Naman/shiv_pc6_1580195635
lab2@lab2-ThinkCentre-M93p:~$ ssh -X lab6@172.16.29.35
lab6@172.16.29.35's password:
Welcome to Ubuntu 18.04.3 LTS (GNU/Linux 4.15.0-74-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:    https://landscape.canonical.com
 * Support:       https://ubuntu.com/advantage

 * Canonical Livepatch is available for installation.
   - Reduce system reboots and improve kernel security. Activate at:
     https://ubuntu.com/livepatch

12 packages can be updated.
0 updates are security updates.

Last login: Mon Jan 20 11:16:46 2020 from 172.16.29.127
lab6@lab6-ThinkCentre-M93p:~$ cd Naman/
lab6@lab6-ThinkCentre-M93p:~/Naman$ ls
blast_2p9p0pius  db.fasta.pln  save_shiv_pc15  shiv_pc2_1575531025  shiv_pc6_1575882760  shiv_pc6_1578051962  shiv_pc6_1579518331
db.fasta        db.fasta.psq  shiv_pc2_1575372449  shiv_pc4_1579519254  shiv_pc6_1576582976  shiv_pc6_1578137993  shiv_pc6_1579519924
db.fasta.phr   New_NR        shiv_pc2_1575372687  shiv_pc6_1575454628  shiv_pc6_1576824994  shiv_pc6_1579502860  shiv_pc6_1580195635
lab6@lab6-ThinkCentre-M93p:~/Naman$ cd shiv_pc6_1580195635
lab6@lab6-ThinkCentre-M93p:~/Naman/shiv_pc6_1580195635$ ls
Merge6.fasta  pc6_blastx_outfile.xml  pc6_runNback_shfile.pl  pc6_time_1580195635.txt
lab6@lab6-ThinkCentre-M93p:~/Naman/shiv_pc6_1580195635$
```

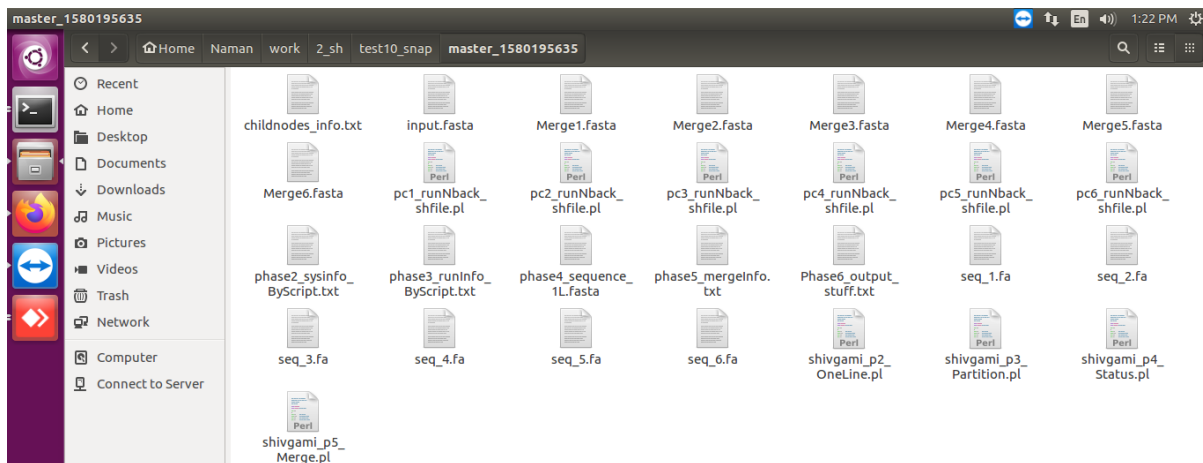
```
lab6@lab6-ThinkCentre-M93p:~/Naman/shiv_pc6_1580195635
top 13:19:34 up 22:35, 2 users, load average: 1.61, 1.27, 1.14
Tasks: 287 total, 2 running, 223 sleeping, 0 stopped, 0 zombie
%Cpu(s): 1.6 us, 0.4 sy, 0.0 ni, 97.7 id, 0.2 wa, 0.0 hi, 0.0 si, 0.0 st
KiB Mem : 3830020 total, 101976 free, 2458296 used, 1269748 buff/cache
KiB Swap: 7915516 total, 7640572 free, 274944 used, 821852 avail Mem

