APPLIED CATEGORY THEORY 2019 SCHOOL

PARTICIPATION REQUEST

FOSCO LOREGIAN

To the organizing committee,

This is the requested information supporting my application; you shall receive in a short time a letter of recommendation from prof. Emily RIEHL (JHU, Baltimore).

- **An explanation of any relevant background you have in category theory or any of the specific projects areas**.
  I was awarded my Ph.D. from SISSA (*International School for Advanced Studies*, Trieste, Italy) in June 2016. Later, I spent a few months as a postdoc at the University of Western Ontario (London ON, Canada), and then moved to Masaryk University (Brno, CZ) working in the group of prof. Jiří Rosický, until April 2018. I am now a postdoc in Bonn's Max Planck Institute for Mathematics.

  Starting from higher category theory and homotopy theory (see below), I recently moved to 2-category theory, and I'm currently tackling a very specific and challenging problem: is there a *Yoneda structure* on the 2-category **Der**, accounting for the possibility to perform "all" known categorical constructions with derivators, while at the same time minding of their homotopy-theoretic origin? Working towards the solution of this problem led me to study (a lot of) 2-category theory.

  Currently, I'd say pure category theory is my main field of expertise. I am the author of [Lor15], a survey on *coend calculus* written with the purpose to provide a unitary reference for the main results in this area of category theory, giving a relatively complete survey of its fundamental applications to algebra, geometry, and to the theory of structured categories. I am extremely happy to see how my note continues to be cited by many people: until now, it served me to deliver a short course on coend calculus at the University of Leeds, upon invitation of prof. Nicola Gambino; it has served to various students as introductory material to original research problems, allowing them to grok the state of the art on the subject.

  Its wide range of applications is also witnessed by the variety of citations it has obtained: it was cited as introductory reference to coend calculus in a book on elementary category theory [Bra16], a book on functorial quantum field theories [Yau18], a paper on a similar subject [BSW17, FS16], three master theses [Ver15, dJ, Can] and doctoral theses [Gen15, Pel17], as well as several papers [Riv18, Pis18, Gen17, MG15], and [Ril18] (that appears as reference for further study in Milewski's post).

- **The date you completed or expect to complete your Ph.D and a one-sentence summary of its subject matter**.
  I earned my Ph.D. in June 2016. The aim of my thesis was to revisit some aspects of homological algebra tied to representation theory and stable homotopy theory, in the fashionable language of stable $(\infty, 1)$-categories: I've been able to prove that certain

classes of reflective subcategories arise as linked to suitable factorization systems on the stable ∞-categories in study; this result, initially stated for Lurie's ∞-categories, was later extended (by me) to the setting of stable derivators, a 2-categorical framework having similar purpose than ∞-categories, but nearer to the taste of category theorists.

- **Order of project preference**.
  Given my acquaintance with coends and monoidal categories, the most enticing opportunity would be to follow Bartosz Milewski's course on profunctors. Here is a list of the remaining courses, sorted by descending familiarity with the topic:
  – Sadrzadeh
  – Spivak
  – Fritz
  – Backens
  – Hofstra

  Feel free to address me to whatever course you want though! I'd be thrilled to participate to each of them.

- **To what extent can you commit to coming to Oxford (availability of funding is uncertain at this time)**.
  My contract ends in March, and I'll be jobless after that. The opportunity to come to Oxford is then strongly dependent on the availability of funding. I will of course promptly notify you if at some point I get another job, and whether this job authorizes and covers my trip.

- **A brief statement (approx 300 words) on why you are interested in the ACT2019 School. E.g.: how can this school contribute to your research goals? How can this school help in your career?**
  I follow with the utter interest the development of Applied Category theory since I first heard of prof. Spivak's research; in a brief exchange of e-mails, I expressed him deep interest in trying to join the nascent community, being a mathematician and category theorist, to further develop this interesting part of applied mathematics. I feel many fields of applied science crave to be categorized. There's a rich land flourishing outside algebraic topology, full of treasures to discover. I firmly believe that category theory has not only the potential, but the *duty* to speak outside pure mathematics, and the opportunity to participate to this process fills me with enthusiasm and playful wonder.

  Unfortunately, publish-or-perish turns a career shift into an extremely complex task: the expertise, if not the mindset, of pure mathematicians is quite different from applied scientists' one (one reason more to feel sincere awe towards the intelligence of who has merged the two disciplines so successfully!), and inevitably every step is burdened by a certain inertia.

