# MFCF S&AS GRAD SESSION
# FALL 2022

# AGENDA

▸ Introduction, Help Centre

▸ Getting online

    ▸ two-factor authentication (2FA)

    ▸ off-campus; Virtual Private Network (VPN)

    ▸ on-campus: wireless and wired network

    ▸ Microsoft 365

▸ Using your desktop machine

    ▸ desktops, accessing your files, central file service, printing, applications

▸ Academic resources

    ▸ personal web pages using Scholar

    ▸ library journals

▸ Computing resources

    ▸ Linux environment - servers (fast, big, GPU, HPC), managing jobs and priorities

    ▸ Windows environment - MS Remote Desktop

▸ Questions

# HELP CENTRE

▸ MC 3017, ext. 46323 (hMFCF)  [mfcfhelp@uwaterloo.ca](mailto:mfcfhelp@uwaterloo.ca)

▸ desktops - re-imaging, downloading software

▸ personal laptop wired connections - submit RT ticket

▸ accounts, printing

▸ Request Tracker - [https://rt.uwaterloo.ca/SelfService/Forms/MFCF/](https://rt.uwaterloo.ca/SelfService/Forms/MFCF/)

▸ please feel free to ask us for help!

# GETTING ON-LINE

▸ two-factor authentication

▸ off-campus: VPN

▸ on-campus: wireless and wired connections

▸ Microsoft 365

# TWO-FACTOR AUTHENTICATION

▸ 2FA is required for:

  ▸ VPN

  ▸ Microsoft 365

  ▸ Quest, Workday, Unit4, Concur

  ▸ Waterloo LEARN

▸ https://uwaterloo.ca/two-factor-authentication

▸ use Duo app, or a special hardware token

# VIRTUAL PRIVATE NETWORK

▸ Allows remote access to all campus network resources

  ▸ e.g. files, remote desktop services

  ▸ all data transferred are encrypted and secure

▸ Install VPN from IST. This is a one-time install.

  ▸ https://uwaterloo.ca/information-systems-technology/services/virtual-private-network-vpn

    ▸ includes Windows and Mac instructions

  ▸ the client is called Cisco AnyConnect

  ▸ WatIAM credentials to login

  ▸ use https://checkvpn.uwaterloo.ca/ to verify things work

# WIRELESS

▸ Select eduroam from the list of available Wi-Fi networks

▸ authentication

  ▸ userid@uwaterloo.ca

  ▸ WatIAM password

▸ Do NOT run your own wifi service. It just interferes with eduroam and makes it worse for everyone!

# WIRED

▸ submit a <u>request</u> in the MFCF RT queue with the following information:

  ▸ operating system

  ▸ room

  ▸ expiry date

  ▸ MAC hardware address

    ▸ https://uwaterloo.ca/math-faculty-computing-facility/services/
      wired-connections/how-find-mac-hardware-address

  ▸ sponsor/supervisor

# MICROSOFT 365

▸ https://uwaterloo.ca/office-365/

▸ Office products including OneDrive

  ▸ 5 TB storage - stored off-campus on MS servers

  ▸ files can also be shared with others outside UW

▸ recommend storing large research datasets on our file server for faster performance when using our servers

# USING YOUR DESKTOP

▸ desktop machines

▸ central file service

▸ printing

▸ applications

# DESKTOPS

▸ managed by MFCF. No administrator access for users.

▸ Masters students share; PhD students have individual machines with their choice of platform

▸ machines must be left on 24/7 for management tasks (automatic rebooting for software upgrades and OS patching)

▸ files on local machine are NOT backed up

▸ Common Mathematical software - R, Maple, MATLAB, Office suite, etc., preinstalled or available via self-serve

# MAC MINI ICONS

# DESKTOPS

▸ Windows PCs are joined to "Nexus" (campus central domain)

  ▸ P: drive is your personal storage on central file server

  ▸ similar access to network and local storage

▸ Mac minis - icons on the desktop for:

  ▸ files.math.uwaterloo.ca - your files on the central fileserver

  ▸ windows.math.uwaterloo.ca- connects to Windows terminal servers using Remote Desktop

    ▸ P: drive is your personal storage on central file server

  ▸ linux.math.uwaterloo.ca - opens Linux command window

    ▸ more about choice of Linux servers later in the presentation

▸ Linux - manage your own

# CENTRAL FILE SERVICE

▸ central research file server "files.math.uwaterloo.ca"

▸ central teaching file server  - coursework "files.student.math.uwaterloo.ca"

▸ frequent online backups for safe reliable storage and easy retrieval of old versions

▸ all central Linux and Windows servers, plus your desktop machines, use the central file servers

▸ keep your important files there, not on your desktop!

