A Topological / Modal Logic Theory of Everything

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The Temporal Logic of Behaviors (TLB)

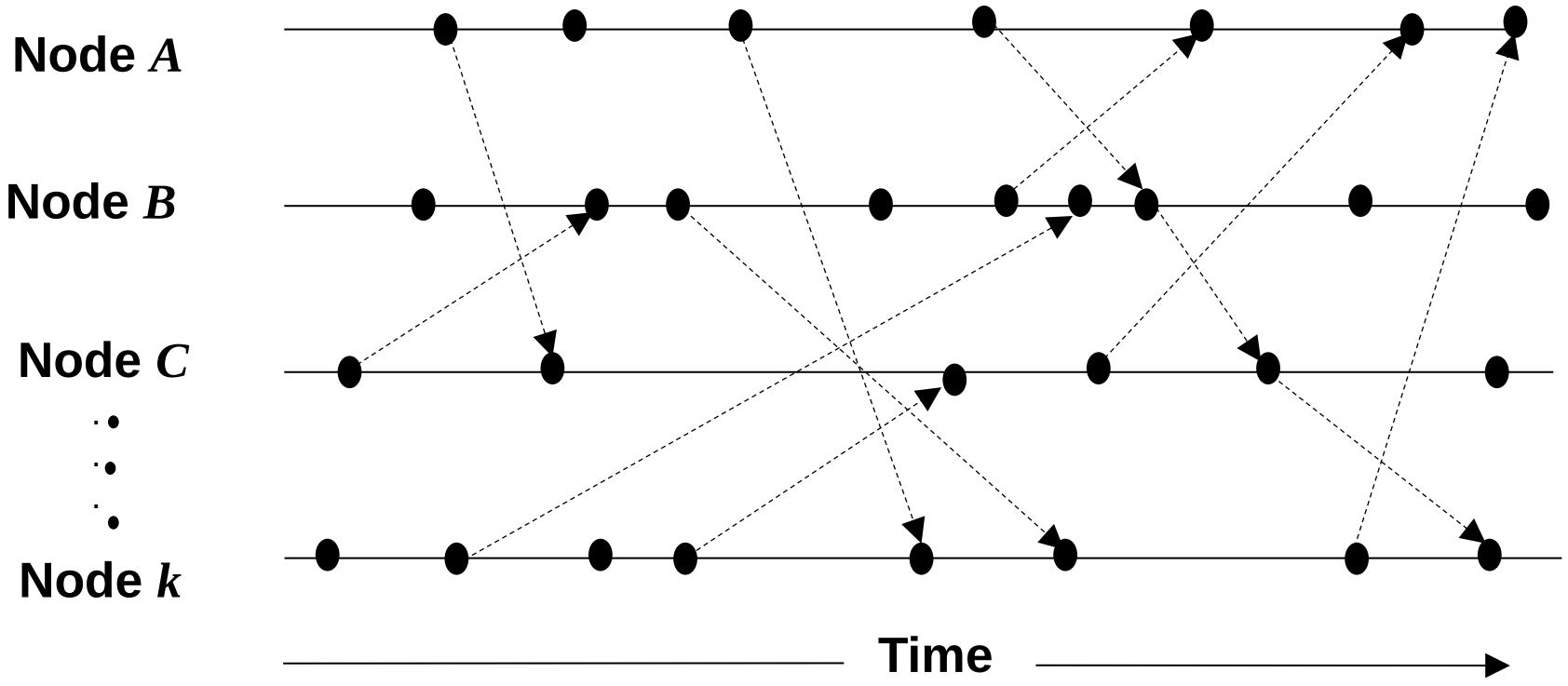
The Logic used in the IEEE Computer Society's series of books on distributed system software engineering.

Basic Concepts

1. Distributed Instants (A, n): local state changes
2. Distributed Time: The set of all distributed instants
3. Distributed Time has a directed ordering
4. Leslie Lamport's TLA logic is a sub logic of TLB
5. TLA Temporal Operators: □ ◇ ∇ △
6. We add two Distributed Temporal Operators ■ ◆
7. And get the two Mixed Modal Operators ▼ ▲
8. And the Convergence & Cluster Operators $\rightarrow \rightsquigarrow$
9. And Projection Operators π_A:$\boldsymbol{\mathcal{S}} \rightarrow$ St^A analogous to the Hermitian operators in quantum mechanics.

