PRETEXT

WRITE ONCE, READ ANYWHERE

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INTRODUCTION

WHAT IS PRETEXT?

- An authoring and publishing system:
  - Extensive support for mathematics (and STEM)
  - Designed to create openly licensed materials
- An abstract specification of a scholarly document
- Implementations of conversions to various formats
- A modern replacement for LaTeX
- A commitment to creating accessible materials
- A community of instructors, authors, and publishers

HISTORY

- A First Course In Linear Algebra: textbook born with an open license (2004)
- PreTeXt: initiated with a Shuttleworth Flash Grant (2013)
- Teaching at AIMS-ZA with open textbooks and Sage (2010-2018)
- UTMOST—US NSF-supported research studies (2010-14, 2016-22)
- Braille: National Federation of the Blind, American Institute of Mathematics (2019, 2020)

READ ANYWHERE

KEY IDEA

The PreTeXt authoring language captures an author's intent and document structure, AS THE AUTHOR WRITES.

An author concentrates on CONTENT and is not able to influence PRESENTATION.

PDF, FOR PRINT AND SCREEN

- Via LaTeX, two slightly different PDFs are possible.
- Electronic is different than hardcopy print.
  - Active links, colored?
  - Color versus B/W
  - One-sided v. two-sided
  - Page size, margins

EPUB

- A superior offline format
- On desktops or laptops
- Or on tablets or dedicated devices
- Example: Foliate reader on Linux

5.2 Dihedral Groups

Another special type of permutation group is the dihedral group. Recall the symmetry group of an equilateral triangle in Chapter 3. Such groups consist of the rigid motions of a regular n-sided polygon or n-gon. For $n = 3, 4, \ldots$ we define the ***nth dihedral group*** to be the group of rigid motions of a regular n-gon. We will denote this group by D_n We can number the vertices of a regular n-gon by $1, 2, \ldots, n$ (Figure 5.2.1). Notice that there are exactly n choices to replace the first vertex. If we replace the first vertex by k then the second vertex must be replaced either by vertex $k+1$ or by vertex $k-1$ hence, there are $2n$ possible rigid motions of the n-gon. We summarize these results in the following theorem.

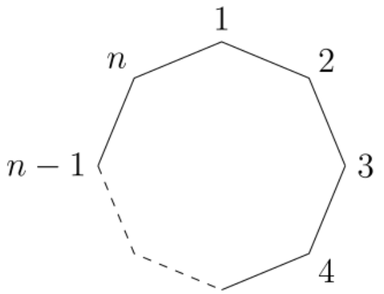


Figure 5.2.1. A regular n-gon

Theorem 5.2.2. *The dihedral group, D_n is a subgroup of S_n of order $2n$*

Theorem 5.2.3. *The group D_n $n \geq 3$ consists of all products of the two elements r and s satisfying the relations*

$$r^n = 1$$
$$s^2 = 1$$
$$srs = r^{-1}.$$

Proof. The possible motions of a regular n-gon are either reflections or rotations (Figure 5.2.4). There are exactly n possible rotations:

