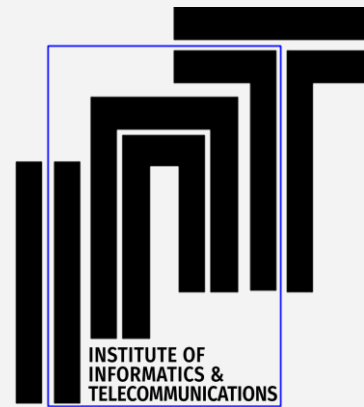




Complex Event Recognition (CER)

<http://cer.iit.demokritos.gr>



Alexander Artikis

15 June 2022

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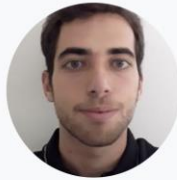
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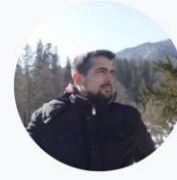
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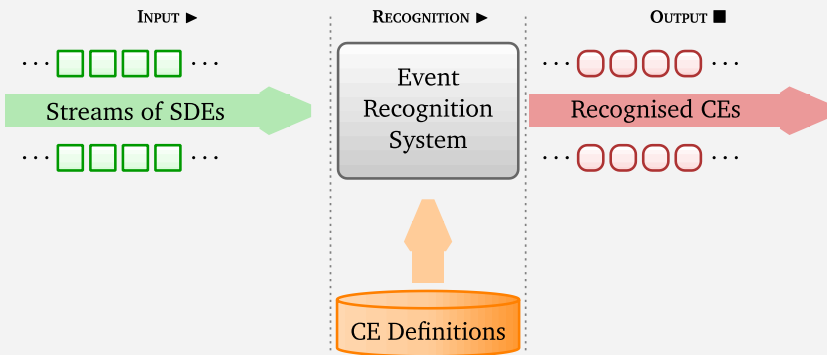


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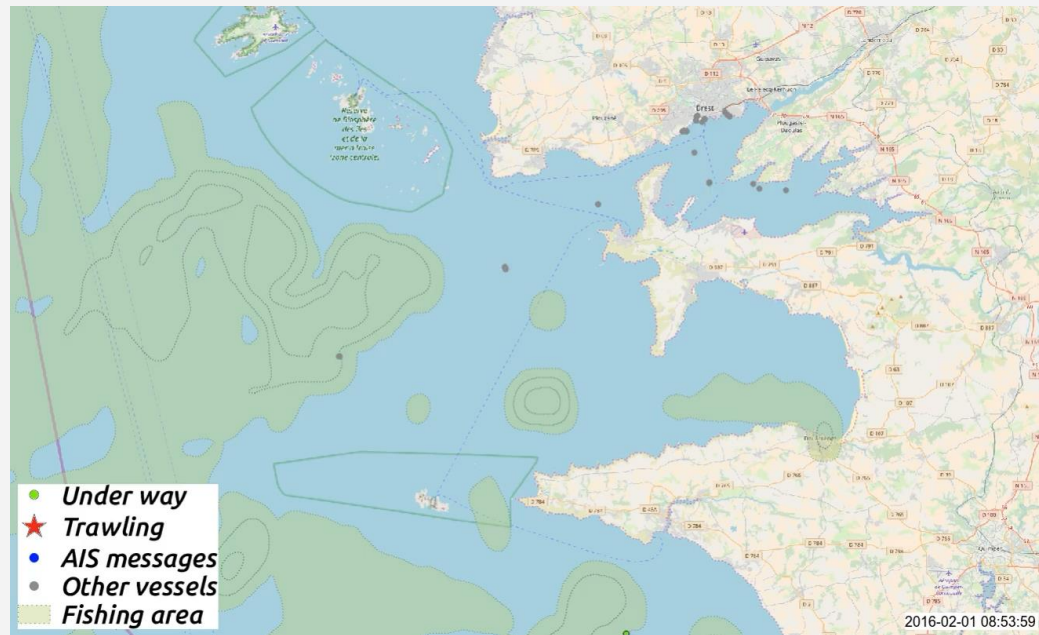


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Complex Event Recognition (CER)

