Open translations in mathematics

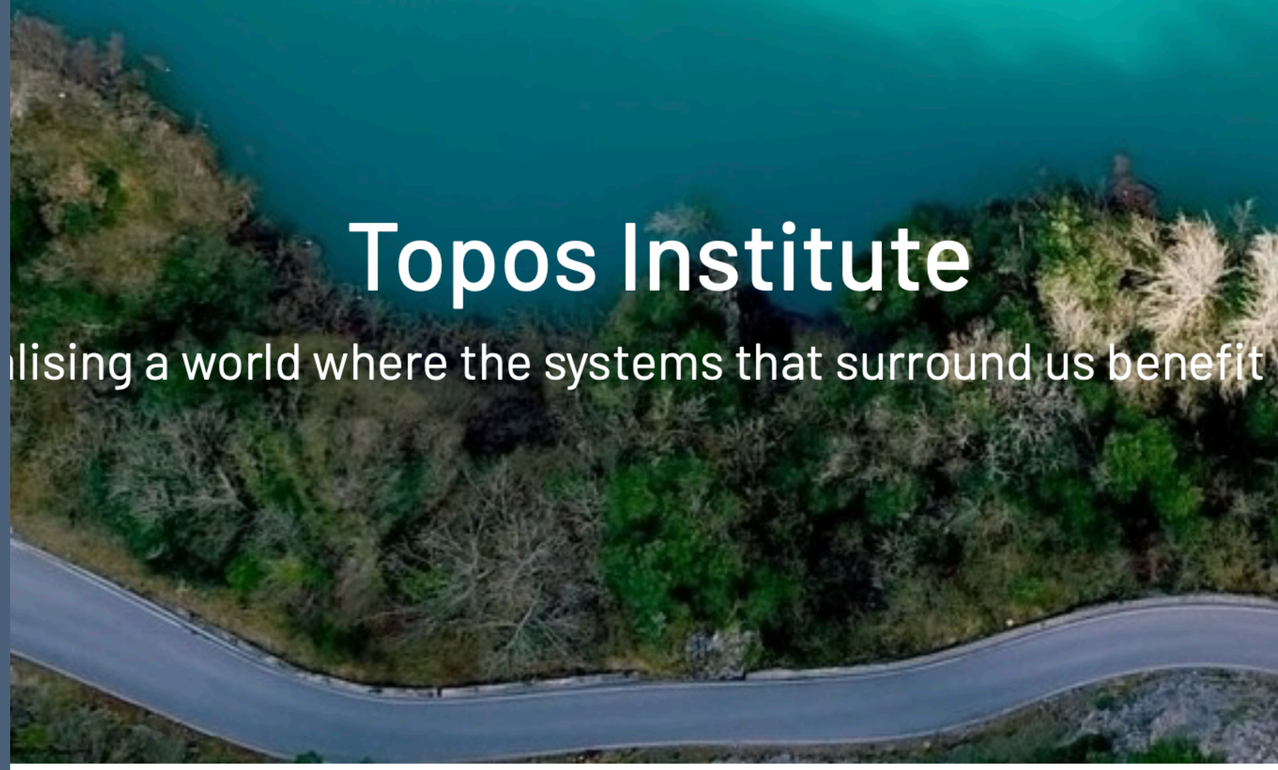
Community building and resources for the future

Tim Hosgood (Topos Institute)
24th of February, 2025

Warning: *I am merely a mathematician*

Topos Institute

A mission-driven non-profit research institute



Who are we?

e are a mission-driven non-profit research institute

a complex and changing world, how can we build a society in which all people and ommunities can flourish? We believe technology can play a pivotal role, but only if well rafted to be responsive to the values, care, and meaning we each hold.

e research, build, and serve others through new technologies that enable cooperation cross difference. We seek to both advance humanity's capacity for knowledge and mpassion, and to help address the pressing, systemic challenges of our time, includin

We do not "solve" the "problem" of translation by imposing a universal language

The "problem" becomes a benefit if we promote *more* languages and get better at translation

I would like *more and more* of these workshops, not *fewer and fewer*

Plan

1. Translation in the context of science
2. Previous projects, large and small
3. Useful tools
4. Difficulties
5. Future resources

1. Translation in the context of science

Translation is that which transforms everything so that nothing changes

— one of the first Google results for "quotes about translation"

Scientific (as opposed to literary) translation

Simpler? Less subjective?

- Not really, no. [citation: books; the rest of this talk; the rest of this fortnight]

Scientific (as opposed to literary) translation

Things to consider, both big and small

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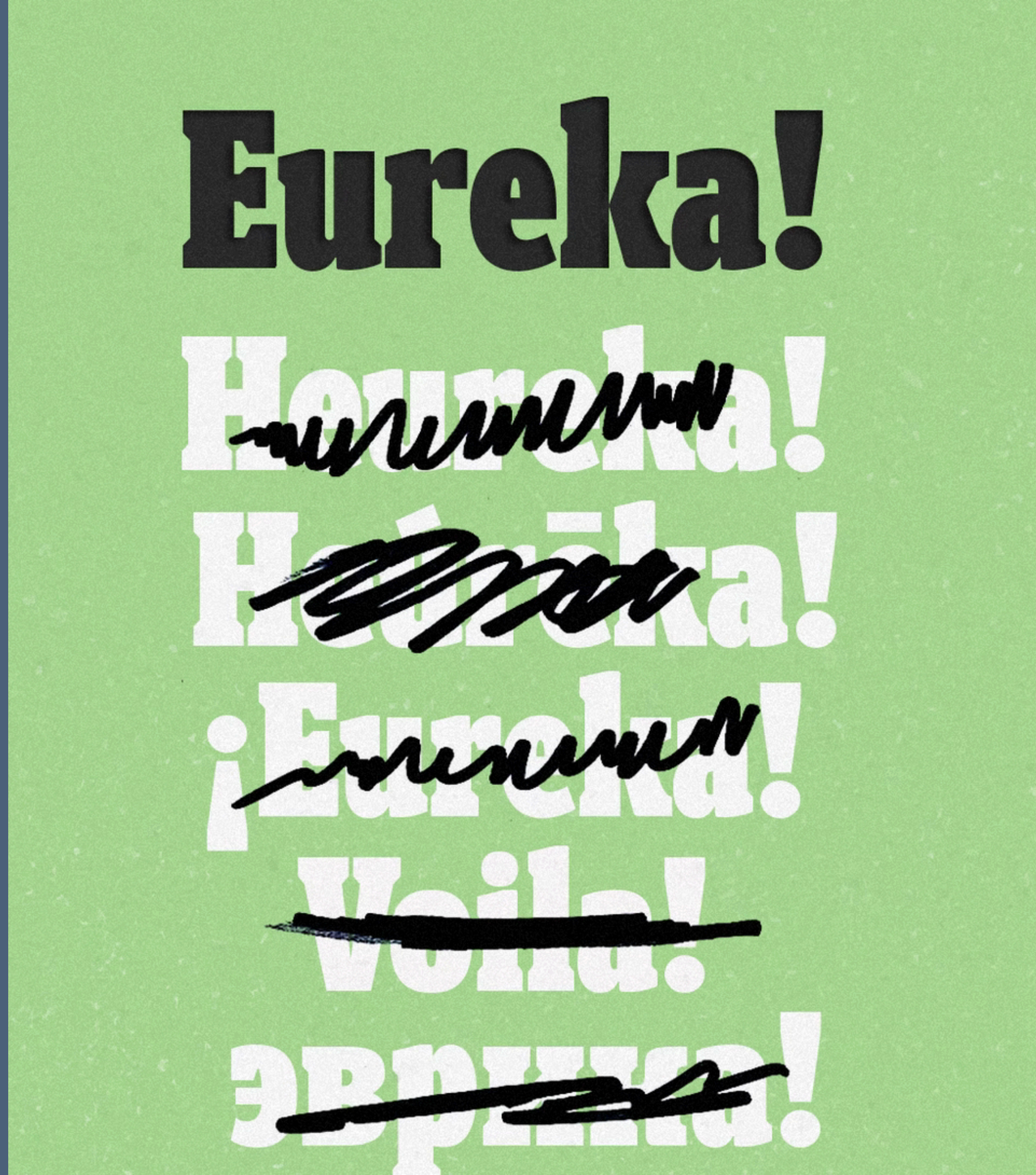
Adam Huttner-Koros —
English: a hegemony

theatlantic.com/science/archive/2015/08/english-universal-language-science-research/400919/



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- [...] "domain collapse," or "the progressive deterioration of competence in [a language] in high-level discourses." In other words, as a language stops adapting to changes in a given field, it can eventually cease to be an effective means of communication in certain contexts altogether.

