From: **David Waszek** david.waszek@posteo.net
Subject: [PHILOS-L] UPDATED PROGRAM: PhilMath Intersem: in Paris & over Zoom, afternoons of the 5, 7, 9, 13, and 15 June 2023
Date: 31 May 2023 at 03:27
To: PHILOS-L@liverpool.ac.uk

The **PhilMath Intersem** is a philosophy of mathematics seminar jointly organized, in June every year since 2010, by the SPHERE research team (Université Paris Cité, UMR 7219) and by the Department of Philosophy of the University of Notre Dame. It takes place **in person in Paris**, and now also **online over Zoom**.
http://www.sphere.univ-paris-diderot.fr/spip.php?article1303

The theme for this year's Intersem is "Individuation of objects, individuation of theories, individuation of proofs" (see general description at the end of this message). The seminar will take place in the afternoons of Monday 5, Wednesday 7, Friday 9, Tuesday 13, and Thursday 15 June, at the Université Paris Cité:

- in the **Condorcet building** (4 rue Elsa Morante, 75013 Paris), **room 454A**, on Monday 5 June and Wednesday 7 June;
- in the **Olympe de Gouges building** (8 place Paul Ricoeur, 75013 Paris), **room 628**, on Friday 9 June, Tuesday 13 June, and Thursday 15 June.

(Entry to the Condorcet building is unrestricted. To access the Olympe de Gouges building, you need to check in at the entrance desk, where you will be asked for an ID and will be given a badge in exchange. There is no need to register in advance. The entrance desk is located to the left of the elevators.)

The **Zoom link** for all sessions is:
https://cnrs.zoom.us/j/97608319964?pwd=T0V0OWdLdDRadnJyZjVHR044ZUJ0dz09
Meeting ID: 976 0831 9964
Password: 75wQx9

PHILMATH INTERSEM 2023 – PROGRAM

MONDAY 5 JUNE, Condorcet building, room 454A, 14:00-17:30 CEST

14:00-15:30: Juliette Kennedy (University of Helsinki), "The supervenience of syntax on semantics in the foundational context"

If a model class is a class of structures of the same similarity type closed under isomorphism, under what conditions can the class be said to have a natural syntax, or a natural logic? How to think about model classes that have no syntax, no notion of formula? More generally, does syntax always supervene on semantics? In this talk we present some old and new results dealing with these questions.

16:00-17:30: Gabriel Catren (Université Paris Cité, SPHERE), "Abstraction, Equality, and Univalence"

We shall propose a conceptual-oriented discussion of the so-called Univalent Foundations Program, that is, of Martin-Löf type theory enriched with a homotopic interpretation, together with the univalence axiom proposed by Voevodsky. In particular, we shall analyze whether Leibniz's principle of the identity of indiscernibles holds or not in Univalent Foundations. We shall finally argue that univalence can be understood as a particular implementation of a constructive notion of abstraction that resolves so to speak Fregean abstraction.

WEDNESDAY 7 JUNE, Condorcet building, room 454A, 14:00-17:30 CEST

14:00-15:30: Lavinia Picollo (National University of Singapore) & Dan Waxman (National University of Singapore), "On Arithmetical Pluralism"

Arithmetical pluralism is the view that there is no one true arithmetic but many competing arithmetical theories, each true in its own language, all equally good from an objective standpoint. Pluralist views have recently attracted much interest but have also been the subject of significant criticism, most saliently from Putnam (1979) and Koellner (2009). These critics argue that, due to the possibility of arithmetizing the syntax of arithmetical languages, one cannot coherently say that arithmetic is a matter of `taste' whilst consistency is a matter of fact. In response, some (e.g. Warren (2015)) have forcefully argued that Putnam's and Koellner's argument relies on a misunderstanding. In this paper we put forward a new argument on the side of the critics: appealing to internal categoricity results for arithmetic, we argue that arithmetical pluralism cannot coherently be maintained while supposing that the consistency of mathematical theories is a matter of fact after all.

16:00-17:30: Tim Button (University College London), "Higher-order logic and internal categoricity"

In *Philosophy & Model Theory*, Sean Walsh and I suggested that higher-order internal categoricity results could help to explain the precision of our mathematical concepts. In this talk, I will explain why higher-order results seem especially helpfully. I will discuss some weaknesses regarding first-order results. I will comment on the reverse-mathematics of these higher-order results. And I will also consider some general reasons to embrace higher types within our home-language.

