Welcome to Data Structures & Algorithms 1

CS 2100

Dr. Nada Basit // basit[*at*]Virginia[*dot*]edu

Spring 2022

Be an Active Participant in Your Learning!

Be Curious!

Ask Questions!

CS 2100 – Data Structures & Algorithms 1

- Meeting Dates: January 19, 2022 to May 2, 2022
- Lecture / Location: **Section 002**: MWF 10:00-10:50am / Ridley Hall G008

Section	Days & Time	Location	Professor
001	M/W/F, 12:00-12:50am	Chemistry Bldg 402	Mark Floryan
002	M/W/F, 10:00-10:50am	Ridley Hall G008	Nada Basit

- Mode of instruction: In person
  - Lecture: *Course Content* (will be **recorded**) and sometimes supplemental material
  - Lab: *Module Quizzes* and continue working on *Assignments*
  - Masks are required at all times *(University Policy) – Please wear your mask when you attend class* (if you forget your mask, there are a few available)

Course Description

- A second course in computing with an emphasis on **foundational data structures** and **program analysis**.
- The course provides a comprehensive look at the **Java programming language** including
  - object-oriented programming,
  - concurrency, and
  - inheritance / polymorphism.
- Additionally, **foundational data structures and related algorithms / analysis** are studied. These include
  - Lists,
  - Stacks,
  - Queues,
  - Trees,
  - Hash Tables, and
  - Priority Queues.

