

CL-1002
Programming
Fundamentals

LAB - 03
Nested Decision Structure &
Ternary Operators

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Nested If-else Statement

Placing the block of if else statement inside an existing if or else block statement is called nested If else statement. Each block of nested if else, logically perform same as simple if else statements. Whenever a user wants to check more than one condition at a time, the appropriate way is to use nested if-else statements. Following is the structure of nested if else statement.

```
IF (logical-expression) THEN
    statements
    IF (logical-expression) THEN
        statements
    ELSE
        statements
    END IF
    statements
ELSE
    statements
    IF (logical-expression) THEN
        statements
    END IF
    statements
END IF
```

Example Nested If-else statement

Problem

From the given three values, find the largest value.

Algorithm	Flowchart
<ol style="list-style-type: none">Step 1: Input X, Y,ZStep 2: if($X > Y$) thenIf($X > Z$) thenMax= X [$X > Y, X > Z$]ElseMax= Z [$Z > X > Y$]EndifElseIf($Y > Z$) thenMax = Y [$Y > X, Y > Z$]ElseMax = Z [$Z > Y > X$]EndifEndifStep 3: Print “The largest number is”, Max	<pre>graph TD Start([Start]) --> Input[/X, Y and Z/] Input --> Cond1{X > Y} Cond1 -- NO --> Cond2{Y > Z} Cond2 -- YES --> MaxY[Largest Number = Y] Cond2 -- NO --> Cond3{X > Z} Cond3 -- YES --> MaxX[Largest Number = X] Cond3 -- NO --> MaxZ[Largest Number = Z] MaxY --> Stop([Stop]) MaxX --> Stop MaxZ --> Stop</pre> The flowchart starts with an oval labeled 'Start'. It leads to a parallelogram labeled 'X, Y and Z'. From there, it branches into three decision diamonds: 'X > Y', 'Y > Z', and 'X > Z'. The 'X > Y' diamond leads to another decision diamond 'Y > Z'. If 'Y > Z' is 'YES', it leads to a parallelogram 'Largest Number = Y' and then to a final oval 'Stop'. If 'Y > Z' is 'NO', it leads to a decision diamond 'X > Z'. If 'X > Z' is 'YES', it leads to a parallelogram 'Largest Number = X' and then to 'Stop'. If 'X > Z' is 'NO', it leads to a parallelogram 'Largest Number = Z' and then to 'Stop'.

C-Implementation

```
Int x,y,z;

printf("Enter value of X");
scanf("%d",&x);
printf("Enter value of Y");
scanf("%d",&y);
printf("Enter value of Z");
scanf("%d",&z);
if(x>y){

    if(x>z){
        printf("The largest value is of x = %d",x);
    }
    else{
        printf("The largest value is of z=%d", z);
    }
}
else{
    if(y>z){
        printf("The largest value is of y= %d",y);
    }
    else{
        printf("The largest value is of z= %d",z);
    }
}
}
```

```
Enter value of X67
Enter value of Y45
Enter value of Z89
The largest value is of z =89
```

Nested Switch-Case Statement

Placing the simple switch case statements inside an existing case statement is called nested switch-case statement. Each block of nested switch case statement logically performs the same as simple switch case statement. Following is the syntax of nested switch case statement.

```
Switch(controlling expression){  
    Label set 1:  
        Statement 1;  
        Break;  
    Label set 2:  
        Statement 2; ←—————  
        Switch(controlling expression){ ←—————  
            Label set 1:  
                Statement 1;  
                Break;  
            Label set 2:  
                Statement 2;  
                Break;  
        Default:  
            Statement d;  
        }  
        Break;  
    Default:  
        Statement d;  
}
```

Example Nested switch-case statement

Problem

Ayesha is interested in knowing the names of different countries. She wants a list of countries by just giving a starting and ending letter.

