Mathematics Textbooks with Open Licenses

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  - Possibly: the right to distribute modifications
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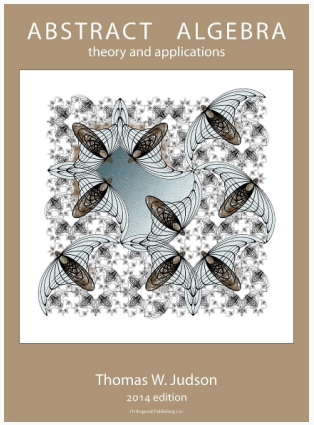
An Open Textbook, Online

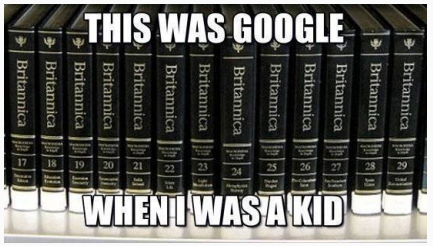
Abstract Algebra: Theory and Applications, by Tom Judson

- #2 in Google "`abstract algebra`"
- Openly licensed
- Hardcopy: R 300 (USD 25)
- PDF download: Free! (Legally!)
- Online: Includes Sage Cell examples



Web Versions of Open Textbooks

- Portable: 64 GB is
  - 64 Encyclopedia Britannica (text)
  - 1 English Wikipedia (text)
  - 10,000 400-page math textbooks (w/ images)
- Ubiquitous: laptop, tablet, or phone
- Up-to-Date: correct, and refresh, at will
- Accurate: crowd-sourced proof-reading
- Open: never out-of-print
- Intellectually Honest:
  no pressure to satisfy market segments
- **FREE!!!!!**

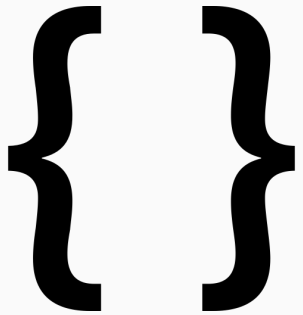


Proprietary Electronic Textbooks

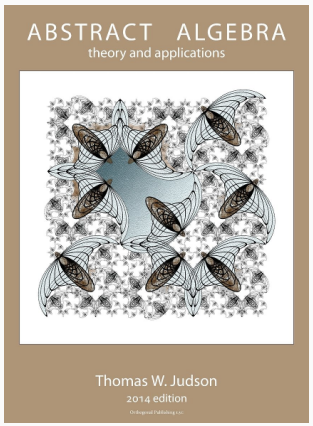
- Expire after course
- Limited printing
- Inconvenient interfaces
- Difficult to resell
- Page-oriented (ala PDF)

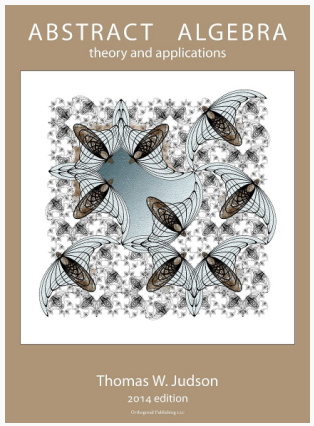
Interactive Web Versions

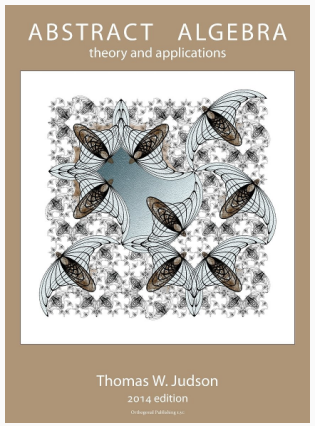
- Extensive cross-referencing, index
- Information hiding ("knowls")
- Acessibility features
- MathJax for math, Google for fonts
- Integrated Google Search
- Embedded YouTube Videos
- Interactive demonstrations: Sage, Python, GeoGebra, CalcPlot3D, Desmos, JSXGraph
- Live, instant-response, homework: WeBWorK, MyOpenMath, two others in development
- Offline? PDF, EPUB, or talk to me

