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Author Guidelines for Preparing Accessible Mathematics Content

Version 1.1: May 6, 2026

Introduction

These *Author Guidelines for Preparing Accessible Mathematics Content* were drafted as a joint collaboration between the American Mathematical Society (AMS), European Mathematical Society (EMS), London Mathematical Society (LMS), and SIAM (Society for Industrial and Applied Mathematics). They are designed to provide concise guidance and examples to help authors prepare accessible mathematical content for books, journals, and other scholarly outputs.

Scholarly works made available in the EU and US are legally required to be accessible under the European Accessibility Act (from June 28, 2025) and an Update to Title II of the Americans with Disabilities Act (ADA) (from April 24, 2026).

Authors must therefore ensure that their content is written in compliance with the W3C WAI (World Wide Web Consortium - Web Accessibility Initiative) guidelines. If you have any feedback or suggestions to improve these guidelines, please contact your publisher.

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Contents

Key principles

Most high-level mathematical content involves "complex images" as defined under the W3C WAI guidelines. These author guidelines provide further specific guidance in this regard.

The following key principles should be followed:

- **Think about accessibility when you are creating your content**, i.e., aim to have born-accessible content, rather than content that has to be remediated after being created.
- When writing, **ensure any complex figure is always fully explained in the body text**.
- **Every complex figure** (whether numbered or not, and whether inserted using `\includegraphics` or a code-generated figure) **must always include** the following:
  - **Informative body text, title, and caption** that clearly convey the takeaway/outcome for the figure and
  - **Short alt text** (i.e., 'alternative text' or 'alt text') that
    - Describes the type of image,
    - Describes a short summary of the key points, and
    - Includes a reference to the location in the body text, figure title, and/or caption that provides comprehensive information.

For short alt text details and instructions, see the 'Short alt text…' sections.

While these author guidelines focus on Complex Images, the W3C WAI guidelines also describe other image types. To help categorize your image, use this alt decision tree.

Preparing a convertible LaTeX source file

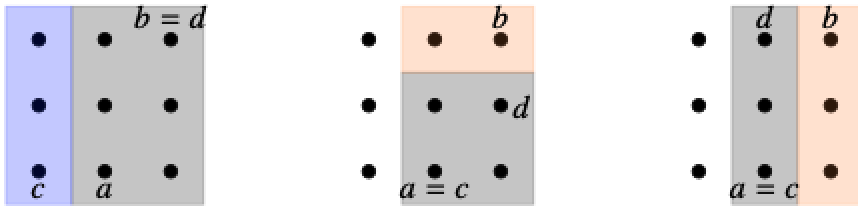
- Make sure to follow the template and instructions provided in these guidelines, paying particular attention to which packages are supported by your publisher.
- If you are unsure if a package is supported, be sure to ask your publisher as soon as possible. Many common LaTeX packages are not compatible with accessible document creation.

Creating accessible figures

- **Never rely on color alone to communicate key information in the figure** (e.g., see Colour is not enough). Instead, pair colors with easily distinguishable textures, labels, shapes, and/or dash patterns. If a figure uses too many patterns, avoid using similar ones (e.g., dashed or dotted lines) that may be difficult to distinguish, especially when lines overlap in charts.

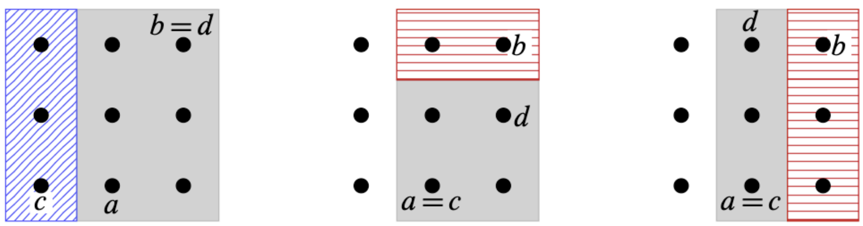
EXAMPLE:

Original version:



choice of $\mathcal{S}$. The region $\mathcal{S} \cap \mathcal{T}$ is shaded gray, the region $\mathcal{S} \setminus \mathcal{T}$ shaded orange, and the region $\mathcal{T} \setminus \mathcal{S}$ shaded blue. The first example can be found after the statement of Proposition 1.6.3.

