# Course Syllabus
## MTH 325: Discrete Structures for Computer Science 2
Fall 2022, Grand Valley State University
Sections 03 and 04

> Let us change our traditional attitude to the construction of programs: Instead of imagining that our main task is to instruct a computer what to do, let us concentrate rather on explaining to human beings what we want a computer to do.
>
> Donald Knuth, *Literate Programming*

# About the course and this syllabus

**Welcome to MTH 325!** I'm Dr. Robert Talbert, the professor of this course. I'm grateful you're here, and I think you're going to love what you learn this semester. MTH 325 really gets into the *structures* part of Discrete Structures by looking at three fundamental constructs that are everywhere in math and CS: **graphs**, **relations**, and **trees**. We'll be learning all about these, and also learning how to think rigorously about these structures through the use of **proof**.

This syllabus contains all the information you need to navigate the course. It is available in an online format as well as a PDF. Both versions will be updated weekly.

When you see blue- or purple-underlined text in the syllabus or any other document, it's a clickable link. For example, click here for a cat video.

**This document is meant to be read once, then searched as needed.** If you need to find something, you can either use the table of contents found in the left sidebar of the web version (click "Expand All" to see the subsections in the table) or hit `Control-F` to bring up a search field, and then type in the text you are looking for.

# Course information

- **Class meetings:** Section 03 meets MWF 12:00-12:50pm in MAK B-1-110. Section 04 meets MWF 2:00-2:50pm in MAK A-1-111.
- **Instructor:** Robert Talbert, Ph.D., Professor of Mathematics.
- **Office location:** MAK C-2-513.
- **Drop-in hours:** *In-person* drop-in hours are MW 3:00-3:50pm. *Online* drop-in hours are MW 4:00-4:50 via the Zoom link found on Blackboard. **No appointment is necessary**.

- **Appointments outside drop-in hours:** Available on a limited basis. Go to https://calendly.com/robert-talbert, choose a meeting type, then choose an open 20-minute time slot.
- **Contacting the prof:** Email (talbertr@gvsu.edu) is preferred. Be sure to read my availability/response policy.
- **Course calendar:** The official course calendar is in Appendix B and on Blackboard. *In case of a date conflict on assignments or course documents, the Class Calendar is assumed to be correct.*
- **Definition of "week":** In our course, a "week" is defined to begin at 12:01am ET on *Monday* and end at 11:59pm ET the following *Sunday*.
- **Blackboard and announcements:** Our Blackboard page is at https://lms.gvsu.edu. Announcements will be posted on Sundays and Wednesdays and other times as needed. *Be sure to check announcements, email, and the calendar at least once daily.*
- **Textbook:** The textbook is Discrete Mathematics: An Open Introduction by Oscar Levin. It's free; just click the link. A PDF copy is available for download here.
- **Perusall:** We will use **Perusall**, a tool for commenting on text and video, regularly through the course. Go to http://perusall.com, sign up for an account, then use the course code posted on Blackboard in the *Important Links* area to join the class.

## Success in MTH 325

**My top prority as a professor at GVSU is your success**. In MTH 325, you can expect:

- A learning environment that challenges you, but also where support is readily available and freely given. This class is *a safe space to make mistakes*.
- Work that is meaningful and not "busy work", and grading practices that prioritize growth and improvement.
- Transparency and openness in how the course is run, including clear instructions on what you need to do and when.
- Openness to your ideas about the course, with regular solicitations for feedback that are taken seriously through a continuous improvement process.
- Above all, **respect** -- for you as a learner, as an adult, and as a human.

On your end, your success in the course depends on three things:

1. **Active engagement during class time**. All the available research on learning says that the best way to learn is to be an active participant in the process. Students who approach the class with a passive mindset typically struggle, and often fail. Those who approach it with an active mindset, on the other hand, often surprise themselves with how much and how well they learn. Make it a priority not to just attend and take notes, but *get involved*.
2. **Asking questions**. The material in MTH 325 is challenging, and it is 100% certain you will be lost, confused, and/or stuck at times. **This is not a defect -- it means you're doing the course right.** When it happens, don't wait for things to make sense on their own: *Ask questions* of me and your classmates and take action to make sense of the material.
3. **Good management of time, tasks, and information.** Understanding the material won't help you if you procrastinate, skip reading announcements, or don't use a calendar. All course information will be clearly laid out for you, but it's up to you to import that information into your own lives and act on it.