Mental Model of a Distributed Computer System

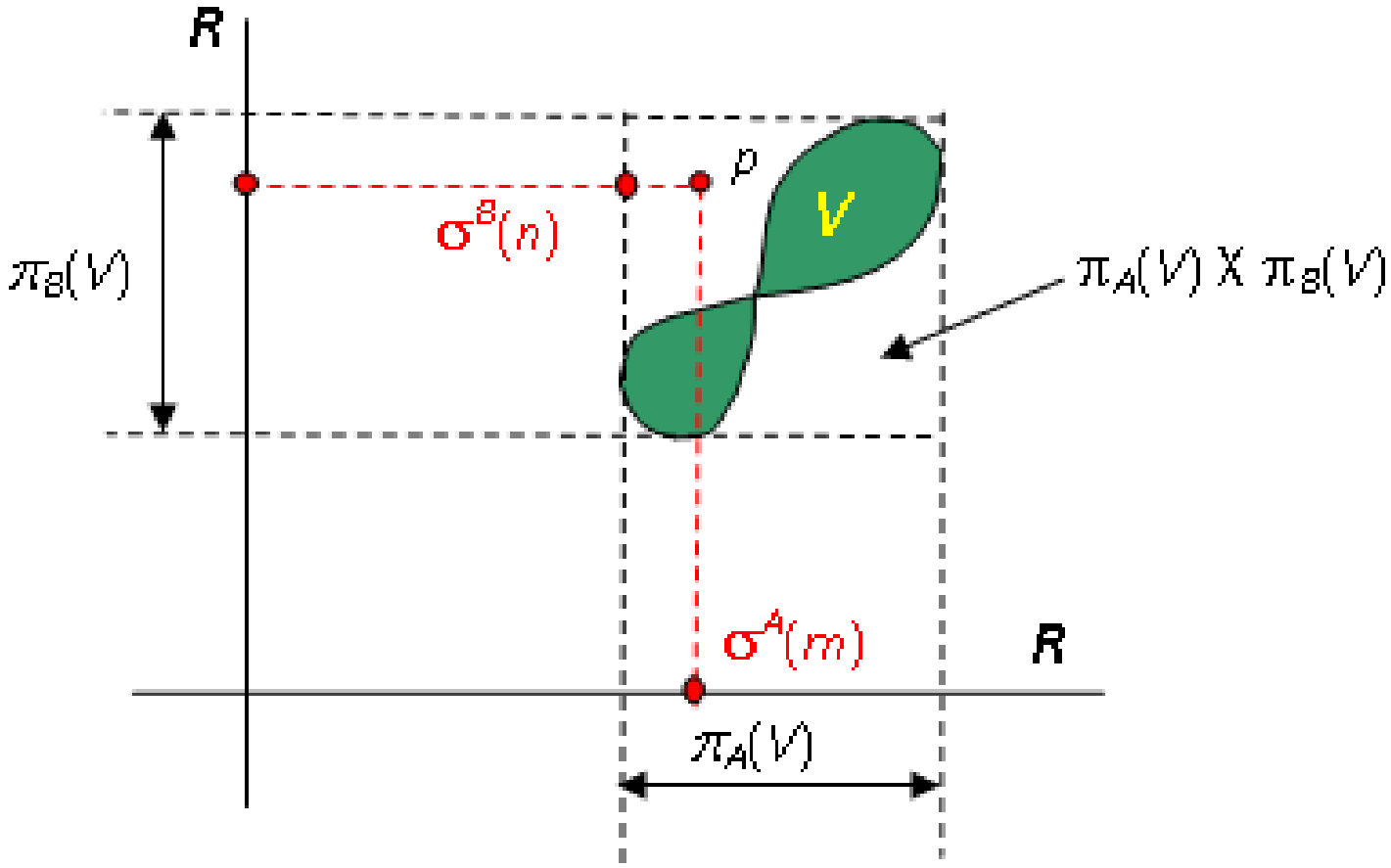
Distributed Heartbeat Subsystem $\mathcal{H}$



Formalization of the Model

- Let **N** be the set of nodes for the system $\mathcal{H}$.
- Let P^A denote the algorithm or program executing on node A.
- Let $\sigma^A = \{s_n{}^A\}$ denote the sequence of states at A as P^A executes.
- For an execution β of $\mathcal{H}$, and a distributed instant (A, n), we define $\beta(A, n) = s_n{}^A$.
- Let **D** be the set of all distributed instants, St^A the state space at node A and **S** the disjoint union (sum) of the state spaces St^A
- Then β is just a mapping of **D** into **S** that we call a *system* or a *global* behavior of $\mathcal{H}$.
- Because of the heartbeat function of $\mathcal{H}$, **D** has a *directed ordering* which makes β a *net*.
- **S** turns out to be the (category theory) *dual space* of $\mathcal{S}$.
- We can know the state of β in **S** because time is distributed in **S**.
- We cannot know the state of $\mathcal{H}$ in $\mathcal{S}$ at a local instant (A, n) but we can know that at any instant (A, n) that β is in the state $\sigma^A(n) = s_n{}^A$ that it is *supposed* to be in because this is how β was defined.

A Distributed Uncertainty Example



It appears to two observers, at nodes *A* and *B* resp., that the state *p* is in *V* but it is not.

