**Body Fat Prediction**

Advanced Computer Science Masters Project

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**Title Page**  
Please use the template provided in the assignment.

**Abstract**

The abstract should be a statement up to half a page in length describing the  
subject matter of the project report and the main findings and conclusions  
presented in the report. A reader should be able to decide what the report is  
about by reading this alone, so be clear and concise.

**Acknowledgements (if any)**

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**MSc Final Project Declaration**  
This declaration is about whether you had any human participants or not.  
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**Introduction to the Project**

Obesity is defined as having an excessive amount of body fat. In the UK, it is estimated that approximately one in four adults and one in five children aged 10 to 11 are affected by obesity. The Body Mass Index (BMI) is the most commonly used tool for identifying obesity, with a BMI range of 30 to 39.9 indicating obesity. However, for individuals of Asian, Chinese, Middle Eastern, Black African, or African-Caribbean descent, a BMI of 27.5 or higher is used to classify overweight and obesity. Obesity can significantly increase the risk of developing various serious health conditions, including high blood pressure, asthma, and cancer (NHS, 2023).

The human body consists of extracellular fluid, bone, fat, and muscle cells. When these components are proportionally balanced, the body maintains optimal composition. White fat tissue, which accounts for about 15-20% of the body, is found in two main areas: under the skin and around internal organs. In infants, brown fat tissue makes up around 4% of body weight[3]. Fat tissue is also considered an endocrine organ with the ability to regulate heat and energy, as well as having secretory functions. Excess energy is stored in white fat for future use. The primary fat cells, called adipocytes, are supported by fibroblasts, preadipocytes, and macrophages. For individuals with obesity, the key focus of treatment is the reduction of excess fat tissue (Uçar e*t al.*,2021).

In healthy individuals, body fat percentages should fall between 25-30% for women and 18-23% for men. Women with more than 30% body fat and men with more than 25% are classified as obese (Penn Medicine, no date).

Feature extraction has been widely used in the medical area to map redundant, relevant, and irrelevant features into a smaller set of features from the original data (Dara *et al*., 2018). For example, Das, Naik and Behera (2020) applied feature extraction methods to extract significant features from the raw data before using an Artificial Neural Network (ANN) model for medical disease classification. Their results showed that feature extraction methods could increase the accuracy of diagnosis.

This project implements a unique approach to predicting obesity by creating machine-learning models that estimate body fat percentage using physical measurements such as weight, abdomen, chest, hip circumferences, and density determined from underwater weighing.

**1.2 Research Question:**

1.) "Can machine learning models accurately predict body fat percentage in humans with multiple anthropometric measurements and density determined from underwater weighing to represent they are obese?"

2.) Does the Hybrid Machine Learning model obtain higher accuracy rates compared to individual models for predicting the body fat percentage?

**1.3 Objectives:**

**Chapter 2: Literature Review: =>**

**(Supervised Machine learning concepts, reference about different ML models, used, with formulas)**

**Chapter 3 : Methodology =>**

1. **Data collection => description.(Tables and charts about data.-statistical info)**
2. **Spearman’s correlation as well.**
3. **Standard scalar technique.**
4. **Feature selection algorithm(proper referencing). Write Each and every feature sub-section.(tables here as well)**
5. **Machine learning models.(MLP, SVR, RandomForest, Regression about it)**

**Chapter 4: Evaluation & Analysis:**

* RMSE, MAE, RMSE, MAD, SH, R squared, MSE.

**Chapter 5: Discussion:**

**Write about the bodyfat estimation is useful, talk about without vs. all anthropometric measurements were used. Write the different values.**

**Purpose of these values.**

**Chapter 6: Conclusions**

**About the methods already available limitations.**

**System based on BPF that can calculate BFP with anthropometric measurements.**

**Bibliography**

Dara S, Tumma P, Eluri NR, Kancharla GR. (2018) “Feature Extraction In Medical Images by Using Deep Learning Approach,” *International Journal of Pure and Applied Mathematics*, 120(6), pp. 305–312.

Das, H., Naik, B. and Behera, H.S. (2020) “Medical disease analysis using Neuro-Fuzzy with Feature Extraction Model for classification,” *Informatics in medicine unlocked*, 18(100288). Available at: <https://doi.org/10.1016/j.imu.20100288>.

**Body fat prediction through feature extraction based on anthropometric and laboratory measurements**[Zongwen Fan](https://pubmed.ncbi.nlm.nih.gov/?term=%22Fan%20Z%22%5BAuthor%5D) 1,2, [Raymond Chiong](https://pubmed.ncbi.nlm.nih.gov/?term=%22Chiong%20R%22%5BAuthor%5D) 1,\*, [Zhongyi Hu](https://pubmed.ncbi.nlm.nih.gov/?term=%22Hu%20Z%22%5BAuthor%5D) 3, [Farshid Keivanian](https://pubmed.ncbi.nlm.nih.gov/?term=%22Keivanian%20F%22%5BAuthor%5D) 1, [Fabian Chiong](https://pubmed.ncbi.nlm.nih.gov/?term=%22Chiong%20F%22%5BAuthor%5D) 4**Chapter 2: LiteratureChapter 3: Tools Used Chapter 4: Introduction to the ProjectChapter 4: ExplanationChapter 6: ConclusionChapter 6: Introduction to the ProjectChapter 7: Introduction to the Project**