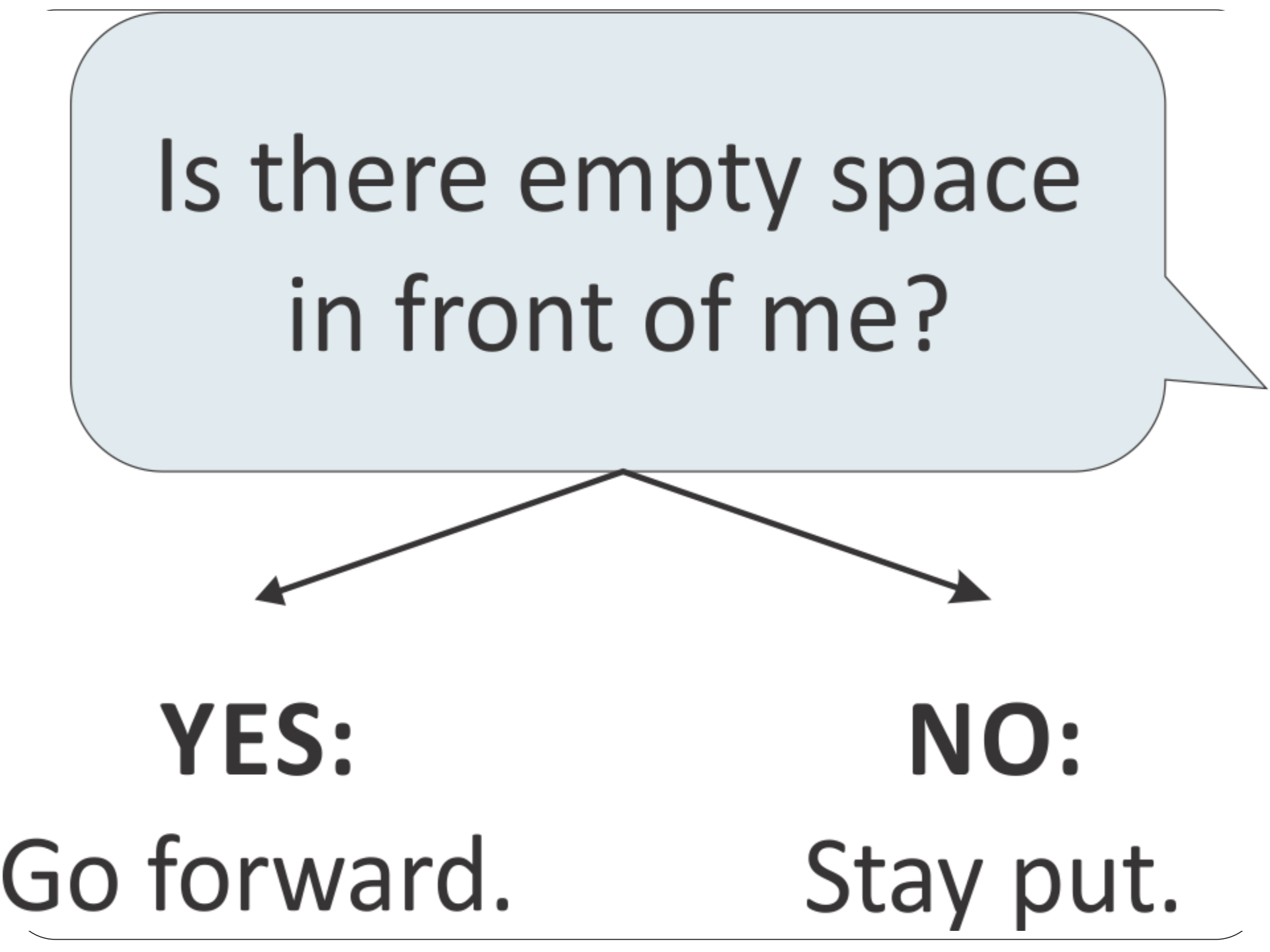
Selection

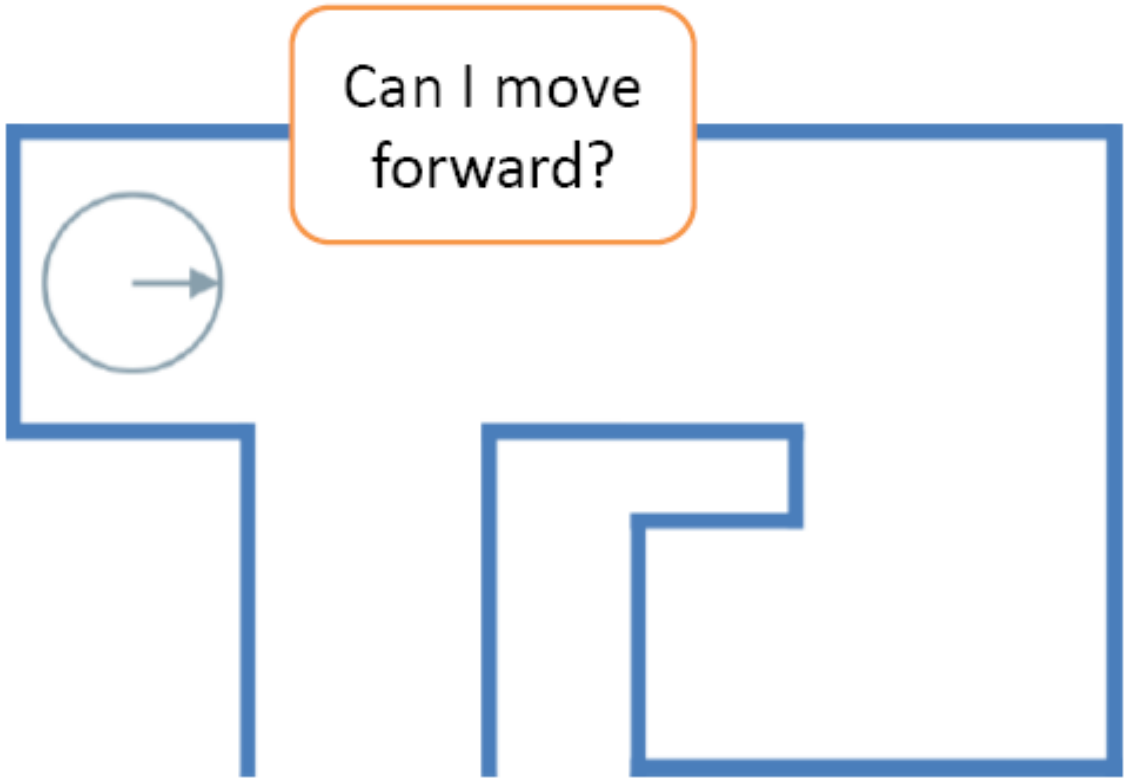
Objectives

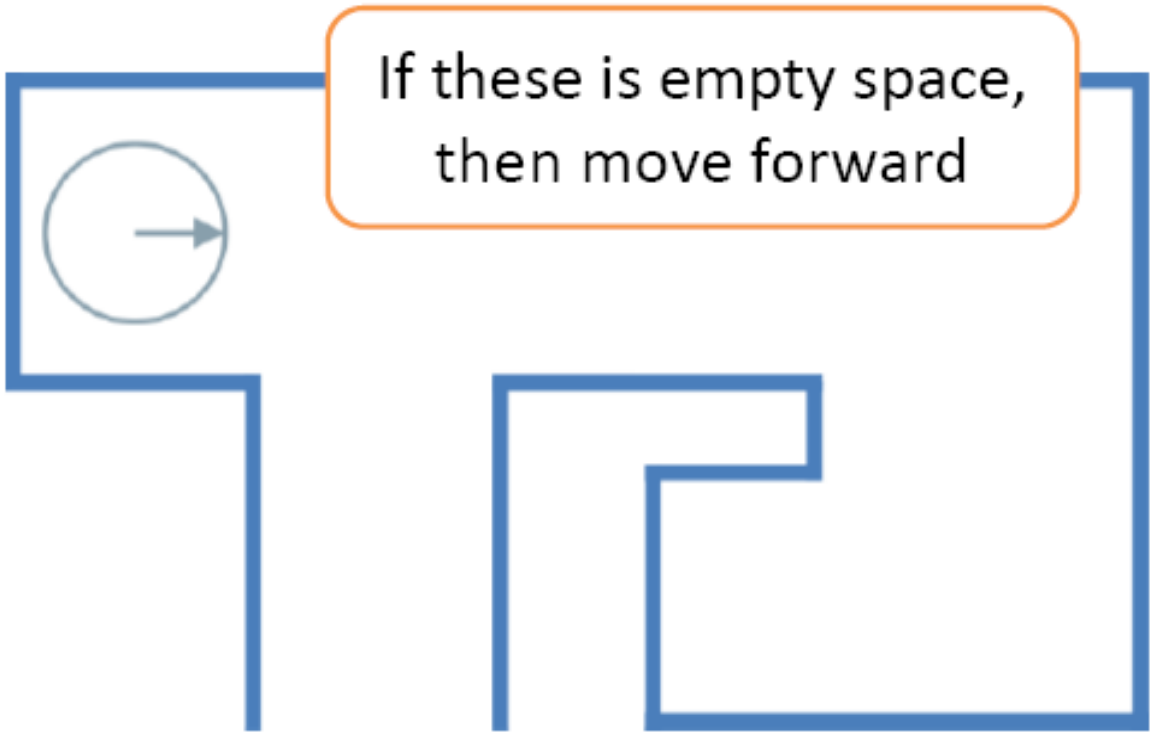
- To understand the form and function of flowchart elements for selection.
- To understand computational state of an algorithm.
- To learn to write algorithms using selection statements.
- To understand form and functional elements for selection.
- To understand computational structure of selection in algorithms.

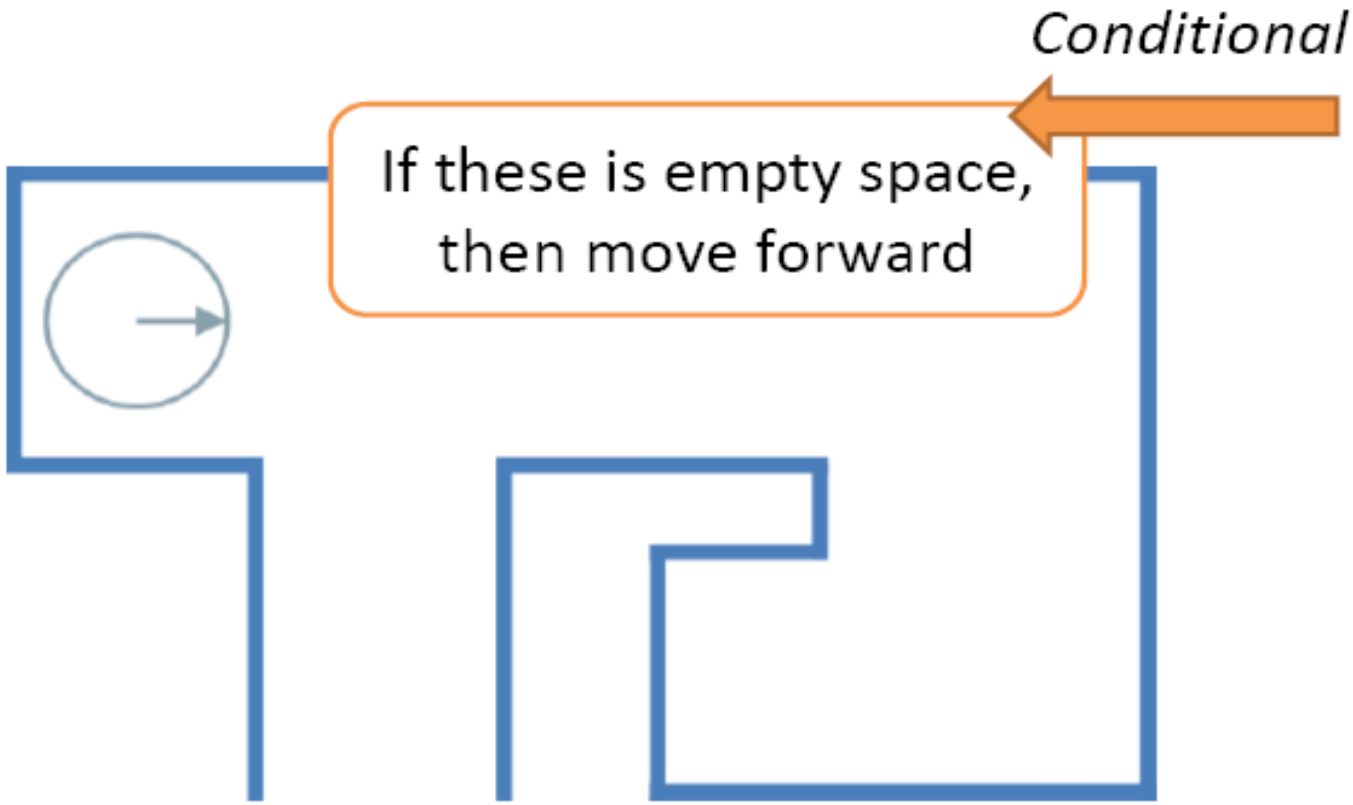
Robots are "dumb"…

- What does a robot need to know how to do to solve a maze?
- What commands and behaviors would be useful?


Is there empty space in front of me?
YES:
Go forward.
NO:
Stay put.


Can I move forward?


If these is empty space,
then move forward


Conditional
If these is empty space,
then move forward

Conditionals

if It is raining

then Wear a raincoat

if Grade is at least 50

then Pass the class

if

There is empty space in front of the robot

then

The robot moves forward

True or false, aka Boolean value

if There is empty space in front of the robot

then The robot moves forward

AND

- Everything has to be true

- **true and true = true**
- **true and false and true = false**
- **false and false = false**

OR

- *Only one thing has to be true*

- **true or true = true**
- **true or false or true = true**
- **false or false = false**

Exercise

- What will the result of this expression be?

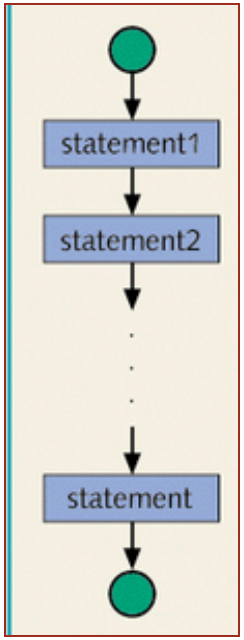
- **(true and (not false) or (true and not false))**

Exercise

- What will the result of this expression be?

- **((not false) or (false and (not true)) and false)**

- Normally, statements in a program are executed sequentially, in the order that they were written.