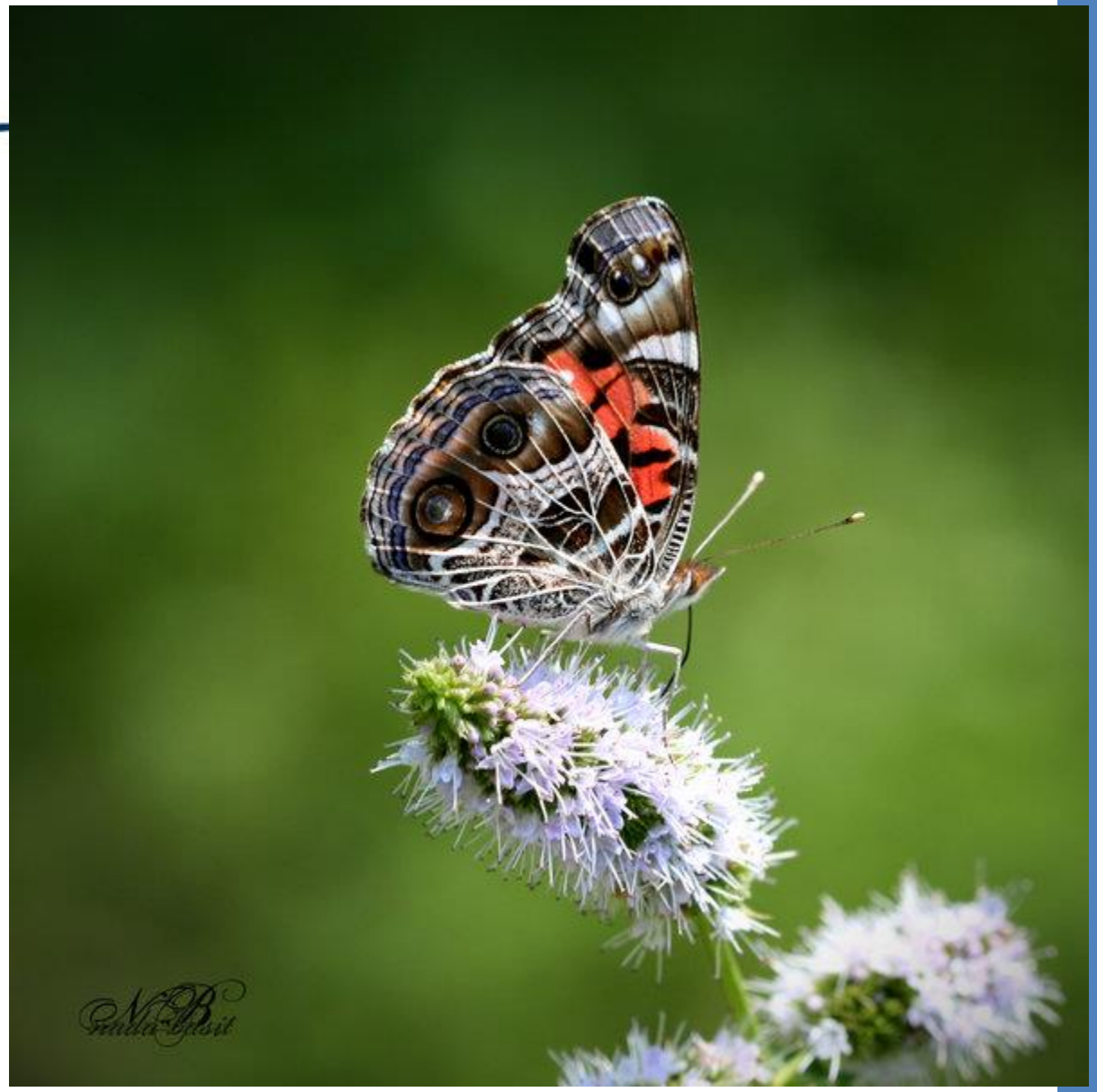
Your Instructors

- **Dr. Mark Floryan**
  - Office: Rice Hall 203
  - OH: Tue and Wed (10:00-11:30am) on *Zoom*
  - mrf8t@virginia.edu

- **Dr. Nada Basit**
  - Office: rice Hall 405
  - OH: Mon (1:15-2:15pm) and Tue (11:30-1:00pm) on *Zoom*
  - basit@virginia.edu
    Best way to get in touch with me!
    (Always include "CS 2100" in email subject line)

Prof. Basit's Office Hours Challenge!

About Me
~Photography



~Photography

~My Background

- Education
  - PhD in Computer Science
  - Machine Learning + Biology/Genetics
    → Computational Mutagenesis
  - Graduate Certificate in Biometrics
- Areas of Interest
  - Artificial Intelligence (Machine Learning/Pattern Recognition/Data Mining)
  - Databases
  - Computational Biology
  - Computer Science Education
  - …and of course, TEACHING! ☺

Course Logistics

Quick & Fun Survey Questions

Get to know your peers! ☺

PC vs. MAC?

Quick & Fun Survey Questions

Get to know your peers! ☺

East coaster / West coaster / Not from the US?

Your Teaching Assistants

- 1 Graduate TA
- ~40-50 Undergraduate TAs
  - 5 of these students are **Head TAs** and can be **contacted directly (via email)** for various reasons (more coming up)
  - Each **lab** will have several (~10-15) TAs present to run lab sections

Head TAs / Points-of-Contact

It's a big class… How to get your questions answered fastest?

Role
Quiz and Quiz Grading Point-of-Contact
Homework and Homework Grading Point-of-Contact
Lab / Cohorts Point-of-Contact
Office Hours Point-of-Contact
Course Admin. Point-of-Contact

*If you have a general question about any of these areas, **first** contact the appropriate Head TA by email.*

Meeting Times

Class Lectures

- Section **002** (MWF, 10-10:50am) taught by yours truly
- **Lecture Attendance** is not required but HIGHLY recommended
  - (*Seriously, just show up! Besides, I don't like talking to myself* ☺)

➢ **NO LAPTOPS ALLOWED**

- Unless I explicitly ask you to use them for an activity or demo

➢ ***Bring a Notebook to Take Notes!***

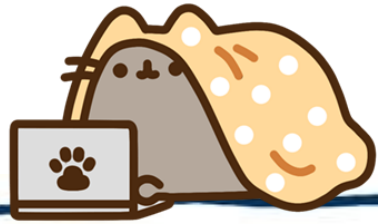
Labs

- Labs *(All on Monday)*
  - ***101: 3-4:45pm (OLS 120)***
  - ***102: 5-6:45pm (Rice 130)***
  - ***103: 7-8:45pm (Rice 130)***
  - ***104: 3:30-5:15pm (Mec 205)***
- **Lab Attendance** is not required, however all quizzes are taken during lab, so you do have to go for that

➢ **PLEASE BRING YOUR LAPTOPS**

➢ ***Bring a Notebook to Take Notes!***

Lab Procedure



- First 30 minutes: Take the **quiz** for the current week and submit
  - Quizzes are closed-book and should represent your **individual effort**, there is absolutely **no** collaboration permitted *(more on quizzes soon)*
- Rest of the time you can either:
  - Continue to work on homework with your cohort
  - Get help on homework from TAs
  - Work on extra programming / interview question challenges (when available)

