Note:- Its not compulsary to attempt both sections(Embedded and Mechanical). However, atleast one section should be attempted.

The solutions of the problem statements should be submitted on A4 size sheets properly stapled with your personal details like Name, branch, ph-no, email id .
The forms should be submitted at verka booth(uncle) latest by 5 pm on 23rd of august
For more details and queries contact Aimer Bhat Ph- +91-9888747106 Sushil pangeni Ph- +91-9988949913

SECTION EMBEDDED

Q1. With reference to the flash file :-
Objectives:-
a) Motion Synchronization of autonomous robot at front and one at the palanquin.
b) Swinging of robot should be reduced(stablisation of robot) by breaking or reduction of speed of front robot while moving over the bridge or moving its support to the palanquin up or down .(as shown in video).

- Make a cost estimation of the system which you propose to implement.
- Requirement in solution(written):-
  a) Details of components and logic of sensing system at robot on palanquin.
  b) Communication system (components and method) between two auutonomous Robots.
  c) Motion control Algorithm of the robot in front.

Q2. THE NASA MAN
You are one of the programmers of the Mars Robot sent by NASA. There is some bad news and good news too (nothing to do with extraterrestrial). The bad news is that the robot is stuck where communication is very weak. Its program memory is dead so it cannot decide what to do and to repair it we need a good communication signal. The good news is that before the memory died it send the images of the sorrounding and we still can send navigation signal from home. Now you have to rescue the bot to some co-ordinate where it can come back online. Remember that since the signal is weak we have to use a minimal instruction set. And also there are limited numbers of instruction that can be sent.

The Format of the instruction is
instruction_name(<instruction>;<conditions>)

examples
Forward(; n[-1]++,n<10) *moves forward 10 steps(note in the first execution itself n becomes 1)*
Forward(; ;) *infinite forward movement*
Forward(left(; n++,n<3) ; n<10 ,n++) *after each forward step it turns left 2 times for 10 forward steps. Note that the forward statement is executed before the contents of the bracket is executed. The above example is counted as one instruction.*

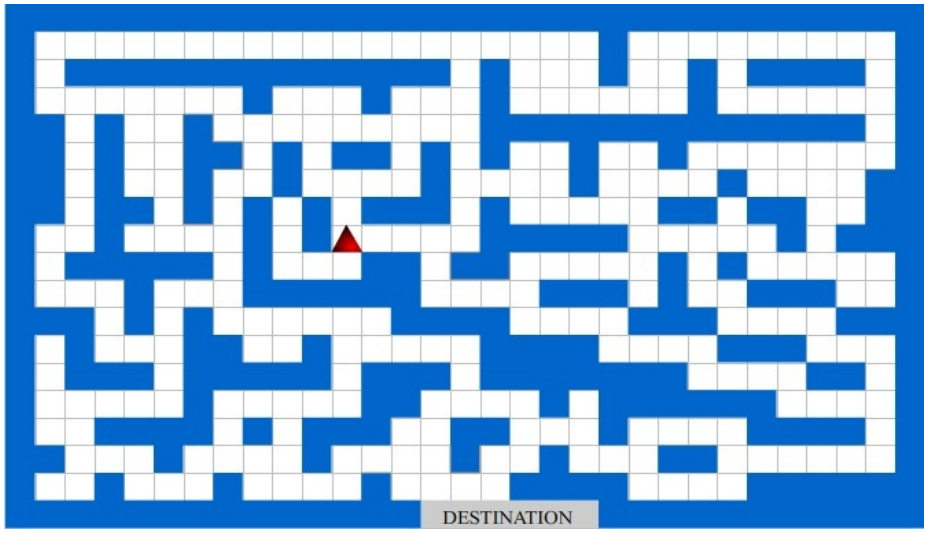
The condition part can have any number of conditions seperated by a comma. The precedence of the execution is from left to right. So first the <operation> is executed and then <conditions> left to right. A preceding square bracket after a variable initializes the variable to value in square bracket

during the first execution. In the above example 'n' is initialized to -1 in the first execution. By default the variable are initialized to 0.

You can use the following ***arithematic operations***
++ (*increment*),**--** (*decrement*), **+** (*add*),**-** (*subtract*), ***(*multiply*),**/**(*divide*).

