Cornell University

Generative-AI-resistant assessment in an intro-to-analysis course

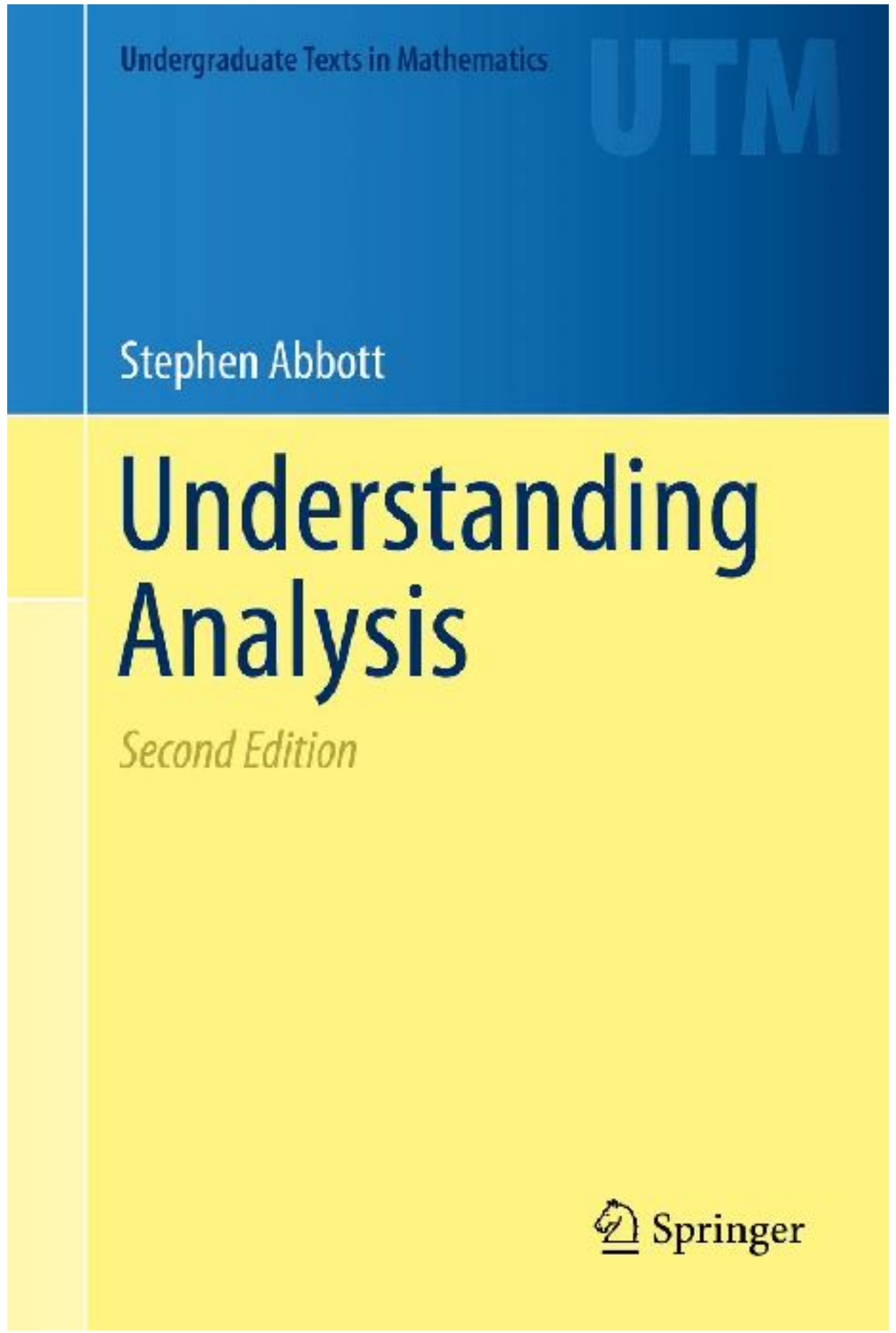
OLSUME
Online Seminar On Undergraduate Mathematics Education

Timothy Riley – February 2026

1 Instructor, 2 TAs, 80 students

Learning goals:

