Math 205 / CS 205 – Foundations of Logic and Proof
Spring 2025 – Sections 1 and 2

Instructor
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Office: Eggleston 110
Office hours: 1-2pm MWF

Section 1
9-9:50am MWF
Birdsong 201

Section 2
10-10:50am MWF
Birdsong 201

What is this course? This course is an introduction to how to speak and write mathematics, to give you the necessary vocabulary, notation, and reasoning skills for later courses. You will learn to write simple proofs and use terminology related to the building blocks mathematics: statements, quantifiers, sets, relations, and functions.

Resources: There is no required textbook. Course notes will be posted on Blackboard.

What will this class be like? The best way to learn math is by doing math, so my goal is to get you doing math during class. Some time needs to be allocated to me explaining, but you will spend around half of your time in class working on solving problems with a partner. Every two weeks, you will be assigned a new partner, who you will work with on all in-class work for those two weeks.

Grades: This course uses a system called *mastery-based grading*, which means your final grade depends on how well you eventually understand each topic, not how well you understand it by the first quiz. Rather than earning points on various assignments which are averaged to get a percentage, your grade primarily depends on how many skills from the course you eventually master. There are two components of the grade:

1. Class preparation assignments
2. Skill masteries

Class preparation assignments: These are short assignments due every class period. To get credit for a class preparation assignment, it must

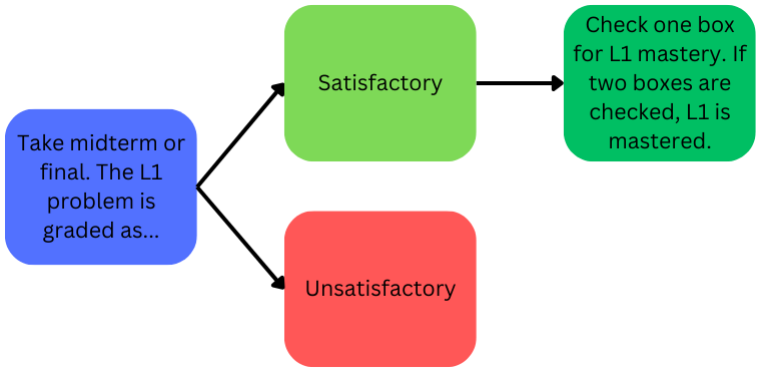
- Be turned in at the start of class
- By a student who is present for the majority of the class period, and
- Exhibit a good-faith attempt to complete all problems.

Any class prep assignment meeting these criteria will receive full credit. It will not be credited if turned in on a later date, submitted on behalf of an absent student, or includes un-attempted problems. Emailing me to tell me that you will miss class (for any reason) will <u>not</u> change this. Please do not email me just to tell me you will miss class, for any reason, unless it is an exam. The best way to keep up when you miss class is to read the day's notes and attempt the problems on that day's handout.

There are ~~41~~ 39 days of class and ~~38~~ 36 class prep assignments (each day except the first day, midterm, and last day). It is possible to miss up to ~~5~~ 10 class prep assignments and still get an A.

Skill masteries: Course content is divided into ~~24~~ 23 skills (see pages 4-5). The main factor in your final grade is how many of these skills you master over the course of the semester. To master a skill, you need to earn a "satisfactory" grade on an assessment related to that skill two times. You have multiple chances to do this for each skill:

- Midterm exam and final exam – Each exam problem will be labelled with a specific skill. Each problem is graded S (satisfactory) or N (not satisfactory). An S grade on a problem completes one partial mastery towards the associated skill.

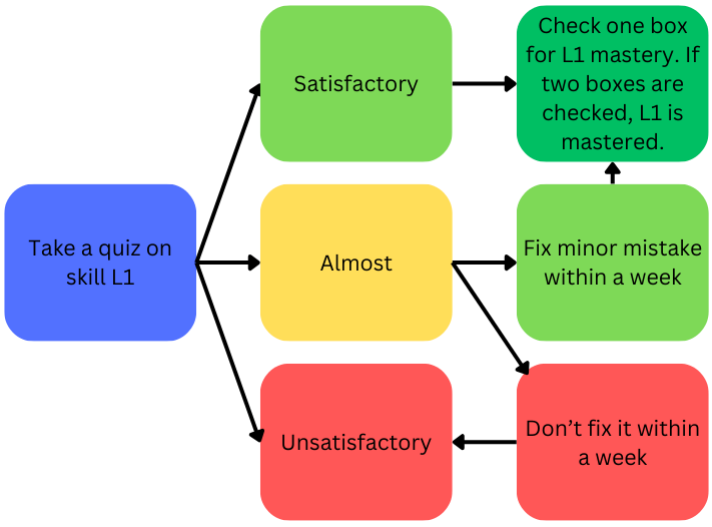


- Skill checks – part of Friday classes are reserved for skill checks/quizzes. The schedule (pages 6-7) lists which skills are checked on which days. You will have around 30 minutes to take skill checks. A skill check has three possible grades:

