- **An explanation of any relevant background you have in category theory or any of the specific projects areas**

My professional background consists of a progressive search for organizational forms adequate to modulate collective behaviors to confront the mutually amplifying economic and ecological global crises we face. This charted course has led me from practicing public international environmental law to participant-research in autonomous social movements, to presently designing cryptoeconomic systems for distributed collaboration.

In this context, my current research centers around the potential for category theoretic compositionality and cryptoeconomic systems to synthesize new approaches to economic design. Accordingly, for the past year I have been avidly studying category theory through, among other things, various online resources such as following John Baez's past *Seven Sketches* course and current applied category theory seminar on Azimuth, Spivak and Fong's *Seven Sketches* course at MIT, Milewski's *Category Theory for Programmers* book and online lectures, the Catsters Youtube channel, and so forth. Additionally, I have been diligently working through books such as Awodey's *Category Theory*, Spivak's *Category Theory for the Working Scientist*, Barr's *Category Theory for Computing Science*, Abramsky's *Introduction to Categories and Categorical Logic* lecture notes, Lawvere and Rosebrugh's *Sets for Mathematics*, Kissinger and Coecke's *Picturing Quantum Processes* for the diagrammatic reasoning afforded by monoidal categories, among others.

In concert with these efforts, over the last year I have also been working with a development team on a substrate independent, formal cryptoeconomic visual language. We plan to model this language using Petri nets, in particular leveraging the exciting work of Statebox in their categorification of Petri nets and resultant programming language. To this end, I am presently researching how we can extend the category theoretic rigor and flexibility of open Petri nets, colored Petri nets and their functorial semantic implementations to support and ensure compatibility in the design of our visual language. We have also been pursuing an implementation of our visual language based on the rho-calculus—a reflective higher order variant of the pi-calculus, which underpins the Rchain blockchain ecosystem and which admits of a modeling in 2-categories with an underlying symmetric monoidal closed category. In addition to actively studying these formalisms, I am particularly interested in developments related to open compositional games and operadic nesting of systems, as potentially fertile paths forward for creating novel configurations of (crypto)economic systems.

Another key dimension of my interest and background in category theory is my continued research into behavioral logic and type systems. Developers working on the Rchain project formulated an algorithmic approach for deriving a spatial-behavioral type system from a formal presentation of a computational calculus using Lawvere 2-theories. Pursuing this line of research has led me to keenly follow the work of Spivak, Fong, and others regarding topos-theoretic accounts of behavioral logics in 'Dynamical Systems and Sheaves' and 'Temporal Type Theory'—and I am especially excited about their present work on 'Behavioral Mereology' and its inclusion as a project track in the ACT School.

Accordingly, I would be thrilled and privileged to temporarily depart the ascesis of autodidacticism to participate with this cohort in the ACT School and bring refurbished intellectual resources back to my team's work on distributed crypto systems.

- **The date you completed or expect to complete your Ph.D and a one-sentence summary of its subject matter.**

N/A

- **Order of project preference**

1) Toward a mathematical foundation for autopoiesis
2) Formal and experimental methods to reason about dialogue and discourse using categorical models of vector spaces
3) Traversal optics and profunctors
4) Complexity classes, computation, and Turing categories
5) Simplifying quantum circuits using the ZX-calculus
6) Partial evaluations, the bar construction, and second-order stochastic dominance

- **To what extent can you commit to coming to Oxford (availability of funding is uncertain at this time)**

I am certainly committed to coming to Oxford for the School and Conference.

- **A brief statement (~300 words) on why you are interested in the ACT2019 School. Some prompts:**
  how can this school contribute to your research goals?
  how can this school help in your career?

With the Economic Space Agency and the Space language project, I am involved in designing and developing a formal diagrammatic language for the creation of open source programmable crypto-economies and –organizations that enables modular composition of flexible governance models and cryptoeconomic primitives. I am exploring implementations for this higher-level language using Petri nets, leading to my ongoing research on the Statebox project's category theoretic approaches to net composition, synchronization and resource sharing, as well as the feasibility of decorating net transitions with typed-conditions a token must fulfill prior to firing. Moreover, with the capacity for tokenized, programmable transmission of value among subsystems/agents, whole new economic assemblages become possible through the ability for formally consistent interconnections of heterogeneous open systems via operads, props, decorated cospans and corelations – avenues I am excited the ACT School will strengthen my foundations to pursue.

From working in the Rchain ecosystem, I am also exploring behavioral logic approaches for the rho-calculus to reason about concurrent interacting processes exhibiting diverse network topologies (not only constrained to logically centralized blockchain-based data structures). I would like to extend this behavior-theoretic framework to our formal visual language, and the apparent scope and expressiveness of the approach of Fong et al. to inter-modal behavioral mereology presents an especially promising area of research and potential application to my current projects in elaborating new economic and organizational forms.