- Content
- Problem solving
- Mathematical literacy



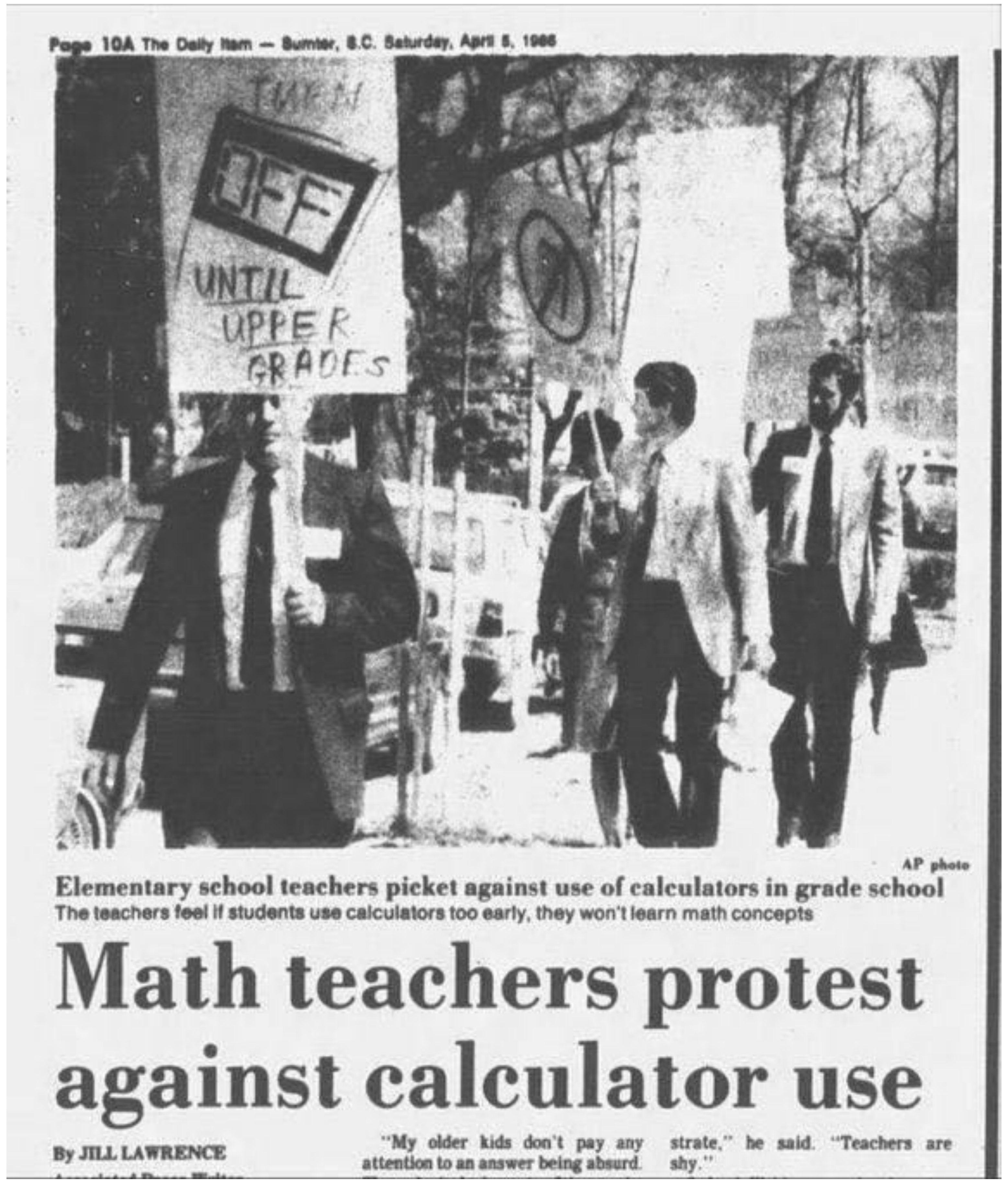
Why not let students use gen-AI?

"Studying mathematics transforms our minds. Our mental skills develop through slow, step-by-step processes that become ingrained into our neural circuitry and facilitate rapid reflexive responses drawing little conscious effort or attention." *Bill Thurston, Foreword to the 2010 Best Writing on Mathematics*

Why not let students use gen-AI?

Why not let students use gen-AI?