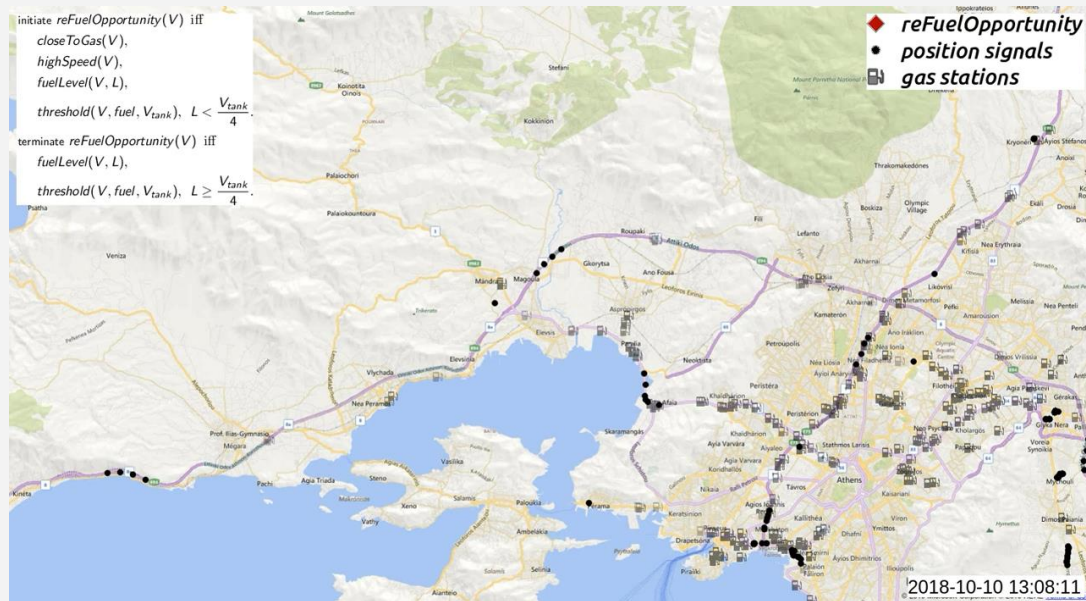


Alevizos et al, *The Complex Event Recognition Group*. **SIGMOD Record**, 47(2), 2018.



A formal computational framework for CER

- Event Calculus for CER
- Explainable
- Support for complex temporal specifications
- Formal semantics
- Support for high-velocity data streams

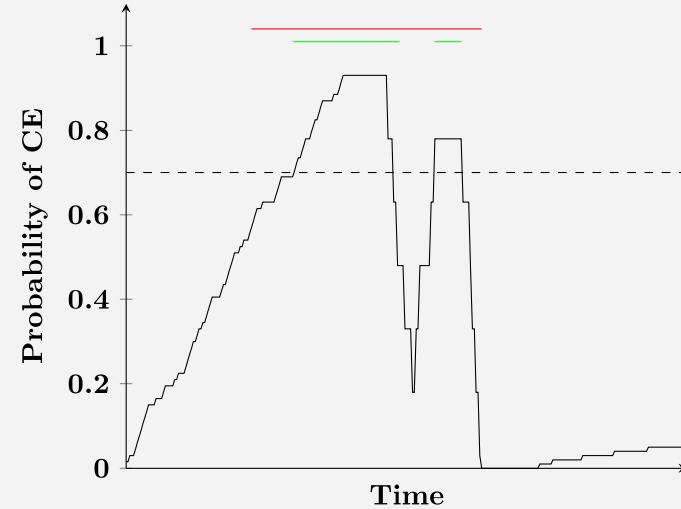


Tsilionis et al, *Incremental Event Calculus for Run-Time Reasoning*. **JAIR**, 2022.

Mantenoglou et al, *Stream Reasoning with Cycles*. **KR**, 2022.

CER under Uncertainty

- Probabilistic Event Calculus for handling the lack of veracity
 - Noisy data streams
 - Imprecise knowledge bases
- Interval-based
- Online reasoning
 - Theoretical guarantees on accuracy
 - Optimal history compression
- Comparable accuracy to batch processing with very small memory



Artikis et al, A Probabilistic Interval-Based Event Calculus for Activity Recognition. **Annals of Mathematics and Artificial Intelligence**, 2021.

Mantenoglou et al, Online Probabilistic Interval-based Event Calculus. **ECAI**, 2020.