As such, I would greatly appreciate the chance, through any of the offered project tracks, to accelerate the development of my capacities to harness the abstractness of the formal methods of category theory to accommodate the concrete complexity of reasoning about and designing rigorous networks of systems of systems. The ACT School would provide me an unparalleled opportunity to continue to upgrade my facility with category theoretic approaches to formal systems, while offering strong foundations among a community of interlocutors to continue pursuing these ambitious projects and discovering new applications for category theory all along the way.

SKYE BOUGSTY-MARSHALL

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SKYE.BOUGSTY@GMAIL.COM

EXPERIENCE

Space, Oakland, CA July 2018 – present
Research & Development Engineer
Designing a substrate-independent, formal diagrammatic language for the creation of open source programmable crypto-organizations which can combine diverse, modular models of governance and economic logics. Researching formal properties and expressivity of different frameworks for distributed concurrent computational systems, including Petri nets, Chu spaces, and the rho-calculus. Exploring spatial-behavioral type systems to provide formal guarantees about the behavior of smart contracts, including through applying topos-theoretic behavioral logic and through 'logic as a distributive law' (LADL) algorithm for deriving type systems from formal presentations of computational calculi. Investigating the creation of new economic forms through novel configurations of dynamical systems based on category theoretic approaches to networks and methods for consistently interconnecting heterogeneous systems.

Economic Space Agency (ECSA), Oakland, CA October 2016 – September 2018
Econautics Engineer
Managed diverse suite of business activities for crypto startup building open source programmable economies on 3rd generation blockchain technology, including token economy design, use case prototyping, client development, investor relations, communications, and consulting. Developed economic and organizational language and design patterns in Rholang, a programming language based on the rho-calculus variant of mobile process calculi. Prototyped token economies and organizational forms for numerous clients, ranging from para-academic institutions, to a translocal crypto village, to an anti-gentrification distributed housing scheme based on collective equity. Researched denotational and operational semantics of linear logic and linear type systems for resource-sensitive multi-agent coordination networks.

Senselab, Concordia University, Montreal, Canada July 2016 – December 2016
Researcher
Engaged in art-philosophy social design laboratory and developed project for an economically self-sustaining alter-university utilizing cryptoeconomic technologies. Elaborated and designed novel event-based organizations, new modes of value production, and qualitative accounting metrics beyond the monopoly of price, at the intersection of blockchain, finance, and radical philosophy. Deployed artistic tools, techniques and interventions to generate social forms and subjectivities to respond to the diversity of economies being precipitated by new network technologies.

Climate Games Network, Paris, France June 2015 – August 2016
Associate
Conceived and executed web-based platform to create transnational direct action adventure game to mobilize distributed collective action for climate justice around UN climate negotiations in Paris. Designed and coordinated this transdisciplinary intervention, from conceptualizing interface design and game incentive structure to organizing teams across the world to take action. Experimented with modes of creative resistance, mass mobilization and social choreography, along with vectors for their application to local and global political movements.

Healthy Sustainable Living LLC, Cheyenne, WY July 2013 – August 2016
Researcher
Conducted research in Peru, Mexico, Bolivia, Tunisia, and across Europe on diverse models for developing sustainable communities that encompass comprehensive healthy living practices and methodologies. Evaluated strategies designed to cultivate economic and community democracy to promote cooperatively managed workplaces and common resources, especially among vulnerable populations. Provided trainings on integration of models that maximize community ownership and control of energy resources, with collective decision-making authority that involves all stakeholders.

Accountability Counsel, San Francisco, CA January 2013 – July 2013
Pro Bono Staff Attorney
Led legal fact-finding and training mission to Liberia to assist communities who were victims of environmental and human rights abuses caused by a corporation that operated a biomass project financed by the US government. Responsible for all phases of video advocacy (i.e., conceptualization, pre-production planning, production, and post-production) to launch a campaign to seek redress for the abuses suffered by these Liberian communities. Analyzed deficiencies in environmental and social due diligence conducted by international financial institutions, export promotion agencies, and corporations based on the IFC Performance Standards. Collaborated with a coalition of NGOs to prevent the World Bank and European Bank for Reconstruction and Development from funding a coal-fired power plant in Mongolia.