Revised accessible version:



choice of $\mathcal{S}$. The region $\mathcal{S} \cap \mathcal{T}$ is shaded gray, the region $\mathcal{S} \setminus \mathcal{T}$ shaded with red horizontal lines, and the region $\mathcal{T} \setminus \mathcal{S}$ shaded with blue oblique lines. The first example can be found after the statement of Proposition 6.3.

Source: B. Blanchette, T. Brüstle, and E. J. Hanson, Exact structures for persistence modules. In *Representations of Algebras and Related Topics.* Proceedings of the Workshop and the 20th International Conference on Representations of Algebras, ICRA 2022, EMS Series of Congress Reports Vol. 221, EMS Press, Berlin. https://doi.org/10.4171/ecr/21/4

Tip: Check your figure's accessibility by viewing it in grayscale—is the meaning still fully conveyed without color?

- **Check color contrast**
  - Ensure the following figure elements have these color contrast ratios against adjacent color(s):
    - Key graphical elements and icons (non-text), such as data lines, pie slices, and bar colors: 3:1
    - Regular text: 4.5:1
    - Large text (18pt / 24px or 14pt bolded): 3:1
    - Decorative elements: No requirement

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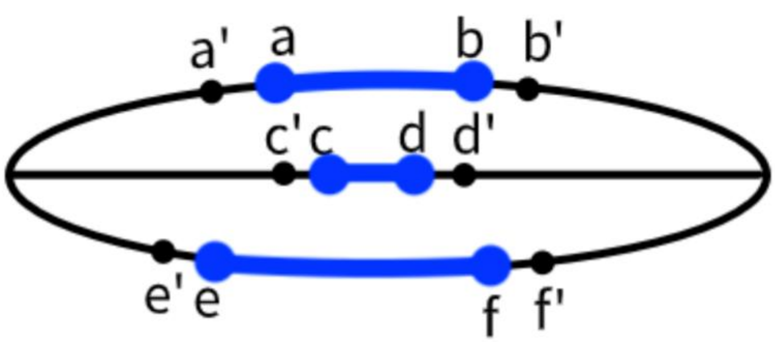
- Color contrast can be checked using WebAIM: Color contrast checker.
- Colored text should be avoided, but if it is used, it should be combined with other typographical elements to convey meaning, e.g., boldface. Check with your publisher whether they support the use of colored text. A color contrast of 4.5:1 will be necessary.
- The following example colors each **individually** have a **color contrast of at least 3:1** against a white background and are appropriate for key graphical elements. However, if these colors are being used together in a figure where the colors are adjacent or overlapping, additional distinguishing features should be provided to differentiate between the colors or adjacent colors should be altered to meet the 3:1 contrast (see next example).

Color	Red	Bluish green	Blue	Orange
HEX	#CC2929	#00A875	#007A99	#DB7D0A
CMYK	0, 80, 80, 20	100, 0, 30, 34	100, 20, 0, 40	0, 43, 95, 14
RGB	204, 41, 41	0, 168, 117	0, 122, 153	219, 125, 10

EXAMPLE:

Original version:



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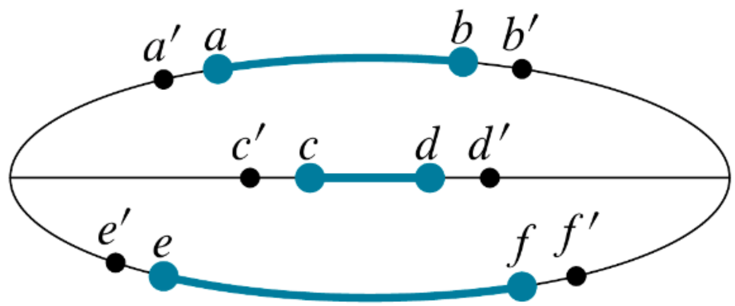
Revised accessible version:



Source: Y. Len, Chip-firing games, Jacobians, and Prym varieties. In *Varieties, Polyhedra, Computation.* EMS Series of Congress Reports Vol. 22, EMS Press, Berlin, 2025. https://doi.org/10.4171/ecr/22/6

- Check that color combinations can be viewed by people who have Color Vision Deficiency (CVD)
  - Example tool: Coblis—Color blindness simulator.
  - In general, avoid the following color combinations: green & red, blue & purple, and light green & yellow.
  - The figure below shows how the above example colors against a white background might be perceived by people with certain types of CVD (protan, deutan, and tritan).

Short alt text for figures inserted using `\includegraphics`

- Short alt text (i.e., 'alternative text' or 'alt text') is behind-the-scenes text that describes the corresponding visual figure to make it accessible to screen readers and braille users. In code, short alt text is the value of the figure's 'alt' field (e.g., see the following bullet).
- The LaTeX package `graphicx` supports alt text using the `alt` argument of the `\includegraphics` command as follows:

```
\includegraphics[alt={plain-text description of image}]{example-image-a}
```

  However, other coding options might apply. Publishers might also request alt text be submitted in a separate document as well as embedded in the LaTex file if any clarity is needed.
- The short alt text should contain the following:
  - 1–2 sentences about the figure, describing the type of image and a short summary of the key points.
    - The recommended character limit for these sentences is 150 characters.
    - Do not simply repeat text verbatim that is in the figure title and/or caption.
  - A concise reference indicating where within the content the reader can obtain further information about the figure (i.e., in the body text, figure title, and/or figure caption).

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    - **NOTE:** Rewrite your body text, figure title, and/or figure caption if they do not provide a sufficiently detailed description of the figure to reference from the short alt text. If you cannot fully describe the figure in the body text for some reason, contact your publisher for information on how to include a longer description elsewhere.
  - **Alt text examples are provided later in these guidelines.**
- Be as concise as possible while still describing the key information presented in the figure.
- Focus on the key takeaway and describe visual elements only if they are relevant for conveying meaning.
- If your figure consists of several parts, it might make sense to provide alt text for each part (see W3C WAI groups of images). For further guidelines, please check with your publisher.
- Write out symbols and abbreviations in your figure's alt text to ensure accurate pronunciation by a range of screen readers. For mathematical notation, write it out as if you were reading it aloud in a conference presentation. See the following examples of how to write out math in short alt text. See also the MathJax Speech Converter.

TeX code	PDF output	Alt text without symbols
`z\in\mathbb{C}`	$z\in\mathbb{C}$	a complex number z
`\int\limits_{-\infty}^\infty f(x)\, dx`	$\int\limits_{-\infty}^\infty f(x)\, dx$	the integral of f over the real line
`\frac{\partial^i f}{\partial x^i}`	$\frac{\partial^i f}{\partial x^i}$	the partial derivative of f with respect to the i th coordinate
`\underline x \cdot\underline y=0`	$\underline x \cdot\underline y=0$	the vectors x and y are orthogonal
`\lim\limits_{x\to\infty}f(x)=0`	$\lim\limits_{x\to\infty}f(x)=0$	f converges to zero as its argument tends to infinity
`f\in\mathcal{L}^2`	$f\in\mathcal{L}^2$	f is square-integrable
`\sum_{k=1}^N e^{ik\frac{2\pi}{N}}=0`	$\sum_{k=1}^N e^{ik\frac{2\pi}{N}}=0$	the sum of the simple N th roots of the unity is zero
`A\cap B =\varnothing`	$A\cap B =\varnothing$	the sets A and B are disjoint
`P_n\coloneq\sum_{i=0}^n a_i x^i`	$P_n\coloneq\sum_{i=0}^n a_i x^i$	Let P sub n be the degree n polynomial in x, with coefficient a sub i at degree i
`\bigoplus_{i\in I} V_i`	$\bigoplus_{i\in I} V_i$	the direct sum of vector spaces V sub i, labelled by the elements i of the index set I
`\{\lambda x \mid\lambda\in\mathbb C\}`	$\{\lambda x \mid\lambda\in\mathbb C\}$	the complex line spanned by x

