

To Do List

December 4, 2023

This chapter contains some material about relations and constructions with them. Notably, we discuss and explore:

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1 Notes to Self

1.1 Things To Ask On MO/Zulip

Remark 1.1.1.1. Here is a list of things to be asked on MO/Zulip.

1. What are
 - (a) Cartesian bicategories
 - (b) Double categories of relations (<https://arxiv.org/abs/2107.07621>)
 - (c) Categories of relations
 - (d) Allegories
 - (e) 1-Category equipped with relations (<https://ncatlab.org/nlab/show/1-category+equipped+with+relations>)

good for? What have these notions been developed for, why are they important, and what have they lead to?

1.2 Things To Explore

Remark 1.2.1.1. Here is a list of things to be explored.

1. internal adjunctions in **Mod** as in [JY21, Section 6.3]; see [JY21, Example 6.2.6].
2. write the “profunctors” equivalent of the relations chapter
3. change χ_B notation throughout the notes
4. maybe note that skew monoidal structures on **Rel**(A, B) satisfy coherence trivially since the 2-morphisms are inclusions
5. reconsider notation $\mathbf{FreeAlg}_{\mathcal{P}}$ in **Relations**
6. Constructions With Sets: Isbell duality for powersets
7. Categories: comma category notation as in <https://mathoverflow.net/questions/455630>
8. Universal property of the bicategory of spans, <https://ncatlab.org/nlab/show/span>
9. Codensity monad $\mathbf{Ran}_J(J)$ of a relation (What about $\mathbf{Rift}_J(J)$?)
10. Relative comonads in **Rel**.
11. Write proper sections on straightening for lax functors from sets to **Rel** or **Span** (displayed sets) when I study the corresponding notions for categories
12. Write about cospans.
13. CoCartesian fibration classifying $\mathbf{Fun}(F, G)$, <https://mathoverflow.net/questions/457533/cocartesian-fibration-classifying-mathrmfunf-g>

1.3 Omitted Proofs To Add

Не так благотворна истина, как
зловредна ее видимость.

Даниил Данковский

Truth does not do as much good in
the world as the appearance of truth
does evil.

Daniil Dankovsky

There's a very large number of omitted proofs throughout these notes; here I list some of the ones that I really want to add to the notes at some point.

Remark 1.3.1.1. Here is a list of omitted proofs that I want to eventually write up or add a reference to.

- Relations, Item 1 of Proposition 2.5.1.1
- Relations, Item 2 of Proposition 2.5.1.1
- Relations, Item 9 of Proposition 2.5.1.1
- Relations, Item 10 of Proposition 2.5.1.1

Appendices

A Other Chapters

Set Theory

1. Sets
2. Constructions With Sets
3. Pointed Sets
4. Tensor Products of Pointed Sets
5. Indexed and Fibred Sets
6. Relations
7. Spans
8. Posets

Category Theory

9. Categories
10. Constructions With Categories
11. Kan Extensions

Bicategories

12. Bicategories

13. Internal Adjunctions

Internal Category Theory

14. Internal Categories

Cyclic Stuff

15. The Cycle Category

Cubical Stuff

16. The Cube Category

Globular Stuff

17. The Globe Category

Cellular Stuff

18. The Cell Category

Monoids

19. Monoids

20. [Constructions With Monoids](#)

Monoids With Zero

21. [Monoids With Zero](#)

22. [Constructions With Monoids With Zero](#)

Groups

23. [Groups](#)

24. [Constructions With Groups](#)

Hyper Algebra

25. [Hypermonoids](#)

26. [Hypergroups](#)

27. [Hypersemirings and Hyperrings](#)

28. [Quantaes](#)

Near-Rings

29. [Near-Semirings](#)

30. [Near-Rings](#)

Real Analysis

31. [Real Analysis in One Variable](#)

32. [Real Analysis in Several Variables](#)

Measure Theory

33. [Measurable Spaces](#)

34. [Measures and Integration](#)

Probability Theory

34. [Probability Theory](#)

Stochastic Analysis

35. [Stochastic Processes, Martingales, and Brownian Motion](#)

36. [Itô Calculus](#)

37. [Stochastic Differential Equations](#)

Differential Geometry

38. [Topological and Smooth Manifolds](#)

Schemes

39. [Schemes](#)