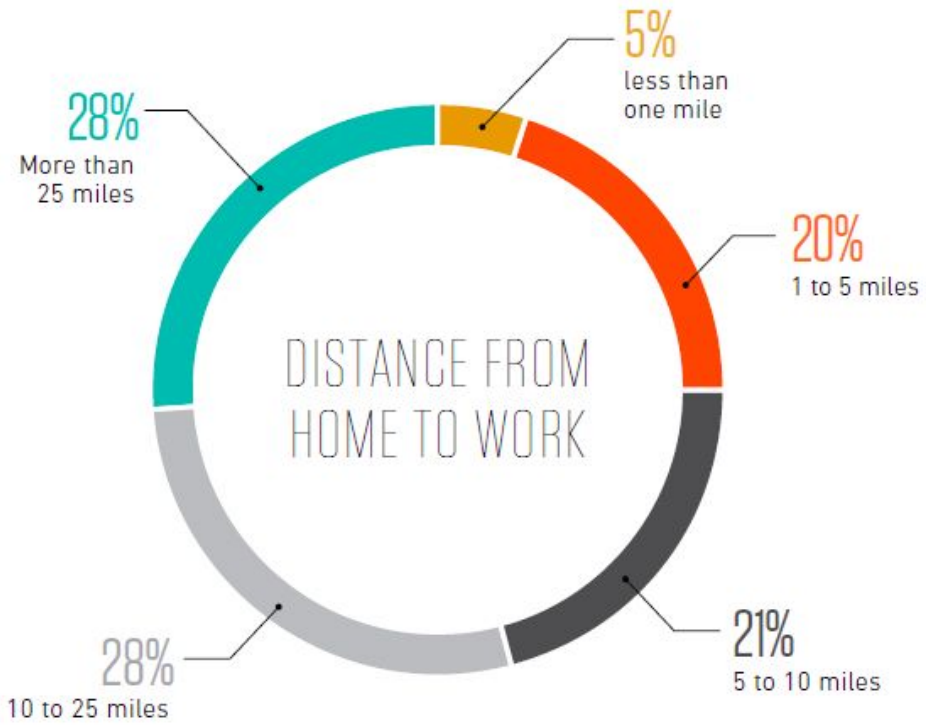
Route Planning Bus Transportation Networks

