1. You are designing a flowchart and algorithm for a distance and speed calculator. The flowchart should prompt the user to input the distance traveled and the time taken and calculate the speed using the formula: **Speed = Distance / Time**.

2. You are developing an algorithm and flowchart for a circle area calculator. The flowchart should prompt the user to input the radius of a circle and calculate the area using the formula: **Area = $\pi r^2$**

3. You are designing an algorithm and flowchart for a fuel efficiency calculator in a car rental app. The flowchart should prompt the user to input the distance traveled and the amount of fuel consumed and calculate the fuel efficiency in miles per gallon (MPG) using the formula MPG = Distance / Fuel Consumption.

4. You are developing an algorithm and flowchart for a discount calculator in an online shopping app. The flowchart should prompt the user to input the original price and the discount percentage and calculate the discounted price using the formula: **Discounted Price = Original Price - (Original Price * Discount Percentage /100).**

5. You are developing a flowchart and algorithm for a monthly budget tracker. The flowchart should prompt the user to input their income and expenses and calculate the total savings using the formula **Total Savings = Income - Total Expenses**.

6. You are designing a flowchart for a loan amortization calculator. The flowchart should prompt the user to input the loan amount, interest rate, and duration, and calculate the monthly payment using the formula Monthly Payment = (Loan Amount * Interest Rate * $(1+ \text{Interest Rate})^{\text{Duration}}$) / $((1 + \text{Interest Rate})^{\text{Duration} - 1})$.

7. You are developing a flowchart and algorithm for a construction materials calculator. The Flow chart should guide the user through the process of inputting the dimensions of a room, including the length, width, and height. The goal is to calculate the surface area of the room using the provided formula:
   Surface Area = 2 * (Length * Width + Length * Height +Width * Height).

8. Develop a flowchart and an algorithm to convert a given time in hours and minutes to minutes only. Prompt the user to input the time in hours and minutes and display the converted time in minutes.

*Skill Oriented Exercise*

9. Farmer Thimmayya bought some mules at Rs. 50 each, sheep at Rs. 40 each, goats at Rs. 25 each, and pigs at Rs. 10 each. The average price of the animals per head worked to Rs. 30.What is the minimum number of animals of each kind did he buy?

10. **A Matter of Rupees and Paisa:** I have money pouch containing Rs.700. There are equal number of 25 paise coins, 50 paise coins and 1 rupee coins. How many of each are there.

11.  Develop an algorithm and flowchart that prompts the user to input the initial velocity, acceleration, and time. Calculate and display the final velocity using the formula Final

Velocity = Initial Velocity + (Acceleration * Time).

12. Develop an algorithm and flowchart that prompts the user to input the lengths of the three sides of a triangle. Calculate and display the area of the triangle using Heron's formula: Area = √(s * (s - Side1) * (s - Side2) * (s - Side3)), where s = (Side1 + Side2 + Side3) / 2.

## *Week 2:   Algorithm and Flowchart*

1. ABC Company wants to calculate the monthly salary for its employees based on various components such as basic pay, DA, HRA, and deductions for taxes and provident fund. The company follows the following rules for salary calculation:
   - The basic pay is a fixed amount each employee receives.
   - DA is calculated as 20 percentage of the basic pay.
   - HRA is calculated as 10percentage of the basic pay.
   - The gross salary is the sum of the basic pay, DA, and HRA.
   - The net salary is the gross salary minus deductions for taxes and provident fund.

   Develop an algorithm and flowchart to calculate the gross and net salary of the employee. Include the necessary steps to calculate the net salary.

2. Sarah, a dedicated student, wants to calculate her average grade for a semester. She has received marks in four different subjects and seeks assistance in creating an algorithm to determine her average grade based on these marks. Develop an algorithm and flowchart to help Sarah calculate her average grade for the semester using the marks obtained in these four subjects. Ensure that the algorithm includes the necessary steps to compute the average grade accurately.

3. John is a programmer who wants to convert a given temperature in Celsius to Fahrenheit. Help John in developing an algorithm and flowchart to perform this conversion. Design an algorithm for John to convert a given temperature in Celsius to Fahrenheit. Provide step-by-step instructions for performing the conversion.

4. **The Tall Men Next Door:** Next door to me live four brothers of different heights. Their average height is 74 inches, and the difference in height among the first three men is two inches. The difference between the third and the fourth man is six inches. Can you tell how tall each brother is?