You can use the following ***logical operaitons***
^ (*or*), **&** (*and*), **!=**(*not equals*), **=** (equals), **<** (less than), **>**(greater than)

You can use the following ***Instructions***.
Forward , Reverse , Left, Right.

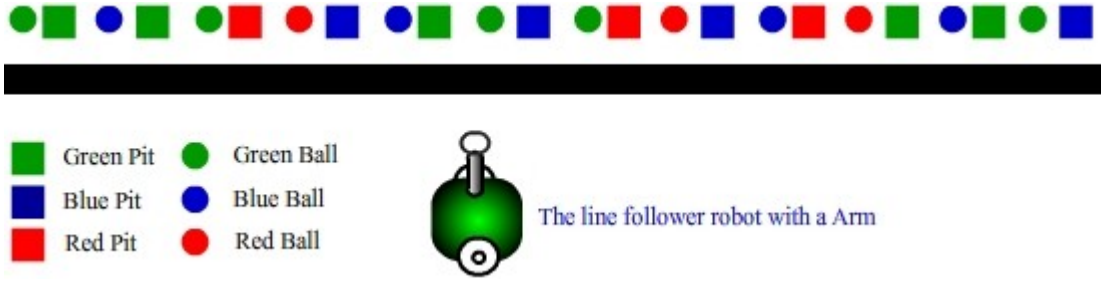


The image of the sorroundings. The traingular object is the Mars Robot.

Hint :- ***Try to wrtie the instruction in recursive way.Write one instruction in one line.***

Q3. CAN SOMEONE GET RID OF THOSE BALLS

You are one of the participant from PEC to MIT(U.S.A) for a line follower event. This time leaving the conventional line follower aside the organizers have brought a different flavour to the Event. There is a single long line about 10 meters. The sides of the line consist balls and a pit placed alternatively and randomly. There are 3 colors of balls (RED, GREEN and BLUE) and Three pits of same colour set as the ball. There can be random number of pits and balls but for a given color there will be same number of pits and balls (eg if there are 5 red balls then there will be 5 red pits). Look at the Picture below. It is not necessary that the colors are distributed equally. No of balls of one color can be more than other.

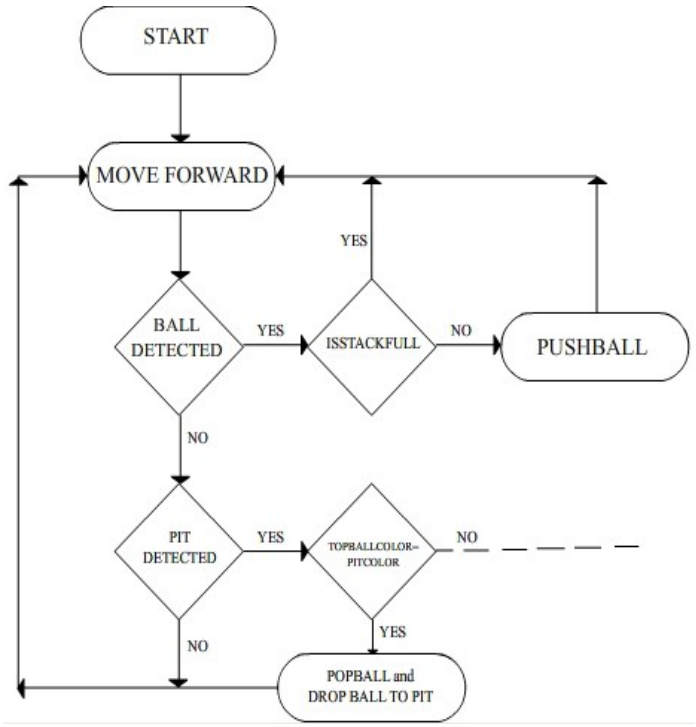


Design a behavioural FLOWCHART Diagram for the robot such that the robot can put maximum balls at the corresponding pit within a given time frame (like 2 minutes).

The robot can move up and down the line. The robot also can detect the three different colors of balls and pit. A red ball can only go inside a red pit and so on.

The robot has a reservoir where it can store upto 2 balls but in a STACK manner (i.e Last in First out).