Contacting Us

- The best way to contact us is via **email**
  - However, you **MUST** include "**CS 2100**" somewhere in your ***email subject line***
  - We all receive a lot of email, so this helps us organize our emails and more efficiently get back to you
- You are most welcome (and encouraged!) to ask me questions **during lecture**, but also after class, too.
- It is a big class… the best way to get your questions answered is **by first contacting a Head TA** (with the appropriate role – see pervious slide). If that person cannot resolve your issue, then we will be happy to help you!

- ***Always email your instructor (do not use Piazza) for personal issues, emergencies, etc.***

Course Content

Where to find the course material?

- Our course **website**: Central hub for CS 2100 this semester
  - https://uva-cs.github.io/dsa1
  - ✓ Link to the Syllabus
  - ✓ Schedule of lectures
  - ✓ Links to lecture notes
  - ✓ Homework assignment **writeups**, starting code, tutorials, etc.
- **Collab**:
  - Announcements sent to class
  - Links to **Quizzes** (hosted on Sherlock.cs.virginia)
  - Syllabus Quiz
- **Piazza** (course forum)
  - Q&A discussion
- **Gradescope**:
  - **Submission** of homework assignments (Work on your homework using the **Eclipse** IDE)

Tools: Collab

- We will use **Collab** in the following way:
  - Announcements sent to class (delivered to your UVa email)
  - One quiz on Collab: the Syllabus Quiz
  - Links to Module Quizzes (more on this later)
    (hosted on *Sherlock.cs.virginia.edu* – external testing site)
  - Final grades will be posted (eventually)
  - Will contain links to other resources (course website, etc.)

Tools: Piazza

- We will use **Piazza** in the following way:
  - Website: https://piazza.com/ [Linked through Collab]
  - Piazza is a great tool for asking questions about **course content**, **policies**, or getting help on **homework** assignments
  - While you are waiting for an answer, see if there's an answer you can provide to someone else's question. We're all in this together!
  - TAs will monitor and answer questions throughout the semester
  - Instructors will not be on Piazza consistently

It is very important to remember the following:

- **Do not post** complete or partial code solutions (for Homework) on Piazza when seeking answers to your question unless it is in a **PRIVATE** post
- **Do not post** complete or partial quiz solutions (code or short-answer) when seeking answers to your question unless it is in a **PRIVATE** post

Tools: Gradescope

- We will use **Gradescope** in the following way:
  - Website: https://www.gradescope.com/
  - Homework assignments will be **submitted**
    - Most programming assignments are autograded
    - Reports and a couple of programming assignments are manually graded

Syllabus Quiz

Don't forget to take the Syllabuzz Quizz!

- This quiz is *Mandatory!*
- This quiz is located on Collab (see Tab on left-hand side).
- Take this quiz ***individually***. Absolutely no collaboration permitted.
- Must get **100%** to stay in the course! *May take it as many times as needed.*
  - Review these lecture notes as well as our detailed Syllabus
  - This quiz is ***open-book***
  - See score out of 18 points on Collab Gradebook to confirm you've completed the quiz
- ***Opens:*** January 21, 2022
- ***Deadline:*** by **January 28, 2022 @ 11:59pm**. *Take it early!*

Quick & Fun Survey Questions

Get to know your peers! ☺

Tea vs. Coffee?

Expectations

- To be successful in this course, students should have the equivalent of one semester of programming knowledge *(specific language does not matter)*, as demonstrated by any of the following:
  - Have taken CS 1110/1111/1112/1120 with a **C- or better**.
  - Have credit on your transcript for an equivalent course from high school or another university.
  - Passed the CS 1110 placement exam, AP exam, IB exam, etc. http://www.cs.virginia.edu/~sherriff/cs1110/placement.php
    - It must be turned in by **3:30pm the first Friday of the semester** to be used as a prerequisite for this course.

  - If you feel you have **not** met these prerequisites, please contact the instructors immediately.

Expectations (cont'd)

- It is expected that you can do the following:
  - You understand variables, program flow, simple problem solving, etc.
  - You understand simple data types like floats/doubles, strings, integers, etc. (though the names you used might be different)
  - You can write simple functions, pass parameters, write loops, use arrays, iterate over lists, etc.