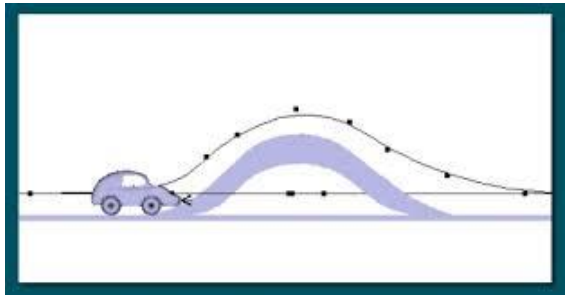


- Many solutions feature several choices or decisions. These decisions lead to different paths . These paths represent the result of making a choice.

- Often it is useful to transfer control in the middle of execution to another section of code—sort of like changing trains at the terminal.

Try it yourself

✓ *Can you say how many choices are available for selection.*

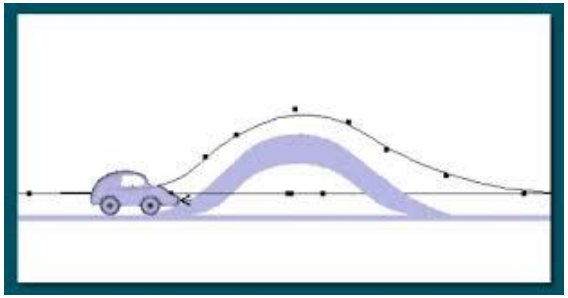


Try it yourself… Answer

✓ *Can you say how many choices are available for selection.*

Multiple Choices

Two Choices



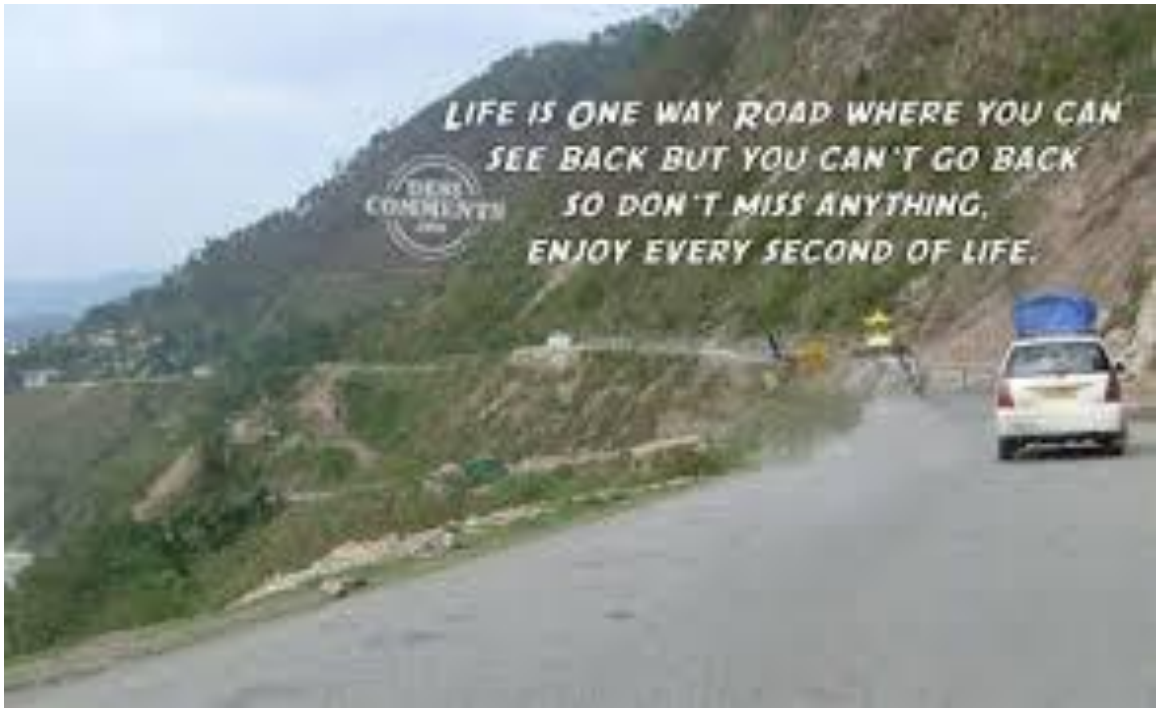
One Choice

Multiple Choices

Selection Statements

- Selection statement gives a program the ability to choose which instruction(s) to next execute based on conditions.
- Types
  - 1-Way selection (if statement).
  - 2-Way selection (if-else statement).
  - Multi-Way selection (or n-way selection, switch/case).
- Considerations
  - *What is the form and type of expression that controls the selection?*
  - *How are clauses specified if at all?*
  - *If nesting is allowed, how is it specified and implemented?*

One-Way Selection



✓ *Can you identify the number of selection choices available?*

One-Way Selection *contd---*

- The ***if*** structure is a one-way selection structure.
- When a control expression in an *if* statement is evaluated to be true, the statements associated with the structure are executed.
- The flowchart for one-way selection is given in Figure: Flow Structure- One Way and the corresponding Syntactic structure is given in Figure: Selection - One Way.

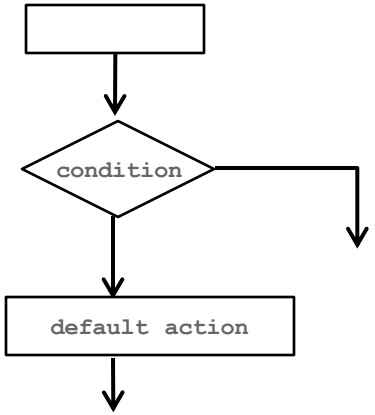


Figure: Flow Structure - One Way

```
If CONDITION then
   ACTIONS
endif
```

Figure: Selection - One Way

One-Way Selection *contd---*

- Consider the following statement…

  If (I have a fishing pole) then

  I am going fishing

- Figure: An example for One -Way selection illustrates a One-Way selection for the above statement.

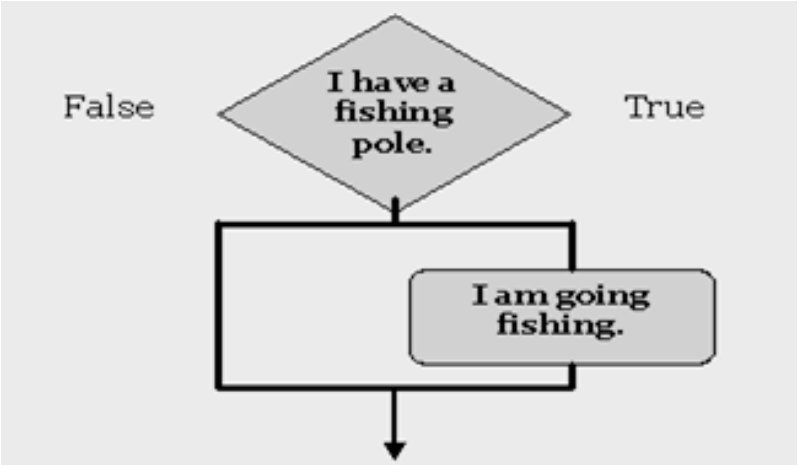


Figure: An example for One-Way selection

One-Way selection *contd---*

- Given the specifications of an *Order System* (Figure: Order system)

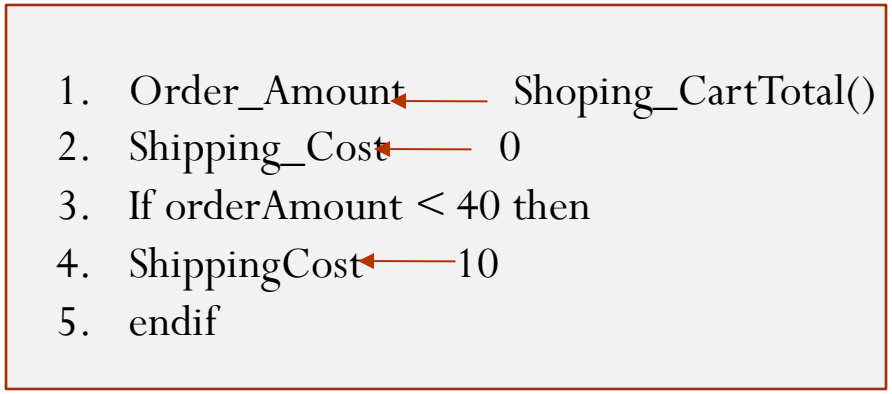


Figure: Order System

✓*Can you identify the type of selection statement needed to model it?*

✓*Can you represent these computational states as flowchart?*

A flowchart for the *Order System*

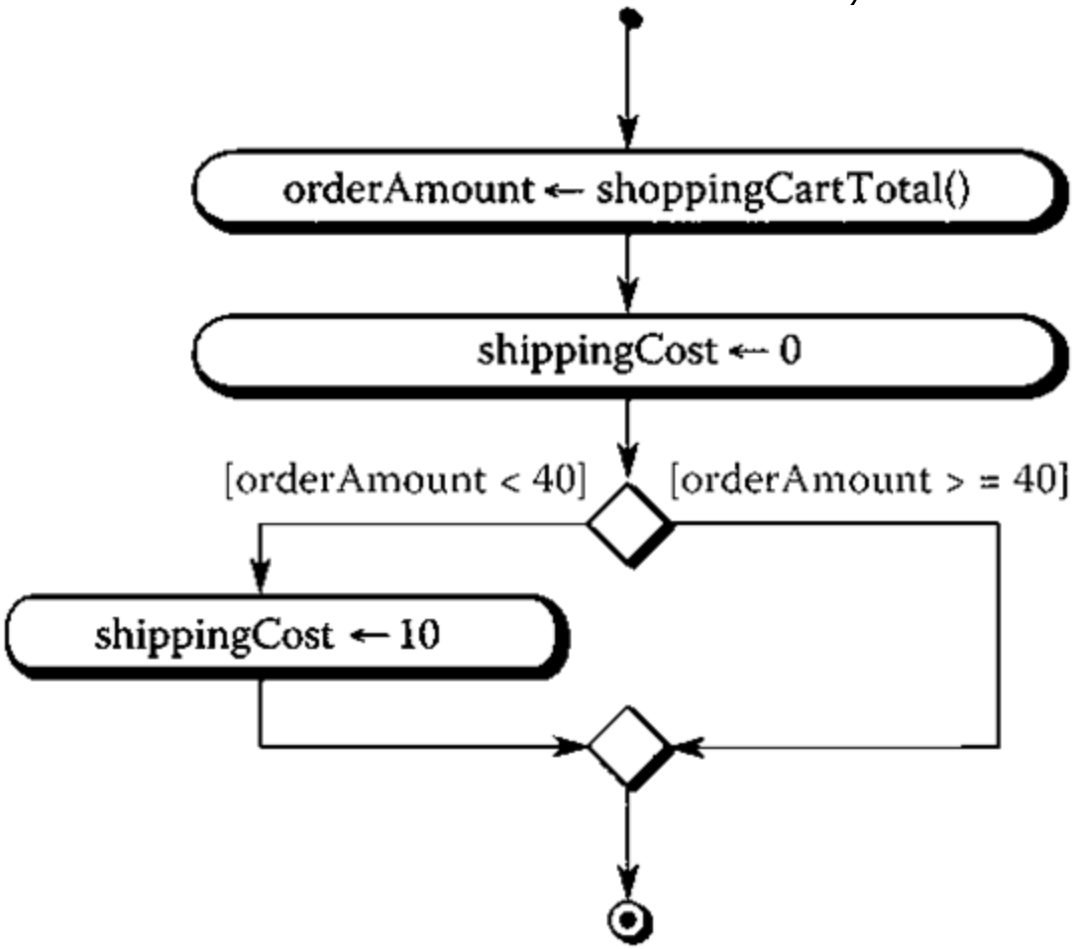


Figure :Flow chart – Order System

- ✓ *Model the following using one-way selection structure:*
  - ✓ *England will qualify for the quarter-finals with Portugal if they win or draw with Romania.*
  - ✓ *If the shop has Croissants buy croissants and leave the shop.*
  - ✓ *If you like salty food then add the amount of salt you prefer.*

Answer

If England wins/draws with Romania then
They will qualify for the quarter-finals with Portugal

If the shop has Croissants then
buy Croissants

If you like salty food then
add the amount of salt you prefer

Two-Way Selection

✓ *Can you identify the number of selection choices available?*

Two-Way Selection *contd---*

- The ***if/else*** structure is a two-way selection structure.
- If the control expression in the *if* statement evaluates to true, one block of statements is executed; otherwise (*else*), another block is executed.
- The flowchart for one-way selection is given in Figure: Flow Structure - Two Way and the corresponding Syntactic structure is given in Figure: Selection - Two Way.

```
If CONDITION then
  if-TRUE ACTIONS
Else
  if- FALSE ACTIONS
endif
```

Figure: Selection - Two Way

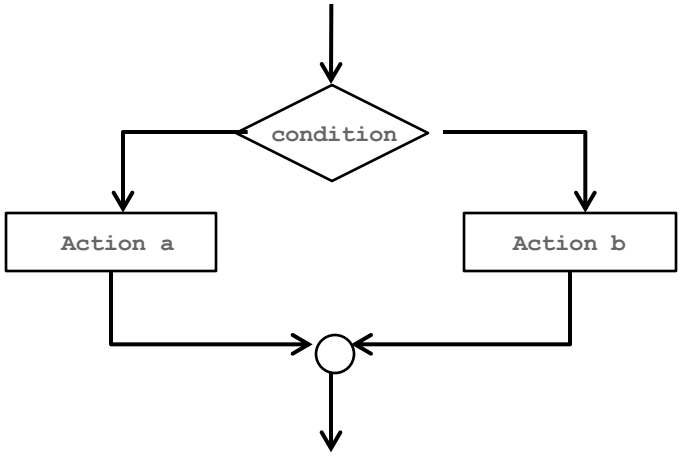


Figure: Flow structure -Two Way

Two-Way selection *contd---*

- Consider the following statements…

  if (the sun is shining) then

  I will go fishing

  else

  I will play computer games.

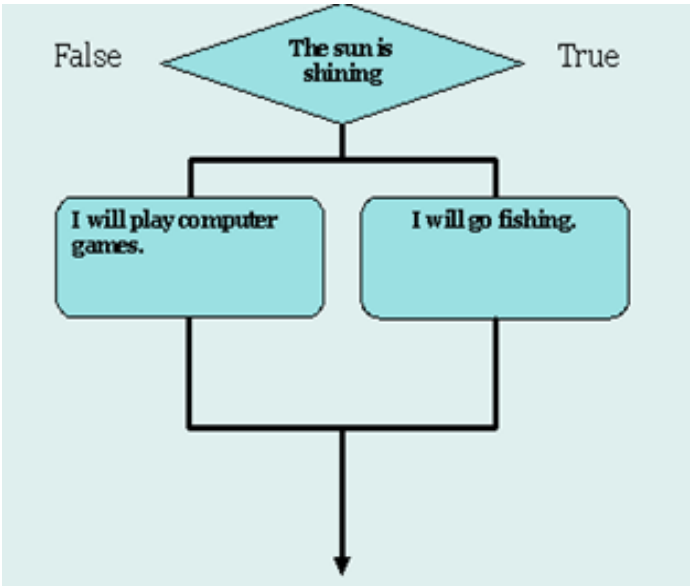


Figure: An example for Two- Way selection

- Figure: An example for Two-Way selection illustrates a Two-Way selection for the above statement.