If you can commit to these three things, then I have every expectation that you'll succeed in the course, no matter what your math background or perceived math skill is.

# How MTH 325 is structured

## Course level learning objectives and catalog description

The overall goal of MTH 225 and MTH 325 is to build a solid foundation in the basic theory and tools for the mathematics that computer science is built on, especially in later coursework such as CIS 263.

After successful completion of MTH 325, you will be able to…

- Compute basic information about graphs, relations, and trees.
- Solve theoretical and applied problems involving applications of basic concepts of graphs, relations, and trees.
- Formulate computational problems in terms of graphs, relations, and trees.
- Construct a logical framework for a proof using mathematical induction, direct proof, proof by contraposition, or proof by contradiction.
- Analyze the structure and validity of a mathematical proof.
- Employ effective problem-solving skills in solving computational problems.
- Explain methods and solutions of computational problems in a clear way to a specified target audience.
- Demonstrate fluency in applying algorithms in the formulation and solutions of mathematical problems.
- Assess one's own work in mathematical problem solving and apply feedback to make improvements to one's own work.

## Module structure and content standards

The course content is split up into four modules:

- **Module 1: Proof.** The concept of proof, examples, and counterexamples; review of (weak) mathematical induction; strong induction; structural induction; direct proof; proof by contrapositive; indirect proof.
- **Module 2: Graphs.** Terminology and examples of graphs; representation of graphs in computer languages; the Handshaking Theorem; Euler and Hamilton paths and cycles; isomorphism; vertex coloring; minimal spanning trees.
- **Module 3: Digraphs and relations.** Terminology of directed graphs and relations; representation of relations in computer languages; properties of relations; composition of relations; transitive closure and Warshall's algorithm; equivalence relations; partial orderings.
- **Module 4: Trees.** Terminology and examples of trees; properties of trees; binary search trees; tree traversals.

The most important skills that you will learn in the course are housed in a list of 20 **Content Skill Standards**, found in Appendix A.

## The MTH 325 Workflow

Each class meeting has activities for you to do *before*, *during* and *after* the class. For details on specific assignment types, see the next section.

- **Before class:** You'll be asked to complete a **Daily Prep** assignment where you'll do a combination of reading, video viewing, and other activities then answering basic questions about it. This way, you'll come to class ready to work, and we can skip the lecturing in class unless it's really needed.

- **During class:** Class meetings will be focused on *answering questions* and *doing active work*. We'll also use time in class for assessment and for completing other assignments. We will *not* be doing much lecturing in class, unless it's something quick and targeted at specific questions from your Daily Prep.
- **After class:** In addition to getting started on the next Daily Prep, you should expect to spend significant time in between classes doing practice on concepts you don't fully understand yet, asking questions, and working on Proof or Applications problems.

# Assessments and grades

## Overall approach to grades in MTH 325

The way grades work in MTH 325 is fairly different from how they are usually done. In MTH 325:

- **None of your assignments have point values**, and therefore there is **no partial credit and no averaging**.
- Instead, assignments have **specifications** which are descriptions of what constitutes "acceptable" work. When you submit an assignment, I will evaluate it and simply determine whether it meets the specifications or not.
- After I evaluate your work, in most cases you will receive **detailed feedback** that will tell you whether your work meets the specifications, and if not, the feedback will tell you what was missing and how you might go about fixing it.
- Then on almost every piece of work, you will have the chance to **revise or reattempt** the assignment, get more feedback, and repeat this **feedback loop** until the work meets our specifications.
- Your course grade is based on **how many important learning tasks you've accomplished** by the end of the semester, using a simple table.

This process, using specifications and feedback loops rather than points and averages, is actually how evaluation of work happens in most situations outside of college. In your future jobs, for example, you'll be reviewed regularly by your manager; it's not a "one and done" situation where you get a point score and that's it, but instead you get 360-degree feedback and coaching on how to improve, and then you act on the feedback.

