Welcome to SI504

Servers and the Shell

SCHOOL OF INFORMATION
UNIVERSITY OF MICHIGAN

slido

Favorite Flavor of Ice Cream

ⓘ Start presenting to display the poll results on this slide.

Teaching Team

Sheza Munir

First year MHI student - Data Science with a focus on health

Undergrad: BS Computer Science at LUMS

From: Lahore, Pakistan

Fun fact: I love playing the flute! – even though I only know one song haha

(still looking for a good ramen place in Ann Arbor, pls pm if you have leads, thanku)

Excited to help you all through the course! Don't hesitate to reach out w questions or just to chat :)

Shamita Rao (She/her)

Shuh-mith-ah

I'm a UX researcher and designer with a bachelor's degree in Interaction Design from India. Currently, I'm a graduate student in the User-Centered Agile Development track at UMSI.

- ★ I love to read
- ★ I have a cat - Noodel
- ★ I sing a lot

My office hours will be on **Thursdays between 10:00 am and 11:00 am.**

Who am I

- Michael Hess
- 3440 NQ
- mlhess@umich.edu
- 734-368-0009
- Office hours calendar

SI Classes

- SI504 – This class
- SI 564 – This Term
- SI 631 – Next Term
- SI 644 – Next Term
- SIADS 643 – Online
- SIADS 671 - Online
- SI XXX -- TBD

Goals

Basic server management

Learning how to use the command line

Git

Collaborative git

Advanced git

Command line tools

Package management

Automation and scripting

Culture

Basic understanding of the internet and routing protocols

TBD

Slack

Please join slack

- Slack.umich.edu
- Always DM the entire teaching team, do not send DM's to a single person.
  - If you want to chat with me directly that is allowed if you have spoken with the 5 of us first.
- Your GSI's are students as well, they will not respond at all hours.

Course format

- Lecture
- Reading
- Homework
- Midterm
- Final exam or Final project (TBD)

This is different

- This is not a CS class
- We are taking a practical approach.

This is different

- I will be tossing a lot of information at you today, then revisiting a large number of topics over the course of the class.

Attendance

- There is a portion of your grade on class participation. Class attendance is important.
- Please let us know if you are not going to show up in class.
- Class outcomes are much higher for students who come to class.
- This policy may change in 3 weeks.

Mental Health

- Mental health is important.
- If you are having issues, with this course, or life, or anything, please reach out to the support systems we have in place.
- If you need an extension on something, given the current world state. Let me know.
- As we move forward, please have understanding. Call out issues early. Let us know what I can do to support you.

Congrats

Well at fake job at least.

- You have a new Job!

Welcome to Borromean

https://borromean.digital/

You have just been hired as a DBA

To: You
From Kelly Davenport

Congratulations on getting hired as a System Administrator (SA) at Borromean digital. HR says you have pasted your background check. We are excited to have you as a member of this team. Look out for email with your first task.

Welcome to the team,
Kelly Davenport
CTO

DBA: Database administrator

Who works here?

(Names and pictures taken from random sources)

- You will be communicating with your co-workers as they request information from you.
- Here are some quick personas.

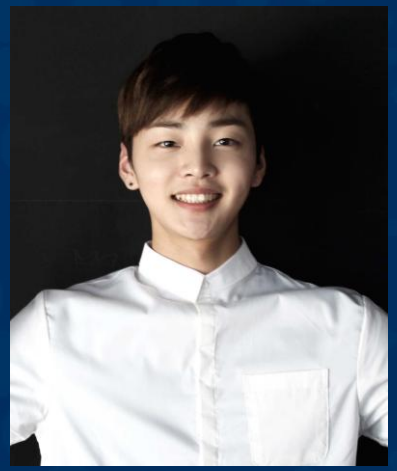
Kelly Davenport

- Is our CTO.
- She has 2 degrees.
  - One being an MBA from Harvard.
- She is not technical in nature, but is a business person.
- She is your boss's boss's boss.
- She has 3 cats, and 1 dog.
- She likes to read a physical paper in the morning.
- She is in her early 50's.
- She is married to Ian McNab who works in Product here (ohh the drama) .

Raj Kumar

- Runs the DBA team.
- Has a CS degree from Oxford.
- Enjoys tinkering with Alexa
- Used to be on the web team
- Is 43 years old and has worked here for the last 10.
- In his personal life:
  - Has been married to Eve for 3 years and has 1 fat cat.

