

**Universität Heidelberg**

**Fakultät für Mathematik und Informatik**

# Winter Semester 2019 / 2020

# Course: Mathematical Structure of Complex Systems

**Supervisor: Professor Markus Kirkilionis <M.A.Kirkilionis@warwick.ac.uk>**

# FoodWeb & All – Understanding Nutrition and Diet from a Hierarchical Hypergraph Perspective

**Student Name:** **Claire Zhao Sun**

**Matrikelnummer: 3630998**

**Studiengang: Scientific Computing (1. Fachsemester)**

*Email:* [*pz237@stud.uni-heidelberg.de*](mailto:pz237@stud.uni-heidelberg.de)

Report Submission: [28] June 2020

**Contents**

**[UPDATE SECTIONS & PAGE NUMBERS]**

**Section 1. Introduction…………………………………………………… 3**

**Section 2. [Literature Review] …………………………………….……… 4**

**Section 3. [Applying Graph to Nutrition] …….……………....………... 6**

* 1. [Nodes & Edges]
  2. [Hypergraph]
  3. [Hierarchical Structure]
  4. [Clusters / Modules ]

**Section 4. [Modelling the Graph Database using Neo4j ] ………….. 10**

* 1. [US FDA Nutrition Database]
  2. [BBC Good Food Recipe Database]
  3. [Environmental Cost Database]
  4. [User base]
  5. [Other stakeholers – potential to expand the web

**Section 5 [Queries Illustration] ……...…………………………………. 15**

**Section 6 Conclusion……………………………………………………... 17**

**Bibliography….………………………………………………… 18**

**1. Introduction**

The primary objective of this project is to apply the concepts of graph, especially hierarchical hypergraph, to model the nutritional database and interactions of people with food and nutrition in real life, considering not only the nutritional content but also the environmental impact of diet.

The global food system is a complex web, consisting of multi-dimensional […] connecting our diet, nutrition, health and also environment. It also [involves] multiple layers of stakeholders: farmers, manufacturer, supply chain, supermarkets, consumers and policy makers.

Shortcomings of existing systems – discrete, not connected. Information floating around but not aggregated. Not enough emphasis or acknowledgement on environmental impact of our food choices.

This paper aims to achieve the following three main goals:

1. Provide a theoretical mathematical model to connect the different databases and aggregate information in a meaningful way by modelling the intricate inner structure of the food system
2. Demonstrate a prototype system built based on the concepts and using graph database Neo4j
3. Demonstrate the potential power of such queries in meaningful ways to solve problems and raise awareness to the environmental impact

In conclusion, a few areas of future research is mentioned.

**2. Literature Review**

xxxx

**3. Graph Representation of FoodWeb**

**xxx**

**4. Building the Database using Neo4j**

**xxx** xxxx

**5. Illustration of Queries Conclusion**

xxxx

**6. Conclusion & Further Research**

xxx

**7. Bibliography**

Harari, Yuval N., Sapiens: A Brief History of Humankind. Vintage (2014)