I've been using this grading method since 2017, originally in MTH 325 and now in all my classes. We do things this way because **learning takes time**, and I believe grading your work based on a single point of data such as a quiz or test and then averaging all of those data is not only inaccurate, but statistically invalid and even unethical. Feedback loops are how all human learning takes place. So this seems like the best way to do grading.

Those are the main concepts; the details are in the rest of the syllabus. Most students need a week or two to adapt to this system, but then everything is fine. I encourage you to ask questions at any time so I can help you.

## Four kinds of assessments in MTH 325

There are four categories of graded assignments:

- **Daily Prep:** Pre-class assignments that combine reading, viewing, and other activities to give you first contact with new material, so we can use class time to work on the applications of that material. Daily Prep assignments are due before almost every class and completed using the Perusall platform.
- **Proof problems:** Problems that involve writing clear and correct proofs of mathematical propositions.

- **Application problems:** Problems that involve applying basic skills from class to applications in a variety of different areas. Some of these focus on programming in Python.

Additionally, you'll be completing **demonstrations of skill** on the twenty (20) **Content Skill Standards** found in Appendix A. The Standards are 20 basic skills from the course. You'll be demonstrating skill on these Standards in one of three different ways, described below.

These assignments are graded as follows:

| Assignment | Basis for grading | What's recorded in Blackboard |
| --- | --- | --- |
| Daily Prep | Completeness and effort only | *Completed* or *Not Completed* |
| Demonstrations of skill on Content Skill Standards | Completeness and correctness | Explained below |
| Proof problems | Correctness and writing quality | *Successful* or *Revise* |
| Application problems | Correctness and writing quality | *Successful* or *Revise* |

The document Specifications for Student Work in MTH 325 contains details on the quality standards for each kind of assessment in the course. Please read this carefully and review before each submission you make.

**You can either revise or reattempt any item of work other than Daily Prep** if your work does not meet the specifications. See "Revisions and Reattempts" below.

## More about Content Skill Standards

The 20 Content Skill Standards, given in Appendix A and elsewhere, are the core basic skills of MTH 325. Part of your job is to **"meet"** as many of these standards as possible. **"Meeting" a standard requires TWO (2) successful demonstrations of skill on that standard**. A demonstration of skill is one of three things:

- **Successful work on a quiz problem targeting that standard.** Almost every week, we will have a quiz over Content Skill Standards. Each quiz contains several problems, and each problem covers exactly one Content Skill Standard. *Each quiz is cumulative*, with new problems for the most recently-covered standards along with new versions of problems for standards on previous quizzes. An answer to a problem that meets the specifications found in the Specifications for Student Work in MTH 325 document, is considered a "successful demontration of skill".
- **Successful work on an oral quiz done during drop-in hours.** You can also demonstrate skill on a Content Skill Standard by requesting a live oral quiz on that standard in drop-in hours. To use this option, go to the Calendly page at https://calendly.com/robert-talbert and request either an oral quiz either in-person or

online. You'll be asked which standard you want to be quizzed over. Then, I will make out a new problem for that standard, and you'll work through it live at the requested time.

- **Successful work on a video solution to a quiz.** Finally, you can demonstrate skill asynchronously by requesting a new problem on a standard and then working out the solution on a video, and posting that video to our class' private Flip channel. The submission link along with additional instructions about video creation will be posted to Blackboard in the first few weeks of the course.

As mentioned above, **to meet a Content Skill Standard, you must provide TWO (2) separate demonstrations of skill on that standard.** (A single successful demonstration of skill could be a fluke; two successful demonstrations generally aren't.) You can mix and match the three different ways of demonstrating skill listed above; for example you can give one demonstration of skill using a video and the second one using a quiz problem. However: **At least one demonstration of skill must come from a quiz problem.**

**How these are recorded on Blackboard:** The Blackboard gradebook contains one column for each of the 20 Content Skill Standards. If you have *no* successful demonstrations of skill on a Content Skill Standard yet, that standard will show *No DOS yet* (where DOS = Demonstration Of Skill). If you have *one* successful demonstration, it will say *One DOS*. Once you have given two successful demonstrations of skill on a Content Skill Standard, in Blackboard it will say *CSS met* (where CSS = Content Skill Standard) and **you do not need to give any more demonstrations of skill on that standard for the rest of the course**. Blackboard entries are updated after every quiz or other demonstration of skill.

