MFCF C&O GRAD SESSION
FALL 2024

AGENDA

▸ Introduction, Help Centre

▸ Getting online

▸ Using your computer

  ▸ 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

▸ Mathematical applications

▸ Questions

HELP CENTRE

▸ MC 3017, ext. 46323 (hMFCF) 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/

▸ please feel free to ask us for help!

GETTING CONNECTED

▸ two-factor authentication - for campus wide services

▸ on-campus: wireless and wired connections

    ▸ Wired connection -

        ▸ submit request with MAC address, OS, name of supervisor, room number, expiry date

▸ off-campus: VPN

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

▸ Microsoft 365 suite - including Teams

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 Secure Client

- ▸ WatIAM credentials to login

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

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

    ▸ name of sponsor/supervisor

USING YOUR COMPUTER

‣ desktop

‣ central file service

‣ printing

‣ applications

DESKTOPS

▸ managed by MFCF

   ▸ but you can request admin access to install applications

▸ files on local machine are NOT backed up

   ▸ use the central file server for important files (thesis!)

▸ Common Mathematical software - Maple, MATLAB, Office suite, R, etc., preinstalled or available via Applications > Self-Serve portal

USING YOUR DESKTOP

files.math.uwaterloo.ca – your files on the central fileserver

linux.math.uwaterloo.ca – opens Linux command window

windows.math.uwaterloo.ca– connects to Windows terminal servers using Remote Desktop
P: drive is your personal storage on central file server

files.math

linux.math

Linked in
LEARNING

Online Training

windows.math

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/services/service-catalogue-printing/adding-printers-your-computer

APPLICATIONS

‣ math software

  ‣ R, Maple, Julia, Octave (freeware version of MATLAB), Python and 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)

‣ Zoom - Free campus wide license. https://uwaterloo.zoom.us

APPLICATIONS – OVERLEAF

▸ Overleaf is a collaborative online document editor - understands LaTeX for typesetting math

  ▸ www.overleaf.com/edu/uwaterloo

▸ works in browser

▸ templates for UW thesis style, etc.

▸ UW site licence, free of charge for grad students

APPLICATIONS - ZOOM

▸ UW site licence free for grad students

▸ pro/educational level features

▸ https://uwaterloo.zoom.us

   ▸ click Sign In, use your UWuserid@uwaterloo.ca address and WatIAM password

▸ https://uwaterloo.atlassian.net/wiki/spaces/ISTSERV/pages/42583425333/Collaboration+-+Zoom

▸ we use Microsoft Teams a lot here too

ACADEMIC RESOURCES

▸ personal web sites

　▸ UW Scholar

▸ library journals

　▸ start at uwaterloo.ca/library

　▸ find articles for your department

　▸ Math representative

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

▸ how long to keep Scholar site after leaving:

    ▸ indefinite (cannot edit after you leave)

      ▸ make sure to put in a link to a new site before it's read only

      ▸ request IST to have it shut down/hidden

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 Combinatorics & Optimization, 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

▸ Loaner laptops - high end Windows, Mac, and Linux

   ▸ laptops with GPU for highly parallel computing

   ▸ can be borrowed short-term with authorization from supervisor

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 server: pegasus.math.private (by request)

      ▸ ask your supervisor if they have extra resources for you to use and if so, they can submit a request to us

▸ 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 than your supplied desktop or laptop