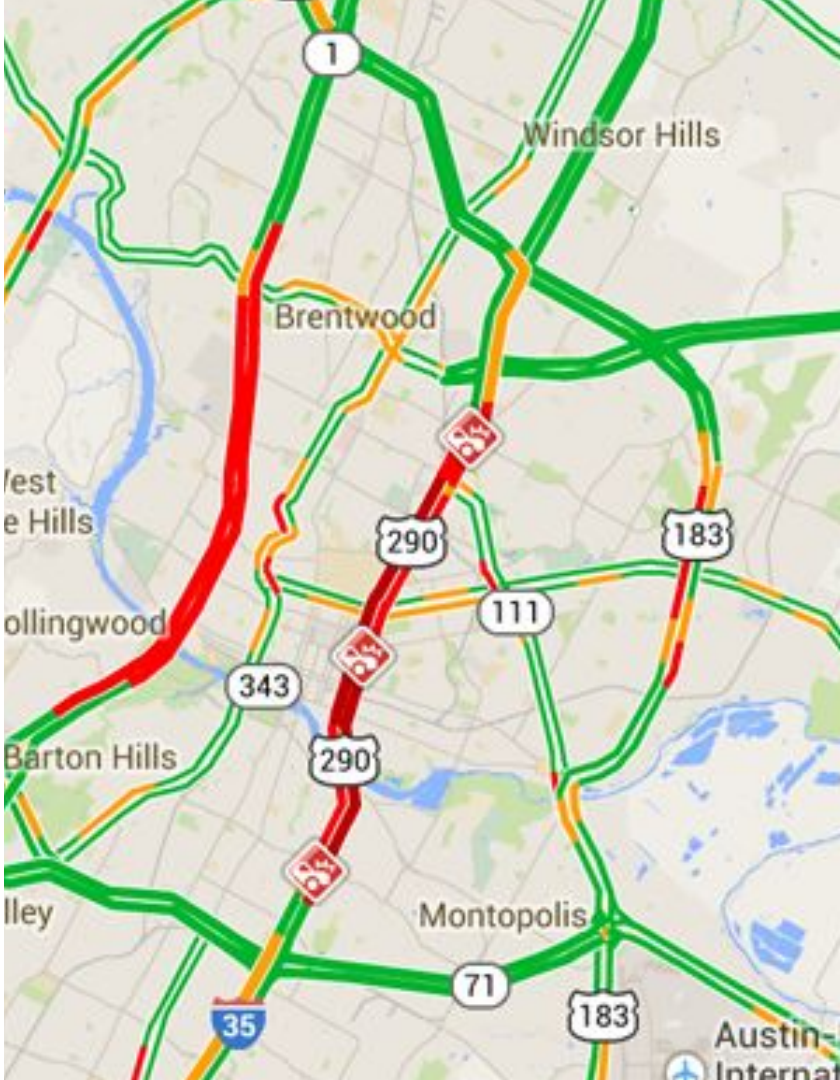
A Genetic Algorithm Approach

galvanize

Downtown Employees *(excluding downtown residents)*



Cap Metro



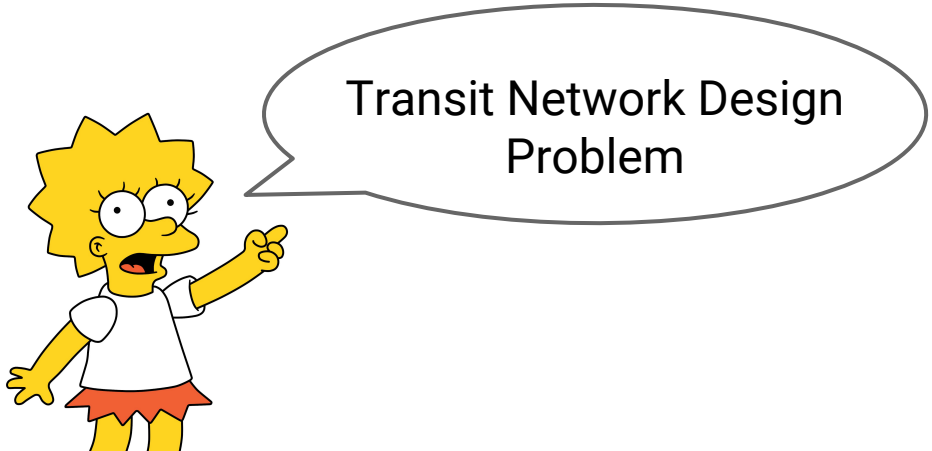
CAPITAL METRO

Jan 2017 - Jan 2018

Month over month

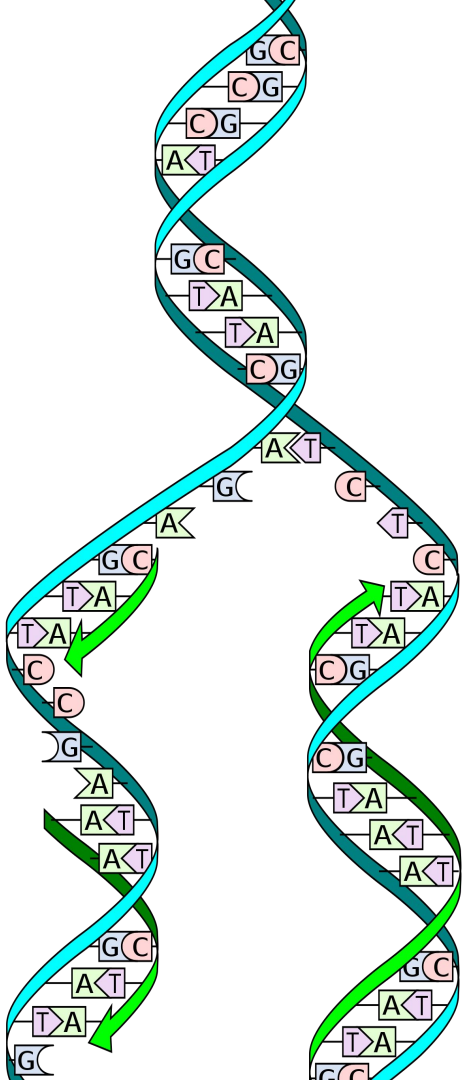
Fixed Route	↓	10%
UT Shuttle	↓	3.5%
Metro Rail	↓	10%

What is wrong with the current transit system and how can we fix it to attract more riders?



Evolutionary Computing and the Genetic Algorithm

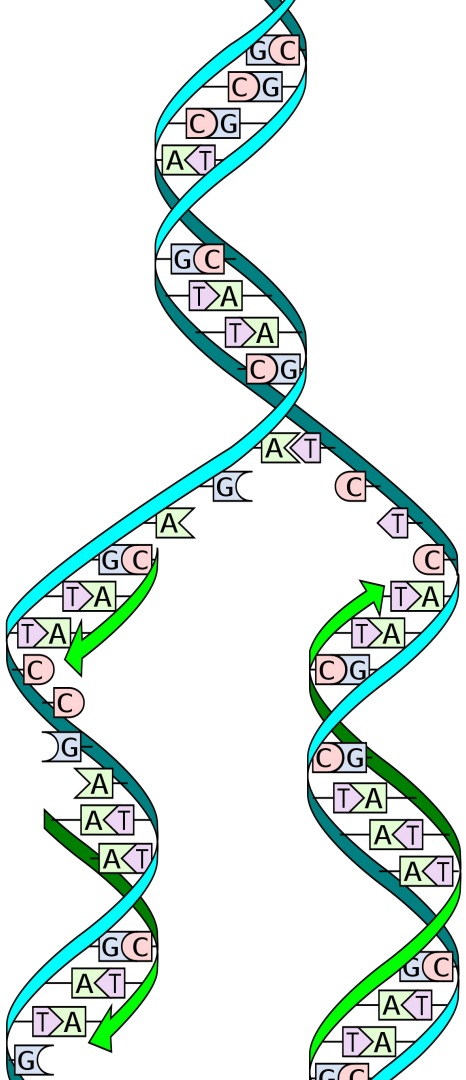
- Mimics biological natural-selection and gene mutation
- Used in solving large, complex, nonlinear optimization problems



Evolutionary Computing and the Genetic Algorithm

1. Random Selections compete for fitness
2. Winners mutate
3. Mutations compete against parent

Random Selection -> Fitness -> Evolve

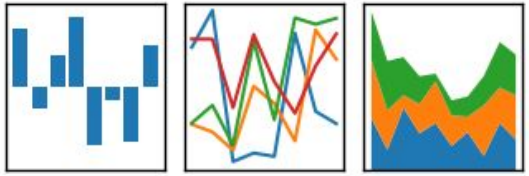


python™

matplotlib

pandas

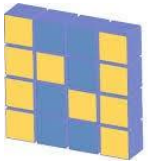
$y_{it} = \beta' x_{it} + \mu_i + \epsilon_{it}$



