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Genetic Diversity: Analysis

SSH / Remote Access

Tuesday, June 17, 2025

ETH
Eidgenössische Technische Hochschule Zürich
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Secure Shell (SSH) is a cryptographic network **protocol for operating network services** securely over an unsecured network. Typical applications include **remote command-line**, login, and remote command execution, but any network service can be secured with SSH.

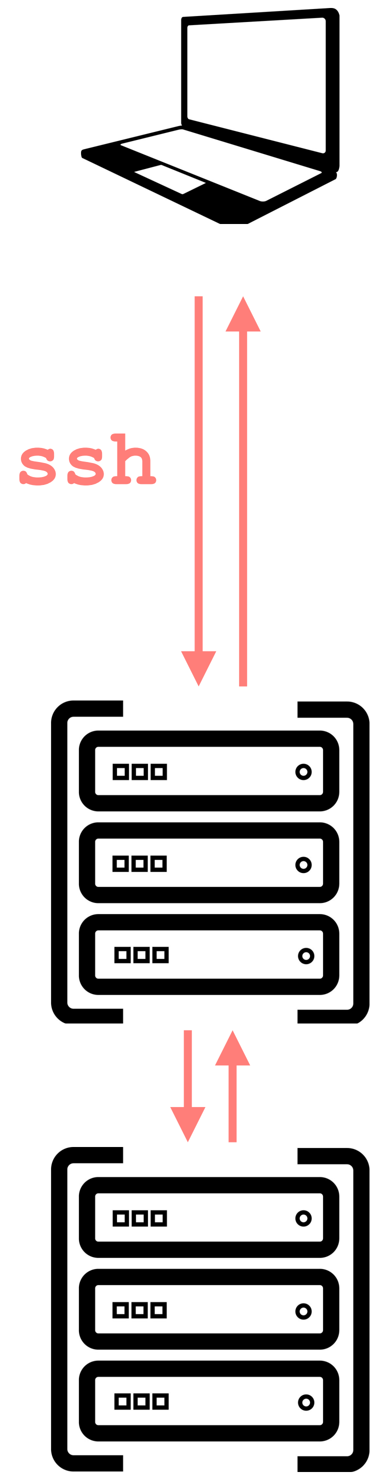
Source: Wikipedia

SSH is like whispering commands to your server through an encrypted tunnel, so no one else can eavesdrop. It's a cryptographic network protocol that lets you log in, execute commands, and control remote machines without handing out an open invitation to hackers. While it's best known for remote command-line access, SSH can wrap its security blanket around just about any network service. Basically, if your connection feels like sending a postcard, SSH turns it into a locked briefcase with lasers.

Terminal ▷ SSH

Local

Remote




```
Model Identifier: MacBookPro
Number of Processors: 1 (M1 Pro)
Total Number of Cores: 8
Memory: 32 GB
```

Abacus (Compute-Server)

```
lscpu; free -m
# Architecture: x86_64
# Model name: Intel(R) Xeon
# CPU(s): 48
# Mem: 775 GB
```

Box (Data/Backup-Server)

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```
> ssh guest99@gdc-vserver.ethz.ch
# guest99@gdc-vserver.ethz.ch's password:🔑
> pwd
# /home/guest99
> users
jwalser nzemp guest99 guest03
```

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```
ssh guest99@gdc-vserver.ethz.ch
```

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```
## Monitoring server activity:
> top # press Q to leave top
```

```
top - 15:31:08 up 198 days,  5:44, 11 users,  load average: 2.28, 2.95, 2.74
Tasks: 4418 total,   3 running, 4414 sleeping,   1 stopped,   0 zombie
Cpu(s):  1.4%us,  0.1%sy,  0.0%ni, 98.5%id,  0.0%wa,  0.0%hi,  0.0%si,  0.0%st
Mem:  926346512k total, 915660416k used, 10686096k free,  1139248k buffers
Swap: 41943036k total,  3202716k used, 38740320k free, 858950540k cached