Minhyong Kim —

Who Owns Mathematics: A Question of Identity

topos.institute/events/topos-colloquium/slides/2023-11-30.pdf

Minhyong Kim — *Who Owns Mathematics: A Question of Identity*

topos.institute/events/topos-colloquium/slides/2023-11-30.pdf

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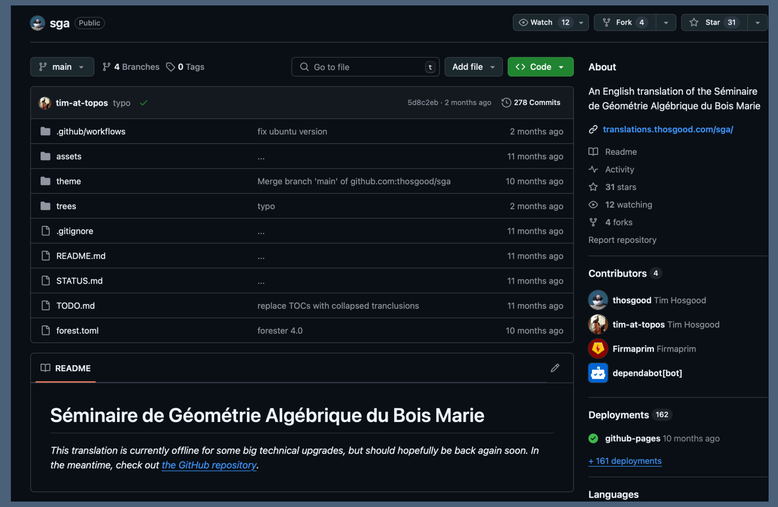
- **We will all be included in a book on the global history of the English written by a future historian.**

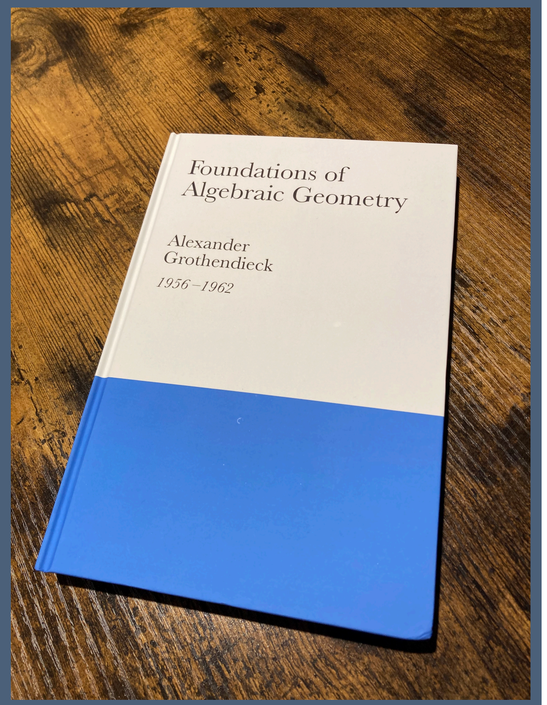
English translations as a stepping stone

Acting intentionally

- English is, for better or worse, the most lingua franca of languages for science…
- *… but this doesn't mean we should stop there*
- Translating a specific text into English is a good way of building a community around that work, and laying the foundations (technical and cultural) for translations into other languages
- Our *choice* of texts to translate can help to *highlight* non-English sources

2. Previous projects, large and small





Articles

- M Balazard, E Saias, M Yor. "Notes sur la fonction ζ de Riemann, 2".
  Adv. in Math. 143 (1999) pp. 284–287.
  web | PDF | source
  original
- A Borel, J-P Serre. "Le théorème de Riemann-Roch".
  Bull. Soc. Math. Fr. 86 (1958) pp. 97–136.
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  original
- P Deligne. "Variétés abéliennes ordinaires sur un corps fini".
  Inv. Math. 8 (1969) pp. 238–243.
  web | PDF | source
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- P Deligne. "Théorie de Hodge I, II".
  (I) *Actes du Congrès intern. math.* 1 (1970) pp. 425–430.
  (II) *Pub. Math. de l'IHÉS* 40 (1971) pp. 5–58.
  web | source
  original (I) | original (II)
- P Deligne. "A quoi servent les motifs?".
  Proc. Symp. in Pure Math. 55 (1994) pp. 143–161.
  web | PDF | source
  original
- Y Diers. "Catégories Multialgébriques".
  Archiv der Math. 34 (1980) pp. 193–209.
  DOI: 10.1007/BF01224953
  PDF | source
- P Donato, P Iglesias. "Exemples de groupes differentiels: flots irrationn
  C. R. Acad. Sc. 301 (1985) pp. 127–130

Seminars

Séminaire Bourbaki, Extracts (1948–49), "Les travaux de Koszul"

In the first series of the Séminaire Bourbaki, H Cartan gave three talks concerning th work of J-L Koszul on Lie algebras. (These specific talks were given in 1948–49, but first published *Séminaire Bourbaki* collection was printed in 1952, containing the first talks, and dating from 1948 up until 1951). I have combined all three talks into one document.

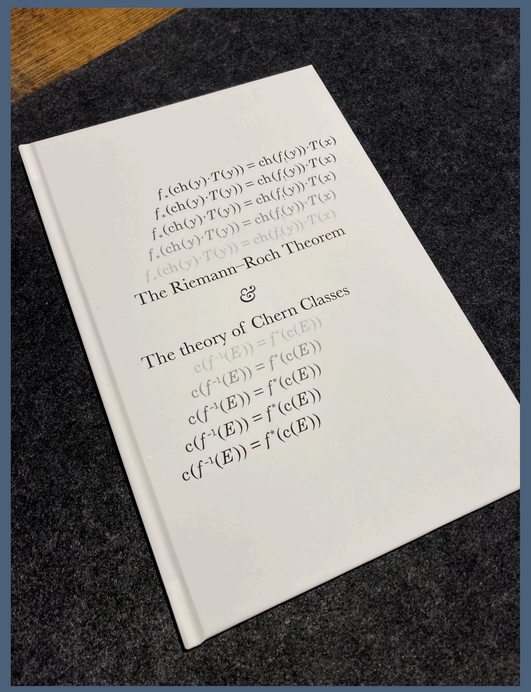
- H Cartan. "Les travaux de Koszul, I, II, and III".
  Séminaire Bourbaki 1 (1952) pp. Talks no. 1, 8, and 12.
  web | PDF | source
  original (I) | original (II) | original (III)

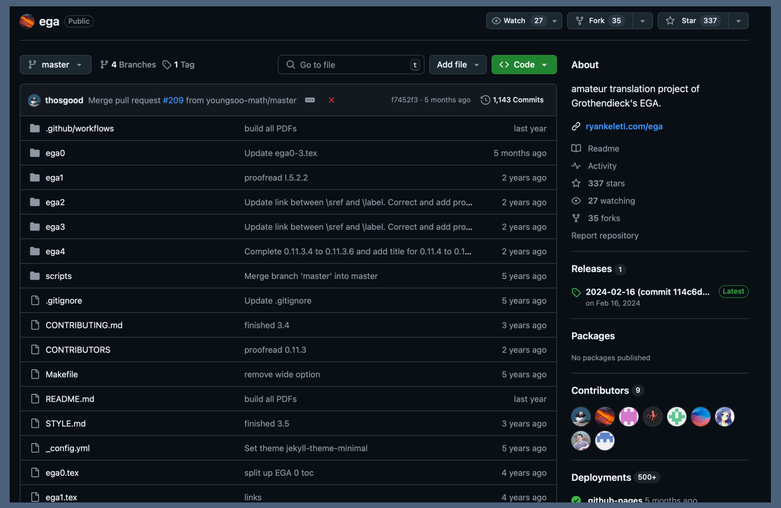
Séminaire Claude Chevalley, Volume 4 (1958–59), "Variétés de Picard"

1. P Gabriel. "Faisceaux quasi-cohérents".
   web | PDF | source
   original
2. P Gabriel. "Le théorème de Serre".
   web | PDF | source
   original
4. C S Seshadri. "Diviseurs en géométrie algébrique".
   web | PDF | source
   original
9. A Douady. "Variétés abéliennes".
   web | PDF | source
   original

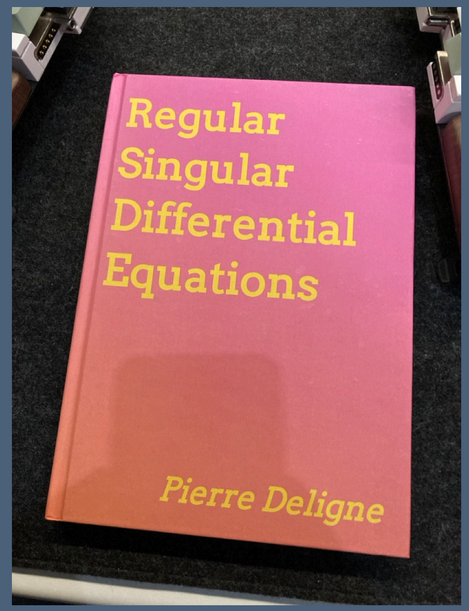
Séminaire Henri Cartan, Volume 9 (1956–57), "Quelques questions de topologie"

2. A Grothendieck. "Sur les faisceaux algébriques et les faisceaux analytiques





mostly *French*, *algebraic geometry* and *category theory* (because this is my background)



