# Calculus: TA information

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**Abstract**

At the end of 2024 I decided to start to clean my office, following 40 years of career work. I had *lots* of notes on calculus teaching. It is evident that I had invested myself in my teaching over the years and I had mounds of notes, records and resources that I had developed and collected. I began to go through this, collate it, curate it, and to try to decide what might be helpful to others and what should just be dumped in the garbage. This manuscript is a transcription of information distributed to TAs in preparation for teaching of 2 large lectures of Math 221: Calculus and Analytic Geometry in 2006.

***Key words***— Calculus

AMS Subject Classifications: Primary 05E05??; Secondary 33D52??.

Dear Math 221 Lecture 4 and 5 TAs,

This message is to get you oriented and prepapurple for this course.

1. Please read, thoroughly,
   - The course home page
   - This TA information page
   - The information for students page
2. Before 3am on Monday September 4 send me an email with your office location and first week office hours. The students are already panicked and need to be reassupurple that help is available right away. I will enter your office hour information on the course home page. This information can be changed later as your schedule becomes more settled. But we must make office hours available for the first week.
3. Think about how you want students to turn in their homework to you. Homeworks will be due on Mondays. During the first week you need to make sure that your students have the homework process clear.
4. Prepare yourself mathematically. During week 1 we will cover
   - Numbers: $\mathbb{Z}_{>0}$, $\mathbb{Z}_{\geq 0}$, $\mathbb{Z}$, $\mathbb{Q}$, $\mathbb{R}$, $\mathbb{C}$
   - Be sure that you review for yourself that these are all universal obects: $\mathbb{Z}_{>0}$ is the free monoid without identity on one generator, $\mathbb{Z}_{\geq 0}$ is the free monoid on one generator, $\mathbb{Z}$ is the free group on one generator, $\mathbb{Q}$ is the field of fractions of $\mathbb{Z}$, $\mathbb{R}$ is the completion of $\mathbb{Q}$ with respect to the valuation induced by the imbedding of $\mathbb{Z}_{\geq 0}$ in $\mathbb{Z}$, and $\mathbb{C}$ is the algebraic closure of $\mathbb{R}$.
   - Functions: $e^x$, $\sin x$, $\cos x$, $\tan x$, $\cot x$, $\sinh x$, $\cosh x$, $\tanh x$, $\coth\ x$ and their inverse functions. I use the power series definitions of $e^x$, $\sin x$, $\cos x$. Think about what ring all these functions live in: $\mathbb{Q}[x]$ is the free $\mathbb{Q}$-algebra on one generator, $\mathbb{Q}[[x]]$ is the completion of $\mathbb{Q}[x]$ with respect to its maximal ideal, and $\mathbb{Q}((x))$ is the field of fractions of $\mathbb{Q}[[x]]$. The inverse functions are not functions. We will cover the angle definition of $\sin x$ and $\cos x$ in week 2.
   - What does $a^b$ mean?
     One of the most important and most subtle mathematical issues (that will always be present in this course) is what $a^b$ means. Think about this. What is the best way to define $a^b$? Unfortunately we will rather sluff over this in class and it will be a source of constant confusion for all. Someday I will purpleesign this course to make a lecture where I cover this properly but I haven't yet and it will be a headache for all. But it is less of a headache if we are all aware of the issues here.
   - I know only 5 trig identities:
     $\sin(-x) = -\sin x$,
     $\cos(-x) = -\cos x$,
     $\sin(x+y) = \sin x \cos y + \cos x \sin y$,
     $\cos(x+y) = \cos x \cos y - \sin x \sin y$,
     $\sin^2 x + \cos^2 x = 1$.
     Note that these identities with $\sin(0) = 0$, $\cos(0) = 1$ could be used to define the trig functions. So, already in weeks 1 and 2 we will be dancing around three different definitions of the trig functions.

It is not completely trivial that these three definitions are equivalent.

5. Find out exactly what goes on in my office hours (the best way is to go to them), 1:30 - 4:30pm on Sundays, at B239.

6. Prepare yourself for the show: think about how you interact with students, how you explain things (how do you give directions from VanVleck to a specific table at the Casbah?), what good boardwork consists of, how to keep chalk from squeaking, how to make sure you don't run out of chalk during section, what you should wear, what you should bring to section, when you should wake up that day, how to time your bathroom stops so you won't feel like you need to pee while you're teaching etc.

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## The show and the wall

**The show** starts the moment you walk in the door. You are a celebrity, you are their TA. You cannot escape this. Some students will shy away, others will try to butter you up.