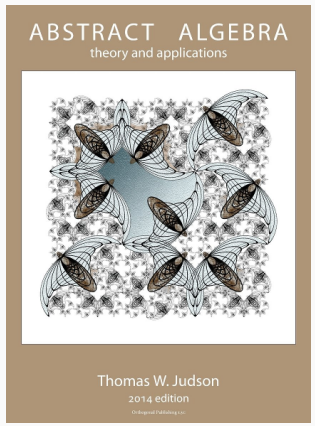


ABSTRACT ALGEBRA DEMONSTRATION









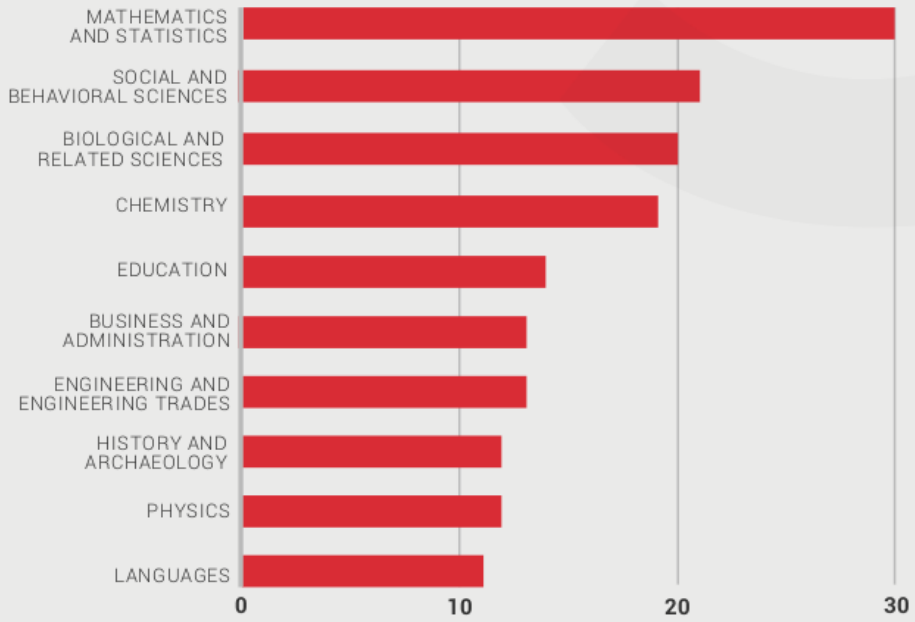
The Movement

SPARC Report, Connect OER 2016-17

KEY INSIGHT #3: MATHEMATICS AND STATISTICS IS THE ACADEMIC SUBJECT WITH THE MOST OER TRACTION

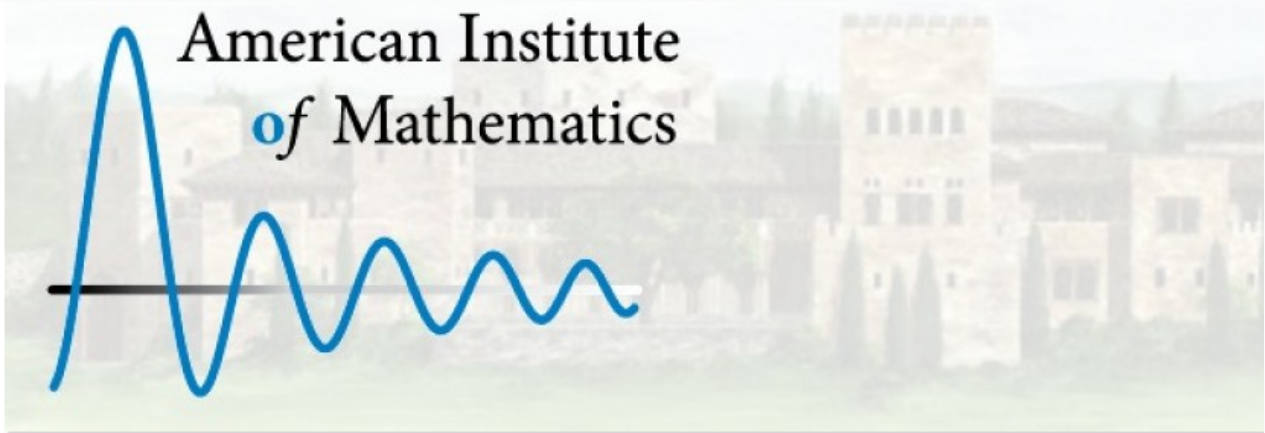
Institutions were asked to note which academic subjects had the greatest OER traction. Amongst the 65 institutions that answered this question, mathematics and statistics ranked the highest with nearly half (30) indicating it had traction, followed by social and behavioural sciences (22), biological and related sciences (21), and chemistry (20). Figure 6 depicts the top 10 academic subjects with the most OER traction.

