CCS Problem-Solving I | Professor: Padraic Bartlett

Syllabus: Problem-Solving

Weeks 1-10 | *UCSB 2014*

Basic Course Information

- Professor: Padraic Bartlett.
- Email: padraic@math.ucsb.edu.
- Class time/location: TTh 2-3:20pm, CCS Building 494, Room 164B.
- Office hours/location: 12-1pm Tuesday, SH 6516 / 5-6:30pm Thursday, SH 6516 / 10:30-12pm Saturday, CCS Building 494, Room 164B. These office hours will be shared with other classes. Also, the Saturday hours might not run every weekend, due to travel commitments; I'll email changes when relevant. Also-also, the Saturday hours will have pancakes! Yay, pancakes.
- Course webpage: http://math.ucsb.edu/~padraic/.
- Homework due date: At the start of each class.

Course Description

This is a problem-solving seminar! Accordingly, you're going to **solve problems**. Here's what this means in a typical run of this class:

1. At the end of each class, I hand out a collection of problems. These problems are all considered "live," in that they can be turned in at the next class for credit.
2. You take these problem sets, go home/to libraries/to a study place with friends/etc, and start working on them.
3. At the start of the next class, students turn in LaTeX-ed solutions to any live problems that they have solved since the last class.
4. Then, I ask the room what problems people were able to solve.
5. Students then present solutions to these problems!
6. Any problem that a student presents a correct solution to is now considered "dead," and cannot be turned in at future classes.
7. Problems that no-one gives a correct presentation to are still "live," and can be turned in at the start of any class at which they are still live.
8. We then talk about currently-open problems for the rest of class.

It's going to be fun! And kind of crazy.

Course Evaluation

There are two components of your grade in this course:

1. **Homework** (100%.) As noted before, there will be daily problem sets, collected and turned in **at the start of the next class** each day. Problem sets need to be written in LaTeX to be graded.

   As in your Introduction to Higher Mathematics class, homework problems will be graded according to two rubrics:

   (a) Did you arrive at the correct answer, using a sound chain of logical statements?

   (b) Does your work cleanly and carefully lay out a full and complete solution to the problem at hand? I.e. could your solution be used as an example in a textbook?

   Each problem will receive either a point (if the work satisfies both of the critera above,) half a point (if it satisfies at least one of these criteria, but has minor flaws on the other) or no credit (if it is fundamentally flawed on at least one of the two criteria above.)

   As discussed above, the only problems that can be turned in to any class are "live" problems. Consequently, there is no way for "late" homework to exist, and thus no way for it to be turned in. If you find yourself unable to attend a class for legitimate reasons (sickness, travel, other reasonable difficulties,) you can email me homework to be turned in as long as it arrives by the start of the corresponding class. Emailed HW will only be accepted from students who are sick or otherwise physically unable to make it to class; if you can make it to class, you need to print off the HW and bring it with you!

   If sickness/travel/etc prevent you from being able to work on a collection of problems, contact me as soon as possible (within no more than a week of the event,) and we'll come up with some sort of system to insure that you are not unfairly penalized for events out of your control.

2. **Presentations** (?%) As mentioned above, the bulk of our class is set aside for student presentations of live problems. If a student successfully presents a correct solution to a problem in a class, they get a flat +.5% to their final grade. In the event that there are multiple students with solutions to a problem, the student with the smallest number of presented problems will get priority. Ties for priority will be resolved via Rock-Paper-Scissors. Incorrect or flawed presentations may or may not receive partial credit, depending on the quality of the attempted solution.

   If you have an alternate solution to a problem that was already solved, we have time in our class, and the solution is markedly different to the one the class has already seen, you may be able to present this alternate solution as well for credit! Talk to me if you have such a solution.

This course is pass-fail and for five units. As defined by the CCS Mathematics department, your percentage score in this class is transformed into units via the following policy:

- Students receive the full five units for work at or above the A- level.
- Students receive four units for work at or above the B level.
- Students receive three units for work at or above the C level.
- Students receive no units for work at or below the C- level.

The correspondence between percentage marks and letter grades depends heavily on class performance. Throughout the course, I will report HW averages along with what letter grade those performances correspond to, so that you can keep track of your position throughout the class. It is very hard to guess where the 5-unit line will lie for this class, as this depends heavily on how the class performs on its sets. I'm pretty confident that averages of 80% or higher would correspond to 5-unit marks; but I would not be surprised to see this line move up by 5% or down by up to 10% depending on how tricky the problem sets get.

Collaboration/resources policy

Collaboration is allowed (and indeed encouraged) on the homework sets; mathematics at the research level is a collaborative activity, and there is no reason that it should not also be this way in a classroom. Work with your classmates!

Resources are a little trickier. On one hand, you are now researchers; limiting your resources would seem to be contradictory to the spirit of emulating what research mathematics is like. On the other hand, answers to almost everything in elementary mathematics can be found via Google and some patience; if you had unfettered access to every resources in existence, you would likely inadvertently rob yourself of some of the best problems in your education. So we need to strike a balance.

For this class: Wikipedia is a legitimate resource, as are any physical books you get from the library or have yourself. Mathematica/Wolfram Alpha/etc. are also valid tools, though you need to justify any calculations you perform using any computational systems. Upper-classmen are also valid resources to talk to about problems, provided you follow the citation system described below; however, I would ask that you restrict them to hints instead of answers if they know the problem! (This should rarely happen; these are not problems they would have seen in their own run of this class.) Other resources are off-limits. If this policy seems restrictive, talk to me; I am more than glad to make common-sense exceptions where appropriate.

The only things that we ask of you are the following:

1. Write up your work separately, and only write up solutions you understand fully.
2. When writing up your own work, you can directly cite and use without proof anything proven in class or in the class notes posted online. Anything else — i.e. results from textbooks, Wikipedia, etc. — you need to both (1) cite in your writeup, and (2) reprove the results you're using from those sources carefully in your own words. Simply copying solutions over directly is plagiarism / cheating / otherwise poor academic form; it is passing of as your own work the ideas of others. You are certainly welcome

to read and learn what other people have attempted! All I am asking you to do here is to (1) not pass it off as your own work, and (2) rephrase and present it in a new way so that it is clear that you have actually learned something.

3. As an important corollary to the above: if the TA or I find that you have copied sentences/work/etc. directly from outside sources,

   (a) On your first violation, the offending set's score will be set to -100%.

   (b) If there is any second violation, we will get the university involved. Consequences include failing the course and a likely dismissal from CCS.

   Please, please don't make me have to ever go through (b) above.

4. If you work with other students on a problem, it is considered good form to refer to them (i.e. "I worked with Andrew Wiles on this proof of Fermat's Last Theorem") when writing up your solutions. I mostly ask this because crediting collaborators is something you're going to do as mathematicians, and should get in the habit of.

5. Don't post questions to online messageboard-style services.

If you have any questions on the collaboration policy, please email me and I'll be glad to clarify matters.

Course Textbook

There is no primary textbook for this course. I will post homework sets on the course website.

Tentative Course Outline

This depends heavily on what pace I can take this course at, and what your respective interests and desires are; it is likely that we will take at least a few detours from this path as the quarter progresses! That said, here is a tentative set of topics for the course:

1. Polynomials.
2. Recursion.
3. Number theory.
4. Calculus.
5. Geometry.
6. Inequalities.
7. Convergence.
8. Linear algebra.
9. Probabilistic techniques.
10. Double-counting.