X	0	1	2	3	4	5	6	7	8	9	10	11	12
0	0	0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10	11	12
2	0	2	4	6	8	10	12	14	16	18	20	22	24
3	0	3	6	9	12	15	18	21	24	27	30	33	36
4	0	4	8	12	16	20	24	28	32	36	40	44	48
5	0	5	10	15	20	25	30	35	40	45	50	55	60
6	0	6	12	18	24	30	36	42	48	54	60	66	72
7	0	7	14	21	28	35	42	49	56	63	70	77	84
8	0	8	16	24	32	40	48	56	64	72	80	88	96
9	0	9	18	27	36	45	54	63	72	81	90	99	108
10	0	10	20	30	40	50	60	70	80	90	100	110	120
11	0	11	22	33	44	55	66	77	88	99	110	121	132
12	0	12	24	36	48	60	72	84	96	108	120	132	144



Page 10A The Daily Item — Sumter, S.C. Saturday, April 5, 1986

AP photo

Elementary school teachers picket against use of calculators in grade school
The teachers feel if students use calculators too early, they won't learn math concepts

Math teachers protest against calculator use

By JILL LAWRENCE

"My older kids don't pay any attention to an answer being absurd.

strate," he said. "Teachers are shy."

The Item, Sumter, South Carolina, April 5, 1986

Assessment

1. Homework as a learning tool
2. Cycles of quizzes

Homework

- Weekly
- A vehicle for learning content and developing skills
- Designed for student buy-in
- Graded for **good-faith-effort**

What is good-faith-effort?

- An authentic account
- Work you have taken pride in
- Clear and coherent writing
- Responsive to feedback
- Not a scattershot of ideas
- Not second-hand from AI, classmates, etc.

Math 3110, Fall 2025

Homework 1

Due by 8pm Wednesday, September 3

Please show your work and explain your reasoning. Your answers should be neatly presented, logically organized, and clearly written. Reference any theorems you appeal to. Follow the advice in the linked handout: Francis Su's *Guidelines for good mathematical writing*.

"Abbott" refers to *Understanding Analysis*, Second Edition. Question numbering differs in the first edition.

Gradescope will ask you to identify your answers question-by-question after you upload your pdf. Please do that carefully. We recommend starting each question on a new page.[1]

0. (*Not for credit.*) Please write a statement attesting that you have read the section of the syllabus titled "Academic integrity and the importance of authentic effort" and will abide by it. (*If it raises any questions, please ask them on the course Ed Discussion forum.*)

   Please acknowledge all the people you have collaborated with on this homework.[2]

1. You are invited to introduce yourself. The page on Assessment on the MATH 3110 Canvas site lists some learning goals for the course. What are your personal learning goals? What would you like the teaching team to know about you? *Please do not feel obliged, but if you would like to include a photograph of yourself with your answer, that would help us learn who you are.*

2. Abbott Exercise 1.2.7

[1] Some students who write their homework on tablets upload it as a very long and thin single page. Please do not do this! It makes your answers hard to find in Gradescope and the TAs might get justifiably grumpy.

[2] Provided you steer clear of the academic integrity issues you just read about, there's no penalty for working others, but it's good practice to acknowledge collaborators. Remember to attempt problems yourself before discussing them with others, and always write up your work in your own words.

3. Example 1.3.7 in Abbott is the result that if $A \subseteq \mathbf{R}$ is non-empty and bounded above, and $c \in \mathbf{R}$, then the set $c + A$ defined by
$$c + A \;=\; \{c + a : a \in A\}$$
satisfies $\sup(c + A) = c + \sup A$.

   (a) Write out in your own words the proof that Abbott gives of this result. Include details of how the definition of supremum is used and where each hypothesis is employed.

   (b) Is it also necessarily the case that
$$c - A \;=\; \{c - a : a \in A\}$$
   satisfies $\sup(c - A) = c - \sup A$?

4. Abbott Exercise 1.2.8

5. Find the supremum and the infimum, if they exist, of

   (a) $A = \{m/(1 + m) \mid m \in \mathbf{N}\}$,

   (b) $B = \{x - y \mid x, y \in \mathbf{R}$ and $|x| + |y| < 1\}$,

   (c) $C = \{2 + 2x - x^2 \mid x \in \mathbf{R}\}$.

6. **Preview question**[3]

   (a) By synthesizing Definitions 1.5.1, 1.5.2 and 1.5.5 in Abbott, state what it means for a set to be *countable*.

   (b) Is the set $\{3, 4, 5, 6, \ldots\}$ countable? Explain.

   (c) What are you curious about concerning the concept of countability?

[3] Preview questions are designed to give you a first sight of a concept that will be discussed in an upcoming class. The idea is that if you have internalized a central concept ahead of time, you will be better equipped and motivated to understand and participate in the class. Preview questions will also help you learn to navigate the textbook for yourself.

