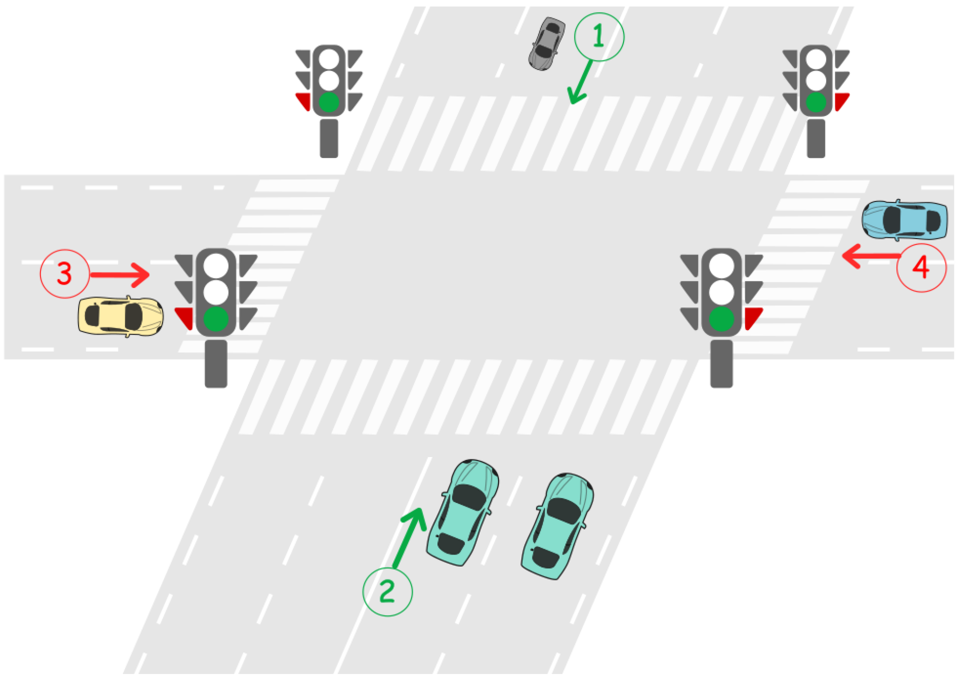
Problem 1279: Traffic Light Controlled Intersection

Problem Information

Difficulty: Easy
Acceptance Rate: 0.00%
Paid Only: No

Problem Description

There is an intersection of two roads. First road is road A where cars travel from North to South in direction 1 and from South to North in direction 2. Second road is road B where cars travel from West to East in direction 3 and from East to West in direction 4.



There is a traffic light located on each road before the intersection. A traffic light can either be green or red.

Green

means cars can cross the intersection in both directions of the road.

Red

means cars in both directions cannot cross the intersection and must wait until the light turns green.

The traffic lights cannot be green on both roads at the same time. That means when the light is green on road A, it is red on road B and when the light is green on road B, it is red on road A.

Initially, the traffic light is

green

on road A and

red

on road B. When the light is green on one road, all cars can cross the intersection in both directions until the light becomes green on the other road. No two cars traveling on different roads should cross at the same time.

Design a deadlock-free traffic light controlled system at this intersection.

Implement the function

void carArrived(carId, roadId, direction, turnGreen, crossCar)

where:

carId

is the id of the car that arrived.

roadId

is the id of the road that the car travels on.

direction

is the direction of the car.

turnGreen

is a function you can call to turn the traffic light to green on the current road.

crossCar

is a function you can call to let the current car cross the intersection.

Your answer is considered correct if it avoids cars deadlock in the intersection. Turning the light green on a road when it was already green is considered a wrong answer.

Example 1:

Input:

cars = [1,3,5,2,4], directions = [2,1,2,4,3], arrivalTimes = [10,20,30,40,50]

Output:

["Car 1 Has Passed Road A In Direction 2", // Traffic light on road A is green, car 1 can cross the intersection. "Car 3 Has Passed Road A In Direction 1", // Car 3 crosses the intersection as the light is still green. "Car 5 Has Passed Road A In Direction 2", // Car 5 crosses the intersection as the light is still green. "Traffic Light On Road B Is Green", // Car 2 requests green light for road B. "Car 2 Has Passed Road B In Direction 4", // Car 2 crosses as the light is green on road B now. "Car 4 Has Passed Road B In Direction 3" // Car 4 crosses the intersection as the light is still green.]

Example 2:

Input:

cars = [1,2,3,4,5], directions = [2,4,3,3,1], arrivalTimes = [10,20,30,40,40]

Output:

["Car 1 Has Passed Road A In Direction 2", // Traffic light on road A is green, car 1 can cross the intersection. "Traffic Light On Road B Is Green", // Car 2 requests green light for road B. "Car 2 Has Passed Road B In Direction 4", // Car 2 crosses as the light is green on road B now. "Car 3 Has Passed Road B In Direction 3", // Car 3 crosses as the light is green on road B now. "Traffic Light On Road A Is Green", // Car 5 requests green light for road A. "Car 5 Has Passed Road A In Direction 1", // Car 5 crosses as the light is green on road A now. "Traffic Light On Road B Is Green", // Car 4 requests green light for road B. Car 4 blocked until car 5 crosses and then traffic light is green on road B. "Car 4 Has Passed Road B In Direction 3" // Car 4 crosses as the light is green on road B now.]

Explanation:

This is a dead-lock free scenario. Note that the scenario when car 4 crosses before turning light into green on road A and allowing car 5 to pass is also

correct

and

Accepted

scenario.

