Faculty
of Arts

# Book of Abstracts TELS 2022

Times, Events and Logical Specification

# TELS 2022:
# *The Program*

## Thursday 19th May 2022

13:00 – 13:45
*The registration is opened*

13:45 – 14:00
*Opening of the conference*

14:00 – 15:00
*Peter Øhrstrøm: Highlights in the development of tense-logic*

15:00 – 15:20
*Coffee break*

15:20 – 16:00
*Vincent Grandjean and Matteo Pascucci: Distinguished Successors and Actuality*

16:00 – 16:40
*Manolis Pitsikalis, Alexei Lisitsa and Shan Luo: Representation of Temporal Phenomena*

16:40 – 17:00
*Coffee break*

17:00 – 17:40
*Tadeusz Ciecierski: Temporal Prefixes*

18:15
*Conference dinner*

## Friday 20th May 2022

9:00 – 10:00
*David Jakobsen: Fulfilling Russell's wish: A.N. Prior's appeal to medieval logic*

10:00 – 10:20
*Coffee break*

10:20 – 11:00
*Ulrich Meyer: The Logic of Eternity*

11:00 – 11:40
*Martina Číhalová: Specification of the Fundamental Concepts in the Ontology of Processes; Event, Process, Activity*

11:40 – 13:00
*Lunch*

13:00 – 14:00
*Bjørn Jespersen and Massimiliano Carrara: Are Impossible Events Unknowable?*

14:00 – 14:20
*Coffee break*

14:20 – 15:00
*Xuanpu Zhuang: A Defense for Presentist Time Travel*

15:00 – 15:40
*Zuzana Rybaříková: Temporalism in Prior and in Tichý*

# Highlights in the development of tense-logic

**Peter Øhrstrøm**
*Aalborg University*

In 1954, on the 27th August, Arthur Norman Prior presented his idea of tense-logic for the first time. He developed the field further in many publications until his death in 1969. His books *Time and modality* (1957), *Past, Present and Future* (1967), and *Papers on Time and Tense* (1968) were clearly very important milestones. Much of Prior's personal motivation had to do with his struggle with the problem of determinism (including his study of the logical tension between the Christian doctrines of divine foreknowledge and human freedom). It turned out that tense-logic gave rise to a powerful tool for dealing with this and similar problems. Furthermore, important highlights in Prior's tense-logic were the development of branching time and the introduction of instant propositions (leading to what has later been called 'hybrid logic'). After Prior's death many further developments of formal tense-logic and its semantics have been presented and carefully investigated, and it has been shown that tense logic (and temporal logic in general) is useful in computer science. In philosophical logic many researchers have focussed on the discussions regarding 'the true future' and the notion of 'the thin red line'.

# Distinguished successors and actuality

**Vincent Grandjean**
*University of Oxford*
**Matteo Pascucci**
*Slovak Academy of Sciences*

In the present work we are concerned with tree-like structures of moments to represent time. We criticize some possibilities of characterizing the notion of actuality within these structures. Specifically, we consider tree-like structures where each moment $m$ is associated with a set of immediate successors, one of which being the *distinguished immediate successor* of $m$, i.e., the only immediate successor of $m$ marked as actual. We review three potential characterizations of actuality and argue that all of these have unsatisfactory consequences, which suggests that providing a plausible account of actuality in tree-like structures still remains an open problem.

From a formal point of view, the structures at issue can be defined as triples $S = \langle M,R,R^*\rangle$, where $M$ is a set of moments, and $R$ and $R^*$ are binary relations on $M$, s.t. $R^* \subseteq R$. For any $m,m' \in M$, $R(m,m')$ means that $m'$ is an immediate successor of $m$ and $R^*(m,m')$ that $m'$ is a distinguished immediate successor of $m$. The notion of *root*, *branch*, *history* and *trunk* (initial part of a history) in a structure are defined as usual (see, e.g., Belnap, Perloff & Xu 2001, and Grandjean & Pascucci 2021). We assume that structures are *rooted* (i.e., have a first moment) and that the past of a moment $m$ corresponds to a single trunk, whereas the future of $m$ to possibly many distinguished branches. Structures of this kind come in two flavors: *static* and *dynamic*. Static ones suppose a permanentist ontology, according to which always, everything exists forever. Dynamic ones allow that what is located in a branch goes out of existence when that branch is ruled out of actuality (McCall 1994); the arguments provided apply to both views.

