Teaching Statement
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I embrace teaching as an opportunity to inspire students to grow intellectually, cultivate curiosity, and take responsibility for their learning. A good teacher develops opportunities for students to explore the subject and their abilities.

I have always maintained high standards in teaching at all the institutions where I have taught. This has been challenging, especially when many of the students are not motivated to learn math and have weak backgrounds. But the most challenging part is that there are always some bright and motivated ones also mixed in the same class with weak students. However, my teaching philosophy that all the students maximize their learning at their own level enables me to adjust myself to the situation.

I have had extensive teaching experience with students of varying backgrounds – engineering, liberal arts students, and pre-service or in-service teachers – at different levels – from the Calculus sequence, undergraduate seminar courses, various upper undergraduate courses to graduate level Algebra – at the University of West Georgia (UWG), University of Central Florida (UCF), and the University of Illinois at Urbana-Champaign (UIUC). I have also engaged in improving undergraduate abstract reasoning and communication through development of an introductory proof course and a seminar class at UWG. I am eager to teach, transform and create courses on a variety of topics, covering the full spectrum of undergraduate mathematics. Even beyond my research interests of Combinatorics, Number Theory, and Geometry, I have worked on expanding my teaching expertise by passing the Financial Mathematics exam of the Society of Actuaries. I am also confident in teaching Actuarial Probability, yet plan to take Probability exam in the near future to better engage with students interested in actuarial studies.

As part of my effort to improve STEM education at UWG, I have participated as a co-PI in a campus-wide grant, awarded $134,444 for 2016–2019 from the state of Georgia. This will be a multi-faceted plan that seeks to develop year-long STEM cohorts where incoming freshman STEM majors take courses together, use a variety of interventions to improve performance in core mathematics courses, support science and mathematics faculty using evidence-based pedagogy in their classes, implement an undergraduate research and mentoring program to improve student engagement in their chosen STEM field, and implement a tutoring program for students preparing for a career as K-12 STEM teachers. Moreover, as a female faculty member, encouraging and retaining women students in mathematics and in sciences is an important issue to me and something I have worked on throughout my career.

Teaching Practice

In my opinion, the two crucial aspects of learning in mathematics are understanding concepts and developing problem-solving skills. These two aspects go hand in hand. A learning only based on an ability to solve problems without understanding the underlying concepts does not last long. Learning concepts without knowledge of their applicability and relation to other concepts, is also no better, as ultimately the ability of a student to apply what they have learned to new situations determines the success of the teaching process.

As a first step, I always explain how and why the concepts and theorems are developed in the way they are. And then, I explain the detailed steps and math skills (that they are supposed to have prepared but not always in reality), which is critical to enable many students to solve problems at hand. Explaining all the connections and detailed steps takes up a lot of class time.
My unwillingness to skip essential topics leads to even more time constraints. To accommodate all these needs, it is essential to organize the materials to be efficient. I carefully organize examples through which they can solidify their weak background enough to understand the new topics. For instance, to the questions of differentiating $\sqrt{x}$, $\frac{1}{x}$ or $\frac{x^2+1}{x}$ in Calculus I, many students give answers like $\sqrt{1}$ or $\frac{1}{\sqrt{x}}$ or $\frac{2x}{x^2}$. It happens not because they don’t memorize the power rule or the quotient rule (in fact, everybody memorizes the power rule!) but because of their poor algebra skills that they cannot identify the format of the functions properly. I do examples of differentiating, roughly, in the order $x^2, x^{-2}, x^\frac{1}{2}, \sqrt{x}, x\sqrt{x}, \frac{1}{x^2}, \frac{1}{\sqrt{x}}, \frac{1}{x+\sqrt{x}}, \ldots$, in which functions evolve slowly from a very basic function to more “uncomfortable” functions. Then they realize the power rule is applicable only when $x^n$ exists as a single term up to a constant, not as a part of square roots or fractions. Then they naturally realize the differentiation $\frac{d}{dx} \left( \frac{x^2+1}{x} \right) = \frac{2x}{x^2}$ is wrong by themselves, and easily acknowledge the quotient rule. I persistently try to improve their basic math background during the whole semester, and by the time we reach the material on integrals in which algebra skills are crucial, I can confidently say that, most of the students in my calculus I class comfortably perform the necessary algebra and are able to apply the integration formulae. To teach $\epsilon - \delta$ argument — probably the most challenging topic in Calculus I, I have adapted the $\epsilon - \delta$ game and developed course materials: I give several numerical values corresponding to $\epsilon$ and they find appropriate values corresponding to $\delta$. Then the examples are gradually developed into the abstract $\epsilon - \delta$ argument. (The relevant handout is attached.)

