

# Cambridge Pathology

## Introduction to High-Performance Computing

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# Outline

We will cover:

- ① how to create an account,
- ② logging in,
- ③ types of data storage,
- ④ types of compute nodes,
- ⑤ running jobs,
- ⑥ how to check on the status of jobs,
- ⑦ how to set up environments.

# Account Creation

Link for account creation:

[www.hpc.cam.ac.uk/applications-access-research-computing-services](http://www.hpc.cam.ac.uk/applications-access-research-computing-services)

Workflow:

- 1 Have your PI create an account first (if they haven't already).
- 2 Students/postdocs/staff apply for their own account.
- 3 PI gets an Email to approve student/postdoc/staff account creation, linking to lab's account.
- 4 Set up multifactor authentication.

# Resources Available Per Account

## Computing Resources Per Lab Account

- 200,000 CPU hours per PI per quarter.
- 3,000 GPU hours per PI per quarter.
- Refreshes on first of: Nov, Feb, May, Aug.

## Data Storage Per User Account

1 TB in rds/hpc-work (hot storage; not backed up).

# Setting up Multifactor Authentication

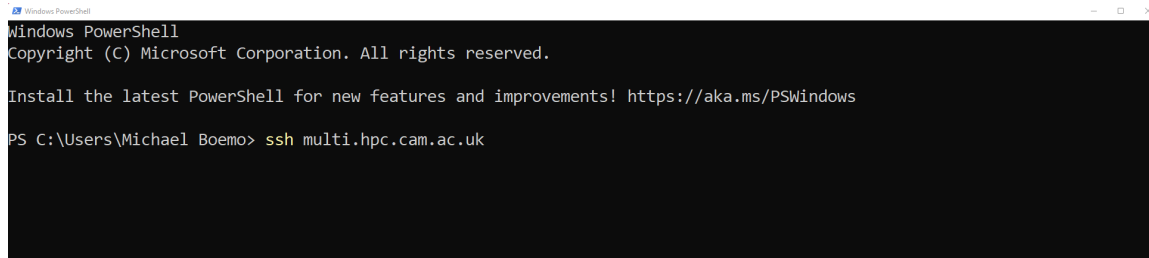
Download and install Microsoft Authenticator app on your phone:

<https://www.microsoft.com/en-us/security/mobile-authenticator-app>

(You probably already have this for Outlook login.)

Open PowerShell (Windows) or a terminal (OSX or Linux).

Type: `ssh multi.hpc.cam.ac.uk`

A screenshot of a Windows PowerShell terminal window. The window title is "Windows PowerShell". The text inside shows the standard PowerShell startup messages: "Windows PowerShell", "Copyright (C) Microsoft Corporation. All rights reserved.", and "Install the latest PowerShell for new features and improvements! https://aka.ms/PSWindows". Below these, the prompt "PS C:\Users\Michael Boemo>" is followed by the command "ssh multi.hpc.cam.ac.uk" which has been entered in yellow text.

```
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

Install the latest PowerShell for new features and improvements! https://aka.ms/PSWindows

PS C:\Users\Michael Boemo> ssh multi.hpc.cam.ac.uk
```

## Setting up Multifactor Authentication

Enter your username and password.

Username: CRSid

Password: Raven password

From phone app: tap “+” in the right corner.

Scan the QR code that appears in the terminal.

Phone app will show a 6-digit TOTP code.

(Code changes every 30 seconds.)

Enter TOTP code in terminal.

Connection should terminate.



# Ways to Log In

## Command Line

- submit jobs,
- move files around,
- ftp files between servers,
- PowerShell or PuTTY (Windows) or terminal (OSX or Linux).

## FTP Client

- move files between your computer and the server,
- graphical user interface,
- FileZilla (Windows, OSX), CyberDuck (Windows, OSX), Nautilus (Ubuntu).

# Logging In (Command Line)

Windows PowerShell

Windows PowerShell

Copyright (C) Microsoft Corporation. All rights reserved.

Install the latest PowerShell for new features and improvements! <https://aka.ms/PSWindows>PS C:\Users\Michael Boemo> `ssh mb915@login-cpu.hpc.cam.ac.uk`



## Logging In (Command Line)

```
PS C:\Users\Michael Boemo> ssh mb915@login-cpu.hpc.cam.ac.uk  
The authenticity of host 'login-cpu.hpc.cam.ac.uk (128.232.224.46)' can't be established.  
ED25519 key fingerprint is SHA256:nFVSXK+VRGCaUpQEdhXzO6kp01m2fzzmbgPr0sc2so.  
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes  
Warning: Permanently added 'login-cpu.hpc.cam.ac.uk,128.232.224.46' (ED25519) to the list of known hosts.
```

```
<><><><><><><><><><><><><><><><><><>  
<>                                                                 <>  
<>                        !WARNING!                               <>  
<>                                                                 <>  
<>                        RCS CSD3 Facility                         <>  
<>                Unauthorised Access Prohibited                  <>  
<>    Use of this system constitutes acceptance of our            <>  
<>                    policies - see                                <>  
<> http://docs.hpc.cam.ac.uk/hpc/user-guide/policies.html        <>  
<>                                                                 <>  
<><><><><><><><><><><><><><><><><><><><><>
```

```
PLEASE NOTE: From 1st November 2022, SSH login to CSD3 will require  
TOTP MFA. For more information, please see  
https://docs.hpc.cam.ac.uk/hpc/user-guide/mfa.html.
```

```
Password:
```