  (S) Satisfactory, one partial mastery in this skill

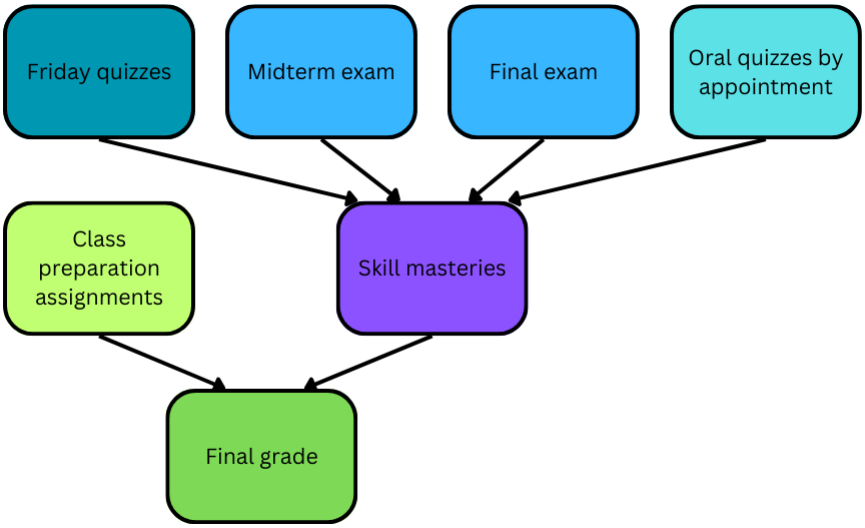
  (A) Almost, would be satisfactory except for a minor error. If you submit a corrected version within one week, upgrades to S. Otherwise, downgrades to N.

  (N) Not satisfactory, not sufficient for a partial mastery



- Office hour appointments – you can make an appointment to meet in my office for a 10 minute oral assessment of a skill. Oral assessments will be graded S/N. These are not available on a walk-in basis, you need to give at least 24 hours notice, and availability is subject to my schedule. Maximum once per week per student. Minimum two weeks between an oral assessment and any other assessment on the same skill, with exceptions at my discretion.

Final grades: Your final course grade is determined by completed skill masteries and completed class preparation assignments.



To calculate your final grade, find the highest grade in the table below that you have completed both requirements for. For example, suppose you have 19 skill masteries and 23 completed class prep assignments. You have met the requirements for a B+ in class prep assignments, but not in skill masteries, so your final grade is a B. If you complete one more skill mastery, your grade will improve to a B+.

Grade	F	D−	D	D+	C−	C	C+	B−	B	B+	A−	A
Required masteries	0	11	12	13	14	15	16	17	18	19	20	21
Required class preps	0	14	15	16	17	18	19	20	21	22	23	24

You can keep track of your class prep assignment completion and skill masteries here.

January	February	March	April	May
☐☐	☐☐☐☐	☐☐☐	☐☐☐☐	☐☐☐
	☐☐☐☐	☐☐☐	☐☐☐☐	
	☐☐☐☐	☐☐☐	☐☐☐☐	

☐ L1	☐ L7	☐ S1	☐ R1
☐ L2	☐ L8	☐ S2	☐ R2
☐ L3	☐ L9	☐ S3	☐ R3
☐ L4	☐ L10	☐ S4	☐ R4
☐ L5	☐ L11	☐ S5	☐ R5
☐ L6		☐ S6	☐ R6
			~~☐ R7~~

Disability accommodations: Please talk to me if you have an accommodations letter so that we can discuss your specific needs. If you do not have an official letter, contact the Executive Director of Academic Support Services, Crit Muniz at (757) 233-8898 or in his office in Clark 204 or at disability-services@vwu.edu.

List of skills

Below is a list of the ~~24~~ 23 skills you need to master to succeed in this class. I suggest tracking your progress throughout the semester by filling a box next to each skill as you complete a partial mastery.

Logic and proof techniques

☐☐ L1. I can explain the meaning of mathematical statements involving and, or, and not. I can use and read mathematical shorthand notation for and, or, and not. I can prove statements involving and, or, and not.

☐☐ L2. I can read, understand, and create truth tables.

☐☐ L3. I can prove implication statements. I can explain how an implication statement can be true even if the conclusion is false. I can explain the difference between a proof and an example.

☐☐ L4. I can prove statements using direct methods such as algebraic manipulation of equations and inequalities, or case analysis.

