Course Syllabus
Discrete Mathematicas – MATH 2603
Dr. Derrick Wigglesworth

Course Information

- **Instructor:** Derrick Wigglesworth.
- **Instructor Office:** SCEN 316.
- **Instructor Email:** drwiggle@uark.edu
- **Office Hours:** Mondays at 1:00 pm & Thursdays at 11:00 am in our Zoom classroom. I am happy to meet outside those times as well; just set up an appointment by email.

Course Materials: All course materials, including the textbook, reading assignments, a copy of the syllabus, and a list of learning target assessments can be accessed through Blackboard at `https://learn.uark.edu/`. Additional resources can also be found on this website. You **MUST HAVE ACCESS** to the textbook (see below) to participate in this course.

Course/Content Delivery: This course will take place entirely online, primarily using Zoom (linked in Blackboard) . The course will be "synchronous" in that we will meet every day at a specified time. You are expected to (virtually) attend class and participate each day. We will be using a "flipped classroom" model for instruction: this means that you will read the textbook *prior to class* each day, and during class we will have short stints of oral instruction, paired with activities/problem sets in small groups.

Textbook: *Discrete Mathematics*, by Sandy Irani. This is an online textbook. To access the textbook, navigate to our class in Blackboard; on the left panel click the link to "ZyBooks Textbook". Subscribe and pay the fee ($58).

What will I learn?

You will learn a potpourri of topics from a wide spectrum of areas of mathematics. The primary *content* of this class consists of an introduction to the topics of mathematical logic, sets, relations, algorithms, counting, probability, graphs, and trees. In addition to this content, you will learn to **write proofs**, explaining you mathematical ideas clearly and concisely.

What is expected of me in this course?

I want you to be successful in this course. I will do my best to help you in this, by creating and maintaining a learning environment based on challenge and support. But, **I cannot do the heavy lifting for you.** To be successful in this course, you need to make sure you are doing the following:

- **Prepare for class** by completing the assigned readings (described below).
- **Attend** all meetings and **participate** actively in class activities.
- **Be proactive** in completing course work and avoid procrastination.
- **Maintain awareness of course announcements and calendar events** at all times, by checking email and the course calendar several times each day.
- **Take initiative to seek help** when you are stuck or have a question, using office visits, Blackboard Forum posts, study groups, or anything else that may work for you.

What will I do to learn?

Learning happens by **doing**, not just by listening. So to learn the concepts in this course, you'll be doing a variety of **active learning** tasks both in and outside of class.

- *Outside of class*, you'll work actively to get your first contact with new concepts through pre-class readings and practice activities. Then, following class meetings, you'll work on activities that ask you to go more in depth by engaging in **Challenge Problems**.
- *In class*, you'll be working with your peers to make sense of concepts and work on creative applications of those basics through group problem-solving sessions, presentations of solutions to the class, and discussions driven by interactive polling activities.

All of the work you do in class is designed to promote learning of the concepts in this course. Some of this work will be collected and graded, so it will directly contribute to your grade. That subset of work can be divided into three basic types: work on **basic skills**, work on **advanced skills**, and work focused on **staying engaged in the course**. Here are the details on those.