In an upper level undergraduate course like Number Theory, students need an insight to understand the structure and logic. Though I point out the key ideas and steps in proofs, when they encounter very abstract and nonintuitive theorems, they tend to be restless. Then I split the statements into several intermediate statements with concrete examples that are easy to understand, and explain the idea of how all those merge together. For instance, the theorem “If $n \in \mathbb{N} > 0$ and $p$ is a prime, then the exact power of $p$ that divides $n!$ is $\sum_{k=1}^{\infty} \left[ \frac{n}{p^k} \right]$ where $\left[ \cdot \right]$ is the greatest integer function.” is not at all intuitive. I start with a concrete example, say $n = 13, p = 2$, and discuss the combinatorial meaning of the greatest integer function $\left[ \frac{k}{2} \right]$, convey the combinatorial idea of counting in two ways by the story that, after drawing towers of 2s with height that is the number of the factors of 2 over all the multiples of 2 from 1 to 13, we ring a bell whenever we come across the multiples of $p = 2$ while passing through 1, 2, $\ldots$, 13 in two different ways – one in horizontal walk and the other in vertical walk along the towers, and then count the number of times that the bell rings. After this step by step approach, students start to understand the strategy of the proof and they can generalize the argument to general $n$ and $p$.

I always organize and show “common mistakes” to them so that the same mistakes do not occur again. Also, I find colors and pictorial images very effective for students to understand necessary math rules correctly. Different color markers for different parts mixed in one formula or in one method helps students see through each part in them. The picture and terminologies $\frac{x^{2}+1}{x}$ “blooming flowers upward” and $\frac{x}{x^{2}+1}$ “dying flowers downward” make them remember the legitimacy of $\frac{x^{2}+1}{x} = \frac{x^{2}}{x} + \frac{1}{x}$ and the illegitimacy of $\frac{x}{x^{2}+1} = \frac{x^{2}}{x^{2}} + \frac{x}{x^{2}}$.

Innovation in Teaching

I have tried and will keep trying different methods to ensure students’ learning depending on the level of the course. I (or a TA sometimes) have led some portion of the classes as small group interactive workshop for Calculus courses; the students discussed homework in groups while I helped them with hints. These students find this format less intimidating. With weaker students, this setting of group workshop is not always very effective. However, I did not want to give up the benefit the students could experience from interactive learning. I have found it’s doable during
review sessions held before exams – students’ best interests, as we teachers like it or not; providing a past exam and soliciting volunteers to work out problems on the board in front. They tend to be shy and reluctant in the beginning, but with some encouragement and guidance, more and more students come forward, and it eventually leads to my classes being more lively and engaged as the semester goes on.

In UWG’s sophomore seminar class, I assigned every student two projects: one was to do research by themselves on general mathematics, such as history of math, job market in math, or topics in mathematics; the other was to give detailed solutions to challenging math-competition-type problems. In both cases, they gave presentations on their results. In the course ‘Transition to Advanced Mathematics’ (an introductory proof course) where students experience logical proofs for the first time and are often frustrated and lost, once I show a couple of examples, I give them “exercise time” for about 5-10 minutes with a very similar problem that they can mimic the proof that I’ve just done. They volunteer to show their proofs on the blackboard afterwards. Since the purpose of this kind of course is to learn “what is a proof” and “how to write a proof” rather than being exposed to a lot of new topics, I believe this method improves the involvement of the students in the class and helps them not be lost in one-way lectures from instructor to students.

