ACT 2017 Workshop Notes

September 7-8, 2017 at the University of Oxford, as a satellite event of [FSCD](http://www.cs.ox.ac.uk/conferences/fscd2017/index.html) 2017.

Late 2017 or early 2018 at the Lorentz Center, Netherlands, as a [Lorentz Center workshop](http://www.lorentzcenter.nl/infoorg.php).

Summer “Kan Extension Lab” to follow Kan Extension Seminar?

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To-dos

1. ~~Name~~ **~~specific~~** ~~external funding sources. Email Merlijn + Nina Otter.~~
2. ~~Josh: go to Bob, Samson, bring them up to date, get them more involved.~~ **~~GET NAMES.~~** ~~(Bob: get names especially on the cognitive side).~~
   1. ~~GET PERMISSION FROM BOB,~~ SAMSON ~~to use their names as organizers.~~
   2. Confirm **senior** participant list! (+ industry people?)
   3. Use this to generate a concrete, well-tuned vision of the program.
3. ~~Josh: email Gromov: yes/no, what, who.~~
4. Josh will figure out more about AI/KR/linguistics/cognition track.
5. ~~Brendan: discussions with John.~~
6. Josh and Brendan: Figure out tutorial content. (~~Josh: email Dan Marsden for help?~~)
7. ~~All: write a workshop proposal.~~
8. All: open workshop proposal to larger community (Dan Marsden, Nina Otter, etc.) to contribute.
9. All: then send to Merlijn (Lorentz) and/or Jamie (FSCD) for final screening.
10. All: apply for additional workshop funding, i.e. to subsidize graduate student travel!
11. All: put together a scientific committee for each track in the final proposal.

How can we make this workshop a success? I.e. how do we get the right people to show up.

Getting the right **senior** people (from both academia as well as industry?)

Getting the program correct (but to a lesser extent)

Advertising (to an even lesser extent)

Do we even want an industrial track? To have a specific industry track, we’d need an industry co-organizer. And you have to be very specific with your invitations, since a general advertisement will get lower-level people with a very vague idea of what CT can do, and the discussions are not productive. **Conclusion: convince people already in the community to invite practitioners (whether academic or industrial) outside the community; promote organic growth.** Possible participants: NIST (manufacturing), Lockheed Martin (Henson Graves), Metron (talk to John), Galois (see David’s CASCADE application), Dassault (Patrick Johnson, see Spencer’s recommendation), Airbus (Dominique Ernadote), Kestrel (ref old Specware program), Google? (contact Mike Stay)

Useful resources:

* [The report from Dagstuhl](http://drops.dagstuhl.de/opus/volltexte/2014/4618/pdf/dagrep_v004_i004_p049_s14182.pdf)
* [compct@nist.gov](mailto:compct@nist.gov) list
* List of external funding agencies for Lorentz. <https://www.lorentzcenter.nl/ExternalFundingAgencies.pdf>

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# Workshop Proposal: Lorentz Center

Due: 15-05-2017

1. Title
   1. Applied Category Theory
2. Organizers and co-organizers
   1. John Baez
   2. Bob Coecke
   3. Aleks Kissinger
   4. Michael Moortgat (?)
   5. Brendan Fong
   6. Joshua Tan
3. Scientific case (motivation and goal)

Category theory was developed to translate ideas from one field of mathematics, e.g. topology, to another field of mathematics, e.g. algebra. More recently, category theory has become an unexpectedly useful and economical tool for modeling a range of different disciplines, including quantum mechanics, systems biology, complex networks, database theory, and programming language semantics. This conference will bring together both theorists and practitioners from a wide variety of sciences to develop existing applications of category theory in network theory, information theory, and computer science, as well as to foster new applications in economics?, biology, and artificial intelligence.  
  
Despite the flexibility and expressiveness of categorical tools in mathematics and computer science, the perceived difficulty of category theory has hindered wider acceptance of the formalism. As a consequence, many researchers in different communities share the feeling of under-exploitation of the potentialities of category theory to their areas of interest, while many applied category theorists feel that the potential of category theory as a toolkit for bridging different disciplines has yet to be fully realized.  
  