[illegible][illegible][illegible]

## Logging In (Command Line)

[illegible]

## Logging In (Command Line)

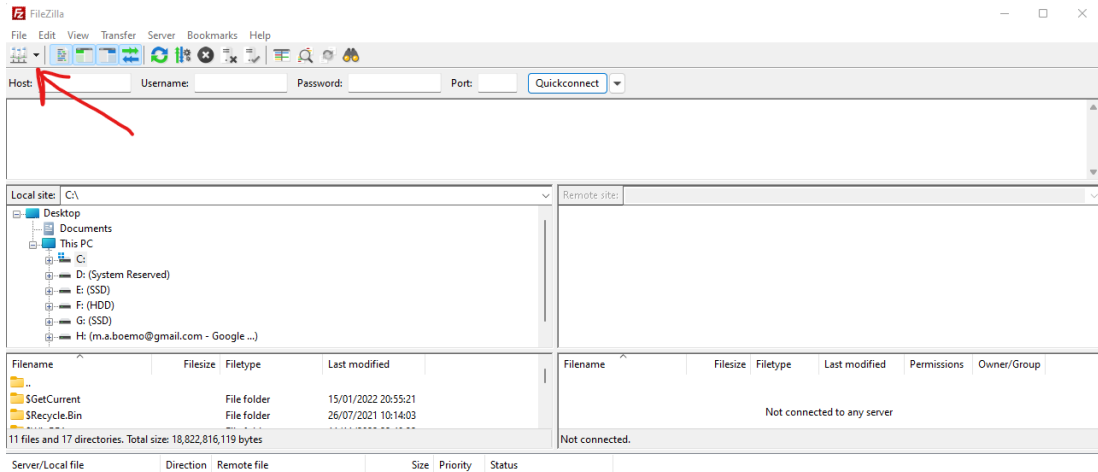
```
PS C:\Users\Michael Boemo> ssh mb915@login-cpu.hpc.cam.ac.uk
The authenticity of host 'login-cpu.hpc.cam.ac.uk (128.232.224.46)' can't be established.
ED25519 key fingerprint is SHA256:nFVSXK+VRGCaUupQEhXzO6kp01m2fzzmbgPr0sc2so.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added 'login-cpu.hpc.cam.ac.uk,128.232.224.46' (ED25519) to the list of known hosts.
```

[illegible]

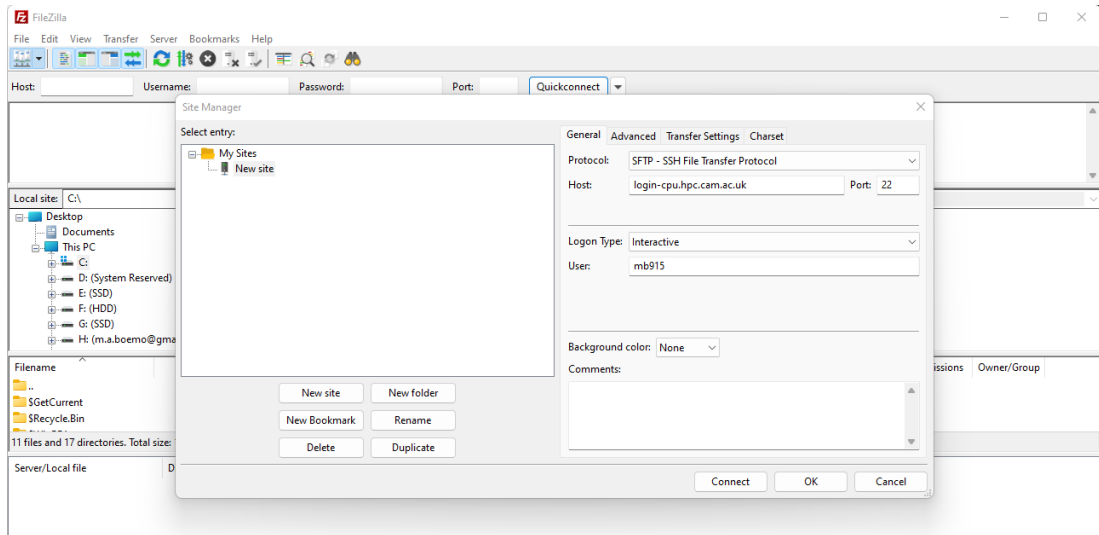
PLEASE NOTE: From 1st November 2022, SSH login to CSD3 will require TOTP MFA. For more information, please see <https://docs.hpc.cam.ac.uk/hpc/user-guide/mfa.html>.

```
Password:
TOTP Verification Code: 055513
Last login: Fri Nov  4 17:39:33 2022 from 10.249.26.95
(base) [mb915@login-e-9 ~]$
```

# Logging In (FTP Client)



# Logging In (FTP Client)



# Logging In (FTP Client)

New site - sftp://mb915@login-cpu.hpc.cam.ac.uk - FileZilla

File Edit View Transfer Server Bookmarks Help

Host: Username: Password: Port: Quickconnect

Status: Retrieving directory listing of "/home/mb915/rds"...