Kim Min-jae

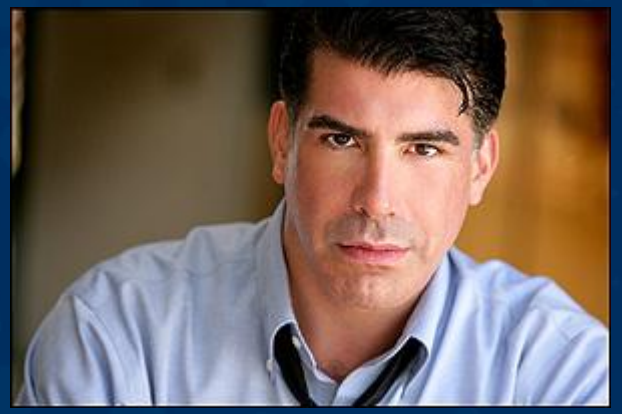


- Director of Security
- Has worked here for 5 years.
- Started in Development, moved into DevOps and now runs the Security Dept.
- Has 4 dogs and loves racing.
- He is unhappy that someone keeps taking the candy out of his desk drawer.

Jack Whitney

- Head of the SA team
- He is your boss.
- He has worked here for 3 years.
- Plays games on the weekend
- Ordered the xbox the day it came out, and has not left his house other than for work since.
- Has a reputation for not being nice.

Lawrence Summerset



- Head of our research group.
- Looks for new products and investments.
- Started here as a analyst 11 years ago.
- Got married to Nadine last week.

More to come later.

Grading

(most assignments, not all)

- You will be graded on 2 scales
  - Did you get the answer correct AND SHOW YOUR WORK *
    - You may request to resubmit work for an "Adequate" or below grade.
  - Did you respond in a professional and clear manner depending on the request.
    - Once you have submitted work you will not get a regrade on this scale.

Grading

- Remember you should always show ALL your work. Do not just turn in the answer, turn in all attempts to get the answer. We want to see how you worked via the problem. You should attach this as an appendix if needed.
- For some questions, the answer is not something that has "work", explain your logic if you feel the need.

Grading

- You may **NOT** work with others on the homework.

LLM

- If you use an LLM, you must cite it.
- You must provide both the prompt you used, and the response.
- If you don’t it is an academic integrity issue.
- The teaching team strongly advises that you don’t use LLM’s

LLM

- LLM's are not allowed on the midterm.
- They are also not permitted on the final exam

Technology

- The IT group here has not provided this type of technology in the past. If you have issues, please let us know asap via email or slack.
- Each student in this class will get one or more dedicated servers for their use. These are real servers.

Class Feedback and topic loop

- I want you to provide feedback.
- If I am moving too fast, let me know
- If you don't think I covered a topic well, or your mental model is off, let me know.
- I will survey the class before we change topics, most of the topics from week to week will build on the previous topic.
- Come to office hours!

Office Hours

- Office hours are on Canvas.
- You will need to make an appointment
- The office hours tool will allow more than one person to sign up
  - If you would like to be alone with the instructional team member, let us know
  - If you do NOT want to be alone, also let us know.
- New this term: In person office hours (timing TBD)

Slack

- Slack.umich.edu
- Workspace name = Borromean Digital
- DM the ENTIRE teaching team. Do not just DM a single person.
- Or post in channel!

504 is also a winter class

- You can take 504 in the winter as well. If your course load is high this semester, keep that in mind.

Policy Questions?

Servers

(Most servers don't look this nice)

What is a server

Something that servers data to a client.

Normally thought of as in a data center

However, you can run a server on your local computer

Most servers don't have a graphical user interface.

Sometimes called "box or boxes"….because they look like a box.

What is the Shell?

- A “shell” is a text based interface for interacting with a computer.
- The name comes from the fact it is the “outer” layer of the OS that you interact with.
- It takes input from an operator (you) and takes actions based on your commands.
- When working in a “shell”, 99.95% of the time, it is a text based interface with no mouse support.

What is the shell?

- For this class, we will be using bash (and its derivatives)
- We will provide students with a dedicated server for this class.

(More on this later)

What is a data center?