   PID USER      PR  NI  VIRT  RES  SHR S %CPU %MEM    TIME+  COMMAND
101909 cstritt   20   0  145m  12m 2216 R 99.5  0.0   1670:03 python2
101912 cstritt   20   0  145m  12m 2216 R 99.1  0.0   1670:03 python2
 47027 smrtanal  20   0 85.2g 1.8g 7224 S 39.5  0.2  77856:07 java
 61899 jwalser   20   0 18404 4652  948 R  4.7  0.0   0:01.10 top
 45866 smrtanal  20   0 65.9g 8.3g 8548 S  0.6  0.9   1050:29 java
   525 root      20   0     0    0    0 S  0.3  0.0   1:33.86 ksoftirqd/130
   649 root      20   0     0    0    0 S  0.3  0.0  49:55.41 events/6
   683 root      20   0     0    0    0 S  0.3  0.0 123:26.83 events/40
  8717 root      20   0     0    0    0 S  0.3  0.0 525:50.39 kondemand/41
  8826 root      20   0     0    0    0 S  0.3  0.0 389:55.32 kondemand/150
 61910 root      20   0 98.4m 3908 2944 S  0.3  0.0   0:00.02 sshd
     1 root      20   0 19368 1136  916 S  0.0  0.0  66:56.88 init
     2 root      20   0     0    0    0 S  0.0  0.0   0:18.69 kthreadd
     3 root      RT   0     0    0    0 S  0.0  0.0   3613:39 migration/0
     4 root      20   0     0    0    0 S  0.0  0.0   3:51.22 ksoftirqd/0
     5 root      RT   0     0    0    0 S  0.0  0.0   0:00.00 stopper/0
     6 root      RT   0     0    0    0 S  0.0  0.0 128:44.45 watchdog/0
     7 root      RT   0     0    0    0 S  0.0  0.0   2585:53 migration/1
     8 root      RT   0     0    0    0 S  0.0  0.0   0:00.00 stopper/1
     9 root      20   0     0    0    0 S  0.0  0.0   2:22.84 ksoftirqd/1
    10 root      RT   0     0    0    0 S  0.0  0.0 105:29.73 watchdog/1
    11 root      RT   0     0    0    0 S  0.0  0.0   2263:28 migration/2
    12 root      RT   0     0    0    0 S  0.0  0.0   0:00.00 stopper/2
```

CPU state percentages