Status: Listing directory /home/mb915/rds

Status: Directory listing of "/home/mb915/rds" successful

Status: Retrieving directory listing of "/home/mb915/rds/hpc-work"...

Status: Listing directory /rds/user/mb915/hpc-work

Status: Directory listing of "/rds/user/mb915/hpc-work" successful

Local site: C:\

Remote site: /rds/user/mb915/hpc-work

Desktop

Documents

This PC

C:

D: (System Reserved)

E: (SSD)

F: (HDD)

G: (SSD)

H: (m.a.boemo@gmail.com - Google ...)

home

mb915

rds

user

mb915

hpc-work

Filename	Filesize	Filetype	Last modified	Permissions	Owner/Group
..					
\$GetCurrent		File folder	15/01/2022 20:55:21		
\$Recycle.Bin		File folder	26/07/2021 10:14:03		

11 files and 17 directories. Total size: 18,822,816,119 bytes

Filename	Filesize	Filetype	Last modified	Permissions	Owner/Group
..					
analysis		File folder	12/10/2022 15:...	drwxrwxr-x	mb915 mb9...
archive		File folder	19/02/2020 16:...	drwxrwxr-x	mb915 mb9...

1 file and 15 directories. Total size: 43,704,069 bytes

Server/Local file	Direction	Remote file	Size	Priority	Status
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# Data Services

## Research Data Storage (RDS)

- high-performance, hot storage mounted on HPC platforms,
- not redundant,
- £54 per TB per year.

## Research Cold Storage (RCS)

- slow, redundant cold storage on two tape libraries,
- £30.72 per TB per year.

## Research File Share (RFS)

- not mounted on HPC platforms, but resilient with frequent snapshots for backups,
- £116.10 per TB per year.

## Accessing Data Services (Command Line)

```
mb915@login-e-10:~/rds
```

```
PS C:\Users\Michael Boemo> ssh mb915@login-cpu.hpc.cam.ac.uk
Warning: Permanently added the ED25519 host key for IP address '128.232.224.47' to the list of known hosts.
```

[illegible]

PLEASE NOTE: From 1st November 2022, SSH login to CSD3 will require TOTP MFA. For more information, please see <https://docs.hpc.cam.ac.uk/hpc/user-guide/mfa.html>.

```

Password:
TOTP Verification Code: 016191
Last login: Fri Nov 11 12:18:20 2022 from 10.249.26.95
(base) [mb915@login-e-10 ~]$ ls
perl5  rcs  rds  slurm_submit.peta4-cclake  slurm_submit.peta4-knl  slurm_submit.peta4-skylake  slurm_submit.wilkes2

```



# Accessing Data Services (FTP Client)

New site - sftp://mb915@login-cpu.hpc.cam.ac.uk - FileZilla

File Edit View Transfer Server Bookmarks Help

Host: Username: Password: Port: Quickconnect

Status: Retrieving directory listing of "/home/mb915/rcs"...  
 Status: Listing directory /rcs/user/mb915  
 Status: Directory listing of "/rcs/user/mb915" successful  
 Status: Retrieving directory listing of "/home/mb915/rds"...  
 Status: Listing directory /home/mb915/rds  
 Status: Directory listing of "/home/mb915/rds" successful

Local site: C:\Users\Michael Boemo\Desktop\ Remote site: /home/mb915

Desktop Documents This PC C: \$GetCurrent \$Recycle.Bin \$WinREAgent AMD Config.Msi

Remote site: /home/mb915

home mb915 .aws .cache .conda .config .gnome2 .keras

Filename	Filesize	Filetype	Last modified	Permissions	Owner/Group
..					
calendar		File folder	04/12/2021 22:56:51		
New folder		File folder	05/11/2022 15:15:53		

14 files and 3 directories. Total size: 1,128,609 bytes

Filename	Filesize	Filetype	Last modified	Permissions	Owner/Group
rcs		File folder	27/01/2020 12:...	lrwxrwxrwx	root root
rds		File folder	19/10/2022 12:...	drwxr-xr-x	mb915 mb9...
slurm_submit.peta4-c...		File folder	21/09/2020 17:...	lrwxrwxrwx	mb915 mb9...

10 files and 21 directories. Total size: 90,375 bytes

Server/Local file	Direction	Remote file	Size	Priority	Status
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# Data Services Working Together

Consider the following lab:

- protocols, spreadsheets, and documents shared and edited between a number of people (Research File Share),
- data and files from lab members that have left (Research Cold Storage),
- backups of all raw sequencing datasets (Research Cold Storage),
- sequencing datasets actively being used for omics analyses (Research Data Storage).