Figure 6. Top 10 academic subjects with the most OER traction.



SPARC SPARC SPARC SPARC SPARC

American Institute of Mathematics (AIM)



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Approved Textbooks • Evaluation Criteria • Guide for Authors • Editorial Board

Approved Textbooks

The list below groups open textbooks by course title. All the books have been judged to meet the evaluation criteria set by the AIM editorial board.

- Liberal Arts Math
- College Algebra and Precalculus
- Calculus
- Differential Equations
- Linear Algebra
- Introduction to Proofs
- Discrete Math
- Combinatorics
- Mathematical Computing
- Numerical Analysis
- Abstract Algebra
- Number Theory
- Real Analysis
- Complex Analysis
- Geometry and Topology
- Probability
- Statistics
- Logic

AIM Open Textbook Initiative

Approved Textbooks

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- Liberal Arts Math
- College Algebra and Precalculus
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- Differential Equations
- Linear Algebra
- Introduction to Proofs
- Discrete Math
- Combinatorics
  - *Applied Combinatorics*
    Mitchel T. Keller and William T. Trotter
  - *Combinatorics Through Guided Discovery*
    Kenneth Bogart
  - *Foundations of Combinatorics with Applications*
    Edward A. Bender and S. Gill Williamson
- Mathematical Computing
- Numerical Analysis
- Abstract Algebra
- Number Theory
- Real Analysis
- Complex Analysis
- Geometry and Topology
- Probability
- Statistics
- Logic






Bogart's Combinatorics Through Guided Discovery

Combinatorics Through Guided Discovery

Kenneth P. Bogart

Digital versions	PDF and HTML
PreTeXt source	Yes
Exercises	Yes
Solutions	Solution manual available to instructors
License	GNU Free Documentation License

- Text for a first course in combinatorics
- Copyright 2004 by author
- 200 pages, 6 chapters, 3 supplemental sections
- Over 400 exercises, many with hints
- Paperback version available for about $9
- For more information and to access PDF or online version

As the title suggests this book is designed for a "discovery method" course. The heart of the book is the hundreds of exercises that guide the student through the key ideas of enumerative combainatorics and a brief introduction to graph theory. The exercises are marked with special symbols to indicate their role in the course, for example, whether they are essential or motivational. The chapter titles are

1. What is Combinatorics?
2. Applications of Induction and Recursion in Combinatorics and Graphy Theory
3. Distribution Problems
4. Generating Functions
5. The Principle of Inclusion and Exclusion
6. Groups Acting on Sets

The three supplmental sections deal with relations, mathematical induction, and exponential generating functions.

This book is the result of an NSF project led by Ken Bogart and is currently maintained by the Mathematics Department of Dartmouth College.

PreTeXt

PreTeXt Authoring Language

- Philosophy: **rigorously** separate
  - structure and content
  - presentation

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- Realization:
  - structure: an XML vocabulary
  - not Markdown, ASCIIDoc, JSON
    YAML, MediaWiki, Pandoc, ...
  - math content: still LaTeX (AMS Math)

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  - math content: still LaTeX (AMS Math)
- Payoff:
  - multiple outputs from a single source
  - powerful and flexible processing with eXtensible Stylesheet Language (XSL)
  - author with your favorite text editor
  - cross-platform open-source toolchain