Data center

(most don't look that nice)

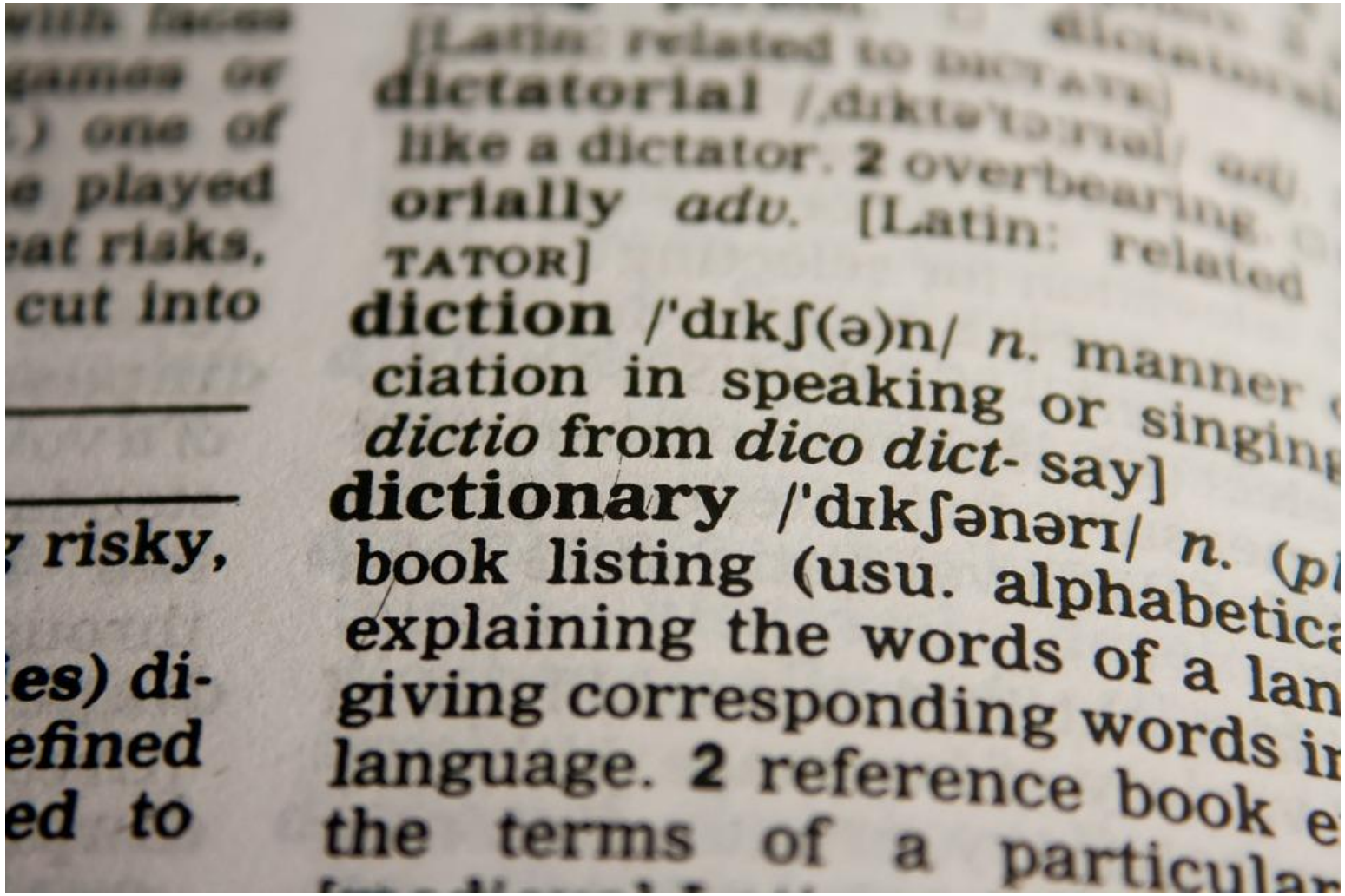
- Datacenter is normally where servers live
- Campus has 3 major ones, and some units have their own.
- Data center hold servers. The larger the datacenter normally the cheaper it is to run per square foot.
- I am hoping that we can get a tour of one of the campus data centers this term.

- Has anyone ever been to Southfield MI?