FRIDAY 9 JUNE, Olympe de Gouges building, room 628, 14:00-17:30 CEST

14:00-15:30: Joel David Hamkins (University of Notre Dame), "A deflationary account of Fregean abstraction in set theory, with Basic Law V as a ZFC theorem"

The set-theoretic distinction between sets and classes instantiates in important respects the Fregean distinction between objects and concepts, for in set theory we commonly take the universe of sets as a realm of objects to be considered under the guise of diverse concepts, the definable classes, each serving as a predicate on that domain of individuals. Although it is commonly held that in a very general manner, there can be no association of classes with objects in a way that fulfills Frege's Basic Law V, nevertheless, in the ZF framework, it turns out that we can provide a completely deflationary account of this and other Fregean abstraction principles. Namely, there is a mapping of classes to objects, definable in set theory in senses I shall explain (hence deflationary), associating every first-order parametrically definable class F with a set object εF, in such a way that Basic Law V is fulfilled:

$$\varepsilon F = \varepsilon G \Leftrightarrow \forall x\, (Fx \Leftrightarrow Gx)$$

Russell's elementary refutation of the general comprehension axiom, therefore, is improperly described as a refutation of Basic Law V itself, but rather refutes Basic Law V only when augmented with powerful class comprehension principles going strictly beyond ZF, one amounting, I argue, to a truth predicate in Frege's system. The main result therefore leads to a proof of Tarski's theorem on the nondefinability of truth as a corollary to Russell's argument, independently of Gödel. A central goal of the project is to highlight the issue of definability and deflationism for the extension assignment problem at the core of Fregean abstraction.

16:00-17:30: Gabriel Scherer (INRIA), "Proof search and program identity"

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Programming language research produced a beautiful result called the Curry-Howard Isomorphism, which establishes a strong link betweeen certain representations of formal proof and certain representations of formal computer programs. This isomorphism creates a bridge between proof theory and programming language theory that can transfer results and intuitions. In this talk, we hope to discuss notions of equivalence, identity and representation of proofs (in propositional intuitionistic logic) and programs (in the simply-typed lambda-calculus):

- Equivalence. Programming languages have a natural notion of equivalence, two program fragments are equivalent if they behave in the same way when placed inside a largeer program. The notion of equivalence of proofs, on the other hand, has no obvious, clear definition.
- Representation: proof theory has seen many different suggestions for representations of formal proofs; in particular, researchers try to capture the "identity" of proofs through representations where equivalent proofs have the same representation.

Some proof representations in particular, namely those based on "focusing", were suggested by studying the problem of proof search. We will discuss how these ideas can be transferred to formal programming languages, to suggest representations of certain programs that capture their identity.

TUESDAY 13 JUNE, Olympe de Gouges building, room 628, 14:00-17:30 CEST

14:00-15:30: Matteo Bianchetti (University of Notre Dame) & Giorgio Venturi (University of Pisa), "Formal Ontology and Mathematics. A Case Study on the Identity of Proofs"

We propose a novel, ontological approach to studying mathematical propositions and proofs. We do so by developing what we call a "formal ontology" of proofs using semantic modeling tools (like RDF and OWL) developed by the computer science community. In this talk, (i) we describe this new approach and (ii), to provide an example, we apply it to the problem of the identity of proofs. In a nutshell, we will investigate the idea that the identity of proofs is connected to the ontology needed for its formalization. This will allow us to discuss another related problem: that of purity of methods and its topic conception illustrated by Detlefsen and Arana, in "Purity of proofs". After providing a few examples of proofs, analyzed through the lenses of formal ontology, we will end the talk by suggesting how this study can shed light on the concept of creativity in mathematics.