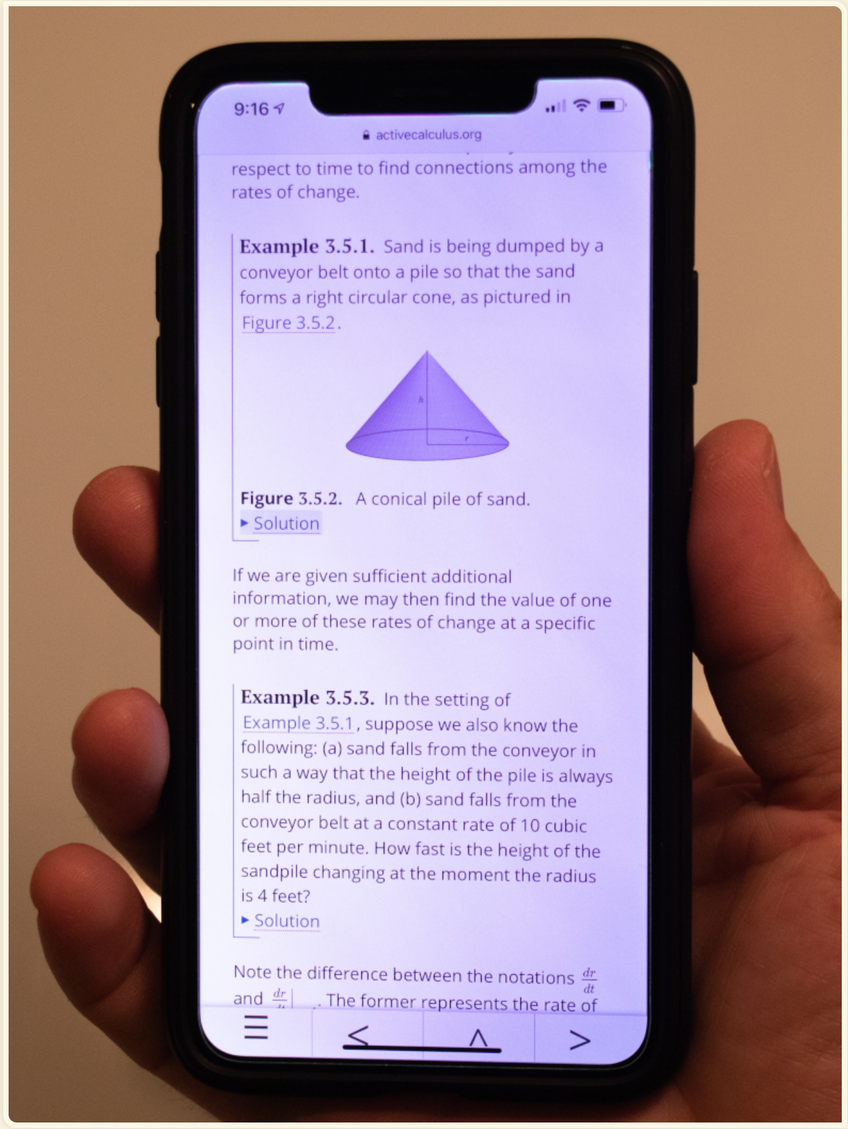
$$\text{id}, \frac{360^\circ}{n}, 2 \cdot \frac{360^\circ}{n}, \ldots, (n-1) \cdot \frac{360^\circ}{n}.$$

We will denote the rotation $360^\circ/n$ by r The rotation r generates all of the other rotations. That is,

$$r^k = k \cdot \frac{360^\circ}{n}.$$

HTML

- Everybody's favorite
- Takes advantage of HTML, CSS, Javascript
- Works well on small screens
- Accessible: works well with screen readers
- Math is powered by MathJax
- Many interactive features
- Principle #6: PreTeXt makes use of the full capabilities of the Web.