Basic skills: Learning Objectives and the Final Exam

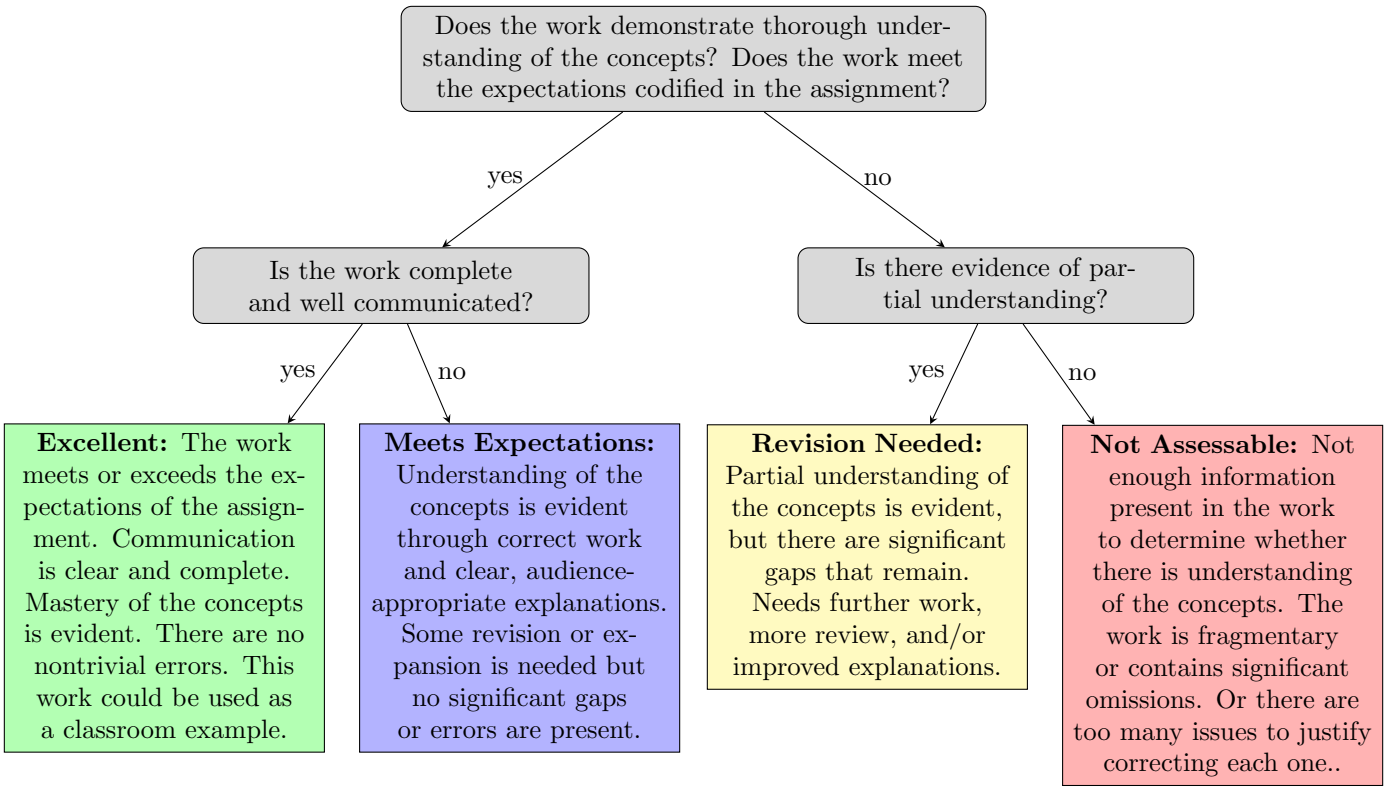
The basic skills you will learn in the course are given in a list of 22 **Learning Objectives**. The list is appended to the end of this syllabus and is also posted to Blackboard under the "Information" tab. During the course, you'll be expected to provide evidence that you can perform the tasks that are given in the Learning Objectives by completing **Learning Objective Assessments**. These are short quizzes, each of which addresses a single Learning Objective. For example the Learning Objective Assessment for Learning Objective L.4 ("I can determine if an integer, real, or rational valued function is one-to-one, onto, or bijective. I can give examples of functions satisfying combinations of these properties.") may consist of 3-4 questions that: assess your understanding of the definition of a function; ask you determine if given functions are 1-1 or onto; or invent a function satisfying specified properties. Learning Objective Assessments are graded either **Satisfactory** or **Unsatisfactory**. See the section below titled Revision Process for information on re-taking Learning Objective assessment that are marked Unsatisfactory.