# Backup and Data Handling Practices

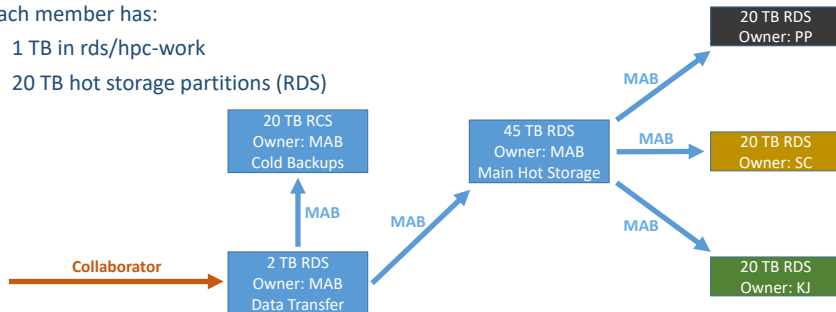
- at least one data copy should be completely raw,
- good naming conventions and record keeping for datasets,
  - 2021\_08\_12\_VM\_ONT\_EdU\_HU\_BrdU\_ULR\_fast5
- think through how data is moving and any weak points,
- accidents should never cause permanent damage,
- clear and agreed upon backup strategies.

# Backup Strategies

## Data Storage

Each member has:

- 1 TB in rds/hpc-work
- 20 TB hot storage partitions (RDS)



# Tracking the Flow of Data

	A	B	C	D	E	F	G	H	I	J	K
1	Collaborator	Institution	Date Received	Cold Storage c/o	Cold Storage Location	Hot Storage c/o	Hot Storage Location	Sequencing Platform	Organism	Cell Line	Protocol/Description
2	XXXXX	XXXXX	26/10/2022	MAB	rds/rcs-mb915-rawdataaar	PLP	rds/rds-pfuderer-G2yvlii	MinION (R9.4.1)	XXXXX	XXXXX	XXXXX
3	XXXXX	XXXXX	26/10/2022	MAB	rds/rcs-mb915-rawdataaar	PLP	rds/rds-pfuderer-G2yvlii	MinION (R9.4.1)	XXXXX	XXXXX	XXXXX
4	XXXXX	XXXXX	26/10/2022	MAB	rds/rcs-mb915-rawdataaar	PLP	rds/rds-pfuderer-G2yvlii	MinION (R9.4.1)	XXXXX	XXXXX	XXXXX
5	XXXXX	XXXXX	24/10/2022	MAB	rds/rcs-mb915-rawdataaar	SY	rds/rds-ye_shutong-xcyv	MinION (R9.4.1)	XXXXX	XXXXX	XXXXX
6	XXXXX	XXXXX	24/10/2022	MAB	rds/rcs-mb915-rawdataaar	SY	rds/rds-ye_shutong-xcyv	MinION (R9.4.1)	XXXXX	XXXXX	XXXXX

# CPU Compute Nodes Available

## Cascade Lake Nodes

- 56 CPUs (112 threads) per node,
- 192 GB of RAM per node,
- high memory nodes with 384 GB of RAM.

## Ice Lake Nodes

- 76 CPUs (152 threads) per node,
- 192 GB of RAM per node,
- high memory nodes with 384 GB of RAM.

# GPU Compute Nodes Available

## A100 Nodes

- four NVIDIA Ampere A100 80 GB GPUs per node,
- 128 AMD CPUs per node.

# At-Once Usage Caps

## SL3

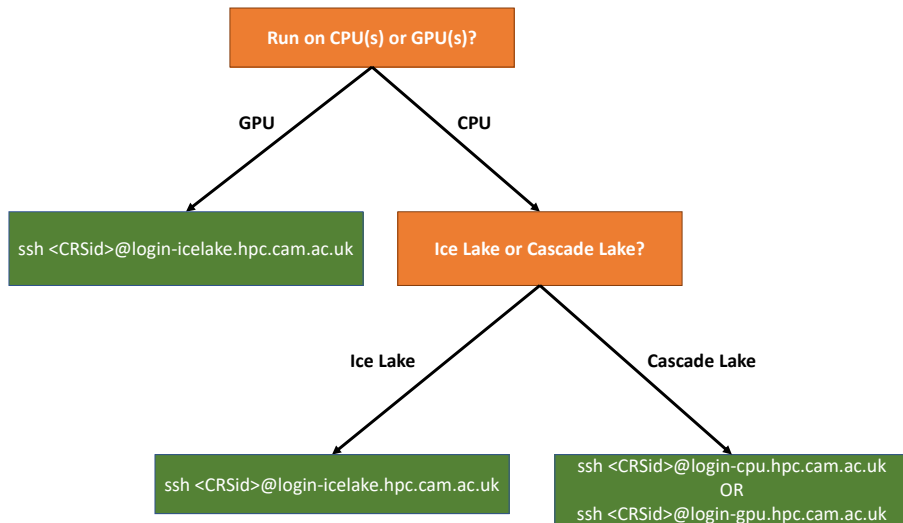
- 320 CPUs,
- 32 GPUs,
- 12-hour maximum job time.