Two-Way selection *contd---*

- *The algorithm for the Order System with two different shipping costs(10,0) based on OrderAmount can be written as given the Figure: Order System- two different shipping costs.*

```
1. OrderAmount ← ShopingCartTotal()
2. ShippingCost ← 0
3. If orderAmount < 40 then
4. ShippingCost ← 10
5. Else
6. ShippingCost ← 0
7. endif
```

Figure: Order System- two different shipping costs

A flowchart for the modified *Order System*

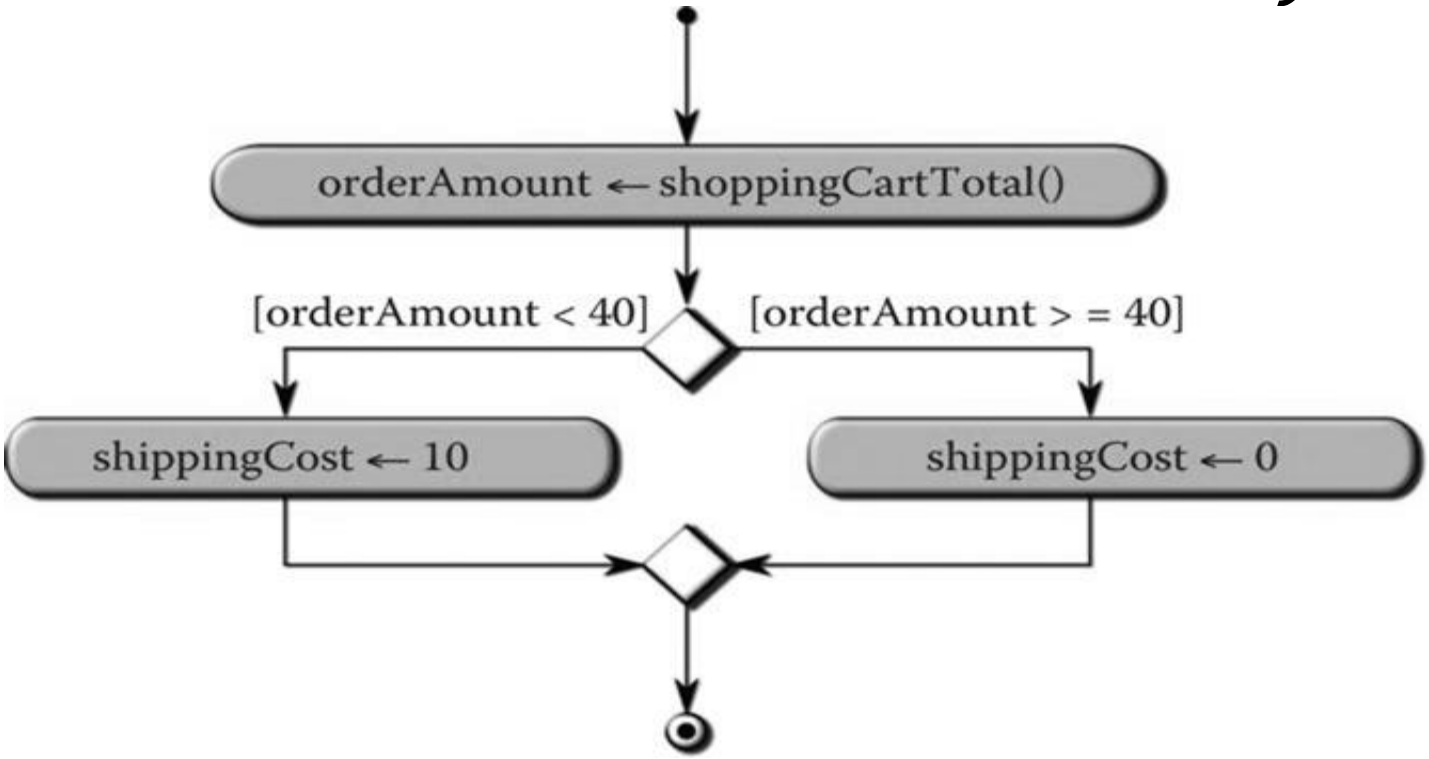


Figure: Flowchart for the modified Order System

- *Model using Two-Way selection structure.*

✓ *If there is a fire outside the door*

then Go to another exit

otherwise Remove the flap covering the handle, turn the handle, pull the door into the plane and throw it out the doorway, as far away as possible.

If there is a fire outside the door

then

1. Go to another exit.

else

1. Remove the flap covering the handle.
2. Turn the handle.
3. Pull the door into the plane
4. Throw it out the doorway, as far away as possible

Multi-Way Selection

✓ *Can you identify the number of selection choices available?*

Multi-Way Selection *contd---*

- Multi-Way selection structure changes flow of control flow based upon a value matching a selected criteria.
- The flowchart for one-way selection is given in Figure: Flow structure - Multi-way selection

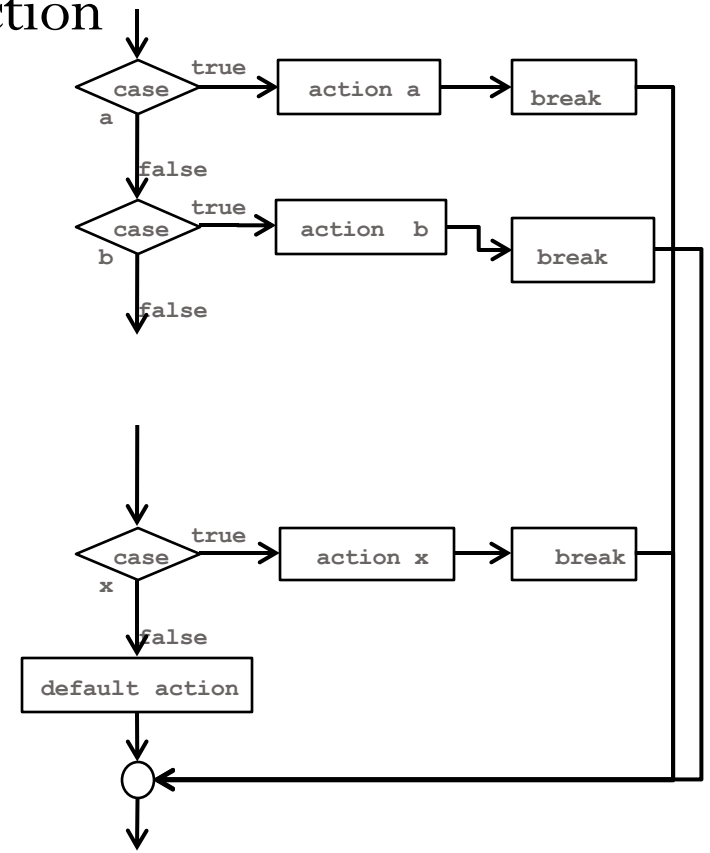


Figure: Flow structure - Multi-way selection

Selection from Multiple Choices

- *Consider the problem of determining a students letter grade given the numerical grade.*
- This can be modeled using a Multi-Way selection structure as shown in Figure: Selection -Multi-Way for student grades.

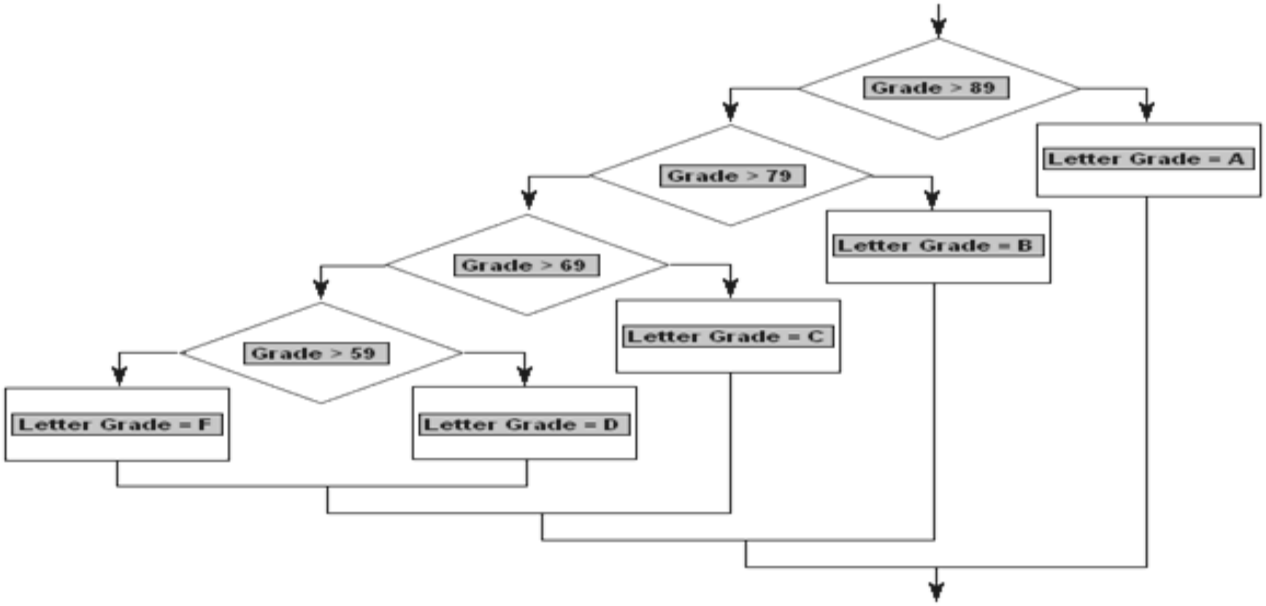


Figure: Selection -Multi-Way for student grades

Multi-Way selection *contd---*

- *Consider the requirements for computing shipping cost based on the information given in table(ShippingCosts Vs OrderAmount)*

Table: ShippingCosts Vs OrderAmount

Shipping Cost Policy	
Order Amount	**Shipping Cost**
$0.00 to $19.99	$10.00
$20.00 to $39.99	$5.00
$40.00 and up	$0.00

An algorithm for Multi-Way selection -Order System

- *The Figure: Algorithm - Multi-Way selection for Order System gives an algorithm for the requirement given in table(ShippingCosts Vs OrderAmount).*

```
1. OrderAmount ←— ShopingCartTotal()
2. ShippingCost ←— 0
3. If orderAmount > 0 and orderAmount < 20  then
     ShippingCost ←— 10
4. elseif orderAmount >= 20 and orderAmount < 40 then
     ShippingCost ←— 5
5. else
     ShippingCost ←— 0
6. endif
```

Figure: Algorithm -Multi-Way selection for Order System

A flowchart for Multi-Way selection -Order System

- *The Figure: Flow structure -Multi-Way selection for Order System gives the flow chart for the requirement given in table(ShippingCosts Vs OrderAmount).*

