JOURNAL

COLTON GRAINGER

1. 2019-01-20

2. 2019-01-19

Worked through the motivating historical calculus in Massey's Singular Homology Theory[1] [1, Ch. 1]. (Massey develops homology theory with n-cubes rather than simplices—why? To have oriented n-cubes available as integrands? Does some argument/limiting process fail when working with an infinitesmally thickening mesh of simplices?)

I struggled with notation for repeated applications of the Fréchet derivative. It was helpful to get perspective for repeated linear transformations in the category of topological vector spaces, from Lang's Fundamentals of Differential Geometry[2] [2, Ch. 1].

In Folland, I gladly found two problems that matched gaps in my knowledge: one to do with Lagrange multipliers and the spectral theorem, the other to do with setting up a meaningful definition of higher Fréchet derivatives.

> Let A be a symmetric $n \times n$ matrix, and let $f(\vec{x}) = (A\vec{x}) \cdot \vec{x}$ for $\vec{x} \in \mathbf{R}^n$. Show that the maximum and minimum of f on the unit sphere $\{\vec{x} : |\vec{x}| = 1\}$ are the largest and smallest eigenvalues of A. **???**
>
> Suppose $f\colon \mathbf{R}^n \to \mathbf{R}$ is of class C^2; then ∇f is a C^1 mapping from $\mathbf{R}^n$ to itself. Show that $D(\nabla f)$ is the Hessian matrix of f. **???**

3. 2019-01-18

Lectures.

- Alg2: went through kernels, quotients, and started is
- Top2:
- Diffgeo1: Stated the implicit function theorem. 10.1 and 10.2 in DF02.

Found out I conditionally passed the algebra prelim, and so, made a haphazard sketch of work TODO in the future.

term	workload
He18	Algebra 1, Topology 1, StatOptML (algebra prelim)
Fr19	Algebra 2, Topology 2, DiffGeo1 (topology prelim)
So19	SIParCS, CU MRE, NSF apps
He19	Algebra (Green, Wise, Casalaina-Martin), Analysis 1, Numerics (Bradley, Meiss, Becker, Raf)
Fr20	Analysis 2, Complex Analysis, Algebraic Topology (Pflaum, Beaudry)
So20	Talbot, more NSF apps, teaching

[1] https://www.springer.com/us/book/9781468492330

[2] https://www.springer.com/us/book/9780387985930

term	workload
He20	topic proposal, advisors in MATH/APPM/CS

(Have 90% confidence that I will drop the reading course.)

4. 2019-01-17

Mostly teaching, then munging surveys I had put out to the calculus sections. I went to the first meeting for a reading course in probability/measure theory. (I then had about 0.3 confidence I would drop.)

For diffgeo1, I reviewed definitions and the chain rule in Folland's *Advanced Calculus* [3, Ch. 2.3].

5. 2019-01-16

Lectures again, worked to flesh out definitions for modules and simplices. Made progress in defining *two* functors:

- $\Delta(-)\colon \mathsf{Top} \to \mathsf{Ch}$ (by moving from graded abelian groups to chain complexes), and
- the correspondence 'tween $F[x]$-modules and F-vector spaces V with a chosen endomorphism $V \to V$.

6. 2019-01-15

Attended offices hours for top2. Asked how to distinguish the monodromy action from action of the group of deck transformations. Got permission to stop reviewing top1 (woot!) and pass onto homology.

Thought about morphisms of vector spaces from a categorical perspective. Skimmed Breezer's FCLA (elementary matrices as transformations, 4 subspaces, similar and diagonal matrices). Worked through examples (especially notation) in PCM I.3.4. Slowly began to understand why one would want eigenvector bases to study subspaces "stable" under linear transformation.

Also spent an upsetting amount of time configuring pandoc on my laptop and server. Gross. I don't even see how the software is held together. Way beyond me.

