

NeuroSymbolic AI for Making Sense of Streaming Data: Topics not covered

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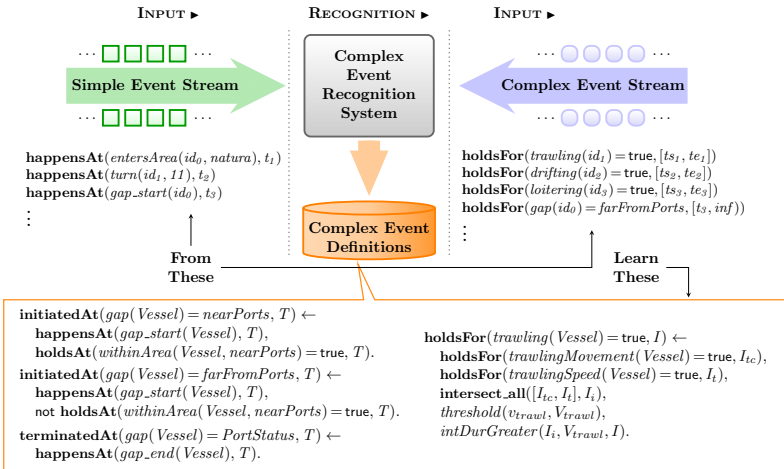
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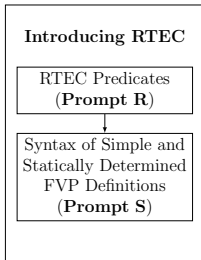
Machine Learning for CER*,†



*Katzouris et al, Online Learning Probabilistic Event Calculus Theories in Answer Set Programming. Theory and Practice of Logic Programming, 2023.

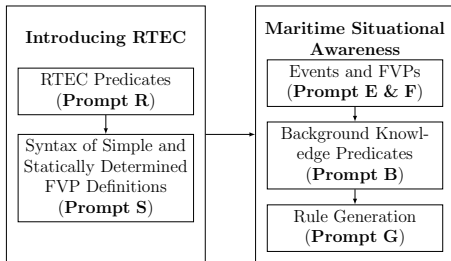
†Michelioudakis et al, Online semi-supervised learning of composite event rules by combining structure and mass-based predicate similarity. Machine Learning, 2024.

LLM-powered CER*



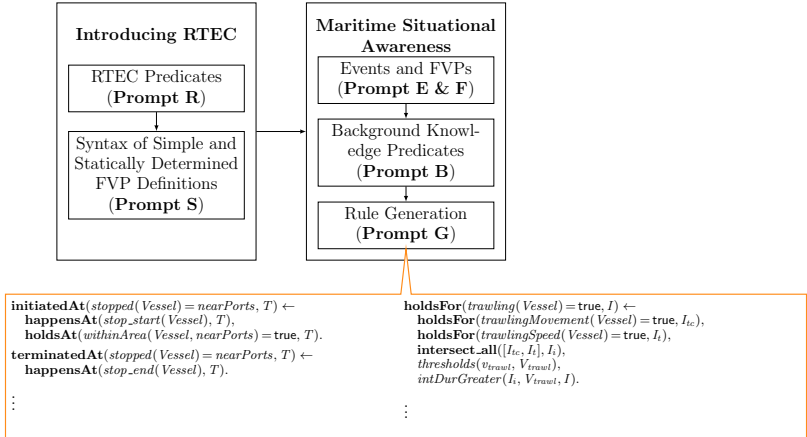
* Kouvaras et al, Generating Activity Definitions with Large Language Models. EDBT 2025.