What constitutes Satisfactory or Unsatisfactory work will be spelled out specifically for each Learning Objective and made known to you in advance. Your mastery of basic skills will also be assessed through a comprehensive final exam given during finals week. The final exam will consist of eight (8) randomly selected Learning Objective assessments that have already been given in the course. See the section "Grading System" below for details. The exam will take place on **Monday, December 14**; details to be announced at a later date.

Advanced Skills: Challenge Problems

Your ability to extend the basics is measured by completing **Challenge Problems**. Each problem is a take-home assignment that consists of: (possibly) reading an extra section from the text, then solving one or two problems. Challenge problems require not only correct solutions, but clear, correct, persuasive, and well-written solutions. See the "Challenge Problems" folder in Blackboard to learn about the expectations for submissions.

Each Challenge Problem is graded using the **EMRN rubric** that classifies the work with marks of **E** ("Excellent"), **M** ("Meets Expectations"), **R** ("Needs Revision"), or **N** ("Not Assessable"). The diagram below shows how these are assigned:



There will be 10-15 Challenge Problems posted during the semester. Each one will be posted in the "Challenge Problems" folder under the Content section of Blackboard. Here are some things to know about these:

1. **You do not have to do all of the challenge problems that are posted.** Instead, you will choose from among the ones posted and focus only on those that you think you would enjoy doing (or those that look easiest to you if you hate this class).
2. **There are no fixed deadlines for Challenge Problmes.** Instead, once you choose a topic, simply work on it at your own pace until you believe it is ready to be assessed, then turn it in (see "Revision Process" below for how to turn in your work).
3. **You can revise any submission of a Challenge Probem if you want to improve your work.** Your submissions will be given extensive verbal/written feedback to draw your attention to issues that can be corrected or improved, and you can resubmit work until you are satisfied with the results. See "Revision Process" for details.

Engagement Credits and Reading Activities

Engagement in the course means preparing well for class and participating productively both in and outside of class. The more engaged you are in the class, the better you will learn the material; conversely, students who disengage and try to complete the course from a distance generally have a hard time succeeding.

Your level of engagement in the course will be measured by earning **engagement credits**. An engagement credit may be awarded for such accomplishments as participating in a group activity in class, giving a particularly helpful comment in an online discussion in between classes, or even asking an insightful question in office hours. Some engagement credit opportunities may be announced in advance, but many will be unannounced, and you will need to be present during scheduled class time to earn them.

The primary means of earning engagement credits is through the assigned readings, and the associated "Reading Activities." These assignments provide you with a structured introduction to the basic ideas of new material so that we dont have to spend time in class doing lectures on this material. They provide readings and computer simulations that will help you acquire the new skills we will work with in class, along with exercises to build your basic skill fluency. The exercises are interspersed with text, and are completed online.

Reading Activities are graded **Satisfactory** or **Unsatisfactory**, and every "Satisfactory" grade earns one engagement credit. A Reading Activity is graded Satisfactory if it meets the following criteria:

1. The assignment is submitted before the deadline, which is usually the start of class. Submissions past this deadline will be automatically marked Unsatisfactory.
2. Every exercise has a response that shows a good-faith effort to be right. Submissions that have exercises left blank will be automatically marked Unsatisfactory.

Please note that correctness is not factored into the grade, so you should feel free to give your best effort on each one without fear of being counted off for wrong answers. In fact, misconceptions about the material are part of what these assignments are set up to collect so we can work on them.

Grading System

Your course grade is determined by the quality and quantity of the work that you submit in the class that is judged to be of an acceptable level of quality. There is a two-step process for determining your grade at the end of the semester:

1. Using your Learning Objective assessments and Challenge Problems to determine your "base grade", which is A, B, C, D, or F.
2. Using your engagement credits and final exam results, determine if your base grade should be modified.

Details on each step of the process are below.