What is the cloud?

- The cloud is just someone else's data center.
- You "rent" a server (normally by the hour or minute)

Crash course in terms and vocabulary.



Short

- We will go over all of these in future weeks, but to get started, it is helpful to know what some terms mean.

Knock Knock

- Knock, Knock
- Who's there?
- Thank.
- Tank Who?
- You're Welcome.

Knock Knock

- What is a knock knock joke?

TCP/IP

- The grouping of rules that define how computers communicate.
- This is a set of protocols that are standard. We agree to 'speak' them so that servers know how to speak to each other.

IP address

141.211.243.251

- Internet Protocol Address
- Sometimes called "IP"
- "What is your IP"
- On the internet, every device has an IP address, it is a method of finding a server or hardware device.
- Public IP addresses are unique.
- Think of it as a street address, if you want to find something, you need the address you are going to.
- Most IP addresses take the form of 4 numbers between 0 and 255 separated by periods*.

IP Addresses

- Public Vs Private
- 172.16.X.X - 172.31.X.X
- 192.168.X.X
- 10.X.X.X
- Private IP's get translated into public IP's. You can't directly access a private IP.

Google

- What is my ip address

DNS

- Domain Name System
- For now:
- This maps a name to an IP address.
- www.umich.edu -> 141.211.243.251
- si.umich.edu -> 18.221.166.136

Service

- A processes that runs on a server that handles a task.
- "Is the web service running"

Protocol

- Each service has a standard way to communicate. These are defined as RFC's.
- They are well documented.
- Examples include
  - Hypertext Transfer Protocol - **rfc2616 (The web)**
  - Simple Mail Transfer Protocol - **rfc5321 (email)**
  - Network time – **rfc1119 (How servers know what time it is)**
- RFC's are very long technical documents that describe how a service should work.

Port

Not this type of port.

- Most servers that expose a service to the internet run on a defined port.

IP address and port

- When you talk to a server, you are talking to an ip address over a port.
- Web ports are
  - 80 (not encrypted)
  - 443 (encrypted)
- You can run a webserver on ANY port, but the standard ones are 80 and 443.
- When working on a local server sometimes you will be directed to a higher port
  - Flask: 127.0.0.1:5000
  - Django: 127.0.0.1:8080
  - Node: 127.0.0.1:4000

Ports

- Each service has an assigned port and protocol it speaks, with this, it makes it easy for clients to connect and communicate
- In your browser, you type httpS://google.com
  - Your browser uses DNS to lookup an ip address for google.com
  - Your browser makes a connection to that ip address using port 443
  - Using the defined RFC's your browser knows how to talk to google's servers and get a response and render a page for you.

Firewall

(This is a very basic explanation and in reality gets a lot more complicated, we will cover this later on)

- A firewall at the basic level prevents or allows traffic from one ip address to another ip address over a port.
- Example
  - Allow traffic from anyone on the internet to 141.211.202.5 on port 80 or 443
  - Deny traffic from the internet to 141.211.202.9 on port 22

SSH

- SSH or Secure Shell
- Is a protocol for remotely accessing the shell of a server.
- It is defined in RFC 4253
- It runs on port 22.

Terminal

Not so long ago

- To interact with a server, you used to have to sit in front of it.
- Your job title might be “Terminal Operator”
- Some industry's still require this for security.

SSH

- SSH runs as a service on computers, and allows users to access those computers remotely.
- If we did not have ssh (or a similar protocol) to do work for this class, you would have to go to a server room.
- We have ssh ☺ This makes things easier.

RFC4253

- The Secure Shell (SSH) is a protocol for secure remote login and
- other secure network services over an insecure network.

- This document describes the SSH transport layer protocol, which
- typically runs on top of TCP/IP. The protocol can be used as a basis
- for a number of secure network services. It provides strong
- encryption, server authentication, and integrity protection. It may
- also provide compression.

- Key exchange method, public key algorithm, symmetric encryption
- algorithm, message authentication algorithm, and hash algorithm are
- all negotiated.

- This document also describes the Diffie-Hellman key exchange method
- and the minimal set of algorithms that are needed to implement the
- SSH transport layer protocol

RFC's are boring

- But they are what make the internet work.