Python vs. Java

- Many of you learned **Python** as your first language
  - Learning your second language will have some overhead, but you can do it and we are here to help you! **You are not behind**!!
- And many of you already have **Java** experience
  - *That's great!* Use the first few weeks as **review/refresher**, or use it to focus on the foundations of some of your other courses, then 'tune back in' after the 3rd week or so
  - You may even wish to polish your Java skills by assisting in answering some of your classmates' questions on **Piazza**!
  - You are still responsible for **all** material, Module Quizzes and Homework assignments

Administrative: Lecture / Lab Switching

- Switching Lecture or Labs
  - If you need to switch Lecture or Lab, you can. However, note this is *NOT an open invitation!* Must be **justified** (i.e., a class conflict)

- **What to do?**
  1. **Do a lecture/lab swap directly in SIS**:
     - This only works if the destination sections are OPEN / have SPACE
  2. **Find someone to swap with:**
     - Once you've found someone who wishes to swap with you (can be only a lecture, only a lab, or both) contact the **registrar's office** and ask them to manually swap you. For Engineering School students, that person is Jesse Rogers in Thornton Hall.
  3. If in doubt don't hesitate to contact me (basit@virginia.edu) I can give you advise but I am unable to do this for you

Course Content

Quick & Fun Survey Questions

Get to know your peers! ☺

Marvel Universe vs. DC Universe (Both?)

Quick & Fun Survey Questions

Get to know your peers! ☺

Cat / Dog / Animal Lover ☺

Course Objectives/Goals

- By the end of the semester, students should be able to:
  - Understand how to write programs in Java, including all basic structures (e.g., if-statements, loops, functions), recursion, objects, methods, inheritance / polymorphism, and exception throwing / handling.
  - Understand and implement several key data structures, required for a foundational education in computer science. These data structures include Vectors, Linked Lists, Stacks, Queues, Binary Search Trees, AVL Trees, Hash Tables, and Priority Queues.

Course Objectives/Goals (cont'd)

- By the end of the semester, students should be able to:.
  - Understand and implement various sorting methods, including bubble sort, insertion sort, mergesort, quicksort, and heapsort.
  - Understand and analyze program analysis using practical approaches (e.g., mergesort vs. quicksort) and theoretical approaches (e.g., balanced vs. unbalanced search trees). This will include both space and time complexity analyses.
  - Gather an abstract and basic understanding of concurrency and associated issues (shared resources, etc.). Students will be able to implement simple multi-threaded programs in Java.

Course Tools: Java and Eclipse!

- You will need to download **Eclipse**, a development tool for Java.
- We expect everyone to use the **Eclipse** development environment and **Java** version 11. **Homework 1** takes you through this. You will also have the opportunity to ask TAs during lab to help you with obtaining Java and Eclipse. Follow the tutorial provided.
- Note: You should **not** use any Java features beyond version 11
- Some systems can be quite picky, *alternative* download links are:
  - **Adopt OpenJDK:** https://adoptopenjdk.net/
    - Here choose OpenJDK 11 (LTS) and the HotSpot JVM options before download
  - **Eclipse:** http://www.eclipse.org/downloads/

  [Attempt the links above if the instructions in Homework 1 do not work for you.]

Modules

- The course is split into **12 modules**
  - You can find the list here in our **Course Schedule**: https://uva-cs.github.io/dsa1/slides/index.html
- Lectures will go through these modules one at a time
- The Modules help you keep the course content organized

Modules (1/2)

- Basic Java 1
  - Basic programs, data types, functions
- Basic Java 2
  - Ifs, loops, Arrays, References, Parameter Passing
- Basic Java 3
  - Objects, Classes
  - Generic types
  - Inheritance / Enums / Interfaces / Polymorphism
  - Java Collections, Etc.
- Basic Java 3 (*cont'd*)
  - Exceptions
  - Debugging
  - JVM, Compilers
  - IDEs
- Lists
  - Vectors (vs. Arrays, Abstract Data Types)
  - Linked Lists, Stacks and Queues
- Big Oh / Big Omega / Big Theta; and Recursion
  - Definitions / Function relationships
  - Analyzing Programs
  - How to think recursively
- Trees
  - Structure
  - Binary Tree / Recursive Traversals
  - BST and operations
  - Balanced trees (AVL & Red-Black)

Modules (2/2)

- Basic Sorting
  - Slow sorts (insertion / bubble)
- Advanced Sorts
  - Fast sorts (merge, quick, heap)
  - Hybrid sorts (TimSort, etc.)
- Hash Tables
  - Structure / Operations
  - Hash functions
  - Collision Resolution
- Priority Queues
  - Structure / Operations
  - Min-Heap / Array Implementation
  - Analysis
- Basic Concurrency
  - High-level abstraction in Java
  - Threading, Deadlocks, etc.