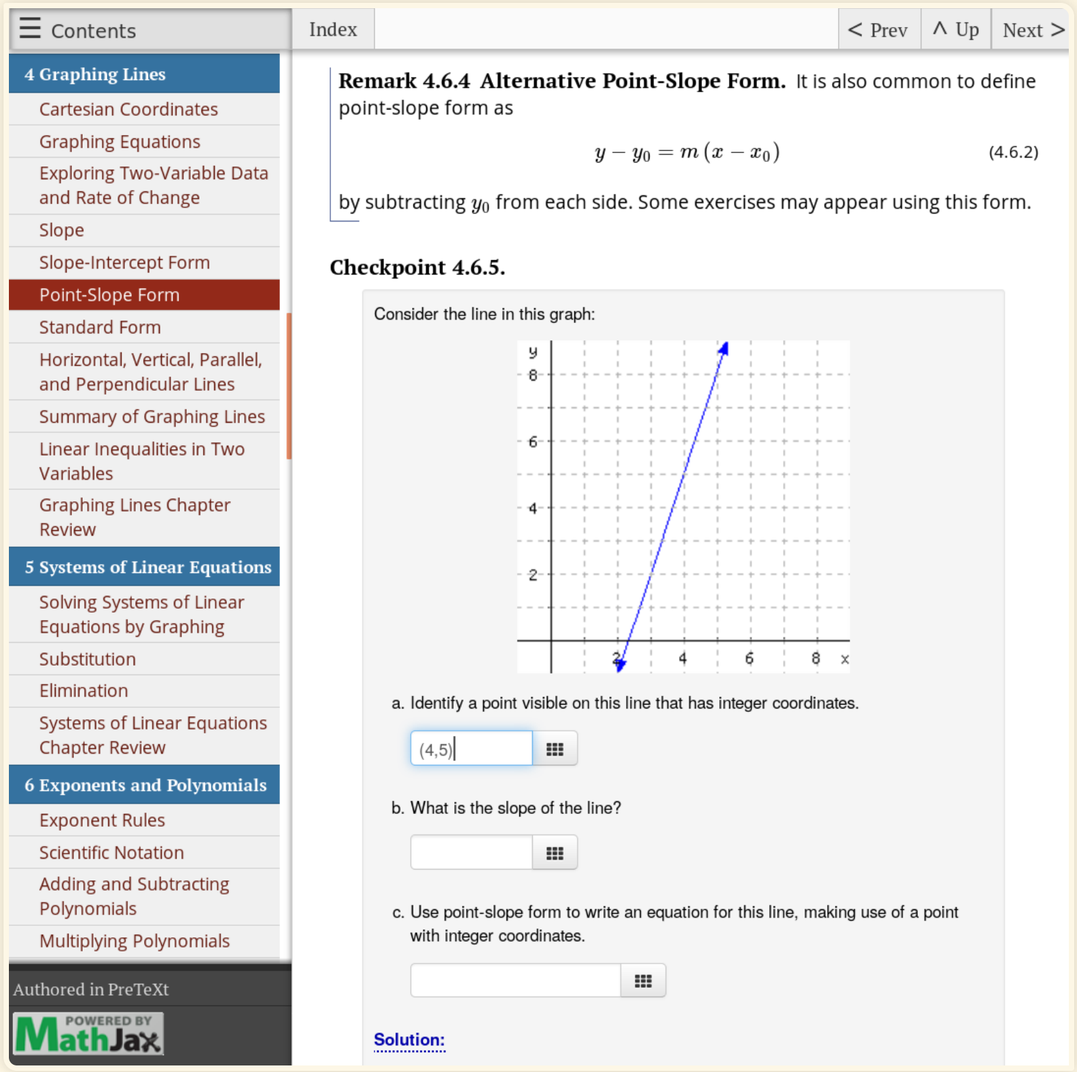
DEMONSTRATIONS

Judson's Abstract Algebra: Theory and Applications

ORCCA: Open Resources for Community College Algebra (Portland Community College)

INTERACTIVE ASSESSMENTS

- Author WeBWorK problems within PreTeXt source
- Host PreTeXt book on Runestone, with login and LMS
- More question types coming:
  - short answer, essay
  - multiple choice
  - true/false
  - fill-in
  - etc.
- MyOpenMath: preliminary, PreTeXt “endpoint”
- NUMBAS, STACK?



BRAILLE

Principle #11: PreTeXt recognizes the inherent value in producing material that is accessible to everyone.

- MathJax makes Nemeth braille
- `liblouis` makes braille for literary text
- `liblouis` formats an embossed page
- One-line (electronic) display is also possible
- PreTeXt makes this integration possible
- Working on tactile graphics for diagrams with labels
- This talk could be converted to braille!

BRAILLE EXAMPLE

A slide from a recent talk

```
     ,slide #d ,:y ,make ,mat}ials
              ,a3essible8

  ,w#c ,web ,a3essibil;y ,9itiative
"<,,wcag #b4j1 ,,iso_/,,iec #djejj">
  ,! ,web is funda;tally design$ to "w =
all p1 :at"e _! h>dw>e1 s(tw>e1
language1 loca;n1 or abil;y4 ,:5 ! ,web
meets ? goal1 x is a3essible to p ) a
div}se range ( he>+1 move;t1 si<t1 &
cognitive abil;y4
  ,?us ! impact ( 4abil;y is radically
*ang$ on ! ,web 2c ! ,web removes b>ri}s
to communica;n & 9t}ac;n t _m p face 9 !
physical _w4 ,h{"e1 :5 websites1
applica;ns1 te*nologies1 or tools >e
badly design$1 !y c cr1te b>ri}s t
exclude p f us+ ! ,web4
  ,a3essibil;y is ess5tial = develop}s &
organiza;ns t want to cr1te hi<-qual;y
websites & web tools1 & n exclude p f
us+ _! products & s}vices4
```

JUPYTER NOTEBOOKS

- Computational notebook format
- Popular in data science community
- We support a Sage kernel
- Conversion could use some attention

WRITE ONCE

THE PRETEXT LANGUAGE

- **PHILOSOPHY**
  - Structure and content
  - VERSUS
  - Presentation
- **REALIZATION**
  - Structure: an XML vocabulary (eXtensible Markup Language)
  - Not Markdown, ASCIIDoc, JSON, YAML, MediaWiki, Pandoc, ...
  - Math content: still LaTeX syntax (AMS Math)
- **PAYOFF**
  - Multiple outputs from a single source
  - Powerful and flexible processing with XSL (eXtensible Stylesheet Language)
  - Author with your favorite text editor
  - Cross-platform open-source toolchain
  - Principle #3: PreTeXt documents serve as a single source which can be easily converted to multiple other formats, current and future.

