# Project Summary

Due to all the restrictions put in place from the COVID-19 pandemic, it has become increasingly more difficult to find restaurants. Our model will determine which restaurant accommodates the most preferences of the user, such as price range, dietary restrictions, and delivery or take out options.

Propositions

* price\_$: Represents the lowest price range, true when the restaurant can provide a meal within the range
* price\_$$: Represents the middle price range
* price\_$$: Represents the highest price range
* restriction\_gluten: True if the restaurant can provide gluten free meals
* restriction\_vegan: True if the restaurant can provide vegan meals
* restriction\_lactose: True when the restaurant can provide lactose-free meals
* restriction\_vegetarian: True when the restaurant can provide lactose-free meals
* dine\_in: True when the restaurant allows the user to dine-in
* Take\_out: True when the restaurant has a take-out option
* delivery: True when the restaurant has a delivery option
* under\_10: Under a 10 minute walk from Queen’s campus
* 10\_to\_20: Between a 10 to 20 minute walk from Queen’s campus
* over\_20: Over a 20 minute walk from Queen’s campus

# Constraints

**Price**

1. (price\_$ ∨ price\_$$ ∨ price\_$$$) - The restaurant must be in one of the price ranges
2. ~(price\_$$ **∧** price\_$$$) - The restaurant cannot have more than one price range (we are assuming that if a user chooses a restaurant in the most expensive category, they do not want to be given options for a restaurant in a category below, price\_$$ or price\_$).

**Dietary restrictions**

* + (restriction\_gluten **∧** restriction\_vegan **∧** restriction\_lactose **∧** restriction\_vegetarian) - the restaurant can accommodate all four types of dietary restrictions
  + (restriction gluten ∨restriction\_vegan ∨restriction\_lactose ∨ restriction\_vegetarian) - the restaurant can accommodate at least one type of dietary restrictions
  + restriction gluten **∧ (** restriction\_vegan ∨restriction\_lactose ∨ restriction\_vegetarian) - the restaurant can accommodate two types of dietary restrictions
  + restriction gluten **∧** restriction\_vegan **∧ (**restriction\_lactose ∨ restriction\_vegetarian) - the restaurant can accommodate three types of dietary restrictions

**Methods of consumption**

* + (dine\_in **∧** take\_out **∧** delivery) - the restaurant offers all three methods of consumption
  + (dine\_in ∨ take\_out ∨ delivery) - the restaurant offers at least one method of consumption
  + dine\_in **∧** (take\_out ∨ delivery) - the restaurant offers dine-in and one other method of consumption

**Distance**

* + (under\_10 ∨ 10\_to\_20 ∨ over\_20) - must be at least one distance
  + ~(under\_10 **∧** 10\_to\_20) - must not be two of the options
  + ~(under\_10 **∧** 10\_to\_20 **∧** over\_20) - must not be three of the options

# Model Exploration

*List all the ways that you have explored your model – not only the final version, but intermediate versions as well. See (C3) in the project description for ideas.*

# First-Order Extension

We could extend our model to a predicate logic setting by changing the propositions and constraints to the following:

* A(x): Represents the lowest price range, true when the restaurant can provide a meal within the range
* B(x): Represents the middle price range
* C(x): Represents the highest price range
* G(x): restaurant can provide gluten free meals
* V(x) True if the restaurant can provide vegan meals
* L(x): True when the restaurant can provide lactose-free meals
* P(x): True when the restaurant can provide lactose-free meals
* D(x): True when the restaurant allows the user to dine-in
* T(x): True when the restaurant has a take-out option
* E(x): True when the restaurant has a delivery option
* W(x): Under a 10 minute walk from Queen’s campus
* Y(x): Between a 10 to 20 minute walk from Queen’s campus
* Z(x): Over a 20 minute walk from Queen’s campus

**Extended Price**

* + ∃x(A(x) ∨ B(x) ∨ C(x)) - There exists a restaurant that is in one of the price ranges
  + ∀x(~(A(x) **∧** B(x)) - All restaurants cannot have more than one price range

**Extended Dietary restrictions**

* + ∃x(G(x) **∧** V(x) **∧** L(x) **∧** P(x)) - There exists a restaurant that can accommodate all four types of dietary restrictions
  + ∃x(G(x) ∨V(x) ∨L(x) ∨ P(x)) -There exists a restaurant that can accommodate at least one type of dietary restrictions
  + ∃x(G(x) **∧ (** V(x) ∨L(x) ∨ P(x))) -There exists a restaurant that can accommodate at least two types of dietary restrictions
  + ∃x(G(x) **∧** V(x) **∧ (**L(x) ∨ P(x)) -There exists a restaurant that can accommodate at least three types of dietary restrictions

**Extended Methods of consumption**

* + ∃x(D(x) **∧** T(x) **∧** E(x)) - There exists a restaurant that offers all three methods of consumption
  + ∃x(D(x) ∨ T(x) ∨ E(x)) -There exists a restaurant that offers at least one method of consumption
  + ∃x(D(x) **∧** (T(x) ∨ E(x)) - There exists a restaurant that offers dine-in and one other method of consumption

**Extended Distance**

* + ∃x(W(x) ∨ Y(x) ∨ Z(x)) - there exists a restaurant that is at least one distance
  + ∀x(~(W(x) **∧** Y(x) **∧** Z(x))) - all restaurants must not be three of the options

# Feedback Request

1. How to use the constraints to sort the list. We would appreciate any unique approaches
2. We wanted to make sure our constraints were modeled appropriately and if not what are we missing ?