C-Implementation

```
#include <stdio.h>

main()
{
    char start,e;
    printf("Please say starting letter of country");
    scanf("%c",&start);
    switch(start)
    {
        case 'A':
        case 'a':
            printf("Please say ending letter\n");
            scanf("\n%c",&e);
            switch(e)
            {
                case 'A':
                case 'a':
                    printf("\n Alaska \n Albania \n Algeria");
                    break;
                default:
                    printf("\n No such country");
            }
            break;
        case 'B':
        case 'b':
            printf("Please say ending letter\n"); scanf("\n%c",&e);
            switch(e)
            {
                case 'A':
                case 'a':
                    printf("\n Bulgeria \n Bolivia \n Botswana"); break;
                default:
                    printf(" No such country");
            }
            break;
        default:
            printf("Please type correct letter");
    }
}
```

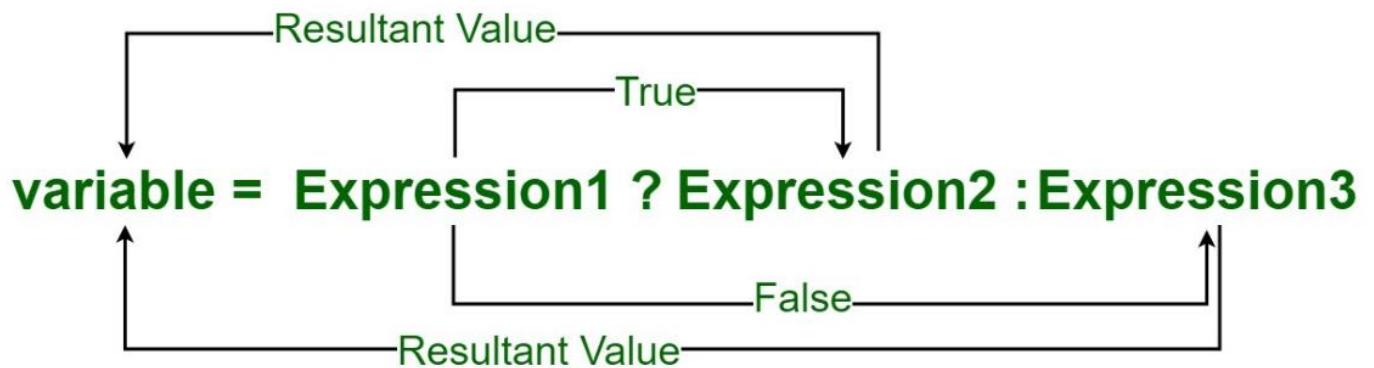
Output:

```
Please say starting letter of countryA
Please say ending letter
A

Alaska
Albania
Algeria
-----
Process exited after 8.774 seconds with return value 28
Press any key to continue . . .
```

Ternary Operator (?:) in C

Conditional or Ternary Operator (?:) in C/C++



Syntax:

The conditional operator is of the form

variable = Expression1 ? Expression2 : Expression3

Or the syntax will also be in this form

variable = (condition) ? Expression2 : Expression3

Or syntax will also be in this form

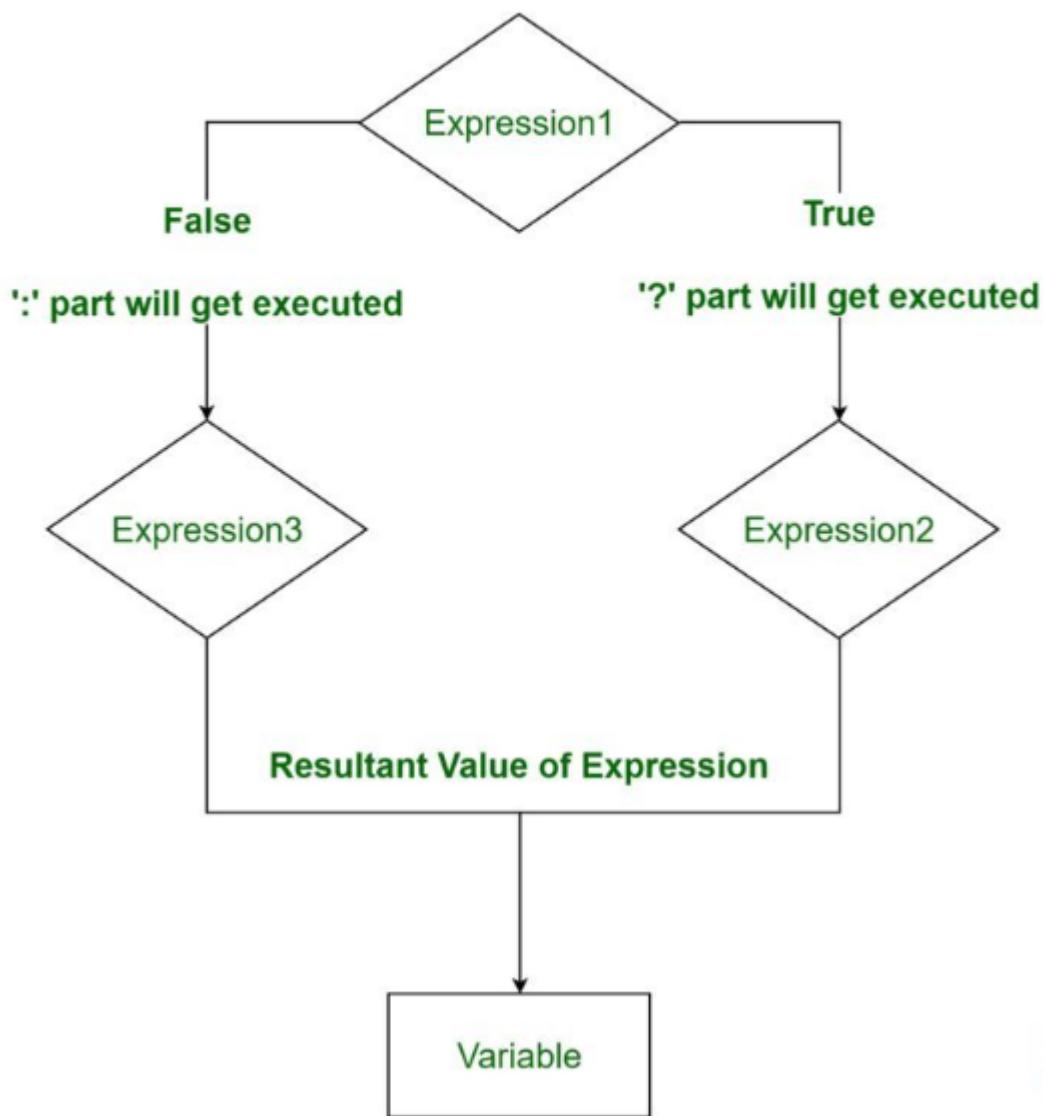
(condition) ? (variable = Expression2) : (variable = Expression3)

It can be visualized into if-else statement as:

```
if(Expression1)
{
    variable = Expression2;
}
else
{
    variable = Expression3;
}
```

The conditional operator is kind of like the if-else statement as it does follow the same algorithm as of if-else statement, but the conditional operator takes less space and helps to write the if-else statements in the shortest way possible.

Flow Chart of Conditional or Ternary Operator



Example:

```
#include <stdio.h>

int main()
{
    int m = 5, n = 4;

    (m > n) ? printf("m is greater than n that is %d > %d",
                      m, n)
               : printf("n is greater than m that is %d > %d",
                      n, m);

    return 0;
}
```

Output:

```
m is greater than n that is 5 > 4
-----
Process exited after 0.03041 seconds with return value 0
Press any key to continue . . .
```

Example 2:

```
1 #include <stdio.h>
2 int main()
3 {
4     int a=1,b=2,ans;
5     //Nested Ternary operator
6     ans=(a==1?(b==2?3:5):0);
7     printf("%d\n",ans);
8 }
```

Output:

```
3
-----
Process exited after 0.02935 seconds with return value 2
Press any key to continue . . .
```

Nesting of these operators can also be done as

```
x = 2 > 5 != 1 ? 5 < 8 && 8 > 2 ? !5 ? 10 : 20 : 30 : 40;
```

EXERCISES

Problem 1: Food Inspection

A nutritionist is creating a report on the healthiness of various food items based on their calorie and fat content. They have asked you to write a program that calculates the percentage of calories that come from fat in a food item.