  PID USER      PR  NI   VIRT   RES    SHR  S  %CPU  %MEM    TIME+  COMMAND
12652 lab6      20   0 39.628g 752036 747484 R 65.0 19.6 33:25.26 blastx
12994 lab6      20   0  51328   3824  3116 R   5.0  0.1  0:00.01 top
   1 root      20   0 225404   5032  3264 S   0.0  0.1  0:10.87 systemd
   2 root      20   0     0     0     0 S   0.0  0.0  0:00.01 kthreadd
   4 root      0  -20     0     0     0 I   0.0  0.0  0:00.00 kworker/0:0H
  6 root      0  -20     0     0     0 T   0.0  0.0  0:00.00
```

The SHIVGAMI process generate a result folder named master_XXXXXXXX, where XXXXXXXX=digits created by time function to generate each time a unique result folder. In this example the result folder is: master_1580195635.

This folder contains partitioned files (seqN.fasta, where N=1, 2, 3..), combined partitioned files for child nodes (mergeN.fasta, where N=1,2,3..), some temp files and other SHIVGAMI program files.

Folder view:



Command line view:

```
lab2@lab2-ThinkCentre-M93p: ~/Naman/work/2_sh/test10_snap/master_1580195635
lab2@lab2-ThinkCentre-M93p:~/Naman/work/2_sh/test10_snap/master_1580195635$ ls
Merge1.fasta generated.....
Merge2.fasta generated.....
Merge3.fasta generated.....
Merge4.fasta generated.....
Merge5.fasta generated.....
Merge6.fasta generated.....
-----
|          SENDING FILES TO CHILD NODES          |
-----
Sending to Child_Node-1:      lab3@172.16.29.122
Sending to Child_Node-2:      lab11@172.16.29.123
Sending to Child_Node-3:      lab14@172.16.29.124
Sending to Child_Node-4:      lab15@172.16.29.125
Sending to Child_Node-5:      user_132@172.16.29.132
Sending to Child_Node-6:      lab6@172.16.29.35

lab2@lab2-ThinkCentre-M93p:~/Naman/work/2_sh/test10_snap$ ls
childnodes_info.txt  master_1580195635  shivgami_p2_OneLine.pl  shivgami_p4_Status.pl
input.fasta          shivgami_p1_Run.pl  shivgami_p3_Partition.pl  shivgami_p5_Merge.pl
lab2@lab2-ThinkCentre-M93p:~/Naman/work/2_sh/test10_snap$ cd master_1580195635/
lab2@lab2-ThinkCentre-M93p:~/Naman/work/2_sh/test10_snap/master_1580195635$ ls
childnodes_info.txt  Merge4.fasta      pc3_runNback_shfile.pl  phase3_runInfo_ByScript.txt  seq_2.fasta  shivgami_p2_OneLine.pl
input.fasta          Merge5.fasta      pc4_runNback_shfile.pl  phase4_sequence_1L.fasta     seq_3.fasta  shivgami_p3_Partition.pl
Merge1.fasta         Merge6.fasta      pc5_runNback_shfile.pl  phase5_mergeInfo.txt        seq_4.fasta  shivgami_p4_Status.pl
Merge2.fasta         pc1_runNback_shfile.pl  pc6_runNback_shfile.pl  Phase6_output_stuff.txt     seq_5.fasta  shivgami_p5_Merge.pl
Merge3.fasta         pc2_runNback_shfile.pl  phase2_sysInfo_ByScript.txt  seq_1.fasta                  seq_6.fasta
lab2@lab2-ThinkCentre-M93p:~/Naman/work/2_sh/test10_snap/master_1580195635$
```

Now, Program-4 -> shivgami_p4_Status.pl will display the status of blastx, here we have shown the status just after the process initiated. As no xml file is generated, the program is not showing any status and telling to run it after sometime!

```
lab2@lab2-ThinkCentre-M93p:~/Naman/work/2_sh/test10_snap/master_1580195635
lab2@lab2-ThinkCentre-M93p:~/Naman/work/2_sh/test10_snap/master_1580195635$ ls
childnodes_info.txt  Merge4.fasta      pc3_runNback_shfile.pl  phase3_runInfo_ByScript.txt  seq_2.fasta  shivgami_p2_OneLine.pl
input.fasta          Merge5.fasta      pc4_runNback_shfile.pl  phase4_sequence_1L.fasta     seq_3.fasta  shivgami_p3_Partition.pl
Merge1.fasta         Merge6.fasta      pc5_runNback_shfile.pl  phase5_mergeInfo.txt        seq_4.fasta  shivgami_p4_Status.pl
Merge2.fasta         pc1_runNback_shfile.pl  pc6_runNback_shfile.pl  Phase6_output_stuff.txt     seq_5.fasta  shivgami_p5_Merge.pl
Merge3.fasta         pc2_runNback_shfile.pl  phase2_sysInfo_ByScript.txt  seq_1.fasta                  seq_6.fasta
lab2@lab2-ThinkCentre-M93p:~/Naman/work/2_sh/test10_snap/master_1580195635$ perl shivgami_p4_Status.pl
#####
#
# SHIVGAMI 1.0
#
# Simplifying the titanIC blastx process using available Gathering of computational units
#
#####
=====
PROGRAM-4 : prog4_process_status.pl
=====
(c) 2020, Software written by: Naman Mangukia
naman.neoanderson007(at)gmail.com, namannangukia(at)gujaratuniversity.ac.in

