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Sepsis Treatment: Reinforced Sequential Decision-Making for Saving Lives

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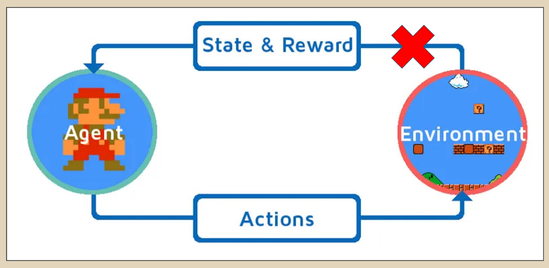
Why this problem?

Sepsis, a life-threatening response to infection, requires swift intervention to prevent complications. This paper introduces the **Reinforcement Learning with Positive and Negative for Sequential Decision-Making** (PosNegDM) framework, using a transformer-based model and mortality classifier to improve sepsis management. Achieving 97.39% patient survival, it outperforms existing methods, signaling a promising approach for enhanced treatment outcomes and reduced healthcare costs.

Challenges



- Environment is not available and thus exploration is not possible (Offline RL)
- Limited Use of Positive and Negative Demonstrations

Proposed Method

- ***Mortality Classifier***
  Trained to distinguish between alive and deceased states, guiding the decision-making process.
- ***Feedback Reinforcer***
  Trained and frozen Mortality Classifier evaluates treatment effectiveness, offering feedback on next states and survival loss for ongoing improvement.
- ***Transformer-Based Decision Maker***
  Generates treatment decisions by predicting both action and subsequent patient states.

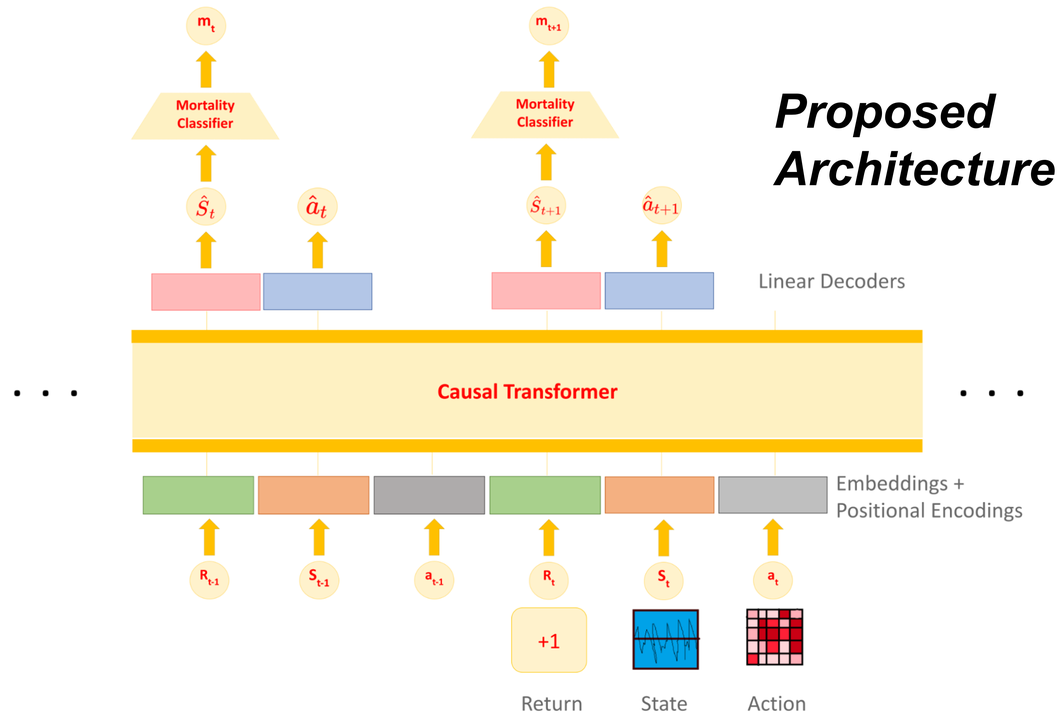
Data

- State: Heart rate, blood pressure, SpO2, temperature
- Action: IV Fluid, Vasopressor

References

- Reinforced Sequential Decision-Making for Sepsis Treatment: The PosNegDM Framework with Mortality Classifier and Transformer, Tamboli et el. (2024).

Proposed Architecture



$$L_{\text{total}} = \alpha L_{\text{action}} + \beta L_{\text{state}} + \gamma L_{\text{survival}}$$

Performance Comparison of Algorithms

Algorithm	Action Prediction Accuracy %	Mortality %		
		Positive	Negative	Total
PosNegDM	94.6	**2.5**	**3.6**	**2.61**
Decision Transformer	94.3	68.2	51.5	66.6
Behavioral Cloning	**95.1**	57.5	46.7	56.5

GitHub Repository

About The Presenter