EGA

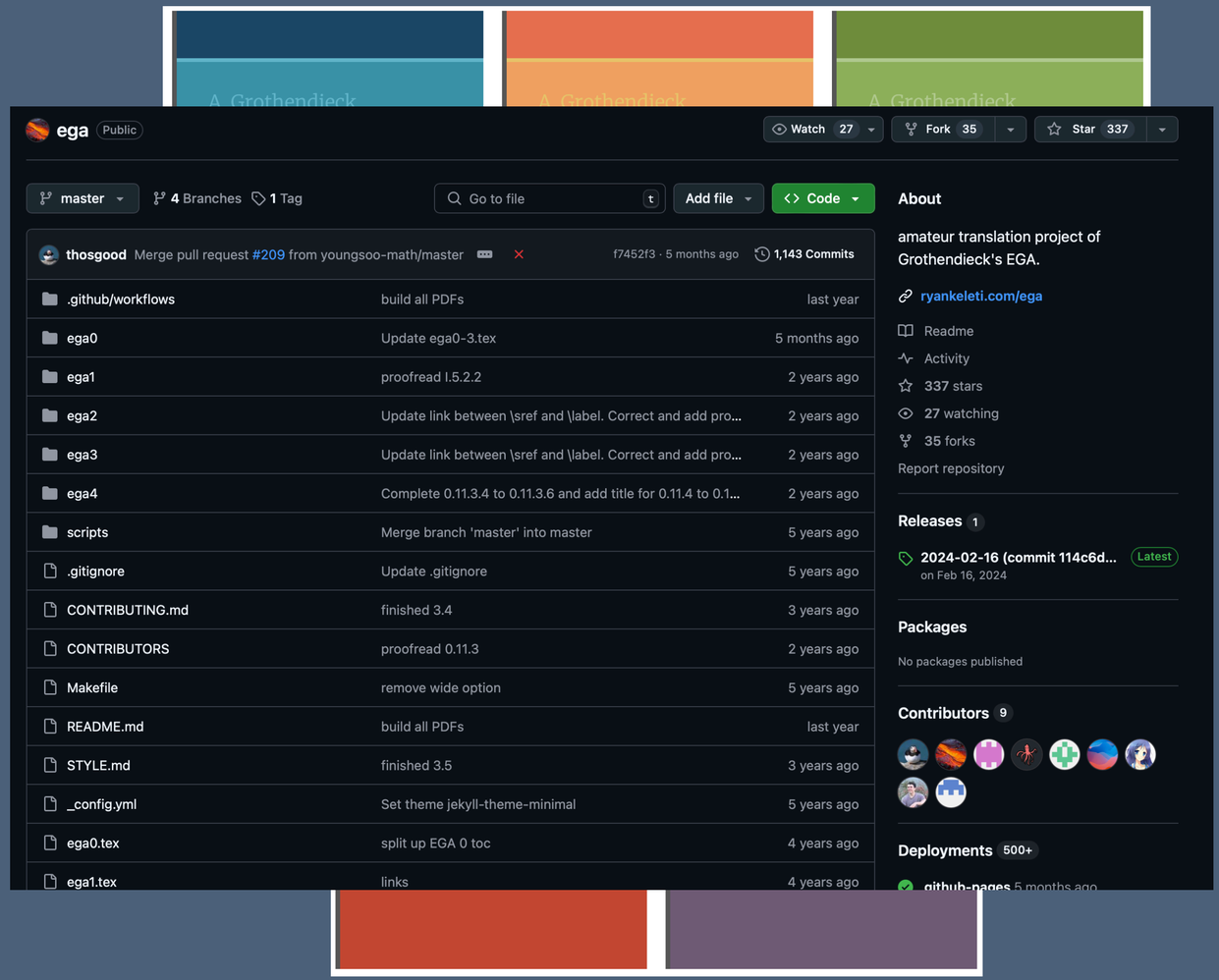
Some history

- Foundational work in algebraic geometry, category theory, sheaf theory, …
- Written throughout the 1960s by Grothendieck and Dieudonné
- Never fully completed, only (!) ~1,800 pages published
- Still the standard reference for many statements for the contemporary working geometer
- (My initial motivation for translation)

EGA

The translation

- Translation mainly joint with Ryan Keleti, but some other (~6) community contributions too
- ~500 pages (~25,000 lines) already translated (EGA I and II, and the corresponding parts of EGA 0)...
- ... ~1,300 pages left
- >300 stars on GitHub, lots of MathOverflow upvotes
- but... why? We have the Stacks project, and "mathematical French is easy"



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- It's an excuse for me to read it
- It's an opportunity for (often early-career) mathematicians to build a community

Grothendieck's '91 letter to Thomason on Derivators

Examples of the difficulties of translating mathematical letters

- Cultural context, such as sayings and profanity:
  - *Having looked at this work (if we can call it that) with attention, I am happy that it is not yours — it made me gnash my teeth from start to finish, and more besides.*
  - [...] *you are very capable of finding where it screws up by yourself [...]*
- Writing style of the author:
  - *This will probably be my next letter, if you are interested in continuing this correspondence. In which case I will be very happy to have you as an interlocutor of my cogitations!*

Two of C. Ehresmann's papers on double categories

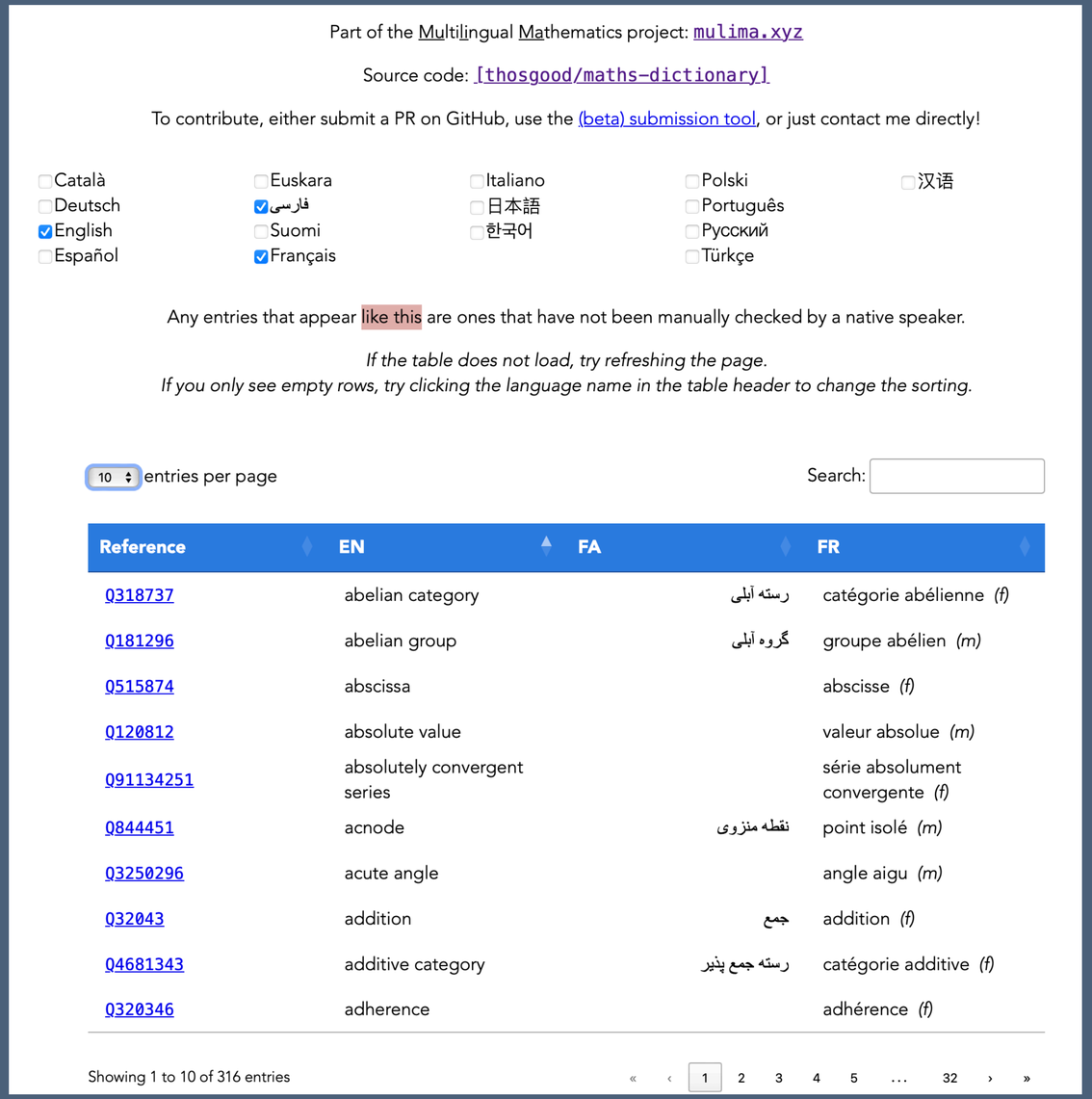
In the context of his Collected Works, edited by A. Ehresmann

- Somewhat nonstandard (by today's writing) notation and definitions (e.g. functors/functions)
- One of the original works on double categories, but largely unread by many working in the double categorical renaissance currently underway
- Contextualised within a Collected Works, including errata and addenda *in English* by A. Ehresmann
    - These give authoritative translations for terminology that has not elsewhere (as far as I can tell) been translated
- Andrée was very happy with the possibility of wider readership

Multilingual maths dictionary

Open source, community written

- ~50 contributors in 16 languages
- ~300 entries, each linked to Wikidata
- Semi-automated Wikidata imports to be checked by native speakers
- Large Catalan and Basque contributions, at high technical level
- Just one large .json file
- Grammatical gender, but no plurals/cases/etc.