## SL1/2

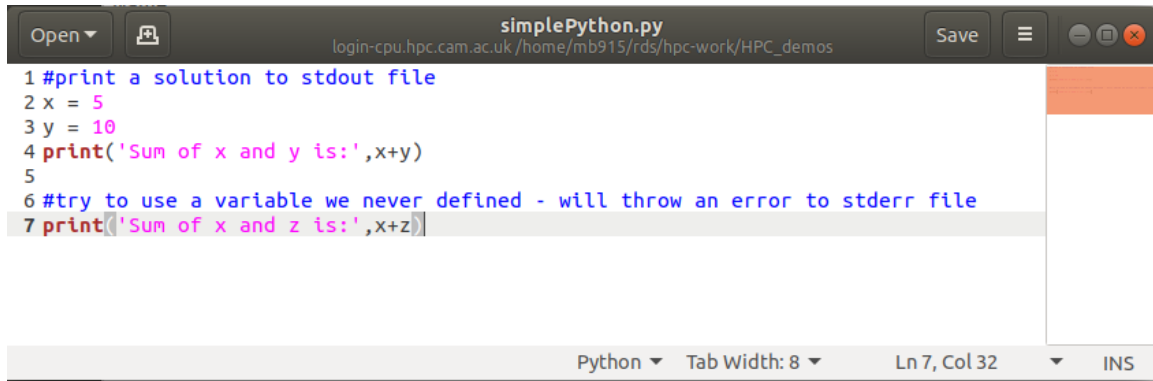
- 1280 CPUs,
- 64 GPUs,
- 36-hour maximum job time.



# Which Login Node to Use?



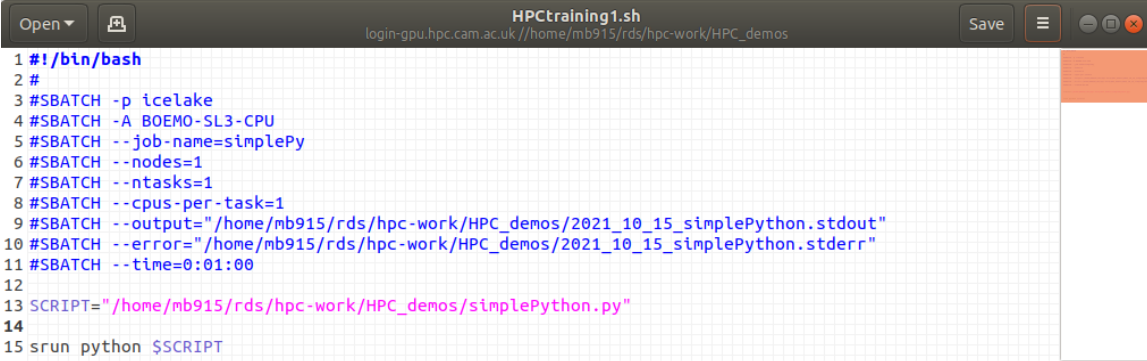
# Create a Simple Python Script



```
1 #print a solution to stdout file
2 x = 5
3 y = 10
4 print('Sum of x and y is:',x+y)
5
6 #try to use a variable we never defined - will throw an error to stderr file
7 print('Sum of x and z is:',x+z)
```

Python ▾ Tab Width: 8 ▾ Ln 7, Col 32 ▾ INS

# Creating an sbatch Script



```
1 #!/bin/bash
2 #
3 #SBATCH -p icelake
4 #SBATCH -A BOEMO-SL3-CPU
5 #SBATCH --job-name=simplePy
6 #SBATCH --nodes=1
7 #SBATCH --ntasks=1
8 #SBATCH --cpus-per-task=1
9 #SBATCH --output="/home/mb915/rds/hpc-work/HPC_demos/2021_10_15_simplePython.stdout"
10 #SBATCH --error="/home/mb915/rds/hpc-work/HPC_demos/2021_10_15_simplePython.stderr"
11 #SBATCH --time=0:01:00
12
13 SCRIPT="/home/mb915/rds/hpc-work/HPC_demos/simplePython.py"
14
15 srun python $SCRIPT
```

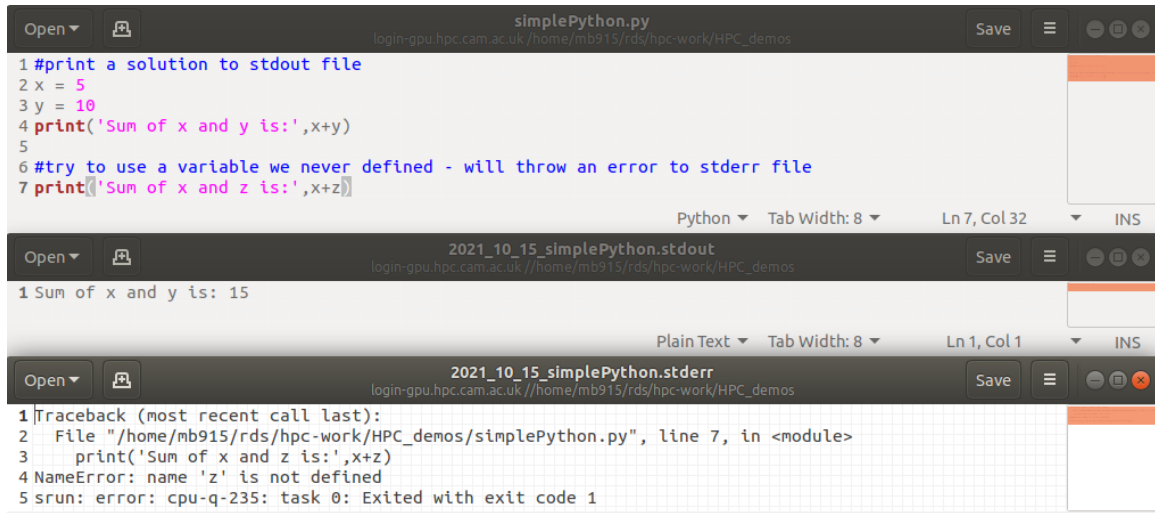
# Submitting Jobs to Compute Nodes

```
(base) [mb915@login-e-8 HPC_demos]$ sbatch HPCtraining1.sh
Submitted batch job 47460048
(base) [mb915@login-e-8 HPC_demos]$ squeue -u mb915
```