jupyter

Notebook

scikit learn



NumPy

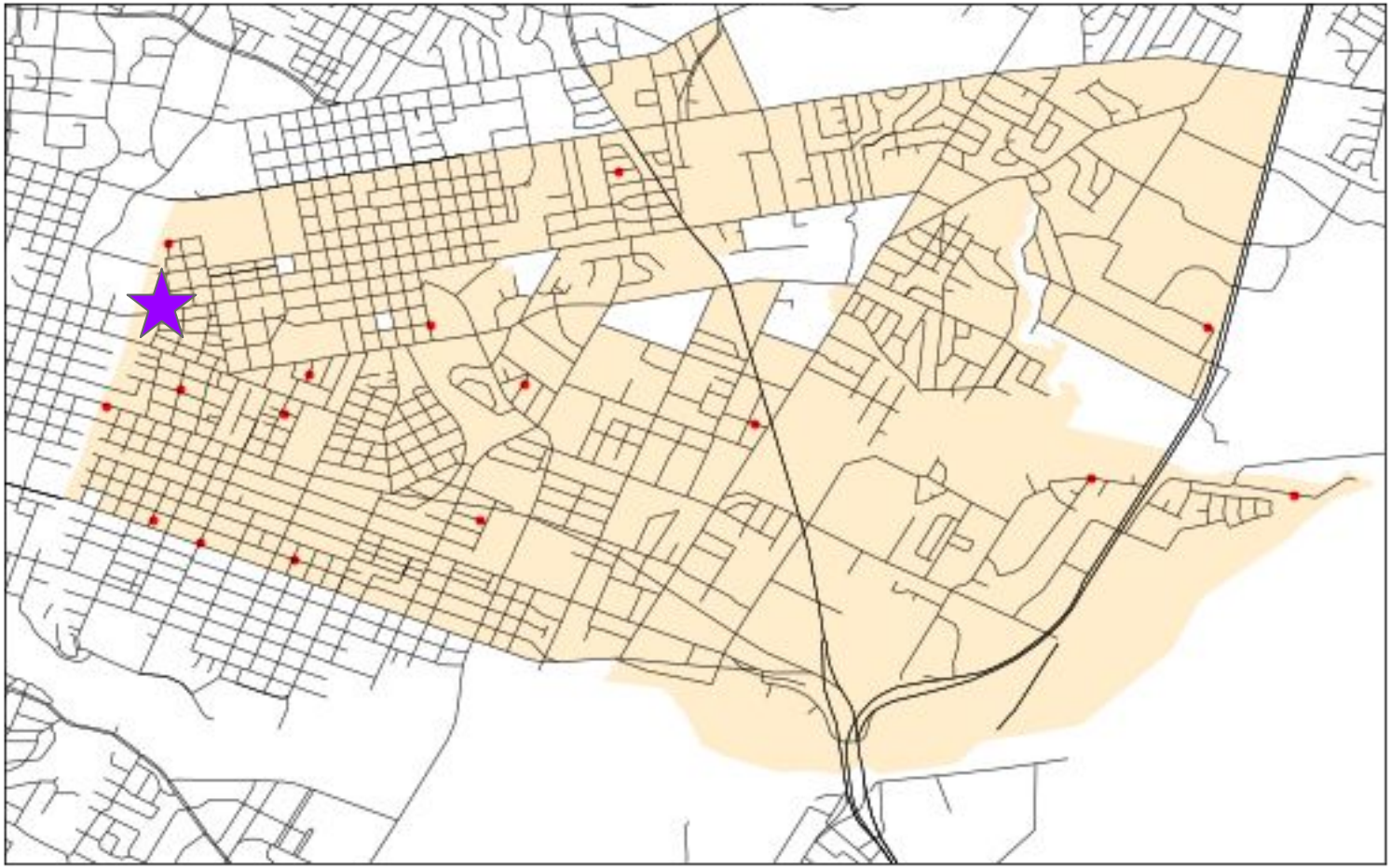
Cap Metro Bus Stops Inside ACL (n=2,542)

K-Means Cluster Bus Stops k=2,542

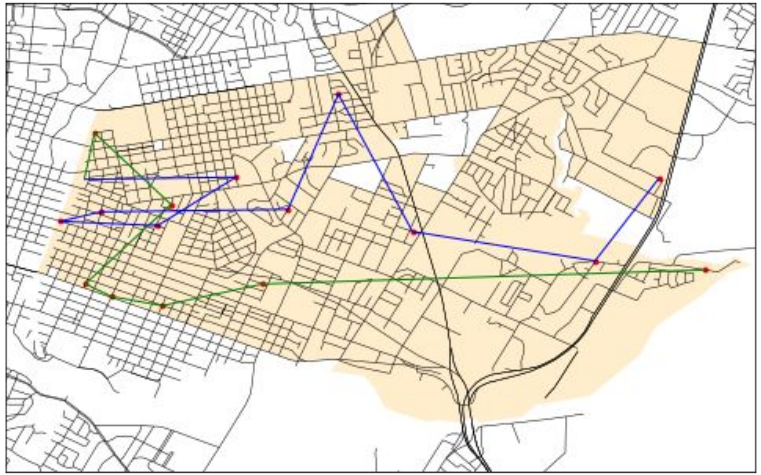
Strategy

- ➔ Identify where the activity nodes are
- ➔ Link those nodes with a rapid service
- ➔ ***Layer a localized system on top***
- ➔ Place the system nodes where they need to be