1. **Review question**

Question 3(a) on Homework 2 stated that a set $I \subseteq \mathbf{R}$ is called an **interval** when for all triples of real numbers x, y, and z such that $x < z < y$, if $x \in I$ and $y \in I$ then $z \in I$. You were then asked to prove that every interval takes exactly one of the following nine forms:

$$(-\infty, a),\ (-\infty, a],\ (a, b),\ (a, b],\ [a, b),\ [a, b],\ (a, \infty),\ [a, \infty),\ \text{or } (-\infty, \infty).$$

This is a good question on which to hone your proof-writing skills. I've asked the TAs not to distribute model solutions for this question. I've asked them instead to discuss what a well-constructed proof could look like and answer all your questions about it in Discussion Sections on 12 September. (So ask them probing questions and keep asking until all is clear!)

Based on their advice, re-write your proof in a way that is as clear and well-organized as possible.

6. **Preview question**[3]

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[3]Preview questions are designed to give you a first sight of a concept that will be discussed in an upcoming class. The idea is that if you have internalized a central concept ahead of time, you will be better equipped and motivated to understand and participate in the class.

1. **Review question.** This point of the semester is a good time to reflect on your progress at writing proofs. Look over the TAs' model answers for Homework 5 and compare them to your answers.

   Read this handout by Dana Ernst: Elements of Style for Proofs. Ernst lists twenty-three points. Pick two you are doing well at. Identify another two that are areas where you can most improve. Briefly explain your choices.

Exams?


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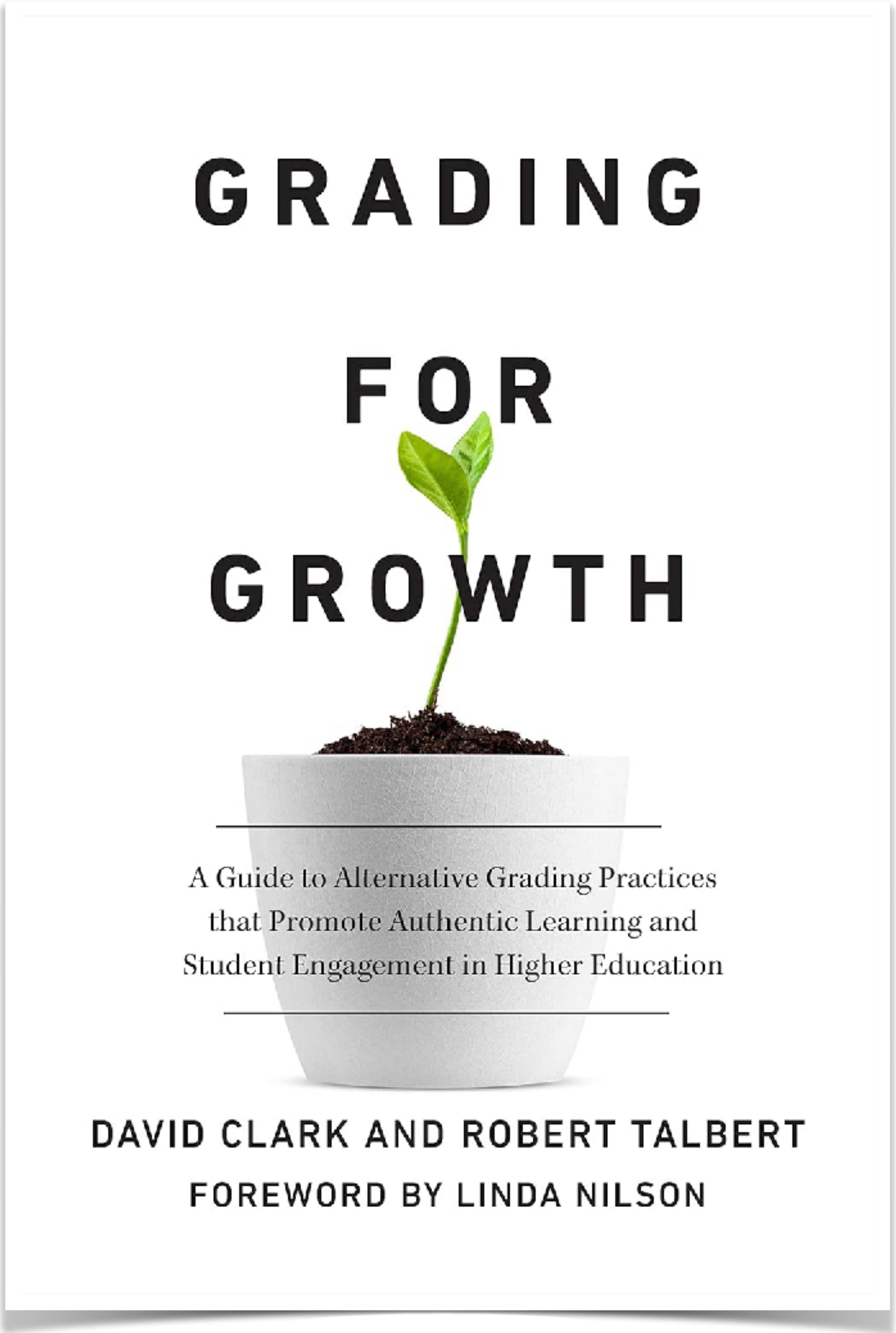