7. 2019-01-14

Started lecture notes for Topology 2[3] (top2), Differential Geometry 1[4] (diffgeo1), and Algebra 2[5] (alg2). Linearity is 4sure the unifying theme of the week. Notably, diffgeo1 made a whirlwind tour of Appendix B in Lee's *Introduction to Smooth Manifolds*.

8. 2019-01-13

I previewed syllabi and reading for the next 2 weeks.

- Homology in Hatcher, Bredon, and May;
- Modules in Dummit & Foote;
- Linear Algebra/Calculus review in Lee.

I also setup `https://cu3d.github.io`, a catalog of 3D-printed models, for the MARC.

9. 2019-01-12

Errands. Odds & ends from last semester's `todo.org`. I had a lengthy, meandering conversation with two older grad students (TK & Carly) about faculty transitions at CU in the last 6 years. I realized how convenient `https://aiwatch.issarice.com` was for summarizing rank/career changes. Not much math.

[3] `https://quamash.net/top2`
[4] `https://quamash.net/diffgeo1`
[5] `https://quamash.net/alg2`

10. 2019-01-11

More teacher training. Finished my SIParCS application[6]. Mnemosyne.

11. 2019-01-10

Attended teacher training. Finished transcribing an interview with Leah Buechley[7]. Setup duplicity with google cloud platform. Defragmented my gmail archive.

12. 2019-01-09

Took the topology prelim. Answered 3 of 6 questions in point-set and algebraic topology.

- separation properties
- applications of Seifert van-Kampen
- homotopy groups of real projective space

Talked to TK: what to review for differential geometry?

- multilinear forms up to the definition of a tensor product
- implicit and inverse function theorems

13. 2019-01-08

More chores, etc. I installed KeePassX.

14. 2019-01-07

As a chore and measure of progress, I attempted the algebra prelim.

- I struggled to understand possible group actions of Q_8 on $\{1, \ldots, n\}$. In a dilemma, I wrote out a treacherously long table of conjugacy classes for S_n, $n = 4, \ldots, 7$ and made a confusing argument about normal subgroups as unions of conjugacy classes.
- Afterwards, Andre and I discovered a one-liner to show "$Q_8 \leq S_n$" is absurd for these cases.

  > When Q_8 acts on I_n for $n < 8$, the stabilizer of any point in I_n contains -1, whence -1 is in the kernel of the action.

- Also afterwards, when I needed to determine which primes in $\mathbf{Z}$ were also Gaussian primes, I found myself impressed with Weissstein's MathWorld[8].
- I expect the Slack channel Chris and I were using to study will soon be defunct.
- To shift gears for topology, I passed over a survey: PCM IV.10[9].

15. 2019-01-06

Chris and I ran through Micky's group theory notes. I discovered Zassenhaus' The Theory of Groups[10] and skimmed through chapter IV on p-groups and Sylow p-groups.

To de-stress before the prelim, I browsed the OED for historical uses of `morphism`, `quaternion`, `group`, `ring`, `field`. (I found Zassenhaus under `quaternions`.)

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[6] `https://github.com/coltongrainger/internships/blob/master/statements/siparcs-climate-models.md`
[7] `https://github.com/coltongrainger/neural-network/blob/master/posts/2018-09-10-leah-buechley.md`
[8] `https://en.wikipedia.org/wiki/MathWorld`
[9] `http://catdir.loc.gov/catdir/toc/ecip0818/2008020450.html`
[10] `https://books.google.com/books?id=_lOycgz7bQYC`

16. 2019-01-05

I continued to atomicize mnemosyne cards by expanding "naive" procedural topics from the GRE. I went through a proof of Sylow's theorems and thought about the conjugation and left translation action of a group G on its p-groups.

17. 2019-01-04

Chris and I sat for a timed practice exam[11], adapted from Ed Dummit's 2014 algebra summer enhancement program[12]. I feel silly taking the exam before I know what I'm doing, but

- there's a timeline, and
- our dept chair emphasizes "trusting oneself"[13] to seek out "new challenges and novel contexts".