16:00-17:30: Paul Tran Hoang (South Puget Sound Community College), "Measuring Theory Through Structure"

There is widespread sentiment among practicing logicians that the notion of bi-interpretability deserves a privileged status as a criterion for when two (single-sorted or many-sorted) first-order theories are "theoretically equivalent." Despite this, the notion of bi-intepretability has largely been ignored by the philosophical literature. The aim of this talk is to evaluate bi-interpretability as a measure of theoretical equivalence. To do this, I first put forth an instrumentalist conception of theories according to which theories are instruments for pursuing a myriad of possibly incompatible scientific aims. I then explore one such aim, namely: to capture a class of mathematical structures of antecedent interest. With this aim in mind, I argue that there is good reason to think that bi-interpretable theories are theoretically equivalent since they have corresponding structurally equivalent (and thus, share the "same" class of) models. This talk also addresses objections given or inspired by Tim Button

and Sean Walsh, Hillary Putnam, and Kameryn J. Williams.

THURSDAY 15 JUNE, Olympe de Gouges building, room 628, 13:30-18:30

13:30-15:00: Caroline Ehrhardt (Université Paris 8), "What is a group? Historical circulation and identities of a mathematical object (1830–1900)"

It is often said that the concept of group is due to Evariste Galois. In this paper, I would like to put this statement in perspective by asking what exactly is meant by it. More precisely, I will examine this mathematical object in the works of mathematicians who used it between the 1810s and the end of the 19th century. Why did they use it? How did they write it? To what point their works were link to Galois'? I hope to emphasize the fact the meanings given to a mathematical objects, as well as the practice it is associated to, are linked to historical contexts: what we call today "the group concept" is the result a historical process of readings and transmission through time of mathematical works.

15:15-16:45: Ivahn Smadja (Université de Nantes), "'No mere play of wit': Kummer's chemical analogy revisited"

In a letter to his former student Leopold Kronecker dated 14 June 1846, then in print a few months later, in a paper completed in September, Ernst Eduard Kummer developed a well-known analogy between his newfound theory of ideal complex numbers and chemistry. Claiming that the "whole conceptual sphere of chemistry" evinced "striking agreement" with that of his extended number theory, he insisted that this analogy should not be deemed a "mere play of wit". In his view, the reason for it would lay in the fact that both the "chemistry of natural substances" and the so-called "chemistry of complex numbers" should be considered as "realizations of one and the same fundamental concept of composition, although within different spheres of being". The present paper aims at providing an interpretive framework for these puzzling statements. In so doing, it will shed light on shared concerns, common to both chemistry, then in flux, and mathematics, pertaining to individuation of either chemical substances or mathematical objects.
Elements of context will be adduced to put Kummer's chemical analogy in perspective, starting with his early texts, the critical reviews he contributed to the *Jahrbücher für wissenschaftliche Kritik*, a journal founded in Berlin under Hegel's aegis.

17:00-18:30: Ivan Marin (Université de Picardie-Jules Verne & IMJ), "Identification problems in and from Group Theory"

Identification in mathematics can take various forms. One is related to the question of classification, very much in line with what happens in Natural Sciences (in the sense in which one can, for example, identify a given species by this or that feature in a classification). Another meaning is related to the way in which one may or may not recognize the identity between various objects (or various expressions of "the same" object). In this talk, I will explore how problems of identification appear in the framework of Group Theory. It will turn out that, in this setting, these two meanings are often intertwined, and that they are closely related to other identification problem in the seemingly remote question of identification of shapes and topological forms.

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This year's theme aims at bringing together logical, philosophical, and historical work on how mathematics individuates its objects, theories, proofs, and methods. There is well-established logical work on, for instance, categoricity (i.e., on how

syntactic theories can manage to uniquely pinpoint objects); on various notions of equivalence between theories; and on how one can identify objects across different syntactic presentations. Another question that deserves historical as well as philosophical attention is that certain results (such as Bézout theorem) and certain entities (for instance elliptic curves) have emerged, formed, and crystallized as fundamental landmarks for certain mathematical theories even though they do not correspond to primitive notions in the axiomatic setting of these theories. Individuals are what one points to (deictic individuals) or what one builds upon (atomic individuals). Does it make sense to speak of mathematical individuals in these two senses? How do we point to them? And how do we recognize them as guiding entities or principles? Questions of individuation also arise in the judgments, often encountered in informal discussions by mathematicians yet hard to explicate, that proofs or methods presented quite differently can nevertheless be 'essentially the same'. Relatedly, a central issue when approaching mathematics from a historical perspective is the successive rewritings that mathematical theories and proofs undergo, and the way these rewritings can re-individuate what earlier mathematics was about.