One gram of fat contains 9 calories, so the number of calories from fat can be calculated as: fat grams * 9
The percentage of calories from fat can be calculated as: calories from fat/total calories

The program should take the number of calories and fat grams in a food item as input and output the percentage of calories that come from fat.

Input Validation:

The program should make sure that the number of calories and fat grams entered are not less than 0. The number of calories from fat cannot be greater than the total number of calories. If this occurs, the program should display an error message indicating that either the calories or fat grams were entered incorrectly.

Sample Input:

Enter Number of Calories: 500,

Enter Fat Gram: 50

Sample Output:

45.0%

Problem 2:

Haris is a software engineer who works Monday to Friday at a tech company. He loves to sleep in on weekends, but sometimes he goes on vacation and gets to sleep in even on weekdays. He wants to write a program that will determine if he gets to sleep in on a given day.

Haris starts by creating a function called "sleepIn" which will take two arguments, "weekday" and "vacation". If both the weekday and vacation arguments are false, the function returns "true", meaning Haris gets to sleep in. If the weekday argument is true and the vacation argument is false, the function returns "false", meaning Haris has to wake up and go to work. If the weekday argument is false and the vacation argument is true, the function returns "true" again, meaning Haris gets to sleep in while he's on vacation.

Haris tests his function with three sets of inputs, as shown in the table below:

weekday	vacation	sleepIn
false	false	true
true	false	false
false	true	true

Problem 3: Coffee Machine

You have been tasked with writing a program to simulate the operation of a coffee machine. The coffee machine can make two types of coffee: Black and White.

The program should prompt the user to choose the type of coffee (B for Black and W for White) and ask if the cup size is double. If the cup size is double, the baking time will be increased by 50 percent. The program should also ask if the coffee is manual.

Based on the user's input, the program should display the steps involved in making the coffee, along with the time required for each step, as per the following table:

Operation	White Coffee	Black Coffee
Put Water	15 mins	20 mins
Sugar	15 mins	20 mins
Mix Well	20 mins	25 mins
Add Coffee	2 mins	15 mins
Add Milk	4 mins	25 mins
Mix Well	20 mins	25 mins

Example Input:

Coffee Type (B/W): W

Cup Size (Double/Single): Double

Manual (Yes/No): Yes

Example Output:

Put Water: 30 minutes

Sugar: 30 minutes

Mix Well: 40 minutes
Add Coffee: 4 minutes
Add Milk: 8 minutes
Mix Well: 40 minutes

Note: Use switch structure to solve this problem.

Problem 4: Grocery Store

You are at a grocery store, trying to buy some groceries for the week. The store has a variety of fresh produce and pantry essentials, but for the purpose of this program, we will focus on the following items: Apples, Bananas, Carrots, and Lettuce. Each item is priced differently, and you have the option of purchasing one or two items.

The store has a unique ordering system where you can place your order using a simple menu. The menu consists of the following items and their respective prices:

- A= Apples \$1
- B= Bananas \$0.5
- C= Carrots \$0.75
- L= Lettuce \$1.5

You are tasked with writing a program that will take the number of items you wish to purchase (1 or 2) and the items you wish to purchase (represented by their letter code: A, B, C, or L) as inputs, and calculate the total cost of your order.

Your program should use nested if statements and ternary operators to determine the cost of each item based on the quantity and the price of each item.

