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ARTORG CENTER
BIOMEDICAL ENGINEERING RESEARCH

AI in Health and Nutrition

Data Driven Diabetes Management

Course Project 2: Insulin advisor with meal announcement using deep Reinforcement Learning

Title	**Insulin advisor with meal announcement using deep Reinforcement Learning**
Author	Maria Panagiotou, PhD Fellow
Editor	Stavroula Mougiakakou, PhD

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Master of Science in Biomedical Engineering

1. Scope of the Project

Machine learning is widely applied in diabetes research. Personalized recommendations on insulin treatment help patients with diabetes to attain and maintain glucose control and to reduce the risk of severe complications. In order to know the correct amount of insulin, People with Diabetes (PwD) need to estimate accurately the carbohydrate content of their meal. The aim of this project is to create a system combining insulin advisors based on a deep reinforcement learning method [1] with a meal detection algorithm [2] in order to minimize the burden of PwD.

2. Data

By using the simglucose Simulator [3] you will be able to have your own interactive environment. You will have access to information such as continuous glucose monitoring (CGM), Blood glucose values, basal insulin rate, bolus injection, the time and type of a meal, plus the patient's carbohydrate estimate for the meal and more. A Type-1 Diabetes simulator is implemented in Python and is available online. The simulator includes 30 virtual patients, 10 adolescents, 10 adults, and 10 children with Type 1 Diabetes Mellitus (T1DM).

3. Experiment

In this task, you need to get familiar with the simulator and then experiment with the combination of these two algorithms (insulin advisor with deep RL and meal detection). Preliminary work using these algorithms separately will be provided.

4. Report

We encourage you to include the following sections in your report:

- Introduction: This section should include a brief presentation of the project's aims, objectives and its clinical importance. You should briefly explain your basic approach and your main conclusions. If needed add a figure.
- Related work: This section should highlight previous work related to your problem and should put your work in a broader context.
- Methods: Here you describe the method/s or glycemic indices you implemented in detail.
- Data and Experiment setup: Data description, preprocessing. Add a table with characteristics of the data, or an example of the data available for a specific individual, before and after any pre-processing. Describe your benchmarks.
- Results: Present the results of your analyses (use graphs and/or tables). Comment on these results: are they statistically significant? Are there interesting trends?
- Discussion: Highlight how your results relate to your original question formulation. Do they support your hypothesis? Do they reveal interesting insights about existing medical practices, global health outcomes, the nature of diseases, etc.? Discuss limitations with your analyses and how they might motivate future research directions.

References

[1] C. Hettiarachchi, N. Malagutti, C. Nolan, E. Daskalaki, and H. Suominen, "A Reinforcement Learning Based System for Blood Glucose Control without Carbohydrate Estimation in Type 1 Diabetes: In Silico Validation," IEEE Engineering in Medicine and Biology Society. Annual International Conference, vol. 2022, pp. 950–956, Jul. 2022.

[2] Daniels, John, Pau Herrero, and Pantelis Georgiou. "A deep learning framework for automatic meal detection and estimation in artificial pancreas systems." *Sensors* 22.2 (2022): 466.

[3] Jinyu Xie. Simglucose v0.2.1 (2018) [Online]. Available: https://github.com/jxx123/simglucose. Accessed on: Month-Date-Year.