New Author-Friendly XML Vocabulary

- Sensible element names
  - book, chapter, section, subsection
  - theorem: title, statement, proof
- Sensible abbreviations
  - p, ul, ol, dl, li, q, em
  - m, me, md/mrow
- Consistent element use
  - title
  - introduction
  - xref, xml:id
- Only three dangerous characters: &, <, >
- Simple rules for special (escaped) characters
- Schema for element relationships, validation

PreTeXt Example

```
<theorem xml:id="power-rule">
    <title>Power Rule</title>
    <idx>power rule</idx>

    <statement>
        <p>The derivative of <m>f(x)=x^n</m>
        is <m>f'(x)=nx^{n-1}</m>.</p>
    </statement>

    <proof>
        <p>Apply induction to the product
            <me>f(x)=x^n=x\cdot x^{n-1}</me>
        using <xref ref="product-rule"/>.</p>
    </proof>
</theorem>
```

Theorem 4.4 (Power Rule)**.** *The derivative of* $f(x) = x^n$ *is* $f'(x) = nx^{n-1}$.

Proof. Apply induction to the product

$$f(x) = x^n = x \cdot x^{n-1}$$

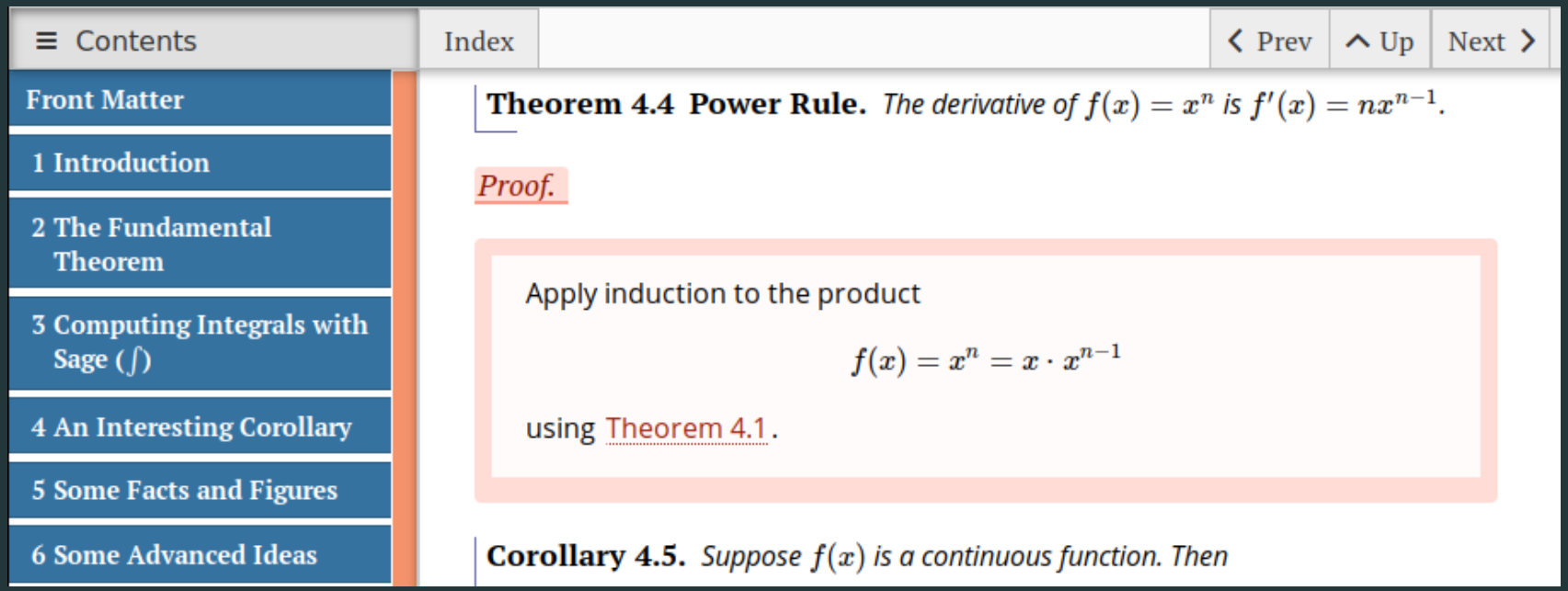
using Theorem 4.1. □

Theorem 4.4 (Power Rule). *The derivative of* $f(x) = x^n$ *is* $f'(x) = nx^{n-1}$.

