Math/CS 103	Professor: Padraic Bartlett

Syllabus for Math/CS 103

Weeks 1-10 *UCSB 2014*

Basic Course Information

- Professor: Padraic Bartlett.
- Email: padraic@math.ucsb.edu.
- Class time/location: MWF 11-12:20, Building 494, Room 160B.
- Office hours/location: Thursdays, 1-2pm, South Hall 6516. Additionally, I have office hours from 1-3pm Tuesday and 2-3pm Thursday for my other three classes; you are welcome to attend these office hours instead if they work better for you, though students from those classes "have priority" during these time slots.
- Course webpage: http://math.ucsb.edu/~padraic/mathcs103_w2014/mathcs103_w2014.html.

Course Description

So, all the things I do research in? That's what we're doing this quarter.

Specifically, this class will consist of a series of topics in **discrete mathematics**. Roughly every week or two, we'll introduce a subfield of discrete mathematics, go through the classical examples and theorems in that area, and (where possible) look at some open questions. Because there are far more subjects in discrete mathematics than we have time to cover, there is no set of topics we will certainly cover; I intend on varying the material based on student interest and aptitude. That said, we likely will study some subset of the following areas:

- **Design theory**.
- **Discrete geometry**.
- **Group theory.**
- **Error-correcting codes**.
- **Cryptography.**
- **Finite fields.**
- **Enumerative combinatorics**.
- **The probabilistic method in combinatorics.**
- **Graph theory.**
- **Generating functions.**
- **Set theory.**

It bears noting that the structure of this course is going to be different from the previous quarter. While I liked several aspects of how our course last quarter ran — people got involved with presenting math to their peers for the first time, I saw some interesting solutions on the HW, people got used to reading through definitions and attacking interesting

problems on their own — I found that the presentation portions of class often didn't do a lot for other people in the classroom. Most of the class would rarely questioned the presentations of others, and mostly just "tune out" during proofs that either (1) they already knew because they did them on the HW, or (2) they got lost in within the first few minutes of presentation and didn't feel like they had the "right" to question the presenter.

This raises the question: how can you change the structure of the class to preserve the "good" gained by giving students presentation experience, but remove the "bad" triggered by presentations that aren't useful to the class? My current theory is the following class structure:

1. Each class will start off with a brief minilecture, where I'll either introduce a topic in discrete mathematics or summarize what we've done in a handful of recent classes.

2. From there, I will hand out **in-class problems**, and divide the class into random groups of 3-4 using a random number generator. You will then work with your randomly assigned group on the problems handed out, and attempt to solve them!

   One thing you may wonder about is why the groups are "randomized." The short reason is basically that Maribel and I want you to get used to working with different groups of people, so that you can find yourself interacting with different kinds of mathematicians! In particular, we feel like both the domestic and international students would benefit greatly from working with each other, and that not nearly enough of this happened last quarter, so we've both decided to implement some sort of randomization into our classes. Let us know how it works?

3. The last third of class will contain presentations. If you are part of a group that gets somewhere with their problem, your group will be encouraged to share this work with the classroom. In presenting, the students in any group should divide themselves into three roles: (1) the person who writes up the solution on the board, (2) the person who verbally explains the solution while it is being written up, and (3) the person who answers questions from the class. In particular, while certain roles can contain more than one person, no person can be in two different roles. This will hopefully insure that within each group, everyone involved understands the solutions they're presenting (rather than one person doing all the work while the others sit and watch.)

4. Finally, these problems along with some others that build off of them will be handed to you to work on at home. On each Friday, the problem sets from the previous Friday, Monday and Wednesday will be handed in. Problem sets will need to be written up in **LATeX**, because honestly it's good for you. Problem sets will be graded on a fairly simple rubric:

   - Full marks: a correct proof of the problem given.
   - Half marks: an incorrect proof that is close to correct.
   - No marks: an incorrect proof that is not close to correct.

   This is basically an evolution of the earlier C/A rubric; the modification here is to reflect that many of the questions you're going to be asked are proof-oriented, and

thus that the "correct" portion is largely irrelevant; I'm mostly just evaluating your logic.

Course Evaluation

There are three components of your grade in Math/CS 103:

1. **Homework** (50%.) As noted before, there will be daily problem sets, collected and turned in on the Friday of each week. Problem sets need to be written in LaTeX to be graded. Again, as before, problem sets can be revised and turned in within a week of their grading for a regrade.

2. **Participation** (25%). Unlike last quarter, this won't be measured quantitatively by just looking at your number of presentations, as I feel like this encouraged quantity over quality. Rather, I will simply qualitatively evaluate students by watching you in class and listening to you interact with your peers. Talk to them, work hard on problems in groups, and occasionally present, and you'll get full marks here. If this qualitative metric bothers you, talk to me and I can create specific goals for you as an individual to shoot for.

3. **Quizzes** (25%.) There will be weekly brief quizzes on Fridays at the start of class, to check your understanding of the basic concepts and ideas we're covering in the course.

This course is pass-fail and for five units. Students will receive the full five units for work at or above the B- line; four of five units for work in the C range; three of five units for work in the D range, and between two to no units for other performance. Please, please don't make me think about how to assign two or less units.

Another thing to note here is that this is a tougher grading rubric than we had in the last quarter. This is because the last quarter was intentionally softer in terms of grading, to help you transition to both CCS life and to college in general. With this quarter, I want to prepare you for what your later career in CCS and mathematics in general will feel like; it might feel a bit harder in parts, but I'm hoping that it will feel correspondingly more exciting as well.

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!

Similarly, mathematics **is** a research activity; I would claim that banning resources like textbooks, Wikipedia, Mathematica, etc. is something of a fool's errand, and contradictory to the spirit in which we pursue research as researchers ourselves.

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

- Write up your work separately, and only write up solutions you understand fully.

- When writing up your own work, you cannot simply cite any paper: you have to write up the proofs of any results you're planning to use, and do so in your own words. The only exception to this policy is for results in the online lecture notes or from previous HW sets.
- Don't post questions to online messageboard-style services.

The tests will have their own resource and collaboration policies, which will be printed on the test.

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 excerpts from relevant textbooks on Gauchospace, though your first encounter with many definitions may come in class via a problem set.