Step 1: Determine the base grade by looking up your accomplishments in the following table:

To earn:	Accomplish the following:
A	Earn **Satistfactory** on **21** Learning Objectives; *and* complete **7 Challenge Problems** with at least an "M" mark, including at least 3 "E" marks.
B	Earn **Satistfactory** on **19** Learning Objectives; *and* complete **5 Challenge Problems** with at least an "M" mark, including at least 2 "E" marks.
C	Earn **Satistfactory** on **16** Learning Objectives; *and* complete **3 Challenge Problems** with at least an "M" mark.
D	Earn **Satistfactory** on **13** Learning Objectives. (No Challenge Problems required)

Please note that all requirements for a base grade must be met in order to earn that grade. The base grade earned is the lowest grade for which all requirements are met. For example, a student who completes 6 Challenge Problems with all "E" grades, but who earns Satisfactory ratings on only 16 Learning Objectives, will receive a base grade of "C". A grade of "F" is awarded if the requirements for a "D" are not met.

Step 2: Determine modifications to the base grade. The base grade can be raised or lowered by one letter as follows:

- Raise the base grade **one full letter** if you earn **at least 60** engagement credits, *and* **at least** 90% on the final exam.
- Lower the base grade **one full letter** if you earn **fewer than 35** engagement credits *or* earn **lower than** 50% on the final exam.

Note the "and" in the first item and the "or" in the second. Also, please note that due to potential changes in the schedule and calendar, the amounts of engagement credits above may change. To be safe, always strive to earn as many engagement credits as possible, and note that since around 35 engagement credits can be earned from pre-class Reading Activities, being consistent about completing these assignments is the simplest way to maintain or improve your base grade.

Revision process

At the heart of the learning process in MATH2603 is a system of submission and revision of your work that will allow you make improvements to your work based on instructor feedback. Most grades on work are not final; you will have the chance on almost every submitted item to revise and resubmit to improve its quality. First lets detail how to submit your work in the first place.

Submission of work

Submissions of **Reading Activities** are done within the zyBooks platform; the questions are interspersed with the text, and you will complete them as you read. Submission of **Learning Objective Assessments** are completed via Gradescope. These short quizzes will happen every other Friday; assignments will become available on Gradescope, you will complete the assignment by printing it out, or using a tablet, then scanning/uploading your work into Gradescope. These assessments are timed.

Challenge Problems are a little more involved. Each problem has the form of an assignment posted to the course Blackboard site in the "Challenge Problems" folder as an "Assignment." On Blackboard, there will be a file to download that contains instructions for the assignment and any grading criteria that pertain to it. Your work on the Challenge Problem is to be typed up, saved as a PDF document, and then uploaded to Blackboard. Once uploaded, feedback is left on the submission itself in the form of margin and text notes.

Revision

You can revise any Learning Objective assessment and any Challenge Problem as often as you need (with some restrictions; see below) **until you are satisfied with the results.** The process for doing these revisions is different for the two kinds of work.

Revising Learning Objective Assessments: Once you have attempted a Learning Objective Assessment, if the grade is Unsatisfactory, you can retake the Learning Objective assessment in one of two ways.

1. You can retake it during a designated assessment period in class (every other Friday of the semester is set aside for LOAs) by filling out an Assessment Request Form on the Blackboard site prior to the assessment period. A new version of the Learning Objective assessment will be written up and made available to you at that period.
2. Once per week, you can schedule a 15-minute session during office or appointment hours to retake up to two (2) Learning Objective assessments orally. Please note the restriction on both the time (15 minutes) and number of assessments (1 appointment per week, 2 assessments per appointment) that can be done orally. Appointment slots are available on a first-come first-served basis.

Revising Challenge Problems: Challenge Problem submissions can be revised and resubmitted by addressing the issues pointed out in the instructor feedback, then writing up a new draft and submitting to the same location on Blackboard as the original submission. The new work will be regraded and given feedback, and you may revise again if needed.