# CONNECT TO FILE SERVER FROM YOUR OWN MACHINE

▸ Use Virtual Private Network (VPN) when accessing campus resources remotely https://vpn.uwaterloo.ca

▸ store files on the central Math fileserver (back up your data)

    ▸ Mac standalone: Go > Connect to Server…

        ▸ smb://files.math.uwaterloo.ca/UWuserid

    ▸ Windows standalone: Map a network drive

        ▸ \\files.math.uwaterloo.ca\UWuserid

    ▸ Windows Remote Desktop: windows.math.uwaterloo.ca

        ▸ P: drive (files are stored automatically on the file server)

    ▸ Linux: File Manager > Connect to Server…

        ▸ smb://files.math.uwaterloo.ca/UWuserid

        ▸ ssh to linux.math.uwaterloo.ca

# PRINTING

▸ access is automatic once registered - check with admin for location of printers

▸ for thesis only - do not print books

▸ can be added to your personal workstation

  ▸ https://uwaterloo.ca/math-faculty-computing-facility/adding-printers-your-computer

# APPLICATIONS

▸ math software

   ▸ R, Maple, Julia, Octave (freeware version of MATLAB), many more

   ▸ MATLAB - Free campus wide license. See https://uwaterloo.atlassian.net/wiki/spaces/ISTKB/pages/284525621/Download+or+use+MATLAB+online

   ▸ others at https://uwaterloo.ca/information-systems-technology/services/software-faculty-and-staff/licensed-software-university-waterloo (some free, some paid by your supervisor)

▸ typesetting

   ▸ LaTeX, including Overleaf Commons (www.overleaf.com/edu/uwaterloo)

▸ common apps are available in all of our environments

▸ Mac:   Applications ⇨   Self Service Portal

# ACADEMIC RESOURCES

▸ personal web sites

▸ library journals

# PERSONAL WEB SITES

▸ UWaterloo Scholar https://uwaterloo.ca/scholar

  ▸ does not require programming or coding skills

  ▸ easy to use tools, self managed with templates/content modules

    ▸ bio, CV, publications, events, etc….

    ▸ publications can be imported into UWaterloo Scholar

  ▸ Documentation and guidelines:

    ▸ https://uwaterloo.ca/web-resources/scholar

# LIBRARY JOURNALS

▸ start at uwaterloo.ca/library

    ▸ Quick Links -> Get Access From Anywhere to connect using your surname and barcode on back of WatCard

    ▸ Quick Links -> Research Guides

        ▸ scroll down, click Statistics, then click the title

        ▸ select the "Find Articles" tab for links to various research databases including MathSciNet (on AMS.org site)

        ▸ check out "Links of Interest" tab

▸ Library support person for Math: Rebecca Hutchinson (r3hutchinson@uwaterloo.ca)

▸ training workshops may be available, or just email Rebecca with any questions

# COMPUTING RESOURCES

▸ Linux environment

  ▸ servers

  ▸ job management

▸ Windows environment

  ▸ servers

  ▸ Remote Desktop

# LINUX ENVIRONMENT

▸ Servers

▸ Job management

# SERVERS

▸ types of Linux servers

   ▸ aliases - ssh to one of: linux.math, biglinux.math, fastlinux.math, and linux.student.math (course work only)

   ▸ GPU servers, Parallel clusters

   ▸ departmental-specific servers: e.g. Biostatistics group, Machine Learning group

▸ what they can be used for:

   ▸ Math applications/IDEs

      ▸ MATLAB, SAGE, CPLEX, Maple, R, Julia, NumPy, SciPy, etc.

   ▸ compilers and numerical libraries (gcc, GSL)

   ▸ parallel tools on biglinux (OpenMP) and the clusters (MPI)