```
us: user
sy: system
ni: nice
wa: IO-wait
hi: hardware interrupts
si: software interrupts
```

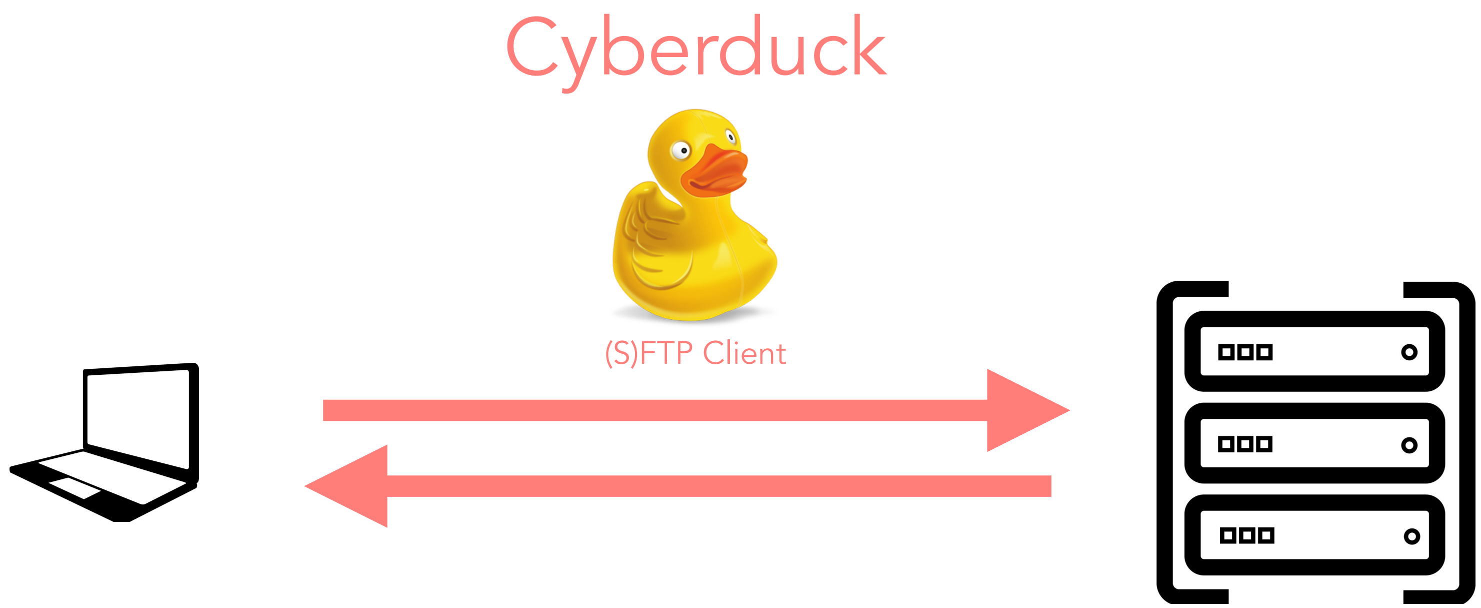
```
PID : Process ID
USER: USER
%CPU: 100% == 1 CPU
%MEM: Memory Usage
CND : Process
```

File Exchange


```
# Create a text files
> echo "Let me see the world" > go.txt
# Send the file to the server
> scp go.txt guest01@gdc-vserver.ethz.ch:/home/guest01
```


```
# Get the file back but rename it
> scp guest01@gdc-vserver.ethz.ch:/home/guest01/go.txt back.txt
> cat back.txt
```

A convenient way to upload or download (exchange) files from or to a remote server is via a (S)FTP client like Cyberduck.

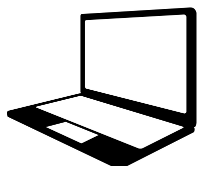



```
File01.fa
File02.fa
File03.fa
File04.fa
File05.fa
```

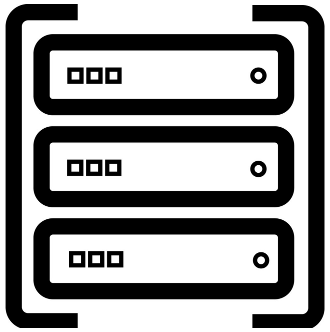
```
scp *.fa guest01@gdc-vserver.ethz.ch:/home/guest01
```

```
zip Files.fa.zip *.fa
```

```
scp *.zip guest01@gdc-vserver.ethz.ch:/home/guest01
```



Verify Upload



File01.fa	File01.fa
File02.fa	File02.fa
File03.fa	File03.fa
File04.fa	File04.fa
File05.fa	File05.fa