Short alt text for code-generated figures

- Code-generated figures, such as TikZ and PGFPlots, do not currently have a universally handled alt text field in LaTeX (only if the latex-lab-graphic package is loaded).
- Check with your publisher how you should provide alt text for your code-generated figures.
  - For example, your publisher may ask you to provide the alt text as a comment in the TeX, use a specific tag, or provide the alt text in a separate file.
- If the code-generated figure is **relatively simple**, e.g., a simple commutative diagram, then include **the code** as the alt text, provided the code captures the purpose/takeaway of the figure.
- If the code-generated figure is **relatively complex** with code much longer than a description of the figure's key takeaway, e.g., a complex commutative diagram or a collection of curves on a surface, then include **descriptive alt text** as per the guidelines above.

Underlying data for complex data plots

For a complex data plot generated by data too lengthy to include as the alt text or in the body text, you may wish to provide this data in a supplemental file. Your publisher might also request this of you at their discretion. Other suggestions from your publisher might include the following:

- If the data set is of a sensible size, include that data in the body text (e.g., in an appendix) for all readers to access.
- If the data set is large and exists someplace linkable (e.g., a webpage), include that link in the body text (e.g., in the figure caption) for all readers to access.

Please contact your publisher for other options or requirements.

Alt text for equations

The publisher will use the equation's LaTeX code and/or MathJax speech-text (e.g., see MathJax Speech Converter) for the equation as alt text. Authors therefore do not need to take any action for equations but should be aware of this.

Acceptable formats for figures inserted using `\includegraphics`

Below is a list of accepted file types. If needed, contact your publisher for additional accepted file types.

Type	**Acronym**	**Name**	**Classification**
VECTOR	EPS	Encapsulated PostScript	Strongly preferred
VECTOR	PDF	Portable Document Format	Strongly preferred
RASTER	JPEG	Joint Photographic Experts Group	Acceptable
RASTER	PNG	Portable Network Graphics	Acceptable

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Animations/videos and photosensitive epilepsy

To help avoid risk of seizure, animations must not include red flashes, animate with red, or be predominantly red. (See this useful tool: Photosensitive Epilepsy Analysis Tool (PEAT) user guide.)

Further reading and useful resources

- W3C WAI: Complex images
- W3C WAI: Images tutorial
- Accessibility Developer Guide: Knowledge about accessibility
- Accessibility Developer Guide: Colour is not enough
- GBH: Effective practices for description of science content—Digital talking books (NSF-funded project from WGBH's National Center for Accessible Media [NCAM])
- DIAGRAM Center: General image description guidelines
- ACM DIS2023: Creating accessible figures and tables
- Chartability: The Chartability workbook
- ACM SIGACCESS: Describing figures
- Observable: What is high contrast for data visualization? (with examples)
- WebAIM: Contrast and color accessibility
- WebAIM: Contrast checker
- Accessible Web: WCAG color contrast checker
- whocanuse: Who can use this color combination?
- Colblindor: Coblis—Color blindness simulator
- arXiv: Accessibility at arXiv
- arXiv: LaTeX markup best practices for successful HTML papers

