One-Dimensional Computational Topology

Jeff Erickson

Foreward$^\alpha$

This book consists of lecture notes from a special-topics class on topological graph algorithms that I have taught several times at the University of Illinois. These lecture notes (and other course materials) are available under a Creative Commons Attribution license (CC BY 4.0).

Figure 1: CC BY 4.0

I drafted most of these notes in Fall 2020 and revised them in Spring 2023; a handful of chapters (13, 16, 26, 27, 29, 30) were first drafted in Spring 2023. Even after a second round of revision, these are all still very rough drafts. Most of the missing chapters either cover material I did not discussed in class, or cover material from my own research papers.

I've *attempted*, with various degrees of success, to write the first draft of each note to exactly cover one 75-minute lecture, to force myself to prioritize the most fundamental results, sometimes at the expense of technical details, prerequisite material (like point-set topology or dynamic-forest data structures), accurate reflection of the state of the art, and historical anecdotes. Later revisions tend to include more technical details that I don't actually cover in lecture, except to say "You can find more details in the notes." In practice, I can cover at most 5 pages of material in detail in one lecture (and each semester has only 25 lectures).

Similarly, I am writing these notes in Markdown instead of LaTeX, in part to intentionally focus my time on *writing* instead of typography, and in part to make the final output more accessible by producing HTML and ePub versions. As a result, the notes are typographically rather awkward/ugly. Some day I will figure out how to use Pandoc templates and filters, or better yet, a more modern system like Quarto. (Real Soon Now, Honest.) For similar reasons, many notes are embarrassingly short on figures and/or references.

I think I'm about 2/3 of the way to a complete first draft of an actual book. I'm reasonably happy with the current *set* of chapters, plus or minus one, but less so about their order, especially in the last third. If I stick to the current outline, the final book should be just over 400 pages long in its current format (or about 600 pages in a more book-friendly format). Depending their degree of completion, each chapter titles has one of the following annotations:[1]

- $\varnothing$: mostly (or completely) unwritten
- α: mostly written, but missing significant details, or only used once

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[1] I would like to include a section describing related state-of-the-art results at the end of each chapter. These annotations ignore those missing sections.)

- β: reasonably polished, but possibly missing some minor details
- δ: complete and totally polished (so needs only five more rounds of copy editing)
- Nothing: actually done

Once I have a complete draft of the entire book, I plan to make the source files available on Github to attract bug reports, feature requests, and pull requests. Stay tuned!