Name: Ngoc Pham
E-mail: ngocpham3499@csu.fullerton.edu

Pseudocode:

Problem:
Given a set of cities arranged in a circle and connected by a clockwise circular road, determine the optimal starting city from which a car can complete the entire circuit without running out of fuel, while refueling at each city's gas station along the way.

Input:
Three types of input where:

- city_distances: an array that represents the distances between neighboring cities
- gas: an array of gas available at each city
- mpg: an integer that represents miles per gallon the car travel

Output:
preferred_start: the index of the preferred starting city

Constraints and Assumptions:

- Valid integer, non-negative numbers
- The total fuel available is sufficient to cover the total distance
- There will always be exactly one valid starting city

```
function preferredCity(city_distances, fuel, mpg):
      initialize total_fuel to 0
      initialize current_fuel to 0
      initialize preferred_start to 0

   // Iterate through each city and calculate the net fuel after visiting city i
   for i from 0 to length of city_distances - 1:
      net_fuel = fuel[i] * mpg - city_distances[i]

      // Update total and current fuel tank
      total_fuel += net_fuel
      current_fuel += net_fuel

      // If the current fuel is less than zero, update the current_fuel and reset the fuel tank amount
      if current_fuel < 0:
         preferred_start = i + 1
         current_fuel = 0

   // Check if total fuel is non-negative and return the index of the best starting city
   if  total_fuel >= 0:
         return preferred_start % length of city_distances
     else:
```

```
// Starting city does not exist
    return -1
```

Big(O) Analysis:

Codes:	**Efficiency Class:**
total_fuel = 0	O(1)
current_fuel = 0	O(1)
preferred_start = 0	O(1)
for i in range(len(city_distance))	O(n + 1)
net_fuel = fuel[i] * mpg - city_distances[i]	O(1)
total_fuel += net_fuel	O(1)
current_fuel += net_fuel	O(n)
if current_fuel < 0:	O(n)
if total_fuel >= 0:	O(n)

Proving Efficiency Class using Limits

$f(n) = 4n + 6 \rightarrow \epsilon O(n)$ $f(n) = 4n + 6$ $g(n) = n$	$\lim_{n \to \infty} \frac{f(n)}{g(n)} = \lim_{n \to \infty} \frac{4n+6}{n} = \lim_{n \to \infty} \frac{4n}{n} + \frac{6}{n}$ $4 + \lim_{n \to \infty} \frac{6}{n} = 4 + \frac{6}{\infty} = 4 + 0 = 4 \rightarrow \epsilon\theta(n)$ Conclude: 4n + 6 = θ(n)