```
md5sum *.fa
```

```
md5sum *.fa
```

File01.fa: 81f4c5b9205a18c4c47307d189846e3b	↔	File01.fa: 81f4c5b9205a18c4c47307d189846e3b
File02.fa: 3bc3be114fb6323adc5b0ad7422d193a	↔	File02.fa: 3bc3be114fb6323adc5b0ad7422d193a
File03.fa: 18dfa68a1bdd6e4329ab2d7227687d91	↔	File03.fa: e355950460780d84ca94a28885cb05e8
File04.fa: 5561612324670105ad9b52d88b37ede6	↔	File04.fa: 5561612324670105ad9b52d88b37ede6
File05.fa: b45b0e608ef277ed8b530408d111efa5	↔	File05.fa: b45b0e608ef277ed8b530408d111efa5

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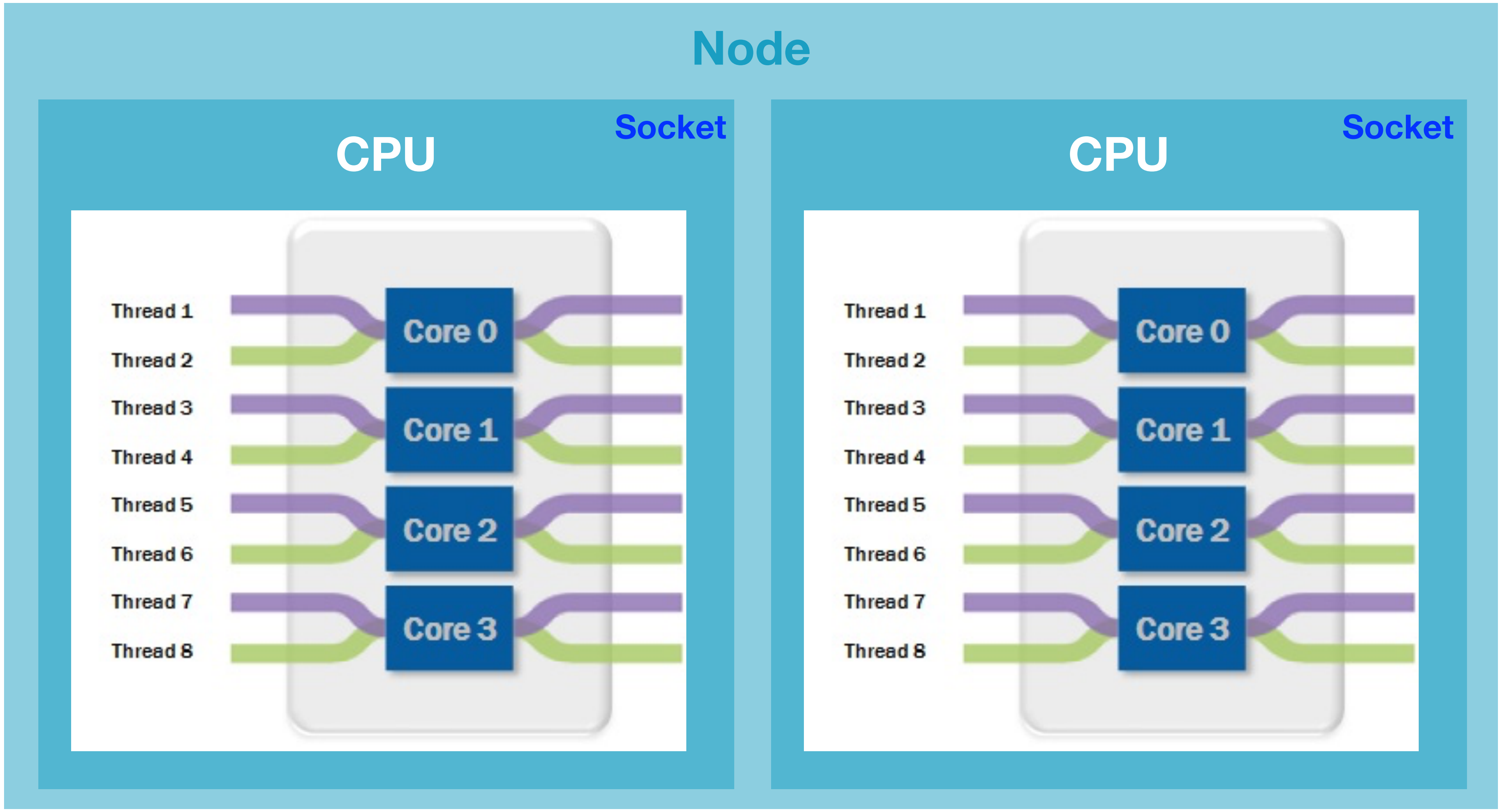
```
md5sum [option] [file(s)]
```

Compute or check 128-bit MD5 checksums is used to that no change has been made to a file, e.g. ensure that a file was not corrupted during transfer. With no files or - specified, read from standard input. The exit status is 0 for success and nonzero for failure.

A Few important terms:

- **Compute node**: Currently most compute node have two sockets, each with a single CPU, volatile working memory (RAM), a hard drive, typically small, and only used to store temporary files, and a network card.
- **CPU**: Central Processing Unit, the chip that performs the actual computation in a compute node. A modern CPU is composed of numerous cores, typically 8 or 10. It has also several cache levels that help in data reuse.