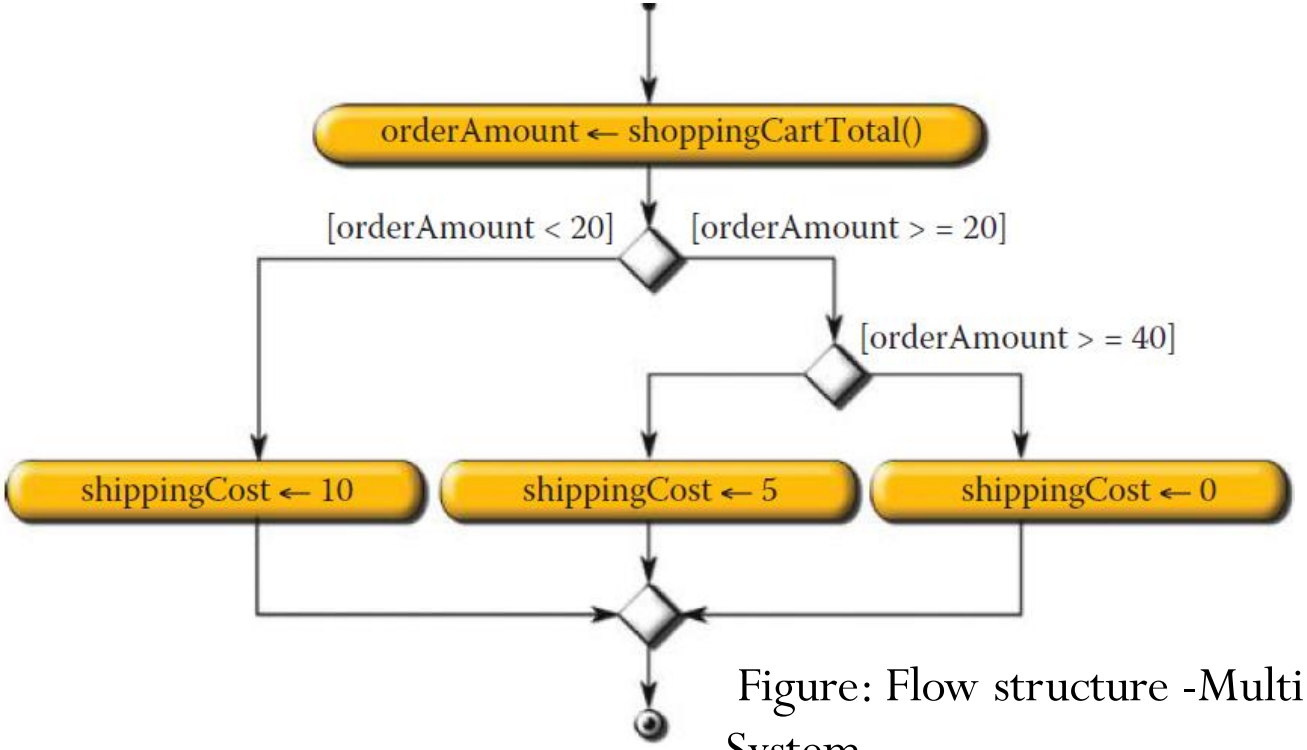


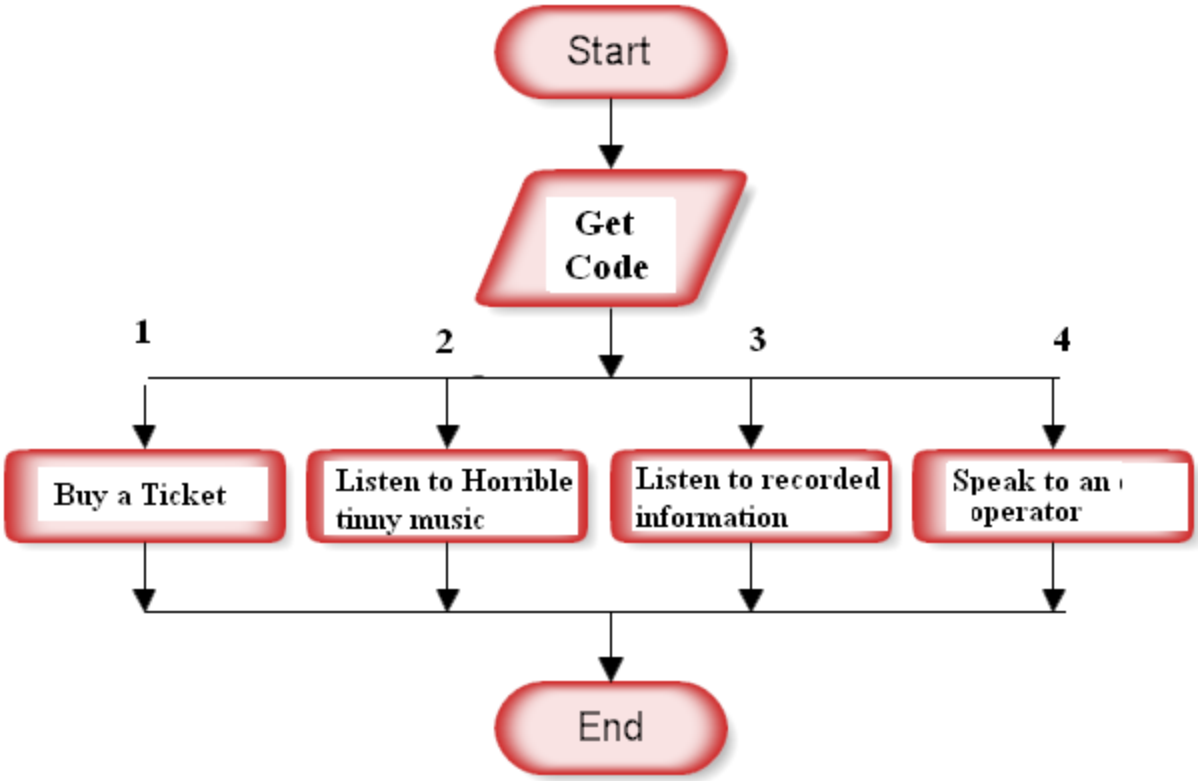
Figure: Flow structure -Multi-Way selection for Order System

✓ *Model using Multi-Way selection structure.*

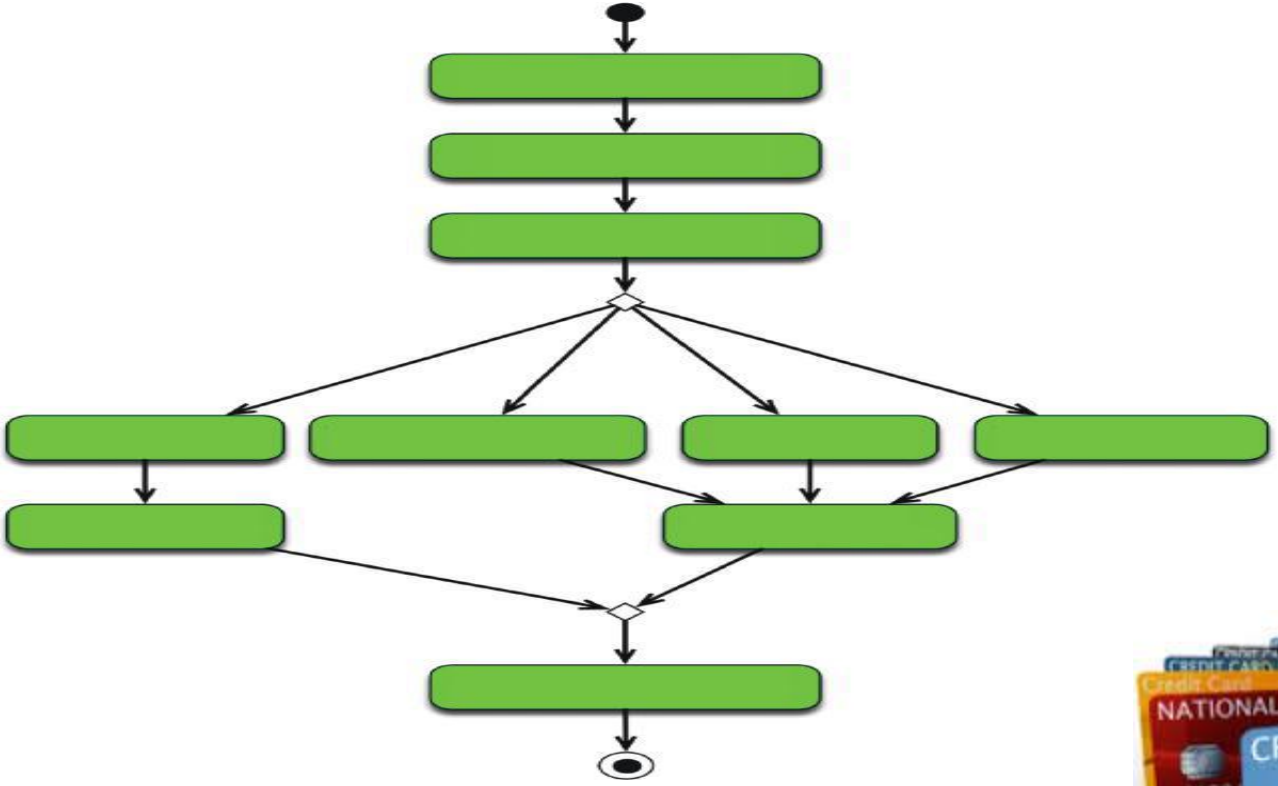
The phone systems giving you instructions in this form. The message will say something like this:

1. *If you wish to buy a ticket then press 1.*
2. *If you wish to listen to some horrible tinny music then press 2.*
3. *If you wish to listen to recorded information that is of no use to you then press 3.*
4. *If you wish to speak to an operator then press 4.*

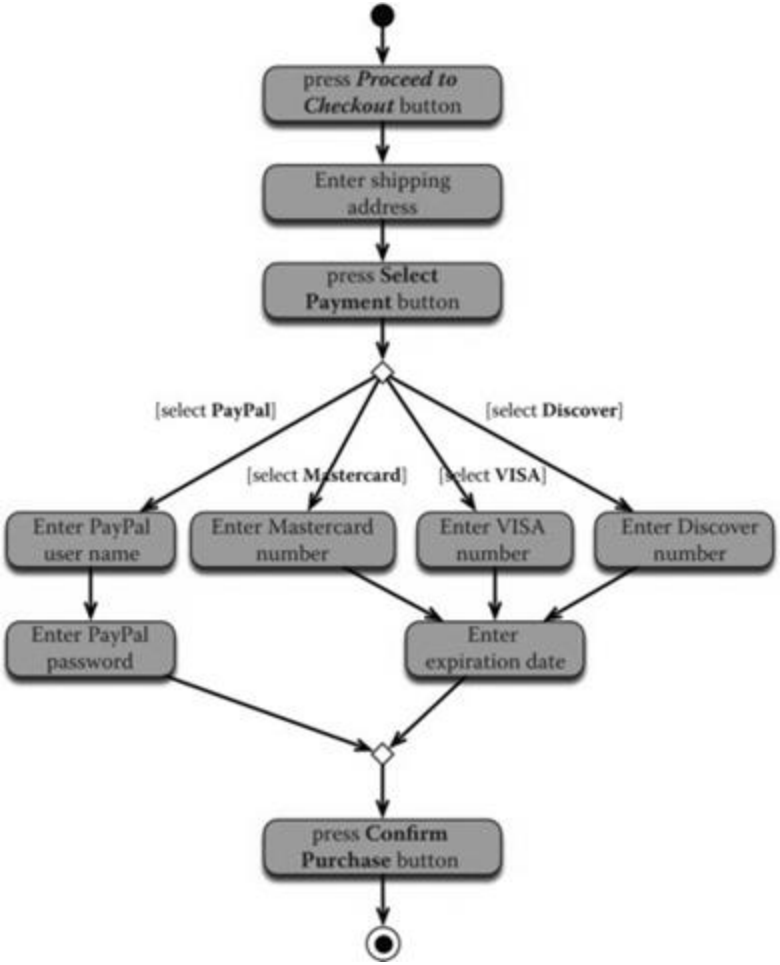
Answer


Start
Get Code
1
2
3
4
Buy a Ticket
Listen to Horrible tinny music
Listen to recorded information
Speak to an operator
End

✓ *Complete the flow chart for Multi-card payment.*



Answer


press *Proceed to Checkout* button
Enter shipping address
press **Select Payment** button
[select **PayPal**]
[select **Mastercard**]
[select **VISA**]
[select **Discover**]
Enter PayPal user name
Enter Mastercard number
Enter VISA number
Enter Discover number
Enter PayPal password
Enter expiration date
press **Confirm Purchase** button

✓ *Model using appropriate selection structure.*

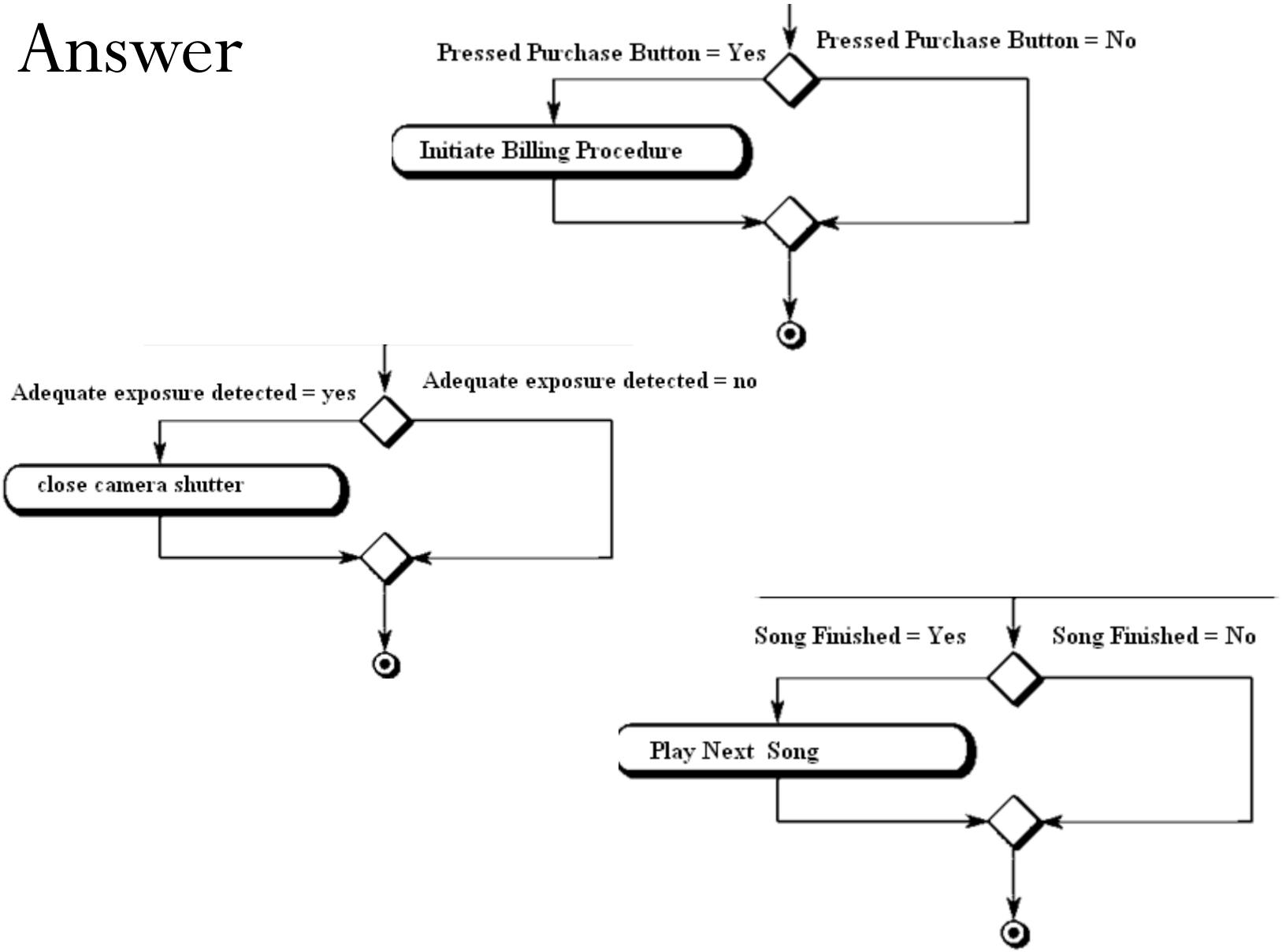
1. *IF the user has struck the Confirm Purchase button, THEN initiate billing procedures.*

2. *IF the camera sensor detects adequate exposure, THEN close the camera shutter.*

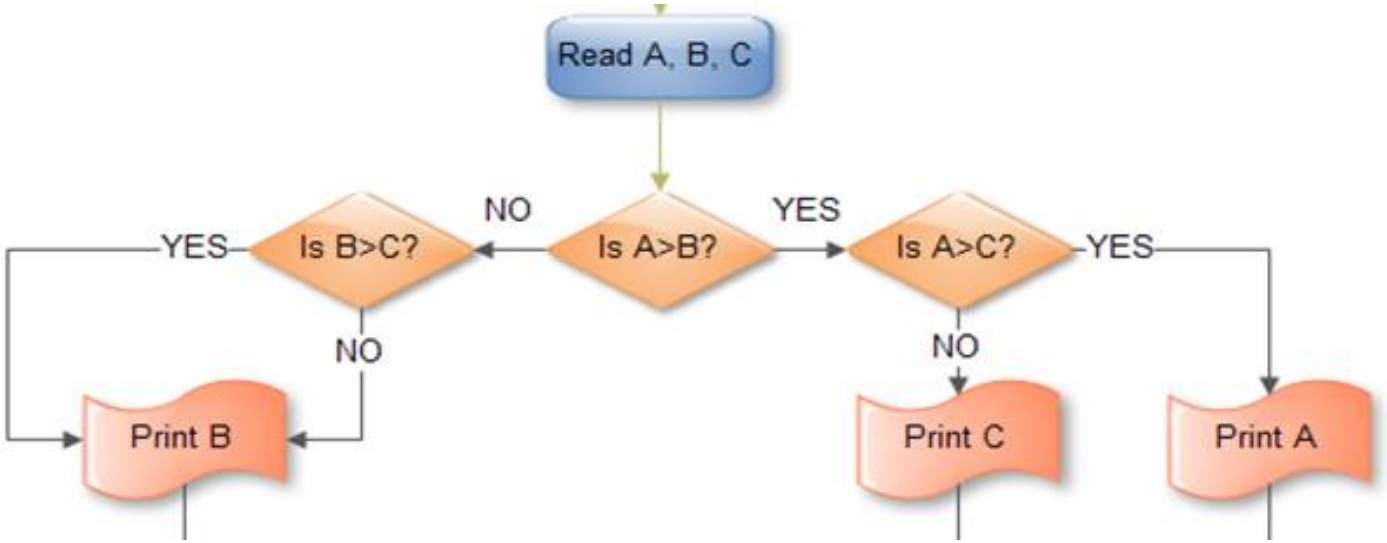
3. *IF a song has just finished playing, THEN begin playing the next song in the playlist.*