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Alt text example: Flowchart

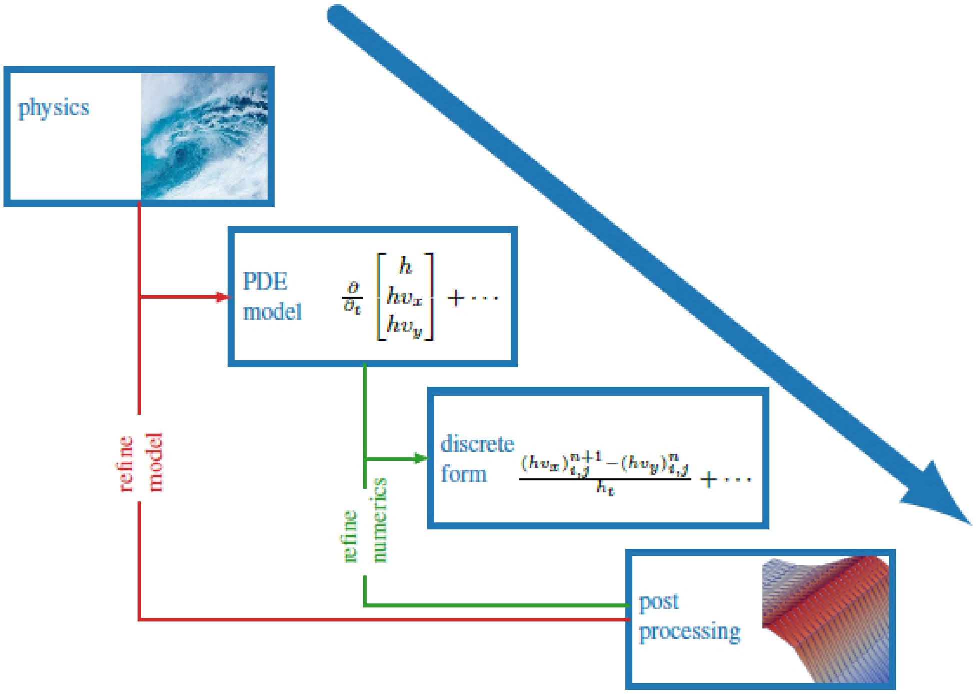

Figure 1.1.1. *CSE simulation process. Ocean wave image credit: CC0 public domain.*

Source: *Numerical Partial Differential Equations*, Adler et al, Chapter 1, https://epubs.siam.org/doi/10.1137/1.9781611978285.ch1.

Alt text:

Flowchart showing physics, PDE model, discrete form, and post-processing steps. For further information, see the paragraph beginning "The overall process of CSE…" in Section 1.1.1.

Referenced description in body text:

The overall process of CSE can be viewed as a series of steps that begins with a question from the underlying scientific or engineering application. To answer that question, a mathematical model is developed that must include sufficient physical detail to be reliable, but not so much detail that the simulation is limited by resolving physical effects that have only a small impact on the question at hand. From this mathematical model (which, in the context of this book, we consider to be a governing PDE or system of PDEs with appropriate initial and boundary-value data), a discrete (computational) model is derived and numerical results are computed. These results are, typically, postprocessed to a quantitative answer to the posed question. In practice, this process is iterative (see Figure 1.1.1), with refinements to the mathematical and computational models naturally incorporated to improve physical fidelity and numerical accuracy once initial results are obtained.

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Alt text example: Graph

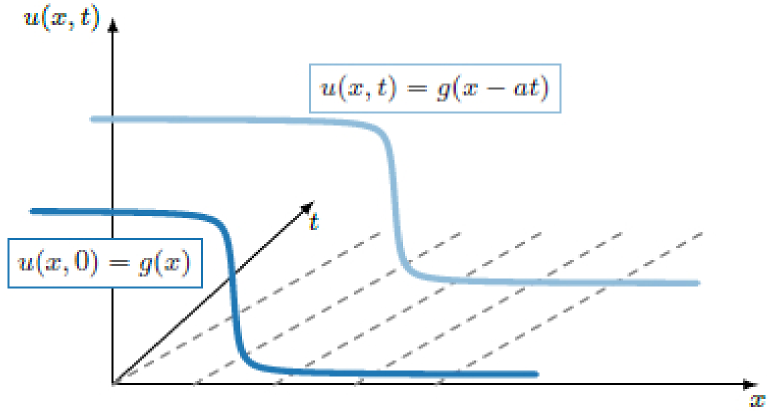

Figure 1.2.1. *Linear advection in 1D. The dotted lines are characteristic curves in the x–t plane, with slope a. The initial profile $g(x)$ is advected with speed a. The solution $u(x,t)$ is constant along the characteristics $x(t) = x_0 + a\,t$.*

Source: *Numerical Partial Differential Equations*, Adler et al, Chapter 1, https://epubs.siam.org/doi/10.1137/1.9781611978285.ch1.