Proof. Apply induction to the product

$$f(x) = x^n = x \cdot x^{n-1}$$

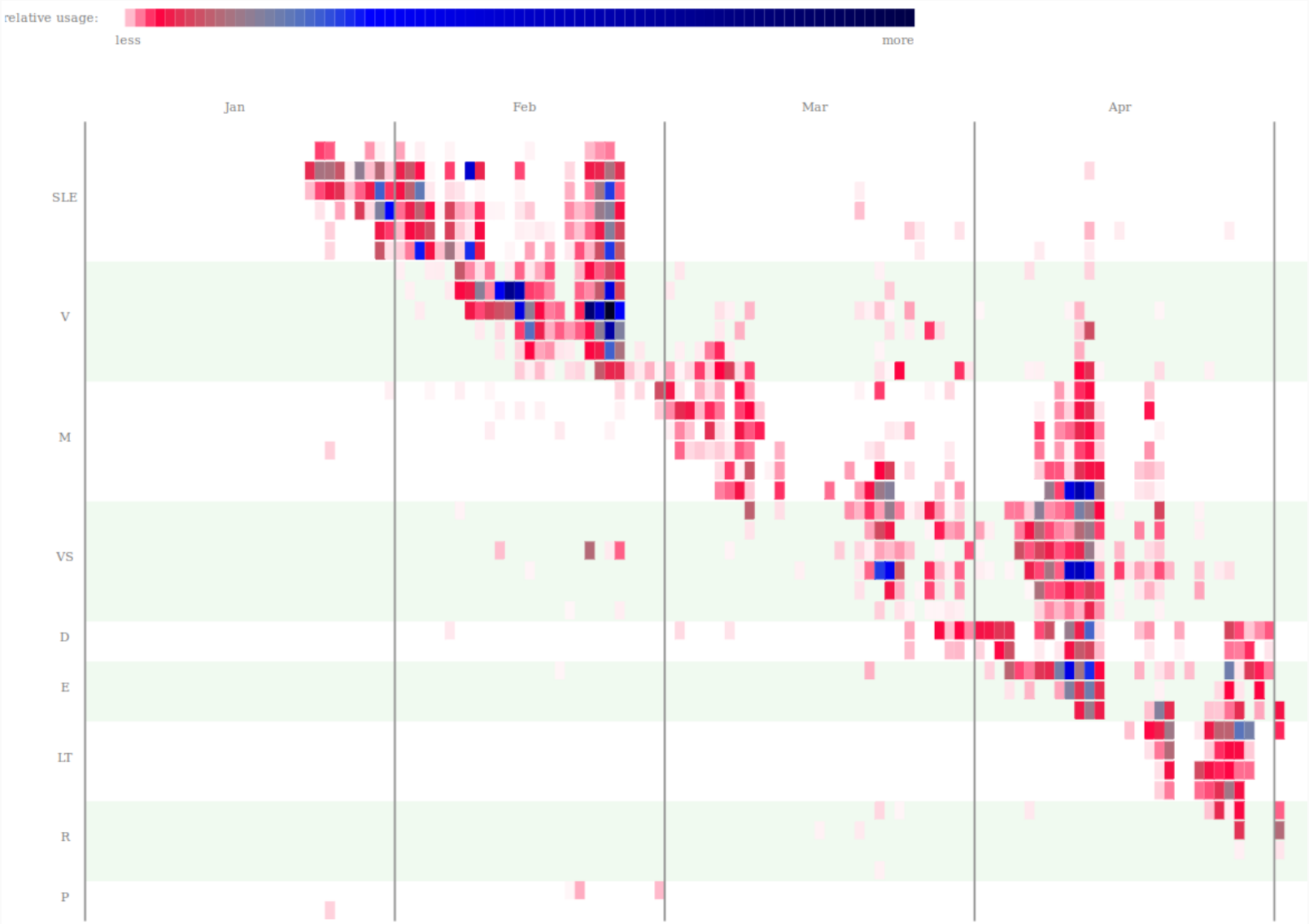
using Theorem 4.1. □



What's New?