RFC 1918

- 192.168.0.0 - 192.168.255.255 (192.168/16 prefix)

- We will refer to the first block as "24-bit block", the second as
- "20-bit block", and to the third as "16-bit" block. Note that (in
- pre-CIDR notation) the first block is nothing but a single class A
- network number, while the second block is a set of 16 contiguous
- class B network numbers, and third block is a set of 256 contiguous
- class C network numbers.

- An enterprise that decides to use IP addresses out of the address
- space defined in this document can do so without any coordination
- with IANA or an Internet registry. The address space can thus be used
- by many enterprises. Addresses within this private address space will
- only be unique within the enterprise, or the set of enterprises which
- choose to cooperate over this space so they may communicate with each
- other in their own private internet.

- As before, any enterprise that needs globally unique address space is
- required to obtain such addresses from an Internet registry. An
- enterprise that requests IP addresses for its external connectivity
- will never be assigned addresses from the blocks defined above.

- In order to use private address space, an enterprise needs to
- determine which hosts do not need to have network layer connectivity
- outside the enterprise in the foreseeable future and thus could be
- classified as private. Such hosts will use the private address space
- defined above. Private hosts can communicate with all other hosts
- inside the enterprise, both public and private. However, they cannot
- have IP connectivity to any host outside of the enterprise. While not
- having external (outside of the enterprise) IP connectivity private
- hosts can still have access to external services via mediating
- gateways (e.g., application layer gateways).

RFC 1149

- This is my favorite RFC

RFC 1149

- This memo describes an experimental method for the encapsulation of IP datagrams in avian carriers. This specification is primarily useful in Metropolitan Area Networks. This is an experimental, not recommended standard.
- Avian carriers can provide high delay, low throughput, and low altitude service. The connection topology is limited to a single point-to-point path for each carrier, used with standard carriers, but many carriers can be used without significant interference with each other, outside of early spring. This is because of the 3D ether space available to the carriers, in contrast to the 1D ether used by IEEE802.3. The carriers have an intrinsic collision avoidance system, which increases availability. Unlike some network technologies, such as packet radio, communication is not limited to line-of-sight distance. Connection oriented service is available in some cities, usually based upon a central hub topology.

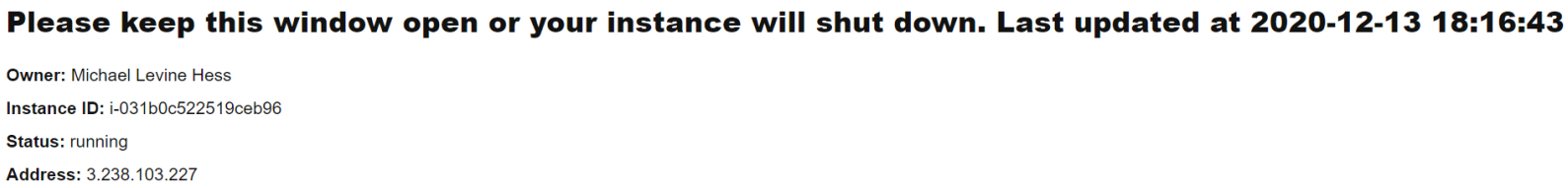
RFC 1149

- 1 April 1990

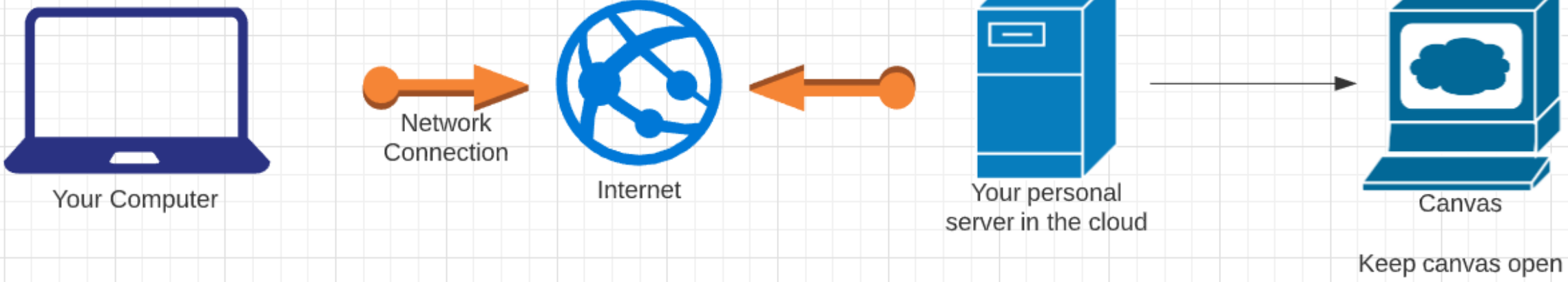
Your server

- In canvas, under introduction, you will have an option called "Your server"
- This will programmatic create a server for your use in this class.
- The first time you click on this you may get an error, just refresh.

