

2018 Berkeley Geometry REU: Program Outline

Mentor Contact Information Feel free to email me at jchaidez@berkeley.edu or call/text me at 323-597-4650 if you need anything.

Research Projects We will start thinking about projects in the middle of Week 2. I have lots of project ideas that you are welcome to choose from. If you come up with a project independently that you would like to spend time on, that's great! Collaboration is an important part of math, so you are encouraged to work on your project with others. However, this is not a requirement.

Math Journal I'm encouraging you all to keep a math journal. This will help you to write regularly and document your work, and it will make writing the final paper easier. I would like you to submit a typeset journal entry in L^AT_EX, at least **2 full pages**, on every **Tuesday and Friday**. A journal entry may consist of:

- solutions to some of the problems and exercises given during lecture;
- proofs of lemmas/propositions that might be useful for your project;
- descriptions of the approaches you recently tried in your project, and an explanation for why the approaches worked or failed;
- and/or drafts of your final writeup (the preferred option later in the program).

Activities Franco and I will be organizing some optional weekend activities, like hikes and trips to the city. Details will be forthcoming.

Final Writeup One of the main goals of the program is for your group to produce a writeup. Near the end of the program, there will be a few soft deadlines where I will ask for drafts and such. Here is a list of those dates.

- Tuesday, July 31st: I will ask for an outline. This should be a latexed section-by-section skeleton of your paper with section descriptions.
- Friday, August 3rd: I will ask for 6-8 pages of the paper.
- Tuesday, August 7th: I will ask for a draft. This should be a rough version of your draft. I will provide comments and edits and return it to you quickly.
- Friday, August 9th: I will ask for a final draft, i.e. the finished paper.

Schedule There will be roughly three phases of the program, during which we will follow three different daily schedules. In the first week, we will have two lectures and a problem session per day. In the second week, we will have two lectures per day and a research problem session, along with more free time. In the remaining weeks, we will have a few lectures per week and mentor-group meetings, but mostly we will be working independently on our research.

Day Schedule For Week 1

Time	Activity	Location
10:30 am - 12 pm	Morning Lecture	Evans 959
12 pm - 1 pm	Lunch Break	Anywhere
1 pm - 1:30 pm	Questions Session	Outdoors
1:30 pm - 3 pm	Afternoon Lecture	Evans 959
3 pm - 3:30 pm	Break Time	Anywhere
3:30 pm - 5 pm	Exercise Sessions	Evans 959
5 pm - ...	Dinner And Free Time	Anywhere

Day Schedule For Week 2

Time	Activity	Location
10:30 am - 12 pm	Morning Lecture	Evans 959
12 pm - 1 pm	Lunch Break	Anywhere
1 pm - 2:30 pm	Afternoon Lecture	Outdoors
2:30 pm - 3 pm	Research Problem Session	Evans 959
3 pm - ...	Open Work Time	Evans 959

Day Schedule For Weeks 3-8

Time	Activity	Location
10 am - 11 pm	Lecture Or Writing Session	Evans 959
11 pm - 4 pm	Open Work Time	Anywhere
4 pm - 5 pm	Research Meetings	TBD
5 pm - ...	Dinner And Free Time	Evans 959

Lecture Schedule This is a tentative lecture schedule for the first two weeks. It may be modified based on the results of the diagnostic. This part of the program will be an intensive overview of manifold theory and homology theory. Ideally this will give you the basic tools necessary to do research with manifolds.

#	Topic	Date/Time	Notes §
1	Introduction, Logistics/Paperwork, Diagnostic	06/18 10-12	None
2	Hamiltonian Mechanics And Geometry	06/18 1:30-3	§1.1-1.2
3	Examples Of Phenomena In Mechanics	06/19 10:30-12	§1.3-1.4
4	More Examples And Open Problems	06/19 1:30-3	§1.4-1.5
5	What Is A Manifold?	06/20 10:30-12	§2.1
6	Fiber And Vector Bundles	06/20 1:30-3	§2.2
7	Review Of Linear Algebra	06/21 10:30-12	§2.3
8	Constructions Of Bundles	06/21 1:30-3	§2.4
9	Natural Bundles On Smooth Manifolds	06/22 10:30-12	§2.5
10	Maps Of Manifolds	06/22 1:30-3	§2.6
11	Pullback, Lie/Exterior Derivatives, Integration	06/25 10:30-12	§2.7
12	Key Theorems And Examples	06/25 1:30-3	§2.8
13	What Is Homology?	06/26 10:30-12	§3.1
14	Simplicial, Singular, De Rham (Co)homology	06/26 1:30-3	§3.2-3.4
15	Features Of Singular Homology	06/27 10:30-12	§3.5
16	Relating Homology Theories	06/27 1:30-3	§3.6
17	Symplectic And Contact Manifolds	06/28 10:30-12	§4.1-4.2
18	Basic Results And Examples	06/28 1:30-3	§4.3
19	Lie Groups And Actions	06/29 10:30-12	§2.9
20	Symmetries And Moment Maps	06/29 1:30-3	§4.4