Application document of John Frederick Kintanar to ACT2019 School

[Revant background in category theory or any of the specific projects areas]

I first became aware of category theory through the work of the logician Jon Barwise on situation semantics, at the interface of NLP and cognitive science. His book with J. Seligman, *Information Flow*, made use of colimits, Chu spaces (*-autonomous categories) and Chu transformations (which they call infomorphisms). His ideas have influenced how I conceptualize language in the context of a long-term project in modeling lexical semantics. I am now realizing that the conceptual framework I have been developing can be made precise, not only in terms of logic and type theory, but by giving a categorical semantics to a planned domain-specific language for specifying lexical entries and modeling the semantic and pragmatic processes of construing utterances in specific ways (constructible in principle from the model and supporting data).

About 4 years ago, I became aware of the work on homotopy type theory, and I found the material exciting but challenging. I started attending lectures in graduate mathematics, including a course in algebraic topology. I am now transitioning to full-time PhD study at the University of the Philippines in Diliman.

I read with interest the paper of Bob Coecke, et al on Interacting Conceptual Spaces (which came to my attention because of the blog post from the ACT 2018 adjoint school), and the dissertation of Dimitri Kartsakalis. I believe that their approach to the geometry of conceptual spaces complements my ideas on algebraic invariants in lexical semantics (realized as shared

“schemes of individuation” for constructing semantic construals via lexicalized concepts). In my approach, I consider that occurrences of lexical forms in an utterance activates polysemic lexical entries that take the form of situation-theoretic “constraints”, ultimately resolving to each lexical item’s semantic contribution to a shared information state (at clause-level, the composite semantic contribution is comparable to discourse representation structure).

I have also been following the work of Robin Cooper at Gothenburg University, who is applying type theory with records to modeling dialog, and have been planning that my work on polysemy in lexical semantics can fit into his framework for dialog. The grammar formalism I am most familiar with is Pollard and Sag’s Head-driven Phrase Structure Grammar, but I have also followed Pollard’s more recent work on Hyperintensional Semantics which connects to the tradition of categorial grammar.

I encountered the concept of autopoiesis many years ago, from Terry Winograd’s discussion of Varela and Maturana. I am surprised to learn that there are prospects for making this precise via category theory. I hope that this work, including connections to Luhmann’s ideas about social systems, can clarify some of my thinking on broader issues of language systems and language evolution. I would like to understand how hominins came to develop signing and vocalized language, and believe more precise models can generate predictions that can guide the understanding of the wealth of recent data about ancient DNA, bones (palaeoanthropology) and stones (archaeology). I am looking for phylogenetic, neural and cognitive constraints on models of language and semantics, perhaps a categorical approach to autopoeisis can be helpful here.

Turing categories and profunctor optics are new to me, but I expect they will connect to some of my background in computer science and software engineering. I am also interested in studying the papers by Joyal, Street and others. I have been interested in Joyal for some time, including his work on the

semantics of HoTT and his video lectures on topos theory, and have been planning to study some of his older works. I have read some expository work of Street on quantum groups.

I am not yet familiar with quantum circuits, but a graphical calculus for studying them sounds interesting. I hope it will connect to the work of Coecke and Kissinger on graphical tools for quantum mechanics, as well as John Baez's wide-ranging work on diagrams and network theory.

[The date I expect to complete my Ph.D and a one-sentence summary of its subject matter]

I hope to complete a PhD in 2021. I am investigating categorical techniques for designing models and a specification language for lexical entries and compositional construal of meaning.

•Order of project preference

1. Mehrnoosh Sadrzadeh: Formal and experimental methods to reason about dialogue and discourse using categorical models of vector spaces
2. David Spivak: Toward a mathematical foundation for autopoiesis
3. Pieter Hofstra: Complexity classes, computation, and Turing categories
4. Bartosz Milewski: Traversal optics and profunctors
5. Miriam Backens: Simplifying quantum circuits using the ZX-calculus
6. Tobias Fritz: Partial evaluations, the bar construction, and second-order stochastic dominance

[Extent I can you commit to coming to Oxford (availability of funding is uncertain at this time)]

Coming from a developing country which is some distance away from Oxford, I could definitely benefit from any available funding. If there is no availablele

funding, I should be able to raise financing for travel expenses. I don't know how much food and housing would cost, but I would be looking for the very cheapest options unless there is funding.

[Why I am interested in the ACT2019 School]

I am excited by the range of projects and readings on offer at ACT 2019 School, and by the participation of several researchers I recognize (Sadrzadeh, Spivak, Milewski), whose work I would like to learn more about. Some of the readings are on matters I know little about, and yet there are connections that may be discovered only through the power of category theory to highlight (and make precise) conceptual connections at the right level of generality. I know this has been going on in Math for 70 years, it is exciting to see new connections emerge in the sciences and beyond. Linguistics and quantum mechanics, who would have thought?

I am moving into academic research after many years first as a political activist, then as a developer and manager in information technology. But I started my undergraduate studies as a Math major at Cornell, and my interest in Math never left me. For many years, my work in IT (involving network management systems) allowed me to maintain a side interest in information modeling and knowledge representation. But I have always had a deep abiding interest in natural language, and how it works deep inside. Now I am recognizing that category theory is the field of Math most likely to allow me to connect these wide ranging interests, and bring rigor to many seemingly intractable deep questions.