If you use this software please cite:
Mangukia N, Raval S, Pandya H and Rawal R (2020)
(Publication is in process)

SHIVGAMI comes with ABSOLUTELY NO WARRANTY and is a free software to use.

SHIVGAMI assemble the computational power of CPUs from available
LINUX machines and uses them to run blastX process.
Dear User!
    Still no xml file is generated !
    You can try again after sometime.
lab2@lab2-ThinkCentre-M93p:~/Naman/work/2_sh/test10_snap/master_1580195635$
```

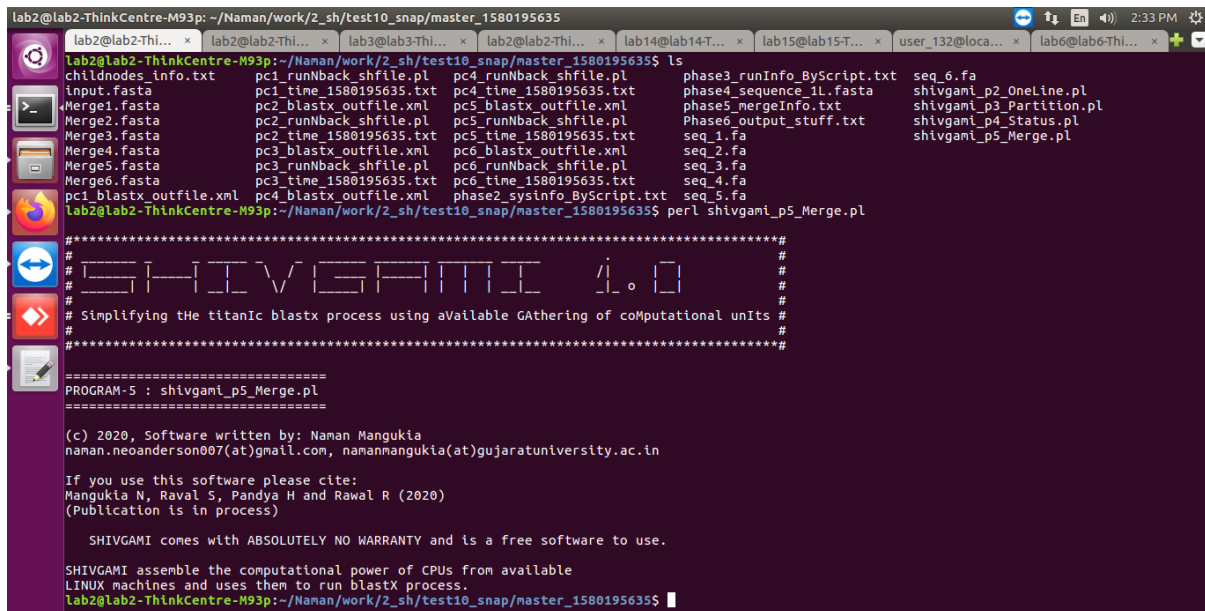
Once the process got completed for all child node, the Program-4 -> shivgami_p4_Status.pl will display the status along with the time consumed by all the child-nodes along with the child-node name which completed the blastx with maximum time span.