JOBID	PARTITION	NAME	USER	ST	TIME	NODES	NODELIST (REASON)
47455220	cclake	bcs	mb915	PD	0:00	1	(Priority)
47455255	cclake	bcs	mb915	PD	0:00	1	(Priority)
47460048	cclake	simplePy	mb915	PD	0:00	1	(Priority)

```
(base) [mb915@login-e-8 HPC_demos]$
```

# Submitting Jobs to Compute Nodes



The screenshot displays a terminal window with three stacked panes. The top pane shows a Python script named `simplePython.py` with the following code:

```
1 #print a solution to stdout file
2 x = 5
3 y = 10
4 print('Sum of x and y is:',x+y)
5
6 #try to use a variable we never defined - will throw an error to stderr file
7 print('Sum of x and z is:',x+z)
```

The middle pane shows the standard output (stdout) of the script:

```
1 Sum of x and y is: 15
```

The bottom pane shows the standard error (stderr) output, indicating a `NameError` because the variable `z` is not defined:

```
1 Traceback (most recent call last):
2   File "/home/mb915/rds/hpc-work/HPC_demos/simplePython.py", line 7, in <module>
3     print('Sum of x and z is:',x+z)
4 NameError: name 'z' is not defined
5 srun: error: cpu-q-235: task 0: Exited with exit code 1
```

# Multicore Processing



```
1 #!/bin/bash
2 #
3 #SBATCH -p icelake
4 #SBATCH -A BOEMO-SL3-CPU
5 #SBATCH --job-name=align
6 #SBATCH --nodes=1
7 #SBATCH --ntasks=1
8 #SBATCH --cpus-per-task=76
9 #SBATCH --output="/home/mb915/rds/hpc-work/HPC_demos/alignment.stdout"
10 #SBATCH --error="/home/mb915/rds/hpc-work/HPC_demos/alignment.stderr"
11 #SBATCH --time=6:00:00
12
13 MINIMAP2="/home/mb915/rds/hpc-work/software/minimap2-2.17_x64-linux/minimap2"
14 OUTSAM="/home/mb915/rds/hpc-work/HPC_demos/alignments.sam"
15 GENOME="/home/mb915/rds/hpc-work/reference.fasta"
16 QUERY="/home/mb915/rds/hpc-work/HPC_demos/reads.fastq"
17
18 srun $MINIMAP2 -ax map-ont -t 76 -a -o $OUTSAM $GENOME $QUERY
```

# Job Arrays

We have:

- one Python script that will do some analysis,
- lots of data files (called `input0`, `input1`, ..., `input6`) that we want to run this same script on.



The screenshot shows a code editor window with a dark theme. The title bar at the top reads "simplePythonArray.py" and the address bar shows the path "login-cpu.hpc.cam.ac.uk/home/mb915/rds/hpc-work/HPC\_demos". The editor contains three lines of Python code: "1 import sys", "2", and "3 print('I was passed:', sys.argv[1])". The third line is highlighted. On the right side of the editor, there is a vertical orange bar. At the bottom of the window, a status bar displays "Python", "Tab Width: 8", "Ln 3, Col 12", and "INS".

```
1 import sys
2
3 print('I was passed:', sys.argv[1])
```

Python Tab Width: 8 Ln 3, Col 12 INS

# Job Arrays



```
1 #!/bin/bash
2 #
3 #SBATCH -p cclake
4 #SBATCH -A BOEMO-SL3-CPU
5 #SBATCH --job-name=simplePyArr
6 #SBATCH --nodes=1
7 #SBATCH --ntasks=1
8 #SBATCH --cpus-per-task=1
9 #SBATCH --output="/home/mb915/rds/hpc-work/HPC_demos/2021_10_15_simplePythonArray.%a.stdout"
10 #SBATCH --error="/home/mb915/rds/hpc-work/HPC_demos/2021_10_15_simplePythonArray.%a.stderr"
11 #SBATCH --time=0:01:00
12 #SBATCH --array=0-6
13
14 SCRIPT="/home/mb915/rds/hpc-work/HPC_demos/simplePythonArray.py"
15 INPUTDATA="/path/to/input${SLURM_ARRAY_TASK_ID}"
16
17 srun python $SCRIPT $INPUTDATA
```