The Behavioural FLOWCHART Diagram could be like below.



You can use ***normal variables*** in flowchart to store informations. Like no_of_red_pits_misses++ (in rectangular boxes).
You can use ***logical operations*** in diamond boxes also (like >,<,= etc).

The Behaviour methods are	***STACK methods are (Reservoir max 2 balls)***
MOVE FORWARD **MOVE BACKWARD** **BALL DETECTED** **PIT DETECTED** **PICK BALL** **DROP BALL TO PIT** **DROP BALL** **IS BALL <COLOR>** *(true if the ball is of the color mentioned. Eg. IS BALL RED)* ***IS PIT <COLOR>*** *(true if the pit is of the color mentioned. Eg. IS PIT RED)* **BALLCOLOR** *(color of the ball)* **PITCOLOR** *(color of the pit)*	**TOPBALLCOLOR** *(gives the color of topmost ball)* **POPBALL** *(Set the Topmost ball to be dropped)* **PUSHBALL** *(Store the ball in the reservoir)* **ISSTACKFULL** *(true if stack is full else false)*

You can use any approach. Be innovative in your approach. If you think explanation is needed then feel free to write paragraphs or explanation for your flowchart. You can use the normal FLOWCHART symbols if you need to.
Bring out the PECOBIAN Spirit. You can do it.

Q4. THE BOMB EXPERT

Fred the manic storekeeper has a large storeroom filled with piles of boxes of explosives that he has been unable to sell. Spring has come and Fred needs to clear out his storeroom so he has space for the next popular product.He will do this by detonating the boxes and he wants you to help him minimise the cost to do so. Task Due to the odd shape of his storeroom, Fred has stored the boxes in N piles, which have been arranged in a single straight line. Each time a box is detonated, it is destroyed and the explosion spreads sideways, destroying the top box of any neighbouring piles of the same height (all boxes are of identical size and shape). The explosion continues spreading in both directions, until it reaches a pile of a different height. For safety reasons, only the top box of a pile can be exploded (either by being detonated or by its neighbour exploding). Fred will only consider his storeroom clear when all boxes have been destroyed. He would like you to calculate the minimum number of detonations required to achieve this so that he can budget accordingly.

Example

Suppose there are four piles, containing 1, 3, 2 and 5 boxes respectively. One way to destroy all the boxes in the minimum number of detonations would be

- Detonate the fourth pile three times, destroying the top three boxes. (three detonations)
- Detonate the second pile once, destroying the top box. (one detonation)
- Detonate the fourth pile once, destroying the top box of the fourth pile and then the top boxes of the third and second piles. (one detonation)
- Detonate any pile, destroying the last box in that pile and then the last box in all of the other piles. (one detonation).

This would clear out the storeroom in six detonations. Look at the figure for more clearity.

Now for the following scenario give the steps as above in the example.Try to formulate minumum number of explosion.

a.) Five piles containing 9, 5, 8, 4, and 6 respectively.
b.) Four piles containing 14, 2 , 5 and 7 respectively.

SECTION MECHANICAL DESIGN

1) Formulate a contraption in which a bucket rotates by 180 degrees when the door opens. The bucket is placed just above the door.

2) Design a mechanical robot which can climb a vertical ladder. The seperation between two vertical bars is 70 cm . Seperation between two horizontal bars is 40 cm.

3) If you are going to design legs for a biped robot having gross weight of 10 Kg than give the type of joints which you will use at ankle, knee and Butt joints .If these joints are being operated by DC motors then give their specification (power , Rpm , Ampere n voltage rating) also. The length of rod connecting butt with knee is 30 cm and 25 cm of that joining knee and ankle. The weights are :-
   a) link between butt and knee joint :- 1 kg
   b) link between knee and ankle joint :- .7 kg
   c) Weight of the foot :- .4 kg

4) An autonomous robot have to beat drums shown in figure, one by one or simultaneously. Suggest a mechanism which can be used in the robot to do this job in shortest possible time period. Make it as elaborative as u can explaining operation sequence, linkages used etc.
   Dimensions of drums (Diameter): -
   Larger drum 60 cm
   Middle drum 50 cm
   Smaller drum 40 cm