Your server



- When doing work for this class, you MUST keep this window open. If you don't, we will shut down your server.
- This will provide an instance id, if you are having issues with your server, you can use this instance id to ask for help.
- Your IP address, will change each time you start and stop your server.
- If you get an exception when you first load this, refresh after 5 seconds.


Your Computer
Network Connection
Internet
Your personal server in the cloud
Canvas
Keep canvas open

How do you access your server?

On a mac

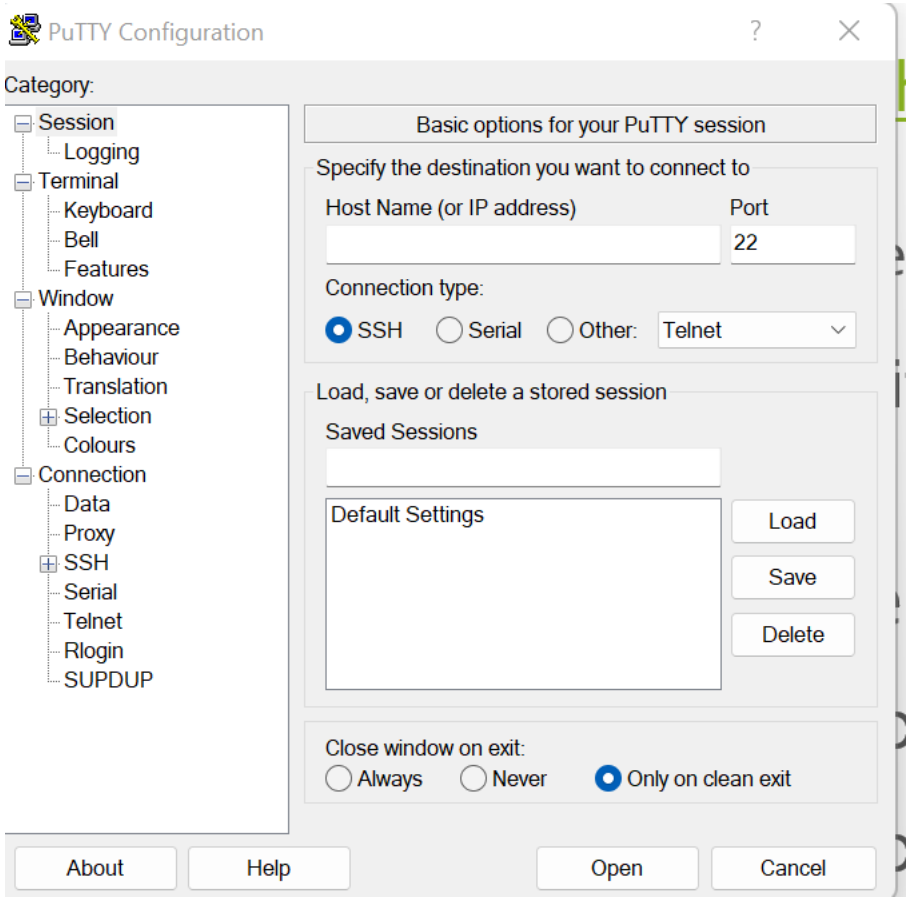
- Open terminal on your mac
- Type
- ssh <uniquename>@<ip>

- Use your Michigan password and your duo device
- If you get a connection refused, wait 3 min and try again.

How do you access your server?