With motivated students in the upper level undergraduate courses, I give them options to study some chapters in “Proofs from the Book” related to the subject and to present their learning to substitute for their HWs or tests.

Regarding technology innovations in the upper level undergraduate courses, I have actively used email and run course webpages throughout my teaching career as means to connect to the students outside of the classrooms. I also used 3-D images online or videos as supplements to stimulate or attract students attention to the extent that in-depth knowledge and higher thinking skills – the essence in learning math – would not be at risk. When appropriate, I encourage students to experiment with computational software like Wolfram Alpha or Maple, to explore and visualize certain concepts in Calculus. I emphasize that these are useful tools but not substitutes for conceptual understanding and ability.

All this has been well appreciated, as often mentioned in evaluations – “well-prepared and organized”, “knowledgeable”. What made me happy the most are “she wants us to learn math in breadth and depth but her methods help me make it through”, “learned a lot”, “got a good foundation for further math courses” as these are my main goals in teaching.

Communication

In order to lead a successful class, it is critical to have good communication with the students inside and outside classroom. Inside the classroom, I pay close attention to students’ reactions and regularly prompt them with leading questions. Students comfortably answer or raise their issues. This kind of atmosphere is well reflected in peer evaluations “she often asks questions to involve students to class”, “she typically elicits several responses”, and “has good rapport with students”. Outside the classroom, I help students during my office hours and use technology by maintaining the course webpage that helps to involve the students in the flow of the course by posting about the material covered, reminders about homework, quizzes, exams, etc. on my webpage, and by encouraging them to email me with their own comments or questions.

However, verbal discussion tends to be insufficient for estimating a student’s understanding. This makes written communication crucial, as a tool for interaction between the teacher and the students, and also as means for a fair grading policy. Whether we, as teachers, like it or not, grades are a major source of motivation for students. So it is important for us to ensure that good grades are meaningful as well as attainable.

I assign homework after almost all the classes, then hold weekly quizzes or collect homework to
keep them up with the current materials. I put more weight on quizzes and exams in the lower level courses, and more value to the homework in the upper level courses with mature students. This is because many problems at upper level are theoretical and require longer and deeper thought, and more importantly, this also encourages self-study and self-discipline. What I always do is that I return their graded quizzes and homework the next class itself, which makes them pay attention to the feedback while their memories are still fresh, and, more importantly, makes them responsible for their learning.

When an exam approaches, a week before the exam, I provide a ‘study guide’ that lists the topics covered. Though those topics can be found in the textbook or the lecture note, my doing so make students become alert to study while getting a feeling of engagement with the instructor. The next class, I hold a review session for the upcoming exam. A couple of days before the exam, I provide past years’ exams. I ask students to test themselves with those old exams under the same environment as a real exam. This method helps students familiarize the exam, self-check on how well prepared they are, and again, feel engaged with the instructor. In addition, I hold special office hours, post commonly asked questions etc. on the course webpage to keep them updated.

This detailed scheme and organization of the course engages students with me and motivates them to study harder, and helps them feel that my grading system is fair even though it appears tough initially, as indicated by their comments in course evaluations – “high expectations for her students” and “fair grading”.

**Student Research and Outreach**

Involvement with students and their learning outside the regular coursework is an important part of the duty of a teacher. I actively look for and create opportunities for students to engage with mathematics outside the standard curriculum. This starts with prospective college students who are considering doing mathematics, and goes onto current college students who want to explore mathematics beyond the prescribed coursework.