Alt text:

Wave propagation graph showing u of x t equals g of x minus a t and u of x 0 equals g of x. For further information, see the caption and the paragraph beginning “Hence, the linear advection solution…” in Section 1.2.2.

Referenced description in body text:

Hence, the linear advection solution $u(x,t)$ is constant along curves $x(t) = x_0 + a\,t$ with slope a. Along these *characteristic curves*, the linear advection equation, equation (1.14), reduces to the ODE

$$\frac{dw(t)}{dt} = 0, \tag{1.20}$$

for function $w(t) = u(x(t), t)$, so the solution $u(x,t)$ is constant along the characteristic curves (see Figure 1.2.1). As a consequence, initial and boundary data cannot be specified along characteristic curves (or they could violate the properties observed above), and the PDE is classified as hyperbolic.

Alt text example: 3D plot

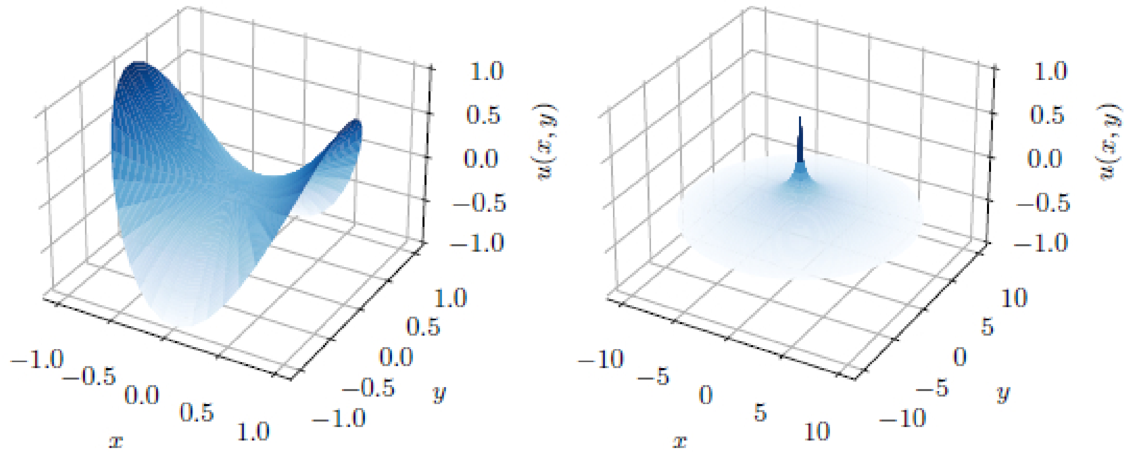

Figure 1.3.2. *Two example solutions to elliptic BVP* (1.45). *(left) A solution that illustrates the maximum principle, with maxima/minima found on the boundary. (right) A point source has global impact on a solution.*

Source: *Numerical Partial Differential Equations*, Adler et al, Chapter 1, https://epubs.siam.org/doi/10.1137/1.9781611978285.ch1.

Alt text:

Two 3D surface plots showing function u of x y with axes x, y, and u of x y. For further information, see the paragraph beginning “We consider two specific examples…” in the section entitled “Elliptic”.

Referenced description in body text:

We consider two specific examples of this BVP that highlight the elliptic nature of the PDE. First, let Ω be the unit circle, $f(\boldsymbol{x}) = 0$, and $g(\boldsymbol{x}) = \cos(2\theta)$ (where $\theta = \arctan(y/x)$ is the angle in polar coordinates, with $r^2 = x^2 + y^2$), so that the unique solution of the BVP is given by $u(x, y) = r^2 \cos(2\theta)$. This solution is shown in the left panel of Figure 1.3.2. Here we see that the maximum (and minimum) of the solution are attained on the boundary of the domain, which is a general property of this type of elliptic BVP when $f(\boldsymbol{x}) = 0$.

Note: This example features a figure that was published before these accessibility guidelines were in use. If this content were to be published now, the author would need to ensure the referenced description in the body text also describes the right panel of the figure.