On a PC

- Download putty
- https://www.chiark.greenend.org.uk/~sgtatham/putty/latest.html
  - Just google "putty"
- Putty.exe 64bit (The second download link in the top box)
  - Run it
- For host name enter your IP address.
- When asked for a username use your unique name
- When asked for a password, use your Michigan password


PuTTY Configuration
Category:
Session
Logging
Terminal
Keyboard
Bell
Features
Window
Appearance
Behaviour
Translation
Selection
Colours
Connection
Data
Proxy
SSH
Serial
Telnet
Rlogin
SUPDUP
Basic options for your PuTTY session
Specify the destination you want to connect to
Host Name (or IP address)
Port
22
Connection type:
SSH
Serial
Other:
Telnet
Load, save or delete a stored session
Saved Sessions
Default Settings
Load
Save
Delete
Close window on exit:
Always
Never
Only on clean exit
About
Help
Open
Cancel

For both

- You may get asked about accepting the fingerprint of a server. You can choose yes here.

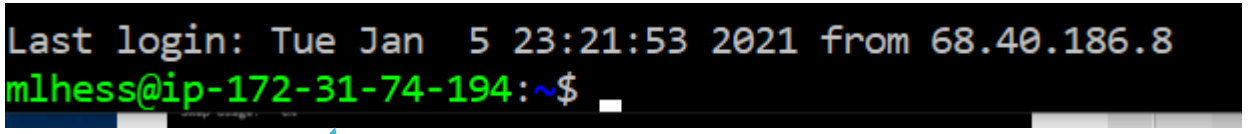
If you don't see this, something is wrong

```
mlhess@DESKTOP-AAR58T6:/mnt/c/WINDOWS/system32$ ssh mlhess@3.238.103.227
The authenticity of host '3.238.103.227 (3.238.103.227)' can't be established.
ECDSA key fingerprint is SHA256:AwL9nvN3jtB1Gh1cS48FiHYvsBZ1EJMWi/m145GE6wA.
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '3.238.103.227' (ECDSA) to the list of known hosts.
Password:
Password:
Duo two-factor login for mlhess

Enter a passcode or select one of the following options:

 1. Duo Push to XXX-XXX-0009
 2. Phone call to XXX-XXX-0009
 3. SMS passcodes to XXX-XXX-0009

Passcode or option (1-3): 1
Success. Logging you in...
Welcome to Ubuntu 20.04.1 LTS (GNU/Linux 5.4.0-1024-aws x86_64)

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

  System information as of Sun Dec 13 18:22:16 UTC 2020

  System load:  0.01              Processes:             106
  Usage of /:   9.7% of 19.32GB   Users logged in:       0
  Memory usage: 21%               IPv4 address for eth0: 172.31.74.194
  Swap usage:   0%


102 updates can be installed immediately.
46 of these updates are security updates.
To see these additional updates run: apt list --upgradable


The list of available updates is more than a week old.
To check for new updates run: sudo apt update

Last login: Thu Dec 10 16:17:16 2020 from 141.213.168.10
```

Prompt

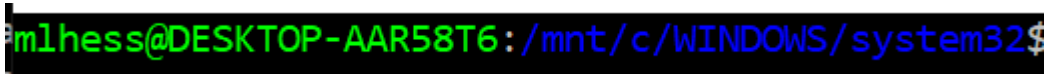
When logged into your server, it should start with ip-X

Anything else is not this classes server.



- Correct

Wrong



Do I have to use this server for this class?

- Yes

Basic Commands

Print working directory

- pwd
- If you type “pwd” without the quotes, it will let you know what directory you are currently in.

Get a listing of files

- You can run the "ls" command (without the quotes)
- To get a listing of the current files in your current directory.

IP address

- You can see the ip address of your server on the canvas page.

Your servers have 2 ip addresses

- Your public IP: This is the IP address that the world can access.
- Your private IP: This is used for internal routing. Your aws box will report this ip address if you ask it.
- Private IP's are defined in RFC1918

If you get stuck

- You can type control-c to stop any running task
- Try it
  - ping google.com
  - This will go forever unless you type control-c to stop
- You can always close the window, this will disconnect the session.

We will learn way commands next week.

- In this class, please don't work ahead. If you have knowledge of how to do something, but we have not covered it in class, please don't use that method.
- You can always ask.

How do you log out?

- Type logout

Homework

- Your homework this will should be somewhat simple, it is just going to validate that you have access to the servers and ask some basic questions.

Information
changes
everything.

THANK YOU

SCHOOL OF
INFORMATION
UNIVERSITY OF MICHIGAN