COLLEGE OF ENGINEERING
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Dissertation Defense

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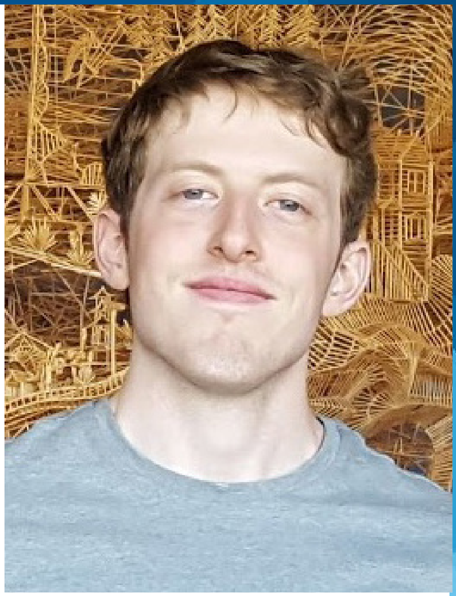

Machine Learning for Physiological Time Series: Representing and Controlling Blood Glucose for Diabetes Management

Friday, July 24, 2020
3:00 – 5:00 PM
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ABSTRACT: Type 1 diabetes is a chronic health condition affecting over one million patients in the US, in which blood glucose (sugar) levels are not well regulated by the body. Researchers have sought to use physiological data (e.g., blood glucose measurements) collected from wearable devices to manage this disease, either by forecasting future blood glucose levels for predictive alarms, or by automating insulin delivery for blood glucose management. However, the application of machine learning (ML) to these data is hampered by latent context, limited supervision and complex temporal dependencies. In light of these challenges, we develop and evaluate novel ML approaches in the context of i) representing physiological time series, particularly for forecasting blood glucose values, and ii) decision making for when and how much insulin to deliver. When learning representations, we leverage the structure of the physiological sequence as an implicit information stream. In particular, we a) incorporate latent context when predicting adverse events by jointly modeling patterns in the data and the context under which those patterns occur, b) propose novel types of self-supervision to handle limited data and c) propose deep models that predict functions underlying trajectories to encode temporal dependencies. In the context of decision making, we use reinforcement learning (RL) for blood glucose management. Through the use of an FDA-approved simulator of the glucoregulatory system, we achieve strong performance using deep RL with and without human intervention. However, the success of RL typically depends on personalized simulators or experimental real-world deployment, neither of which are practical for problems in health. Thus, we propose techniques for leveraging imperfect simulators and observational data. Beyond diabetes, representing and managing physiological signals is an important problem. By adapting techniques to better leverage the structure inherent in the data (e.g., ordering across patterns) we can help overcome these challenges.

Chair: Prof. Jenna Wiens