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# Introduction

## Motivation and Context

“What care I how time advances? I am drinking ale today.” - Edgar Allen Poe

For over six thousand years, beer has been engrained in our culture. Dating back to nearly 5000 BC, ancient civilizations brewed varieties of beer in large quantities. The beer was used for sustenance, medical purposes and as a form of currency. Recipes and brewing techniques developed over time. In 2018, the U.S. beer industry sold over 200 million barrels of beer. Based on beer shipments and the US Census, U.S. citizens of age 21 years and older consumed 26.5 gallons of beer per person in 20181. To say we love our beer would be considered an understatement by many.

Given this affinity for beer, many people find themselves indulging in the activity of drinking beer on the weekends in the form of a “bar crawl”. However, there is an ever-growing number of potential bars to go to, making it difficult for a group to decide on the best set of bars to include on the bar crawl. Team 1 is here to help!

We propose creating a model for our final project that will optimize a group’s bar crawl route to optimize a function including the aggregate rating of all of the bars that are included on their crawl and the total walking plus wait time at bars needed to complete the crawl. Using a Yelp dataset for the various cities in North America, we will employ a combination of an assignment model and the Traveling Salesman algorithm to select a set of bars that the group will include on their bar crawl, including the suggested route between the bars. Using inputs from the user such as the number of bars they would like to visit, the time and day they want to do the crawl, their desired walking time, and specific parameters regarding the quality and quantity of the Yelp reviews for the bars, we will create additional constraints for the model to ensure the user’s desires are met.

## Parallel Applications

Amazon Fresh…

# Data Filtering

Baseline Yelp dataset:

City

Has Alcohol?

# Optimization Model Formulation

## High-Level Description

Our model is a generalization of the Travelling Salesman Problem (TSP)…

## Assumptions

Distance Calculation

## Decision Variables

The optimal bar crawl route is calculated with the following decision variables:

## Objective Function

The objective function will maximize the Yelp rating of the bars visited on the crawl:

## Set

We will define the following set for the formulation of our linear program:

* where n is the number of locations included in our data set

## Parameters

The following parameters are also used in our formulation:

## User Inputs

We will also ask the user for the following inputs to formulate the relevant constraints for our model:

## Data Filtering Constraints

*Minimum Bar Yelp Rating*

The rating for each location on the bar crawl much be greater than or equal to the minimum rating specified by the user:

*Minimum Number of Yelp Reviews*

The number of reviews for each location on the bar crawl must be greater than or equal to the minimum rating specified by the user:

## Model Constraints

*The Number of Locations Visited*

The number of locations visited on the bar crawl must be equal to the number of locations specified by the user:

*Maximum Time Between Locations*

The maximum walk time between any 2 locations *i* and *j* on the bar crawl must be less than or equal to the maximum time specified by the user:

*Maximum Total Walk Time*

The maximum total walk time for the full bar crawl must be less than or equal to the maximum time specified by the user:

*Rating Minimum*

The rating for each location on the bar crawl much be greater than or equal to the minimum rating specified by the user:

*Review Minimum*

The number of reviews for each location on the bar crawl much be greater than or equal to the minimum rating specified by the user:

*No Movements Between the Same Bar*

*From/To Upper Bound*

*From/To Lower Bound*

*One Movement Per Matrix*

*Can’t Visit the Same Bar Twice*

*The Movement to the Next Bar Must Start at the Bar Previously Visited:*

*Open Time:*

The opening time of any location included on the bar crawl on the specified day must be before the time that the bar crawl will visit the bar. In other words, the start time of the crawl plus the sum of the walking time, wait times, and time spent at and between each bar up until bar *i* needs to be at least the open time of bar *i*.

*Close time:*

The closing time of any location included on the bar crawl on the specified day must be after the bar crawl departs the location. In other words, the start time of the crawl plus the sum of the walking time, wait times, and time spent at and between each bar up until and including bar *i* needs to be at most the close time of bar *i*.

*Must Exit Last Bar Before Its Closing Time:*

Where the time spent at each bar is defined as:

*Total Wait Time Less than Max Allowed*

# Results

## Example Experiment

## Qualitative Discussion

## Sensitivity Analysis

## Implementation Issues

Algorithm runtime for large number of bars was initially a struggle…

# Appendix

## Python Code