Grading / Assessments

Quick & Fun Survey Questions

Get to know your peers! ☺

Android vs. Apple vs. Pixel?

Structure of Each Module

- As mentioned before, the course has **12 modules**
- EACH MODULE CONTAINS:
  - 1 Quiz: More on this later
  - 1 Homework: Usually programming or similar
  - 1 Supplemental HW: Not all modules have this. Usually, analysis
- *A couple of the modules are structured differently, but the majority are consistent*
- EACH COMPONENT OF THE MODULE IS GRADED
  - **Quiz**: out of **8 points** each. 6 or higher automatically rounded up to 8 *(will explain verbally)*
  - **Homework**: out of **10 points** each.
    - Programming assignments are auto-graded, others are manually graded

Final Grades

- Your final grade breakdown will be:
  - **Homework:** 40%
  - **Total Quiz score**: 60% (over all quizzes)

Quizzes: *Every Module Has A Quiz*

- This course has **NO TRADITIONAL EXAMS!**
- **Quizzes** are **closed-book** and taken **during lab (in-person)** on your own laptop
  - Quizzes are located on our external testing site ("Sherlock") and linked to from Collab
  - Every week in-lab, you will take a **quiz** based on the **module** we have just covered.
- Certain labs throughout the semester will be ***"special"*** in that we give you the opportunity to **retake** up to **two (2) quizzes** from the recent Modules *to improve your scores*.
  There may be a limit placed on which quizzes you can retake.
- During these "special" labs, you will still have to take the quiz for *that week*, covering material in the module we have just covered (**not** optional). However, retaking quizzes is completely optional.
- The final exam period is your last opportunity to improve your scores on as many quizzes as you can.

Quiz Procedure

1. Attend lab in-person *(please show up on time!)*
2. Take out your **laptop** *(it's a good idea to bring your laptop charger with you)*
3. Go to our external testing site ("Sherlock")
4. **Open up the Quiz** for the current week
5. **Answer** all quiz questions and **submit on the testing site**

During "special" labs where you are allowed to re-take past quizzes, you will go to the external testing site and
(1) *open and take the quiz for* ***the current week,*** *then*
(2) *open and take* ***a separate quiz based on the past quiz you wish to retake***
(you cannot take the quiz for the current week twice in the same day)

Homework Assignments

- **1 or 2 per module** (depending on the module)
- Will be officially *"released"* once the module is covered in lecture
  - Though available on course site if you want to get ahead!

- Most weeks will have the following schedule: PLEASE NOTE THE DUE DATES.
  - **Homework 1** for that week (usually coding): due **by 11:59pm on Wednesday**
  - **Quiz Attempts**: Taken for 30 minutes during lab
  - **Homework 2** for that week (usually a report): due **by 11:59pm on Friday**

Life Happens… What's the "**Late**" Policy?

- **Each type of assignment has a different late policy:**
  - **Homework 1 (coding):** You can have up to **one week (7 days)** to submit late for a 10% penalty
  - **Quiz:** Must be done for 30 minutes in lab but can be retaken in future weeks.
  - **Homework 2 (reports):** No late grace period. Friday deadline is a hard deadline.

If you wish to make use of the grace period for Homework 1 (for a particular Module) you may simply go ahead and submit up to one week late – there is no need to let anybody know. It is your responsibility to submit with the grace period.

No homework 1's will be accepted after the grace period. No exceptions!

Question About Your Graded Assignment?

- After assigned work is returned, it may be that you would like to discuss the points you earned for one or more questions. This is called a *regrade request*.
- Regrade requests can only be made to hand-graded assignments (homework and reports that are not auto-graded). Your request must be specific and address an issue when an assignment may have been graded incorrectly.
- All regrade requests must be made **within 7 days** of the assignment being returned to the student. If you do not show understanding of the material in your request, it will be denied.