5. **Driving Through the Country:** I decided to travel through the country leisurely and on the first day I did only 7 miles. On the last day I did 51 miles, increasing my journey by 4 miles per day. How many days did I travel and how far?

6. There is a beautiful pond in a park, filled with clear water. The park management wants to monitor the water level in the pond regularly to ensure it remains at an optimal level. They have asked you to create an algorithm to help them with this task. Develop an algorithm and  flowchart to monitor the water level in the pond and notify the park management if it falls below a certain threshold. (Note: You can assume that the input for the current water level and threshold level is obtained from a monitoring device or sensor).

7. If a participant can make one submission every 45 seconds, and a contest lasts for Y minutes, create an algorithm and flowchart to find the maximum number of submissions that the participant can make during the contest? Assume the participant is allowed to make submissions until the last second of the contest.

## *Skill Oriented Exercise*

8. Michael wants to find the largest number among a set of given numbers. Help Michael write an algorithm to determine the largest number from the given inputs. Create an algorithm and flowchart for Michael to find the largest number among a set of given inputs. Provide step-by-step instructions to identify the largest number.

9. A construction worker needs to paint the exterior walls of a rectangular building. The dimensions of the walls are L meters in length, H meters in height, and W meters in width. If the cost of painting is Rs. 20 per square meter, what will be the total cost of painting the walls? Prepare an algorithm and flowchart to calculate the total cost of painting.

10. An ice cream vendor brings 'i' litre of ice cream to a fair. Each cone requires 0.25 liters of ice cream. If the vendor sells 80 cones, Develop an algorithm and flowchart to find the number of liters of ice cream left with the vendor.

11. Amanda is planning a party and wants to determine the total number of guests attending. Assist Amanda by writing an algorithm to calculate the total number of guests based on the number of adults and children invited. Create an algorithm and flowchart for Amanda to calculate the total number of guests attending her party, considering the number of adults and children invited. Include the necessary steps to calculate the total number of guests.

1.  You are working as a financial analyst at a bank. As part of your job, you need to calculate the maturity amount for fixed deposits (FD) based on the principal amount, interest rate, and duration. For that help me to write a C program that takes the principal amount, interest rate, and duration (in years) as input from the user. Calculate and display the maturity amount using the simple interest formula: Maturity Amount = Principal + (Principal * Interest Rate * Duration).

2.  Jenny, a budding mathematician, was studying the concept of area and perimeter. She was given a rectangular garden with a known length and width. Jenny wondered if she could find the area without knowing the width. Can you help Jenny derive a formula to calculate the area of a rectangle using only the length and perimeter?

3.  Develop a C program that computes the hypotenuse of a right-angled triangle given the lengths of its two perpendicular sides. Prompt the user to enter the lengths and display the result. (Pythagorean theorem: $\text{Hypotenuse}^2 = \text{Side1}^2 + \text{Side2}^2$)

4.  Once upon a time, there was a mathematician named Alex. Alex loved solving mathematical problems and puzzles. One day, Alex came across an ancient scroll that contained a secret formula to calculate the sum of the first n natural numbers. The scroll mentioned that by using the formula, one could find the sum of any given number of natural numbers without having to manually add them up. Alex was intrigued and decided to test the formula. Can you help Alex implement a C program that uses the formula to calculate the sum of the first n natural numbers?

**Instructions:**
Write a C program that takes an input integer n from the user and calculates the sum of the first n natural numbers using the formula: **sum = (n * (n + 1)) / 2**

5.  Once upon a time in a small town, there were two friends, Kavi and Jei, who were fascinated by the concept of slopes in mathematics. They loved exploring the hills and valleys around their town and wondered how they could calculate the slope of any given landscape. One sunny day, while hiking up a hill, Kavi and Jei discovered an ancient map that had the secret to finding the slope of a line between two points. The map indicated that by using the coordinates of two points, they could determine the slope of the line connecting them. Excited about their discovery, Kavi and Jei decided to create a C program that could calculate the slope for any two points. They wanted to share their program with others so that everyone could explore the slopes of various landscapes. Can you help Kavi and Jei bring their idea to life by implementing a C program that calculates the slope of a line?