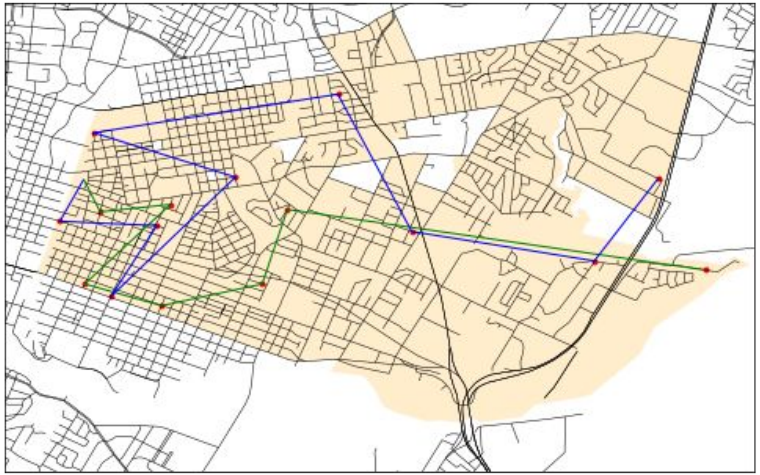
East Side Zone



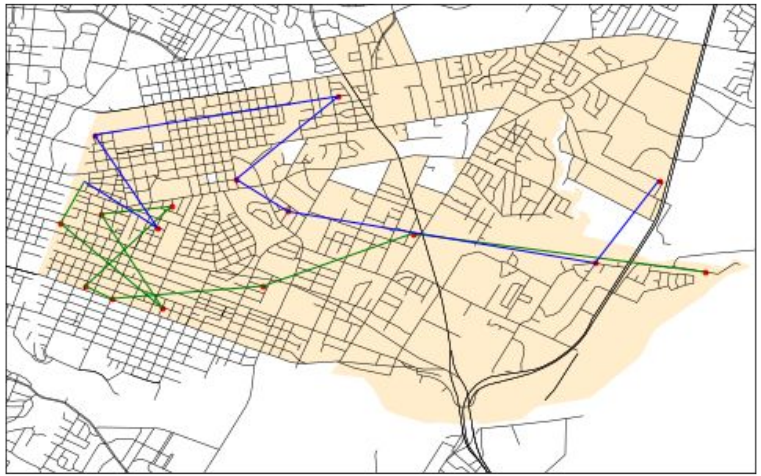
East Side Route Map 1
Fitness = 0.21707503695164926



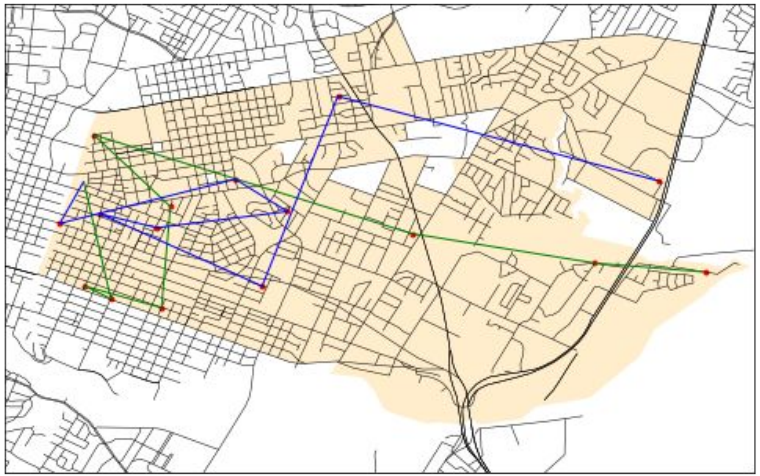
East Side Route Map 2
Fitness = 0.22919315764963433



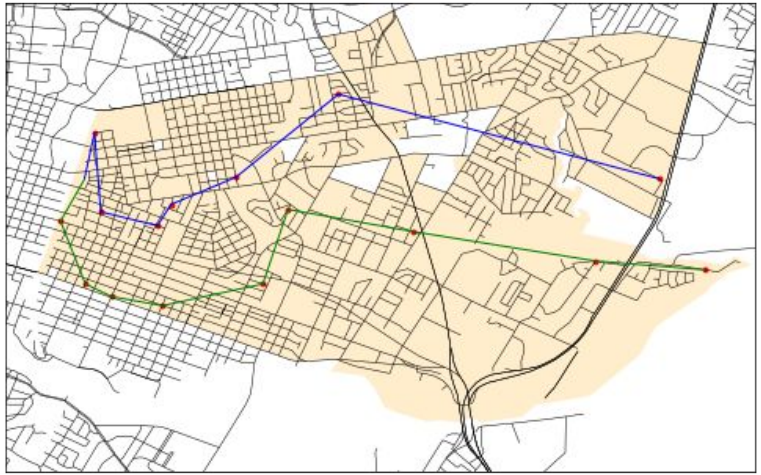
East Side Route Map 3
Fitness = 0.23124455371046082



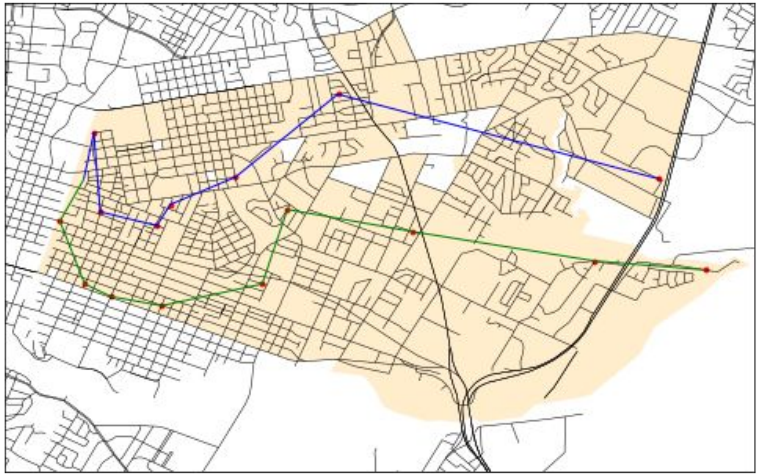
East Side Route Map 4
Fitness = 0.2406594610583861