Part of the Multilingual Mathematics project: mulima.xyz

Source code: [thosgood/maths-dictionary]

To contribute, either submit a PR on GitHub, use the (beta) submission tool, or just contact me directly!

Català, Deutsch, English, Español, Euskara, فارسی, Suomi, Français, Italiano, 日本語, 한국어, Polski, Português, Русский, Türkçe, 汉语

Any entries that appear like this are ones that have not been manually checked by a native speaker.

If the table does not load, try refreshing the page.
If you only see empty rows, try clicking the language name in the table header to change the sorting.

10 entries per page — Search:

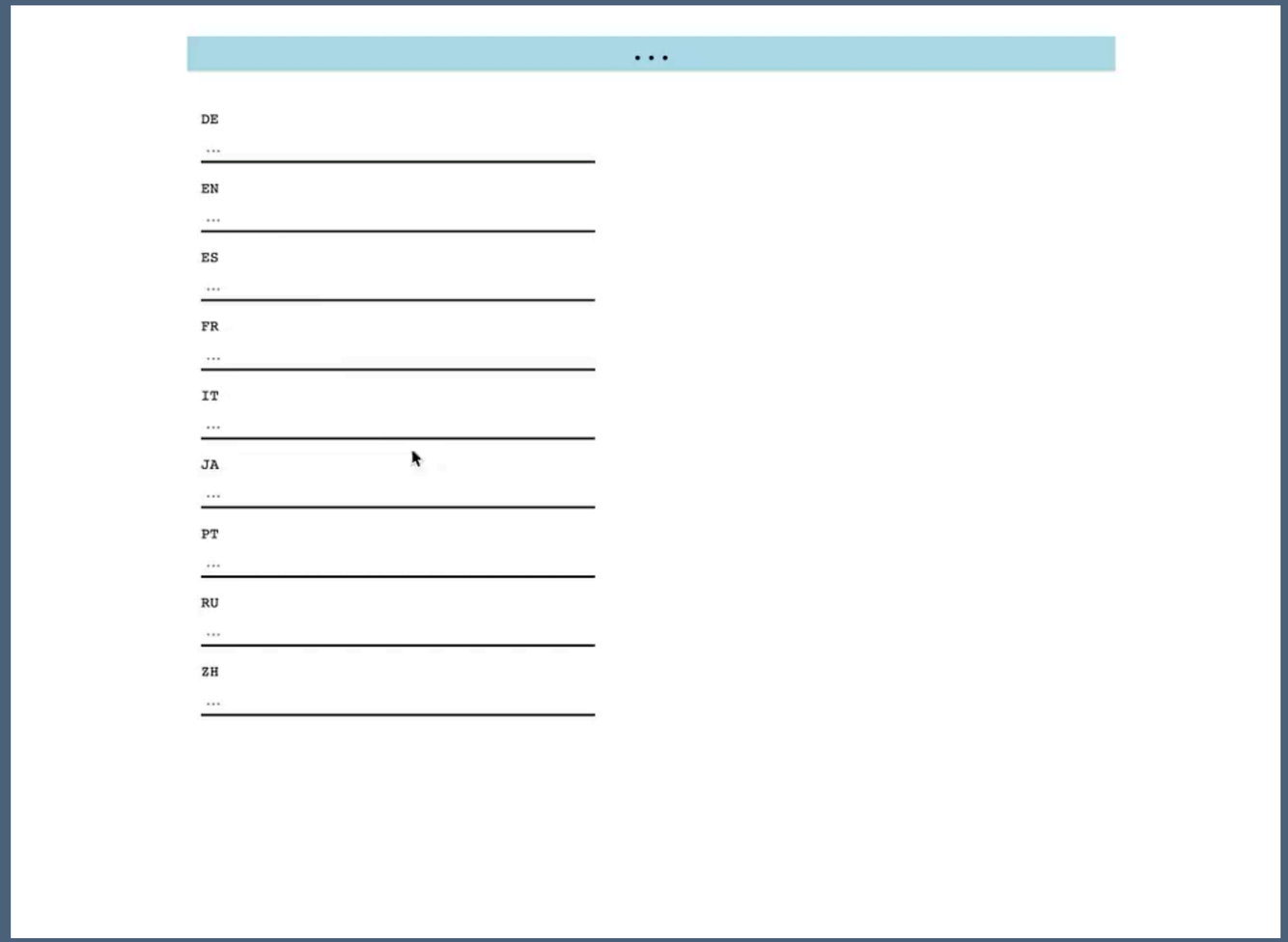
Reference	EN	FA	FR
Q318737	abelian category	رسته آبلی	catégorie abélienne *(f)*
Q181296	abelian group	گروه آبلی	groupe abélien *(m)*
Q515874	abscissa		abscisse *(f)*
Q120812	absolute value		valeur absolue *(m)*
Q91134251	absolutely convergent series		série absolument convergente *(f)*
Q844451	acnode	نقطه منزوی	point isolé *(m)*
Q3250296	acute angle		angle aigu *(m)*
Q32043	addition	جمع	addition *(f)*
Q4681343	additive category	رسته جمع پذیر	catégorie additive *(f)*
Q320346	adherence		adhérence *(f)*

Showing 1 to 10 of 316 entries — « ‹ 1 2 3 4 5 … 32 › »

Parsers and a DSL

Imagining tailored technologies

- Small proof-of-concept web app
- Parser-based, non-statistical
- Plugs in to the maths dictionary
- "Scratch/Lego for writing Bourbaki"
- Similar (in some sense) to the Formal Abstract project



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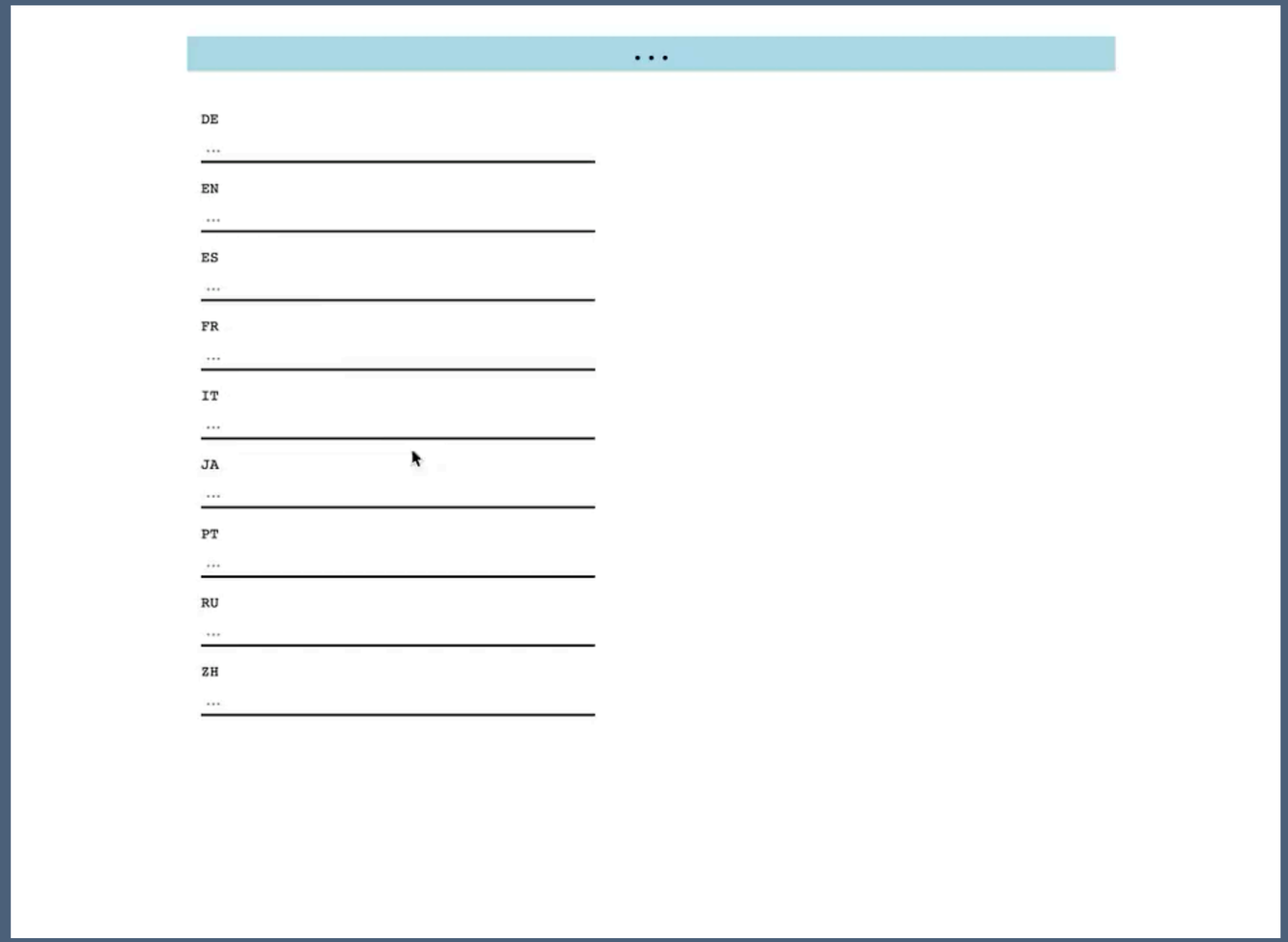


3. Useful tools

Contemporaneous work (and later)

For specific terminology, but also general sentence construction

- Other texts by the same author?
- Other texts published in the same volume/book?
- Reprints (collected works)?
- Commentaries, reviews, summaries?
- Textbooks (if available)?
- Texts that cite it?
- MathOverflow, or even Wikipedia?

