**Statement of Work**

# PrepPal

**Team Members**
Ioana-Andreea Cristescu - ioanacristescu@g.harvard.edu
Jonas Raedler - jraedler@g.harvard.edu
Rosetta Hu - yifan_hu@fas.harvard.edu
Alice Cheng - acheng@g.harvard.edu

## Background and Motivation

Professionals, students, and stay-at-home parents often struggle to find enough time for meal preparation due to their busy schedules. This becomes even more difficult when considering the need to search for recipes that fit both their preferences and the time they have available. A study revealed that to discover new recipe ideas, individuals often turn to family and friends (71%), cookbooks (41%), or online food communities (45%) (Doub et al., 2016). However, these fragmented sources lack a centralized, personalized approach, making it time-consuming and inefficient for users to filter through multiple recipes to find one that suits their tastes and time availability.

This challenge is further worsened by the inefficient use of ingredients, as many purchased items go unused or spoil before they can be incorporated into meals. According to Lebersorger and Schneider (2011), avoidable food waste constitutes a substantial share of residual waste, accounting for 14.1% by mass. This waste predominantly includes perishable items like vegetables, bread, and meat, highlighting a pressing need for more efficient meal-planning solutions that optimize ingredient use and reduce unnecessary waste.

Our project seeks to address these challenges by developing an application that offers a centralized and personalized solution to meal planning. By utilizing user preferences, available ingredients, and time constraints, the app will generate tailored recipe suggestions, helping users reduce food waste and the time spent searching for meal ideas, ultimately providing a more sustainable and enjoyable cooking experience.

## Scope and Objectives

This project aims to develop an AI-powered meal-planning application that simplifies recipe discovery and ingredient management while minimizing food waste. The application leverages two separate foundational models, as well as speech recognition and transcription, to provide a seamless and personalized user experience, making it a complex, yet interesting and rewarding endeavor.

Application Key Features:

- Recipe Management: Users can add and rate recipes through text input or via links, building a personalized collection of meals. These will be made available to the LLM via RAG.
- Pantry Management: Users can update their pantry through text input or through a voice-to-text model, to ensure real-time tracking of ingredients. The voice model will convert user speech into text for efficient pantry updates, minimizing manual input.
- Meal Recommendations and Ingredient-Based Recipes: The chatbot will provide personalized recipe suggestions by analyzing the ingredients available in the user's pantry or based on specific ingredients provided via text or images. With an LLM (e.g. Llama), fine-tuned on a recipe dataset, and an image-text-to-text model (e.g. Llava), fine-tuned with images of ingredients, the system will identify available ingredients, suggest appropriate meals, and even generate new recipes. The system prioritizes recipes that maximize the use of already available ingredients and generates a shopping list for any missing items.
- Dynamic Pantry Updates: After cooking, the app updates the pantry, dynamically optimizing future recipe recommendations.

To deliver these features, our application will mainly consist of a single chatbot interface, which the user can use to converse about possible recipes. Next to this chatbot, the user will find a camera button and a voice-to-text button, with which they can provide additional information that the chatbot can use to recommend more accurate recipes. The user will also be able to use the voice-to-text or text input fields to update their pantry/ingredient list, on a separate tab of the application, which will be used by the model to generate recipe recommendations.

**Resources We Require**

- Pre-trained Llama model, available through the HuggingFace library
- Extensive recipe dataset (all-recipes; textual data) used for fine-tuning Llama model, available through HuggingFace Datasets. The fine-tuning will allow the Llama model to more effectively suggest new recipes to the user.
    - This dataset contains 2.2 million recipes. Each recipe has a title, a list of ingredients and their respective quantities, and a list of directions for how to cook the recipe.
- Pre-trained Llava image-text-to-text model, available through the HuggingFace library
- Extensive ingredients dataset (image data), labeled with the ingredient's name, used for fine-tuning a Llava model. The fine-tuning will allow the Llava model to more effectively identify the ingredients in user-provided images.
    - We will scrape Google Images using a list of primary ingredients and save N different images for each type. We will use the query term of the search as the label for the image. We will then conduct a quality assessment of the data-label pairs, thereby ensuring that all images are high-resolution and correctly labeled; this should allow us to bypass much of the laborious data-labeling process.

- Pre-trained Google Cloud Speech-To-Text model (same as used in Mega-Pipeline Lecture)

**High-Level Key Deliverables**

- Scrape Google Images for images of ingredients
- Fine-tune Llava on scraped images of ingredients
- Fine-tune Llama for recipe-specific meal recommender chatbot system
- Create a database to support accurate pantry inventory management
- Scalable backend implementation (s.t. multiple queries can be handled at once)
- Frontend development with Camera and Voice Input capabilities
- Integrate Google Cloud Speech-To-Text model with the application to update the pantry
- Create Container/Cloud Infrastructure for Development
- Create Cloud Deployment Architecture

**References**


1. Doub, A. E., Small, M. L., Levin, A., LeVangie, K., & Brick, T. R. (2016). Identifying users of traditional and internet-based resources for meal ideas: An association rule learning approach. *Appetite*, *103*, 128–136. https://doi.org/10.1016/j.appet.2016.04.006
2. Lebersorger, S., & Schneider, F. (2011). Discussion on the methodology for determining food waste in household waste composition studies. *Waste Management*, *31*(9–10), 1924–1933. https://doi.org/10.1016/j.wasman.2011.05.023