    Instructions:
    Write a C program that prompts the user to enter the coordinates of two points: (x1, y1) and (x2, y2). The program should then
    Calculate, the slope of the line connecting these points using the formula: slope = (y2 - y1) / (x2 - x1)
    Finally, the program should display the calculated slope to the user.

6.  Ravi and Kavi are on an exciting treasure hunt adventure, following a map with hidden treasures located at different coordinates. They want to calculate the distance between

two treasures to determine how far apart they are. Can you help them by writing a C program that performs this calculation?

Instructions:
Write a C program that prompts the user to enter the coordinates of two treasures: Treasure A and Treasure B. The coordinates should be in the form (x, y). Calculate the distance between the treasures using the distance formula:
$$distance = sqrt((x2 - x1)^2 + (y2 - y1)^2)$$
Finally, output a message indicating how far apart the treasures are.

7. Imagine a scenario where there is a coconut tree with multiple coconuts hanging from it. There is a person standing at a distance of "D" meters away from the tree. The coconuts are positioned at a height of "H" meters from the ground. Could you please help write a C program that calculates the angle at which the person should aim in order to hit the coconuts? (Hint: you can use the inverse tangent function (atan() in C) to determine the angle based on the ratio of the height of the coconuts to the distance from the tree.)

## *Skill Oriented Exercise*

8. In a faraway kingdom, two treasure hunters named Alex and Bella embarked on a daring quest to find valuable treasures. While exploring a mysterious cave, they stumbled upon two treasure chests, each containing a unique gemstone. Curiosity took over, and they decided to swap the gemstones inside the chests. However, a magical enchantment prevented them from directly swapping the gemstones. To fulfill their quest and restore the treasures to their rightful chests, Alex and Bella realized they could use a third variable and arithmetic operations. Can you help them by writing a C program that takes the values of the gemstones as input, and swap their values.

9. Emily, a young architect, was working on designing a cylindrical water tank for a new building. As she was finalizing the plans, she needed to calculate the surface area of the cylinder to determine the amount of material required for its construction. However, she was unsure of the exact formula and the steps involved in the calculation. Can you help Emily by writing a C program that assists her in calculating the surface area of a cylinder?( Surface Area $= 2\pi r^2 + 2\pi rh$)

10. Hemanth is an architect who wants to design a garden with a beautiful polygon-shaped fountain at its center. He needs to calculate the area of the polygon so that he can determine the appropriate size for the fountain. Help Hemanth by writing a C program that calculates the area of a regular polygon when given the number of sides and the length of each side.
Area = (numSides * sideLength * sideLength) / (4 * tan($\pi$ / numSides))

11. Prathima loves ice cream cones and wants to decorate the surface of her favorite ice cream cone with colorful stickers. To know how many stickers she needs, she wants to calculate the surface area of the cone. Help Prathima by writing a C program that calculates the surface area of a cone when given the radius of the base and the slant height, (Surface Area $= \pi * r * (r + l)$)

12. **RIGHT FOOT FORWARD:** A short man takes three steps to a tall man's two steps. They both start out on the left foot. How many steps do they have to take before they are both stepping out on the right foot together?

**Week: 4  Data Types, Console I/O, Operators Storage Classes**

**PREDICT THE OUTPUT:**
**1.** #include <stdio.h>                                    **Output:**
  int main() {
     int a = 5; float b = 3.5;
     int result = a + b; printf("%d\n", result); return 0;
  }


2. #include <stdio.h>                                    **Output:**
    int main() { int a = 10; int b = 20;
    int result = a * b / 4 % 3; printf("%d\n", result); return 0;
  }


3.  #include <stdio.h>                                    **Output:**
    int main() { int a = 15; int b = 10;
    int result = (a > b) && (b != 0); printf("%d\n", result);
    return 0;
  }

4.  #include <stdio.h>                                    **Output:**
    int main() { int a = 10; int b = 5;
    int result = (a > b) || (a == 10); printf("%d\n", result);
    return 0;
  }

5. #include <stdio.h>                                    **Output:**
    int main() {
    int x = 3, y = 2;
    int result = x * y - y / x % y; printf("%d\n", result);  return 0;
  }

**6.** #include <stdio.h>                                    **Output:**
    int main() { int x = 5;
    int *ptr1 = &x;
    int **ptr2 = &ptr1; printf("%d\n", **ptr2); return 0;
}

