One important outcome of the work of Carl Adam Petri and Anatol W. Holt has been the idea of computer as a “general medium for strictly organized information flow” (Petri), together with the insight that “the function of a system is to establish certain relations of communications among a set of role players” (Holt). Their vision on the role of computers in coordinating human activity, and the theory that underlies such a vision, is especially needed in the current situation, where computers have become more communication tools than calculating machines, as they were originally conceived. This view on computers and communication is a natural outcome of the original idea of scientific research and modeling underlying all of Petri’s work, including General Net Theory. Petri argued that computers and information flow should be in accordance with the laws of modern Physics. From these laws he deduced versions that apply also for discrete world models and models of human interaction.

Both Petri and Holt passed away in 2010. We feel that their scientific legacy should be preserved not just as a collection of results of historical interest, but rather as a repository of deep insights whose reception has been only partial, and still in need of thorough exploration and understanding. The tutorial aims at celebrating their pioneering contributions, hoping to whet the research interest that, in our opinion, such topics deserve.
The talks

Giorgio De Michelis,

*A slide by Petri*

In the lecture given in June 2003 at the Petri Net conference in Eindhoven (Petri (2003)), Carl Adam Petri presented, in his third slide, the viewpoint he adopted on the nature of models of natural and social phenomena, where he detached them from any ambition to directly relate with reality. In this tutorial, I will comment on it.

The view illustrated on this slide, in fact, shows a radical change in the perspective Petri adopted in his research work, with respect to standard scientific approaches adopted, e.g., in physics. We can relate it, for example, to the “phenomenological stance” discussed by Rorty (1979) and to the debate raised by Bridgman’s operationalism in the philosophy of science (Bridgman (1927)). But Carl Adam Petri was not a philosopher and refused to discuss his work in philosophical terms: he was an engaged practitioner of scientific research. His viewpoint must therefore be read and evaluated as a contribution to science, and not to philosophy! I will begin to do it, relating to the view, presented in the above-mentioned slide, two major contributions he gave to the development of scientific knowledge.

First, the basic math, underlying his nets, with the central role, played in it, by concurrency. We will see that, as a relation characterized by Reflexivity and Symmetry, Concurrency can have several different interpretations, all of which refer to qualities depending on observation procedures.

Second, the Communication Disciplines (Petri (1977a,b), de Michelis & Ellis (1985)) as a theoretical framework to deal with human pragmatics. Again, the novelty, with respect to Shannon’s Communication Theory, is the change of viewpoint on communication phenomena: while the former is based on a panoptical observation, Communication Disciplines look at the questions any human being needs to discipline (in both senses of understanding and performing) in order to communicate effectively.

**Giorgio De Michelis, short bio:** Born in Asiago in 1947, Giorgio De Michelis holds a degree in Mathematics (1970). He has taught at Università degli Studi di Milano, then at Dipartimento di Informatica, Sistemistica e Comunicazione, Università degli Studi di Milano-Bicocca and at the University of Italian Switzerland in Lugano. He is currently Full Professor at the Università degli Studi di Milano-Bicocca. His research interests include Computer Supported Cooperative Work, Workflow Management Systems.
and Interaction Design. In previous years he worked on Petri Nets and Concurrency Theory, having several occasions of discussing with Anatol Holt and participating frequently at Carl Adam Petri’s Seminars, deepening his understanding of “Communication Disciplines”.

**Felice Cardone,**

*Communication mechanics: A prospectus.*

Communication mechanics, the study of formal relations of communications among role players in organized activities, has been the main research concern of Anatol Holt. It has also been the motivating force behind Holt’s work on Petri nets, starting from his early contributions in the context of the Information Systems Theory Project (1968), which had a pivotal role in disseminating acquaintance with Petri nets in the American computer science milieu, notably the hugely influential Project MAC, based at MIT. Holt’s investigations on themes directly pertaining to communication mechanics or, as he later used to call it, *coordination mechanics* (Holt (1985)), span nearly four decades and, although taking a different bias through the years, display a coherent group of leading themes. It is these that we shall resume in our tutorial, striving to put them in context and following their development throughout Holt’s writings.