In all retake/revision situations, the highest grade attained so far will be the one recorded in Blackboard. The following restrictions apply to Challenge Problems:

- No more than **one Challenge Problem submission per week** may be made. This can be a new submission or a revision. A second submission may be made if a token is spent (see below). This restriction is in place to ensure that students dont procrastinate until the end of the course to work on these assignments.
- **A token (see below) must be spent to revise any submission of a Challenge Problem that is marked "N"** (Not Assessable). This is in place to ensure students do not submit incomplete or significantly flawed work just to get feedback.

Definition of a "week": For the purposes of this class, each "week" begins at 12:01am Central time on Monday and ends at 11:59pm Central time the following Sunday. There is one minute each week during which I will rest.

The following restrictions apply to Learning Objective assessments:

- Requests for in-class retakes of Learning Objective assessments must be made using the Assessment Request Form by the stated deadline in order to allow sufficient time to construct and copy the correct batch of assessments. Requests that come in after the deadline will be declined, and students who attempt an assessment without requesting it will be charged one token per assessment.
- The oral retake option is only for work that showed a good-faith and complete effort on paper initially but was rated Unsatisfactory. Assessment work that is incomplete or does not show sufficient effort may require a second attempt on paper before an oral retake is allowed. If this is the case, a note will be left on the paper assessment saying so. This is to prevent students from intentionally doing Unsatisfactory work in class because they want to do an oral exam instead.
- The oral retake option for Learning Objective assessments may be used no more than once per week per student and must be scheduled at least 24 hours in advance. Requests for oral retakes with less notice will be declined. Students who are late for appointments may be asked to reschedule at a later date, and repeated issues of not showing up on time for appointments may result in not being allowed to use oral retakes at all in the future.

There are two important dates for your work:

- No requests for oral retakes of Learning Objective assessments will be accepted after 5:00pm on Friday December 11. This means the last round of oral assessments will take place prior to the final exam.
- No further submissions of Challenge Problems (either a new submission or a revision) will be accepted after 11:59pm on Friday December 11.

Tokens

Tokens are a "currency" in the course that you can use to purchase exceptions to the course rules, especially the rules for revisions. Each student begins the course with five tokens, and tokens can purchase any of the following:

- One token buys a second Challenge Problem submission (new submission or revision) during a given week. Further tokens may not be spent to obtain fourth, fifth, etc. submissions.
- One token buys a second 15-minute oral retake appointment in a given week. Further tokens may not be spent to obtain third, fourth, etc. appointments, and all the above rules about scheduling still apply.
- Two tokens will buy one engagement credit.

Opportunities to earn more tokens may be made available during the semester.

Academic integrity

Academic integrity refers to the concept that **the work that you do for UArk courses should accurately reflect your own efforts and not come significantly from the work of another.** Academic integrity means that your work is "integrated" with your understanding and that you are using personal integrity when doing your work.

If you are encountering so much pressure or stress in your life that you are tempted to break one of these policies, **STOP AND GET HELP from me (the professor).** I am committed to helping you succeed in the course through your legitimate hard work, and I am available and willing to work with you. And **remember that most work in the course can be revised and resubmitted to improve your grade**, which means that academic dishonesty really isnt necessary to do well.

The University's Academic Integrity Policy may be found at `http://honesty.uark.edu`. Every student has the responsibility of reading and understanding these policies, especially the consequences for engaging in academically dishonest activities.

In MATH2603, we will adopt the following specific policies to ensure academic integrity in your work. It is each students responsibility to understand these policies and abide by them all semester.