Extended debates around the notion of actuality as a *property of entire histories* can be found in many works on temporal logic; see, for instance, Øhrstrøm & Hasle (1995; 2020) and Belnap, Perloff & Xu (2001). By contrast, much less has been said on actuality as a property emerging from the possibility of singling out a distinguished immediate successor of a moment (here, via R*). There seem to be *three ways* of justifying such a notion of actuality, that we will illustrate and criticize in our work.

The first way is saying that we may select any moment $m$ in a structure and assume that it is our present (hence, an actual moment). However, it might be the case that the past of $m$ does not correspond to a sequence of reversed steps of the accessibility relation $R^*$. In other words, if $\sigma = m(1),\ldots,m(n)$ is the series of moments leading from the moment at the root of the model, $m(1)$, *to* $m$ (i.e., assuming $m(n) = m$), it might be that, for some $1 \leq i < n$, it does not hold that $R^*(m(i),m(i+1))$.

The second way is saying that only moments that are connected to the moment at the root of the structure via a sequence of reversed $R^*$-steps can be assumed to be actual. However, following this option it is no longer clear how to read $R^*(m,m')$ in general.

The third way consists in regarding R as associated with a 'thin red line' function $f(TRL)$. However, this option yields a new version of a dilemma concerning actual future inheritance that is discussed by Belnap, Perloff & Xu (2001).

In the light of our observations it seems that further investigations are needed in order to address the problem of actuality in the structures at issue.

**References:**


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# Representation of Temporal Phenomena

**Manolis Pitsikalis**
*University of Liverpool*

**Alexei Lisitsa**
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*King's College, United Kingdom*

In the field of Computer Science, Temporal Logics have been used in a wide variety of applications. For example, in Complex Event Processing temporal phenomena of interest are frequently formalised and detected with the use of patterns written in a logic based language. In another example, Temporal Logics are used for System Analysis and Verification. While Temporal Logics are undeniably useful in the aforementioned applications, the accurate formalisation of a temporal phenomenon or the specification of the temporal properties of a system is always subject to the expressive power of the language in use. Languages that use a point-based model of time associate facts to instants of time, while languages with an interval-based temporal model associate facts with intervals. As a result, the representation of durative and instantaneous phenomena in each case respectively either is impossible or becomes too complicated. Some exceptions that offer both options are among others, the Event Calculus and the Two--Sorted Point Interval logic, however these options lack of relations on intervals such as those specified by Allen's interval algebra, and operations such as the temporal union, intersection and complement respectively. To this end, in this work we formally introduce a new extensional logic based language dedicated to Complex Event Processing, which allows the specification of both instantaneous and durative temporal phenomena and the relations between them. We assume that time is linear and represented by non-negative integers and we divide temporal phenomena into three categories: events, states and dynamic temporal phenomena. Events are true on instants of time, states are inertive and hold on disjoint intervals, while dynamic temporal phenomena hold on non-disjoint intervals. Events are defined with the use of formulae utilising the connectives of conjunction, disjunction and negation; states are defined via formulae constructed with the use of the temporal operators of maximal range, union, intersection and complement; finally, dynamic temporal phenomena are defined with the use of formulae utilising the seven basic relations of Allen's interval algebra. Our language comes with formal semantics and operational semantics for stream processing i.e., the computation of the instants and the intervals at which phenomena definitions are true or hold. We demonstrate the expressive power of our language by employing examples inspired from the maritime and other domains.