UWG hosts “Math Day” every spring. It is an annual math festival for high school students and undergraduate students. I have helped in organizing Undergraduate Math Competition, in which I composed Putnam-type problems, proctor, grade, and finalize the winners. I also co-organized ciphering problem sessions for high school participants, and supervised team competitions. All these give me an opportunity to interact with high school students and add to their motivation to do mathematics or sciences in their near future. It is especially inspiring to see the growing numbers of female students interested in pursuing math and science. A program like this is influential in building a presence for mathematical studies in the community of local high schools - a worthwhile goal no matter where the students go to college. I am also involved with the UWG “Preview Day”, meeting prospective students and explaining the math major programs, providing a direct link to the major and the opportunities it provides.

For students who are already in the university, I enjoy doing independent study or individual research with students who wish to deepen their knowledge beyond what they learn in the regular classroom or who would like to experience research. I enjoy thinking about problems and topics that cut across mathematical areas, both in their formulation and solution. This approach naturally lends itself to working with undergraduate students who are interested in exploring mathematical creativity beyond their coursework. As written earlier, I have given motivated upper level undergraduate students options to study some chapters in “Proofs from the Book” and discuss their learning for their homeworks and exams. A couple of motivated students have done an independent study with me on Linear Algebra to explore its abstract aspects. A student finished his M.S. thesis with me in Spring 2012. Master’s thesis is optional at the UWG, and this was the first thesis in pure math done since the program started in 2008. He is now working on his PhD. in Math
education.

My research interests lie in graph theory and combinatorics, and their connections to other areas in math including geometry, number theory, algebra, coding theory and probability. Many problems in these areas are elementary in nature and are accessible to undergraduate students with sufficient mathematical maturity. This makes my research interests suitable for undergraduate students’ research experience as well, and I can involve students in my research naturally. These problems easily lend themselves to both computational and theoretical approaches even at an undergraduate level. To give just one example, in the problem of finding chromatic numbers of the integer lattice in $n$-dimensions under $\ell_1$-norm with given distance sets in my research statement, special cases of $n = 3, 4, 5$ would be appropriate problems for undergraduate students. The beauty of a problem like this is that it motivates the student to learn about topics as diverse as high dimensional geometry, metric spaces, combinatorics, and number theory, while getting their hands “dirty” with algorithmic computation.

I wish to continue to engage with students at every stage of their career, from high school though college, and organize opportunities such as those outlined above that improve their motivation and involvement with mathematics.

Curriculum Development

Improving undergraduate abstract reasoning and communication is possibly the most important mission of teaching in undergraduate mathematics. When I taught the a sophomore seminar class and an introductory proof course, I ran both courses more interactive than usual. In the seminar class, making the students experience math-competition-type problems is indeed rare at UWG, yet I persisted in doing so because I believe it is a good way to expose what it takes to be a creative thinker in mathematics to sophomores.

At UWG this semester, I have been working on developing a discrete math course for CS majors that the Department of Computer Science desires. Meetings with CS faculty members to gauge what they hope to get out of this course, and also contacting CS faculty in three different universities at various levels to learn how other universities build and manage such courses, has given me insight into the process of building a course from a partly non-math perspective while maintaining its mathematical standards.

Even beyond my research interests of Combinatorics, Graph Theory, Number Theory, and Geometry, I have been proactive worked on expanding my teaching expertise by learning new subjects. In 2013, I took and passed the Financial Mathematics exam of the Society of Actuaries, even though its a subject far from my research interests because I was eager to challenge myself and learn firsthand the difficulties of taking such an exam that is important for students wishing to be an actuary, a popular career choice these days. Two exams are typically required in order to start a career as an actuarial analyst: Financial Mathematics, and Probability. Since Probability is already a familiar subject to me, I tried a new area, Financial Math. To better understand how an actuarial program is run, I visited UIUC (named a Center of Actuarial Excellence by the Society of Actuaries) in 2012 with the purpose of observing how they ran undergraduate courses and the problem sessions to get the undergraduate students prepared the exams. I feel confident to advice and prepare students with regard to the actuarial exams and potentially help build an actuarial study program.