- For work on Reading Activities, you may collaborate with others freely on the assignment but you must complete the assignment on your own, and you may not simply copy from another. Evidence that copying has taken place will be investigated as an academic integrity policy violation.
- For work on Learning Objective assessments, which are done either in class or in the office, and the final exam, no collaboration with another person (or tutor) may take place at all, and any evidence that this has taken place will be investigated as an academic integrity policy violation. You may consult the book, and your notes for LOAs.
- For work on Challenge Problems, you may collaborate with one or two other students at the level of sharing of ideas and strategies for solving the problem. But, you may not collaborate at any level with any other person on the final written solutions that you submit for evaluation. This means that once you have discussed a problem with a collaborator, you must write your final solution independently (and joint writeups are not allowed). Solutions to the same problem from different students, even collaborators, should include differences that reflect each students individual understanding and writing style. Excessive similarities in submitted solutions will be interpreted as evidence of inappropriate collaboration. Additionally, in your final solution, if you have collaborated in any way with one or two other students, you must disclose the names of those students and give a short description of what you collaborated on. Any evidence that collaboration has gone farther than the extent described above, or any evidence of collaboration with another student who was not disclosed in your writeup, will be investigated as an academic integrity policy violation.

For all work in the class, you may not look up solutions to any problems on the internet or in other resources without prior instructor permission. Any submitted solution that is substantially similar to one that appears on the internet will be considered evidence of academic dishonesty.

On any assignment that bears your name, if there is doubt that you were solely responsible for the final solution, you may be called upon to explain your reasoning on the entire solution to the professor in a one-on-one interview. In such cases, you are individually responsible for understanding and being able to explain the entire submitted solution without the assistance of others, even if collaboration on the assignment is allowed. If, following this interview, I determine that you have overstepped the boundary for collaboration because you cannot explain the work, it will be taken as a sign of academic dishonesty and will be reported.

Finally, please note that the minimum penalty for academic dishonesty is to receive an N or Unsatisfactory mark on the assignment with no opportunity for future revision, and a report is filed with the Mathematics Department head, the Dean of Students, and the Dean of the College of Sciences. More severe infractions of this policy, or if an infraction is not your first, could result in failure of the course or even suspension from the university.

Extra Help

Extra Help & Tutoring: There are many resources available to you for getting help in this course. I want each and every one of you to succeed. You have drill/recitation sections on Tuesdays and Thursday. Your drill instructor will have some office hours in addition to these recitations. You can come to my office during office hours or schedule an appointment with me if you want to discuss a homework problem (or any aspect of the course). The Mathematics Resource and Teaching Center (MRTC), located at CHPN 326, can provide help with homework and other questions. Each drill instructor will be in the MRTC for 2-3 hours per week, and you can get help from any drill instructor. A

list of all times when a Calc III drill instructor will be present at MRTC will be made available during the second week of class. Another option is the Center for learning and Student Success (CLASS+), which can provide free tutoring. Information is available at: `https://class.uark.edu/tutoring.php`.

Center for Multicultural and Diversity Education: If you are a member of the LGBT+ community, I want you to know that my classroom is a safe zone. Additionally, the University of Arkansas has resources on campus. They are located in Room 404 of the Union Building. You can visit their website to find more information about the support they can offer, a list of events through the center and links to additional resources: `https://multicultural.uark.edu/`. Please also let me know if there is any additional support you need in this class.

Veterans Center: If you are a student veteran, the University of Arkansas has a Veterans Support Center located in Suites 115-116 at 640 N. Garland Avenue. Please visit their website for more information about what support they offer, a list of ongoing events and links to outside resources: `https://veteranscenter.uark.edu/`. Please also let me know if you need any additional support in this class.

Addressing Sexual Misconduct: Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a civil rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veterans status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator at titleix@uark.edu, in person at room 405 of the administration building, or by phone at 479-575-7111. To report to the police, contact the University Police, 479-575-2222.

Students with Disabilities: The University of Arkansas seeks to provide equal access to its programs, services and activities for students with disabilities. If you have a documented disability and require accommodations, please contact me privately to make arrangements for necessary classroom adjustments. Please note, you must first verify your eligibility for these through the Center for Educational Access (contact (479)575-3104 or visit `https://cea.uark.edu` for more information on registration procedures).

