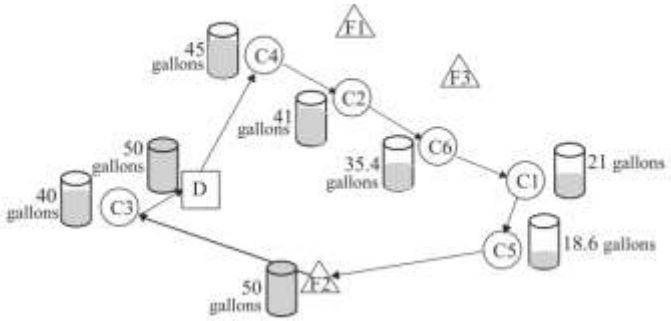
VRP with environmental constrant

GREEN VRP

- Considers environmental constraint

1) Minimize carbon emissions
2) Minimize Fuel consumption
3) Consider charging(should transit depot or charging station when it has insufficient fuel)

Description



- Should transport objects to customers(C_i)
- Should visit Charging station(F_i) to charge when we have no fuel
- A green Vehicle Routing Problem(2012, sevgi Erdogan, Transportation Research Part E: 100-114)

- Do parallel genetic algorithm and SGA

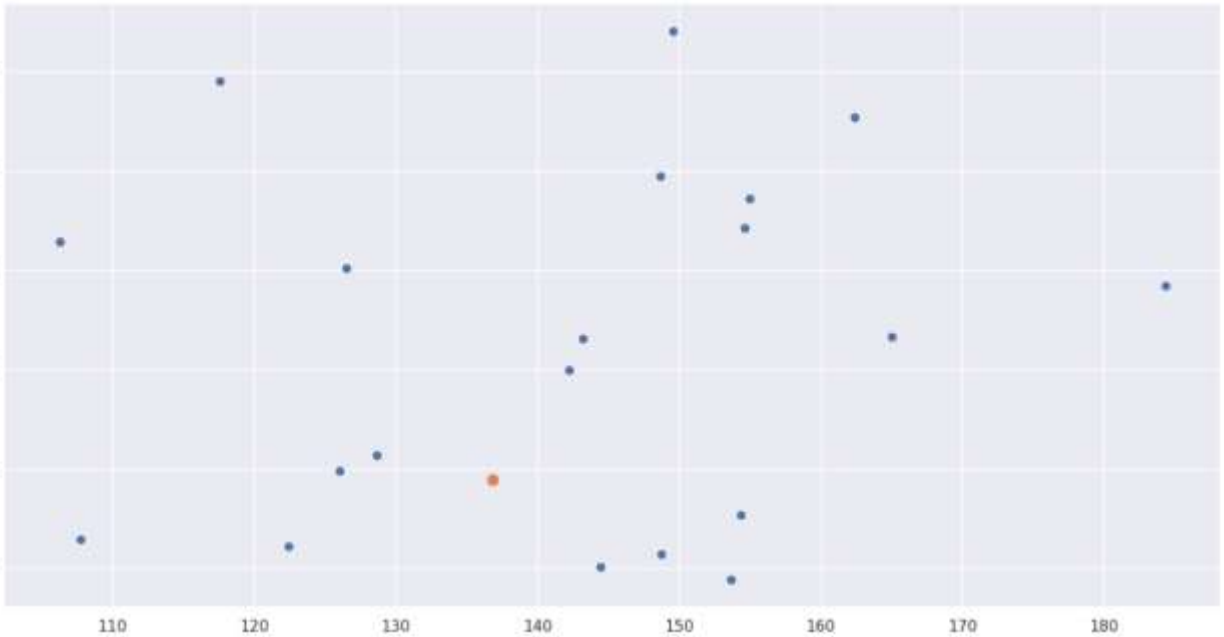
```python
def feasibility_with_fuel(_chromo):
    tmp = fuel_capacity
    excess_payload = [vehicle_payload - _chromo[1].count(i) for i in range(num_vehicles)]
    _vehicle_id = [i for i in range(num_vehicles)]

    while any(_p < 0 for _p in excess_payload):
        v_id = next(i for i,_p in enumerate(excess_payload) if _p < 0)
        available_vehicles = [i for i,e in enumerate(excess_payload) if e > 0]

        if len(available_vehicles) == 0:
            raise Exception('INFEASIBLE SOLUTION: No available vehicle to accept excess cargo. Increase the number of vehicles or the vehcile payload')

        idx = [i for i, x in enumerate(_chromo[1]) if x == v_id]
        to_vehicle = rand.choice(available_vehicles)
        idx_to_move = rand.choice(idx)

        # Check if the move exceeds fuel capacity, then visit a charging station or depot
        current_location = _chromo[0][idx_to_move]
        destination = _chromo[0][(idx_to_move + 1) % len(_chromo[0])]  # Next location in the route
        distance_to_destination = dist_matrix[current_location][destination]

        if distance_to_destination > tmp:
            # If the distance is greater than fuel capacity, visit a charging station or depot
            nearest_charging_station = min(charging_stations, key=lambda x: dist_matrix[current_location][x])
            _chromo[0].insert(idx_to_move + 1, nearest_charging_station)
            tmp = fuel_capacity

        tmp-= distance_to_destination
```