Previous workshops at Dagstuhl, NIST, and Berkeley identified categorical methods as “a unified approach to the modeling of complex systems, and category theory as a paradigm for mathematical modeling and applied science.” This workshop...   
  
Each working day will include two survey lectures during the morning. These will be followed by three shorter talks in the early afternoon, which present active areas and innovative application for these methods. The day will be closed by a working group session: during these sessions the attendants will split into several groups according to the main thematic areas that had been identified on the first day. Suggested application areas include (quantum) computation, physics, biology, complex systems, economic, social and cognitive science, and linguistics. Indeed, some of the items span more than one discipline, e. g. game theory, and the list is definitively not exhaustive.

The goals of the workshop are (1) to create a more cohesive and connected ACT community, especially among early-stage researchers, (2) to develop existing and new applications of category theory, and (3) to try to outline common goals and open problems for the field, i.e. across multiple applications.

1. Program
   1. **Dynamical systems + networks**
      1. David Spivak
      2. Eugene Lerman
      3. Dan Koditschek?
   2. **Systems biology**
      1. Gordon Plotkin
      2. Luca Cardelli
      3. Vincent Danos?
      4. Russ Harmer?
   3. **AI / Linguistics**
      1. Samson Abramsky
      2. Bob Coecke
      3. Dan Marsden + others in the Concept Group
      4. Misha Gromov
      5. Michael Robinson? (it’s unclear that he would actually come)
   4. Entropy and information theory
      1. Tobias Fritz
      2. Tom Leinster - measurement
   5. Computational methods/rewriting
      1. Jamie Vicary
      2. Jason Morton
      3. Fabio Gadduci
      4. Pawel Sobocinski
   6. Databases/bidirectional transformations
      1. David Spivak
      2. Mike Johnson
      3. Jeremy Gibbons
      4. Ben Pierce
2. Participants
   1. Provide list of key participants + confirmation of interest
      1. The organizers
      2. All the people above.
      3. Don’t need to have all the participants lined up, but presumably you have a list of key participants, and try to obtain a confirmation of interest from as many of these as possible, and you can supplement that with names of others that you plan on inviting.
   2. How to handle submissions:
      1. Invited submissions sent out 7 months before the workshop / ASAP.
      2. Open submissions beginning 6 months before the workshop, closing 4 months before the workshop.
   3. Junior people
      1. Ask senior people to recommend/encourage PhD students as well as postdocs.
      2. Have an open submission process.
      3. Financial aid process (also open to senior and applied people)
   4. Gender balance
      1. We’ll advertise it broadly.
3. Factsheet

Title: Applied Category Theory

Dates First Preference:

Dates 1st Preference: tutorial week: 20-24 Jan, 2014 workshop week: 27-31 Jan, 2014 Dates 2nd Preference: tutorial week: 13-17 Jan, 2014 workshop week: 20-24 Jan, 2014 2014 Dates 3rd Preference: To be determined. Finances: funds from Lorentz center, and others

Participants: 5 key note speakers 30 participants for the tutorial weekend, 55 participants for the workshop week

Addresses:

Aleks Kissinger

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1. Budget (excel form provided)
   1. Funding: we provide a small $25 euros per participant per day. For a weeklong workshop, it’s ~3000 (for 25) to ~7000 euros (for 55). Especially if you have many junior people from abroad, external sources would help supplement it.

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# Integrated Notes

## List of open problems

1. Can we realize “entropy” as some sort of functor? (ask Gromov)
2. Stability of interconnected dynamical open systems
3. Integrating AI systems, “what is an AI system”
4. “What questions would you ask for which categories would be the answer, or monoidal categories would be the answer?” “What’s everyone doing right now, where is everything doing the same thing?”
5. “Database of categories” (by Rosebrugh)
6. Globular? Use it as a basis for doing other things?
7. What would be nice: if nLab had tons and tons of examples. If everything they had, here’s what a modification is or a bicategory is or an adjoint equivalence is, and here is how someone should use it.
8. How to contribute to FQL as a research project? E.g. through “proof = program”.