# Temporal Variadic Operators

**Tadeusz Ciecierski**
*University of Warsaw*

In this paper I introduce and develop an approach to tenses that occupies a middle ground between *eternalism* and *temporalism*. In contrast to the most widespread positions on the market, the view proposed treats tenses neither as circumstance-shifting sentential operators (as standard versions of temporalism would have it), nor as quantifiers binding temporal variables that verbs come attached with (as standard versions of eternalism would have it), but as adjuncts modifying the verb. The idea of adjunctivity is spelled out by using the framework of variadic functions proposed in Recanati (2002, 2004, 2007). Variadic functions are of two kinds: recessive and expansive; they are represented by variadic operators, which are also of the two kinds mentioned. The general form of the expansive variadic operator, the type used in this paper, is the following:

(1) $\mathbf{V}\,(\mathrm{P}\,(x_1, x_2 \ldots x_n)) = \mathrm{P}^*\,(x_1, x_2 \ldots x_n, y)$,

where **V** is the generic expansive variadic operator, P the input predicate, $x_1, x_2 \ldots x_n$ its arguments, P* the new predicate with increased adicity and *y* the additional argument place created as a result of the effect of the variadic operator on the input predicate.

Appeal to variadic operators has proven useful in accounting for several types of natural language expressions: adverbs (McConnell-Ginet (1982)), prepositional phrases (McConnell-Ginet (1982), Keenan and Faltz (1985), Recanati (2002, 2004)), relational terms (Barwise (1988)), etc. The expressions at stake will be construed as having a double role. On one hand, they will contribute a variadic operator that transforms the input predicate in a different predicate with an additional argument place occupied by a corresponding variable; on the other, they will either contribute a specific value or bind that variable.

Following Recanati (2007), in this paper the variadic functions framework will be applied to tenses. First we define a specific temporal expansive variadic operator, whose general form is the following:

(2) $\mathbf{V}_{\text{time}}\,(\mathrm{P}\,(x_1, x_2 \ldots x_n)) = \mathrm{P}^*\,(x_1, x_2 \ldots x_n, t)$,

where $\mathbf{V}_{\text{time}}$ is the temporal expansive variadic operator, P the input predicate, $x_1, x_2 \ldots x_n$, its arguments, P* the new predicate with increased adicity and *t* the additional argument place for times created as a result of the effect of the variadic operator on the input predicate.

Tenses will be treated by appeal to the temporal variadic operator defined in (2) as described above. To illustrate, consider the following tensed sentences:

(3) Socrates sat.
(4) Socrates will sit.

(3) will be represented by employing the temporal expansive variadic operator corresponding to the past tense:

(5) $\mathbf{V}_{\text{time: past}}$ (sit (Socrates)) = ∃t ($t < t_u$ & sit_at (Socrates, $t$)),

where "sit_at" is the new predicate created by the temporal variadic operator and $t$ is a time before the time of utterance, $t_u$. In a similar vein, (4) will be represented by employing the temporal expansive variadic operator corresponding to the future tense:

(6) $\mathbf{V}_{\text{time: future}}$ (sit (Socrates)) = ∃t ($t > t_u$ & sit_at (Socrates, $t$))

where "sit_at" is as before and $t$ is a time after the time of utterance, $t_u$. Sentences in the present tense, like "Socrates sits", will be treated as expressing temporal propositions, thus taking the view that present tense is vacuous (for arguments, see Sauerland (2002), Recanati (2007)). In their case, no temporal variadic operator applies to the verb. The variability in truth-value of such sentences across contexts comes from evaluating them at different circumstances of evaluation, thought of as comprising a temporal parameter.

To test the basic framework sketched above, it has to be applied to more complex phenomena. While an exhaustive treatment is beyond the reach of this paper, I illustrate how the framework could be applied to the phenomenon known as "sequence of tense". Sentence

(7) John heard that Mary was pregnant

is said to have a "simultaneous" reading and a "shifted reading". Applying the variadic functions apparatus to (7), we get

(8) ∃t ($t < t_u$ & *heard_at* (*John*, ∃t′ ($t′ < t_u$ & pregnant_at (Mary, $t′$))), $t$)

(8) allows for both readings of (7), but leaves it to pragmatics to establish the relation between t and t′. The third reading, in which Mary's pregnancy takes place after John's hearing, is excluded on pragmatic grounds. That this is a desirable result is witnessed by the availability of the third reading when the choice of verb is different: the so-called "later than matrix" reading is available for sentences such as "Peter saw a man who was a cyclist".