4. *Sort three characters and print them out in ascending order.*

Answer


Pressed Purchase Button = Yes
Pressed Purchase Button = No
Initiate Billing Procedure
Adequate exposure detected = yes
Adequate exposure detected = no
close camera shutter
Song Finished = Yes
Song Finished = No
Play Next Song

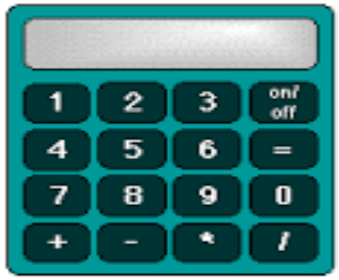
Answer


Read A, B, C
Is A>B?
NO
YES
Is B>C?
YES
NO
Is A>C?
YES
NO
Print B
Print C
Print A

5. *Shop opening timings*

Monday	8am-8pm
Tuesday	8am-12pm
Wednesday	8am-8pm
Thursday	8am-8pm
Friday	8am-8pm
Saturday	9am-5pm
Sunday	10am-4pm

6. *Which selection structure is suitable for allowing the users to perform basic operations(add, sub, mul, div, modulo division)?……Can you model it?…….Are there any alternate solutions?*



Answer

if the day is Monday then the opening hours are 8am-8pm.

elseif the day is Tuesday then the opening hours are 8am-12pm.

elseif the day is Wednesday then the opening hours are 8am-8pm.

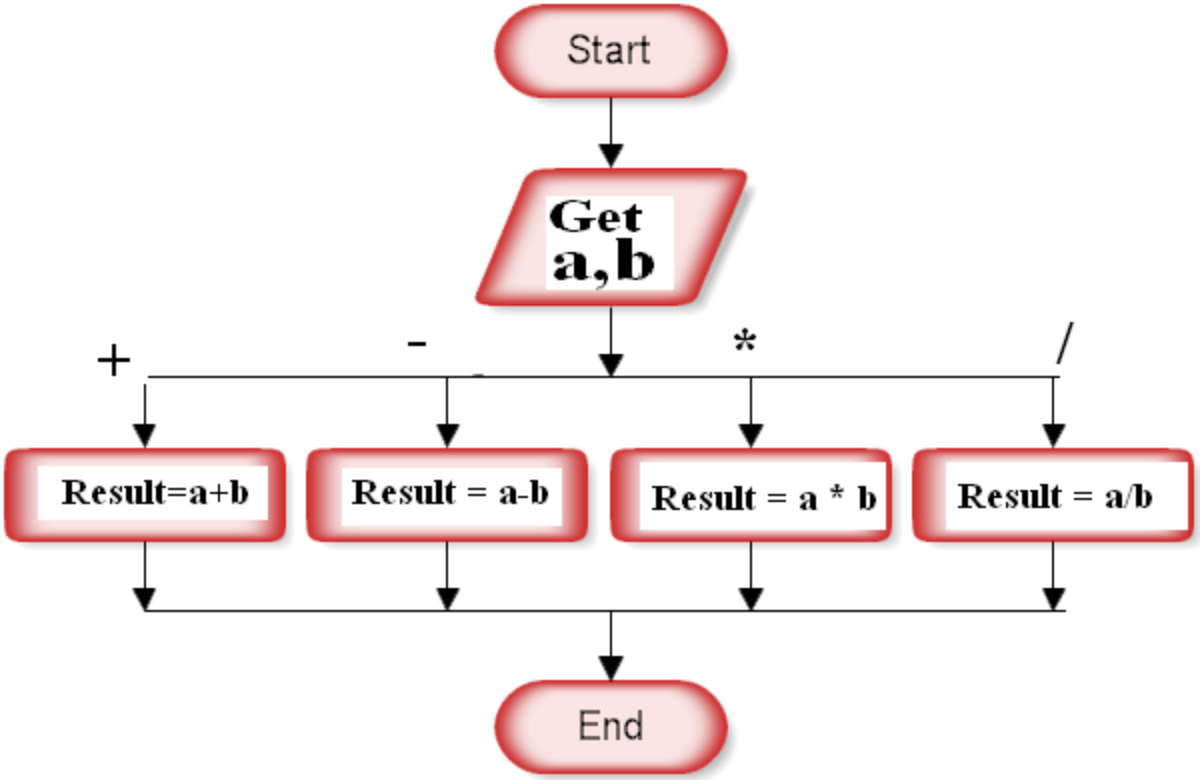
elseif the day is Thursday then the opening hours are 8am-8pm.

elseif the day is Friday then the opening hours are 8am-8pm.

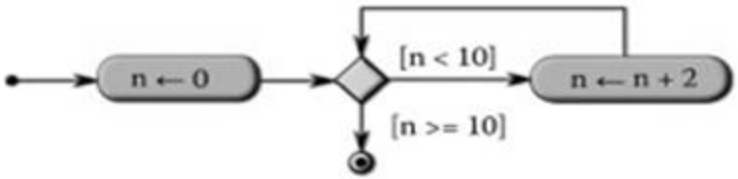
elseif the day is Saturday then the opening hours are 9am-5pm.

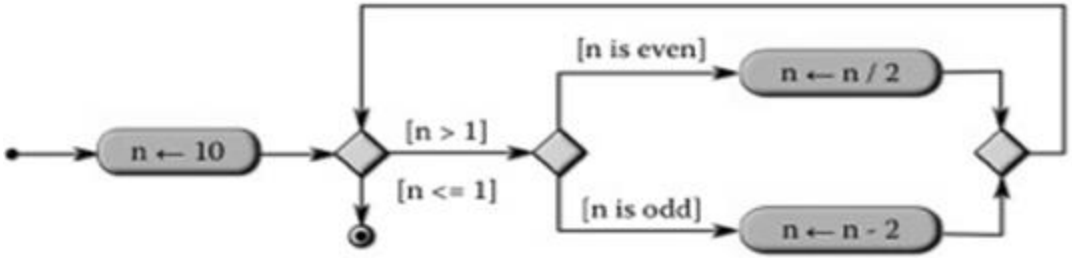
Else the day is Sunday and the opening hours are 10am-4pm.

Answer

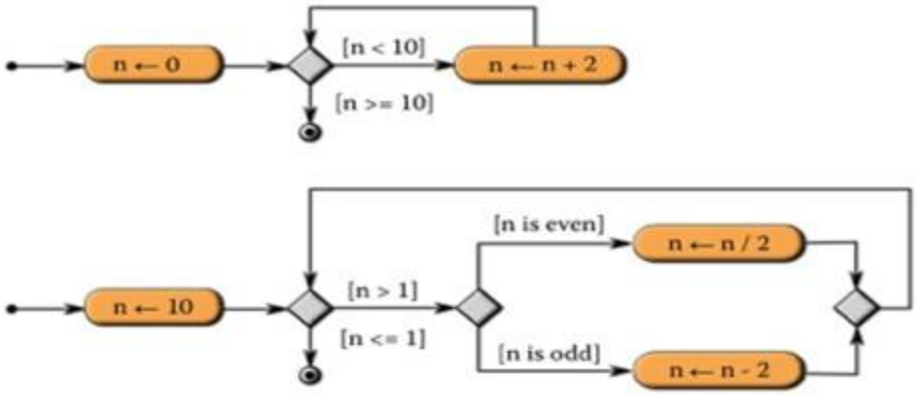


- ✓ *For each of the following flow of instructions, list each action that the computer takes and indicate the computational state that follows from each action.*





Answer



Variable	Initial	Final
n	0	2
n	10	5

- ✓ *Calculate the sales tax and total amount due for different tax codes.*

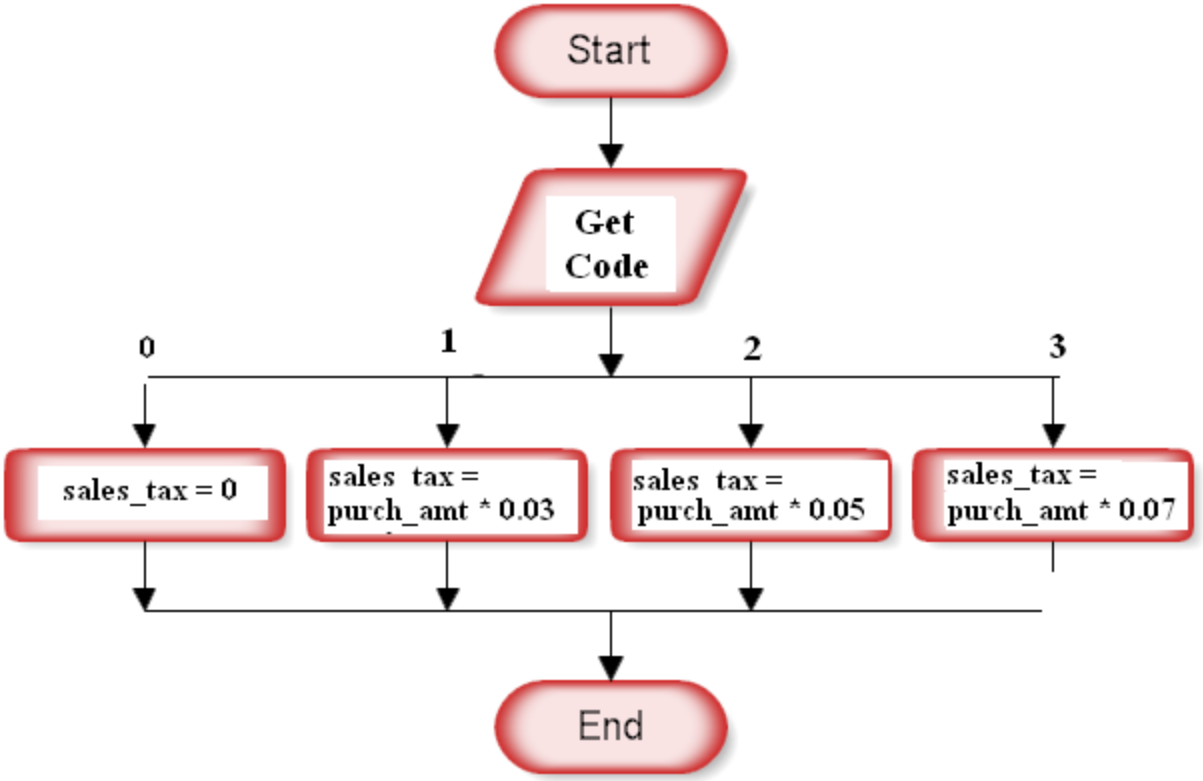
  0: sales_tax = 0

  1: sales_tax = purch_amt * 0.03

  2: sales_tax = purch_amt * 0.05

  3: sales_tax = purch_amt * 0.07

Answer


Start
Get Code
0
1
2
3
sales_tax = 0
sales_tax = purch_amt * 0.03
sales_tax = purch_amt * 0.05
sales_tax = purch_amt * 0.07
End

Complex Conditionals

- Anything that results in **true or false** can go into the if part of a conditional

if — I am buying a movie ticket *and* I am a student

then — I will get a discount on the price

if

My percentage is at least 77 *and* my percentage is at most 79

then

My grade is B+

if

The battery is dead *or* there is no gas

then

The car will not start

if

Not married *and* not engaged *and* like it

then

Put a ring on it

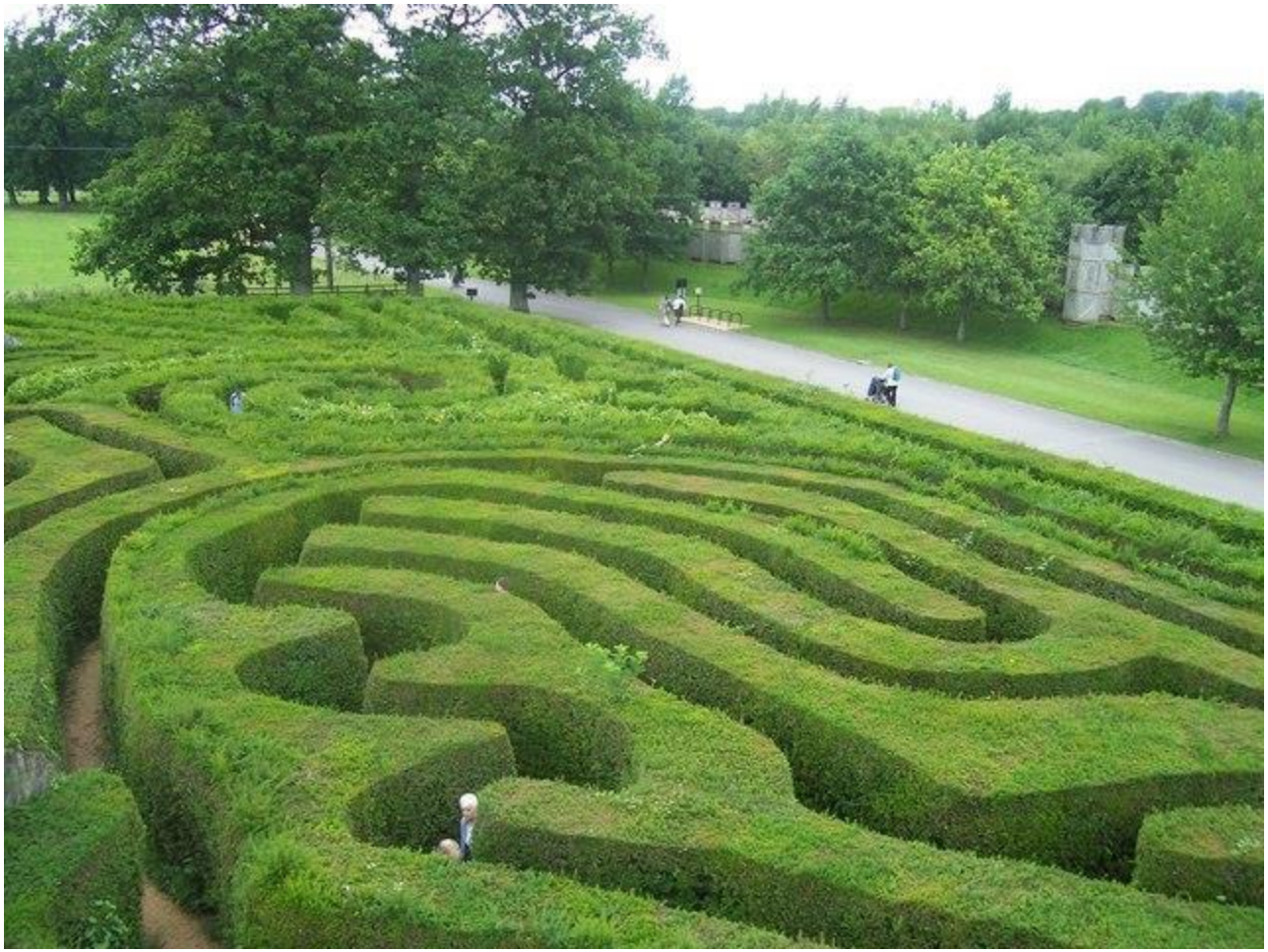
Predict the output

What is the output?

```
x = 25
if x < 15:
    if x > 8:
        print(1)
    else:
        print(2)
else:
    print(3)
```