AN AUTHOR-FRIENDLY XML VOCABULARY

- `<book>`, `<chapter>`, `<section>`, `<subsection>`
- `<theorem>`: `<title>`, `<statement>`, `<proof>`
- `<p>`, `<ul>`, `<ol>`, `<dl>`, `<li>`, `<q>`, `<em>`
- `<m>`, `<me>`, `<md>`/`<mrow>`
- Extensive cross-reference support
- Excellent index creation
- Consistent element use
  - `<title>`
  - `<introduction>`
  - `<xref>`, `@xml:id`
- \, $, {, }, _, ^, %, # authored normally (regular and verbatim text)
- Accented characters fine in Unicode (e.g. French)
- Only two dangerous characters: < and &
- (Authored as < and &)

STRUCTURE OF SCHOLARLY DOCUMENTS

- Principle #1: PreTeXt captures the structure of textbooks and research papers
- *Strictly* separates content and style
- `<book>`, `<article>`, `<memo>`, `<slideshow>`, ...
- `<chapter>`, `<section>`, `<subsection>`, ...
- `<example>`, `<remark>`, `<theorem>`, ...
- `<figure>`, `<table>`, `<listing>`, ...
- Mathematics: LaTeX inside `<m>`, `<me>`, `<md>`
- Slideshow: `<slideshow>`, `<section>`, `<slide>`, ...
- Principle #2: PreTeXt is human-readable and human-writable.

PRETEXT XML EXAMPLE

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

    <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>
```

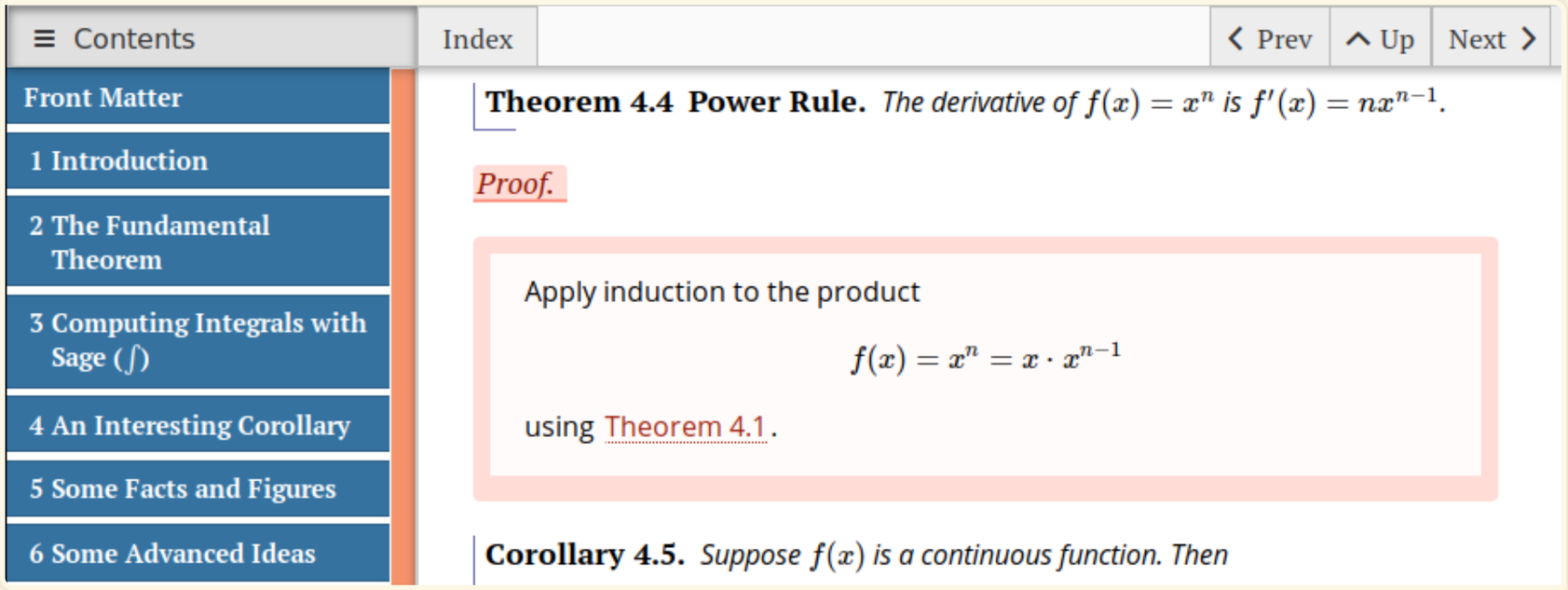
EXAMPLE OUTPUT

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. □



COMMUNITIES AROUND TEXTBOOKS

PreTeXt does not have “users”. Instead there are:

- Students and Readers
- Instructors
- Authors
- Publishers

Principle #10: PreTeXt recognizes that scholarly documents involve the interaction of authors, publishers, scholars, instructors, students, and readers, with each group having its own needs and goals.

CONCLUSION

Principle #8: PreTeXt is free: the software is available at no cost, with an open license. The use of PreTeXt does not impose any constraints on documents prepared with the system.

Links

- pretextbook.org
- buzzard.ups.edu/talks.html
- Twitter: #PreTeXtGang

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