Over the past year I have been involved with a campus-wide initiative to improve STEM education at UWG. I am a co-PI in a grant from the state of Georgia as I mentioned in the introduction. Without repeating my discussion from the introduction, I would only like to mention that my involvement in this project has given me the experience in putting together a large-scale proposal for funding, and organizational expertise need to set-up the requisite organizational framework for
making such a multi-faceted plan successful. I am eager to be actively involved in such initiatives for improving STEM education at a university level.

Mentoring Junior Faculty and Teaching Assistants

As a faculty member, I have actively worked to train my TAs as future educators. In order to ensure the quality of the classes and also for my TAs to learn the basics of teaching, I held weekly meetings with my TAs who led recitation sections of my calculus courses. I always prepared written instructions for the weekly meetings and discussed grading rubric and comments in detail. (Copies of the TA instruction sheets are attached.) At UIUC, I benefited from the high standards of training and high expectations for ethical standards for TAs. Due to the practice of multi-section Calculus courses taught at UIUC, I learned by observing the practices of the experienced course coordinators at UIUC who organized the activities and duties of numerous instructors for such courses. I want my TAs to have similar training that informs them throughout their careers as teachers.

In fact, one my TAs has been hired as an instructor in our department for last five years, and he is the first such hire among our M.S. graduates. He has expressed appreciation of how much my TA training and work with me was influential to him as a student and teacher.

I also conduct class observations for junior faculty as well as TAs to give them constructive feedback on how to improve their performance in the classroom. The former chair has commended me in the past for my report to a particular junior faculty.

In the long term, I would like to organize a more formal training program for our TAs and fresh faculty. MAA’s Handbook for Mathematics Teaching Assistants (available online) gives an excellent overview of issues faced by many fresh teachers. A basic training program would consist of: an initial two to three day intensive program before the semester starts to discuss these potential pitfalls with opportunity to prepare and give trial lectures with videotaping and immediate feedback, this would be followed by regular meetings in small groups over the semester to discuss issues that arise in their classrooms, and at least one classroom visit by an experienced teacher to give them constructive feedback. There has to be a system of cohorts to help provide a social support network for the new teachers as they go through the learning process of being independent instructor. This support system has to be supplemented by opportunities to learn about non-traditional pedagogical methodologies such as small-group learning, flipped lectures, etc. I am confident that I have the experience as a teacher, as a trainer of TAs, and as an organizer of large scale academic efforts, to successful set-up and direct such a training effort.

Conclusion

Apart from teaching methods, there are other important qualities that teachers should be equipped with. We should be knowledgable. It helps to give insight to students about the subject, and respond to students’ various questions and confusions better, but most of all, students learn the subject from the teacher as a role model whether they are aware of it or not. We should be fair – fair in treating students in class, fair in grading whether some students are polite or rude, friendly or indifferent. It lays a foundation of the trust and belief in each individual student and can raise their learning efficiency.

Every teacher needs to adjust their teaching style to their own strengths and weaknesses. Several years of teaching my own courses to undergraduates and graduates at University of Illinois, University of Central Florida, and University of West Georgia has given me the experience to formulate my own opinions on various aspects of teaching. As I learn from my experiences, I keep updating my teaching principles and methods. Since I consider teaching as an integral part of my academic life, I actively pursue evolving into a better and more effective teacher.
Addendum

1. The ϵ – δ Game (*sample pages*)
2. TA Instruction for Each Class (*sample pages*)
MATH 1634 \( \epsilon - \delta \) Game; Version 1.