**Final exam:** There is no final exam for this course. During your section's final exam period (see the Calendar), there will be a Content Skill Standard quiz available with all 20 standards represented, in case you need one last attempt on these.

## Proof and Application problems, and the Proof and Applications Badges

While Daily Prep and Content Skill Standards focus on the basic elements of MTH 325, Proof and Applications problems highlight advanced theory and applications, respectively, using those basics. Both kinds of problems involve analytical problem solving and clear, coherent professional communication as their primary criteria for evaluation -- definitely not just "right answers".

Detailed instructions for completing and submitting Proof and Application problems will be printed on the assignments themselves. The document Specifications for Student Work in MTH 325 has details on what constitutes acceptable work on these, in a general sense. There will be several Proof problems, most of which will be posted on Blackboard in the first three weeks of class. Application problems will be released more gradually, as we cover more topics, and it's expected there will be about 4-6 of these total.

**Badges:** To show that you have acquired a strong grasp on Proofs or Applications, you can earn the **Proofs Badge** or the **Applications Badge**.

To earn the Proofs Badge:

- Meet **Content Skill Standards P.1, P.2, and P.3** (through two successful demonstrations of skill on each).
- Do "Successful" work on **three different Proof problems**: *At least one must use mathematical induction*; *at least one other must use a technique other than mathematical induction*; the third can be anything.
- Complete a reflective essay about proofs. Details will be posted later.

To earn the Applications badge:

- Complete the following portions of the Codecademy Python 2 course at https://www.codecademy.com/learn/learn-python: Python Syntax, Strings and Console Output, Conditionals and Control Flow, Functions, Lists & Dictionaries, Lists and Functions, and Loops.
- Do "Successful" work on **three different Application problems**, at least one of which must be designated as a Programming-Focused problem.
- Complete a reflective essay about applications. Details will be posted later.

Please note, **although several Proofs and Applications problems will eventually be posted, you do not have to do them all** -- just the ones needed to earn the badge you are trying to earn. Choose your favorites.

## Course grades

Your course grade is assigned using the table below. **To earn a grade, complete ALL the requirements listed in the row for that grade.**

| Grade | Daily Preps completed (out of 22) | Content Standards met (out of 20) | Badges earned |
|-------|-----------------------------------|-----------------------------------|---------------|
| A | 18 | 18 | Both Proof and Applications |
| B | 16 | 16 | Either Proof or Applications |
| C | 14 | 14 | Either Proof or Applications |
| D | 6 | 6 | None required |

Additionally: **To earn a grade of A, B, or C you must specifically meet Content Skill Standards P.1, P.2, G.1, G.2, and DR.1**. Failure to meet all five of these "core" standards results in a one letter grade deduction after all other tabulations are done.

A grade of "F" is earned if not all of the requirements for a "D" are met.

**Plus/minus grades:** A "plus" is given on a letter grade if you satisfy all the requirements for that letter *plus* you either complete both the Proof and Applications badges (not just one of these) *or* if you meet the number of content standards for the next letter grade up. A "minus" is given on a letter grade if you meet all the requirements for that letter except for Daily Prep. The exact amount of downward adjustment in this case will be at the professor's discretion based on how many Daily Preps were completed.

**Exceptions:** GVSU does not award grades of A+ or D-.

# Revision and reattempts

**You can revise or reattempt any work you turn in, without penalty, until it meets the criteria for acceptable work given in the Specifications for Student Work in MTH 325 document.** *The exception is Daily Prep*, which due to its time-sensitive nature cannot be reattempted.

**Demonstrations of skill for Content Skill Standards** can be reattempted at every quiz, since the quizzes are cumulative; if your work on a problem is not successful, just try again at the next quiz, or try an oral or video quiz instead. Unsuccessful oral or video quizzes can be redone simply by scheduling a new one.

**Proof and Applications Problems** that are marked *Revise* can be revised and resubmitted by uploading a revised version of the work to the same Blackboard "assignment" folder where it was previously submitted. All versions of the problem will be kept in that folder for reference.

