

# Making Sense of Streaming Data:

## Topics not covered

Alexander Artikis<sup>1,2</sup>  
Periklis Mantenoglou<sup>3</sup>  
Manos Pitsikalis<sup>1</sup>

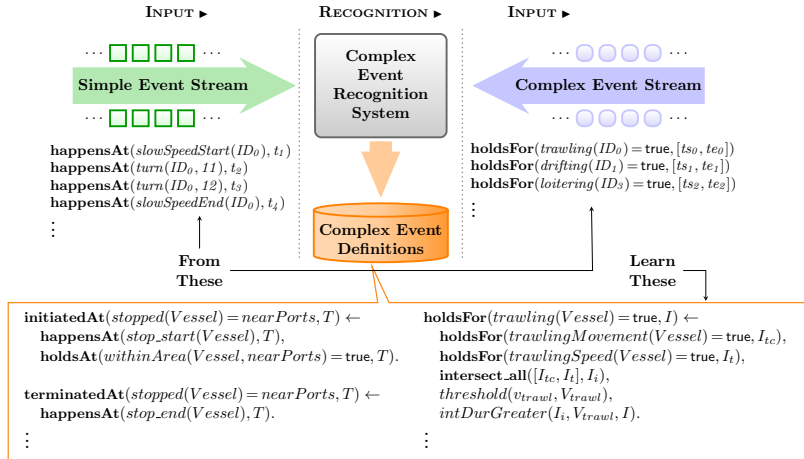
<sup>1</sup>NCSR Demokritos, Athens, Greece

<sup>2</sup>University of Piraeus, Greece

<sup>3</sup>Örebro University, Sweden



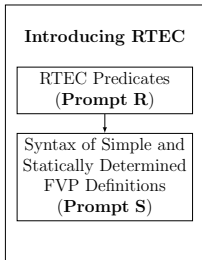
# Machine Learning for CER\*,†



\* 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.

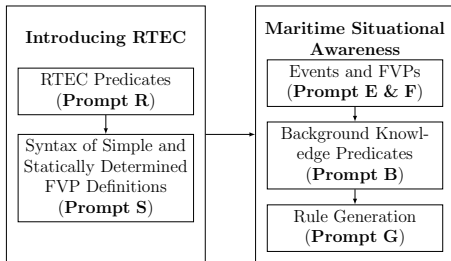
# LLM-powered CER\*



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

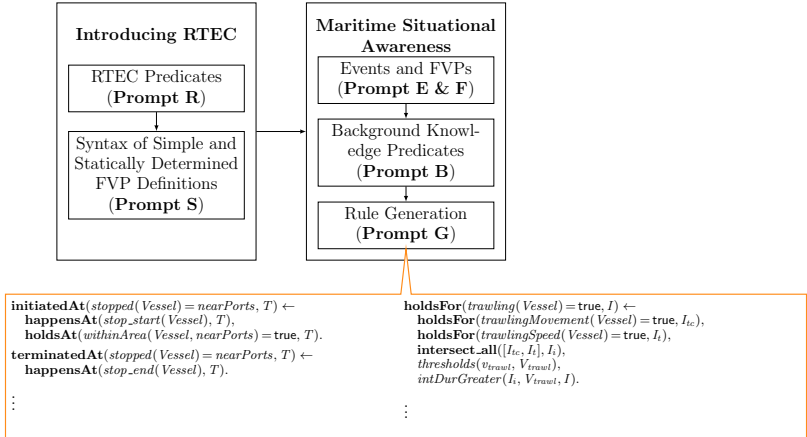
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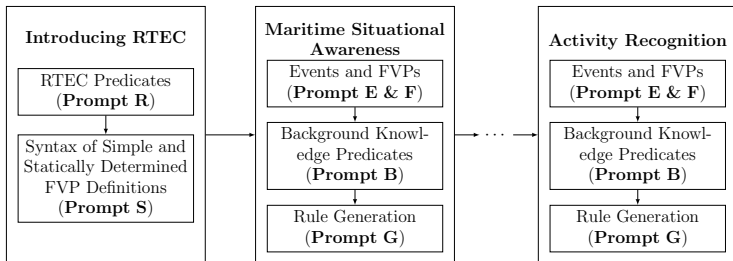
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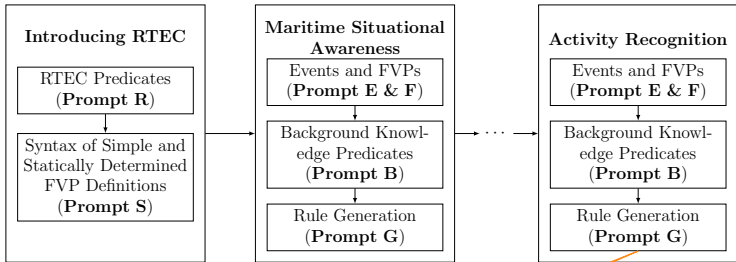
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# LLM-powered CER\*



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# LLM-powered CER\*



```
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).
```

⋮

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# Formal models of CER

- ▶ Other approaches on formal complex event recognition<sup>\*,†</sup>

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<sup>\*</sup>Bucchi et al, CORE: a COMplex event Recognition Engine. VLDB, 2022.

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

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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<sup>\*,†</sup>
  - ▶ ... including combinations of logic-based and automata-based approaches<sup>‡</sup>.

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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<sup>\*,†</sup>
  - ▶ ... including combinations of logic-based and automata-based approaches<sup>‡</sup>.
- ▶ Comparison in terms of expressive power, complexity and performance<sup>§</sup>.

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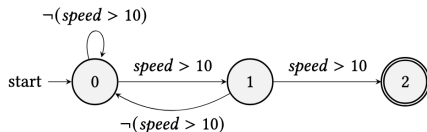
<https://github.com/EIAlev/Wayeb>

<sup>‡</sup>Mantenoglou and Artikis, Sequencing in the Run-Time Event Calculus. ECAI 2025.

<sup>§</sup>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.

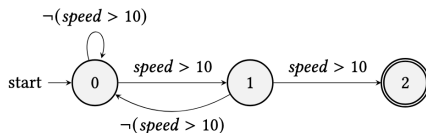


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\* Alevizos et al, Complex Event Forecasting with Prediction Suffix Trees. VLDB Journal, 2022.

# 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))

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\* 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](#).



[Making Sense of Streaming Data](#)



[Complex Event Recognition lab](#)