## Potential Funding Sources

In the UK

* [Royal Society International Scientific Seminar](https://royalsociety.org/grants-schemes-awards/grants/international-seminars/) (Due **17 Nov**, comes with accommodation, $5000)
* [OASIS](https://www.cs.ox.ac.uk/seminars/oasis/) (controlled by Bob)
* [Wolfson Cluster Fund](https://www.wolfson.ox.ac.uk/funds) (rolling, only 600 pounds)
* Oxford CS department slush funding (link unknown)
* [Lorentz Center](http://www.lorentzcenter.nl/progsel.php) workshops in Leiden, Holland (this is a longer-term application; “Workshops taking place sooner than 16 months after the deadline will be evaluated. Thus, the upcoming deadline, 15 January 2017, is for workshops with starting date before 1 May 2018.”)
* [EPSRC](https://www.epsrc.ac.uk/funding/howtoapply/routes/network/workshops/) (rolling deadline), also see [network funding](https://www.epsrc.ac.uk/funding/howtoapply/routes/network/networks/intro/) (includes workshop grants)
* [London Mathematical Society](https://www.lms.ac.uk/grants/research-workshops-grants) ($10k, due 12 months before date, but it’s in math)
* [London Mathematical Society](https://www.lms.ac.uk/grants/conference-grants-scheme-1) “Conference Grants - Scheme 1”. (Max 7k pounds, deadline 22 January 2017, and application needs to be written or supported by an LMS member.)

In the US

* [ICERM](https://icerm.brown.edu/get_involved/#tab_topical) at Brown ($25k, rolling)
* [NSF funding for workshops](https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=11701) in the mathematical sciences (rolling)
* [Elsevier Mathematical Sciences Sponsorship Fund](http://www.journals.elsevier.com/annales-de-linstitut-henri-poincare-c-analyse-non-lineaire/news/apply-now-elsevier-mathematical-sciences-sponsorship-fund), max $5k, deadline 30 November 2016, (this could be for support for graduate students, and/or to cover costs for the Summer “Kan Extension Lab”)

## People

See <https://docs.google.com/spreadsheets/d/1BSe4Mc5FOa5cx-0QkQkv7mCYFBghFE2-4EZGUI-D7vA/edit#gid=0> for the full list.

Tangentially associated, possibly invite?

1. Kathryn Hess?
2. Heather Harrington?
3. Steve Awodey?
4. Emily Riehl?
5. Dan Koditschek?
6. Rob Ghrist?
7. Rick Blute?
8. Richard Wood?

# Advice from Merlijn @ Lorentz, Dec. 12, 2016

merlijn is the scientific coordinator

he helps us develop our ideas into a full proposal.

want: diverse organising committee. have applied people input into tutorials. Important: how do you attract both experts in category theory as well as people on the applied side? Tutorials may not be interesting to experts in category theory.

dutch organisers: kissinger. Strongly recommend having a Dutch co-organizer. There will be an intake meeting at the Lorentz Center where one of the organizers has to be present. See the venue, see the facilities, etc. make it easier to visualize how you’re going to run the workshop. “ Also, we are funded by Dutch tax money, so we always ask what the connection to Dutch research is, and it’s easier to attract people from the Dutch research community.”

draft to merlijn asap.

deadline january 15

review board: mathematics, life sciences, computer science (take most positive recommendation)

reply by end of march

intake meeting 6-9months before workshop date.

proposal: scientific case, concrete examples of progress, goals (roadmap), preliminary program -- justified in terms of goals, first two days general get-to-know, social session monday afternoon (wine+cheese welcoming party), next two days core work, workshop dinner on wednesday evening (on boat 4 hours), generous coffee breaks (.5hrs) and lunch breaks (1.5-2hrs),

proposal audience: 2 sections (general, in depth)

diversity: junior-senior, gender

25/euros/participant/day

25 or 55 people

ie 3000 or 7000 euros

get assigned workshop coordinator.

2.5 month approval turnaround. The intake meeting takes place 6-9 months before the planned workshop date.

We recommend draw up a preliminary program / timetable which should connect to the goals in the previous session.

The program session then lays out what you want to do during the day. Merlijn recommends first 2 days for general introductions, esp. If you bring people together. It takes a while for people to get to know each other. Wednesday + Thursday you can really get to the core of the problem. Then you have Friday to wrap it up. Coffee + lunch breaks: half an hour! Make these generous, allows for additional discussion. Coffee machine. Lunch breaks: 1.5 hours to 2 hours.