Human Rights Law Network, Mumbai, India January 2012 – January 2013
Attorney
Engaged in strategic human rights and environmental litigation before the High Court of Bombay to enforce the rights of poor marginalized groups concerning issues of housing, food security, right to education, discrimination based on caste, disability, gender, and sexual orientation, as well as litigation to address environmental pollution. Drafted a report analyzing the negative environmental impacts of the proposed nuclear power project in Jaitapur. Evaluated the legal deficiencies of the Pune municipal government's management and development of its water bodies. Organized and facilitated community meetings and "know-your-rights" trainings for slum dwellers.

Public International Law & Policy Group, Washington, DC January 2011 – July 2011
Law Fellow
Provided legal services and policy advice to Kenyan government officials, policymakers, and reform institutions on implementation of the 2010 Constitution, including in the areas of land reform, peri-urban development, and human rights. Liaised and developed relationships with local partners in Kenya to initiate educational and advocacy trainings to improve the rights of women and disabled persons. Developed, drafted, and implemented a negotiation simulation and a scenario planning exercise, using the methodology employed by the US Department of State, related to effective joint management and dispute resolution concerning water resources in the Indus River Basin.

EDUCATION

American University, **School of International Service**, Washington, DC
Master of Arts in International Politics, August 2011
GPA: 4.0

American University, **Washington College of Law**, Washington, DC
Juris Doctor; *summa cum laude*; May 2010
GPA: 3.84 (Top 2%)
Honors: Presidential Management Fellows Program Finalist; Order of the Coif; American University International Law Review, Senior Staff
Study Abroad: Comparative Law Program in London, Paris and Geneva, 2008

Colorado State University, Fort Collins, CO
Bachelor of Arts in Economics, Philosophy (double major); *summa cum laude*; May 2007
GPA: 4.0
Honors: Phi Beta Kappa; WUE Scholar (annual merit-based scholarship, 2003-2007)

PUBLICATIONS

Bougsty-Marshall, S. (2016) "Flooding Wall Street: Echoes from the Future of Resistance around Climate Change" in *Capitalism Nature Socialism* (vol. 27, issue 3). pp. 64-82.

ADDITIONAL INFORMATION

Bar Membership: New York State Bar, admitted 2012
Language Skills: Spanish
Interests: Professional Raft Guide (Swiftwater Rescue Technician; CPR and First Aid Certified)

Theodore Wilson
Economic Space Agency // Space
Oakland, CA

January 30, 2019

ACT2019 School

To Whom It May Concern:

I am writing on behalf of Skye Bougsty-Marshall to heartily recommend his participation in the ACT2019 School based on our work together for the last one-and-a-half years. My history of collaboration with Skye and the origins of our present work stem from the Economic Space Agency (ECSA), a conceptually diverse group of practitioners and theorists who coalesced around a vision of economy and interaction that allows for the free expression and communication of value forms using open patterns and instruments. Central to ECSA's perspective is the concept of Economic Space, which envisages a universal state-space of value and interaction. It was in this context that the need for and formulation of the Space project was born--a general, substrate-agnostic grammar and pattern language designed to express, explore, and expand Economic Space.

The development of Space is concerned with the following efforts: Definition of the grammar and language; a visual representation of the grammar; implementation/operationalization of the grammar across various infrastructures and substrates; exploration of language space and generation of pattern forms; and a formalization and behavioral analysis of the core grammar. It is the latter of these that Skye has been principally involved in. It is also the aspect of the project that is most critical to the project's long-term realization.

In a slightly poetic but entirely sincere framing, the ambition of Space is to provide a language for elucidating and interpreting the underlying stories that comprise conventional social structures, to allow for their mappings between contexts and substrates, and to provide the broad capacity for the innovation and exploration of new narratives. However such a language, regardless of its expressivity, does not represent a significant improvement over existing methods unless its expressions and propositions are supported by rigorous assertions of behavior. In this manner a story told in the Space language can be generally and unambiguously realized.

Towards providing formal behavioral guarantees to the language, an incomplete summary of Skye's past and present efforts in this area would include: research and application of Statebox's categorification of Petri nets, open compositional games, multi-party session types, process calculi, spatial-behavioral type systems. Beyond this aspect of his work, I feel it necessary as well to highlight Skye's deep understanding of the nature of language and communication, as well as his unique ability to synthesize and expand concepts to/from diverse areas, building bridges across conceptual domains. Skye's background in law and sociology brings to the project a capacity for mapping forms and languages of interaction in order to effect positive change. His decision to immerse himself in category theory is an extension of this same intention. Skye's participation in the ACT school would allow him to better wield category theory through a Space lens, as category theory presents a natural "language" to understand concepts of economic space.

Accordingly, I highly support Skye’s participation in the ACT2019 School, as his multidisciplinary background would provide a powerful contribution to the community of thinkers it will bring together, while enabling him to return to integrate category theoretic tools to the construction of new economic space.

Sincerely,

Theo Wilson