**Limitations on revisions:** Although there is no penalty for revising or reattempting work, we place the following reasonable limitations on this process to keep the process manageable:

- **Only two submissions per week are allowed for Proof or Applications problems**. This can be new submissions of two different problems; or revisions of two different problems; or one new submission and one revision.
- **Only one request per week for oral quizzes on Content Skill Standards may be made**, and *only one Content Skill Standard per quiz* is allowed.
- **Only one request per week for video quizzes on Content Skill Standards may be made**; *only one Content Skill Standard per quiz is allowed*, and *you must complete any pending video that you had requested earlier before you can request a new one*.
- **No requests for oral or video submissions for Content Skill Standards may be made after 11:59pm ET on Sunday, December 4** so that the last week of class can be used to complete the requests that have been made.
- **No revisions of Proof or Application problems are allowed after 11:59pm ET on Sunday, December 11** in order to provide time and space to grade all pending revisions for final course grade determinations.

# Academic integrity and honesty

:::warning
This course is subject to GVSU course policies and the GVSU student code. This document establishes guidelines and expands and clarifies these policies with respect to all work done in MTH 325 this semester.
:::

The student code defines **academic misconduct** as *any action or behavior that misrepresents one's contributions to or the results of any scholarly product submitted for credit, evaluation, or dissemination*. This includes cheating, collusion, dual submission, falsification, and plagiarism as well as any behavior that enables or helps others do these things.

Academic misconduct is a serious matter and carries significant consequences, up to and including failure of the course and possible suspension from the university. In all cases, the guidelines established in the GVSU catalog and GVSU student code will be followed. I reserve the right to discuss the nature and origins of any assignment with any student before assessing it.

On **Daily Prep assignments**, you are **allowed and encouraged to collaborate with others** as long as the responses you submit reflect your own understanding. Remember these are only graded on completeness and effort, and mistakes are not penalized.

On **all other work** (Content Skill Standard work, Proof problems, and Applications problems) **no collaboration is allowed with another person**, including former students, Math Center tutors, or online discussion forums. Further, **you may not use unauthorized resources**. A list of "authorized" resources will be printed on the assignments; they may include your textbook, class videos, or other items.

"Collaboration" here means any interaction where significant ideas on solutions are shared. You may talk with a classmate, for instance, in very general terms about an assignment; but sharing information about *how to complete* an assignment is not allowed. Exception: *Technical* details about an assignment (for example how to use the equation editor in Word, or the syntax of how to use a Python dictionary) are fine to discuss, in fact you are encouraged to help each other out in such matters.

In the end, **your work must reflect your own understanding of the problem, and the solution must consist entirely of ideas you thought of yourself**.

PLEASE NOTE: **There's no need to be academically dishonest in MTH 325, because you can revise and resubmit almost everything.** Rather than cheat, *ask questions and use the feedback loop* so that you really grow and learn in the course.

# Getting help

As mentioned, you will almost certainly find yourself lost, stuck, or confused on *something* in this course, possibly quite often. This is not a defect in your character or intelligence; it's a sign you are being challenged, and you can turn that challenge into real growth by **seeking out help as soon as you need it**.

Make every effort to get yourself unstuck and resolve your questions on your own first. But then:

- **Attend drop-in hours and ask questions there.** You can use the in-person drop-in hours, the online ones, or both. No appointment needed.
- Schedule an appointment through Calendly if drop-in hours don't work for you.
- **Work with a classmate** especially on Daily Prep, as long as you're staying within bounds on academic honesty.

# Course policies

## Attendance, absences and participation

**Attendance:** Attendance is expected at all class meetings. Attendance will be taken, so I can have a record of it and reach out to see if you're OK if you miss several classes; but it is not graded, nor does it count in your final grade.

**Remote attendance:** Class meetings will be live-streamed on Zoom and recorded. If you cannot be physically present for class, you can access the recording at any point within 30 days of the class. You may join the Zoom meeting if you can't be present, but my attention will be focused on those who are present; you won't be able to work with others, and if you leave questions in the chat I may not see them until well after they are asked.

**Absences:** If you must be absent, you do not need prior permission or justification; a heads-up is appreciated. However *please avoid any non-essential absences* such as skipping class, or scheduling a vacation during a day where class is scheduled. If you miss, you are solely responsible for catching up.

**Missing Content Skill Standard quizzes:** There is no makeup available if you miss Content Skill Standard quizzes in class. These are begun in class but completed outside of class, so missing the in-class time for working on them should not affect you.