Wikipedia and Wikidata

Fantastic when it's fantastic

algebra over a field (Q1000660)

vector space equipped with a bilinear product

algebra

edit

In more languages

Configure

Language	Label	Description	Also known as
default for all languages	No label defined	–	
English	algebra over a field	vector space equipped with a bilinear product	algebra
French	algèbre sur un corps	No description defined	algèbre
German	Algebra über einem Körper	Vektorraum über einem Körper, der um eine mit der Vektorraumstruktur verträgliche Multiplikation erweitert wurde	Algebra über K K-Algebra Algebra über einem Körper K Algebra
Spanish	álgebra sobre un cuerpo	No description defined	algebra sobre un cuerpo algebra

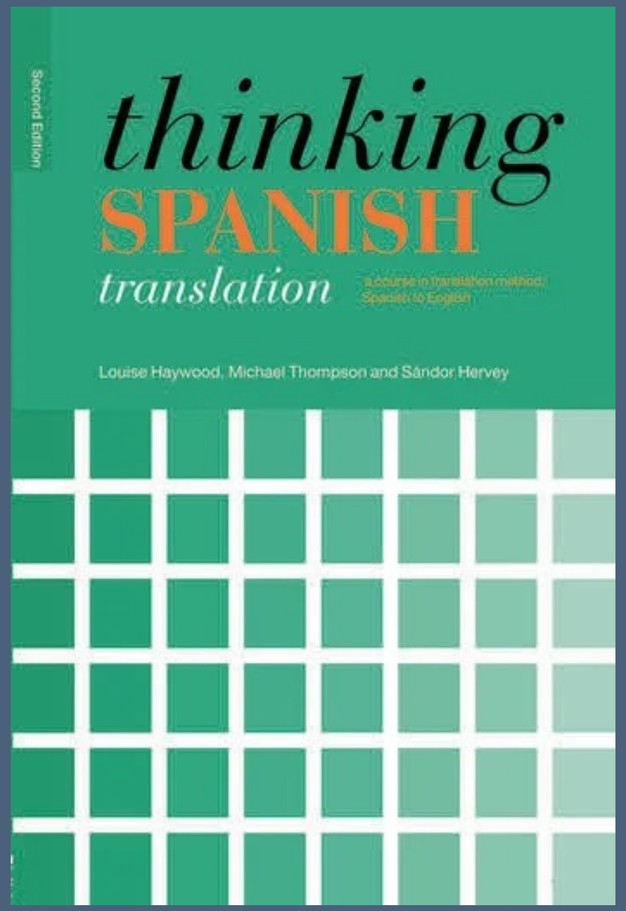
Wikipedia (28 entries) edit

- arwiki جبر على حقل
- bgwiki Алгебра над поле
- cawiki Àlgebra sobre un cos
- cswiki Algebra (struktura)
- cvwiki Алгебра (уй çийĕн)
- dewiki Algebra über einem Körper
- enwiki Algebra over a field
- eowiki Alĝebro
- eswiki Álgebra sobre un cuerpo
- fawiki جبر روی یک میدان
- frwiki Algèbre sur un corps
- glwiki Álxebra sobre un corpo
- iawiki Algebra super un corpore
- idwiki Aljabar atas medan
- itwiki Algebra su campo
- jawiki 体上の多元環
- nlwiki Algebra (structuur)
- nnwiki Algebra over ein kropp
- plwiki Algebra nad ciałem
- ptwiki Álgebra sobre um corpo
- rowiki Algebră peste un corp
- ruwiki Алгебра над полем
- svwiki Algebra över en kropp
- ukwiki Алгебра над полем
- viwiki Đại số trên một trường
- zh_classicalwiki 代數 (代數)
- zh_yuewiki 代數 (代數結構)
- zhwiki 域上的代数

Translation methodology

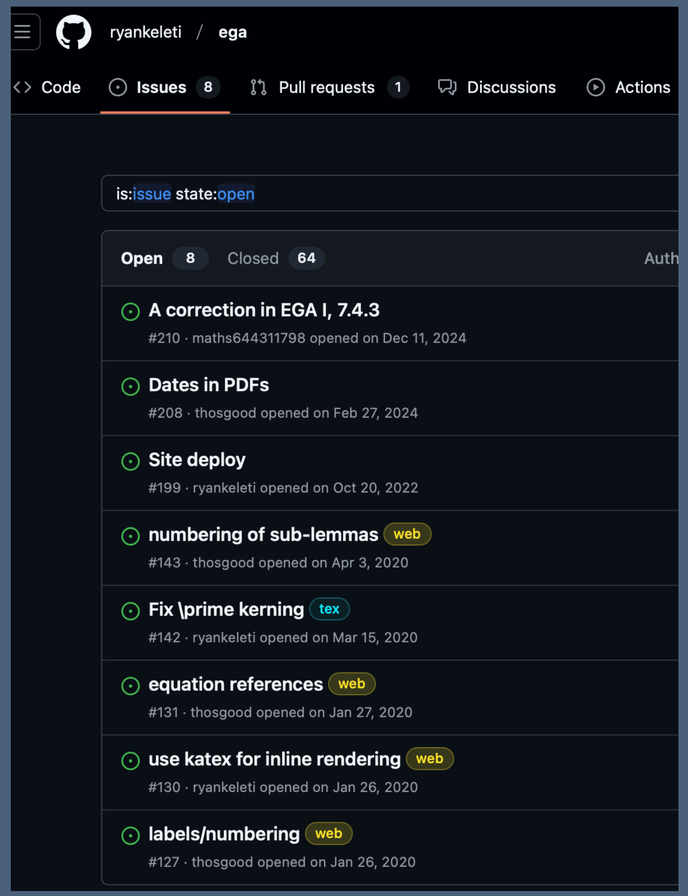
Don't forget that translation is itself an entire field of study

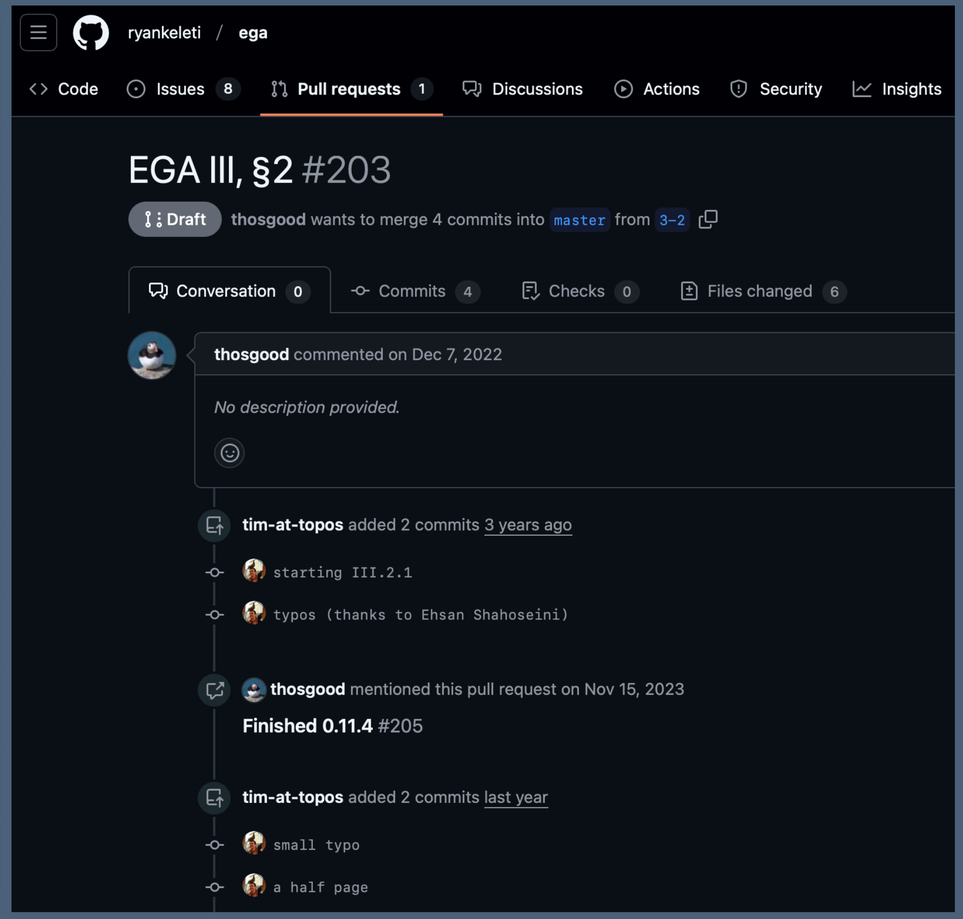
- Scientific (or "technical") translation is a standard (choice) part in a course in translation — not as simple as "simply" being a bilingual domain expert
- There are good arguments that highlight how it is in fact just as "contextually subjective" as literary translation, but in different ways
- Highlighting the importance of the "pre-translation" work
  - Reduce duplication of effort
  - Make it possible to resolve detailed questions in a consistent manner
  - Good for building community standards ("style guide")

