

Master Project Digital Health – Machine Learning

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Admitted MSc programs: Data Engineering, Digital Health, ITSE, Software Systems Engineering

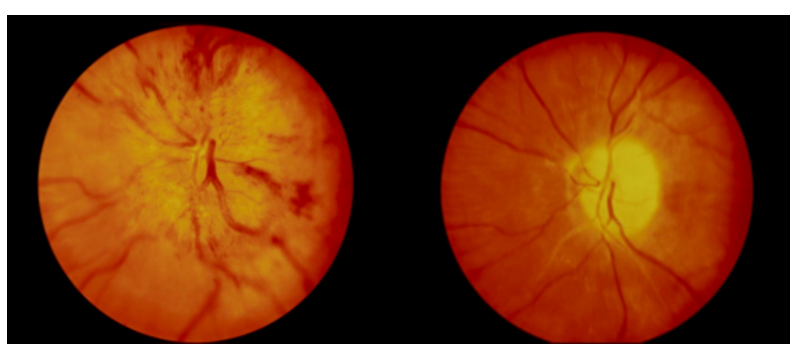
Longitudinal Data Analysis of the DUKE Kempner Rice Diet.

Abstract

Deep Learning and Data Analysis have been a catalyst for groundbreaking insights in numerous sectors, with healthcare being a prime focus. In this project, we are stepping back in time to leverage these modern technologies to unlock the **historical data** from **Dr. Walter Kempner's famed Rice Diet introduced in the 1930s** for treating **severe hypertension**.

Main Objectives:

1. Deep data analysis to provide an **overview of the population characteristics** in Kempner's Rice Diet Program, including details about the clinical data, its efficacy, and potential for future research.
2. An investigation into **weight change patterns** and their association with other factors in treating obesity.
3. Study of **hypertension** population data with a clinical perspective, focusing on potential **abnormalities, progression modeling**, and the **efficacy of Kempner's treatment** approach.
4. Exploration of the **relationship between hypertension and retinal health**, using deep learning to draw inferences and predict health endpoints.
5. Predicting health outcomes like **life expectancy** and potential **risk factors** for death.
6. Various machine learning subprojects aimed at **predicting initial diseases** from diagnoses, weight, date of death, time series prediction.
7. Analyzing smaller subgroups like **diabetics** for more targeted insights.
8. Author a **scientific publication** that describes the results.



Drastic improvement in retinal vasculature. **left (04/19/1964):** retina before the rice diet **right (10/12/1964):** retina after the rice diet

This project provides an opportunity to **merge historical medical data with modern machine learning and statistical analysis** to potentially redefine our understanding of dietary influence on hypertension and metabolic diseases. The ultimate goal is to contribute **towards improving health outcomes by influencing future dietary guidelines, treatment strategies, and diagnostic approaches**.

Partnerships:

The HPI team will work in collaboration with the Duke University team, who will provide the data and expertise necessary to understand and interpret the findings. Support will also come from members of the previous Bachelor project in deep learning model training on medical data.



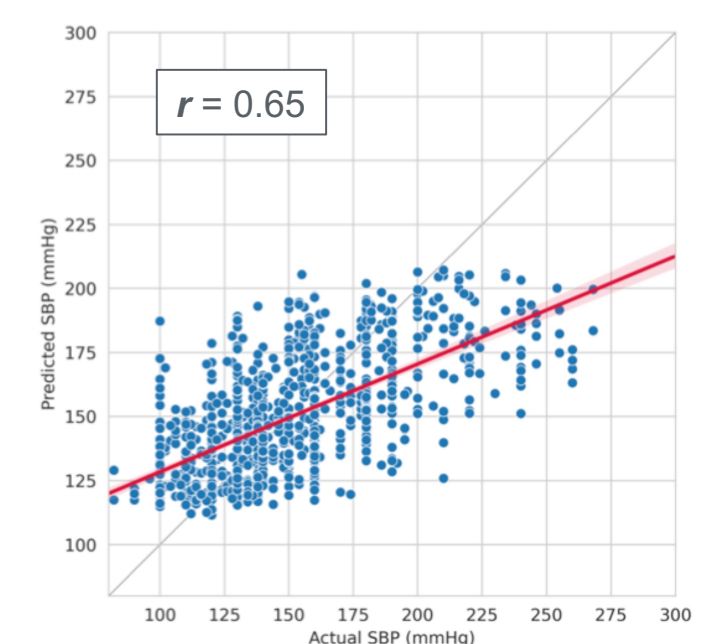
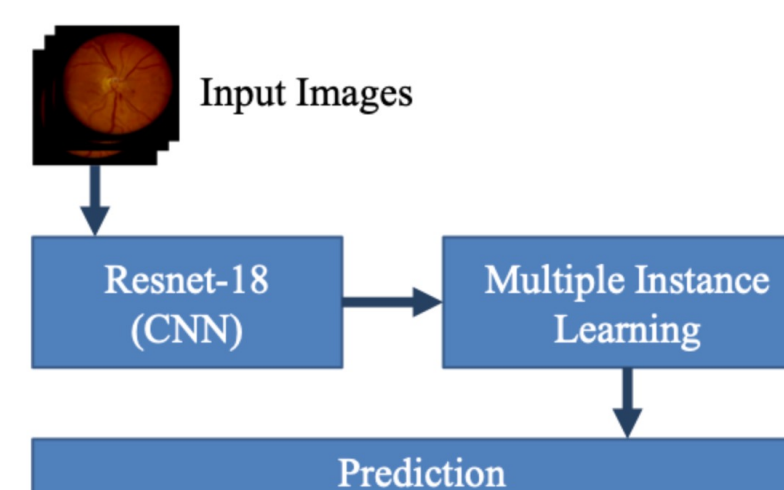
Study Population

The Kempner Rice Diet Program data comprises diverse longitudinal data spanning over **31,500 person-years** for **14,708 individuals**, mainly adults aged 18 years and older. These participants, from diverse backgrounds and medical histories, joined the Kempner Rice Diet Program aiming to combat obesity, hypertension, and other related health conditions. The dataset is particularly rich due to its longitudinal nature, containing **years of follow-up data on each participant**. This diversity and depth allow for extensive exploration of **weight change patterns, hypertension treatment response, retina health**, and overall health outcomes.

Prior Results

Initial exploration of the dataset has revealed compelling patterns. Our previous Bachelor project focused on **digitizing the DUKE Kempner Rice Diet data from hand-written patient sheets**, providing a foundation for deeper exploration.

It was observed that many participants experienced **significant weight loss** and **reductions in blood pressure** during the program. We also have demonstrated that blood pressure can be predicted from **retinal fundus images** (Sommerfeld et al. 2022).



However, the specifics of these patterns, how they vary among individuals, and their long-term health implications, remain open questions. The goal of this Master Project is to further investigate these questions and expand upon these initial findings.

Prerequisites:

Students interested in this project should have a strong background in data analysis, machine learning, and have an interest in healthcare applications.

Through this master's project, we hope to bridge the gap between health, technology, and data analysis, offering students an exciting opportunity to delve into a meaningful, real-world application of their skills.

Supervisors



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References:

Machine Learning Detects Associations Between Retina Features And Blood Pressure Status In Rice Diet Patients
Romeo Sommerfeld¹, Cedric Lorenz², David Lopez³, Anthony Kuo⁴, Benjamin Bergner¹, Friedrich C Luft¹, Christoph Lippert¹, Ingrid Daubechies⁵, Philip Klemmer⁶, Scott Sanoff⁷, Pao-Hwa Lin²
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