**7.** #include <stdio.h>                                    **Output:**
    int main() { int x = 5;
    int *ptr1, *ptr2; ptr1 = &x;
    ptr2 = ptr1; printf("%d\n", *ptr2); return 0;
}

**8.** #include <stdio.h>                                    **Output:**
    int main() { int x = 51;
    int *ptr = &x; printf("%d\n", *ptr); x = 15;
    printf("%d\n", *ptr); return 0;

}

**9.** #include <stdio.h>                                    **Output:**
```
int main() { float *ptr;
printf("Size of ptr: %lu bytes\n", sizeof(ptr)); return 0;
}
```

**10.** #include <stdio.h>                                   **Output:**
```
int main() { double arr[5];
printf("Size of arr: %lu bytes\n", sizeof(arr)); return 0;
}
```

**11.** #include <stdio.h>                                   **Output:**
```
int main() {
int x = 10; if (x > 5) {
printf("Hello\n");
}
printf("Goodbye\n"); return 0;
}
```

### *Skill Oriented Exercise*

**Find the syntax error, logical errors if any in the following code snippet:**

**1.**   #include <stdio.h>                                   **Errors:**
```
int main() {
printf("Hello, KLU Family!\n") return 0;
}
```

**2.**   #Include <stdio.h>                                   **Errors:**
```
int main() {
int x = 5, y = 0; int result = x / y;
printf("The result is: %d\n", result); return 0;
}
```

**3.** #include <stdio.h>                                     **Errors:**
```
int main() { int x = 5; int *ptr;
*ptr = &x; printf("%d\n", *ptr); return 0;
}
```

**4.** #include <stdio.h>                                     **Errors:**
```
int main() { int x = -5; if (x) {
printf("x is not zero\n");
} else
{
printf("x is zero\n";)
}
return 0;
}
```

1. Chef and Chefina are playing with dice. In one turn, both of them roll their dice at once. They consider a turn to be good if the sum of the numbers on their dice is greater than 6. Given that in a particular turn Chef and Chefina got X and Y on their respective dice, find whether the turn was good.

2. Chef has been working hard to compete in MasterChef. He is ranked *X* out of all contestants. However, only 10 contestants would be selected for the finals. Check whether Chef made it to the top 10 or not?

3. Apple considers any iPhone with a battery health of 80% or above, to be in *optimal* condition. Given that your iPhone has *X*% battery health, find whether it is in *optimal* condition.

4. In a classic chase, Tom is running after Jerry as Jerry has eaten Tom's favorite food. Jerry is running at a speed of *X* metres per second while Tom is chasing him at a speed of *Y* metres per second. Determine whether Tom will be able to catch Jerry.
Note that initially Jerry is not at the same position as Tom.

5. Chef has started studying for the upcoming test. The textbook has *N* pages in total. Chef wants to read at most *X* pages a day for *Y* days. Find out whether it is possible for Chef to complete the whole book.

6. Chef has finally got the chance of his lifetime to drive in the *F*1 tournament. But, there is one problem. Chef did not know about the 107% rule and now he is worried whether he will be allowed to race in the main event or not.
Given the fastest finish time as *X* seconds and Chef's finish time as *Y* seconds, determine whether Chef will be allowed to race in the main event or not.
Note that, Chef will only be allowed to race if his finish time is within **107%** of the fastest finish time.

## *Skill Oriented Exercise*

7. Chef wants to host a party with a total of *N* people. However, the party hall has a capacity of *X* people. Find whether Chef can host the party.

8. Chef has to attend an exam that starts in *X* minutes, but of course, watching shows takes priority. Every episode of the show that Chef is watching, is 24 minutes long. If he starts watching a new episode now, will he finish watching it **strictly before** the exam starts?

9. Chef has to travel to another place. For this, he can avail any one of two cab services.
   • The first cab service charges *X* rupees.
   • The second cab service charges *Y* rupees.
   Chef wants to spend the **minimum** amount of money. Which cab service should Chef take?

10. Chef categorizes an Instagram account as *spam*, if, the *following* count of the account is more than 10 times the count of *followers*.

Given the *following* and *follower* count of an account as *X* and *Y* respectively, find whether it is a *spam* account.

11. Chef is watching TV. The current volume of the TV is *X*. Pressing the volume up button of the TV remote increases the volume by 11 while pressing the volume down button decreases the volume by 11. Chef wants to change the volume from *X* to *Y*. Find the minimum number of button presses required to do so.