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Alt text example: Geometric shapes and lines 1

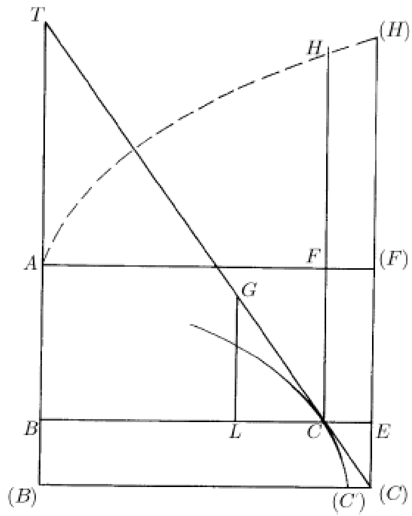

Figure 4.12. Leibniz on the Fundamental Theorem of the Calculus

Source: Image, caption, and referenced description from June Barrow-Green, Jeremy Gray, and Robin Wilson, *The history of mathematics: a source-based approach. Vol. 2*, AMS/MAA Textbooks, vol. 61, MAA Press, Providence, RI, 2022. MR4567739

Alt text:

Diagrammatic representation of the setup for Leibniz's argument. See details in the caption and the first paragraph of Subsection "Leibniz on the Fundamental Theorem of the Calculus" in Section 4.4.

Referenced description in body text:

... Then I shall show how this line can be described by a motion that I have invented. For this purpose [Figure 4.12] I assume for every curve $C(C')$ a *double characteristic triangle*, one, TEG, that is assignable, and one, GLC, that is inassignable, and these two are similar. The inassignable triangle consists of the parts GL, LC, with the elements of the coordinates CF, CB as sides, and GC, the element of arc, as the base or hypotenuse. But the assignable triangle TBC consists of the axis, the ordinate, and the tangent, and therefore contains the curve at the given point C. Now let $F(H)$, the region of which the area has to be squared, be enclosed between the curve $H(H)$, the parallel lines FH and $(F)(H)$, and the axis $F(F)$; on that axis let A be a fixed point, and let a line AB, the conjugate axis, be drawn through A perpendicular to AF. We assume that point C lies on HF (continued if necessary); this gives a new curve $C(C')$ with the property that, if from point C to the conjugate axis AB (continued if necessary) both its ordinate CB (equal to AF) and tangent CT are drawn, the part TB of the axis between them is to BC as HF to a constant [segment] a, or a times BT is equal to the rectangle AFH (circumscribed about the trilinear figure $AFHA$).

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Alt text example: Geometric shapes and lines 2

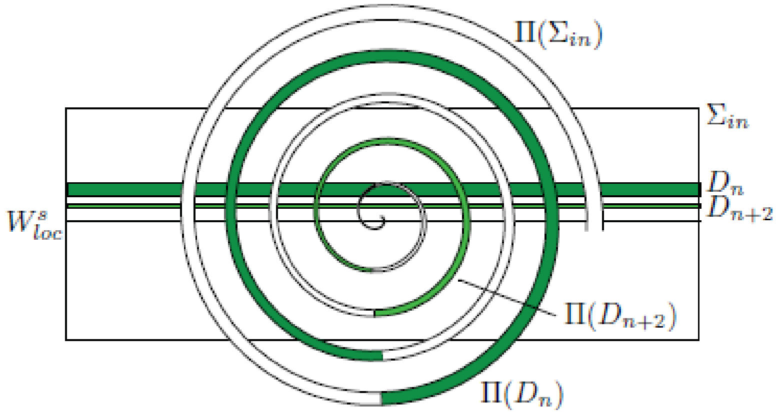

Figure 4.14. Strips D_n in the cross section Σ_{in} that accumulate onto $W^s_{loc} \cap \Sigma_{in}$ are mapped over itself in a horseshoe shape by Π.