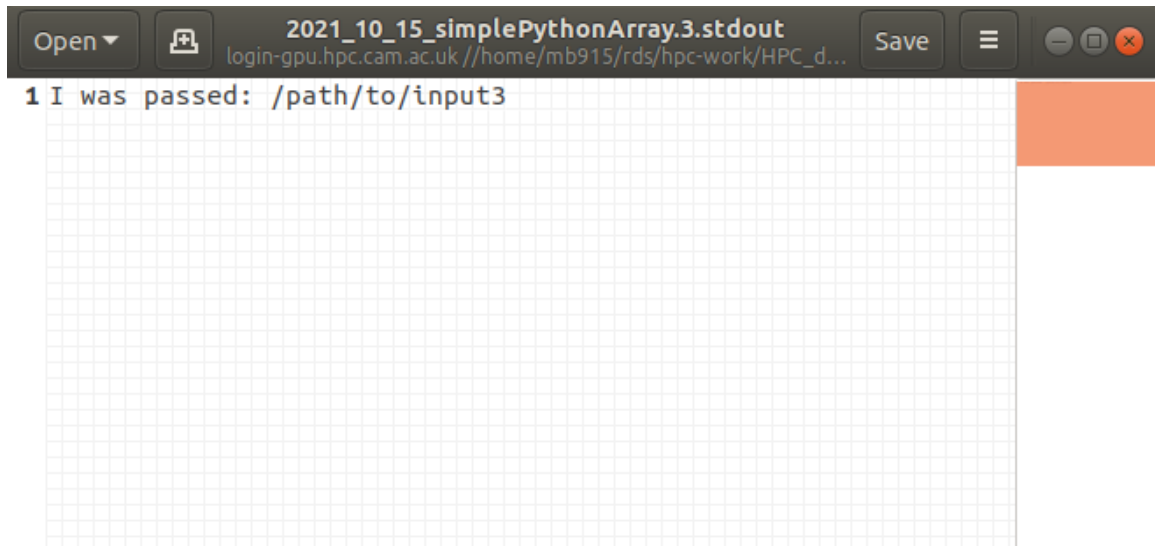


# Job Arrays

login-gpu.hpc.cam.ac.uk home mb915 rds hpc-work HPC\_demos

	Name	Size	Type	Modified
	2021_10_15_simplePython.stderr	181 bytes	Binary	Mon
	2021_10_15_simplePython.stdout	22 bytes	Binary	Mon
	2021_10_15_simplePythonArray.0.stderr	0 bytes	Binary	Yesterday
	2021_10_15_simplePythonArray.0.stdout	30 bytes	Binary	Yesterday
	2021_10_15_simplePythonArray.1.stderr	0 bytes	Binary	Yesterday
	2021_10_15_simplePythonArray.1.stdout	30 bytes	Binary	Yesterday
	2021_10_15_simplePythonArray.2.stderr	0 bytes	Binary	Yesterday
	2021_10_15_simplePythonArray.2.stdout	30 bytes	Binary	Yesterday
	2021_10_15_simplePythonArray.3.stderr	0 bytes	Binary	Yesterday
	2021_10_15_simplePythonArray.3.stdout	30 bytes	Binary	Yesterday
	2021_10_15_simplePythonArray.4.stderr	0 bytes	Binary	Yesterday
	2021_10_15_simplePythonArray.4.stdout	30 bytes	Binary	Yesterday
	2021_10_15_simplePythonArray.5.stderr	0 bytes	Binary	Yesterday
	2021_10_15_simplePythonArray.5.stdout	30 bytes	Binary	Yesterday
	2021_10_15_simplePythonArray.6.stderr	0 bytes	Binary	Yesterday
	2021_10_15_simplePythonArray.6.stdout	30 bytes	Binary	Yesterday

# Job Arrays



The screenshot shows a terminal window with a dark title bar. The title bar contains the text "2021\_10\_15\_simplePythonArray.3.stdout" and a URL "login-gpu.hpc.cam.ac.uk //home/mb915/rds/hpc-work/HPC\_d...". There are buttons for "Open", "Save", and window control icons. The terminal content shows a single line of output: "1 I was passed: /path/to/input3". The background of the terminal is a light gray grid.

```
2021_10_15_simplePythonArray.3.stdout
login-gpu.hpc.cam.ac.uk //home/mb915/rds/hpc-work/HPC_d...
1 I was passed: /path/to/input3
```

# Modules

All modules currently loaded:

```
module list
```

List all modules available to load:

```
module avail
```

Search for an available module (samtools, for example):

```
module avail samtools
```

# Virtual Environments

We have:

- at least one Python package we want to install.

We could do:

- `pip3 install --user tensorflow=2.4.1`

Better:

- use virtual environments!

# Virtual Environments

Making a new virtual environment:

- `virtualenv HPC_TRAINING`

Activate it:

- `source /path/to/HPC_TRAINING/bin/activate`

Deactivate it:

- `deactivate`

# Putting It All Together: Run on GPUs



```
1 #!/bin/bash
2 #
3 #SBATCH -p pascal
4 #SBATCH -A BOEMO-SL3-GPU
5 #SBATCH --job-name=gpuJob
6 #SBATCH --gres=gpu:1
7 #SBATCH --ntasks=1
8 #SBATCH --nodes=1
9 #SBATCH --cpus-per-task=3
10 #SBATCH --output="/home/mb915/rds/hpc-work/output/2021_10_15_gpuJob.stdout"
11 #SBATCH --error="/home/mb915/rds/hpc-work/output/2021_10_15_gpuJob.stderr"
12 #SBATCH --time=4:00:00
13
14 module purge
15 module load rhel7/default-gpu
16 module unload cuda/8.0
17 module load python/3.6 cuda/11.0 cuda/11.1 cudnn/8.0_cuda-11.1
18
19 source /home/mb915/rds/hpc-work/tensorflow-env/bin/activate
20
21 SCRIPT="/home/mb915/rds/hpc-work/trainLargeDNN.py"
22
23 srun python $SCRIPT
```