Any time the students see you they are taking it in. They are watching you, figuring out what mathematicians are like, what it takes to do mathematics, what mathematics is made of.

Before you start your section erase the board – COMPLETELY. The stuff that has been left by previous classes is DISTRACTING and your job is to focus the students (and yourself) on doing math and learning calculus.

**The wall.** While the students have been sitting there waiting for you to show up they have been building a wall, right between your desk and the seats in the room, putting the bricks in one by one. When you walk in the door the wall is not finished but it is already a foot or two high. You MUST break down the wall. Silence helps to build the wall. Talking about yourself helps to break it down. TALK while you erase the board, while you are waiting for the bell, anytime there is dead time, talk. **Talk** about yourself, your life, your experiences, your passions. Make yourself human, it is alot easier to build a wall around a machine or an armopurple scary "creature" who never says anything than it is to build a wall around a living breathing human with feelings. Back to contents

## What is teaching?

Teaching is transferring information in the easiest way possible. Your job is to teach humans. You will be able to communicate with them better if you are genuinely interested in your students as people.

Although it is possible to be genuinely interested in someone without knowing their name, it is not very polite.

Your job is to read their minds. You need to figure when they are confused, why they are confused, and how to make them unconfused, ESPECIALLY when they are scared and confused and don't say a word or ask you any questions. *Nobody said this was easy, but its even harder if you don't think about what is involved* in teaching. Back to contents

## What do the students want from you?

Most of all the students want you to make them able to do the HW. This is different, but not exclusive, from doing the homework for them. It is pretty hard to learn to do something without seeing it done by someone else first.

The students want you to make them able to do well on the exams. In many ways this is the same as being REALLY able to do the HW but in some more subtle ways it is not.

Next, the students want you to be cool. Think about what this means. What makes someone cool?

Finally, the students want you to be professional. You are an expert, paid for what you do. You can be both cool AND professional, the terms are not contradictory (example Italian businessmen in Milan). Back to contents

## Your job

- Your job is to teach humans.
- Your job is to read their minds.
- Your job is to break down the wall.
- Your job is to get them started, on track, oriented to the course and focused on mathematics.
- Your job is to be a model for your students: a model of mathematical exposition, a model of mathematical writing, a model of clarity, a model of social interaction and a model human being.
- Your job is to be cool.
- Your job is to be professional.

Time to read Unfreaking yourself. Back to contents

## Your students on day 1

It's easier if you mentally try to put yourself in their shoes. What is the state of a student in your class on the first day? Last weekend they moved into their dorm room. This is a totally new experience: they are leaving family, friends, home, security and going off to a total unknown where they are going to get eaten alive by ugly mean professors and TAs and where they are going to be surrounded by 40000 other students that they have to impress. They tried to move into their dorm room, they are tired of moving boxes, rearranging, realizing that they forgot their favourite stuffed bunny rabbit that has slept with them since they were 5 years old (actually, they didn't forget him but they don't want their roommate to think that they have to sleep with a stuffed animal). Life is horrible, everything sucks, ... and then the parties start. They have met 10000 new people in the last 48 hours, already gone to a few too many parties, and have walked up and down State Street 4000 times. The alarm rings on Tuesday morning and gets turned off. When they finally wake up they have 15 minutes to take a shower and look smashing before section starts, they have no idea where Van Vleck is and

even less idea what B207 means. They finally find the room 10 minutes after section starts and are trying to get oriented as to what the heck is going on in your section in the first few seconds when they walk in. The **worst** thing you can do is add to their insecurity by getting on their case for being late to your section. *Your job is to get them started, on track, oriented to the course and focused on mathematics. Your job is to teach them calculus. What would you want your TA to do if you were them?* Back to Contents

## Unfreaking the students

This has to be done constantly throughout the semester and should be mentioned in every section, especially in the first few weeks. Discuss with them

- Why the homework is not as long as it looks,
- Why the homework is easy,
- Why the exams are easy,
- How many students have made it through this class before?
- How much is the homework worth?
- That this course is designed for students that have not taken calculus before.

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## Length of the Homeworks

The Homework assignments are roughly 100 problems per week. Each week

- approximately 20 of these get done in lecture as examples. In lecture I do not say "HW problem xx" I say "Example" but these examples are taken verbatim from the Homework assignments. Tell the students about this in section to help them pick up on this.
- approximately 10 of these get done in section.
- approximately 20 of these get done in office hours. My office hours are Sunday 1:30 - 4:30pm in B239. All TAs should come to these during the first month of class. This is one of the best resources for this course.