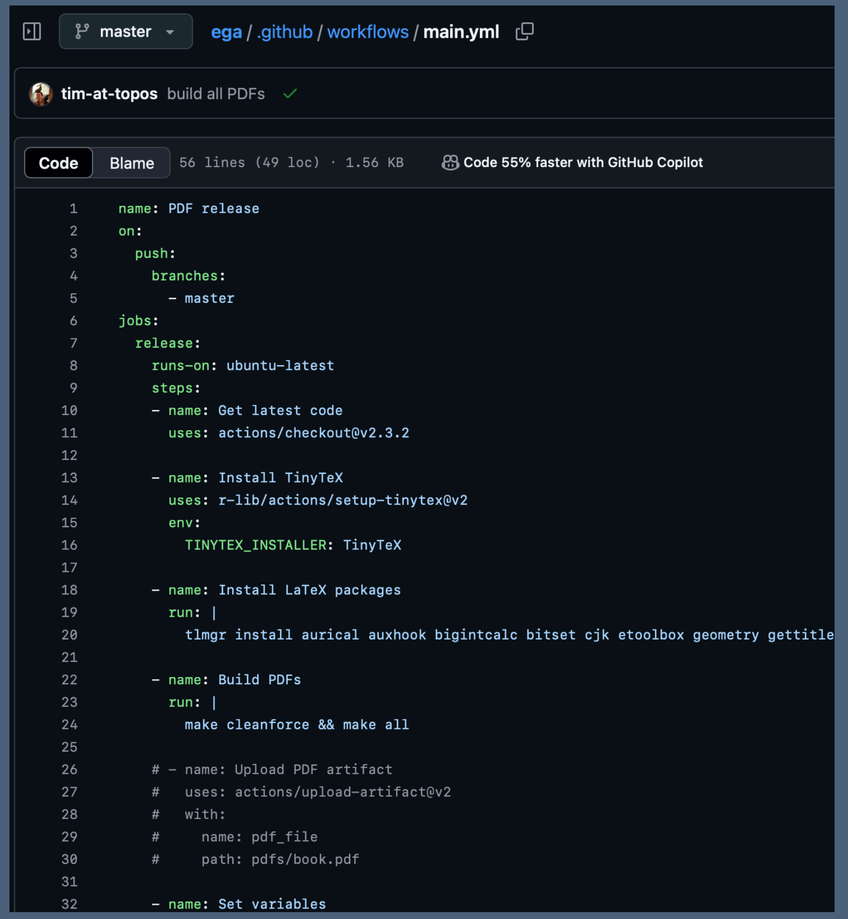


GitHub

Issues, pull requests, and builds







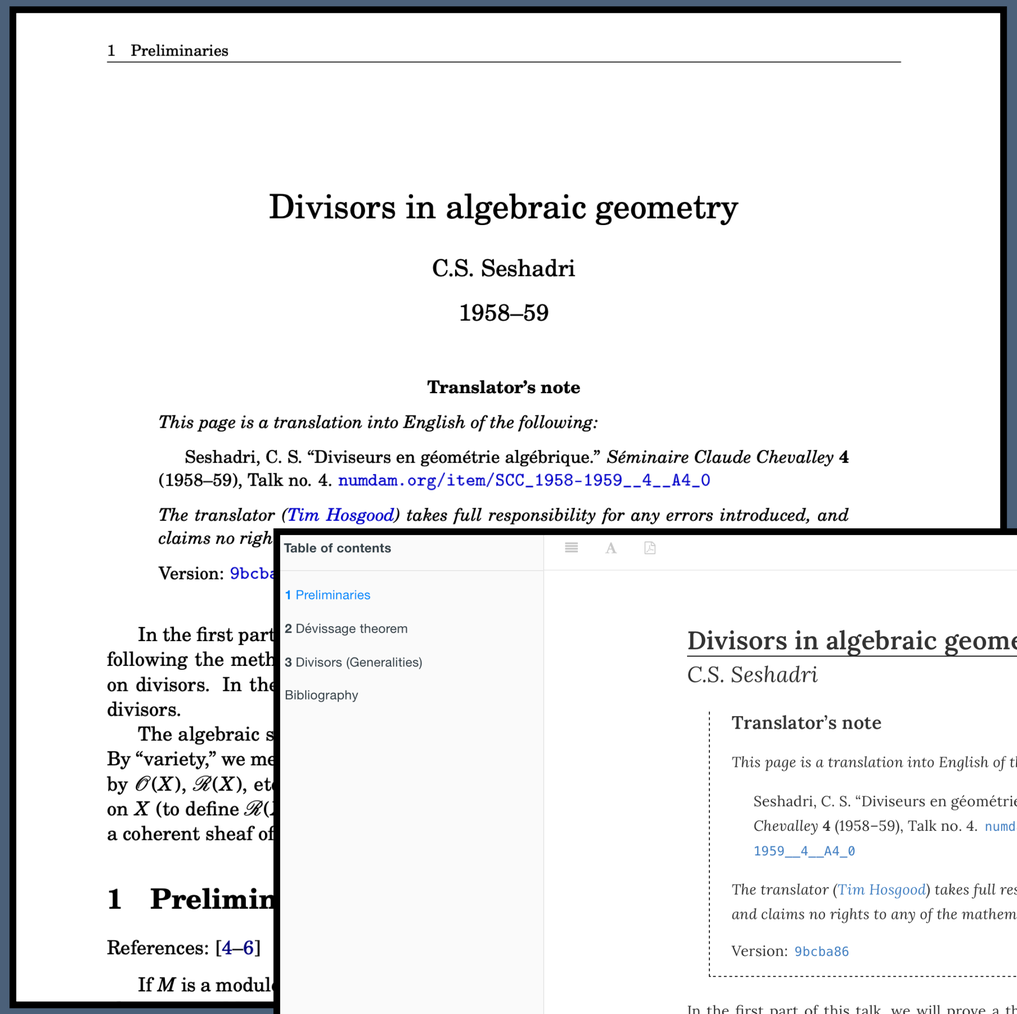
RMarkdown

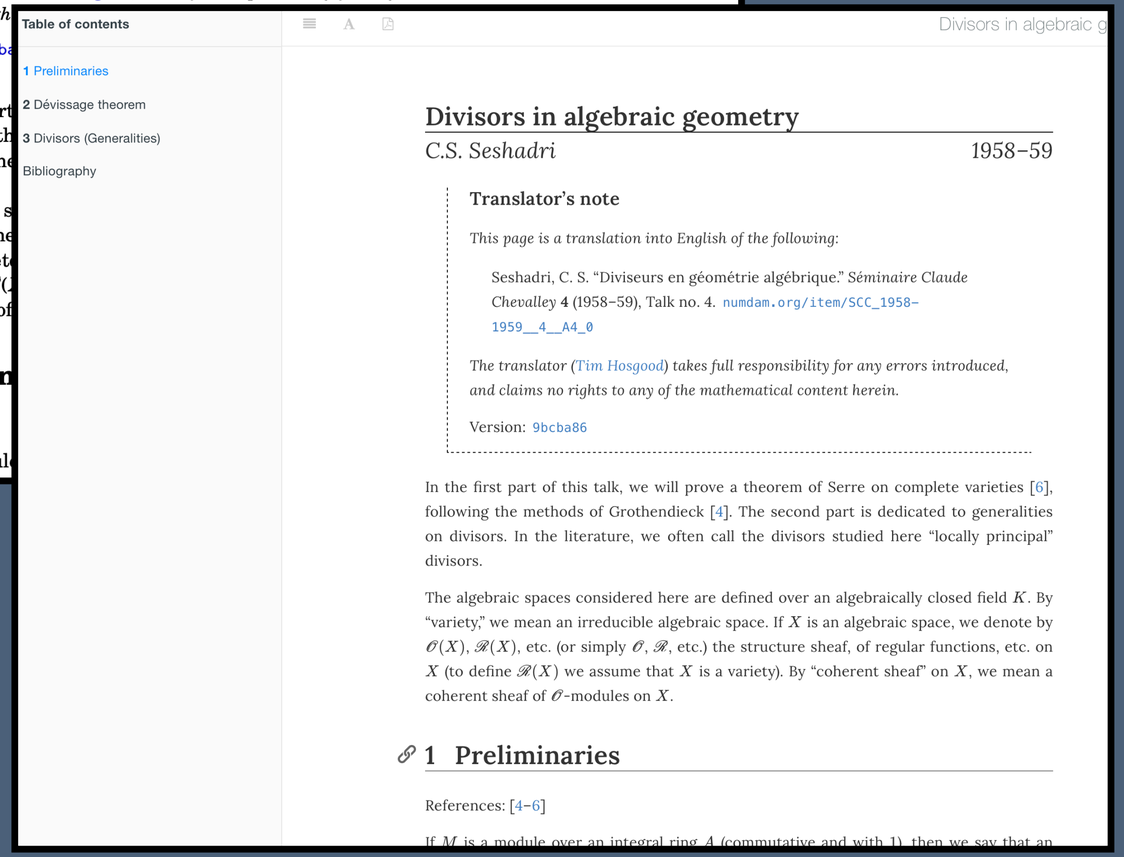
```yaml
---
title: "Divisors in algebraic geometry"
author: "C.S. Seshadri"
date: "1958--59"
original: 'Seshadri, C. S. "Diviseurs en géométrie algébrique". _Sé
bibliography: SCC-4-4.bib
nocite: '@*'
link-citations: true
csl: maths-translations.csl
reference-section-title: "Bibliography"
github-repo: "thosgood/translations"
favicon: "favicon.ico"
---
```

```
Let $\scr{F}$ be a torsion-free coherent sheaf on a variety $X$.
Then the canonical homomorphism $\scr{F}\to\scr{F}\otimes_{\scr{O}}\scr{R}$ is inje
The sheaves $\scr{R}$ and $\scr{F}\otimes_{\scr{O}}\scr{R}$ are locally constant sh
We can then identify $\scr{F}\otimes_{\scr{O}}\scr{R}$ with a vector space of finit
We call this dimension the *rank of $\scr{F}$*, and we can then consider $\scr{F}$ 

::: {.itenv #proposition-4 title="Proposition 4" latex="{Proposition 4}"}
Under the same hypotheses as in [Proposition 3](#proposition-3), there exists a coh
then $\scr{O}^n/(\scr{I}\cdot\scr{F})$ and $\scr{F}/(\scr{I}\cdot\scr{F})$ are tors
:::

::: {.proof}
The proof is immediate.
:::

\oldpage{4-03}
If $Y$ is a closed subset of an algebraic space $X$, then we denote by $\scr{I}_Y$ 

::: {.itenv #proposition-5 title="Proposition 5" latex="{Proposition 5}"}
Let $Y$ be a closed subset of an algebraic space $X$, and $\scr{F}$ a coherent shea
then there exists an integer $k$ such that $\scr{I}_Y^k\scr{F}=0$.
:::

::: {.proof}
We can reduce to the case where $X$ is affine, since there exists a finite cover of
In this case, the hypothesis implies that the set defined by the ideal $\ann\HH^0(X
This implies, as is well known, that $\ann\HH^0(X,\scr{F})\supset\scr{I}_Y^k$.
:::
```

PDF (LaTeX)

HTML

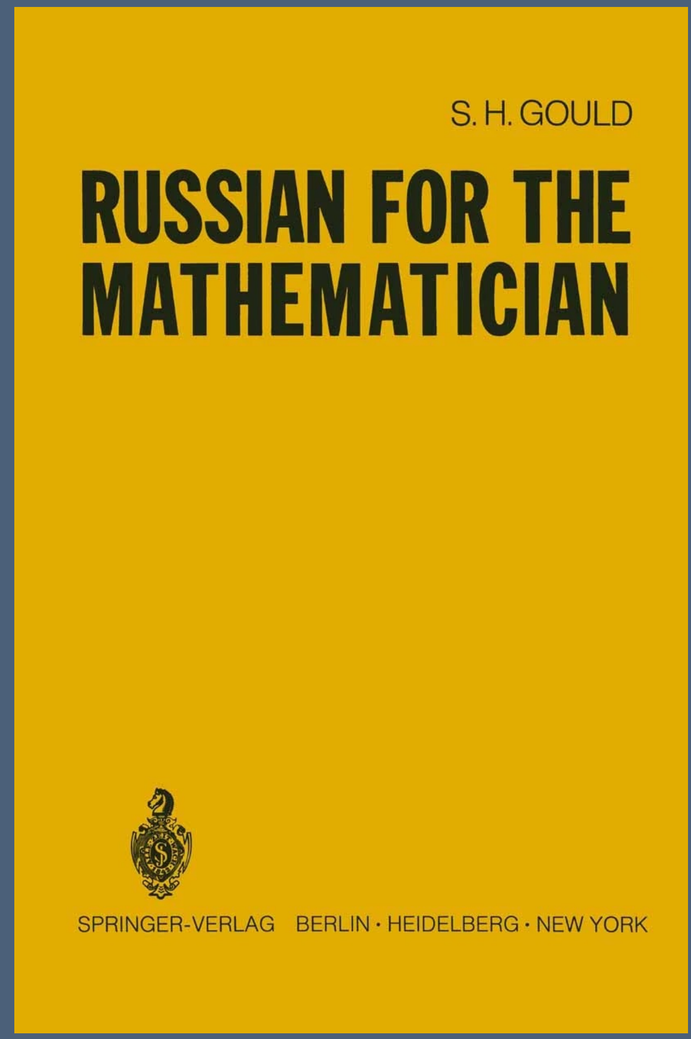




Russian for the Mathematician

The only book of its kind?

- "The Board of Trustees of the American Mathematical Society, expressing its belief that a great deal of time would be saved for mathematicians if they could study a textbook of Russian precisely adapted to their needs, granted to the present author nine months leave of absence from his duties as Editor of Translations."

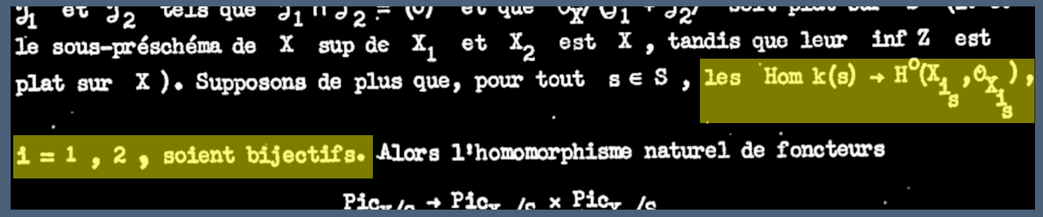


4. Difficulties

Technical terminology

Things can get oh-so specific

- Sometimes a native speaker (or good standard dictionary) could suffice
  - … but sometimes you need them to be a mathematician
  - … in the specific domain
  - … from a specific period of time