# Seeing Past Jobs and Statuses

```
(base) [mb915@login-e-5 HPC_demos]$ sacct --starttime 2021-10-14
```

JobID	JobName	Partition	Account	AllocCPUS	State	ExitCode
47654390_0	simplePyA+	cclake	boemo-sl3+	1	COMPLETED	0:0
47654390_0.+	batch		boemo-sl3+	1	COMPLETED	0:0
47654390_0.+	extern		boemo-sl3+	1	COMPLETED	0:0
47654390_1	simplePyA+	cclake	boemo-sl3+	1	COMPLETED	0:0
47654390_1.+	batch		boemo-sl3+	1	COMPLETED	0:0
47654390_1.+	extern		boemo-sl3+	1	COMPLETED	0:0
47654390_2	simplePyA+	cclake	boemo-sl3+	1	COMPLETED	0:0
47654390_2.+	batch		boemo-sl3+	1	COMPLETED	0:0
47654390_2.+	extern		boemo-sl3+	1	COMPLETED	0:0
47654390_3	simplePyA+	cclake	boemo-sl3+	1	COMPLETED	0:0
47654390_3.+	batch		boemo-sl3+	1	COMPLETED	0:0
47654390_3.+	extern		boemo-sl3+	1	COMPLETED	0:0
47654390_4	simplePyA+	cclake	boemo-sl3+	1	COMPLETED	0:0
47654390_4.+	batch		boemo-sl3+	1	COMPLETED	0:0
47654390_4.+	extern		boemo-sl3+	1	COMPLETED	0:0
47654390_5	simplePyA+	cclake	boemo-sl3+	1	COMPLETED	0:0
47654390_5.+	batch		boemo-sl3+	1	COMPLETED	0:0
47654390_5.+	extern		boemo-sl3+	1	COMPLETED	0:0

# Checking Used Diskspace

```
mb915@login-q-3:~
(base) [mb915@login-q-3 ~]$ quota
Filesystem/Project  GB      quota      limit      grace      files      quota      limit
ser/Grp/Proj
/home              16.4      50.0      55.0      -      ----- No File Quotas
:mb915
/rds-d4            754.5     1099.5     1209.5     -      715031    1048576    1048576
:mb915
/rds2              6152.7    21990.2    21990.2    -      588937    2000000    2000000
rds-6m653hlCD3A    13.3      1000.0     1000.0     -        35      512000     512000
/rds-d2             0.0        0.0        0.0      -         1         0         0
/rds-d4            1114.8     2199.0     2199.0     -       5082    1048576    1048576
/rds-d4            48311.7    48378.5    48378.5    -    15564252    23068672    23068672
/rds-d5             0.0         0.0         0.0      -         1         0         0
rds-e89MpZIIFKg    6000.3     6000.0     6000.0     -     198691    3072000    3072000
rds-G2yvliM05O4    3174.8     20000.0    20000.0    -     387968    10240000    10240000
rds-KxAwp6sTNTA    11795.3     20000.0    20000.0    -     41396    10240000    10240000
rds-lbo2YIBtMG4     223.0      1000.0     1000.0     -       2580     512000     512000
rds-llQYKINinB8     877.8      20000.0    20000.0    -       9592    10240000    10240000
rds-povrOiKbCCA      0.0        1000.0     1000.0     -         1     512000     512000
rds-PwZwSmUxXag     570.5      10000.0    10000.0    -     112705    5120000    5120000
rds-X7FJV3IVi1A      91.2       1000.0     1000.0     -        799     512000     512000
rds-xcywAxU6Kd0     384.3      20000.0    20000.0    -     22586    10240000    10240000
(base) [mb915@login-q-3 ~]$
```



# Checking Number of CPU/GPU Hours Remaining



mb915@login-q-3:~



```
(base) [mb915@login-q-3 ~]$ mybalance
```

User	Usage		Account	Usage		Account Limit	Available (hours)
-----	-----	+	-----	-----	+	-----	-----
mb915	10,749		BOEMO-SL2-CPU	10,749		385,000	374,251
mb915	1,694		BOEMO-SL2-GPU	1,694		11,035	9,341
mb915	294,418		BOEMO-SL3-CPU	344,289		543,375	199,086
mb915	8,644		BOEMO-SL3-GPU	8,946		11,831	2,885

```
(base) [mb915@login-q-3 ~]$
```

## Where to Find Resources

- These slides and Slurm scripts: <https://github.com/MBoemo/HPC-resources>
- HPC computing documentation: <https://docs.hpc.cam.ac.uk/hpc/>
- HPC storage documentation: <https://docs.hpc.cam.ac.uk/storage/>
- Purchasing storage: <https://selfservice.uis.cam.ac.uk/>
- SBS bioinformatics Slack channel:  
<https://www.bio.cam.ac.uk/facilities/bioinformatics-computing>