## Deadlines and late work

Daily Preps are due by 11:59pm on the day it says; late work is accepted up until the point that I sit down to grade them, which could happen at any point between 5am and noon. After that point, the work is marked "Not Completed".

Quizzes on Content Skill Standards are *begun* during class meetings but then you will have until 11:59pm ET of that day to complete and submit your work on Blackboard.

Proof and Applications problems will come with deadlines printed on the assignments (and listed on the course calendar). You are expected to submit your work on these by that deadline, but there are no deadlines on revisions except for the end-of-semester deadline on Sunday, December 4.

**Deadline policy:** The policy on deadline extensions in MTH 325 will mirror that of real-world jobs, but this might not mean what you think. In the real world, due dates and deadlines exist, but studies have shown that a little over half of these are flexible, assigned mainly as a "commitment device" to help you stay motivated to complete the task. But, if things go sideways and you need more time to get the job done well, you email whoever set the deadline and ask if you can have some more time. Studies have shown [1] that deadline extensions, when requested in moderation and when truly needed, can lead to better evaluation (and better work).

Therefore if you are needing an extension on a due date, you can request one, without penalty. Just fill out the **Due Date Change Request form** found here:

https://docs.google.com/forms/d/e/1FAIpQLScek4frZuSxHwMN2a1Ino4GETPwH4v5tyL3KLTNRpXY3qDQcw/viewform

(This is also linked on the Blackboard sidebar.) You do not need approval; this form is simply informing me of when you plan on turning in the work. Please note, you may not get timely feedback on your work if you change the due date. If you ask for repeated extensions, I will likely reach out to see if we can find ways to help you keep up better.

And please note, due dates on Daily Prep assignments *may not* be changed due to their time-sensitive nature. Remember these are graded on completeness and effort only.

## Technology skills and support

You should be proficient in the basic technology skills listed at this GVSU policy page. This list is specifically for online and hybrid courses, but the skill set applies to our class as well. If you need help at any time with those skills, please ask me or a classmate.

**Tech support:** Technology issues will happen with almost 100% certainty, usually at the worst possible moment. **When this happens, do NOT contact me first!** Instead, contact the appropriate person or office listed below:

:::success

- For help with **Blackboard:** Email the Blackboard Help Desk at bbadmin@gvsu.edu or call (616)331-8526. For hours of operation and more information see http://www.gvsu.edu/elearn/help.
- For help with **the GVSU network, email, or printing**: Email the GVSU IT Help Desk at helpdesk@gvsu.edu; or call (616)331-2101 or toll free (855)435-7488. For hours of operation and more information see https://www.gvsu.edu/it.
- For help with **your computer:** Try the GVSU IT Help Desk (above) or contact your device's manufacturer or a computer store.
- For help with **Perusall:** Contact **Perusall Help** at https://support.perusall.com.
- For help with **any other technology:** Ask a question of a classmate (or me), seek out the help documentation in the tool you are using, or do a targeted Google search.
  :::

**I (Talbert) am not able to provide tech support** since I lack the skill and permissions to fix all possible problems.

**If technology issues prevent submitting work:** If you have contacted an appropriate source of help and an issue still persists that prevents you from turning in work in the usual way (for example on Blackboard), **you are expected to take alternative measures to get your work turned in on time.** For example, if Blackboard is offline and a deadline is looming, send an email with an attachment. Then, submit the work using the normal means later. If Zoom isn't working on your computer, try joining the meeting on your phone.

## Instructor availability and message responses

**You can ask a question about anything at any time.** You have both the right and the responsibility to ask questions about anything in the course you don't fully understand, whether math or some aspect of the syllabus or anything else. You can use email (talbert@gvsu.edu), drop-in hours (either in person or virtual), or grab me after class. Email is usually the best venue.

However, please note that I do not always respond immediately to messages. In particular **I do not check email between 6:00pm and 6:00am on weeknights**, and **I do not check email at all on weekends**. That said,

- Messages sent on a weekday (Monday-Friday) before 4:00pm ET will get a response *the same day*.
- Messages sent after 4:00pm ET Monday-Thursday will get a response *the next day*.
- Messages sent after 4:00pm on Fridays or on the weekend will get a response *the following Monday*.