    - Example: "trace" — not even anywhere on any relevant French Wikipedia page… apart from the actual page
  - (Also sometimes there are just typos, mistakes, or even mildly (forgivably) sloppy writing)



Technical terminology

Bingener, J. "Über formale komplexe Räume"

In der vorliegenden Arbeit soll nun zunächst die Grundtheorie der formalen komplexen Räume entwickelt werden. Letztere werden in 1 als induktive Limiten eines geeigneten Systems von komplexen Räumen eingeführt. Spezielle formale komplexe Räume erhält man, wenn man die formalen Kompletierungen komplexer Räume längs analytischer Teilmengen betrachtet. Natürlich ist auch jeder komplexe Raum ein formaler komplexer Raum. Die Strukturgarbe $\mathcal{O}_X$ eines formalen komplexen Raumes X ist stets kohärent mit lokalen noetherschen Halmringen ((1.1) und (1.4)) . Es ist von Bedeutung zu wissen, daß wie bei den komplexen Räumen die Schnittringe Steinscher Kompakta in X ausgezeichnete noethersche Ringe sind ((1.4),(1.10)) . Formale komplexe Räume lassen sich (lokal) in Zahlenräume einbetten, vgl.(1.7).

In the present article, we first develop the basic theory of formal complex spaces. These are introduced in §1 as inductive limits of a suitable system of complex spaces. We obtain special formal complex spaces if we consider the formal completions of complex spaces along analytical subsets. Of course, every complex space is also a formal complex space. The structure sheaf $\mathcal{O}_X$ of a formal complex space X is always coherent with local Noetherian stalks ((1.1) and (1.4)). It is important to know that, as in the case of complex spaces, the !!TO-DO: **intersection rings?**!! of compact Stein subsets of X are excellent Noetherian rings ((1.4) and (1.10)). Formal complex spaces can be (locally) embedded into !!TO-DO: **number spaces?**!!, cf. (1.7).

Anachronistic translation

Where does translation end and commentary begin?

Anachronistic translation

Where does translation end and commentary begin?

- Terminology changes over time, in many ways
  - "good", "satisfying Axiom B", "of Grothendieck [G1967a]" ➟ ?
  - Do we translate "literally", or so that the modern reader will know what it means? Footnote it?

Anachronistic translation

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  - Do we translate "literally", or so that the modern reader will know what it means? Footnote it?
- Different choices are made at different times by different groups
  - In double categories: vertical/horizontal vs. horizontal/vertical vs. taut/loose vs. tight/loose vs. arrow/pro-arrow vs. weft/warp
  - "tribu" vs "σ-algèbre"
  - ... why did the author make their specific choice?