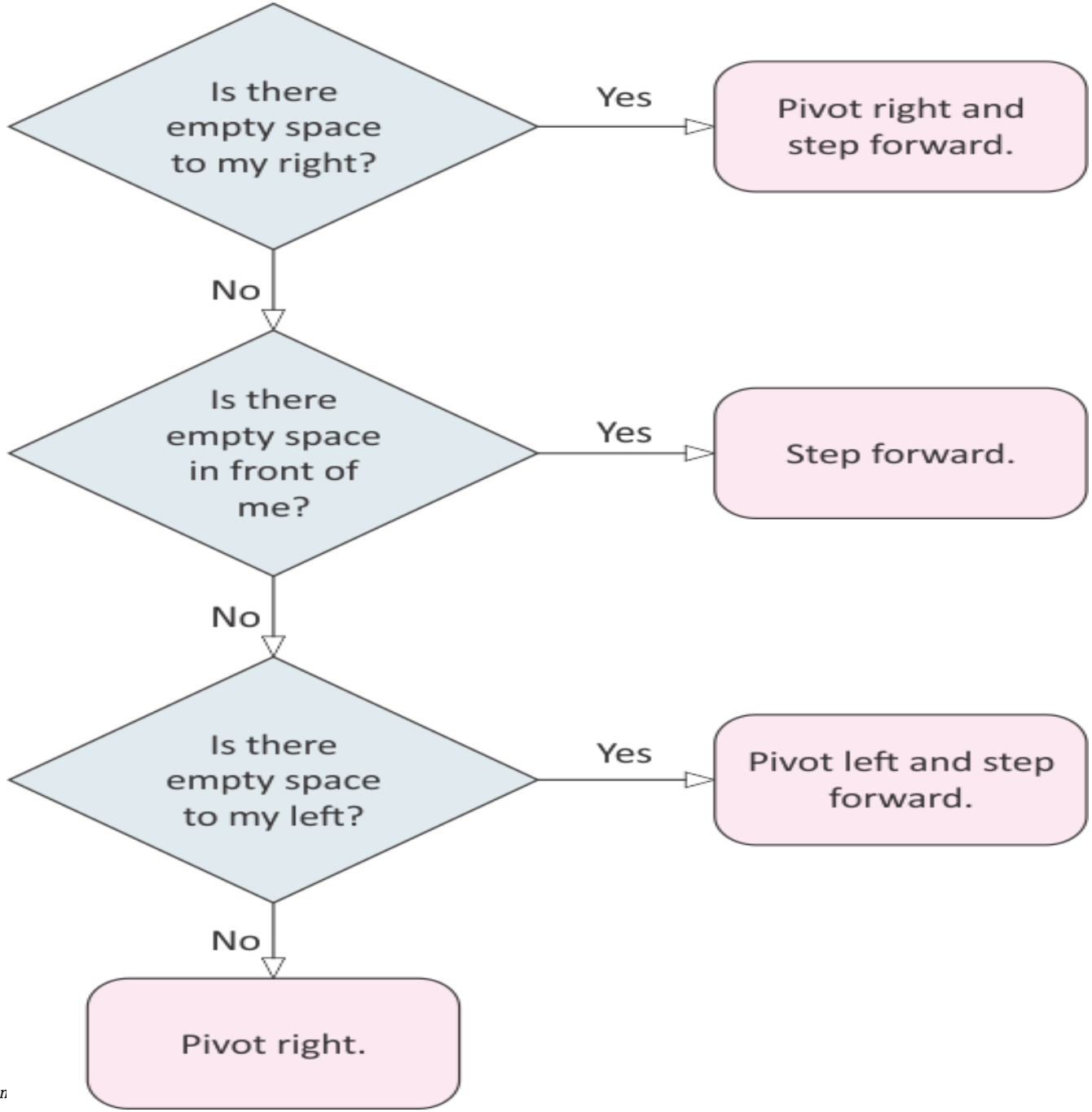
Case study time .....

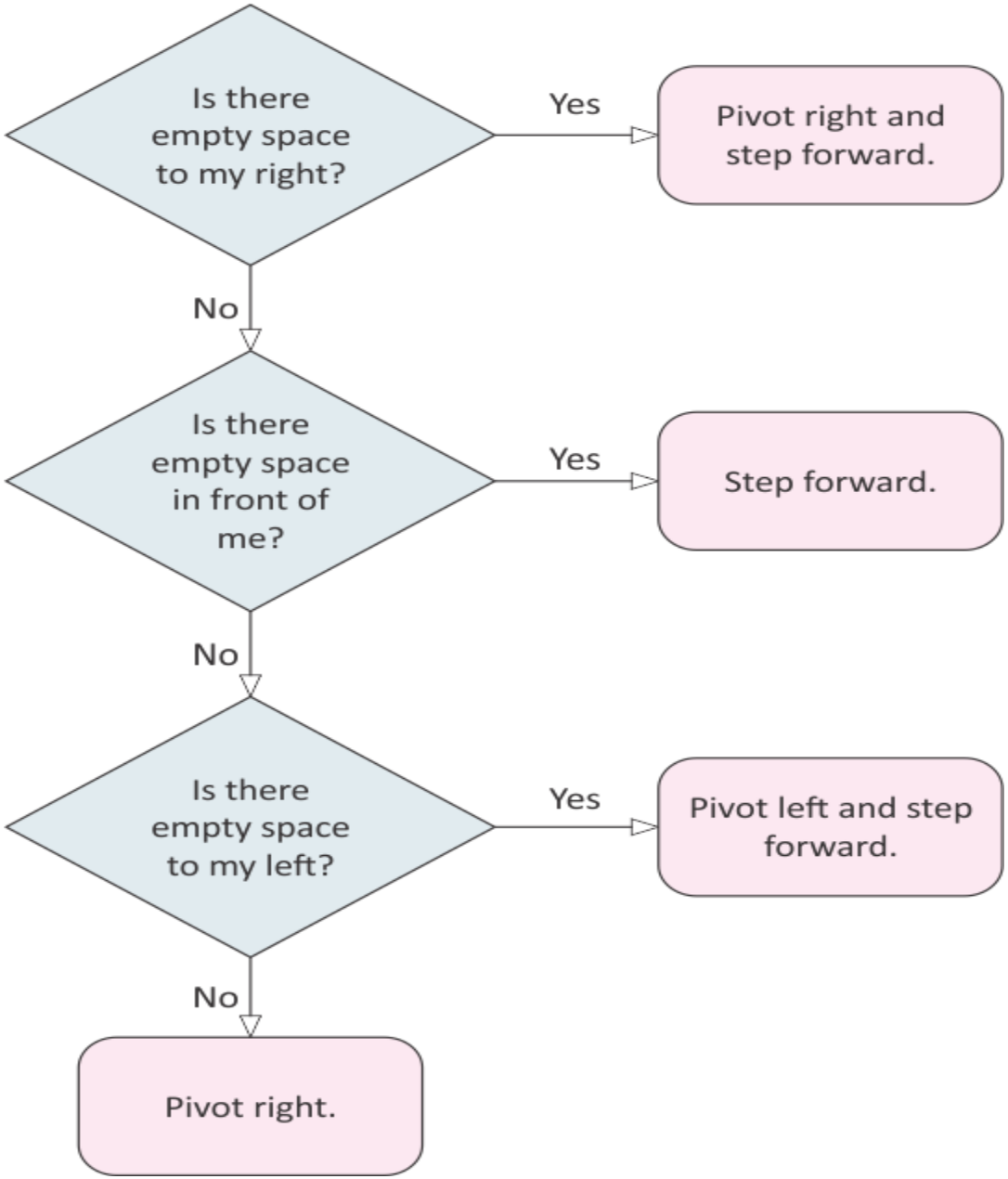
How would you find your way out of a maze?

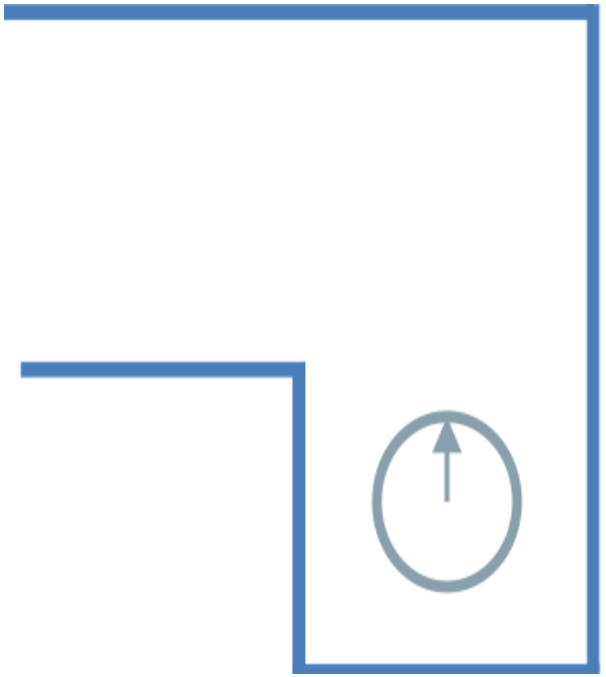


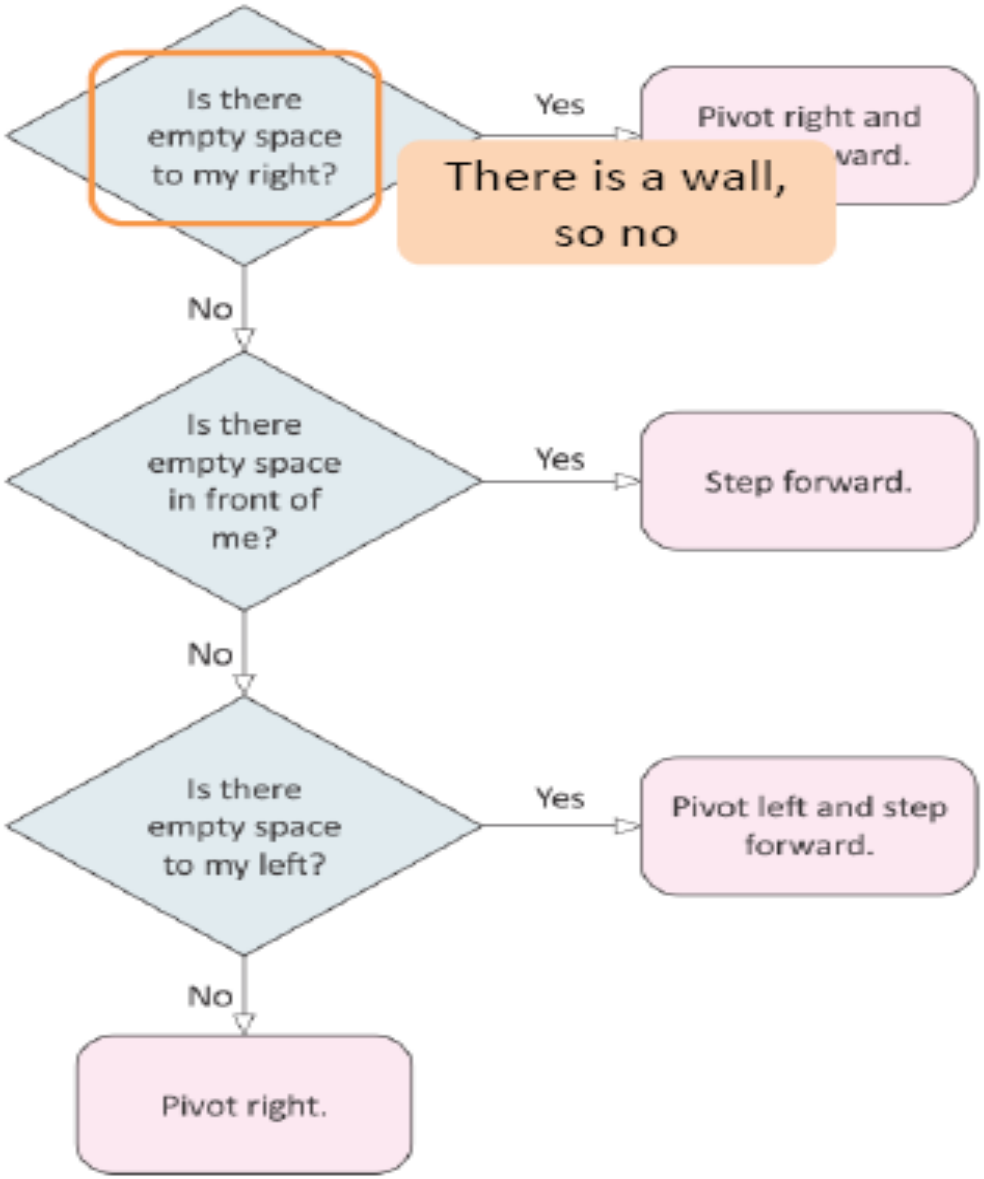
One Move with Right-Hand Rule

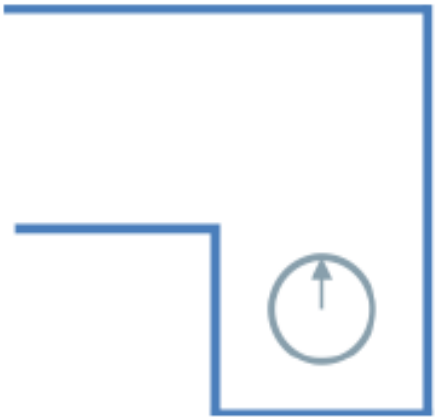
- 1.If there is empty space to my right, then pivot right and step forward.
- 2.Otherwise, if there is empty space in front of me, then step forward.
- 3.Otherwise, if there is empty space to my left, then pivot left and step forward.
- 4.Otherwise pivot right without stepping forward.