Constraints:

1 <= cars.length <= 20

cars.length = directions.length

cars.length = arrivalTimes.length

All values of

cars

are unique

1 <= directions[i] <= 4

arrivalTimes

is non-decreasing

Code Snippets

C++:

```
class TrafficLight {
public:
TrafficLight() {

}

void carArrived(
int carId, // ID of the car
int roadId, // ID of the road the car travels on. Can be 1 (road A) or 2
(road B)
int direction, // Direction of the car
function<void()> turnGreen, // Use turnGreen() to turn light to green on
current road
function<void()> crossCar // Use crossCar() to make car cross the
intersection
) {

}
};
```

Java:

```
class TrafficLight {

public TrafficLight() {

}

public void carArrived(
int carId, // ID of the car
int roadId, // ID of the road the car travels on. Can be 1 (road A) or 2
(road B)
int direction, // Direction of the car
Runnable turnGreen, // Use turnGreen.run() to turn light to green on current
road
Runnable crossCar // Use crossCar.run() to make car cross the intersection
) {
}
}
```

Python3:

```
class TrafficLight:
def __init__(self):
pass

def carArrived(
self,
carId: int, # ID of the car
roadId: int, # ID of the road the car travels on. Can be 1 (road A) or 2
(road B)
direction: int, # Direction of the car
turnGreen: 'Callable[[], None]', # Use turnGreen() to turn light to green on
current road
crossCar: 'Callable[[], None]' # Use crossCar() to make car cross the
intersection
) -> None:
```

Python:

```
class TrafficLight(object):

def __init__(self):
pass

def carArrived(self, carId, roadId, direction, turnGreen, crossCar):
"""
:type roadId: int --> // ID of the car
:type carId: int --> // ID of the road the car travels on. Can be 1 (road A)
or 2 (road B)
:type direction: int --> // Direction of the car
:type turnGreen: method --> // Use turnGreen() to turn light to green on
current road
:type crossCar: method --> // Use crossCar() to make car cross the
intersection
:rtype: void
"""
```

C#:

```
public class TrafficLight {

public TrafficLight() {

}

public void CarArrived(
int carId, // ID of the car
int roadId, // ID of the road the car travels on. Can be 1 (road A) or 2
(road B)
int direction, // Direction of the car
Action turnGreen, // Use turnGreen() to turn light to green on current road
Action crossCar // Use crossCar() to make car cross the intersection
) {

}
}
```

Solutions

C++ Solution:

```
/*
* Problem: Traffic Light Controlled Intersection
* Difficulty: Easy
* Tags: general
*
* Approach: Optimized algorithm based on problem constraints
* Time Complexity: O(n) to O(n^2) depending on approach
* Space Complexity: O(1) to O(n) depending on approach
*/

class TrafficLight {
public:
TrafficLight() {

}

void carArrived(
int carId, // ID of the car
int roadId, // ID of the road the car travels on. Can be 1 (road A) or 2
(road B)
int direction, // Direction of the car
function<void()> turnGreen, // Use turnGreen() to turn light to green on
current road
function<void()> crossCar // Use crossCar() to make car cross the
intersection
) {

}
};
```

Java Solution:

```
/**
* Problem: Traffic Light Controlled Intersection
* Difficulty: Easy
* Tags: general
*
* Approach: Optimized algorithm based on problem constraints
* Time Complexity: O(n) to O(n^2) depending on approach
* Space Complexity: O(1) to O(n) depending on approach
*/

class TrafficLight {

public TrafficLight() {

}

public void carArrived(
int carId, // ID of the car
int roadId, // ID of the road the car travels on. Can be 1 (road A) or 2
(road B)
int direction, // Direction of the car
Runnable turnGreen, // Use turnGreen.run() to turn light to green on current
road
Runnable crossCar // Use crossCar.run() to make car cross the intersection
) {
}
}
```

Python3 Solution:

```
class TrafficLight:
def __init__(self):
pass

def carArrived(
self,
carId: int, # ID of the car
roadId: int, # ID of the road the car travels on. Can be 1 (road A) or 2
(road B)
direction: int, # Direction of the car
turnGreen: 'Callable[[], None]', # Use turnGreen() to turn light to green on
current road
crossCar: 'Callable[[], None]' # Use crossCar() to make car cross the
intersection
) -> None:
```

Python Solution:

```
class TrafficLight(object):

def __init__(self):
pass

def carArrived(self, carId, roadId, direction, turnGreen, crossCar):
"""
:type roadId: int --> // ID of the car
:type carId: int --> // ID of the road the car travels on. Can be 1 (road A)
or 2 (road B)
:type direction: int --> // Direction of the car
:type turnGreen: method --> // Use turnGreen() to turn light to green on
current road
:type crossCar: method --> // Use crossCar() to make car cross the
intersection
:rtype: void
"""
```

C# Solution:

```
/*
* Problem: Traffic Light Controlled Intersection
* Difficulty: Easy
* Tags: general
*
* Approach: Optimized algorithm based on problem constraints
* Time Complexity: O(n) to O(n^2) depending on approach
* Space Complexity: O(1) to O(n) depending on approach
*/

public class TrafficLight {

public TrafficLight() {

}

public void CarArrived(
int carId, // ID of the car
int roadId, // ID of the road the car travels on. Can be 1 (road A) or 2
(road B)
int direction, // Direction of the car
Action turnGreen, // Use turnGreen() to turn light to green on current road
Action crossCar // Use crossCar() to make car cross the intersection
) {

}
}
```