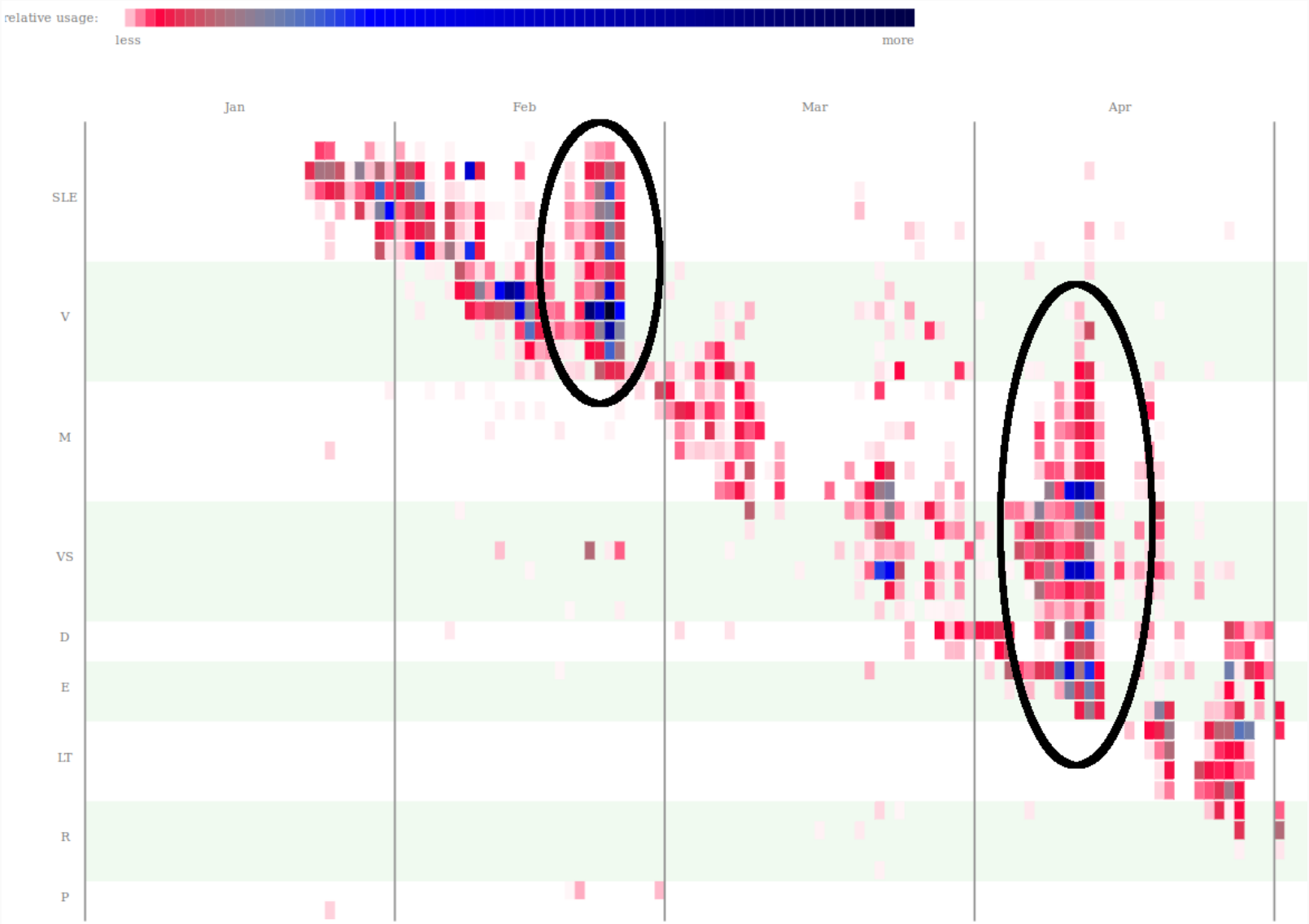
Textbook Use: All Students for Entire Semester

