Wesley Calvert
Title: The Most Annoying Restriction

Abstract: Every third-grade student knows how to do real number arithmetic, and engineers do it on digital computers every day. Only after studying the formal definition of a Turing machine do we know that we cannot. This is the most annoying feature of the Turing machine as a model of computing.

Real computation attempts to use what we've learned in the past eighty years about Turing machines to make a sensible model that obeys the intuition that real arithmetic is possible. It allows the statement and proof of several interesting results about effectiveness in mathematics. It also shows us just how much advantage we've had all these years working with the classical Turing model. The present talk will describe real computation, and survey some classical and recent results in the field.

Martin Davis
Title: Universality Is Ubiquitous

Abstract: The work of Turing, Post, Church, Gödel, and Kleene during the 1930s fundamentally altered our notion of the nature of computation. I will discuss this in terms of the theoretical underpinnings of the development of all-purpose computers and of modern computer science. I will go on to speculate about the role of computation in the human mind and in biological evolution.

Damir Dzhafarov
Title: Applications of computability theory

Abstract: Much of current research in computability theory focuses not on the properties of computation itself, as was the case in the past, but rather on applications to other branches of mathematics. I will present a survey of some the ongoing programs in this line of investigations, including reverse mathematics, algorithmic randomness, and the study of Muchnik reducibility. The success these programs have enjoyed can arguably be attributed to the relative simplicity and broad scope of Turing's model of computation, and to the ease with which it lends itself to looking at problems from outside of logic.

Joel Hamkins
Title: The hierarchy of equivalence relations on N under computable reducibility

Abstract: This talk will be about a recent generalization of the concept of Turing degrees to the hierarchy of equivalence relations on N under computable reducibility. The idea is to develop a computable analogue of the enormously successful theory of equivalence relations on R under Borel reducibility, a theory which has led to deep insights on the complexity hierarchy of classification problems arising throughout mathematics. In our

computable analogue, we consider the corresponding reduction notion in the context of Turing computability for relations on N. Specifically, one relation E is computably reducible to another, F, if there is a computable function f such that x E y if and only if f(x) F f(y). This is a very different concept from mere Turing reducibility of E to F, for it sheds light on the comparative difficulty of the classification problems corresponding to E and F, rather than on the difficulty of computing the relations themselves. In particular, the theory appears well suited for an analysis of equivalence relations on classes of c.e. structures, a rich context with many natural examples, such as the isomorphism relation on c.e. graphs or on computably presented groups. In this regard, our exposition extends earlier work in the literature concerning the classification of computable structures. An abundance of open questions remain. This is joint work with Sam Coskey and Russell Miller. (Article available at http://boolesrings.org/hamkins/equivalence-relations-on-naturals/).

Pieter Hofstra

Title: Turing Categories: structural aspects of computability

Abstract: Over the years, computability theory has been generalized in various directions. In this talk, I will give an overview of a particular approach to generalized computability using category theory. This approach starts by describing a very general structural setting for computation, which is not based on sets. Next, it tries to understand specific features of classical computation in terms of extra structure or additional axioms on this basic theory, isolating which particular properties or structure are needed to recover certain classical constructions or results. I will describe the basic framework, give an impression of how various classical phenomena can be understood in this setting, and explain how ideas and techniques from categorical logic and categorical algebra can be brought into the picture. (Based on joint work with J.R.B. Cockett.)

David Leavitt

Title: Alan Turing's Humility and His Genius

Abstract: This talk will address the role played by Alan Turing's humility and its associated character traits—his shyness, his literal-mindedness, his honesty—in his life and his work.

Robert Lubarsky I

Title: Infinite Time Turing Machines

Abstract: If you take a regular Turing machines and let it run for a transfinite number of steps, through the ordinals, you get an infinite time Turing machine. I will discuss some of the theory and applications of ITTMs, focusing on connections with set theory.

Robert Lubarsky II
Title: Reflections on Turing's Suicide

Abstract: I have no academic qualifications to speak about this, being neither a historian, a psychologist, nor a Turing expert. Instead, this will be a personal, Turing-inspired, perhaps idiosyncratic, hopefully not too emotional reflection on being a gay logician.

Russell Miller
Title: Computable Categoricity, Fields, and Automorphism Groups

Abstract: Fields were the first structures for which the concept of computable categoricity was considered. Even before the time of Turing, mathematicians (notably van der Waerden) had concluded that certain questions about fields could not be solved in any finite number of steps. The definition of the Turing machine allowed the notion of undecidability to be made rigorous, so that in 1956, Fröhlich and Shepherdson were able to produce "isomorphic, explicitly presented fields" and prove that they were not "explicitly isomorphic." That is, they produced computable fields which were not computably categorical. The question of exactly which computable fields are computably categorical remains open, and we will survey the current state of knowledge on this topic.