**Why the homework is easy:** All together we do about 50 problems for them. This means that the homework assignments are really only about 50 problems long and those other problems are similar to problems that were done in class or section or office hours.

**How many students have made it through this class before?** Do the calculation: I have taught 12 Large lectures of exactly this course since 1999, each with about 225 students. Even if we round down to 200 students per lecture that makes 2400 students that made it through this class. So your students can do it too. Back to contents

### Planning time

It is more or less impossible to do the average homework assignment for this course in one night. Planning 3-4 hours per day for 3-4 days per week is one possible way for a student to manage the time on this course. I am aware that the students also have other classes to study for that will also

require 2-3 hours of outside of class study per hour of class time. If a student tells you that they are spending more than 15 hours per week on the homework for this class and you are convinced that that is actually the case, please come see me and let's talk about it. If you do not keep me informed I cannot help.

- **Homework time.** Do the calculation for them. If the homework takes 15 hours, this means that they need to spend 2 hours per day, 7 days a week. If they miss a day then they'll have to make it up the next day and put in 4 hours. It should average out to getting about 14 problems done per day.

- **Study groups.** Study groups help alot but they also take alot of time because another requirement of study groups is that you blow off alot of time talking about other things (Sex and the City, Prof. Ram's clothes, OC, OMG Do you know what happened last night...). On average, study groups make the calculus (a) easier, by a factor of 2, and (b) take more time, by a factor of 4-6. Thus if they plan to work on calculus only in study groups they should plan about 20-30 hours a week of study group for calculus.

- **Non Math221 time.** Help the students plan their other time: How does their daily/weekly schedule look? How much time is spent where? Did they watch TV today? Did they put it in their daily schedule? Did they call their mom today? Did they put it on their schedule? How much time did it take from their calculus time? Did they sleep enough? Will they be in good enough mental shape from so little sleep to do calculus or will the calculus take twice as long because you are tired and thinking only 1/2 as well?

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## Unfreaking yourself

Don't kid yourself. You *will* need to unfreak yourself. You will need to learn how to do this, when to do this, and how to avoid getting freaked.

**Be prepared.** Know your stuff. Practice your calculus. Think about everything in advance. When are you going to walk into class? What are you going to wear? Where is your class? What are you going to eat for breakfast? Which things are actually clearly defined? Are you in the middle of writing an incomplete sentence?

**Expect the unexpected.** What do you do when you can't do a problem on the homework? What do you do when your fly is open and you notice it halfway through class? What do you do when a student tells you you are not fair? What do you do when a student comes in late? What do you do when the equation you are writing doesn't fit on the board? The more you think about these things in advance, the less you get freaked out when they happen.

**Play psychological tricks with yourself.** Figure out what things make you confident and what buttons make you insecure and learn to recognise when students are pressing these buttons. Figure out ways to steal instants for yourself. Figure out how to make the pace of the class or the conversation suit you, so that you have time to think.

**The hardest thing** is to be honest with yourself. Do you really know what $a^b$ means? Are you, or are you not, trying to control your attraction to the babe sitting in the back row? Really, did you stay up too late last night to be perfectly on top of things in front of a classroom? The most wonderful thing is that no one else has to know these things that have you a little off kilter, but the most dangerous thing is to lie to yourself and not recognise them at face value. Be honest with yourself!
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## Day 1

The first day of class is an important one. It is much easier to do the first day right than to try to correct for it later.

- **Plan in advance.** There are three important stages:
  - The week before you find out where your class is, go check out the room so you have a clear picture of the space, the desk, the board, the window positioning and the furniture. Think about whether adjustments need to be made, and how you are going to work with what is there.
  - The day before you make sure all your notes are ready and in order, you plan your time between now and the upcoming section, you decide what you are going to wear, what you are going to have for breakfast, and how long you are going to sleep, and exactly which homework problems you need to do to prepare.
  - The morning of you go through your check list and make sure that everything is in order in your head.
- **Focus.** Set a time in your head 30 to 60 min before your class when you shift all focus to your upcoming discussion section. Organise and fiddle with your papers and notes to get your brain fully into the mode. Do a couple homework problems to get warmed up. Think about the students in the class, who they are, what they will say, how they will react.
- **Plan your entrance.** The right entrance is important. It sets the stage for how the students will treat you and interact with you. The timing is important: do you prefer to be hanging around way in advance staring at the students and having them stare at you, or do you prefer to come in on the bell so that all your students are bloody scared of you. Figure out a good way, that will work well for you and make you and your students comfortable.
- **The material to cover.** You need to make sure they understand how to do trig identities starting with my 5 favourite trig identities as a definition. I will cover numbers on Wednesday and the power series definitions for $e^x$, $\sin x$, $\cos x$ and the derivations of my 5 favourite trig identities on Friday. You will need to use your time Tuesday and Thursday to make sure the students are solid and comfortable with the stuff that I will cover on Friday, and to make sure you fill any gaps that I might leave (for example, what if I don't get to sinh and cosh in lecture? They're on the HW and we don't want the students to panic.)
- **RELAX!** Any tension you have will get transmitted to the students and they will get tense. In this course we have to reduce tension wherever possible as there is alreay enough tension built into the HW and exams. The students don't need tension from you too.