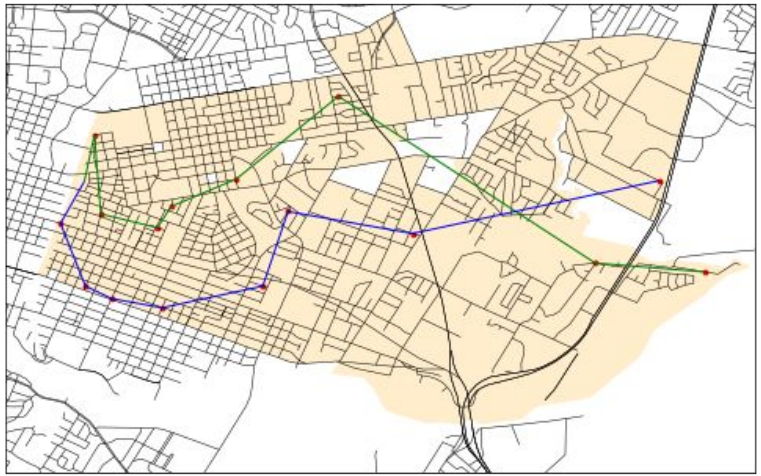
East Side Route Map 1
Fitness = 0.1646053011620352



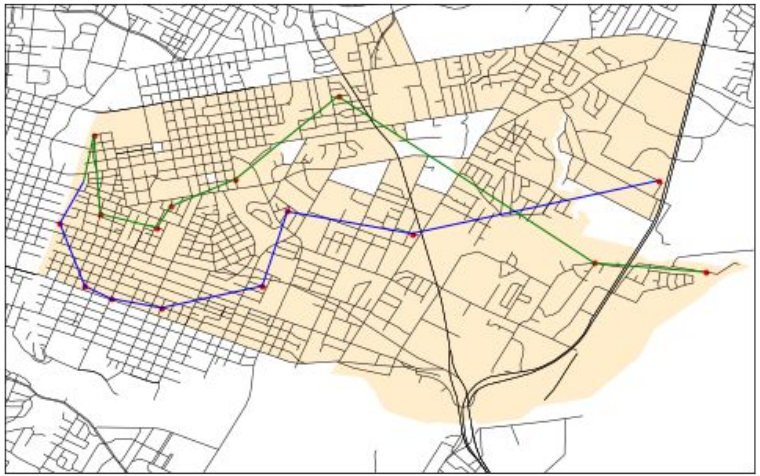
East Side Route Map 2
Fitness = 0.1646053011620352



East Side Route Map 3
Fitness = 0.16905013402714



East Side Route Map 4
Fitness = 0.16905013402714



The Evolutionary Algorithm resulted in a 20-30% improvement over random selection.

Next Steps

- ➔ **Re-define fitness function**
  Use an a-star algorithm to search optimal routes between nodes.
- ➔ **Re-evaluate the full dataset of nodes**
  Use an AWS server to run algorithm overnight with a very high number random selections and evolutions
- ➔ **Tune my model & continue research**

Thank you!

Follow my progress on GitHub

GitHub: https://github.com/Schmidtbit/DSI_Project

LinkedIn: https://www.linkedin.com/in/schmidtbit/

Email: schmidtabox@gmail.com

Why Public Transit Matters

AMERICAN PUBLIC TRANSPORTATION ASSOCIATION

- ➔ $66 Billion industry employs 400,000 people
- ➔ Every $1 investment = $4 in economic returns
- ➔ Every $1B invested supports & creates 50,000 jobs
- ➔ Property values increase 42% more on average if located near high frequency stops

Why Public Transit Matters

AMERICAN PUBLIC TRANSPORTATION ASSOCIATION

- ➔ Enhances Personal Economic Opportunity
- ➔ Provides a social service
- ➔ Saves time, money, & environmental resources

Andrea Schmidt

Data Scientist with a background in Industrial Operations and an advocate for quality as a culture and promoting continuous improvement in any organization.