- **Core**: part of a modern CPU. A core is capable of running processes, and has its own processing logic and floating point unit. Each core has its own level 1 and level 2 cache for data and instructions. Cores share last level cache.
- **Threads**: a process can perform multiple computations, i.e., program flows, concurrently. In scientific applications, threads typically process their own subset of data, or a subset of loop iterations.


Node
CPU
Socket
Thread 1
Thread 2
Thread 3
Thread 4
Thread 5
Thread 6
Thread 7
Thread 8
Core 0
Core 1
Core 2
Core 3
CPU
Socket
Thread 1
Thread 2
Thread 3
Thread 4
Thread 5
Thread 6
Thread 7
Thread 8
Core 0
Core 1
Core 2
Core 3

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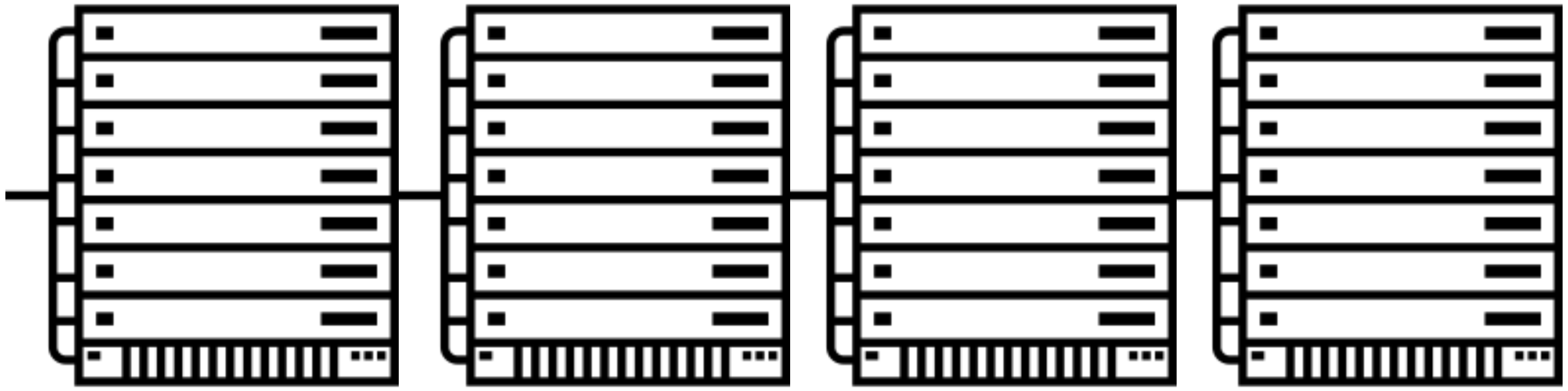
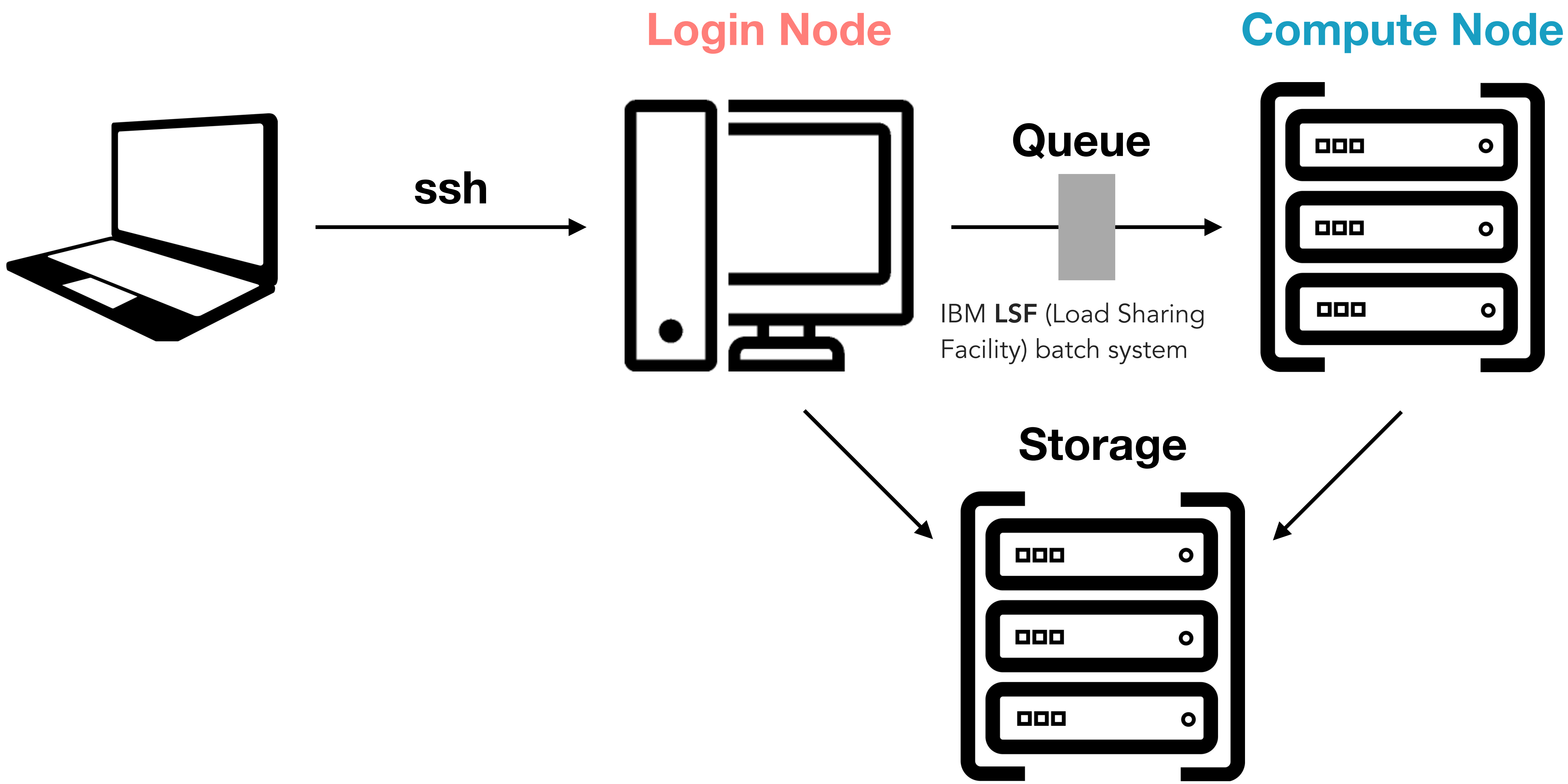
High Performance Cluster (HPC)




Login Node
Compute Node
ssh
Queue
IBM **LSF** (Load Sharing Facility) batch system
Storage

Euler II

Euler II contains **768** compute nodes of a newer generation — BL460c Gen9 —, each equipped with:

- Two 12-core Intel Xeon E5-2680v3 processors (2.5-3.3 GHz)