GRADING
FOR
GROWTH
A Guide to Alternative Grading Practices
that Promote Authentic Learning and
Student Engagement in Higher Education
DAVID CLARK AND ROBERT TALBERT
FOREWORD BY LINDA NILSON

Cycles of quizzes

Seven chapters

Three 25-minute quizzes on each

Only highest score on each chapter counts

- Some in class time
- Some in scheduled midterm / final times

Formative rather than summative

MATH 3110, Quiz 1.1 Name: ______________

Fall 2025 NetID: ______________

Electronics, notes, and books may not be used. Answer all the questions on both sides of this paper. Write your answers in the spaces provided. You have **25 minutes** to complete this quiz.

Question 1. Sort the following twelve sets into groups according to which have the same cardinality. (*You do not need to justify your answer.*)

$\emptyset$	$\{0, 1, 2, 3\}$	$\{3, 5, 7, 11\}$	the interval $(0, 1)$
$P(\mathbf{Z})$	$P(\mathbf{Q})$	the interval $[0, 1)$	$P(P(\mathbf{Z}))$
$\mathbf{Z}$	$\mathbf{Q}$	$\mathbf{R}$	$\mathbf{R} \setminus \mathbf{Z}$

Question 2.

a. State the definition of *supremum*.

b. State the Axiom of Completeness.

c. Suppose $I_n = [p_n, q_n] \subset \mathbf{R}$ are intervals with $I_1 \supseteq I_2 \supseteq I_3 \supseteq \cdots$ and $p_n < q_n$ for all $n \in \mathbf{N}$. Explain why $x = \sup\{p_1, p_2, \ldots\}$ exists and is an element of $\bigcap_{n=1}^{\infty} I_n$.

Question 3. True or false?

a. If A and B are non-empty bounded sets, then necessarily $\sup(A \cup B) = \max\{\sup A, \sup B\}$.

True: ☐ False: ☐

b. If A and B are non-empty bounded sets and $A \cap B \neq \emptyset$, then necessarily $\sup(A \cap B) = \min\{\sup A, \sup B\}$.

True: ☐ False: ☐

c. If $a < b$ are real numbers, then there necessarily are $p \in \mathbf{Z}$ and $m \in \mathbf{N}$ such that $a < \frac{p}{3^m} < b$.

True: ☐ False: ☐

d. If A is a non-empty subset of $\mathbf{R}$ and is bounded below, then its infimum is the supremum of the set of lower bounds for A.

True: ☐ False: ☐

e. If a subset A of $\mathbf{R}$ is uncountable, then the set of irrational numbers in A must be uncountable.

True: ☐ False: ☐

f. Every one-to-one function $\mathbf{N} \to \mathbf{N}$ is onto.

