AI Lab

Assignment 1: *Car Repair*

General Instructions:

1. Any form of copying will be attract negative marks and penalties
2. You can code inside lab as well as outside lab after the normal working hours, however the code should be your own
3. Any magnitude of verbal discussion outside lab is allowed. No codes must be exchanged
4. Please protect your own codes. Copying will more severely affect the person whose codes are taken.
5. The TAs/portal itself will check for plagiarism.
6. If your performance is very good during the semester and poor in the mid-sem and end-sem, it would be assumed that you have copied and all marks would be zeroed.
7. In the exams you will be allowed to carry your own codes, written apriori, but not of anybody else.

Imagine a car-repair shop with an expertise in changing car tires. The shop is located on a road and it does not have a floor to house the cars needing repair. Hence some cars are parallel parked before the shop and some are parallel parked after the shop as shown in Figure 1. Let us approximate that every car has 4 tires, 2 at the extreme rear and 2 at the extreme front. The length of every car is '1 car length'. The width of every car is 'half car length'. There is a uniform spacing of '1 car length' between every pair of cars. The shop has a capacity of a maximum of *N* (even) cars, with a capacity of *N*/2 cars of the left of the shop and *N*/2 cars on the right of the shop. The locations are numbered C1 to CN. The car Ci has tires numbered Ci1, Ci2, Ci3 and Ci4 as shown in Figure 1. Each location may not may not be occupied by a car. An agent is asked to find out all the tires needing repair and to further repair them. Based on this setup answer the following questions:

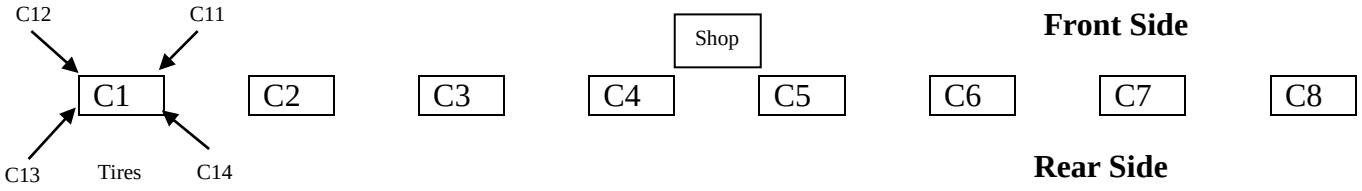


Figure 1: Layout of the repair service area

Suppose an agent starts from the shop, the door of the shop located in the middle of the two adjoining cars. The agent plans to visit all the cars on the left followed by all the cars on the right. The tires towards the shop on the front side are inspected first, and then the tires on the rear of the shop for cars on the left and vice versa for the right. So the agent basically takes a circle around the cars for inspection. If a car has a faulty tire, the agent must remove the faulty tire, carry it back to the shop with the shortest route (first coming to the front side if the fault was at the rear side), carry a new tire from the shop to the faulty location (travelling the same path

again) and fit the new tire. This goes on until all the vehicles are inspected to be fault-free, when the program terminates.

You could take any sensors that you like. Typical choices would be a sensor which can sense whether the current location is occupied by a car or not, a sensor indicating the current location from (C11 to CN4), a sensor that states whether the current car has a faulty tire (and whether there is a tire present at the location), a sensor which indicates whether the tire in hand is faulty or not, etc.

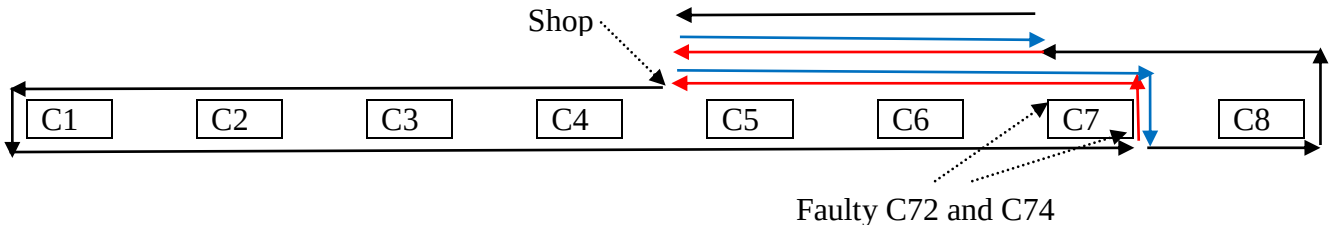
Your codes should start with a comment block mentioning the PEAS and further the rules made for the reflexive agent. Further your codes must minimally have the agent function, agent class and environment class.

Input: The first input is the number of test cases. In every test case the first number is the capacity of the shop (N). This is followed by N lines. The i^{th} line gives the particulars of the i^{th} location. The particulars consist of 4 numbers: l_i (0 if a car is not present at that location, 1 if a car is present at that location), F_{i1} (1 if the location Ci1 has a faulty tire, 0 otherwise), F_{i2} (1 if the location Ci2 has a faulty tire, 0 otherwise), F_{i3} (1 if the location Ci3 has a faulty tire, 0 otherwise) and F_{i4} (1 if the location Ci4 has a faulty tire, 0 otherwise).

Output: For each test case print the path followed by the agent with every move separated by a space.

Sample Input

```
1
8
1 0 0 0 0
0 0 0 0 0
1 0 0 0 0
0 0 0 0 0
1 0 0 0 0
1 0 0 0 0
1 0 1 0 1
1 0 0 0 0
```



Legend: Black (normal inspection route), Red (carrying faulty tire to shop), Blue (carrying new tire to the faulty sight)

Figure 2: Path for the sample problem

Sample Output

Shop C41 C42 C31 C32 C21 C22 C11 C12 C13 C14 C23 C24 C33 C34 C43 C44 C53 C54 C63 C64 C73 C74 C71 C72 C61 C62 C51 C52 Shop C52 C51 C62 C61 C72 C71 C74 C83 C84 C81 C82 C71 C72 C61 C62 C51 C52 Shop C52 C51 C62 C61 C72 C61 C62 C51 C52 Shop

1. Solve the above question with the assumption that no tire is faulty (i.e. take all inputs, but only carry inspection). Make a **reflexive agent**. Which sensors do you need?
2. Solve the above question with the assumption that no tire is faulty (i.e. take all inputs, but only carry inspection). Make a **model based reflexive agent**. Which sensors can you now drop?
3. Solve the above question as stated in the description using a **model based reflexive agent**. Which sensors do you need?
4. Suppose that only 1 tire is faulty. Suppose that the location of the faulty tires is known at the start without the agent going and sensing the location. In case of multiple plans possible, a plan which spends more time on the front side of the car is more reliable. So the agent should change from rear side to front side as soon as possible. Make a **goal based agent**.
5. Suppose the agent has a capacity to hold 2 tires at the same time. Further suppose that only 2 tires are faulty. Also suppose that the location of the faulty tires is known at the start without the agent going and sensing the location. Make a **goal based agent** with the assumption that carrying a faulty tire takes twice the time and effort than carrying no tires. Carrying 2 faulty tire takes 4 times the time and effort than carrying no tire. The agent must minimize the total time. In case of a tie between 2 plans, the plan first catering to the fault with the car with a lesser numerical value of the position must be serviced first. *(Hint: Can you write down all possible plans and then select the best. What is the formula for calculating time to go from location A to location B?)*
6. Solve the question with the strategy that first all cars are inspected in the stated order, then all the tires are carried and replaced using a **goal based reflex agent**. The agent must replace the tires in the same order as they were inspected. The agent can carry any number of ties. Carrying any number of tires has the same cost, equal to the cost of carrying no tire.