- Between 64 and 512 GB of DDR4 memory clocked at 2133 MHz (32 × 512 GB; 32 × 256 GB; 32 × 128 GB; 672 × 64 GB)

Euler II also contains **4** very large memory nodes — Hewlett-Packard DL580 Gen9 —, each equipped with:

- Four 16-core Intel Xeon E7-8867v3 processors (2.5 GHz)
- **3072** GB of DDR4 memory clocked at 2133 MHz

Euler III

Euler III contains **1215** compute nodes — Hewlett-Packard m710x —, each equipped with:

- A quad-core Intel Xeon E3-1585Lv5 processor (3.0-3.7 GHz)
- 32 GB of DDR4 memory clocked at 2133 MHz
- A 256 GB NVMe flash drive

All these nodes are connected to the rest of the cluster via 10G/40G Ethernet.

Euler IV

Euler IV contains **288** high-performance nodes — Hewlett-Packard XL230k Gen10 —, each equipped with:

- Two **18-core** Intel Xeon Gold 6150 processors (2.7-3.7 GHz)
- 192 GB of DDR4 memory clocked at 2666 MHz

All these nodes are connected together via a new 100Gb/s InfiniBand EDR network.

Euler V

Euler V contains **352** compute nodes — Hewlett-Packard BL460c Gen10 —, each equipped with:

- Two **12-core** Intel Xeon Gold 5118 processors (2.3 GHz nominal, 3.2 GHz peak)
- 96 GB of DDR4 memory clocked at 2400 MHz

https://scicomp.ethz.ch/wiki/Euler

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Basic job submission