- Online structure and weight learning for Event Calculus programs
- Non-monotonic ILP over established ASP tools
- First-order logic graph-cut minimisation for supervision completion
- Approximation of globally-optimal solutions from locally-optimal ones

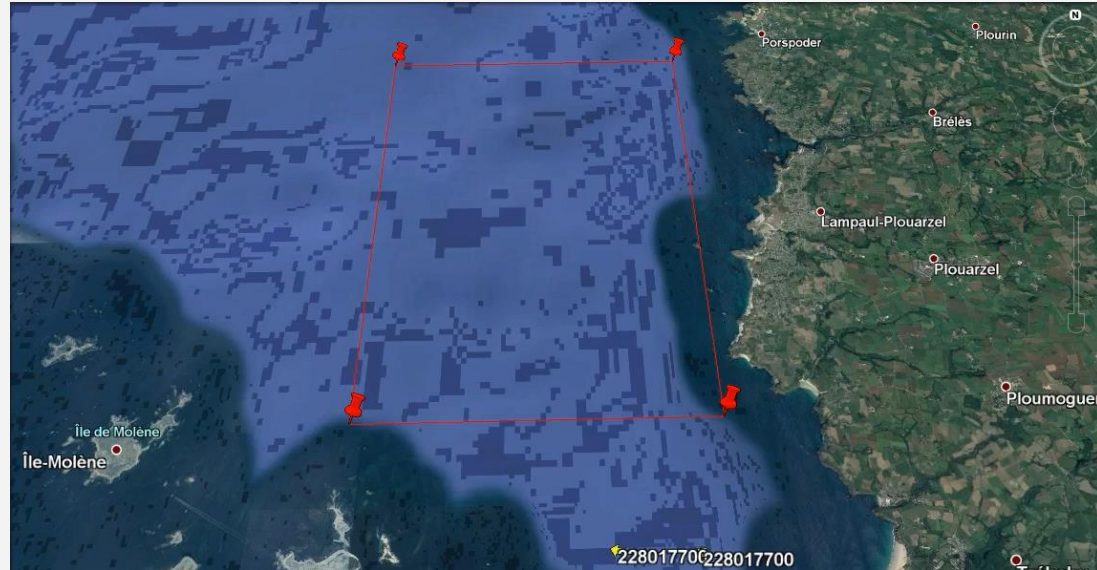


Katzouris et al, *Online Learning Probabilistic Event Calculus Theories in Answer Set Programming*. **Theory and Practice of Logic Programming**, 2021.

Michelioudakis et al, *Semi-Supervised Online Structure Learning for Composite Event Recognition*. **Machine Learning**, 108(7), 2019.

Complex Event Forecasting

- Forecast the occurrence of a complex event
- Symbolic automata for complex event patterns
 - Closure properties
 - Formal compositional semantics
- Prediction suffix trees for long-term dependencies
 - Higher accuracy
 - Comparable training time and acceptable throughput

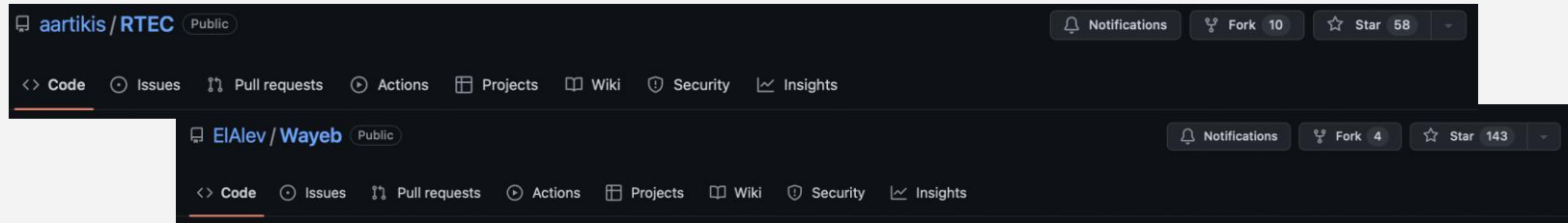
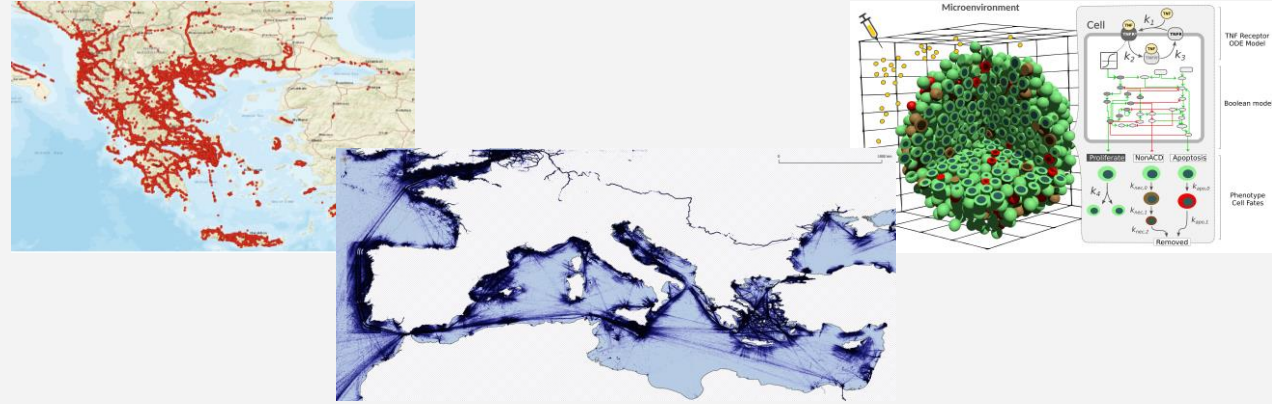