One class of computable fields for which the problem has been solved (by Shlapentokh and the speaker) contains the 1-decidable algebraic computable fields. The solution here involved the decidability of the orbit relation on the field, and has given rise to a notion of computability for the automorphism group of a computable structure, which can hold even when the automorphism group is uncountable. We will explain this concept, which follows the principles of computable analysis.

Anil Nerode
Title: The Logic behind Mathematical Representations of Quantum Mechanics

Abstract: I will discuss the impact of choice of representation on the design of quantum devices.

Gerald Sacks
Title: Logic on Inadmissible E-Closed Sets

Abstract: Completeness and compactness in the inadmissible case via computable proofs.

Andre Scedrov
Title: Collaborative Systems

Abstract: Our earlier work with Kanovich and Rowe introduced a formal model of collaboration, in which the participants are unwilling to share all their information with each other, but some information sharing is unavoidable when achieving a common goal. The need to share information and the desire to keep it confidential are two competing notions which affect the outcome of a collaboration. Our model is based on the notion of a plan which originates in the AI literature. Here we consider two extensions of the model, motivated by two different applications, to network security protocols and to pharmaceutical trials.

We investigate how much damage can be done by insiders alone, without collusion with an outside adversary. In contrast to traditional intruder models, such as in protocol security, all the players inside our system, including potential adversaries, have similar capabilities. They have bounded storage capacity, that is, they can only remember at any moment a bounded number of facts. This is technically imposed by only allowing balanced actions, that is, actions that have the same number of facts in their pre and post conditions. On the other hand, the adversaries inside our system have many capabilities of the standard Dolev-Yao intruder, namely, they are able, within their bounded storage capacity, to compose, decompose, overhear, and intercept messages as well as update values with fresh ones. We investigate the complexity of the decision problem of whether or not an adversary is able to discover secret data. We show that this problem is PSPACE-complete when all actions are balanced and can update values with fresh ones. As an application we turn to security protocol analysis and demonstrate that when our adversary has enough storage capacity, then many protocol anomalies, such as the Lowe anomaly in the Needham-Schroeder public key exchange protocol, can also occur in the presence of a bounded memory intruder. We believe that precisely this is a theoretical reason for the successful use in the past years of model checkers in protocol verification.
Moreover, we also provide some quantitative measures for the security of protocols, namely, the smallest amount of memory needed by the intruder to carry out anomalies for a number of protocols. This is joint work with T. Ban Kirigin, M. Kanovich, and V. Nigam.

We turn to an extension of collaborative systems with explicit time. Time often plays a key role when specifying the rules and requirements of a collaboration. The extension introduces a model that allows for the specification of policies and systems with explicit time. Time is discrete and is specified by timestamps attached to facts. Actions, goal and critical states may be constrained by means of relative time constraints. An important example of this in the U.S. Food and Drug Administration (FDA) regulations for pharmaceutical trials on human subjects, which contain specific time requirements, such as deadlines, which have to be obeyed by a pharmaceutical trial. This is joint work with T. Ban Kirigin, M. Kanovich, V. Nigam, R. Perovic, and C. Talcott.

Robert Irving Soare
Title: The Art of Classical Computability

Abstract: Why Turing and not Church, his teacher who was jointly responsible for the Church-Turing thesis? Church got it right and he got it first. He proposed his thesis in 1934 for λ-definable functions and in 1935 for the Herbrand-Gödel recursive functions, both of which formally capture the effectively calculable functions. In contrast, Turing machines [1936] were a fanciful new invention without such a concise, mathematical definition in a familiar formalism. The characterization of computability by a formal model was not a purely mathematical problem, like solving a problem in number theory, but a much more abstract even artistic problem. Even Gödel had questioned whether it could be done.

Why Michelangelo and not Donatello? Donatello (1386-1466) was a sculptor in Florence. In 1430 he created the bronze statue of David, his most famous work, a remarkable, innovative work, the first major work of Renaissance sculpture. Michelangelo's marble statue of David (1501-1504) is the most famous statue in the world. Michelangelo broke away from the traditional way of representing David, and has caught David tense with increasing power as he is about to go to battle.

Michelangelo and Turing both completely transcended conventional approaches. First, they both created something completely new from their own visions, something which went far beyond the achievements of their contemporaries. Second, both emphasized the human form. Michelangelo brought out the human form in his statues and in the Sistine ceiling with magnificent human figures often shown in contraposto. Turing left behind the formal systems of lambda-definable or recursive functions. Turing reflected on how a human being actually computes. He built his theoretical automatic machine (a-machine) to realize this process and he demonstrated that his machine captured all of human computing.

This lecture will include slides of Renaissance art and can be found at:
http://www.people.cs.uchicago.edu/_soare/Art/