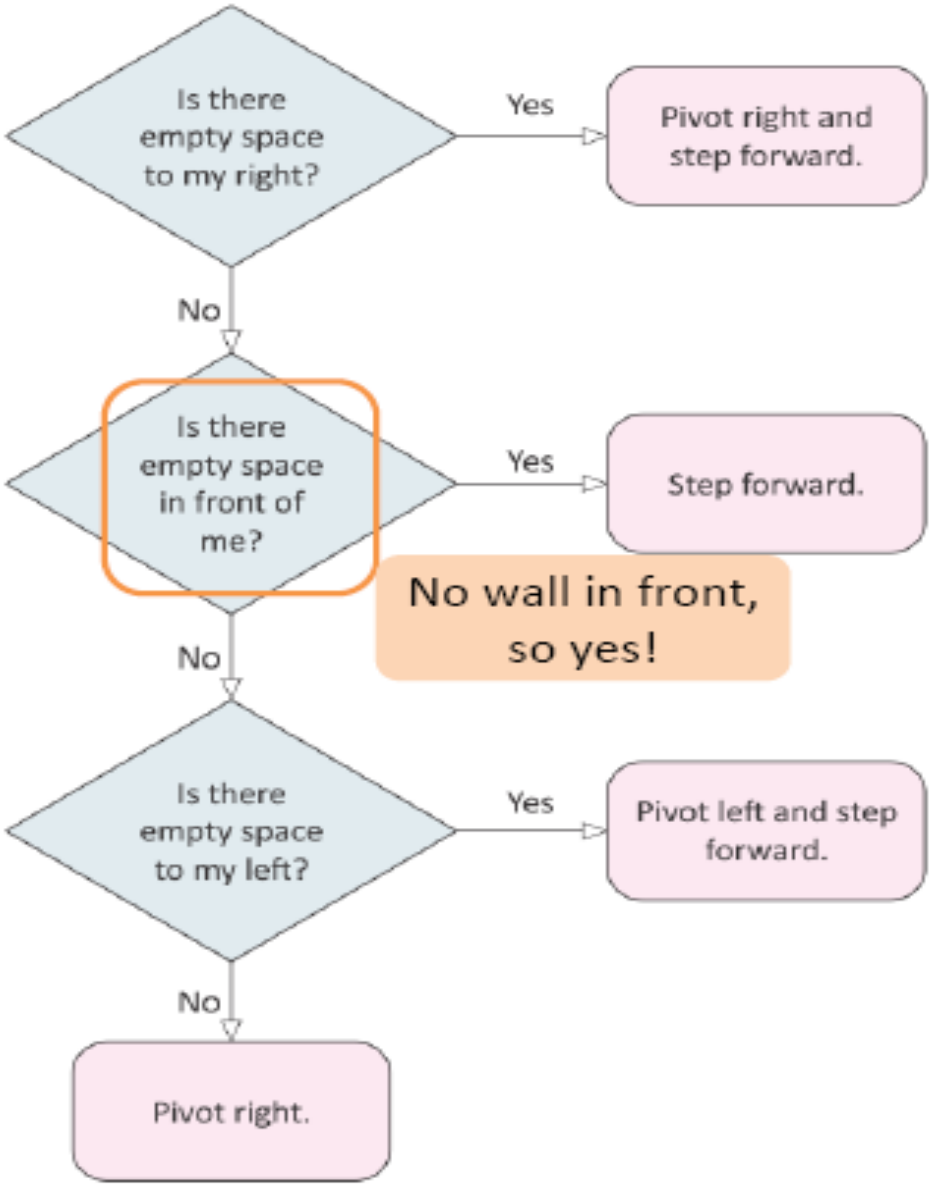

Is there empty space to my right?
Yes
Pivot right and step forward.
No
Is there empty space in front of me?
Yes
Step forward.
No
Is there empty space to my left?
Yes
Pivot left and step forward.
No
Pivot right.

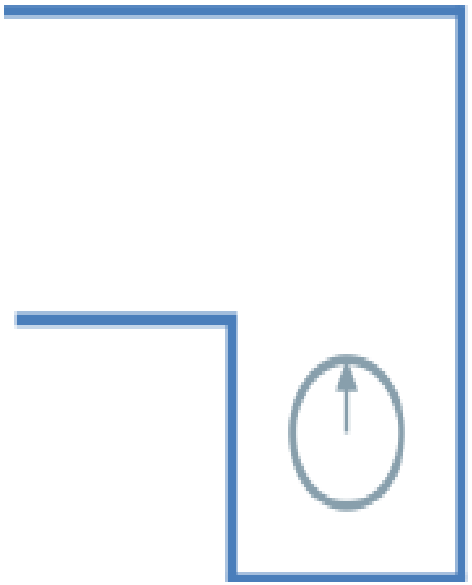

Is there empty space to my right?
Yes
Pivot right and step forward.
No
Is there empty space in front of me?
Yes
Step forward.
No
Is there empty space to my left?
Yes
Pivot left and step forward.
No
Pivot right.

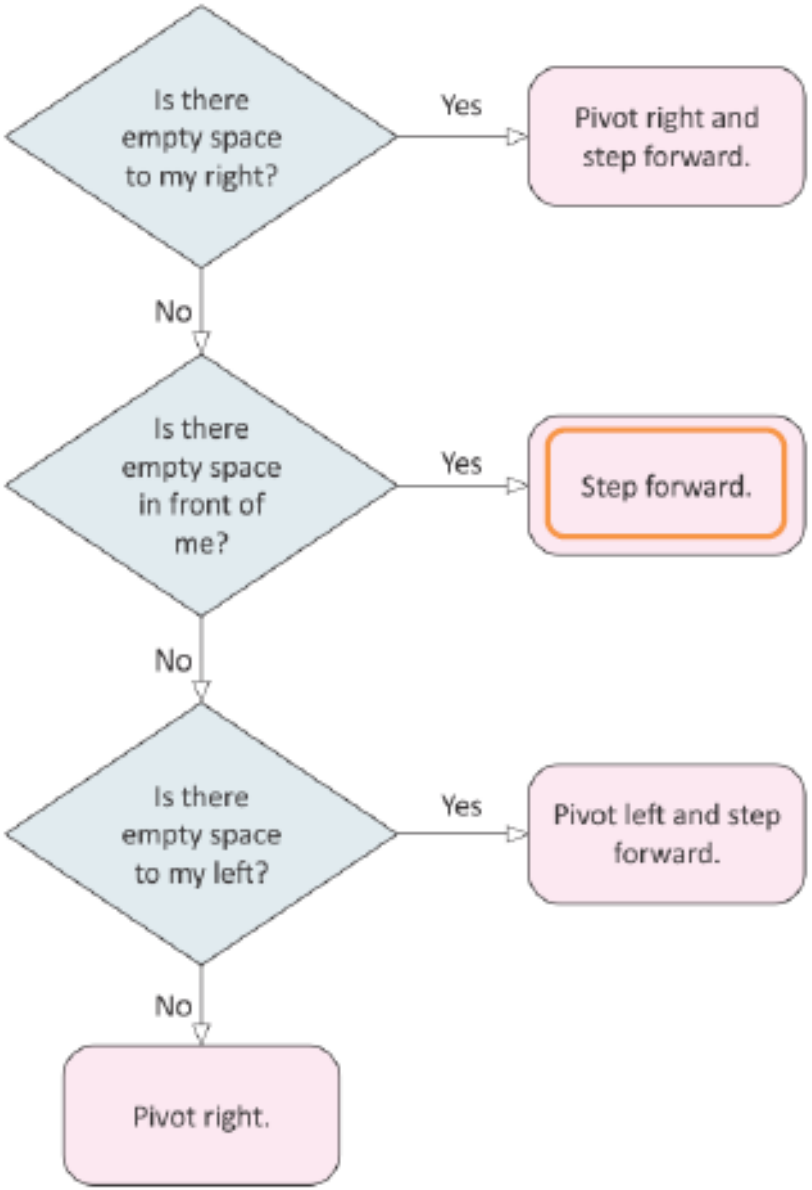



Is there empty space to my right?
Yes
Pivot right and
vard.
There is a wall, so no
No
Is there empty space in front of me?
Yes
Step forward.
No
Is there empty space to my left?
Yes
Pivot left and step forward.
No
Pivot right.




Is there empty space to my right?
Yes
Pivot right and step forward.
No
Is there empty space in front of me?
Yes
Step forward.
No wall in front, so yes!
No
Is there empty space to my left?
Yes
Pivot left and step forward.
No
Pivot right.

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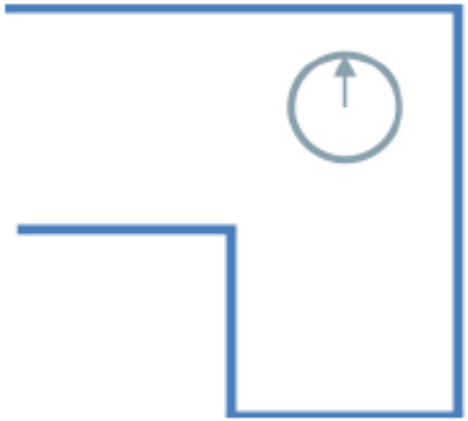
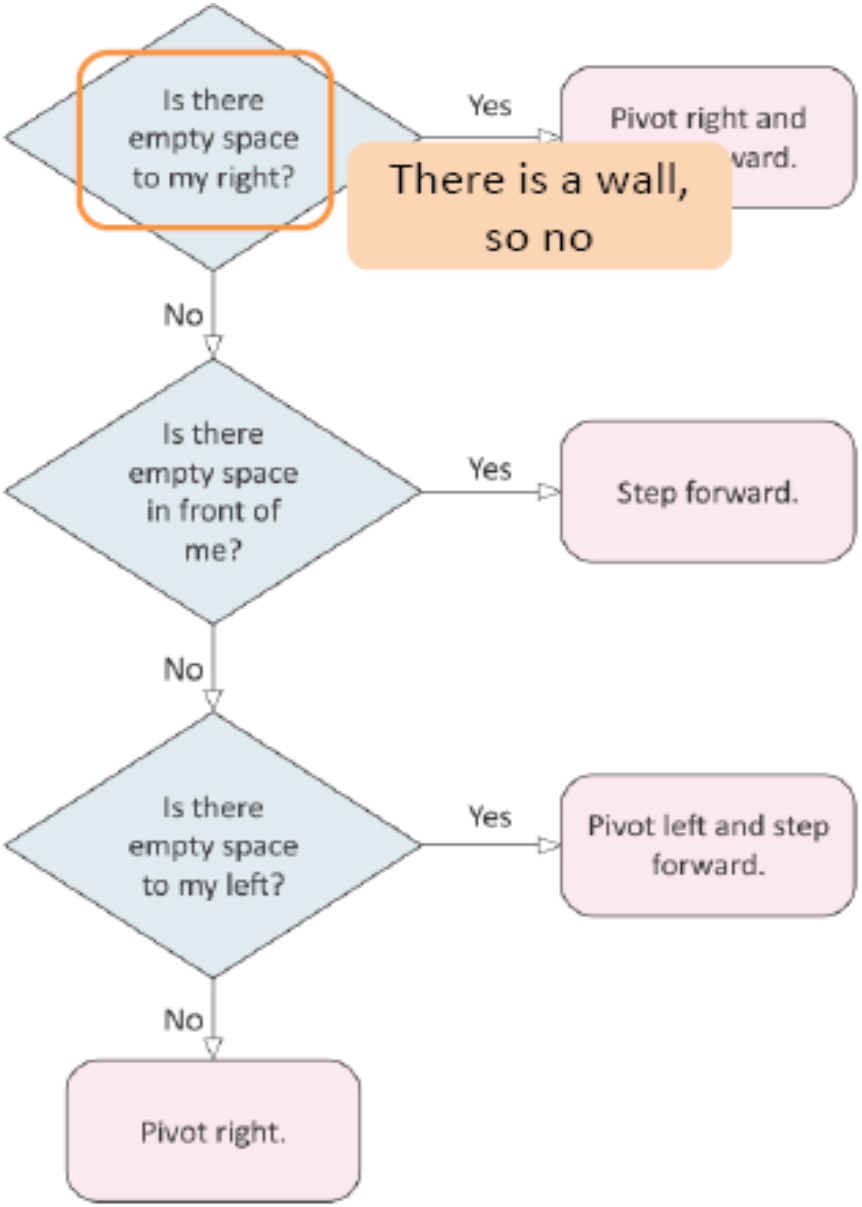
Pivot right and step forward.
No
Is there empty space in front of me?
Yes
Step forward.
No
Is there empty space to my left?
Yes
Pivot left and step forward.
No
Pivot right.