```
lab2@lab2-ThinkCentre-M93p: ~/Naman/work/2_sh/test10_snap/master_1580195635
lab2@lab2-Thi... lab2@lab2-Thi... lab3@lab3-Thi... lab2@lab2-Thi... lab14@lab14T... lab15@lab15T... user_132@loca... lab6@lab6Thi...
Lab2@Lab2-ThinkCentre-M93p:~/Naman/work/2_sh/test10_snap/master_1580195635$ perl shivgami_p4_Status.pl
#####
#
# SHIVGAMI 1.0
#
# Simplifying the titanIC blastx process using available GATHERING of computational units
#
#####
PROGRAM-4 : prog4_process_status.pl
=====
(c) 2020, Software written by: Naman Mangukia
naman.neanderson007(at)gmail.com, namannangukia(at)gujaratuniversity.ac.in
If you use this software please cite:
Mangukia N, Raval S, Pandya H and Rawal R (2020)
(Publication is in process)
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SHIVGAMI assemble the computational power of CPUs from available
LINUX machines and uses them to run blastX process.
=====
System_information  PC      XML      Time      Description
=====
lab3@172.16.29.122  pc-1    YES:20985  YES:5     XML_desc: No-Description-Found |Time_desc: No-Description-Found
lab11@172.16.29.123  pc-2    YES:20986  YES:5     XML_desc: No-Description-Found |Time_desc: No-Description-Found
lab14@172.16.29.124  pc-3    YES:20986  YES:5     XML_desc: No-Description-Found |Time_desc: No-Description-Found
lab15@172.16.29.125  pc-4    YES:20986  YES:5     XML_desc: No-Description-Found |Time_desc: No-Description-Found
user_132@172.16.29.132  pc-5    YES:20989  YES:5     XML_desc: No-Description-Found |Time_desc: No-Description-Found
lab6@172.16.29.35    pc-6    YES:20985  YES:5     XML_desc: No-Description-Found |Time_desc: No-Description-Found
```

```
SHIVGAMI assemble the computational power of CPUs from available
LINUX machines and uses them to run blastX process.
=====
System_information  PC      XML      Time      Description
=====
lab3@172.16.29.122  pc-1    YES:20985  YES:5     XML_desc: No-Description-Found |Time_desc: No-Description-Found
lab11@172.16.29.123  pc-2    YES:20986  YES:5     XML_desc: No-Description-Found |Time_desc: No-Description-Found
lab14@172.16.29.124  pc-3    YES:20986  YES:5     XML_desc: No-Description-Found |Time_desc: No-Description-Found
lab15@172.16.29.125  pc-4    YES:20986  YES:5     XML_desc: No-Description-Found |Time_desc: No-Description-Found
user_132@172.16.29.132  pc-5    YES:20989  YES:5     XML_desc: No-Description-Found |Time_desc: No-Description-Found
lab6@172.16.29.35    pc-6    YES:20985  YES:5     XML_desc: No-Description-Found |Time_desc: No-Description-Found
pc1_blastx_outfile.xml : Process Completed
pc2_blastx_outfile.xml : Process Completed
pc3_blastx_outfile.xml : Process Completed
pc4_blastx_outfile.xml : Process Completed
pc5_blastx_outfile.xml : Process Completed
pc6_blastx_outfile.xml : Process Completed
Time span by pc1 = 3683 sec
Time span by pc2 = 3785 sec
Time span by pc3 = 3841 sec
Time span by pc4 = 3721 sec
Time span by pc5 = 3778 sec
Time span by pc6 = 3750 sec
Overall Maximum time span by pc-3 = 1 Hour 4 min 1 sec
lab2@lab2-ThinkCentre-M93p:~/Naman/work/2_sh/test10_snap/master_1580195635$
```

5. Merge

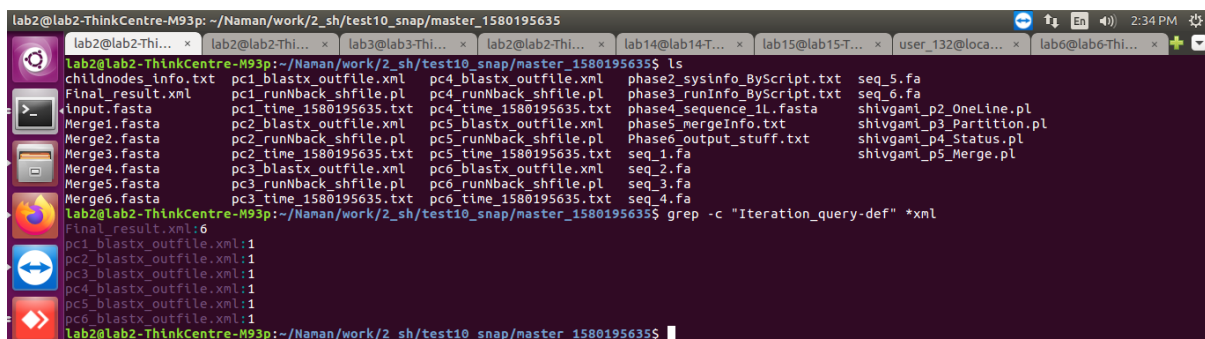
After, the completion of blastx process on all child-nodes, user should run Program-5 -> shivgami_p5_Merge.pl, which will merge all XML-result files from respective child nodes into a single xml file.