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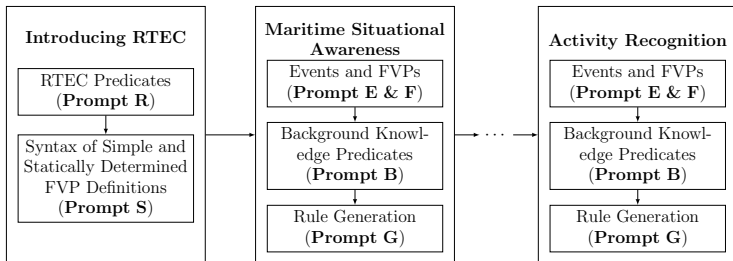
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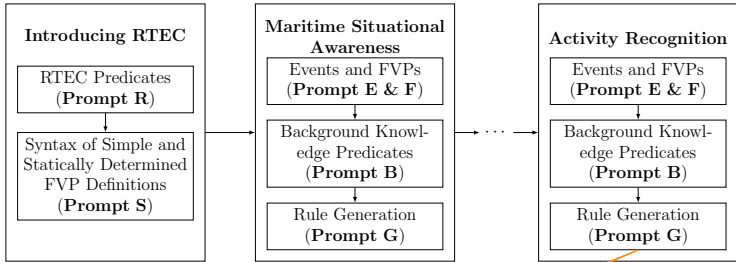
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```
initiatedAt(person(Id) = true, T) ←  
  happensAt(start(walking(Id)) = true, T),  
  not happensAt(disappear(Id), T).  
terminatedAt(person(Id) = true, T) ←  
  happensAt(disappear(Id), T).  
⋮
```

```
holdsFor(moving(P1, P2) = true, MI) ←  
  holdsFor(walking(P1) = true, WP1),  
  holdsFor(walking(P2) = true, WP2),  
  intersect_all([WP1, WP2], WI),  
  thresholds(movingThr, MovingThr),  
  holdsFor(close(P1, P2, MovingThr) = true, CI),  
  intersect_all([WI, CI], MI).  
⋮
```

* Kouvaras et al, Generating Activity Definitions with Large Language Models. EDBT 2025.

Formal models of CER

- ▶ Other approaches on formal complex event recognition^{*,†}

^{*}Bucchi et al, CORE: a COMplex event Recognition Engine. VLDB, 2022.

<https://github.com/CORE-cer/CORE>

[†]

Alevizos et al, Complex Event Recognition with Symbolic Register Transducers. VLDB, 2024.

<https://github.com/EIAlev/Wayeb>

Formal models of CER

- ▶ Other approaches on formal complex event recognition^{*,†}
 - ▶ ... including combinations of logic-based and automata-based approaches[‡].

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[‡]Mantenoglou and Artikis, Sequencing in the Run-Time Event Calculus. ECAI 2025.

Formal models of CER

- ▶ Other approaches on formal complex event recognition^{*,†}
 - ▶ ... including combinations of logic-based and automata-based approaches[‡].
- ▶ Comparison in terms of expressive power, complexity and performance[§].

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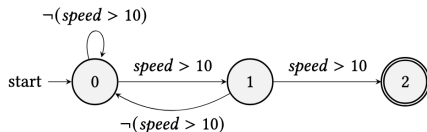
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[‡]Mantenoglou and Artikis, Sequencing in the Run-Time Event Calculus. ECAI 2025.

[§]Grez et al, A Formal Framework for Complex Event Recognition. ACM TODS, 2021.

Complex Event Forecasting*

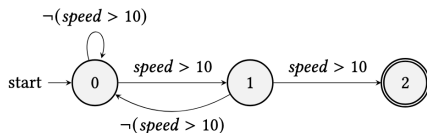
- ▶ Forecast the occurrence of a complex event.
- ▶ Symbolic automata for complex event patterns
 - ▶ Closure properties.
 - ▶ Formal compositional semantics.



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

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.



[https://cer.iit.demokritos.gr \(forecasting\)](https://cer.iit.demokritos.gr (forecasting))

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

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Resources

- ▶ Slides, papers, code & data.
- ▶ Opportunities for (funded) collaboration: [job openings](#) and [topics for BSc/MSc theses and internships](#).



[StreamingNeSy](#)



[Complex Event Recognition lab](#)