```
bsub -W 2:00 -n number_of_procs -R "rusage[mem=2048,scratch=5000]" <command>
<parameters>

# -n request multiple cores (or threads)
# -R mem default the batch system allocates 1024 MB (1 GB) of memory per
processor core
# -R scratch for temporary data
```

Submission script

```
#!/bin/bash
#BSUB -J "MyScript"             ## Job Title
#BSUB -n 10                     ## Number of Cores
#BSUB -R "rusage[mem=2048]"     ## Memory Request
#BSUB -W 2:00                   ## Running Time

## Load environment
module load gcc/4.8.2 gdc perl/5.18.4

## ...
```

Job monitoring

```
[leonhard@euler08 ~]$ bbjobs 31989961
Job information
 Job ID                          : 31989961
 Status                          : RUNNING
 Running on node                 : e1268
 User                            : leonhard
 Queue                           : normal.4h
 Command                         : compute_pq.py
 Working directory               : $HOME/testruns
Requested resources
 Requested cores                 : 1
 Requested memory                : 1024 MB per core
 Requested scratch               : not specified
 Dependency                      : -
Job history
 Submitted at                    : 08:45 2016-11-15
 Started at                      : 08:48 2016-11-15
 Queue wait time                 : 140 sec
Resource usage
 Updated at                      : 08:48 2016-11-15
 Wall-clock                      : 34 sec
 Tasks                           : 4
 Total CPU time                  : 5 sec
 CPU utilization                 : 80.0 %
 Sys/Kernel time                 : 0.0 %
 Total resident memory           : 2 MB
 Resident memory utilization     : 0.2 %
```

A Few important terms:

- **HPC cluster**: relatively tightly coupled collection of compute nodes. Access to the cluster is provided through a login node. A resource manager and scheduler provide the logic to schedule jobs efficiently on the cluster.
- **Compute node**: an individual computer, part of an HPC cluster. Currently most compute node have two sockets, each with a single CPU, volatile working memory (RAM), a hard drive, typically small, and only used to store temporary files, and a network card.
- **CPU**: Central Processing Unit, the chip that performs the actual computation in a compute node. A modern CPU is composed of numerous cores, typically 8 or 10. It has also several cache levels that help in data reuse.
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