

# Applied Compositional Thinking for Engineers (ACT4E)



## Session 13 - Summary

### Questions & Answers

**Q: in the course we have very rarely spoken about universal properties which often characterize categorical objects. Why? Do we have some notion of universal object in engineering...? Thanks!**

AC: there are of course universal objects but we didn't find any reason to discuss them.  
also: we didn't find good examples of natural transformations in an application.

NM: I think the logical constraints were an example of universal properties, but haven't had a chance to properly digest it yet

**Q: Is co-design used in software engineering? probably!**

AC: Formally not yet, but there is a lot to do here.  
(Of course the experts use it in an intuitive way)

**Q: So what does co-design mean? Contravariant design? :) Cooperative design maybe? Maybe a synonym for over-engineering; the more you design, the worse the result. (contravariant)**

AC: I say:  
collaborative design  
continuous design

computational design

compositional design

Definitely not over-engineering: it after all tells you how to find *minimal* designs.

**Q: Can you elaborate on how to use ACT to formulate physics principles? For example how do we formulate conservation of energy and transformations of energy types (kinetic, potential, chemical, thermal, etc). How do we formulate conservative vs dissipative energy and second law of thermodynamics? How do we formulate Noether's theorem?**

AC: Baez on physics and laws:

[https://golem.ph.utexas.edu/category/2020/06/getting\\_to\\_the\\_bottom\\_of\\_noeth.html](https://golem.ph.utexas.edu/category/2020/06/getting_to_the_bottom_of_noeth.html)

AC: picturing quantum processes

Authors: Coecke and Kissinger

<https://www.cambridge.org/core/books/picturing-quantum-processes/1119568B3101F3A685BE832FEEC53E52>

NM: Is this XZ calculus?

**Q: How long will you be watching the zulipchat?**

AC: a long time. Thinking of also having the ETH students join.

**Q: Last lecture. Lets get philosophical. What kind of process is life? What is intelligence?**

KL: Some loose thoughts: Life is an open system that exchanges matter and energy with it's environment. It is by def far from equilibrium (equilibrium with environment is death). It is a dissipative system. I am not sure how it relates to compositionality...

As for intelligence, maybe [https://en.wikipedia.org/wiki/Markov\\_blanket](https://en.wikipedia.org/wiki/Markov_blanket) is relevant?

**Q: Is there any connection of applied category theory to complex adaptive systems and emergence?**

**Q: What is the relation of sheaf theory (gluing over overlaps) and compositionality (gluing over interfaces)?**

NM: can you define what you mean by compositionality? Do you just mean composition of morphisms?

**Q: You said that every topos has its own logic, possibly different from the one we use in sets. Are there some usual logical laws that are valid in Set but also in any topos, making them kind of “universal among all possible logics”?**

Conjunction and implication?

KL: <https://ncatlab.org/nlab/show/internal+logic> is a good place to start.

**Q: the ETH course will be online? If yes can we attend?**

**Q: I would like to rewatch some of the videos. How long will you leave them on the web?**

**Q: Why exactly you did not include Yoneda lemma in the course?**

**Q: Can you imagine a real-world use case (running problem) used to expose elements of ACT, while at the same time incrementally building a solution (set of solutions) to the use case problem(s)? A “from zero to hero” approach...**

**Q: What would ACT-hub look like (thinking of github)?**

NM: Maybe something like the algorithm zoo?