CS3263 – Foundations of Artificial Intelligence
Term Project Report
SmartFridge, an AI agent that recommends the best recipe for you

Lei Jianwen (A0281480E, e1155608@u.nus.edu)
Chen Yixun (A0281405L, e1155533@u.nus.edu)
San Muyun (A0271888J, e1121291@u.nus.edu)

October 29, 2025

1 Introduction

1.1 Motivation

Research has shown that households often waste food because expiration dates are overlooked and meal planning is not done systematically. The amount of avoidable food waste is equivalent to each household throwing away a 2.5kg bag of rice every week. And over half such waste can be reduced if meals are better planned. Recognizing this issue, our team aims to develop an AI-driven solution. An AI-driven menu suggestion system can address this challenge by tracking food items, reasoning about their freshness, and proposing meal options that prioritize ingredients with shorter expiration dates.

1.2 Project Scope

Our solution contains the following features

- Keep track(Add/Delete) food items from the fridge

- Keep track(Add/Delete) recipes from a recipe book

- Recommend the most suitable recipe from the recipe book

1.3 Techniques Used

The recommendation is simulated by a decision-making process to decide which recipe to recommend. A decision tree is constructed to solve this problem. The parameters of the decision tree can be categorized into two types. Two Bayesian networks are implemented to calculate the feasibility of the recipe and probabilities of expiration of food items. The utility function for each recipe is calculated using an unsupervised machine learning model.

2 Bayesian Network Inferencing

The probability of successfully making the recipe depends on various foods available in the fridge. In order to infer the probability of the success, a Bayesian Network is used for modeling.

2.1 BN structure

2.2 Learning

2.3 BN reasoning

3 Utility theory

Refer to textbook **?**

3.1 Utility Formulae

$i \leftarrow 10$
if $i \geq 5$ **then**
　　$i \leftarrow i - 1$
else
　　if $i \leq 3$ **then**
　　　　$i \leftarrow i + 2$
　　end if
end if

3.2 Learning for utility

4   Decision Making

Aim to maximize the expected utility of a recipe.

$$\text{MEU} = \max_{a \in A} \mathbb{E}[U \mid a] = \max_{a \in A} \sum_s P(s \mid a)\, U(s, a)$$

4.1   Decision Network

4.2   Decision Making Process

5 Future Improvement

5.1 Machine learning loopholes

5.2 Reinforcement Learning