**Please plan ahead for instructor availability.** Many assignments are due on Sunday evenings; if you don't begin the assignment until Friday afternoon and encounter a question, you may not be able to get help from me in time.

## Special accommodations and basic needs

If you have special needs because of learning, physical or other disabilities, it is your responsibility to contact Disability Support Resources (DSR) at (616)331-2490 or http://www.gvsu.edu/dsr/. DSR will help you arrange accommodations. Then, speak with me in person about making those accommodations and ensure that they are consistent with your arrangements with DSR.

If you have difficulty affording groceries or accessing sufficient food to eat every day, or if you lack a safe and stable place to live, I encourage you to visit Replenish, a food resource for GVSU students. If you are comfortable doing so, please speak with me about your circumstances so that I can advocate for you and to connect you with other campus resources.

If, for purposes of gender identity and expression, your official name (in Banner) does not match your preferred name, your name can be updated in Blackboard. Please contact the registrar's office to submit this request. The registrar's office will contact the Blackboard administrator to make the change and will also contact your professors to inform them that your name in Banner will not match the name in Blackboard.

# About the instructor
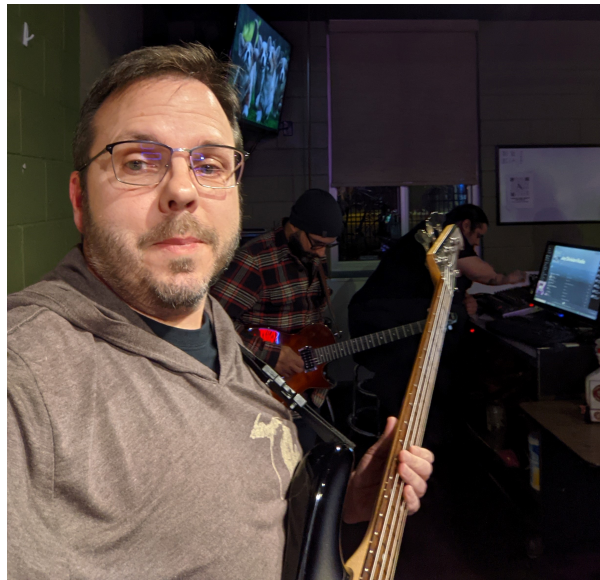


I'm Robert Talbert, the professor for this course. I'm a Professor of Mathematics and also work in the president's office as Presidential Fellow for the Advancement of Learning. This is my 31st year of teaching overall (not counting tutoring gigs). I have a Ph.D. in Mathematics from Vanderbilt University and a B.S. degree from Tennessee Tech University.

I was, at best, a thoroughly mediocre math student in school until my senior year of high school, when I had a teacher for Calculus (hi, Mrs. Allen) who stopped trying to cram things into my head and instead showed me the basics -- and then backed off, and let me work things out on my own (with support if I got stuck). Basically, this is how I teach today.

After a two-year gig as a Psychology major in college, I changed my major to math after a late-night dare from my roommate (long story) and, to my great surprise, I fell in love with the subject. I ended up getting a Ph.D. working in an obscure area at the intersection of abstract algebra and geometry, and I also discovered I loved teaching math to college students. So I went on to spend 14 years teaching in small liberal arts colleges before coming to GVSU in 2011.

Now, I teach computer scientists and engineers how to think like mathematicians, I do research on how to make college teaching better, and I coordinate large-scale teaching/learning projects for President Mantella's office. (The fancy active learning classroom in which we are meeting, is one of my projects.) When nobody is looking, I am working on my skills in Python and R, learning data science, and dabbling in project management.

I live in Allendale with my wife, two teenage kids (there's another kid who lives in Greenville), and three cats. I am a halfway-decent cook, a longtime bass guitarist (see picture), and lover of the outdoors. I aspire to spend more time in a kayak or on a bike than in front of a computer. You can read more about what I'm thinking and doing at my website, rtalbert.org, or at my "other blog" Grading for Growth about alternative grading practices which I co-author with my GVSU colleague Prof. David Clark. I'm also on Twitter at @RobertTalbert and on LinkedIn. I will accept any connection request on LinkedIn from a student!