For a given \( \lim_{x \to a} f(x) \),

**Player A** (Student) Asserts that a certain number \( L \) is the limit:

\[
\lim_{x \to a} f(x) = L.
\]

**Player B** (Teacher) Challenges this assertion by giving Player A a specific value for \( \epsilon > 0 \).

**Player A** Must respond to the challenge by coming up with a value of \( \delta > 0 \) such that

\[
|f(x) - L| < \epsilon \quad \text{whenever} \quad |x - a| < \delta, \quad \text{possibly except for} \quad x = a.
\]

- If Player A can always find a value of \( \delta > 0 \) that works, then he wins, and the limit converges to \( L \).
- If Player B can give a specific value of \( \epsilon > 0 \) for which Player A cannot respond adequately, then Player B wins, and we conclude that the limit does not converge to \( L \).
Examples of “one value” for $\delta$

Example 1 \( \lim_{x \to 3} (2x) \) is given.

Player A (Student) Asserts that \( \lim_{x \to 3} (2x) = 6 \).

ROUND 1.

Player B (Teacher) Challenges this assertion by giving Player A 
\[ \varepsilon = 0.2. \]

Player A Come up with the value of 
\[ \delta = 0.1 \]
that yields 
\[ |2x - 6| < 0.2 \quad \text{whenever} \quad |x - 3| < 0.1. \]

Proof.
\[
|2x - 6| < 0.2 \iff |2(x - 3)| < 0.2 \iff |x - 3| < 0.2/2 = 0.1.
\]

ROUND 2.

Player B Challenges this assertion by giving Player A 
\[ \varepsilon = 0.03. \]

Player A Come up with the value of 
\[ \delta = 0.015 \]
that yields 
\[ |2x - 6| < 0.03 \quad \text{whenever} \quad |x - 3| < 0.015. \]

Proof.
\[
|2x - 6| < 0.03 \iff |2(x - 3)| < 0.03 \iff |x - 3| < 0.03/2 = 0.015.
\]
**ROUND 3.**

**Player B** Challenges this assertion by giving Player A

$$\epsilon = 0.001.$$  

**Player A** Come up with the value of

$$\delta = 0.0005$$

that yields

$$|2x - 6| < 0.001 \text{ whenever } |x - 3| < 0.0005.$$  

**Proof.**

$$|2x - 6| < 0.001 \Leftrightarrow |2(x - 3)| < 0.001 \Leftrightarrow |x - 3| < 0.001/2 = 0.0005.$$  

Keep doing ROUND 4,5,....

**Player B** Challenges this assertion by giving Player A

$$\epsilon > 0.$$  

**Player A** Come up with the value of

$$\delta = \frac{\epsilon}{2} > 0$$

that yields

$$|2x - 6| < \frac{\epsilon}{2} \text{ whenever } |x - 3| < \frac{\epsilon}{2}.$$  

**Proof.**

$$|2x - 6| < \frac{\epsilon}{2} \Leftrightarrow |2(x - 3)| < \frac{\epsilon}{2} \Leftrightarrow |x - 3| < \frac{\epsilon}{2}.$$  

**CONCLUSION:** Since Player A can always find a value of $$\delta := \epsilon/2 > 0$$ that works, he wins, and the limit converges to 6.

**QUESTION:** What if Player A choose $$\delta := \epsilon/4 > 0$$? Would that $$\delta$$ work?

**Answer:** Yes.

$$|x - 3| < \frac{\epsilon}{4} \Rightarrow |2(x - 3)| < 2 \cdot \frac{\epsilon}{4}$$

$$\Rightarrow |2x - 6| < \frac{\epsilon}{2} \leq \epsilon$$

$$\Rightarrow |2x - 6| < \epsilon$$
Example of multiple options for $\delta$

**Example 7** $\lim_{x \to 3} x^2$ is given.

**Player A** (Student) Asserts that $\lim_{x \to 3} x^2 = \underline{\ldots}$.

**Player B** Challenges this assertion by giving Player A $\epsilon > 0$.

**Player A** Come up with the value of

$$\delta = \underline{\ldots} > 0$$

that yields

$\underline{\ldots}$ whenever $\underline{\ldots}$.