Example:

Number of items: 2

Item 1: C

Quantity: 1

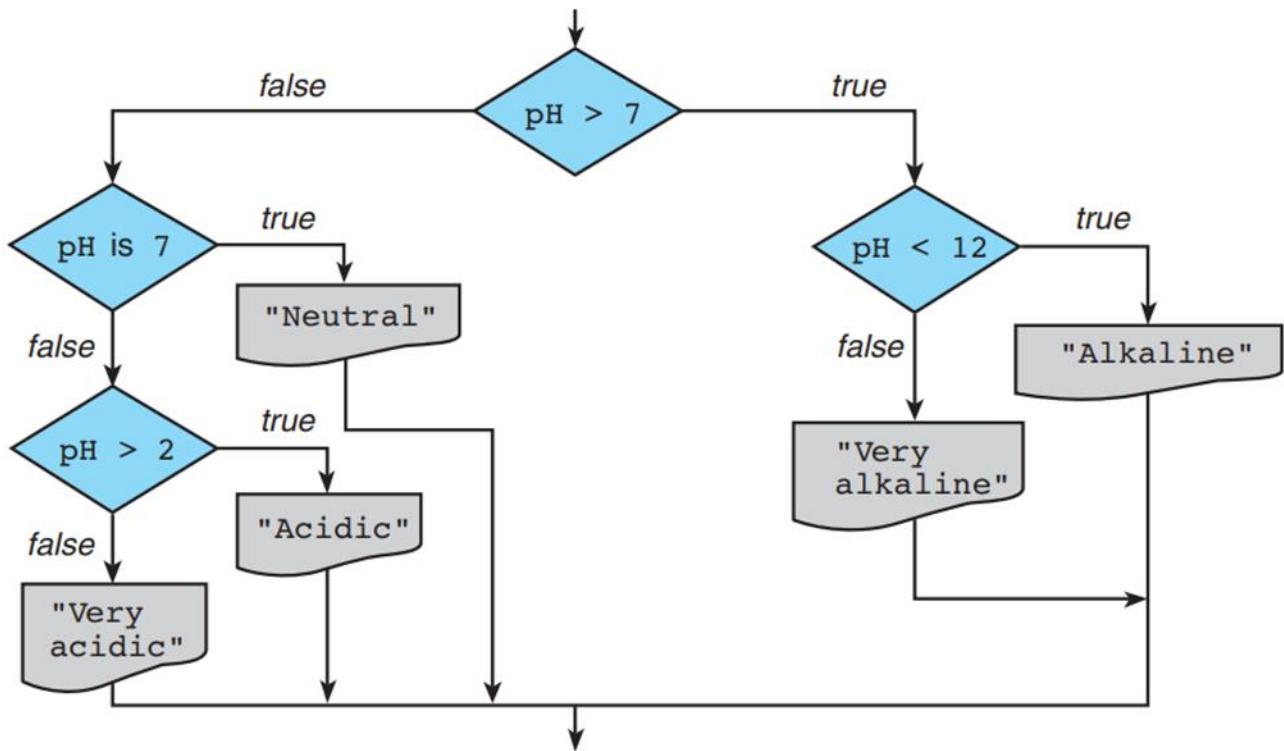
Item 2: L

Quantity: 1

Total cost: \$2.25

Problem 5:

Write a nested if statement for the decision diagrammed in the accompanying flowchart. Use a multiple-alternative if statements for intermediate decisions where possible.



Problem 6:

Implement the following decision table using a nested if statement. Assume that the grade point average is within the range 0.0 through 4.0.

Grade Point Average	Transcript Message
0.0–0.99	Failed semester—registration suspended
1.0–1.99	On probation for next semester
2.0–2.99	(no message)
3.0–3.49	Dean's list for semester
3.5–4.00	Highest honors for semester

Problem 7: Rock, Paper, Scissors Game

Two friends, Jack and Jill, have decided to play a game of Rock, Paper, Scissors. Jack will play first and will input either 'R' for rock, 'P' for paper, or 'S' for scissors. Then, Jill will input her choice. The program will then determine the winner and print the result.