CAL POLY
College of Engineering

I35

Tech Ridge
Parmer
Copperfield Park
Broadmoor (Proposed)
Braker
Pioneer Hill
Kramer McKalla/Braker (Proposed)
Rundberg
Gus Garcia Park
Northgate
Payton Gin
N Lamar Transit Center
Rutherford
Delco Center
Crestview
Cameron
ACC Highland
Highland
Koenig
Triangle
Hancock
Hyde Park (38th)
St David's
Hemphill Park (29th)
UT West Mall (24th)
MLK
ACC Eastview
Capitol West
Courthouse (10th)
Plaza Saltillo
Pleasant Valley
Broadway
Red Bud Ln
Downtown
South Central Waterfront
Republic Square (6th)
Barton Springs
Town Lake
Lamar Square
SoCo (Monroe)
Oltorf West
Oltorf
St Edward's
Todd Lane
To Downtown Austin
St. Elmo
Brodie Oaks
West Gate Transit Center
South Congress Transit Center
ACC South Austin
Stassney
Franklin Park
Cannonleague
William Cannon
Williamson Creek
McKinney Falls
Ford Oaks
Slaughter
CAPITAL - Alamo Connections Study
To San Antonio
Austin Bergstrom Intl Airport
Expo Center
Decker
Delwau
Loop 1
Westgate
Wheless
Westminster
Philomena
Berkman
Hathin
Lakeshore
Pleasant Valley
Taro
Montopolis
Metrocenter
Frank Heights
Manchaca
Springdale
Chicon
Cherry
Lafayette
McCarty
Thea
Duval
Shady Lane
Wooldridge
Rosewood
Airport
Expo Park
Colony Park
Jimmy Harris
Wellborne
Springdale
Lake Park
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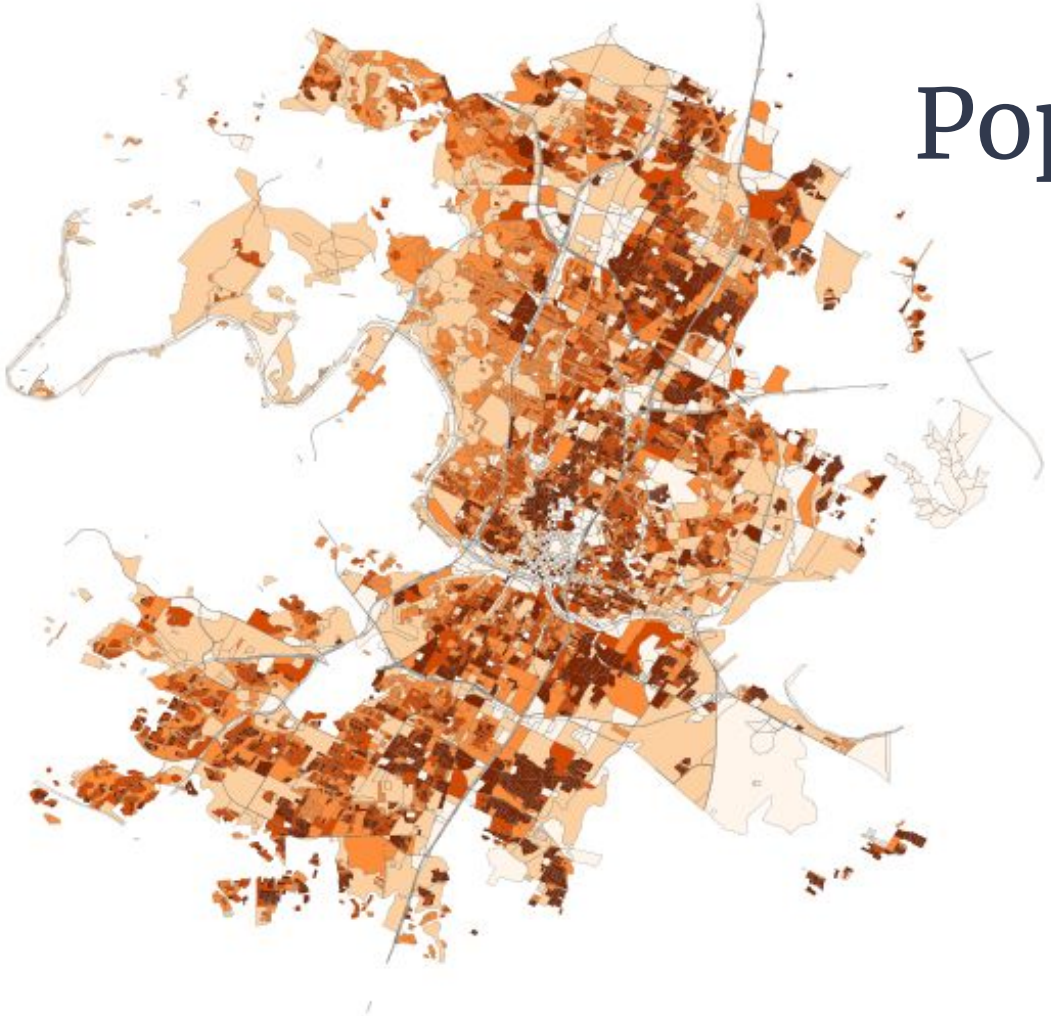
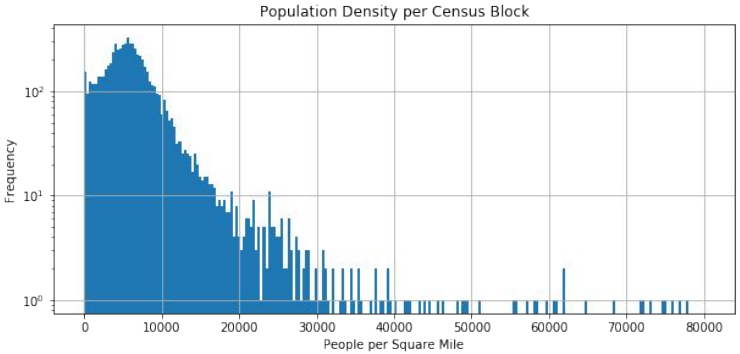
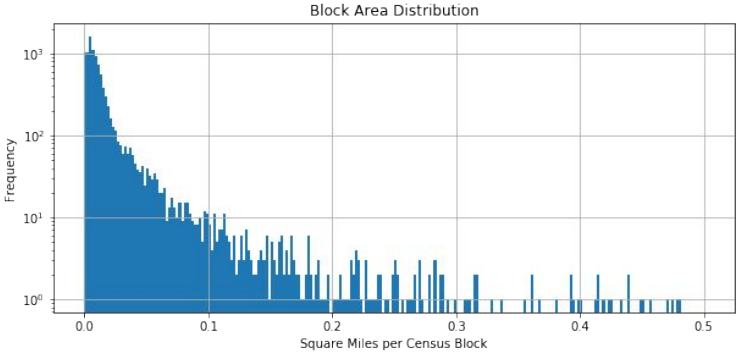
Population Density