Kinds of things can we can prove in TLB

- *Definition: A system behavior* β *converges to a global state* $p \in \mathcal{S}$ *if for each open* $U \subset \mathcal{S}$ *containing* p*, there is a residual* $R \subset \mathbf{D}$ *with* $\beta(A, n) \in \pi_A(U)$, for each $(A, n) \in R$.
- *Theorem: A system behavior* β *converges to a global state* p*, if and only if each local behavior* $\sigma^A \subset \beta$ *converges to* $\pi_A(p)$ *for each* $A \in \mathbf{N}$.
- *Definition*: *A system behavior* β *clusters to a global state* $p \in \mathcal{S}$ *if for each open* $U \subset \mathcal{S}$ *containing* p*, there is a fully cofinal* $C \subset \mathbf{D}$ *with* $\beta(A, n) \in \pi_A(U)$, for each $(A, n) \in C$.
- *Theorem: A system behavior* β *clusters to a global state* p*, if and only if each local behavior* σ^A *of* β *clusters to* $\pi_A(p)$.
- *Theorem*: *The heartbeat subsystem* $\mathcal{H}$ *has correct behavior iff each behavior* β *of* $\mathcal{H}$ *clusters to each global state* $m^* = (m, m, \ldots, m)$*, the state with each entry equal to* m*, for each* $m = 1 \ldots k$.
- *Theorem*: *The secure publish & subscribe system* $\mathbf{E}$ *has correct behavior iff each behavior* β *of* $\mathbf{E}$ *clusters to each global state* $m^* = (m, m, \ldots, m)$ *in* $\mathcal{S}$.

Kinds of things can we prove in TLB continued

- *Theorem*: All theories in TLB, except the theory $\mathfrak{F}$ that consists of all TLB formulas, are consistent.
- *Theorem*: Distributed system theory types Θ_β, $\Theta_{\mathcal{Q}}$ and θ in TLB are instances of the classical modal logic S4.2.
- Where type θ is if the form $\theta = \cap\{\Theta_{\mathcal{Q}} \mid \mathcal{Q}$ is a distributed system$\}$
- And type $\Theta_{\mathcal{Q}}$ is if the form $\Theta_{\mathcal{Q}} = \cap\{\Theta_\beta \mid \beta$ is a behavior of $\mathcal{Q}\}$
- And type Θ_β is the collection of all TLB formulas that are valid for a particular execution β of a particular distributed system $\mathcal{Q}$
- In 1980 Robert Goldblatt proved that Einstein's Special Relativity Theory is an instance of S4.2.
- *Theorem*: Sequential TLB (i.e., when the TLA subset of TLB is used) is an instance of S4.3.1

What is TLC?

- In a lecture, *Mathematical Creation*, given to the Psychological Society in Paris early in the 20th century, Henri Poincare (1854-1912), the most famous mathematician of his time, talks about his "revelations" which, he contends, "*every good mathematician has probably experienced*." He starts by saying: "*It is time to penetrate deeper and see what goes on in the soul of the mathematician*."
- *The Temporal Logic of Consciousness* (TLC), is a generalization of TLB for logically, mathematically and scientifically explaining, not only Poincare's revelations, but how any collection of individual human consciousnesses behave collectively.
- Rabindranath Tagore, Nobel Prize winner in literature in 1913, explains the Vedantic concept of the *Universal Consciousness* in *The Four Stages of Life*, which is a non-scientific, philosophic version of our *Collective Consciousness*.
- TLC is the theory Karl Jung should have discovered instead of his *Collective Unconscious* theory, despite studying and lecturing in India on the Vedantic sciences in his book *The Psychology of Kundalini Yoga* which seems to be Karl Karus' 1846 idea Jung accepts uncritically.

What is TLC? Continued

The Debates on what consciousness is (which is different from how consciousness behaves):

1. Roger Penrose's conjectures on how consciousness arises from quantum entanglement, given in 1995 lecture at Cambridge Univ.
2. Stephen Hawking's Critique of Penrose's conjecture is that quantum gravity causes what Penrose calls *objective reduction* of the wavefunction which affects the operation of the brain through its effect on coherent flows through the microtubules.
3. Hawking states that in quantum gravity, which is what I know best, his objective reduction is a form of decoherence that comes about through interactions with the environment or through fluctuations in the topology of space-time. But Roger wants neither of these. Instead he claims it occurs from a slight warping of space-time produced by the mass of a small object. But according to accepted ideas, the warping will not prevent a Hamiltonian evolution with no decoherence or objective reduction.
4. Nancy Cartwright's Critique of Penrose's Conjectures
5. Abner Shimony's Critique of Penrose's Conjectures

Misunderstandings about Physical Systems

The NSF's Cyber-Physical System Program

The NSF's Cyber-Physical System Problem

The NSF *assumption* that the physical part of a cyber-physical system will behave continuously, whereas the cyber part of the system will behave discretely, leads to a contradiction.

One can prove within TLB that both parts behave discretely. Also, all the laboratory experiments we conducted on *distributed* physical systems confirmed this.

Our example Hydro-Electric Power Plant system in Vol. 4 of the IEEE distributed system software engineering series of books is one John Howes worked on while at Johnson Controls, illustrates this problem.

Moreover, Feynman's 1948 discrete space-time approach to non-relativistic quantum mechanics, and more recently, Kull 2002, Barbour 2000, and several other physicists, question the continuity of space, or time, or both.