      ▸ lots more memory and processors than your supplied desktop or laptop

   ▸ long running jobs

# BIGLINUX.MATH

▸ for very large multi-threaded jobs

▸ four computers, each with 4 high-core-count CPUs, large memory

# FASTLINUX.MATH

▸ for jobs where processor speed is most important

▸ four computers with fastest CPUs, only 2 CPUs per machine

▸ low core count; moderate memory

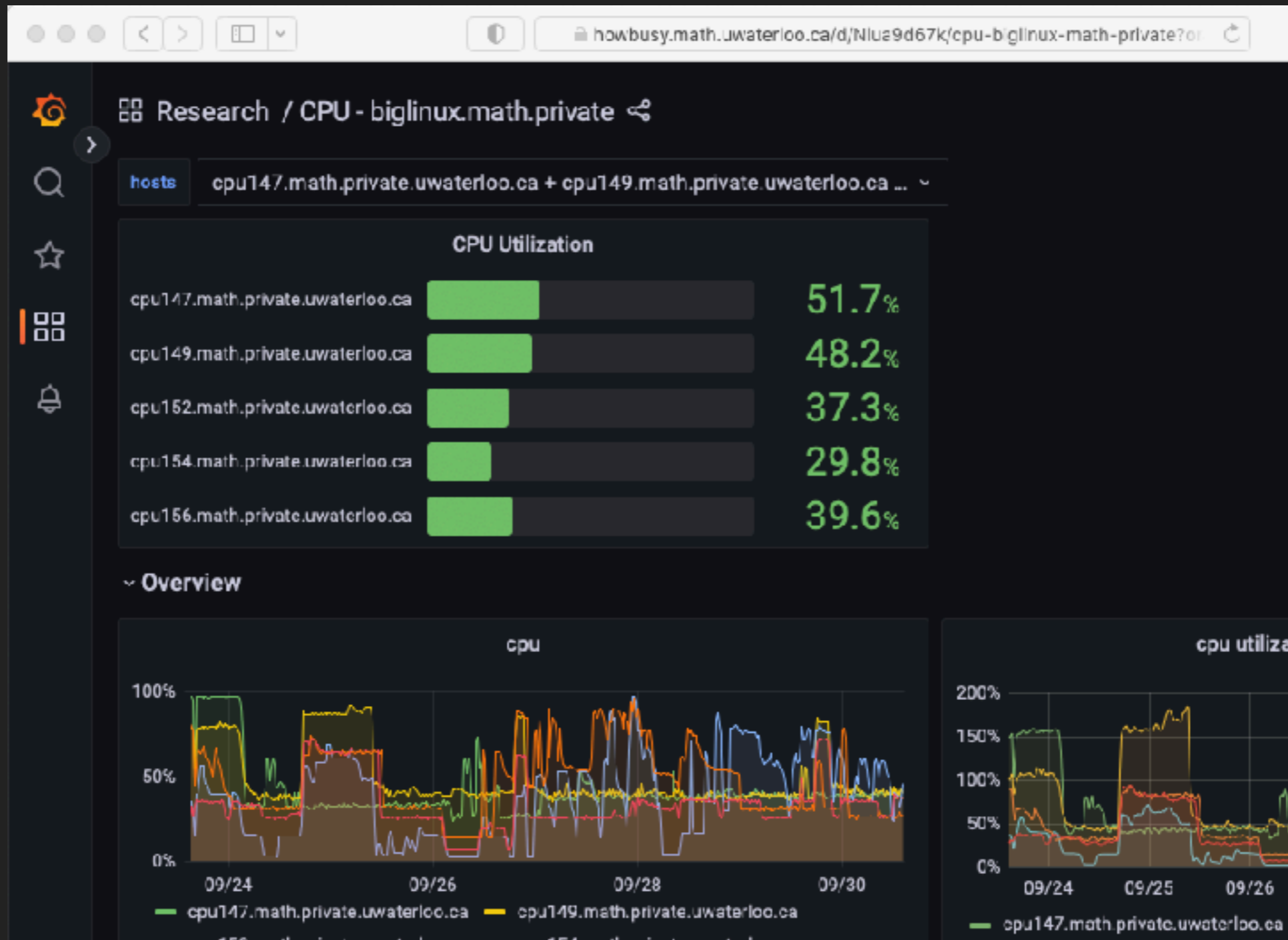# LINUX.MATH

▸ for light-duty casual use

▸ four computers, pretty old

# CHOOSING A MACHINE FROM ONE OF THE POOLS

▸ https://howbusy.math.uwaterloo.ca/

# SOFTWARE ENVIRONMENT

‣ Ubuntu 18.04

‣ see details at

  ‣ https://uwaterloo.ca/mfcf/services/ -> Computing -> Research and staff Linux servers

# JUPYTER

▸ web-based application that allows you to use or create documents that contain live code, equations, and visualizations

▸ use it remotely for Python, R, MATLAB, Octave, etc., or a command shell for quick work