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## In class

**Boardwork.** One of the most helpful skills you can learn for teaching math is how to work your blackboard.

1. Always erase the board completely before you start as other stuff on the board is distracting. You want your audience, and yourself, to be focused.
2. Plan your space in your head, and revise your plan as you go and see how things are laying themselves out.

3. Make sure the size is right to be seen from the back, and the letters are coming out clear. Don't write too big or you can't fit enough information on the board at a given time.

4. Always talk as you write, the easiest thing is to say and explain about what you are writing as you write it.

5. The pace and the flow are important so make sure you practice writing on the blackboard ahead of time.

6. Always write in complete sentences. Don't use little things off at the side.

Your board should be so that if someone comes in late, or spaces out for half a minute, they can figure out what you are doing and they can catch up from what is written on the board.
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**Math writing.** An integral part of mathematics is writing. Every professional mathematician writes LOTS. The main goal in writing is that your reader understands easily what they read.

- Math writing has alot of words in it. Go to the math library on floor B2 of Van Vleck and look at a math journal and see for yourself that when mathematicians explain things to each other they use mostly words and not so many equations. Watch how many words Prof. Ram writes in lecture. Actually the symbols that we use are just abbreviations for the words – we use them because we are lazy (for example, 2+2=4 is an abbreviation for two plus two is four).

- Math writing is in complete sentences. If it is not in complete sentences and not grammatically correct then it is usually impossible to read and make sense out of. If you don't write in complete sentences in section you can be sure that your students will get confused. Note: = is a verb. A sentence without a verb is not grammatically correct. Note: = is not the only verb.

- In mathematics, an arrow is a symbol used to denote a function. The left end of the arrow is the domain of the function and the right end of the arrow is the range. An arrow is NOT a synonym for an equal sign. NOR is it an indication of where the sentence continues. When you teach, do NOT use an arrow for anything except a function.

One of the goals of this course is to teach the students how to write mathematics well, and so, **yes, we will count off if an answer is not written up properly with good grammar and good mathematical writing style.** Your writing must be a model for your students.
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**Interpreting what you say.** One of the most difficult things about the classroom dynamic is getting your point and your information across the way you meant. Too often what the students hear is not quite what you said. Be on your toes for possible misinterpretations of what you have said and be sure you correct for these immediately whenever the situation is appropriate. Be careful with any expressions or statements that are sarcastic or nuanced as these require an extra level of interpretive parsing. This does not mean that you should be boring in class, it just means that your students need to get used to what you say in class and how you say it in order to understand you properly. You can help them by being aware and using all the tools you have at hand: inflection, body language, revision (don't just say the same thing over – change it slightly when you repeat it). It helps if you are Italian and have some actor genes. Back to contents

**Interpreting what your students say.** After you have taught a couple of sections you will be aware of how difficult it is to say what you mean. This situation is even worse for the students when they ask a question as they have no practice at this type of communication in this medium. So very

often what a student means to ask is not quite what they say. You must fill in the gap yourself, **restate the question with what you think they meant, get a facial expression confirmation from them, and then answer the question they meant to ask with directness and clarity and brevity.** If you go on and on explaining, your answer will surely be lost in the chaff, at least as far as the student who asked the question is concerned.

**Being professional.** You are a professional, you are being paid for what you do and this is your job. You are an educated expert and you need to take this role to have a good client rapport. This must be reflected in your body language, handling of situations and conversations, and dress. One of the tricks for dealing with the huge variety of environments in today's society is to have learned all the actions and characters for a large variety of roles so that you can be flexible to the situation. If you always wear a T-shirt and jeans perhaps there is room for some expansion of your character roles. This does not require lots of funds but rather an attitude of social flexibility.