Ambiguity inherent to English

Or: different languages do different things in different ways

- Sometimes a word-for-word translation will be much more ambiguous in English than in French/German/any language with grammatical gender/case/any accordances (e.g. plurality of adjectives)

- Certain "grammatically correct" constructions in English can sound overly formal:

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In order for X to satisfy Y		that Z satisfy W
For X to satisfy Y	it is necessary and sufficient	that Z satisfies W
To have that X satisfying Y		for Z to satisfy W

[it is necessary and sufficient for Z to satisfy W for X to satisfy Y] ?!

Editorial consistency

Community submissions and community vibes

- How do we make it sound like a community translation glosses nicely as if written by a single author?
  - (Bonus question: do we always want this?)
  - Style guides help, but ...
    - ... hard to write, and even harder to write well
    - ... don't solve all problems (even in a monolingual environment!)
- How much effort should be asked of contributors?
  - "I ran this chapter through Google Translate"
  - Balancing useful contributions with unnecessary gatekeeping
- What counts as a contribution?

5. Future resources

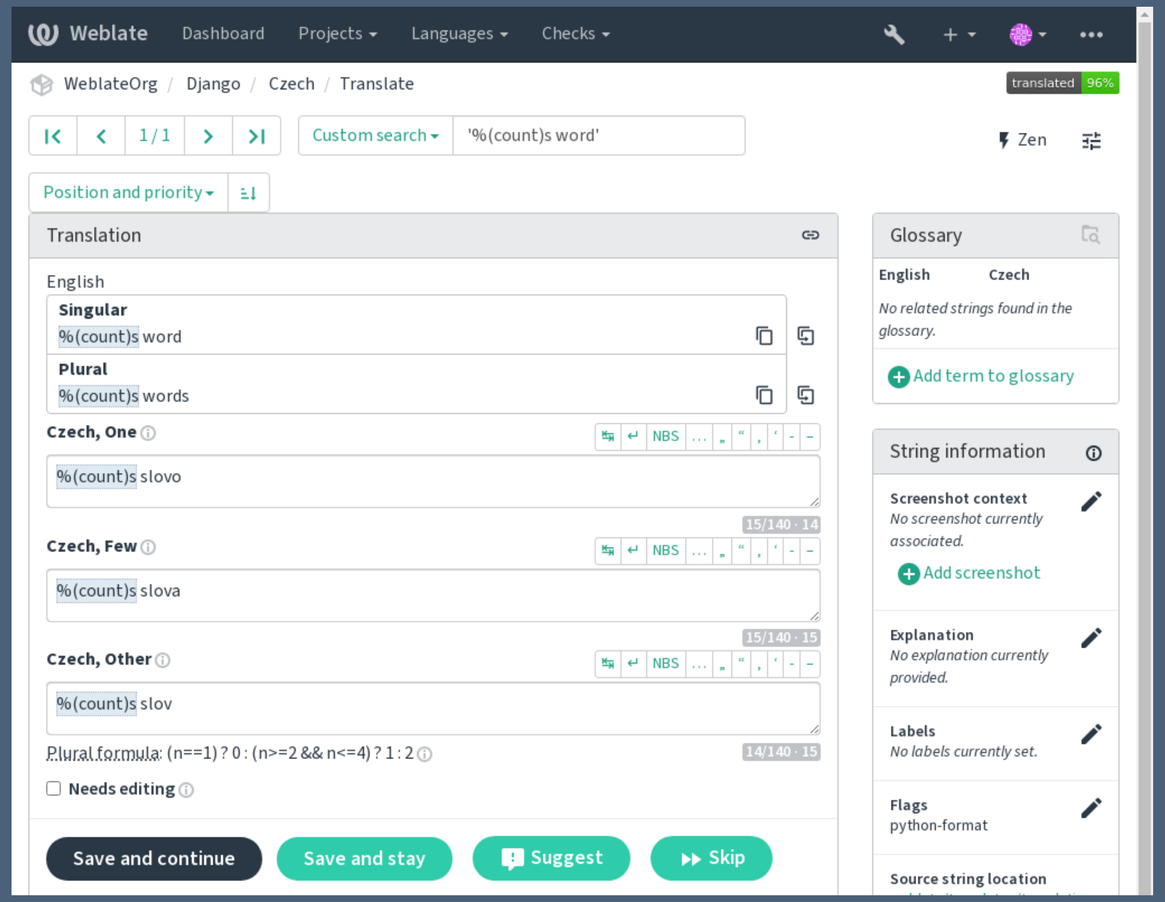
Improved maths dictionary

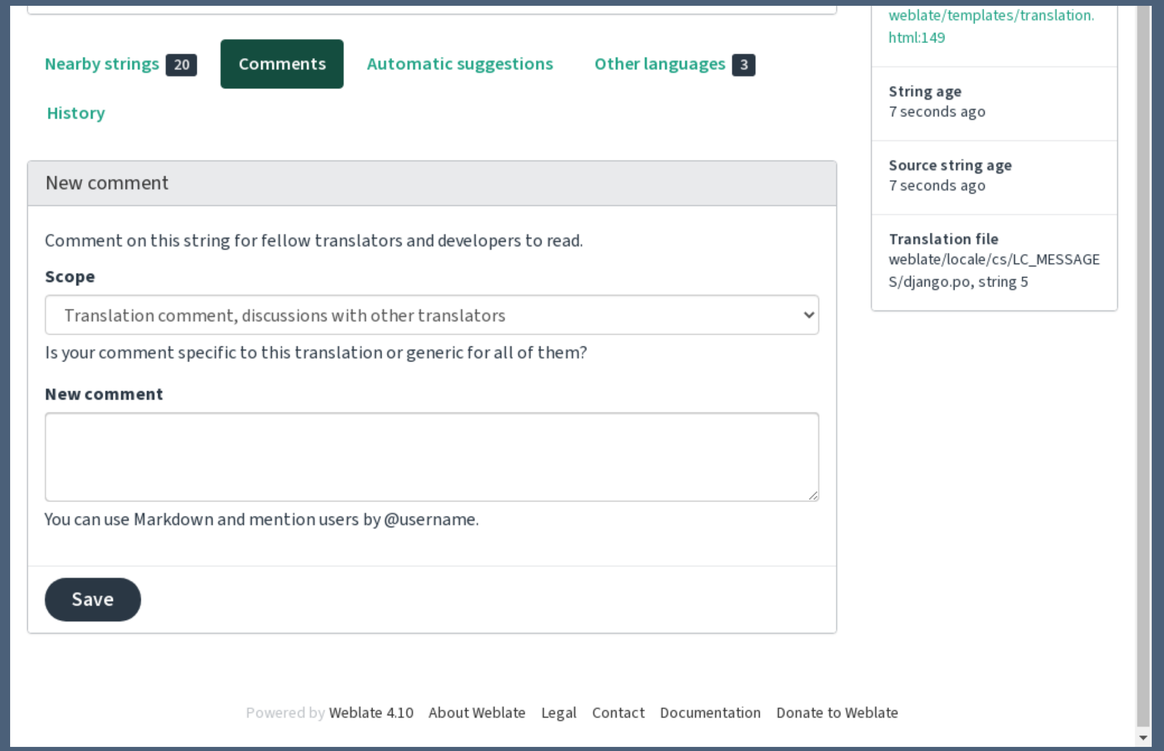
Enabling community

- More utility as a single-language dictionary
  - Pluralisation, cases, ... ???
  - Common phrases ("let X be a Y", "if A then B", "it is necessary and sufficient that")
  - Example sentences from actual papers, placing words into context
- Better usability as software
  - Allow people to make suggestions, comments, corrections
  - Export vocab lists for specific language pairs (and specific topics?)
- Really figure out how to make it "open by design"

Weblate

Translation for software … for mathematics?





Languages for the Mathematician

Tailored introductions to languages

- Highly specific: I can't go to the cinema last weekend with my friends, but I can take a left Kan extension along an acyclic cofibration of delta lenses
- Start with useful building-block phrases ("let X be a Y", "if A then B", etc.) and general vocabulary (definition/theorem/proof)
- Vocabulary lists for specific domains
- Examples from actual papers
- What would a term-long course based on this look like?
    - Masters theses?

Expository articles and blog posts

Again: translation over universality

- General expository articles (AMS "What is...") in non-English languages
  - Help people with translations in both directions
  - Push back against domain collapse
  - Build communities around translation, indirectly
  - Highlight language-specific references
    - We "know" what these might be for the most common languages (German complex geometry, French category theory, Italian geometry), but are still missing key parts, and ...
    - ... what about all the things we don't know? What mathematics is happening in Basque? in Farsi?

GitHub templates

Reducing technological cost of entry

- Somebody wants to create a community around a new translation project? "One click" setup for it all:
  - Repository
  - Issues
  - Discussions
  - Builds
  - Contributor lists

Workshops and conferences

Like this one!

- I was so excited to get an invite!
- Building on top of "mere" translation and into commentary/exposition/historical contextualisation is seen as core in other domains, so why not in mathematics?
  - Creating legitimacy and "prestige" is hard, but events and community building is not a bad way to start
- Good excuse to bring together TL and SL researchers
  - Run the translation parts in tandem with standard research talks
- Long-term dream: more multi-lingual journals

Thanks!