You are tasked with creating a simple console-based game of rock, paper, scissors. In this game, two players will play against each other and the winner will be determined based on the following rules:

Rock beats scissors

Scissors beat paper

Paper beats rock

Your task is to write a program using nested-if that will prompt the players for their moves and determine the winner.

Example:

Jack's move: R

Jill's move: S

Result: Jack wins! Rock beats Scissors.

Problem 8: Car Insurance

You work as a software developer for a car insurance company. The company wants to develop a program that will determine the premium rate for a customer based on their driving record and car type.

The premium rate is calculated as follows:

For a customer with a clean driving record, the premium rate is calculated as follows:

- If the customer drives a sedan, the premium rate is \$100 per year.
- If the customer drives a sports car, the premium rate is \$200 per year.
- If the customer drives a truck, the premium rate is \$150 per year.

For a customer with one speeding ticket, the premium rate is calculated as follows:

- If the customer drives a sedan, the premium rate is \$110 per year.
- If the customer drives a sports car, the premium rate is \$220 per year.
- If the customer drives a truck, the premium rate is \$165 per year.

For a customer with two speeding tickets, the premium rate is calculated as follows:

- If the customer drives a sedan, the premium rate is \$120 per year.
- If the customer drives a sports car, the premium rate is \$240 per year.
- If the customer drives a truck, the premium rate is \$180 per year.

Your task is to write a program that will prompt the user for their driving record and car type, and then output the premium rate for the customer

Example:

A customer, Jane, has approached the car insurance company and is looking to get an insurance policy for her car. She has provided the company with information about her driving record and car type. The company's system will now use the information to determine the premium rate for her policy.

Input:

Enter driving record (0 for clean, 1 for one speeding ticket, 2 for two speeding tickets): 0

Enter car type (S for sedan, T for truck, C for sports car): S

Output:

The premium rate for Jane's policy is \$100 per year.

Problem 9: Salary Hike Decision

You are an HR manager at a large company and are responsible for determining employee salary hikes. The company has a complex system in place where salary hikes are determined based on various factors such as the employee's performance, years of service, and education level.

Your task is to write a program that will take the employee's information as input and determine the amount of the salary hike.

John, one of your employees, has approached you to discuss his salary. You pull up his file and start to review the information to determine the amount of the salary hike he will receive.

Based on the information in John's file, the following factors will determine his salary hike:

If his performance rating is 'Outstanding', he will receive a 15% salary hike.

If his performance rating is 'Very Good', he will receive a 10% salary hike.

If his performance rating is 'Good', he will receive a 5% salary hike.

If his performance rating is 'Average', he will receive a 2.5% salary hike.

If his performance rating is 'Below Average', he will receive a 1% salary hike.

Additionally, John has been with the company for 5 years. Based on his years of service, he will receive a 2% salary hike.

Finally, John has a Master's degree, so he will receive an additional 1% salary hike.

Example Input:

Performance Rating: Outstanding

Years of Service: 5

Education Level: Master's Degree

Example Output:

Salary Hike: 15% (Performance) + 2% (Years of Service) + 1% (Education) = 18%.

Problem 10: Air Traffic Control System

You are tasked with creating a simple air traffic control system for a small airport. In this system, planes can either take off or land based on the current weather conditions.

The weather conditions are either good (G) or bad (B). If the weather conditions are good, then planes can take off (T) or land (L). If the weather conditions are bad, then planes can only land and not take off.

Your task is to write a program that will prompt the user for the weather conditions and the action of the plane (take off or land). If the conditions are bad and the plane tries to take off, the program should print an error message. If the conditions are good or bad and the plane tries to land, the program should print a message confirming that the landing is allowed.

Example:

Weather conditions (G or B): G

Plane action (T or L): T

Result: The take off is allowed.

Weather conditions (G or B): B

Plane action (T or L): T

Result: The take off is not allowed due to bad weather conditions.