Her accompanying advice is, of course, to "doubt oneself" and "build what you know", which I look forward to reverting to after next week.

I compiled Micky Steinberg's 2014 group theory notes[14] into a light-hearted practice exam[15] for tomorrow.

18. 2019-01-03

Chris talked me through problems 1–3 on CU's Jan 2008 algebra prelim[16], which I didn't understand. For prob 2, we needed to make a recursive argument to find a nontrivial abelian normal subgroup of prime power order in a finite solvable group. Ian also mentioned this problem (with enthusiasm) before break, so I might revisit it.

I started reviewing from Hubbard[17], following the week 1[18] schedule for Paul Bamberg's Math 23a[19]. (The supplemental materials for math 23a are great, and I think I'll exhaust most of my free time before Jan 14 going over these.)

Lastly, I went through exercises in I.1 Fields from Halmos's Finite Dimensional Vector Spaces[20], which is admittedly out of date. I'm going through Halmos, however, because

- I found a hardcopy in the math dept's reading room, and
- I was impressed when I skimmed Halmos's and Steenrod's[21] 1973 *How to Write Mathematics*.

19. 2019-01-02

Distracted today: I setup yst to compile yaml data into a CV[22], as per Dom Moritz's `https://domoritz.de/cv/`. Dom's job-hunting stress thoroughly dosed me (by proxy) with timeline stress, and, incidentally, I spent the day "signalling".

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[11] `https://github.com/coltongrainger/fy19alg1/blob/master/2019-01-04-algebra-sep-practice.md`
[12] `https://sites.google.com/a/wisc.edu/math-intranet/home/quals`
[13] `http://math.colorado.edu/~kstange/gradstudy.pdf`
[14] `https://www.math.wisc.edu/~micky/grouptheory.pdf`
[15] `https://github.com/coltongrainger/fy19alg1/blob/master/2019-01-05-algebra-micky-practice.md`
[16] `https://github.com/coltongrainger/prelims/blob/master/2008-01-15-cu-algebra-prelim.pdf`
[17] `http://matrixeditions.com/5thUnifiedApproach.html`
[18] `https://canvas.harvard.edu/courses/45219/pages/weekly-schedule`
[19] `https://canvas.harvard.edu/courses/45219/files/6701269/download?verifier=Yvcu1AARsTzhWbCTmjtM2cT0BWA4sCCxBS3VftOE&wrap=1`
[20] `https://www.springer.com/us/book/9780387900933`
[21] `https://news.ycombinator.com/item?id=16829440`
[22] `https://coltongrainger.com/cv`

20. 2019-01-01

I revised cards on introductory measure theory, also group actions. I continued through a backlog of reviews I owed mnemosyne from last semester.

(Oddly as well, I flicked through photos from 2018 back to the beginning of 2016, when I was skiing a bit and preparing to graduate. From my undergraduate coursework, maybe I'm only interested to mnemo-fy notes from electricity and magnetism? from ordinary differential equations?)

21. 2019-12-31

I spent some time convincing myself that "chunking mathematical concepts" would be more rewarding "completing prerequisites in a satisfactory order" after reading Michael Nielsen's essay on anki[23]. I reactivated mnemosyne cards[24] I had made studying for the math GRE.

While revising cards I had starred for typos, I began to recognize I'd been trying to chunk concepts that were too complex for a first pass. (I found a particularly bad batch of measure theory cards—should delete these or just atomicize them?)

22. 2018-12-30

I finished `https://prooflogger.quamash.net`, which I hope Lee will allow me to force some of the calculus sections to use. Here[25] is an outline I'd give students. I aim to game students into presenting proofs to each other and providing constructive oral feedback.

23. 2018-12-29

I thought about social support networks while travelling from Idaho back to Boulder, specifically cohorts[26].