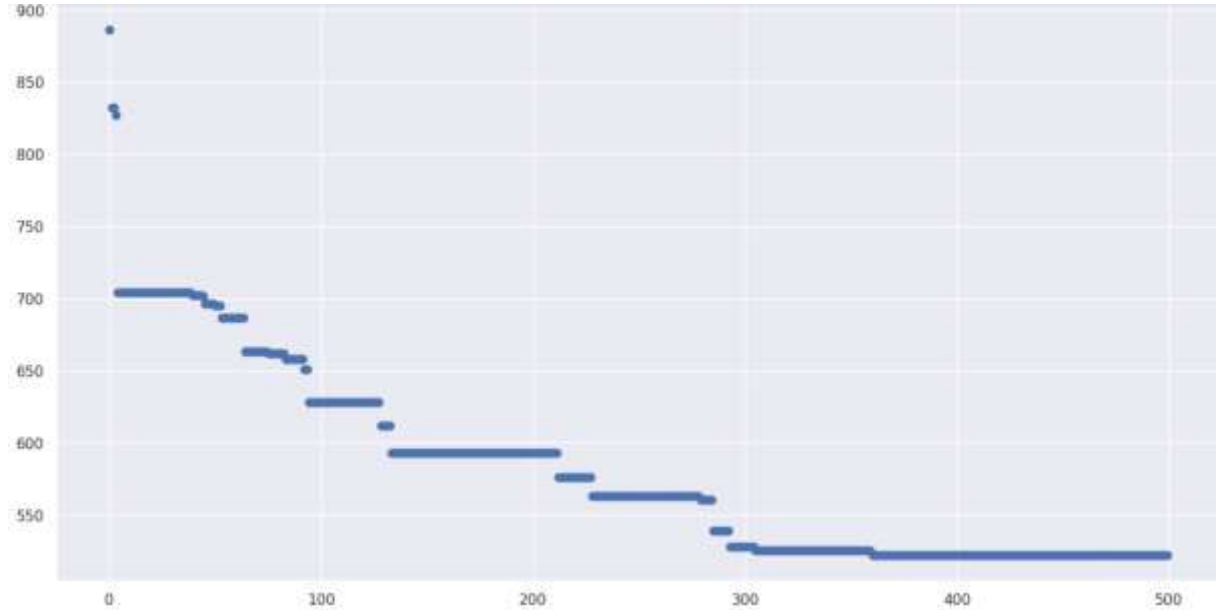
Choose next destination

Find charging station

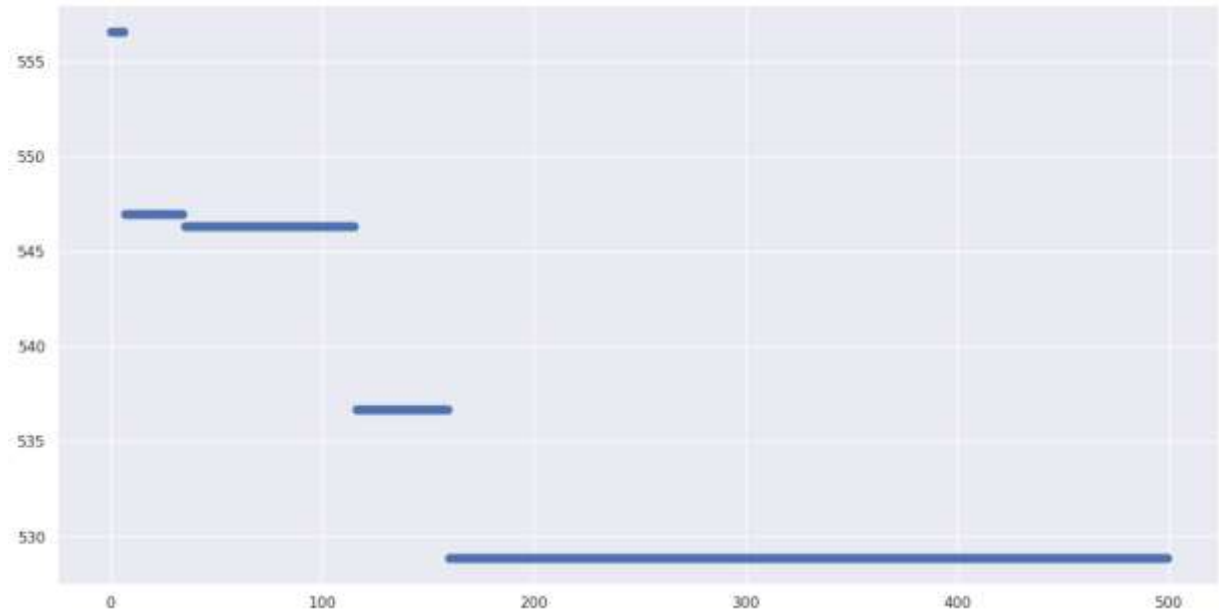
scenarios

- 20 random customer and 3 fixed charge station
- 20 clsutered customer and 3 fixed charge station
- 10 random customer, 10 clustered customer





Scenario1 (20 random customers)



- Changing constraints and conditions and do experiments