Other Policies:

1. If you have circumstances which require flexibility, it is *your* responsibility to communicate with me as soon as possible. The longer you wait, the less willing I am to be accomodating.
2. I will not offer any extra credit at the end of the semester or any other means for you to improve your grade at that time.

Disclaimer: I reserve the right to alter these policies at any time as I see fit. If such changes are made, I will notify the class via email and post the updated syllabus to Blackboard.

Learning Objectives

Logic, Sets, Functions, Proofs

L.1 I can make a truth table for a compound proposition, determine the truth value of a compound proposition, and determine when two propositions are logically equivalent.

L.2 I can determine the truth of a proposition with quantifiers, or the equivalence of two such propositions. I can negate a quantified statement. I can give examples of true and false propositions with quantifiers.

L.3 I can determine relationships between elements and sets that have been defined using set notation (e.g., Is $x \in A$? Is $A \subseteq B$? Write all elements in the powerset of A.).

L.4 I can determine if an integer, real, or rational valued function is one-to-one, onto, or bijective. I can give examples of functions satisfying combinations of these properties.

L.5 I can set up a framework of assumptions and conclusions for proofs using direct proof, proof by contrapositive, and proof by contradiction.

Relations

R.1 I can give examples of relations on a set that have combinations of the properties of reflexivity, symmetry, antisymmetry, and transitivity.

R.2 I can determine when a set with a relation is a partially ordered set, or a totally ordered set. I can determine when a relation is an equivalence relation, and I can determine the equivalence class for an element and determine whether two elements belong to the same equivalence class.

Algorithms, Complexity, Induction & Recursion

I.1 I can determine the output of an algorithm written in pseudocode. I can compare the time complexity of two algorithms to determine which would be better suited to large inputs using "Big Oh" notation.

I.2 I can identify the predicate being used in a proof by mathematical induction and use it to set up a framework of assumptions and conclusions for an induction proof.

I.3 I can determine the output of a recursive algorithm for small input values, and use pattern recognition to determine the output in general. I can list elements contained in a recursively defined set, or give a recursive definition of an explicitly defined set.

I.4 I can solve a linear homogeneous recurrence relation to find an explicit formula for the n-th term in a sequence.

Counting & Probability

C.1 I can perform the extended Euclidean algorithm to determine the greatest common divisor of two numbers, and to write the gcd as a linear combination of these numbers.

C.2 I can count permutations, combinations, and subsets in a variety of scenarios, confidently using the sum and/or product rules as appropriate.

C.3 I can count permutations with repetitions, or the number of ways to distribute a set of n items between k people, using equivalence and the inclusion/exclusion principle appropriately. I can use the pigeonhole principle.

C.4 Given an experiment with a discrete sample space, and a probability distribution on said sample space, I can compute the probability of an event occurring. I can also determine the probability distribution on a sample space for basic examples.

C.5 I can compute conditional probabilities, and probabilities for unions, complements, or independent events.

C.6 I can give examples of random variables satisfying specified properties. I can compute the range, distribution, and expectation of a random variable.

Graphs & Trees

G.1 I can create a graph given information or rules about vertices and edges. I can give examples of graphs having combinations of various properties and examples of graphs of special ("named") types.

G.2 I can represent a graph in different ways and change representations from one to another. I can determine whether or not two graphs are isomorphic, and justify my conclusion.

G.3 I can construct a planar embedding of a (planar) graph. I can apply Euler's identity (or its corollaries) to make conclusions about the planarity of a graph.

G.4 I can determine whether a graph has an Euler trail (or circuit), or a Hamiltonian path (or cycle), and I can clearly explain my reasoning.

G.5 I can list the nodes of a tree in the correct order when visited using preorder and postorder traversals. I can create a spanning tree for a graph using BFS or DFS algorithms.