**Proof.**

**CONCLUSION:** Since Player A can always find a value of

$$\delta := \underline{\ldots} > 0$$

(in terms of $\epsilon$)

that works, he wins, and the limit converges to $\underline{\ldots}$. 

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Recitation 2/1

- The rosters after Quiz 3.
- Discuss grading a few answers from Quiz 2.
- Return the graded quiz and the rosters by 10am on Tuesday. That way, I have enough time to look through the grade and correct grades if necessary.
- The list of homework problems are available online.
- Handout on the limit laws
- Do the following exercises.
  
  - Section 3.3 #41
  - Section 2.5 #17
    
    Go through the following items clearly.
    (1) \( f(0) = 0 \) (using \( f(x) = x^2 \))
    (2) \( \lim_{x \to 0} f(x) \) DNE because RHL \( \neq \) LHL;
      * RHL: \( \lim_{x \to 0^+} f(x) = \lim_{x \to 0^+} x^2 = 0 \)
      * LHL: \( \lim_{x \to 0^-} f(x) = \lim_{x \to 0^-} e^x = 1 \)

    (Mention: No need to check the condition (3) \( f(0) = \lim_{x \to} f(x) \)).

    Therefore, \( f \) is not continuous at \( x = 0 \).
  
  - Section 2.6 #17 (if time permits.)

    They must give the stage where the limit law can be applied:
    \[
    \lim_{x \to -\infty} \frac{1/x^2 - 1/x - 1}{2 - 7/x^2}
    \]
Recitation on Section 3.4 Chain Rule, with 3.6 Logarithm functions

- Do the following exercises.
  - Section 3.4 #11,23,33
  - Section 3.6 One of #13,15,19

- Always specify the “outer function” and “inner function” verbally. Do not try to specify the $f$ and $g$ in the composite function $f(g(x))$ formally.
  - Sec 3.4 #23. $f(x) = e^{x \cos x}$.

- When both Chain rule and Product rule/Quotient rule are involved, specify which comes first.
  - Sec 3.6 #13. $g(x) = \ln(x \sqrt{x^2 - 1})$: Chain rule first, then Product rule while differentiating the “inner function”.
  - Sec 3.6 #15. $f(x) = \frac{\ln x}{1 + \ln(2x)}$: Quotient rule first, then Chain rule while differentiating the bottom.

Recitation on Section 3.5 Implicit Differentiation

- The must use the notation $d/dx$, not $'$ for derivatives.

- Do the following exercises.
  - Section 3.5 #17
Recitation 4/5

- Discussion of the final exam. Proctor & Math Tutoring Hours
- Compare the exercises #12 and #13 in Section 4.7. Solve one of them completely. Write the whole statements of the problems and the high-lighted statements in the following (as well as the solution) on the blackboard.

#12 A box with a square base and an open top must have a volume of 32,000 cm³. Find the dimensions of the box that minimize the amount of material used.

  (a) Picture and Variables.

  (b) Set up, but do not evaluate, the function and the equation in terms of two variables as we did in class. That is, choose MAXIMIZE or MINIMIZE, find appropriate expressions at underlines ____ in the followings:

  \[
  \begin{align*}
  &\text{MAXIMIZE/MINIMIZE} \quad \underline{\text{expression}} \\
  &\text{Restricted to} \quad \underline{\text{expression}}
  \end{align*}
  \]

  (c) Set up, but do not evaluate, the single variable function and the interval to be solved as we did in class.

  \[
  \begin{align*}
  &\text{MAXIMIZE/MINIMIZE} \quad (\quad) = \underline{\text{expression}} \\
  &\text{Restricted to} \quad \underline{\text{expression}}
  \end{align*}
  \]

  (d) Find the optimum points of the function in (c). Give your answer in ordered pairs. Show the reason why your critical point yields the optimum value.

  (e) Interpret your answer. That is, state clearly the dimensions.