## References:

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# Fulfilling Russell's wish: A.N. Prior's appeal to medieval logic

**David Jakobsen**
*Aalborg University*

In History of Western Philosophy (1945), Bertrand Russell expressed his preference for discussing theology with Thomas Aquinas than Jean-Jacques Rousseau. He would 'prefer the ontological argument . . . and the rest of the old stock-in-trade, to the sentimental illogicality that has sprung from Rousseau' because, contrary to modern theology, it was possible to demonstrate whether the medieval philosophy of Thomas Aquinas was valid. Russell was however in a somewhat ambivalent situation, given his own role in developing the analytic philosophy that, so he believed, had finally made it possible to do away with metaphysics through analysis. In Our Knowledge of the External World as a Field for Scientific Method in Philosophy (1914), Russell argued that all philosophical problems—under a correct analysis—will be found to not be philosophical, or else to be logical, 'in the sense in which we are using the word, logical'. The ontological argument, a crown jewel of medieval philosophy, was a case in point. Modern logic, according to Russell, had made it possible to demonstrate, through an analysis of the concept of 'existence', that the argument was invalid. This, Russell surmised, "is not a matter of temperament or of the social system; it is a purely technical matter." In light of Russell's assessment from 1945, it is a remarkable and unexpected turn of events that the last 40 years have seen a resurgence in philosophical theology in the analytic tradition, comparable only to that of the Middle Ages. Several books have been published on the topic, or in the genre, discussing anything from God's foreknowledge and human freedom, to divine impassibility, the incarnation and the atonement. What explains this unusual turn of events? Nicholas Wolterstorff's coarse-grained explanation, in Analytic Theology (2009), is good, but should be supplied with a more fine-grained explanation, focusing on the importance of Arthur Norman Prior's turn to medieval philosophy. Such an explanation will be given here, in which it will be argued that A. N. Prior's invention of tense-logic challenged Quine's view on the nature of modern logic and should be seen as a decisive turning-point in analytic philosophy toward the importance of medieval logic which made it possible to analyze metaphysical questions regarding time, modality and existence. It is however also evident, that Prior's discovery of tense-logic, not only constituted a challenge to Russell's treatment of the concept of existence, but also underscores a central difference between modern and medieval philosophy which troubled Prior and questioned the success of his turn to medieval logic. Indeed, it will here be argued that Prior's turn to medieval logic is hampered by his unwillingness to accept essential medieval assumptions regarding facts about objects that do not exist. Furthermore, it is argued that philosophers who, like Prior, turn to the medieval view of propositions must accept a worldview with facts about individuals that, in principle, do not supervene (present tense) on being, for they do not yet exist.

# The Logic of Eternity

**Ulrich Meyer**
*Colgate University*

According to ancient philosophical doctrine, some objects exist "outside" time altogether. Candidates for such *eternal* existence, as it is usually called, include God, numbers, and other abstract objects.

Eternal objects would differ from the *temporary* objects of our direct acquaintance. Ordinary concrete objects, such as trees or chairs, come into existence at some time, exist for a while, and then go out of existence again. Eternal objects are not supposed to get created or destroyed in this way, but a mere lack of temporal boundaries would not distinguish them from *sempiternal* objects, which never come into or go out of existence because they exist at all times. Yet if temporary objects exist at some times but not at others, and if sempiternal ones exist at all times, then there is only one way in which eternal objects could be any different: they would have to exist at no time.

This clarifies the "outside time" metaphor but also makes eternal existence look incoherent. Suppose some object α exists at no time. Then α did not exist, does not exist now, and will not exist, which seems to be a roundabout way of saying that α does not exist at all, and that 'α' lacks a referent. Eternal objects, which do not exist at any time, appear to be like impossible objects, which do not exist at any possible world. The challenge is to explain how eternal objects would differ from non-existent objects. Unicorns and round squares do not exist *at* any time, either, because they do not exist at all. Non-existent objects cannot be counted as eternal without eroding the difference between eternalism about God and atheism, or between eternalism about numbers and mathematical nominalism.