▸ https://jupyter.math.uwaterloo.ca

# GPU SERVERS

‣ gpu-pr1-01.math / gpu-pr1-02.math

‣ two 14-core CPUs, 128GB RAM / two 32-core CPUs, 512 GB RAM

‣ four NVIDIA Tesla P100 GPUs / four A100 GPUs

   ‣ P100: ~3600 cores, 5.4 teraFLOPS DP / ~6900 cores, 19.5 TFLOPS

‣ CUDA and other parallel GPU tools

‣ access via SLURM job scheduler — see our web site

   ‣ https://uwaterloo.ca/mfcf/services/specialty-research-linux-servers

# PARALLEL CLUSTERS

▸ mosaic - hybrid, with InfiniBand

  ▸ 19 nodes with 20 cores, 256 GB RAM, and 2 Tesla K20 GPUs

  ▸ four nodes with 32 cores, 768 GB RAM

▸ hpc-pr2

  ▸ 8 nodes with 12 cores and 64 GB per node

▸ access via SLURM job scheduler — see our website

  ▸ https://uwaterloo.ca/mfcf/services/specialty-research-linux-servers

# HIGH-PERFORMANCE COMPUTING

▸ Digital Research Alliance of Canada  https://alliancecan.ca/

  ▸ formerly Compute Canada

▸ graham cluster located here at UW

  ▸ 32,000 CPUs

  ▸ InfiniBand high-speed interconnect

  ▸ 320 NVIDIA P100 GPUs

▸ sponsored by your faculty member, free of charge

# JOB MANAGEMENT

▸ background jobs

▸ nice

▸ nohup, screen, tmux

# PUT JOBS IN THE BACKGROUND

▸ if you do this:

  ▸ $ firefox

you can't run another command until firefox exits

  ‣ put an ampersand on the end:

    ‣ $ firefox &

it runs in the background and you can type more commands

‣ see what jobs you have in the background:

  ‣ $ jobs

‣ e.g. bring the third one to the foreground again:

  ‣ $ fg %3

‣ e.g. kill the second one:

  ‣ $ kill %2

# NICE

‣ commands started at the shell prompt run at normal interactive priority ('nice' value of zero)
‣ having many things competing for interactive priority can make the system feel slow
‣ so it is not polite (or "nice") to run big/long jobs at normal priority
‣ use the "nice" command to start a job at a polite background level (value higher than zero):

```
% nice 19 ./a.out &
```

‣ use the "renice" command to reset the priority of a running job:
```
 % ./a.out &
  % ps -u
  USER          PID %CPU %MEM    VSZ    RSS TTY        STAT START    TIME COMMAND
  rblander 14142   0.8  0.0  13796   2016 pts/3      Ss   11:29    0:00 ./a.out

% top
  PID   USER       PR  NI  VIRT  RES   SHR S %CPU %MEM    TIME+    COMMAND
  14142 rblander   20   0   269m 150m 5092 R 100.0  0.0    0:01.12 ./a.out

% renice 19 14142

% top
  PID   USER       PR  NI  VIRT  RES   SHR S %CPU %MEM    TIME+    COMMAND
  14142 rblander   39  19   269m 150m 5092 R 100.0  0.0    0:01.23 ./a.out
```

# NOHUP

▸ log-out sends "hang up" (HUP) signal to child processes

▸ "nohup" command blocks HUP signal

▸ syntax: put 'nohup' in front of usual command line

  ▸ % nohup ./myprog.a    <infile   >outfile

  ▸ % nohup matlab -nojvm -r [a,b,c]=myarray -logfile myarray.log

  ▸ % logout

# SCREEN

▸ lets you disconnect from session and reconnect later

▸ start: screen

▸ disconnect: ctrl-A d

▸ reconnect: screen -x

# TMUX

▸ terminal multiplexer: multiple terminal sessions in one window

# WINDOWS ENVIRONMENT

▸ Servers

▸ Remote Desktop

# SERVERS

▸ types of Windows servers

- ▸ windows.math

    - ▸ pool of four servers for research computing

    - ▸ P: drive is files.math

- ▸ windows.student.math

    - ▸ pool of six servers for student/coursework computing, NOT for research

    - ▸ M: drive is files.student.math

# REMOTE DESKTOP

▸ Microsoft Remote Desktop

    ▸ icon on Mac mini desktop

    ▸ can disconnect from a session and reconnect later

        ▸ but on windows.student.math, disconnected sessions get closed after two hours

▸ save your work often

▸ write code with checkpoint methods

# WEB RESOURCES

‣ MFCF Web site - uwaterloo.ca/mfcf

‣ LinkedIn Learning (LiL )- online training

    ‣ formerly known as Lynda.com

‣ Request Tracker - online reporting system

‣ handy one-page reference to all the main topics we covered:

    ‣ https://uwaterloo.ca/mfcf/mfcf-information-sheet-math-faculty

‣ services for grad students:

    ‣ https://uwaterloo.ca/mfcf/services/audience/25

Math Faculty Computing Facility (MFCF) » Services » Mathematical software web page »

# Mathematical Applications

[Maple worksheets](#) - developed for Applied Math courses

[MATLAB tutorials](#)

[Introduction to GPU computing in MATLAB, R, and C++ with CUDA](#) (PDF)

[R and GPU computing](#)- specifically for Statisticians (PDF)

[Comparison of R and Python Data Science Applications](#)

MFCF I
Info

EMAIL, LEARN

IST S

# THANK YOU

From the MFCF Team

suggestions for future topics?

https://uwaterloo.ca/math-faculty-computing-facility/services/audience/25