To facilitate this, on Monday afternoon we offer a wine + cheese welcoming party, which is just a nice way to get to know each other, and on Wednesday evening there is a workshop dinner (on a boat!).

**We will always go with the recommendation from the most positive board.** Math, dynamical systems, and biologist boards. E.g. if the biologists endorse this, then Lorentz will go with this.

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# Feedback from the Concept Group, Oct. 31, 2016

To do:

1. Ask John about a previous workshop at Dagstuhl, which had a broad mix of applied CT people.
2. The main recommendation coming out of the discussion was that we should focus on bringing in new practitioners, and having talks from different areas and practicums that teach people how to use category theory for their work, rather than focusing on theorems and definitions. Bob: the multidisciplinarity aspect of the workshop would be the most interesting part of it.
   1. Practicums should deal with these two barriers: most people tend to think in terms of set theory, and they’re afraid of CT’s reputation for abstraction. A practical consequence between set theory and CT: in CT it’s easier to prove things but it’s much more difficult to define them in a convincing way.
3. We should target young people if we want to build a community, but there’s a tension between this and “opening up” the ACT community, since most new practitioners will likely be mid- to late-career professionals. We need opportunities for young people to participate, meaning speaking slots and a publication. What if we negotiate a special issue to come out of the workshop, or a book with commissioned chapters? Dan had a really good idea: what if we organized something like the Kan Extension Seminar for ACT? “Kan Extension Lab”?
4. Draw up a list of related workshops (Calco? QPL? CMCS?) and what niche we fall into. Avoid being too niche or too broad.
5. Also, Bob is against attaching it to FSCD. Should we consider an independent workshop?
6. Invite people in industry, like Mehroosh and some students of Bob’s that went to Deepmind.

**Other notes:**

* Maikke is interested in a conference rather than a workshop, where every day the attendees focus on a different aspect of applied category theory.
* What do applied category theorists all have in common; is there enough there for a field? Upshot: inconclusive.
* Why is category theory effective for modeling something in the real world?

1. The “real category theory” position, from Bob. Stuff is categorical; categories are the stuff around us. Processes happening all around us. You don’t need to “apply” it, which is already too mathematical. Categories are “real” stuff. They transcend different disciplines. The most basic model of interaction is a compact closed category.
2. The “strong empirical category theory” position, i.e. “it works because it’s strong”. It’s a diagrammatic, calculus; a more elementary way of modeling the interaction that’s going on, with richer notions of composition.
3. The “weak empirical category theory” position, i.e. “it works because it’s easy”, articulated by Maaike and Francisco: one throws away all the minor details in a field, and the category models just the structure of things in that field and how they interact. (Bob interjects: the category IS the structure.) “I think CT is an economical description of a problem, in the sense of cheap. You talk about elements, you get a lot of noise going around, e.g. in linear algebra, get huge matrices of stuff. CT tells you: I don’t give you #s, I just give you the structure that leads to those numbers. The main reason it’s important is because it’s a way of clearing away the noise, so that you can just focus on what matters, without worrying about #s. How to go from A to B. Once you know it, then you can put in #s.”
   1. But is this just a language for insightful manipulation, or are there real theorems that go between applications?
      1. Bob: the functor from grammar to meaning gives you an algorithm for computing meanings of sentences. So the algorithm is fundamentally categorical.
      2. Robin: The functors are linking abstract representations, and commutation models how the abstract stuff represents the concrete stuff well. Functors are things that mediate interaction.

Alternative names:

* Applied category theory
* Real-world category theory
* “A theory of anything”[[1]](#footnote-0)
* Profitable category theory
* Fundamental category theory
* “Slutty” category theory aka semantics

Secondary questions:

* What is the state-of-the-art in (practical) applied category theory?
* What new definitions and theorems do we need?
* What computational tools do we need?
* What’s missing from subjects like set theory, graph theory, or [even economics]?

Josh’s goal: consensus and techniques for how to integrate the sciences.

Brendan’s goal: get computable artifacts; things we can apply. (But also unification.)

1. According to Jack Morava. [↑](#footnote-ref-0)