Rows are sections, columns are days



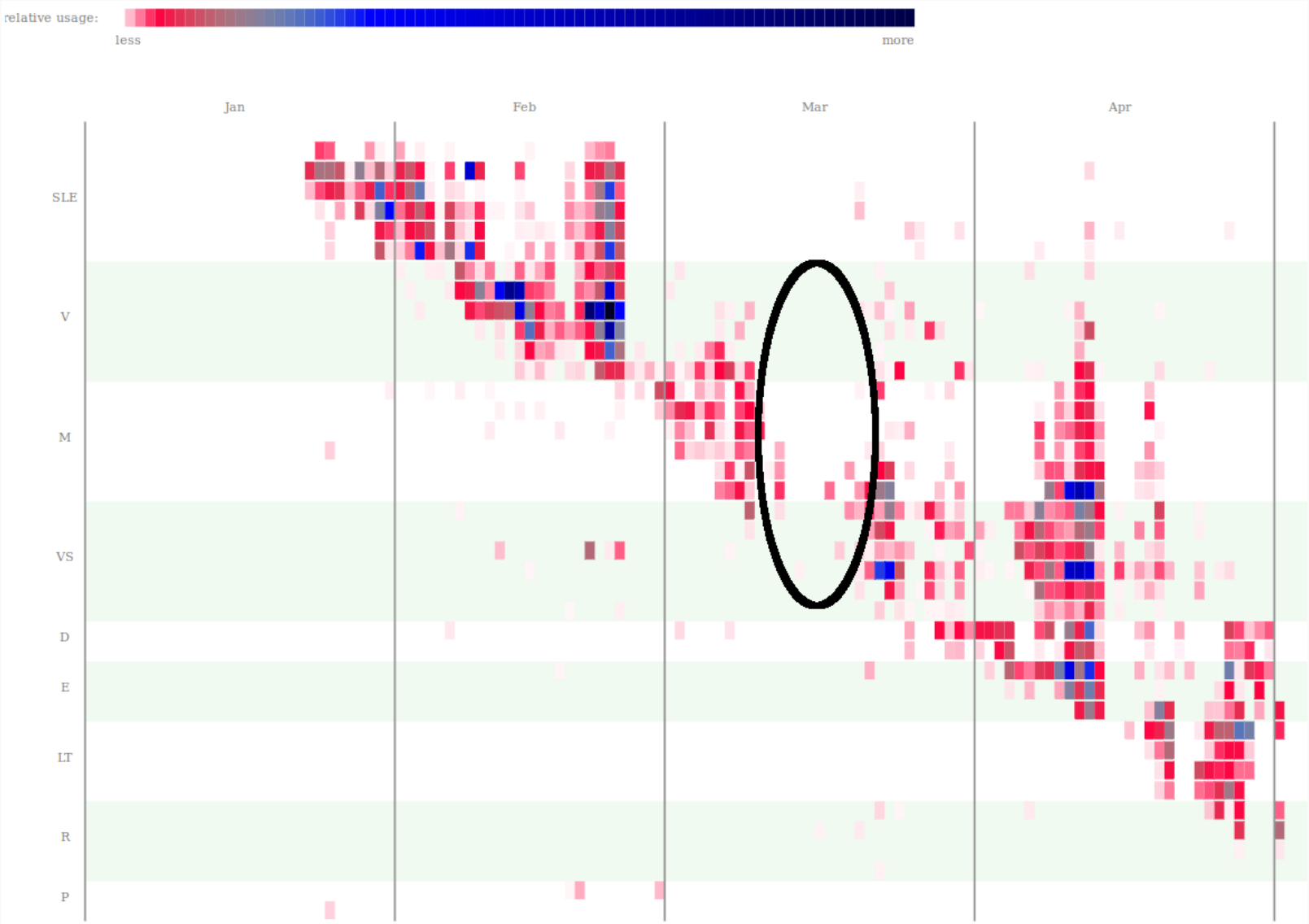
Textbook Use: Exams

Rows are sections, columns are days



Textbook Use: Spring Break!

Rows are sections, columns are days



Thank-you for your attention

PreTeXt: `mathbook.pugetsound.edu`

`buzzard.pugetsound.edu/talks.html`

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