Final Exam

- **NO TRADITIONAL FINAL EXAM**
- Our final exam will be a 2-hour exam (note the shortened time span) for you **to improve your score on any quizzes that you want.**
- You will complete quizzes **you wish to improve on.** That is, you can take as many quizzes as you want one last time to raise your scores on those quizzes.
  - For example, if you wish to improve your score on quizzes 4, 8, and 11, you will use the final exam time to complete these quizzes.
- Thus, if you are satisfied with your scores on all your quizzes, you will not need to take the final exam! ☺

Other Course Policies

Quick & Fun Survey Questions

Get to know your peers! ☺

Cake vs. Pie?

Cohorts

- Everyone in the class will be assigned into a **Cohort**
  - Your cohort will all be enrolled in the **same lab section**
  - You may *collaborate* with your cohort as much as you'd like (*exceptions* on next slide!)
  - Each Cohort will be **assigned a TA** they can reach out to if they need

- What do you do when you have **specific questions** related to homework or course content?
  - Well first, make use of your **assigned cohort** and discuss your questions (at a high level) with them *(again, see next slides on how you may or may not collaborate w.r.t. homework)*
  - After that, the *next* source of information is **Piazza**
    - **Search** to see if a similar question to yours has already been asked and answered
    - *If not,* then **make a post!** (Remember no code or solutions in a public post)
    - While you're waiting, perhaps try to answer questions posed by your classmates

Honor Policy – What you may do

- You may collaborate with your **cohort** in the following ways:
  - Collaborate on homeworks by discussion / whiteboarding / pseudocoding
  - Compare code AFTER homework submitted
  - Show code to **TA** or **Instructor** to get help / confirm solution(s)

- All submitted work must be individual effort, so:
  - **YOU MUST WRITE CODE, REPORTS, ETC. BY YOURSELF!**

Honor Policy – What you may **NOT** do

- You may NOT:
  - Look at code (other than your own) BEFORE submitting homework
  - Look at code **online** that implements a key part of data structure or assessment
    - E.g., looking up syntax in **the Java API** is definitely **OK** (and ***encouraged***)
    - However, looking up how to implement a queue (for example) is **not** permitted
  - **WHEN IN DOUBT, PLEASE ASK!**

COVID Policies

- **Masking required** (University policy) in class for the duration of the class meeting.
  - If you forget your mask: I will have a limited number of disposable masks – just ask me!
- No eating or drinking in the classroom (exception: straws)
- Attendance at lecture, while highly encouraged, is *not* required, but **engagement** is
  - Watch lecture videos (if you don't attend in person)
  - Connect with cohort in lab times
- If you don't feel well, please stay home and watch the video recording -- ***it will be okay!***
  - Will work with you–if you stay home–to ensure no effect to grade
  - Make use of quiz re-takes and homework grace period (where applicable)
  - Contact your instructor – we'll be happy to work with you, so you don't fall behind!
- Plans will change

We are in this together, and we'll get through it! ☺

Recording Policy

- You may **not** record me lecturing. This is a personal decision.
- This is also a **UVA POLICY**: *"The University prohibits the recording or transmission of classroom lectures and discussions by students unless written permission from the Instructor has been obtained and all students in the class as well as guest speakers have been informed that audio/video recording may occur."*
- Remember, that I will be recording and posting lectures on Collab for most lectures.
  - *Allow up to **24-48** hours for the recorded lecture to post. (Often sooner).*
  - *Do not hesitate to email me if you do not see the recorded video after 48 hours (sometimes the system is glitchy and doesn't post it – I'll be happy to fix that!)*

Summary / Reminders

Syllabus Quiz

- *Mandatory!* Take by **Jan. 28 @ 11:59pm**. Must get **100%** to stay in the course! May take it as many times as needed. *Take it early! (Located on Collab)*

Regrades

- Request within **7 days** for hand-graded assignments

Academic Integrity

- Collaboration: discuss within your **cohort** but do your own work; ***single source*** at a time; ability to **explain**

Deadlines are at 11:59pm ET!

Quick & Fun Survey Questions

Get to know your peers! ☺

Mountain view vs. Ocean view?