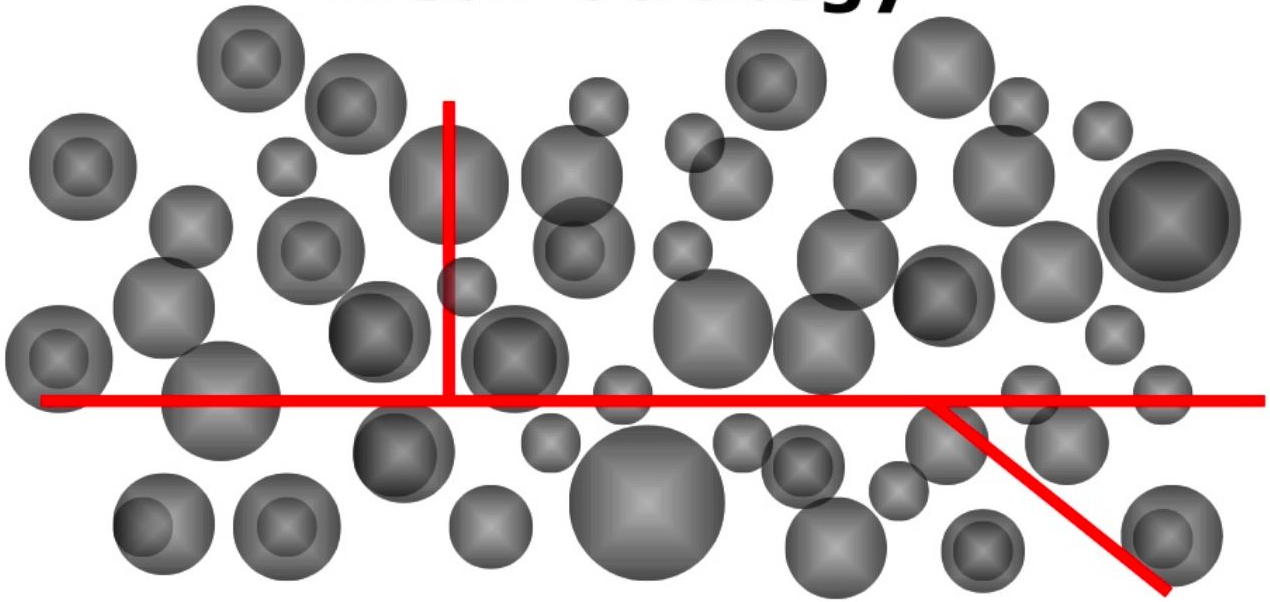




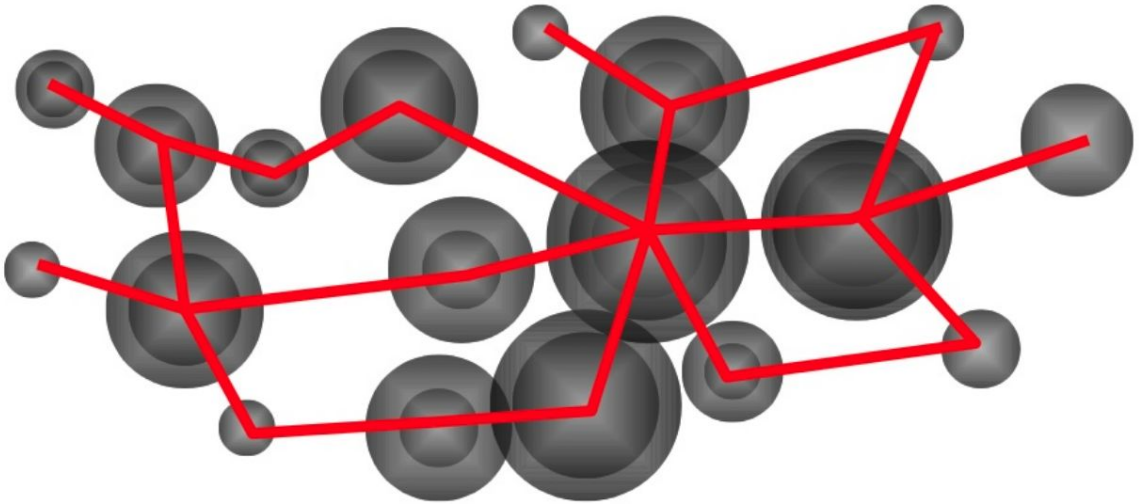


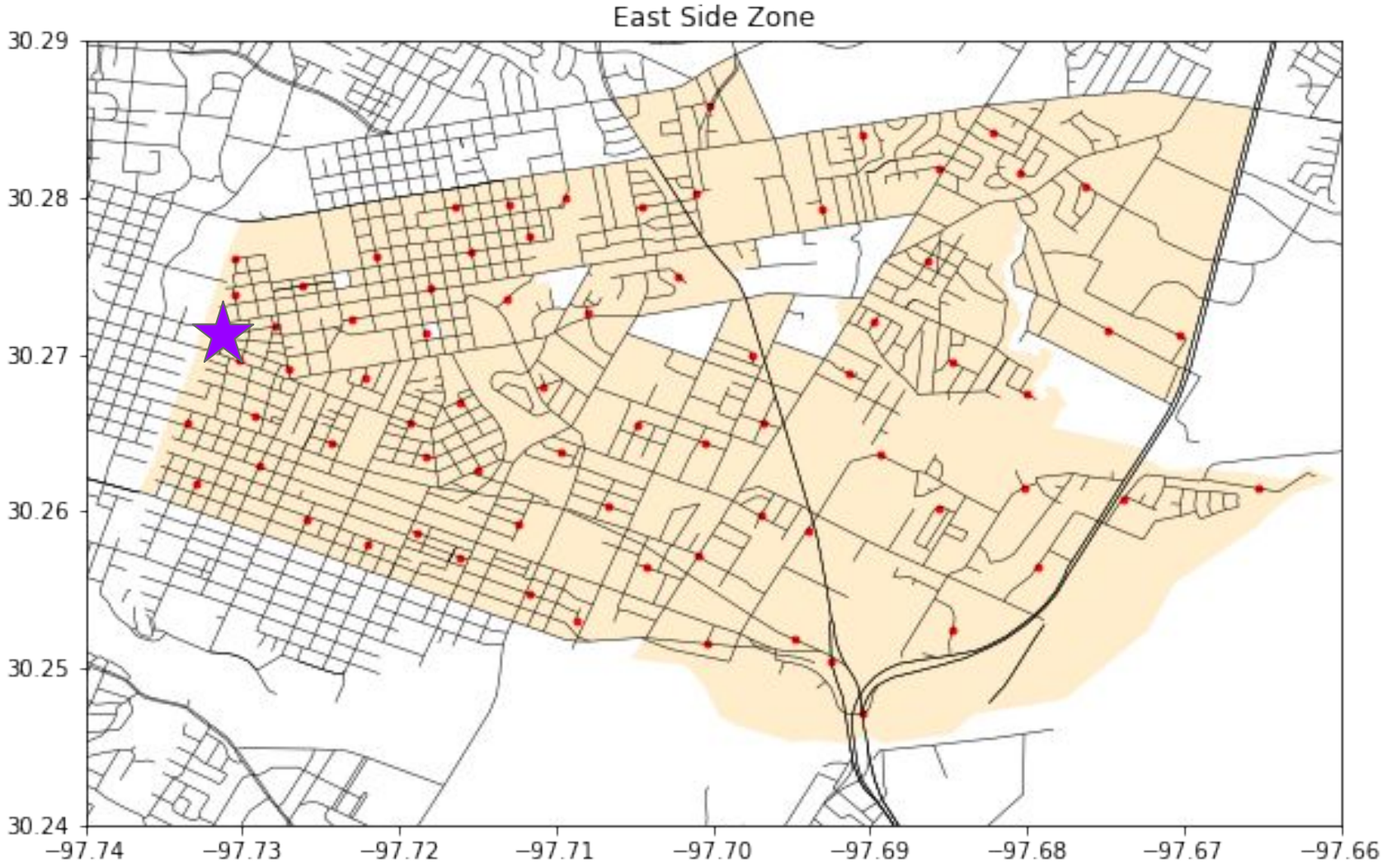
local roads
secondary roads

Weak Strategy



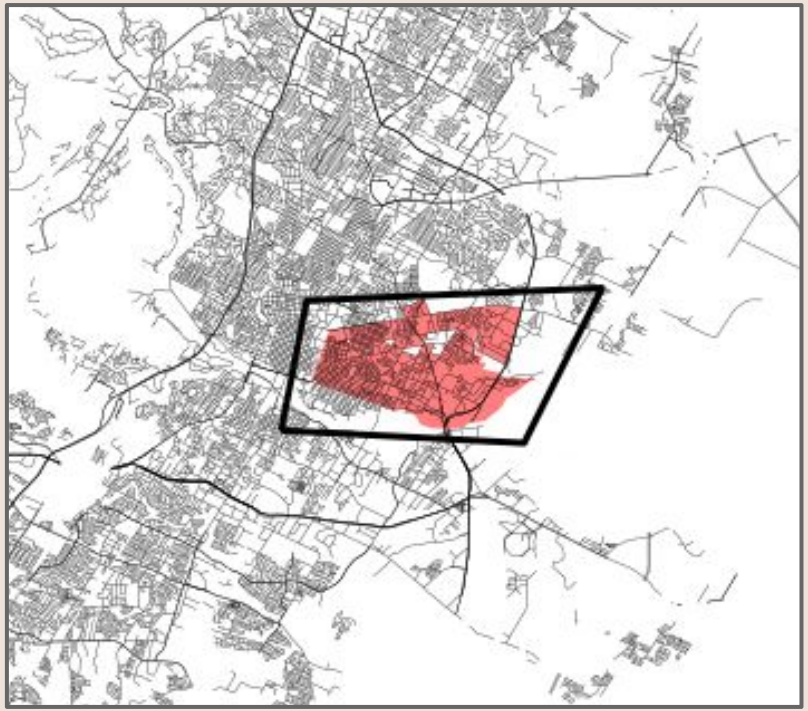
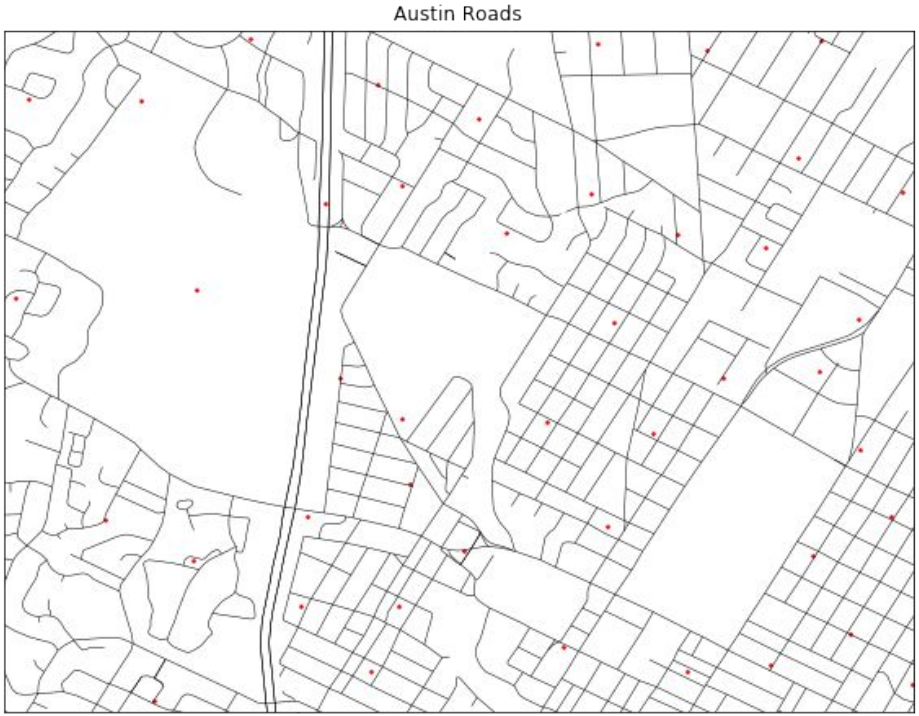
Strong Strategy




East Side Zone
30.29
30.28
30.27
30.26
30.25
30.24
−97.74
−97.73
−97.72
−97.71
−97.70
−97.69
−97.68
−97.67
−97.66

Pick an Area of Focus

- ➔ Define the boundaries
- ➔ Overlay the road network
- ➔ Identify the nodes



Snap to Grid