Our first topic will be a survey of the mathematical aspects of communication mechanics, developed in early (unpublished) papers on the subject, following a few recurring themes in the development of Holt’s ideas, for example the following programmatic statement from Holt (1973):

*One can specify the flow of well-defined effects only in a context in which the flow-paths close to form circuits.*

This idea is first reported (*in statu nascendi*) in Bateson (1972) and may be seen as a basic theorem of communication mechanics: in particular, it is the main architectural principle behind asynchronous communication (Patil (1970)).

Besides important technical contributions to the theory of Petri nets, the early foundational work on communication mechanics also developed the first bits of a language for organized human activity. It is here that make their appearance the notions of *body, operation, role* (or *part*) that pervade Holt’s later work on coordination theory (or theory of organized activity). We shall survey this work, attempting to offer a systematic presentation.

Another theme which pervades Holt’s work is that of *information* and its proper treatment in the context of organized activity. From his early
criticism of superficial uses of Shannon’s mathematical information theory (Holt (1974)), to a sketch of a theory of information in the context organized activity based on the vocabulary alluded to above (developed with the present author, Holt & Cardone (2000)), through the mathematical formulation, developed with Commoner, of a notion of information in state machines, we shall illustrate Holt’s main contributions.

The final part of the tutorial will illustrate briefly some applications of coordination theory where Holt’s ideas are embodied in specific “coordination machines”: the operating system Igo and the Pulsar from Holt (1997), and the Interest Book.

Felice Cardone, short bio: Born in Torino in 1960, Felice Cardone holds a degree in Philosophy (1983), and a PhD in Computer Science (1990). He has taught at Università degli Studi di Milano, then at Dipartimento di Informatica, Sistemistica e Comunicazione, Università degli Studi di Milano-Bicocca. He is currently Associate Professor at the Università di Torino, Dipartimento di Informatica. His research interests include mathematical models of computation; semantical aspects of type systems, especially those that include recursive types; and the conceptual foundations of informatics – an interest that he has developed through a decade of discussions with the late Anatol Holt.

Rüdiger Valk,
From fundamental laws in Physics to coordination principles.

The constructive work of engineers, in particular of those building computers, should not be in conflict with the laws of nature. Following C.A. Petri, the compatibility of artificial constructs with the principles of Physics will improve their correctness, sustainable fault tolerance and agreeability with other systems (Petri (2007)). It was an ongoing tenet of Petri’s work to formalize fundamental laws of modern Physics in such a form that they apply to ordinary and finite discrete event systems.

Abstracting Minkowski-time-space diagrams to Petri spaces the Lorentz-transformation of special relativity theory is rewritten in a form which does not contain the speed of light (Petri (1996)). Instead of that it contains the notion of slowness which is playing an important role for coordination processes of macroscopic level.

Foldings in time and space lead to cycloids which can be interpreted as
finite nets having an initial marking and concurrent behaviour. They are invariant with respect to the modified Lorentz transformation and lead to loss free computing primitives.

We derive the information operators from the idea of space-time periodic movement of signals in an integer Minkowski space. The derived loss free computing primitives have the same topology as the simplest patterns of repetitive group behaviour.

We can fulfil several systematic principles of construction in one single step. Each of those principles alone leads to the same result: the construction of loss-free transfers, which permits, in the long view, a great simplification. It follows that, if we base our models on the combinatorial concepts of signal flow suggested by informatics, and insist on continuity, we end up inevitably with a model of a finite universe.

Petri wrote: *We have to reject infinite results, and to consider the results of analysis as good approximations of reality and not – contrary to widespread opinion – as more precise than observed reality.*

**Rüdiger Valk, short bio:** Born in 1945, Rüdiger Valk holds a diploma degree in Mathematics (1971), and a PhD in Mathematics (1974). He has taught at the universities of Hamburg and Paris 6. He is currently working as a Professor at the Department of Informatics, University of Hamburg. His research interests include formal languages, verification and semantics of programs, theory of concurrency and Petri nets. He published several books and articles in the field of Petri nets, contributed to the organisation of the Petri net conferences and experienced a long cooperation with Carl Adam Petri.

**References**