This short paper looks at two attempts at addressing this problem. The first proposal introduces an eternal tense operator that is supposed to make claims about a point at eternity in the same way in which, say, the past tense makes claims about past times. The second proposal is inspired by the way numbers and other abstract objects get treated in David Lewis' modal realism. Lewis regards possible worlds as aggregates of concrete objects and claims that numbers are *unworldly* objects that exist without being in any world: "Numbers *et al.* are no more located in logical space than they are in ordinary time and space" (Postscripts to "Counterpart Theory and Quantified Modal Logic," p. 40). To characterize unworldly objects, Lewis uses an unrestricted notion of quantification that is not world-bound. His strategy is to put numbers into the range of his quantifiers without placing them in any world.

This paper argues that both attempts at making sense of eternal existence lead to failure: (i) Adding an eternal tense operator to any standard tense logic leads to inconsistency. We cannot first claim that some objects are non-temporal and then try to put them at a time-like eternal point. (ii) Without an eternal tense operator, the Lewisian proposal either collapses into the view that abstract objects exist sempiternally, or into the nominalist thesis that they do not exist at all. A corollary of (ii) is that Lewis does not really have a coherent account of unworldly existence, either.

# Specification of the Fundamental Concepts in the Ontology of Processes; Event, Process, Activity

**Martina Číhalová**
*Palacký University, Olomouc*

The problem of conceptualization concerns not only philosophy and logic but also the computer science. The conceptualization of processes and events nowadays represents a challenge especially for the field of artificial intelligence where the reasoning of intelligent agents has temporal aspects and have to deal with the changes in agents' environment. Each attempts at conceptualization are based on the effort to provide basic definitions and stable classifications of defined entities. Therefore, it is very problematic to capture change in general and time-dependent concepts as events.

In my contribution, different approaches to conceptualizing processes and events are compared in order to obtain basic concepts, their definitions and interrelationships. Then, a conceptual framework for process ontology is proposed, which is close to natural language and based on John Sowa's approach and the linguistic theory of verb valency frames. In natural language, each event is expressed by a special type of verb. Tichý (1980) calls these verbs *episodic* and distinguishes them from *attributive* verbs. I call the concept that *episodic* verbs denote an *activity*. It is the concept of *activity* that is crucial to specify the distinction between concepts of *process* and *event*. A closer specification of the different types of *activities* is based on the linguistic theory of verb valency frames. There are also illustrative examples from the field of multi-agents systems to demonstrate the application of the proposed process ontology.

# Are Impossible Events Unknowable?

**Bjørn Jespersen**
*Utrecht University*

**Massimiliano Carrara**
*University of Padua*

We begin with a fact. It is an arithmetic fact that the decimal expansion of π does not terminate in a final number. Hence, nobody could possibly calculate the final number of this series. It is an impossible event that somebody should do so, unlike the possible event of somebody being in the (non-terminating) process of calculating this final number. Hence, nobody could possibly know that this impossible event ever occurred; not that there would be an event that nobody could know about, but rather that there is nothing to know. We have just described an impossible event. Is it an event, only one that could not possibly be realized at any possible world? Or are impossible events not events, but concepts of events? We claim that an impossible event is a concept that could not possibly have an instance. So in this sense unrealizable events are unknowable, as no instances could be known. But in another sense they are perfectly knowable; once you know about an impossible event, you know everything there is to know about a particular conceptualization of the single impossible event of possible-world semantics. We offer a counterproposal to the standard modal Meinongian take on impossibilia such as impossible events. We do not frontload impossibilities, including impossible events that nonetheless occur somewhere in logical space. We do not require that one must try to make sense of a number that would be the final one in the expansion of π. Rather we are, in some sense, elevating modal Meinongianism's comprehension principles to concepts while jettisoning the impossible objects that answer to these comprehension principles. Our counterproposal is a concept-first account of impossibilities and the epistemic access to them.

# A Defense for Presentist Time Travel

**Xuanpu Zhuang**
*Bowling Green State University*

Suppose Katy owns a time machine. She enters the time machine, waits for two minutes, and then leaves the machine. She finds a dinosaur in front of her. Katy succeeds in traveling back to the time of the dinosaurs, which is two hundred million years ago.