# Appendix A: Content Skill Standards

**Note**: The five Content Skill Standards marked with a star (★) are **required** for grades of A, B, or C. Failing to meet all five will result in a one-letter grade deduction on the final grade. Those standards are **P.1, P.2, G.1, G.2, and DR.1**.

# Group P: Proof

- ★ P.1: Given a statement to prove with mathematical induction, I can identify the predicate, state and prove the base case, state the inductive hypothesis, and outline the rest of the proof.
- ★ P.2: Given a conditional statement, I can state the assumptions and conclusions for a direct proof, proof by contrapositive, and proof by contradiction.
- P.3: I can conduct a critical analysis of a proposed proof of a logical proposition.

# Group G: Graphs

- ★ G.1: I can represent a graph in different ways and change representations from one to another.
- ★ G.2: I can determine information about a graph and its individual vertices and edges using different representations.
- G.3: I can give examples of graphs having combinations of various properties or explain why no such example exists, and I can draw examples of special ("named") graphs.
- G.4: I can determine whether two graphs are isomorphic; I can give an explicit isomorphism if they are, and an explanation if they are not.

- G.5: I can give a valid vertex coloring for a graph and determine a graph's chromatic number.
- G.6: I can determine whether a graph has an Euler path or Euler circuit, and whether a graph has a Hamiltonian path or cycle.
- G.7: I can use Prim's Algorithm and Kruskal's Algorithm to construct a minimum spanning tree for a weighted graph.
- G.8: I can use Dijkstra's Algorithm to find a minimum-weight path between two vertices in a connected weighted graph.

## Group DR: Digraphs and Relations

- ★ DR.1: I can determine information about a directed graph and its individual vertices and edges using different representations.
- DR.2: I can give examples of relations on a set that have combinations of the properties of reflexivity, symmetry, antisymmetry, and transitivity.
- DR.3: I can determine if a relation is an equivalence relation; I can determine the equivalence class of an element under an equivalence relation and determine whether two elements belong to the same equivalence class.
- DR.4: I can find the $n$th order composition of a relation with itself.
- DR.5: I can sketch the transitive closure of a relation as a directed graph.
- DR.6: I can determine when a set with a relation is a partially ordered set; I can draw the Hasse diagram of a poset and identify maximal/minimal elements and/or greatest/least elements, if they exist.

## Group T: Trees

- T.1: I can determine whether a description of a graph (list of vertex and edge sets, degree sequence, a drawing, or list of properties) represents a tree.
- T.2: Given a list with a total ordering, I can construct the binary search tree.
- T.3: I can list the vertices of a tree in the order they are visited using preorder, inorder, and postorder traversals.

## Appendix B: Class Calendar and important dates

The course calendar shown below is also linked in the Blackboard sidebar. **In all cases of apparent date or time conflicts, this course calendar is assumed to be correct.**

**Important dates:** (All found on the calendar but summarized here for reference)

- Monday August 5: No class (Labor Day recess).
- Friday Ocobter 7: No class (Talbert at conference) but Content Skill Standard quiz done on your own
- Monday October 24: No class (Fall Break).
- Wednesday November 2: No class (Talbert at conference).
- Wedensday November 16 and Friday November 18: No class (Talbert at conference).
- Wednesday November 23 and Friday November 25: No class (Thanksgiving Break).
- Sunday, December 4: Deadline for oral and video quiz requests.

- Friday, December 9: Deadline for completing oral and video quizzes.
- Sunday, December 11: Deadline for Proof and Application problem submissions.
- Wednesday, December 14: Final Exam periods -- 12:00-1:50pm for Section 03, 2:00-3:50pm for Section 04.

## Appendix C: Important Links

- **Blackboard**: http://lms.gvsu.edu, then look for your section of MTH 325.
- **Zoom**: See the *Important Links* area in the Blackboard sidebar for links to your section's class meeting and for online drop-in hours.
- **Calendly**: https://calendly.com/robert-talbert then choose the kind of appointment you want, then pick any open 20-minute time slot.
- **Perusall**: http://perusall.com (Use the invite code posted to Blackboard in the *Important Links* area; log in to access course materials)

---

1. See "Go Ahead and Ask for More Time on that Deadline", https://hbr.org/2021/12/go-ahead-and-ask-for-more-time-on-that-deadline ↩