24. 2018-12-27

Following `https://nadiaeghbal.com/notes`, `https://issarice.wordpress.com/`, and `https://youtu.be/M2pGiBrw-Ns?t=422` I'm starting a working journal with a broad scope: early graduate school in the mathematics department at CU Boulder.

I haven't gotten permission to emulate any one of these authors, so I'm sort of planning to write in a manner that oscillates between each's style. In spite of the common medium (˜daily entries) it seems each author's motivation is tangential to the other two's: writing for exploration, for transparency, for reflection.

I imagine I will be keeping this journal

- to narrate what I've been working on in a chronological fashion,
- to give myself encouragement by tracking progress through my coursework,
- to urge myself on (as in ski-racing, where we'd often yell at each other "up up up!").

I think it would be appropriate to include characteristic quotes, which motivate this journal.

Nadia Eghbal (notes[27])

> 11/26/18
>
> Realizing that I love to be alone, like in a physically low-stimulation environment, but I still think of myself as socially oriented even in that context. I still like texting/FaceTiming friends. And: I only want to be alone to work on ideas that I eventually take back to others. Like, if I were just writing for the sake of writing and not publishing it out, I'd probably get pretty bored and antsy

[23] `http://augmentingcognition.com/ltm.html`
[24] `https://quamash.net/maths-GRE`
[25] `https://quamash.net/math1300#participation`
[26] `http://www.pgbovine.net/PG-Vlog-252-cohort-effects.htm`
[27] `https://nadiaeghbal.com/notes/`

11/26/18

> Amplification vs. exploration: Usually I say that I prefer writing to talks/interviews bc I can think better through writing over speaking. But I think another big reason is bc people often want you to talk about stuff you've already done, which is not that interesting to me. Whereas with blog posts, it's my blog, I don't really care if you read it or not, I'm just putting stuff out there and hopefully connecting with a few ppl who feel the same way. To me, writing is pushing to the edges, exploring the limits of my identity and what I'm comfortable sharing in public. Whereas any other form of communicating ideas feels performative: I'm rehashing things I already know, and that you know me for. Also why I had to get off Medium (bc it made blogging feel performative)

Issa Rice (a note on scope of updates[28])

> As I stated at the beginning, this blog came about because I wanted to make available information about "what I'm up to" in cases where "what I'm up to" doesn't naturally lead to public updates. So I think it's not so important to record things on here when the same information can be obtained through other sources (i.e. my public activity on other websites).
>
> However, I also want to have some kind of conceptual coherence about this blog. And since the overlap between "my activity that doesn't naturally lead to public updates but where I would like to make public updates available" and "my AI safety learning" is nearly perfect, I think I will track the former by writing about the latter.

Philip Guo (vlog transcript, talking about his journal[29])

> anyways so when I started my postdoc I thought of this idea I don't know how I thought of it but I thought this idea that I would just keep a running diary of anything that I've encountered that to work-related that I felt like writing down. so it was very simple. I created a text file. this is my first one (reading it) this is really funny I'm just reading this. this is July 2013, my first month as a postdoc.
>
> > July 2013 I'm going to start a rough weekly work diary reflecting on my thoughts about life as a young academic. I need to focus more on how I feel rather than what I did since it's easy to later reconstruct what I did from other artifacts but it's hard to recreate old feelings. this diary is gonna be quite rough and I don't want to hold myself to a strict writing schedule. let's keep this fairly freeform and low-key.
>
> once again in parentheses I said: focus on how I feel rather than just what I did

[1] W. S. Massey, *Singular Homology Theory*. New York: Springer-Verlag, 1980.

[2] S. Lang, *Fundamentals of Differential Geometry*. New York: Springer-Verlag, 1999.

[3] G. Folland, *Real analysis*. John Wiley & Sons, Inc., New York, 1999.

[28] https://issarice.wordpress.com/2018/12/01/a-note-on-scope-of-updates/

[29] https://youtu.be/M2pGiBrw-Ns?t=272