Introduction and Problem

It is undeniable that customer service staff at Burger King and other restaurants often face inappropriate conduct, disrespectful actions, aggressive behaviour, offensive comments, and sometimes even verbal harassment from customers. While self-ordering and order-receiving systems are in place to minimize direct contact and communication between staff and customers, staff members are still largely responsible for managing these services. This issue becomes even more pronounced during busy periods, such as weekends and public holidays. To address this challenge, I propose a novel solution: the "Restaurant till Assistant System (RTAS)" powered by Large Language Models (LLMs).

The first paper I bumped into is: <https://ieeexplore.ieee.org/abstract/document/10730393>,

Topic: Retrieval Augmented Generation (RAG) Based Restaurant Chatbot with AI Testability

The abstract of this paper is very similar to what I intend to develop. So, I decided to read this paper thoroughly.

The main takeaway from this paper is that they used 2 LLMs BERT for intent and entity classification, and T4 for text generation. They also utilize RAG using Neo4j Knowledge graph using AuraDB database, which seems like a very cleaver move. The authors also emphasis the testing and evaluation of the whole system using MultiRC dataset using multiple advanced evaluation metrices such as BELU, ROGUE, etc.

The following figure shows the pipeline of the system.

A diagram of a software development

Description automatically generated

However, the authors left some room for criticizing such as even though T4 was trained on a question answering dataset, but the dataset name is not mentioned also there is no mentioning how BERT was trained for both classifications.

Overall, the authors claim that the main goal of the restaurant chatbot's development to improve the dining industry has been effectively attained. For me, this paper turned out to be as useful as expected.

Thus, I decided to follow this paper and do some modifications as needed because of technological differences, scope differences, knowledge/skills differences, etc.

The first step is to collect dataset…. One dataset for intent and entity classification to train BERT, another for question and answering to train the T4 gen model.

First, I will start with intent classification, the intent of each utterance from the customer can be assumed to be one of the following:

1. Greeting
2. Goodbye
3. Menu
4. Price
5. Payment
6. Order
7. Modify/Cancel order
8. Customization
9. Ingredients
10. Promotions/offers
11. Confirmation
12. Help

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Finding a suitable dataset for this project online appears to be highly unlikely. One potential approach is to record actual interactions while taking orders at the till, but this raises ethical concerns as it would require obtaining explicit consent from every customer. A more practical alternative, though labour intensive, is to simulate conversations by having two individuals role-play as customer and restaurant staff. While this method may lack generalizability, it serves as a solid starting point.

In terms of intent classification, the “Modify/Cancel Order” intent would necessitate more complex functionality, as it requires the chatbot to revisit and alter existing orders. Implementing this feature will be deferred to a future version. Similarly, the farewell (goodbye) is always at the end of the conversation of taking/receiving order, I plan to set this manually with some fixed farewell phrases instead of training it on the classifier. Similarly, the promotions are mostly normally visible in any BK restaurant, there will be no need of doing it. Consequently, the final intent classifier will include the following categories:

1. Greeting
2. Menu
3. Price
4. Payment
5. Order
6. Customization
7. Ingredients
8. Confirmation
9. Help

Additionally, a sample menu and ingredient database have been created using MySQL, each linked via a unique item ID. The "menu" database includes fields such as ID, item name, price, and category, while the "ingredient" database links each ID to its respective ingredients. This allows the management team to update the menu as items are added or removed, and the system can leverage these databases for order processing and responding to customer inquiries.

To identify ordered items and verify their presence on the menu, a machine learning model for Named Entity Recognition (NER) will be developed. Regarding the generative model, further research is necessary to determine the most suitable approach.