Is there empty space to my right?
Yes
Pivot right and
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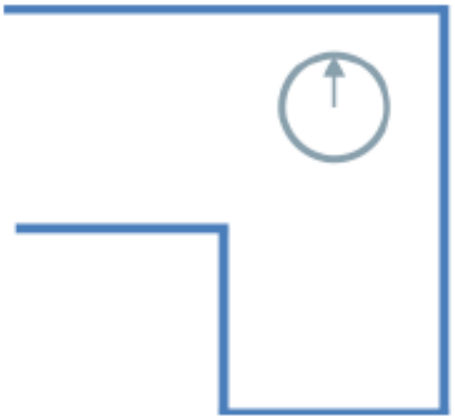
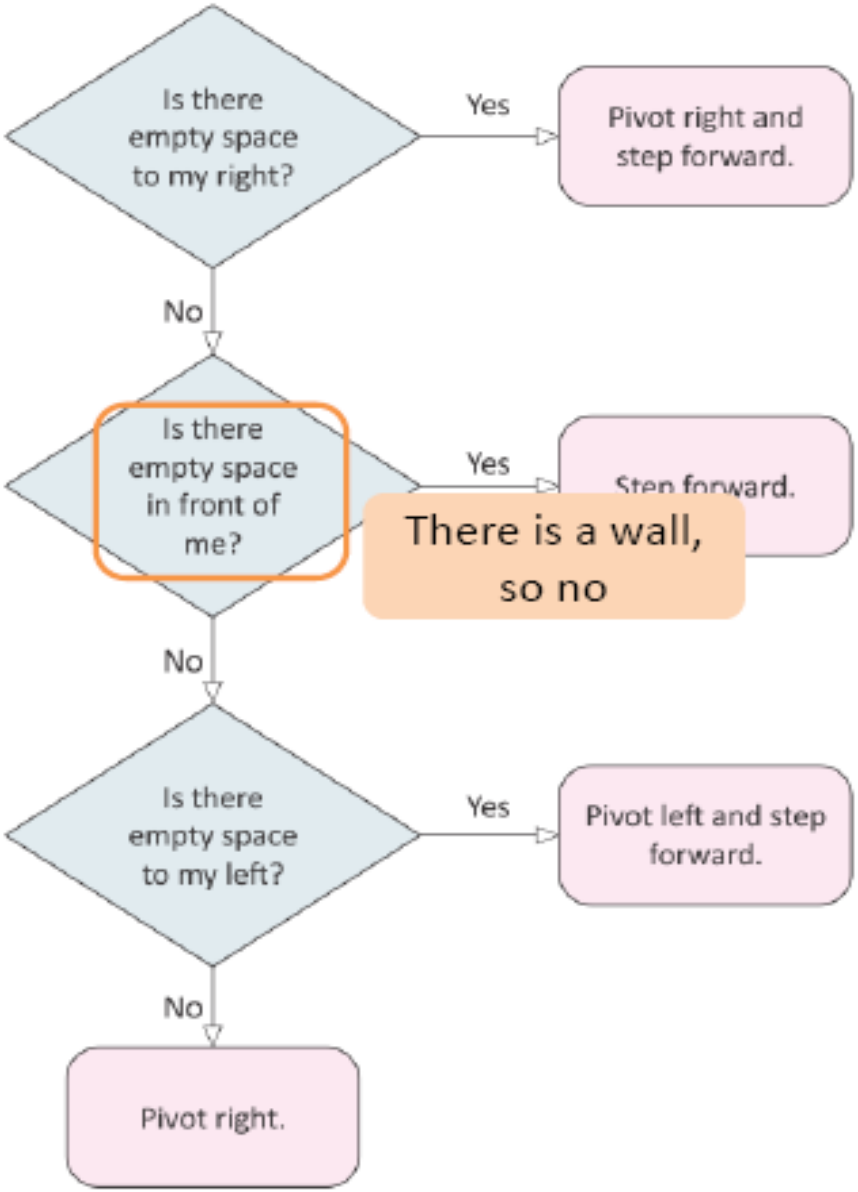
There is a wall, so no
No
Is there empty space in front of me?
Yes
Step forward.
No
Is there empty space to my left?
Yes
Pivot left and step forward.
No
Pivot right.

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Yes
Step forward.
There is a wall, so no
No
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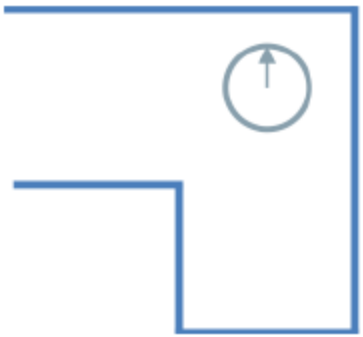
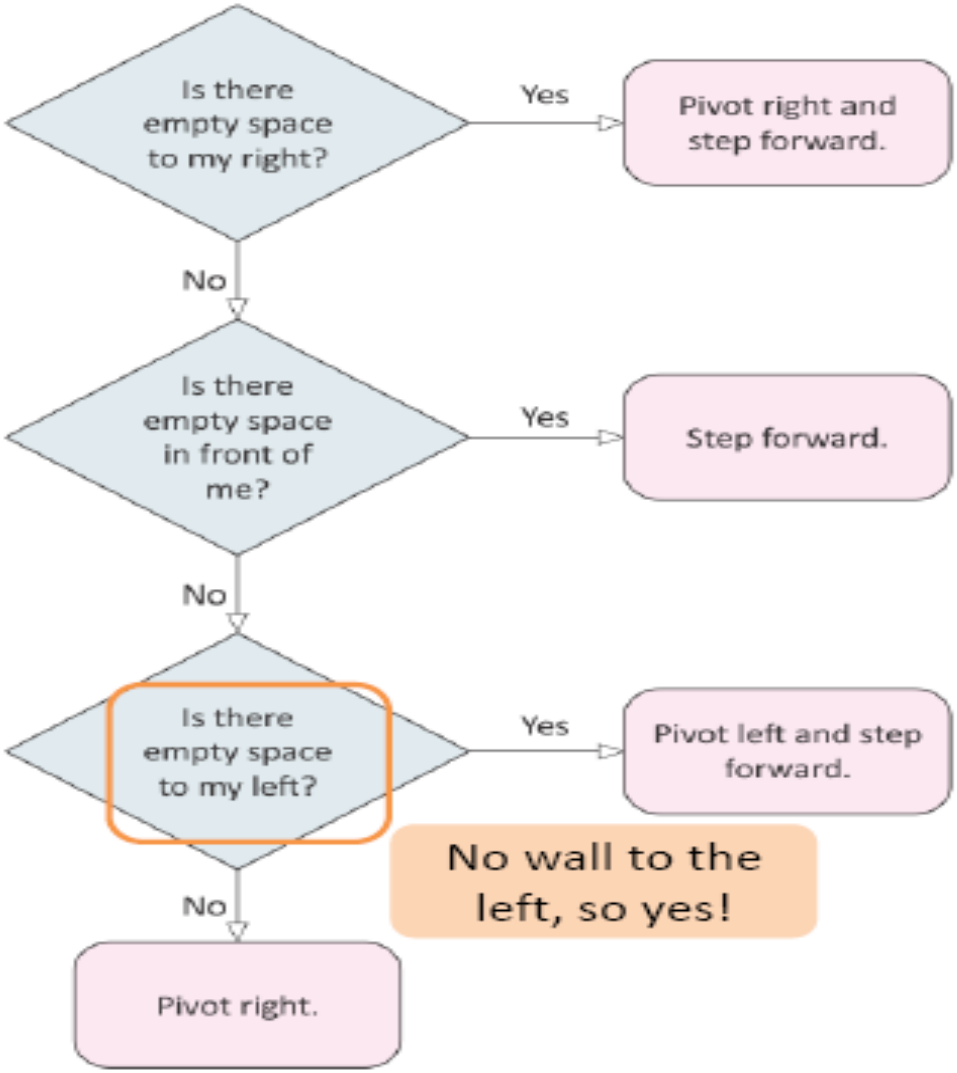
Yes
Pivot left and step forward.
No
Pivot right.

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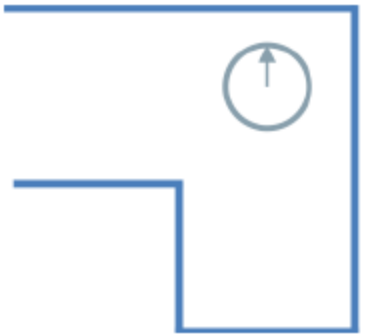
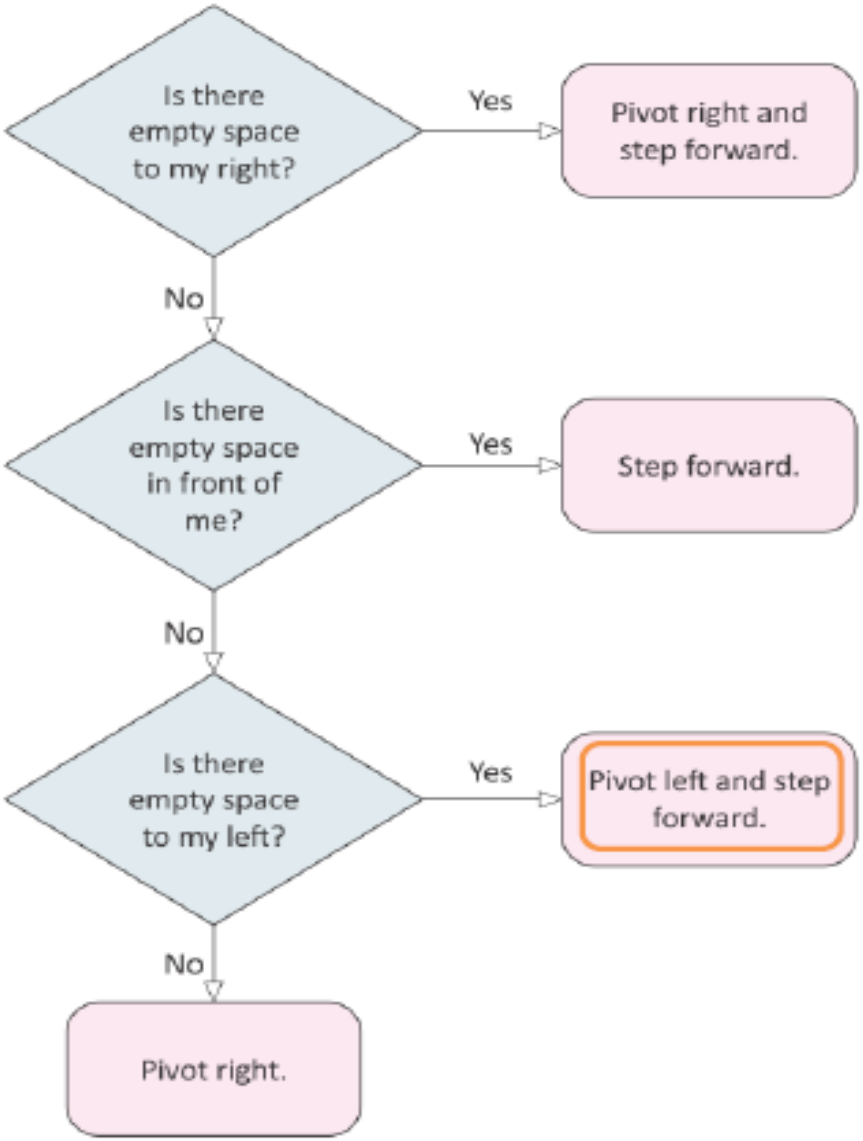
Yes
Pivot right and step forward.
No
Is there empty space in front of me?
Yes
Step forward.
No
Is there empty space to my left?
Yes
Pivot left and step forward.
No wall to the left, so yes!
No
Pivot right.

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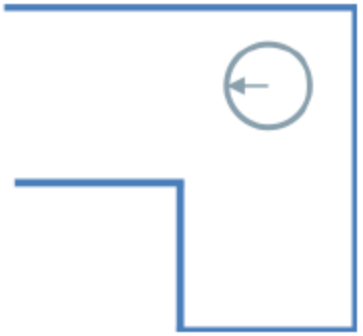
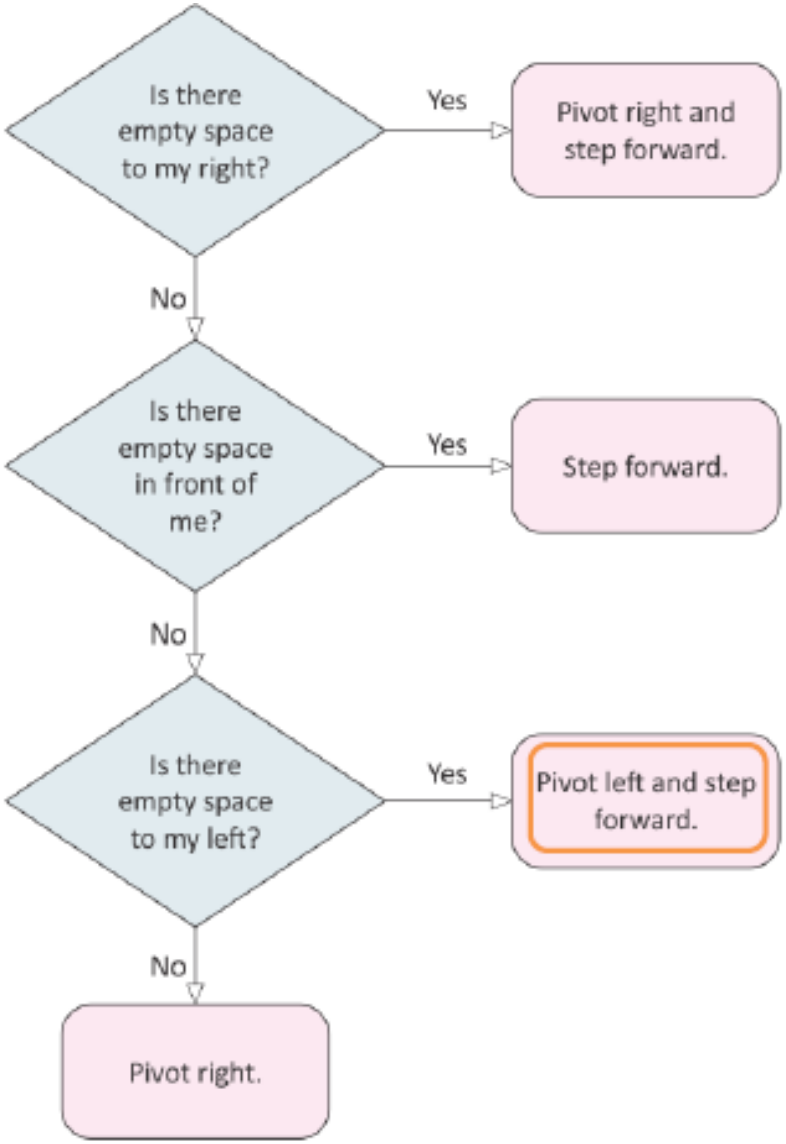
No
Pivot right.

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Yes
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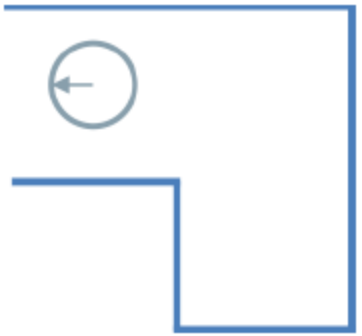
No
Pivot right.



Exercise

- Using the logic at right, suppose our robot decides to pivot left. Which of the following can be true?

```
if (wall on left) and
(no wall on right) and
(no wall on front):
    then pivot right
otherwise:
    pivot left
```

- (a)There is a wall only behind the robot and to its left.
- (b)There is a wall only behind the robot.
- (c)There is a wall to the left and right of the robot, but not in front.

What has been described?

- Selection control structure and its various forms.
- Using selection statement in algorithms and computational processes.
- Form and function of flowchart elements for selection.

Credits

- ***Programming Languages, 2nd edition, Tucker and Noonan***
- ***www.cse.msu.edu / Organization of Programming Languages-Cheng (Fall 2004)***
- ***Computing Without Computers, A Gentle Introduction to Computer Programming, Data Structures and Algorithms, Version 0.15, Paul Curzon***
- ***Google images***