Source: Image, caption, and referenced description from Ale Jan Homburg and Jürgen Knobloch, *Bifurcation theory*, Graduate Studies in Mathematics, vol. 246, American Mathematical Society, Providence, RI, 2024. MR4815036

Alt text:

Diagram of strips D subscript n and D subscript n plus 2 that are mapped in a horseshoe shape by Pi. See details in the caption and the first paragraph following the proof of Lemma 4.31.

Referenced description in body text:

...

The first return map Π is a perturbation from $\Pi_0 : \Sigma_{in} \to \Sigma_{in}$ given by

$$\Pi_0(\theta, z) = \begin{pmatrix} \phi_1(0) z^\beta \sin\left(-\frac{\phi^s}{\mu^u} \ln z\right) + \phi_2(0) z^\beta \cos\left(-\frac{\phi^s}{\mu^u} \ln z\right) \\ \phi_3(0) z^\beta \sin\left(-\frac{\phi^s}{\mu^u} \ln z\right) + \phi_4(0) z^\beta \cos\left(-\frac{\phi^s}{\mu^u} \ln z\right) \end{pmatrix},$$

where Π_0 is obtained from Π by removing the higher-order terms and computing the coefficients $\phi_1, \ldots, \phi_4$ in $\theta = 0$. The image under Π_0 of a line piece $L = \{z > 0, \theta = 0\}$ is a spiral centered at $(0,0)$. More precisely, it is the image under a linear map of a logarithmic spiral. Take a sequence of points $\hat{z}_n > 0$ converging to 0, where $\Pi_0(L)$ has a local minimum z-coordinate. A calculation shows $\hat{z}_n \sim \alpha^n$ for some $\alpha < 1$, where the notation $\hat{z}_n \sim \alpha^n$ stands for $0 < \liminf_{n\to\infty} \hat{z}_n/\alpha^n \leq \limsup_{n\to\infty} \hat{z}_n/\alpha^n < \infty$. This indicates that Π maps strips

$$D_n = \{(\theta, z) \in \Sigma^{in} \; ; \; \hat{z}_{n+1} \leq z \leq \hat{z}_n\}$$

to parts of a thickened spiral as indicated in Figure 4.14. From $\beta < 1$ it is seen that the image $\Pi_0(D_n)$ intersects D_n as in a horseshoe map. To prove Theorem 4.29, we must make this intuitive picture rigorous. ...

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Alt text example: Multiple graphs

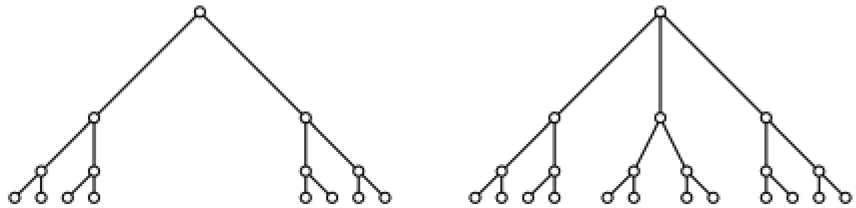

Figure 1.4. $T_{3,3}$ and $\tilde{T}_{3,3}$.

Source: Bogdan Nica: B. Nica, *A Brief Introduction to Spectral Graph Theory.* EMS Textbooks in Mathematics Vol. 20, Eur. Math. Soc., Zürich, 2018. https://doi.org/10.4171/188

Alt text:

Two tree graphs, called capital T sub 3, 3 and capital T tilde sub 3, 3. For more information, see the paragraph following Exercise 1.2.

Referenced description in body text:

A *tree* is a graph that has no cycles. For instance, star graphs and path graphs are trees. Two important examples are the trees $T_{d,R}$ and $\tilde{T}_{d,R}$, described as follows. There is a 'root' vertex of degree $d-1$ in $T_{d,R}$, respectively of degree d in $\tilde{T}_{d,R}$; the pendant vertices lie on a sphere of radius R about the root; the remaining intermediate vertices all have degree d. See Figure 1.4 for an illustration.

Note: For the location of referenced descriptions in the alt text, some publishers discourage the use of directional terms (like above/below) in reference to the figure location. Sometimes figure location can change within the body text when producing an accessible version of the text. Please check with your publisher for further details.