☐☐ L5. I can negate implication statements, and I can disprove an implication by proving the negated statement. I understand when and how to use a counterexample to disprove an implication.

☐☐ L6. I can take the converse or contrapositive of an implication. I understand the relationship between the truth values of an implication, its converse, and its contrapositive.

☐☐ L7. I can use and understand terminology like "if," "only if", "necessary," and "sufficient" to describe aspects of double implications, and I can prove double implication statements.

☐☐ L8. I can use and understand quantifiers ("for all" and "there exist") and prove quantified statements, including statements involving nested quantifiers.

☐☐ L9. I can negate nested quantified statements, and I can disprove a nested quantified statement by proving its negation.

☐☐ L10. I can prove statements using proof by contradiction.

☐☐ L11. I can prove statements using induction.

Sets

☐☐ S1. I can use and read set-builder notation (in both of its two main forms). I can translate between descriptions of sets using set-builder notation, listing elements, and verbal descriptions.

☐☐ S2. I can determine and describe unions and intersections of sets, and prove statements about unions and intersections of sets. I can identify and describe partitions of sets.

☐☐ S3. I can determine and describe set subtraction/set complements, and prove statements about set subtraction/ set complements.

☐☐ S4. I can prove a set is a subset of another set.

☐☐ S5. I can prove that two sets are equal by proving that each is a subset of the other.

☐☐ S6. I can use and understand tuple notation to describe Cartesian products of sets.

Relations and functions

☐☐ R1. I can use and understand both tuple notation and $\sim$ notation for relations, and translate between them. I can describe and reason about various properties of relations such as reflexivity, symmetry, antisymmetry, transitivity, and completeness.

☐☐ R2. I can describe the conditions on a relation that make it a partial or total order. I can prove that a relation is a partial or total order.

☐☐ R3. I can identify when a relation is or is not an equivalence relation, and I can prove that a relation is an equivalence relation. I can articulate the connection between equivalence relations and partitions.

☐☐ R4. I can explain what a function is in terms of relations, and I can identify when a relation is a function. I can use terms like domain, codomain, and range to talk about functions. I can explain when two functions are the same or not.

☐☐ R5. I can identify when a function is one-to-one, and prove that a function is one-to-one or not.

☐☐ R6. I can identify when a function is onto, and prove that a function is onto or not.

☐☐ R7. ~~I can identify when a function is invertible, and prove a function is invertible or not.~~

Key dates

March 14	Midterm exam
March 17-21	Spring break
April 21	Easter Monday, no class
May 7	Last day of class
May 10	Final exam (11:30am-2pm, 10am section, section 2)
May 12	Final exam (8-10:30am, 9am section, section 1)

Schedule

Day	Skills covered	Skills assessed
Week 1		
January 27	Syllabus and course overview	
January 29	L1 And, or, and not	
January 31	L2 Truth tables	L1
Week 2		
February 3	L3 Implications	
February 5	L4 Direct proof	
February 7	L5 Negating implications	L2, L3, L4
Week 3		
February 10	L6 Converses and contrapositives	
February 12	L10 Proof by contradiction	
February 14	L10 Proof by contradiction	L5, L6
Week 4		
February 17	L7 Double implications	
February 19	*Class cancelled due to weather*	
February 21	*Class cancelled due to weather*	
Week 5		
February 24	L7/L8 Double implications/quantifiers	
February 26	L8 Quantifiers	
February 28	L9 Nested quantifiers	L7, L10
Week 6		
March 3	S1 Set notation	
March 5	S1 Set notation	
March 7	S2 Unions and intersections	L8, L9
Week 7		
March 10	S3 Set complements	
March 12	Review	
March 14	Midterm exam	L1-10, S1-3
Spring Break		
March 17-21		

Day	Skills covered	Skills assessed
Week 8		
March 24	S4 Subsets	
March 26	S4 Subsets	
March 28	S5 Set equality	S1, S2, S3
Week 9		
March 31	S6 Products of sets	
April 2	R1 Relations	
April 4	R1 Relations	S4, S5
Week 10		
April 7	R2 Order relations	
April 9	R2 Order relations	
April 11	R3 Equivalence relations	S6, R1
Week 11		
April 14	R3 Equivalence relations	
April 16	R4 Functions	
April 18	R4 Functions	R2, R3
Week 12		
April 21	*Easter Monday, no class*	
April 23	R5 One-to-one functions	
April 25	**Skill checks by request**	R4, R5, ?
Week 13		
April 28	R6 Onto functions	
April 30	L11 Proof by induction	
May 2	**Skill checks by request**	R6, R7, ?
Week 14		
May 5	L11 Proof by induction	
May 7	Review	L11
Exam week		
May 10	11:30am Final exam (Section 2)	
May 12	8am Final exam (Section 1)	