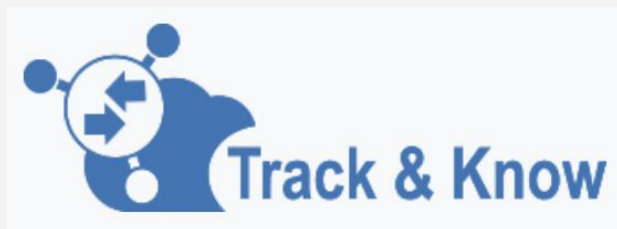
Alevizos et al, Complex Event Forecasting with Prediction Suffix Trees. **VLDBJ**, 2022.

Patent pending!

The CER Toolbox

- Open-source computational frameworks
- Empirical analyses
 - Reproducible
 - Big real and synthetic data
 - Complex domains





datAcron



INFORE Interactive Extreme-Scale
Analytics and Forecasting

 ARIADNE

The ARIADNE logo features a stylized blue icon on the left that resembles a fingerprint or a circular pattern. To the right of the icon, the word "ARIADNE" is written in a blue, serif font.

External Visibility

February 9 – 14 , 2020, Dagstuhl Seminar 20071

Foundations of Composite Event
Recognition

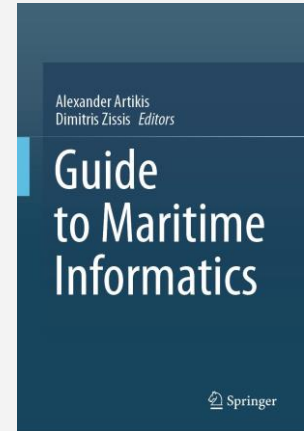


IJCLR 2021



T06 Complex Event Processing: Languages, Recognition and Forecasting

Aug 20 10:00 – 13:00 Montreal Time (UTC-4)



The Present and the Future

- Current work

- Events with delayed effects in CER (under review in IEEE TKDE).
- Probabilistic CER (under review in IJAR).
- Semi-supervised ML for CER (under review in MLJ).
- Complex event forecasting (under review in Fundamenta Informaticae).
- Early Time-Series Classification (under review in IEEE TKDE).

MBDW 2022

- Future work

- Efficient Explainable Learning on Knowledge Graphs
- Robust Learning and Reasoning for Complex Event Forecasting

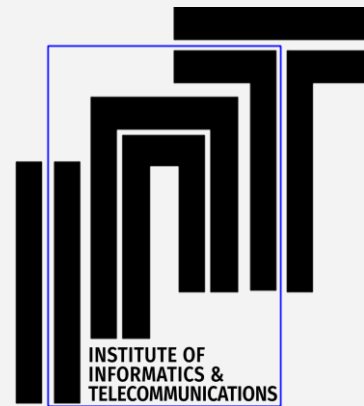
DEBS 2022

TIME 2022

PLP 2022



Thank you!



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