**Being cool.** Nobody likes to hang around people that are not fun and stimulating. Your role also demands that you command respect without being severe. This combination is called "being cool". You will have lots more success as a teacher if you are cool. Genuine interest in your students is your greatest asset for this.

**The party line.** Your students will ask you lots of questions that put you on the spot and that are difficult to answer if you have not thought about them in advance. Many of these questions have "party line" (as in Communist party) answers which are short, make the rule clear, and explain why it is there. I will update these as the term goes on and I remember the questions and the corresponding answers.

- Calculators are not allowed on exams for the same reason books and notes are not allowed on exams.
- Thomas' Calculus Eleventh Edition is a very good calculus book.
- Texts are resources. You must use your resources wisely and find the right combination that makes you learn the most.
- 2-3 hours of outside class study per credit hour per week.
- We do cover all the different equivalent definitions of the derivative thoroughly.
- Infinite polynomials are no more difficult that infinite decimals.
- $e^x$ is the most important function in mathematics.
- A solution is an explanation of why your answer is correct. We give credit for solutions not answers.
- Simplification is an aesthetic. We will count off for bad simplication.
- Good mathematics writing is one of the main goals of this course. You get no credit for solutions which are not written well.

## Exams

The homework and exams are interrelated and are structured to motivate the students to learn. This is a 5 credit course and the homework is designed accordingly (2-3 hours of outside class work per hour of class time).

**Why the exams are easy.** The exams are taken verbatim from the homework. There is never a problem on the exam that the students have not seen before on the homework. The disadvantage is

that there is lots of homework. However, effort spent on the homework problems usually translates to good scores on the exams and students that do most of the homework usually feel that they have learned a lot at the end of the course. It is quite a bit of work and requires discipline but the pay off is significant.

**Why are the midterm questions chosen randomly?** One method of assessing whether somebody knows something is to pick a random question from that subject and pose that question. If the person can answer that question then they know that subject and if not they don't, or at least they don't know it well enough. If you pay attention in daily life, and keep track, you will be amazed at how often this principle of assessment is applied. This is the idea that led to randomly choosing the problems.

Another reason the problems are randomly chosen: Inevitably, a tired student, looking at all the homework left to be done, will look through and think to themselves, "Prof. Ram will never put this problem on the midterm, it takes 25 minutes to do" or any one of an infinite number of other reasons, and then not do it. As soon as they don't do that problem they don't learn that stuff. In order to curtail this chain of events the exam problems are chosen randomly.

**Why are the midterms 10 problems?** For years I adjusted the length of the midterms by doing them myself and then multiplying the time it takes me to do it by 3. A 50min exam would take me 16-17min. I found that the length of the midterms almost always turned out be around 10 problems. Finally, since it makes several other things easier (grading, dealing with student questions on how long the exam will be, since the grades are curved anyway) I decided just to fix it at 10 problems on each midterm and it has worked well.
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## Grades

**Recording grades:** YOU, the TA, are responsible for keeping a legible, readable, up-to-date gradebook with complete accurate records of all the grades of your students. Keep a $1000 bill in this gradebook to make sure that it is so important to you that it will never get lost or damaged and will always be accessible whenever I need any student grade information (or if I happen to need $1000). You can get a blank gradebook from Sharon Paulson on the 2nd floor. Digital gradebooks are acceptable but make sure you have overly thorough backup procedures to avoid any unpleasant losses. At the exam grading sessions you will need printed copies at hand for reference.

Grades are normalised 8% for HW, 20% for MT1, 20% for MT2, 20% for MT3, 32% for the final exam.

- **How much is the homework worth?** Do the calculation: In terms of points, ALL the homework assignments are equivalent to 40 points on a midterm. In other words, missing 10 points on each exam is equivalent to getting a 0 on all the homeworks. This concept helps to unfreak the students regarding the homework. ON THE OTHER HAND, if you don't do the homework you will almost certainly not do well on the exams, especially since the exam questions are taken verbatim from the homework.

- **Computation of the grades:** At the end of the term after the final exams are graded, all the points are added up (after normalizing to the correct percentages) and a histogram is made. The general guidelines for giving the grades are 20% A, 30% B, 30% C, 20%D-F.