   ▸ long running jobs

BIGLINUX.MATH

▸ for large memory or multi-process jobs

▸ pool of computers with 4 high-core-count CPUs, large memory

FASTLINUX.MATH
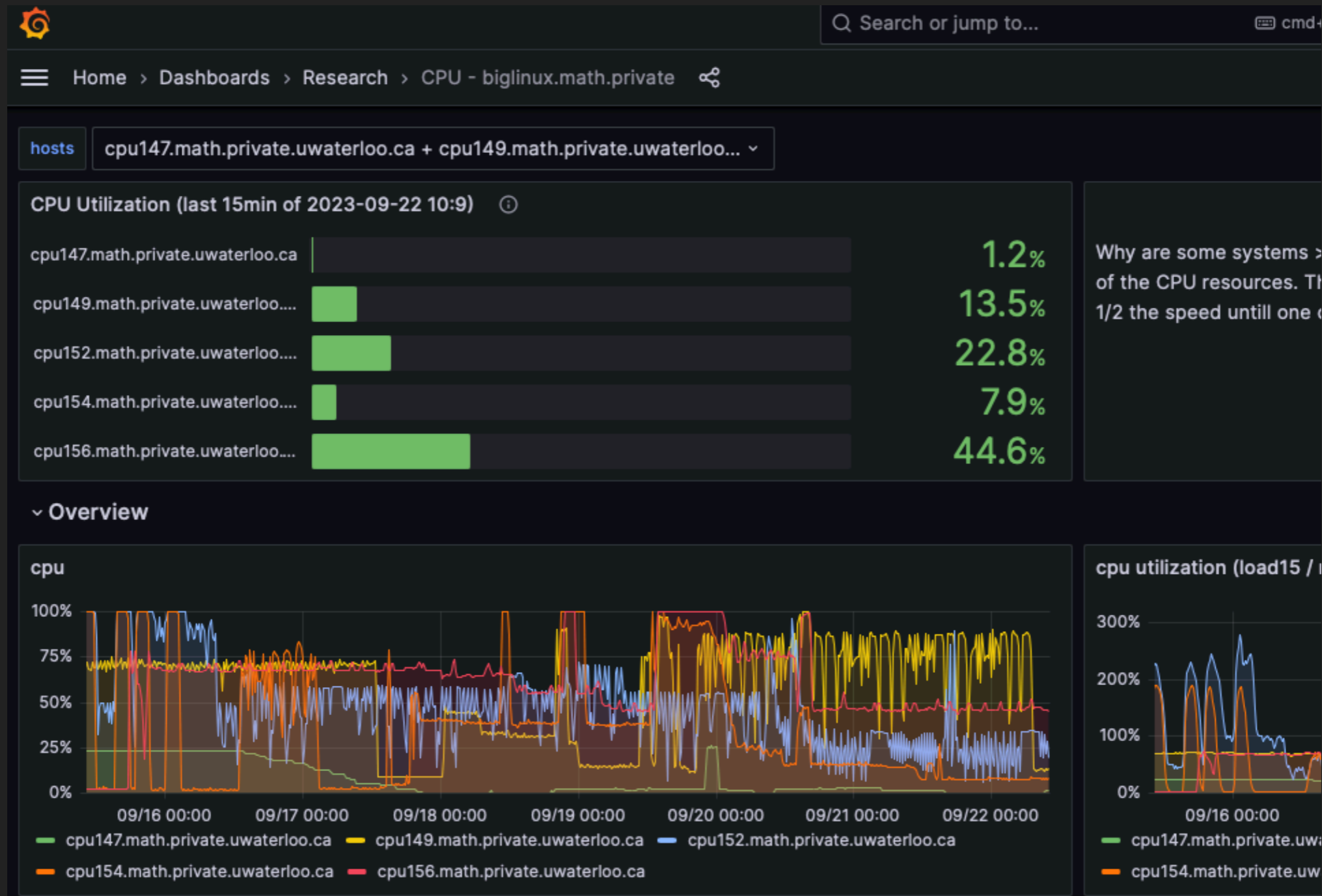
▸ for jobs where processor speed is most important

▸ pool of computers with fastest CPUs

▸ 2 CPUs per machine, low core count; moderate memory

LINUX.MATH

▸ for light-duty casual use

▸ pool of older computers

CHOOSING A MACHINE FROM ONE OF THE POOLS

▸ https://howbusy.math.uwaterloo.ca/

SOFTWARE ENVIRONMENT

▸ Ubuntu 22.04

▸ see details at

  ▸ https://uwaterloo.ca/mfcf/services/ -> Research 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 / gpu-pr1-02 / gpu-pr1-03 / gpu-pr1-04

▸ NVIDIA P100, A100, H100, and L40S

▸ 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

▸ Hpc-pr3

  ▸ 8 nodes with 32 cores and 128 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

▸ file storage is mapped to P: drive (files.math)

  ▸ windows.math

    ▸ pool of servers for research computing

  ▸ wingpu.math (request access)

    ▸ GPU server with three NVIDIA T4 GPUs

  ▸ mondo.math (request access)

    ▸ GPU workstation for highly parallel computing

  ▸ windows.student.math

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

    ▸ M: drive (files.student.math)

REMOTE DESKTOP

▸ Microsoft Remote 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

Mathematical Applications

| View | Edit | Delete | Layout | Revisions | Clone |

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Maple worksheets - developed for Applied Math courses

MATLAB tutorials

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

Accelerating MATLAB code with GPUs - compares CPU and GPU performance

Accelerating physics calculations with CUDA in Python using Numba: A Monte-Carlo example

Theoretical Background Notes for "Accelerating physics calculations with CUDA in Python using Numba"

R and GPU computing- specifically for Statisticians (PDF)

Comparison of R and Python Data Science Applications

Scientific Blogging with R and Blogdown

Dedalus

MFCF Help Centre Information

EMAIL, LEARN, QUEST AND MORE FROM
IST SERVICES

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

THANK YOU

From the MFCF Team

suggestions for future topics?

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