Katy succeeds in time traveling because there is a discrepancy between her personal time and the external time. The personal time Katy experienced is two minutes to her future, while the external time is two hundred million years to the past. It is easy to understand external time. But regarding personal time, if there are only two disparate bodies in different temporal stages, why do we count this as a time-traveling person? According to David Lewis, the person who appeared two hundred million years ago is identical to Katy because there are causal relations between them. In other words, we may adopt a criterion of personal time as follows:

*Personal Time:* if a person P with certain features Fs at $t_0$ causes the existence of a person P′ with certain features Gs at $t_1$ in the relevant way, then P is identical with P′ and the existence of P′ is after the existence of P in personal time.

So, for any theory of time that accepts time travel, there is a need to construct personal time and view the causally related set of person-stages as one person. But some argue that this is not possible for presentism. Different from eternalism which holds that past, present, and future entities all exist, presentism usually holds that only present entities exist. According to the opponents, causal relations between objects at different times are necessary for constructing personal time, which is impossible because only present entities exist for presentists. This could be called Causation Objection to presentism.

I put forward a fact-based account of causal relation to reply to Causation Objection. I argue that presentists could accept facts instead of events as causal relata in "p CAUSE q" (where both p and q are existing causal relata). All facts about the past, the present, and the future exist in the present, e.g., the fact that I drank a cup of coffee five minutes ago exists in the present. With this fact-based account of causal relation, we could describe the discrepancy between personal time and external time in a presentist framework. We could define presentist personal time as follows:

*Personal Time (for Presentism):* if the fact about a person P with certain features $F_s$ at $t_0$ causes the fact about a person P′ with certain features Gs at $t_1$ in the rele-

vant way, then P is identical with P′ and the appearance of P′ is after the appearance of P in personal time.

In this way, we may say the fact that Katy enters the time machine causes the fact that Katy appeared two hundred million years ago, which provides the identity between these two persons. In conclusion, we could vindicate the compatibility between presentism and time travel.

# Temporalism in Prior and in Tichý

**Zuzana Rybaříková**
*Palacký University Olomouc*

At the beginning of modern logic, propositions were defined as unchangeable entities placed in a certain idealistic realm. Such notion of propositions appears in the works of Bolzano or in the works of the founder of modern formal logic Gottlob Frege. Those unchangeable propositions contain in themselves so-called indexical, i.e. the place, time and other circumstances of the utterance. Thus 'It is sunny' is a different proposition when uttered by me yesterday and today at the University of Ostrava. Similarly, for other speakers or for other circumstances of utterance. This concept of the proposition, which is sometimes called eternalism, was and is still prevalent among analytic philosophers. Often even the term 'proposition' is identified with an idealistic entity placed outside the real world.

In my talk, I would like to focus on the concept of propositions of two logicians who deviated from the standard understanding of propositions, Arthur N. Prior and Pavel Tichý. They both were proponents of temporalis, i.e. the view that the proposition "It is sunny" uttered by me yesterday and today is still the same proposition, which could, however, change its truth-values with respect to circumstance. I will discuss the reasons why they were proponents of temporalism and compare their views.

When Prior argued for temporalism, he added that he is not the only one who held it. He called the concept 'medieval' concept of propositions as he identifies scholastic philosophers as his precursors. The reasons why he was a proponent of temporalism lay, however, in his entire concept of logic. He (1996a, 45) once argued: 'Philosophy, including Logic, is not primarily about language, but about the real world.'. Eternalism would have unwelcomed metaphysical consequences to him; therefore, Prior was a proponent of temporalism. Namely, Prior (1996b) claimed that it implies a tapestry view of time, while Prior was a proponent of dynamic concept of time and presentism.

Tichý (1988, 189–191) also considered temporalism more natural approach to propositions. His reasons differed from Prior's ones, however. When he presented his arguments against temporalism, he focused primarily on natural language. Namely, he argued that in eternalism time-telling propositions like 'It is noon' are difficult to interpret properly.

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