```
lab2@lab2-ThinkCentre-M93p: ~/Naman/work/2_sh/test10_snap/master_1580195635
lab2@lab2-ThinkCentre-M93p:~/Naman/work/2_sh/test10_snap/master_1580195635$ ls
childnodes_info.txt      pc1_runNback_shfile.pl  pc4_runNback_shfile.pl  phase3_runInfo_ByScript.txt  seq_6_fa
input.fasta              pc1_time_1580195635.txt pc4_time_1580195635.txt  phase4_sequence_1L.fasta    shivgami_p2_OneLine.pl
Merge1.fasta             pc2_blastx_outfile.xml  pc5_blastx_outfile.xml  phase5_mergeInfo.txt       shivgami_p3_Partition.pl
Merge2.fasta             pc2_runNback_shfile.pl  pc5_runNback_shfile.pl  Phase6_output_stuff.txt    shivgami_p4_Status.pl
Merge3.fasta             pc2_time_1580195635.txt pc6_blastx_outfile.xml  seq_1_fa                    shivgami_p5_Merge.pl
Merge4.fasta             pc3_runNback_shfile.pl  pc6_runNback_shfile.pl  seq_2_fa
Merge5.fasta             pc3_time_1580195635.txt pc6_time_1580195635.txt  seq_3_fa
pc1_blastx_outfile.xml   pc4_blastx_outfile.xml  phase2_sysinfo_ByScript.txt  seq_4_fa
lab2@lab2-ThinkCentre-M93p:~/Naman/work/2_sh/test10_snap/master_1580195635$ perl shivgami_p5_Merge.pl
#####
# SHIVGAMI 1.0 #
# #
# Simplifying the titanIC blastx process using aVailable GATHERing of coMputational units #
# #
#####
PROGRAM-5 : shivgami_p5_Merge.pl
=====
(c) 2020, Software written by: Naman Mangukia
naman.neanderson007(at)gmail.com, namanmangukla(at)gujaratuniversity.ac.in
If you use this software please cite:
Mangukla N, Raval S, Pandya H and Rawal R (2020)
(Publication is in process)
SHIVGAMI comes with ABSOLUTELY NO WARRANTY and is a free software to use.
SHIVGAMI assemble the computational power of CPUs from available
LINUX machines and uses them to run blastX process.
lab2@lab2-ThinkCentre-M93p:~/Naman/work/2_sh/test10_snap/master_1580195635$
```

The file named as "Final_result.xml" is the merged file and can be used for the further downstream analysis.

From below illustration of result count, it can be seen that, the merged result file Final_result.xml - is having all 6 sequences' result.



```
lab2@lab2-ThinkCentre-M93p:~/Naman/work/2_sh/test10_snap/master_1580195635
lab2@lab2-ThinkCentre-M93p:~/Naman/work/2_sh/test10_snap/master_1580195635$ ls
childnodes_info.txt      pc1_runNback_shfile.pl  pc4_runNback_shfile.pl  phase2_sysinfo_ByScript.txt  seq_5_fa
Final_result.xml         pc1_blastx_outfile.xml  pc4_blastx_outfile.xml  phase3_runInfo_ByScript.txt  seq_6_fa
input.fasta              pc1_time_1580195635.txt pc5_blastx_outfile.xml  phase4_sequence_1L.fasta    shivgami_p2_OneLine.pl
Merge1.fasta             pc2_blastx_outfile.xml  pc5_runNback_shfile.pl  phase5_mergeInfo.txt       shivgami_p3_Partition.pl
Merge2.fasta             pc2_runNback_shfile.pl  pc5_time_1580195635.txt  Phase6_output_stuff.txt    shivgami_p4_Status.pl
Merge3.fasta             pc2_time_1580195635.txt pc6_blastx_outfile.xml  seq_1_fa                    shivgami_p5_Merge.pl
Merge4.fasta             pc3_runNback_shfile.pl  pc6_runNback_shfile.pl  seq_2_fa
Merge5.fasta             pc3_time_1580195635.txt pc6_time_1580195635.txt  seq_3_fa
pc1_blastx_outfile.xml   pc4_blastx_outfile.xml  pc6_blastx_outfile.xml  seq_4_fa
lab2@lab2-ThinkCentre-M93p:~/Naman/work/2_sh/test10_snap/master_1580195635$ grep -c "Iteration_query-def" *xml
Final_result.xml:6
pc1_blastx_outfile.xml:1
pc2_blastx_outfile.xml:1
pc3_blastx_outfile.xml:1
pc4_blastx_outfile.xml:1
pc5_blastx_outfile.xml:1
pc6_blastx_outfile.xml:1
lab2@lab2-ThinkCentre-M93p:~/Naman/work/2_sh/test10_snap/master_1580195635$
```