  But I did not lose heart! I started to study what I could put my hand on, and (for example) I became a slightly-less-than-decent Haskeller (since I decided to study Haskell for real, I feel a better and happier category theorist!).

  To ignite the career-shift that I have long desired I need a boost to reach the right community, start interacting and publishing with them; the event you're organizing the opportunity I was expecting for.

References

[Bra16]   Martin Brandenburg, *Einführung in die kategorientheorie: Mit ausführlichen erklärungen und zahlreichen beispielen*, Springer-Verlag, 2016.

[BSW17]   Marco Benini, Alexander Schenkel, and Lukas Woike, *Operads for algebraic quantum field theory*, arXiv:1709.08657 (2017).

[Can]   Nicolás Abel Canevali, *2-filtered bicolimits and finite weighted bilimits commute in cat*, Ph.D. thesis, Universidad de Buenos Aires.

[dJ]   R.S. de Jong, *Segal objects in homotopical categories & k-theory of proto-exact categories*.

[FS16]   Jürgen Fuchs and Christoph Schweigert, *Coends in conformal field theory*, 2016.

[Gen15]   Francesco Genovese, *Quasi-functors as lifts of fourier-mukai functors: the uniqueness problem*, Ph.D. thesis, Università degli studi di Pavia, 2015.

[Gen17]   ———, *Adjunctions of quasi-functors between dg-categories*, Applied Categorical Structures **25** (2017), no. 4, 625–657.

[Lor15]   Fosco Loregian, *This is the (co)end, my only (co)friend*, arXiv:1501.02503 (2015).

[MG15]   Aaron Mazel-Gee, *Hammocks and fractions in relative ∞-categories*, Journal of Homotopy and Related Structures (2015), 1–63.

[Pel17]   Luc Pelissier, *Réductions et approximations linéaires*, Ph.D. thesis, Université Sorbonne Paris Cité, 12 2017.

[Pis18]   Paolo Pistone, *Proof nets, coends and the yoneda isomorphism*, arXiv:1810.01252 (2018).

[Ril18]   Mitchell Riley, *Categories of optics*, arXiv:1809.00738 (2018).

[Riv18]   Exequiel Rivas, *Relating idioms, arrows and monads from monoidal adjunctions*, arXiv:1807.04084 (2018).

[Ver15]   Marco Vergura, *A Giraud-type theorem for model topoi*.

[Yau18]   Donald Yau, *Homotopical quantum field theory*, arXiv:1802.08101 (2018).

Fosco Loregian

Max Planck Institute for Mathematics

Vivatsgasse 7, 53111 Bonn — Germany

flore@mpim-bonn.mpg.de

I am writing to enthusiastically recommend Fosco Loregian for the 2019 applied category theory summer school. Fosco has held a few very prestigious postdocs since earning his PhD in summer 2016 but has struggled to find a permanent job, due to biases against category theory and the overall lack of enough research positions for strong mathematicians. If you give him the opportunity to participate in this program it could have a transformative impact on his career. He loves category theory and would do anything to keep working in that field, so I'm hopeful he'll find a home in an applied research group somewhere.

I first met Fosco in 2014, when he was my student in the Kan Extension Seminar, an online graduate reading course in category theory with some similarities to the ACS. After advertising the seminar online, I selected a dozen students from around the world from a surplus of applications. Over six months, we read twelve research papers in category theory. Each student presented one paper and wrote an accompanying expository blog post, appearing on the n-Category Cafe´, a group mathematics blog. In addition, the students were asked to write reading responses and comment on all of the papers. Fosco was an enthusiastic participant in all aspects of the seminar, and the one who contributed the most to our private class discussions as I recall.
Fosco and I have kept in touch over the intervening years, corresponding frequently on mathematical topics of common interest. We recently wrote a joint expository paper together on the various notions of fibration in category theory — a project that is entirely at his instigation. This is not his first foray into expository mathematics. His paper on coends is excellent and has become the definitive reference on that topic. He has a number of strong research papers on various topics, from derivators to stable ∞-categories to formal category theory.

Fosco has a natural instinct to collaborate and is an excellent communicator. He's extraordinarily hard working and will likely view this opportunity as make or break. If I were leading one of the ACS research groups, I'd want him on my team. I hope you give him this opportunity.

Emily Riehl