**ANY ESTIMATE OF A GRADE THAT IS MADE BEFORE THE FINAL EXAMS ARE GRADED IS ONLY AN ESTIMATE AND MIGHT BE WAY OFF THE MARK.**
In particular, by experience we have noticed that there are two groups of students

1. Those that don't concentrate on calculus in the first month, fail the first exam, realise that they are in trouble, and start working on calculus and do very well on the the second midterm,

2. Those that work hard on calculus in the first month and do well on the first midterm and then get cocky and start slacking and fail the second exam. Not everybody lies in one of these two groups, but these two groups are Larger than you might think.

Midterm letter grades should be taken with a grain of salt. MUCH more important towards getting a good grade is to keep your point total high.
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**Grading the exams.** In an effort to get exam results back to the students the next day, and to get it off our plates as quickly and efficiently as possible we begin the grading of the exams immediately after the exam is over and continue until we are done. Usually we finish shortly before midnight. I need a break at dinner and so we all go down to State Street together and I buy all the TAs dinner. I use this dinner as an important meeting to touch base with the TAs as a group so please arrange your schedule that day for grading AND dinner.

**Grading the homeworks.** Your main role in graduate school is to write a Ph.D. thesis not to grade oodles of calculus homework problems. Moreover, the State of Wisconsin does not provide us with funding to give feedback to our students on every homework problem so we must make do with having you grade a minimal amount in order to get *some* feedback to the students. Each week I will provide you a list of 5 randomly chosen homework problems to grade carefully and each HW is worth 10 points: 1 point for each graded problem and, for the rest, 2 points for completeness and 3 points for quality.

## Psychology

**The team.** You are part of the students' team for getting through calculus. Prof. Ram is the bad guy. He creates all the problems. You are helping them learn how to do the homework. You are helping them out every way that you can. You are their advocate.

**Constantly unfreak the students** about the homework.

**Be patient.** The students, and probably you yourself, have not been trained in math. I certainly wasn't very capable in math when I was a graduate student and, even now, I sometimes have my doubts. There is a famous saying in violin study: "It takes 10 years of practice to be bad". It is to be expected that the students cannot follow simple algebra manipulations (particularly at the beginning of the term) and they do not know how to write mathematics. You must teach them, show all the steps, be a model of clarity.

**Why are we doing it this way?** There is always a good EASY reason. The difficulty is to think about it long enough to realise what the reason is. If you don't know and don't think of the reason ASK me. AND THEN TELL THE STUDENTS THE REASON. It's alot easier to get through this if you have the idea that it is reasonable.

**Calculus is easy.** Most of it is a no brainer. DON'T THINK, JUST COMPUTE. Every time you make a comment, or convey that something is difficult, or hesitate, the students will add it to their mental reasons why they can't do calculus. Every one of these is detrimental to our mission. Unfortunately, mathematical culture loves to pretend that math is hard (it makes us feel good about ourselves) and so we have, built into our math world, that we say how hard it is *lots* of the time. You must resist this urge. It will only make your students resist you in your effort to have them do work in this class. Back to contents

## Calculus is COOL

Why is it cool? What makes something cool? Fine wine is cool, fancy people with lots of money spend zillions of dollars on this drink of rotten grapes that tastes terrible. Fine wine is cool, and has no applications. Ludacris is cool. Zillions of people buy these albums of noise and bad words–music that has no applications. But Ludacris is definitely cool. Calculus is also cool. We have to show everybody how and why it's so awesome. Why is calculus cool?

- an answer that is too often given: calculus is cool because it have applications to other fields (biology, neuroscience, security and codes, stocks and bonds, are some of the oft quoted applications). This is equivalent to saying that calculus is cool because is is connected to other things that are cool. This is true, but it puts math second tier on the spectrum and math is *not* second tier on the spectrum.

- calculus is cool because the thought process is used in every step of every day life and it gives you an edge over other people. In other words, calculus is cool because it makes you smart.

- calculus is cool because cool people do it. Of course this means that you, their TA, also have to be cool, and you have to show the students how other people that do mathematics are cool. You can be cool by being genuinely interested in your students and learning how to "hang out" with them. To see what I attempt to do with 200 students at a time, come to lecture. You can explain to the students why other mathematicians are cool by finding out the cool things that mathematicians do and telling the students about them. Prof. Ram spends his time traveling the world, hanging out in coffee shops and bookstores and art museums, having dinner at fancy restaurants.

- calculus is cool because the ideas are beautiful and captivating, like a fine painting. In other words, mathematics stimulates the artist in your soul, and so doing mathematics is like listening to a CD of your favourite songs in the whole world.

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