I have some focused research questions I would like to make progress on, but I still have a lot to learn about productive academic research. The opportunity to interact with both younger and more experienced researchers,

with energetic enthusiasm across disparate but surprisingly connected topics, will strengthen my resolve, as well as capability, to make a contribution as rapidly as I can.

The Philippines has a large university system, which is notably weak in many areas including scientific research. With the training I am trying to acquire in category theory and its interdisciplinary uses, I hope to provide leadership and new directions to the still emerging research community here, especially in Math, Computing, Linguistics and maybe Cognitive Science.

CURRICULUM VITAE

John Frederick B. Kintanar

PERSONAL DETAILS

Nickname: Fred
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BIRTHDATE: July 21, 1961
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NATIONALITY: Filipino
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INFORMATION TECHNOLOGY INDUSTRY EXPERIENCE

2015-2019 Systema Corp. I developed new IT projects in the domain of IT infrastructure. I conceptualized and designed training programs in data analytics.

2007-2014 SIMON, Cebu City. Chief Technology Officer. At this information technology consultancy, I planned, organized and evaluated the implementation of enterprise management systems with companies in retail and resource extraction industries.

2006-2007 Infoweapons Corporation, Cebu City. Director for Research and Quality Assurance.
I initiated the definition of process standards for agile development methods; I organizedplanning and training for establishing standards-based quality management systems and information security management systems. I defined the technology research agenda for strengthening product lines in networking and security, and improved alignment with emerging networking standards.

1999-2006 NEC Telecom Software Philippines, Cebu City. Senior Technology Expert. I managed the introduction of new technologies into software development projects. I lead the definition and improvement of software development processes and quality assurance. I helped grow the organization from 90 to 300 engineers. I defined competency standards and assessment systems for engineering staff, and developed and managed the training program for new intake engineers. I implemented a quality management system and established related standards and training activities.

1992-1999 NEC Technologies Philippines, Lapu-lapu City, Cebu. Supervisor then Manager of the Software Design Engineering Department. I was responsible for software development and research projects for NEC divisions in Japan and their worldwide customers, focused on network management systems and embedded telecommunications software. I defined and organized technology training programs for software engineers.

1990-1992 University of the Philippines in the Visayas, Cebu College. Instructor, Math and Computer Science. I negotiated the introduction of a new program in computer science. I also help established their research center and its publications program.

1988-1990 DSI International. Systems Software Engineer. I developed software for data communications in Appletalk (Macintosh) and TCP/IP Networks. I helped introduce object-oriented technology (Object Pascal and C++) into our software product.

1986-1988 University of the Philippines in Diliman. Instructor in Community Development (part-time, then later full-time), College of Social Work and Community Development. I taught courses in economic development and supervised fieldwork with farming communities. I also contributed to establishing new programs for a Diploma in Community Organizing, and a Diploma in Women in Development.

1983-1987 I worked with various non-governmental organizations engaged in social development projects in several areas including as adult education.

EDUCATION

1993 3-month scholarship in Japan with the Association of Overseas Training and Scholarship, covering Japanese Language and On-The-Job Training in Software Development.

1988-1995 Coursework in various Masters programs, described below:

1993-1995 24 units towards MS Computer Science, UP Los Baños (outreach program in Cebu City). I lacked only minor subjects and a thesis, but got busy with my work in industry and I have allowed my university residency to expire.

1990 15 units towards MS Computer Science (Artificial Intelligence), Ateneo de Manila University, Loyola Heights campus, Quezon City. I studied full time for one semester with a government DOST scholarship. I gave up my scholarship to move to a new position Cebu City.

1987-1989 12 units towards MS Applied Mathematics (Computer Science), UP Diliman

1978-1983 Bachelor of Arts (Asian Studies) at Cornell University, Ithaca NY. I had a scholarship from Cornell University. I spent two years as a Mathematics major, during that time I also studied programming. For about two years during this period, I was in Indonesia and the Philippines, as described below. In Asian Studies, I focused on the social history and anthropology of Indonesia and Thailand. I acquired fluency in spoken Indonesian.

1981-1982 Part-time coursework in Philippine Studies at University of the Philippines in Diliman

1980 Course in Indonesian Language and Culture at Universitas Kristen Satya Wacana, Salatiga, Central Java, Indonesia.

1979 Summer course in Field Marine Science, Shoals Marine Laboratory, New Hampshire

1974-1978 Philippine Science High School, Diliman, Quezon City.

PROFESSIONAL AND CIVIC ACTIVITIES

2001-2011 Cebu Educational Development Foundation for Information Technology (CEDF-IT). I helped organize this non-governmental organization and have served in various capacities including Corporate Secretary and member of the Academic Board of its IT Training Academy (for IT faculty). CEDF-IT initiated, developed and implemented programs involving formal education institutions and private sector companies, focused on integrating information technology and digital resources into curricula, and preparing university students for applied work in industrial companies. We organized on-the-job training programs, training seminars for teachers, and study tours (including visits to educational and information technology organizations in India and other countries.)

2002-2010 Philippine Science High School System, Member of the Board of Trustees. I helped define educational policy and operational guidelines for a group of highly selective high schools in different regions of the Philippines. PSHS schools are state funded, but are managed by the Department of Science and Technology, not the Department of Education. During my tenure on the board, we mobilized funding to build three new schools.

2006-7 Cebu Provincial ICT Council, Executive Committee. I was co-chair of the Task Force on Basic Education.