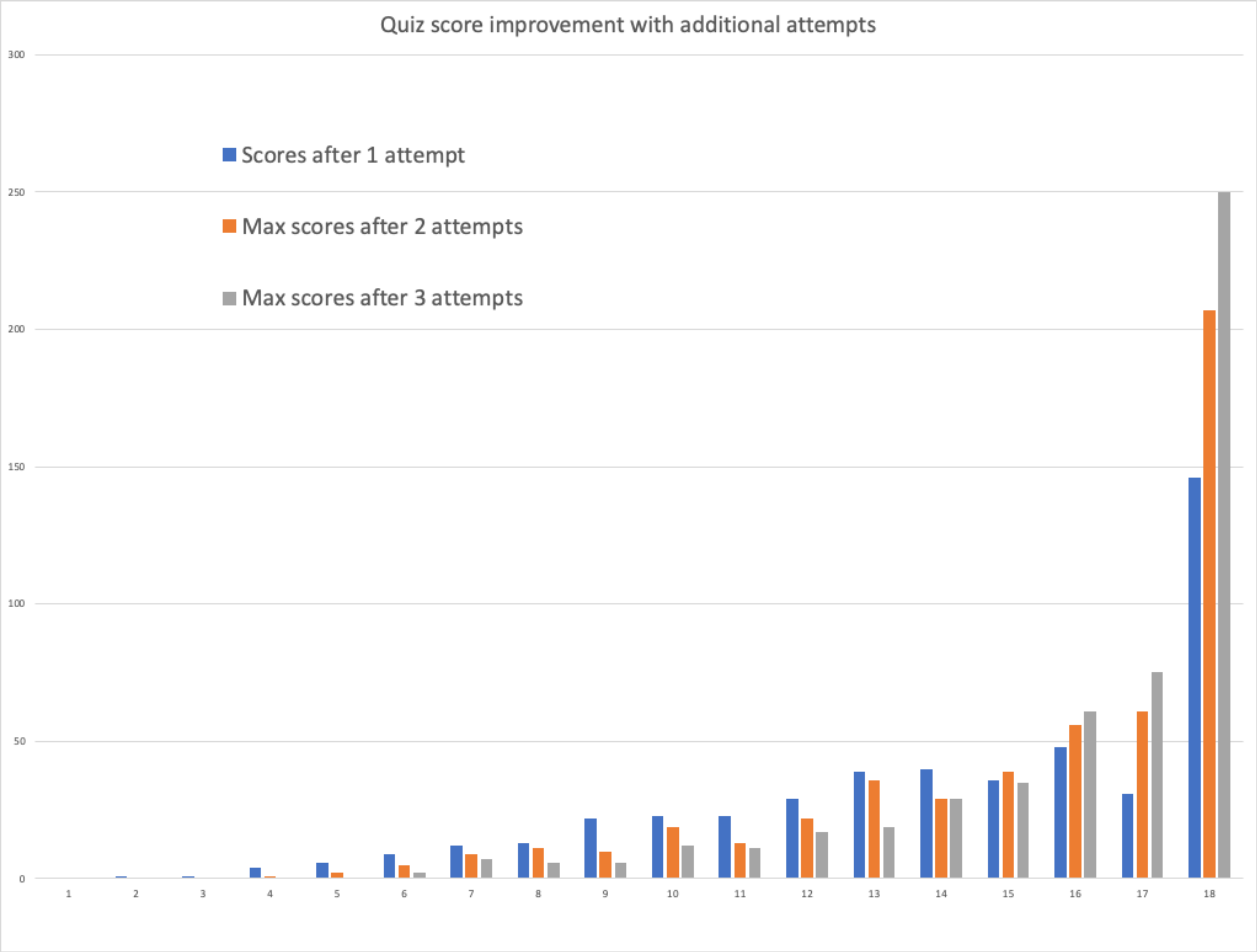
True: ☐ False: ☐

Question 4. Let $X = \{1 + x + x^2 + \cdots + x^n : n \in \mathbf{N} \text{ and } 0 \leq x < 1/5\}$. *You are not required to justify your answers:*

What is $\inf X$? *Answer:* ☐ Is it the minimum of X? Yes: ☐ No: ☐

What is $\sup X$? *Answer:* ☐ Is it the maximum of X? Yes: ☐ No: ☐

You will guarantee yourself a grade of…	… by having both of the following:	
	Quizzes	**Homework**
at least A-	Scores of at least 16/20 on five out of seven. Scores of at least 11/20 on two others.	Good faith effort on 95% of homework questions
at least B-	Scores of at least 16/20 on three out of seven. Scores of at least 11/20 on three others.	Good faith effort on 80% of homework questions
at least C-	Scores of at least 11/20 on six out of seven.	Good faith effort on 70% of homework questions
at least D-	Scores of at least 11/20 on four out of seven.	Good faith effort on 60% of homework questions



Quiz score improvement with additional attempts
Scores after 1 attempt
Max scores after 2 attempts
Max scores after 3 attempts
300
250
200
150
100
50
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18

Student stress

Grading burden

Quiz-writing burden

Homework-writing burden

Content coverage

Academic integrity

Accommodations

TA experience

Recitation sections & Office Hours

Alignment

Calibration of grades

Are these approaches widely applicable?

- Context (e.g. scale, content, learning goals, ...)
- Practicalities (rooms, resources, scheduling, rules on accommodations, coordination teaching teams, ...)
- Personality

Other approaches

- Student presentations
- Oral exams
- Exam rewrites
- Exam rewrites in groups
- Standards-based exams with greater granularity

Thank you