12. Cities on a map are connected by a number of roads. The number of roads between each city is in an array and city 0 is the starting location. The number of roads from city 0 to city 1 is the first value in the array, from city 1 to city 2 in the second, and so on. How many paths are there from city 0 to the last city in the list, modulo 1234567?

**13. Square within Square**
Write a C program to determine the number of squares in the given illustration below
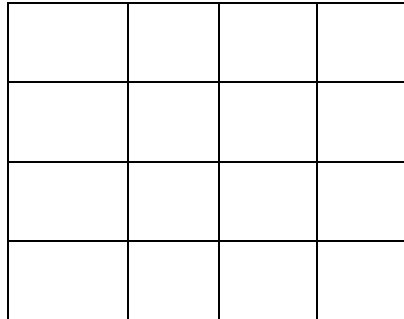
## Week 6: Loops, Increment and Decrement operator

1. Sum of digits of five digit number.
   Given the five digit number, print the sum of its digits.
   **Input**
   10564
   **Output**
   16

2. Write a program that takes two integers as input, start and end. The program should use for loop to iterate from start to end (both inclusive).

3. Write a C program that takes the input for multiple test cases. For each test case, the program should receive two integers, E and K, representing the energy at the lowest trophic level and the energy reduction factor, respectively. The program should calculate and output the maximum length of the food chain for each test case.

4. Write a program in C that takes an integer, n, as input, representing the number of multiplication tables to be generated. The program should output the multiplication table for each number from 1 to n, up to a multiple of 10.

5. Alice, Bob, and Charlie have different preferences for numbers. Alice likes numbers that are even and multiples of 7, while Bob prefers numbers that are odd and multiples of 9. They have found a number, A, and the task is to determine who takes it home.
   Write a program that takes an integer, A, as input and outputs the person who takes the number home based on their preferences. If A is an even multiple of 7, Alice takes it home. If A is an odd multiple of 9, Bob takes it home. If neither Alice nor Bob likes the number, Charlie takes it home.

6. Chef owns a car that can run 15 kilometers using 1 litre of petrol. He wants to attend a programming camp at DAIICT, which is a distance of Y kilometers from his house. Chef currently has X litres of petrol in his car. The task is to determine whether Chef can attend the event at DAIICT and return to his home with the given amount of petrol. Write a program that takes two integers, X and Y, as input and outputs whether Chef can complete the round trip with the available petrol.

### Skill Oriented Exercise

7. Listen to this story: a boy and his father, a computer programmer, are playing with wooden blocks. They are building a pyramid. Their pyramid is a bit weird, as it is actually a pyramid- shaped wall - it's flat. The pyramid is stacked according to one simple principle: each lower layer contains one block more than the layer above. The figure illustrates the rule used by the builders:
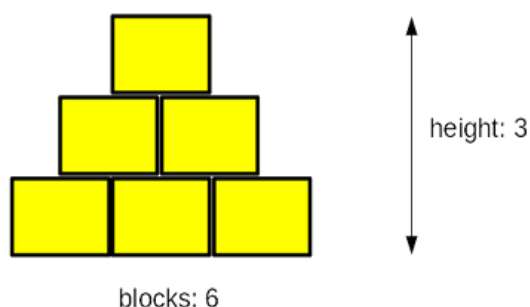


height: 3

blocks: 6

Note: the height is measured by the number of fully completed layers - if the builders don't have a sufficient number of blocks and cannot complete the next layer, they finish their work immediately.

**Sample input: 6**
**Expected output: The height of the pyramid: 3 Sample input: 1000**
**Expected output: The height of the pyramid: 44**

8. **The Special Number**
There is a number whose double is greater than its half by 45. Can you find this number?

9. Chef is a student at a university, and the university has a requirement that students must be present for at least 75% of the working days in a semester to pass. The semester has a total of 120 working days. Chef has been taking a lot of holidays and is worried about meeting the attendance requirement. The information about the days Chef has attended or been absent is given as a sequence of N bits: B1, B2, ..., BN. If Bi = 0, it means Chef was absent on the ith day, and if Bi = 1, it means Chef was present on that day. The task is to determine if Chef can pass the attendance requirement by the end of the semester. Write a program that takes an integer N as input, followed by a sequence of N bits, and outputs whether Chef can hope to pass the attendance requirement or not.

10. There are N piles where the i$^{th}$ pile consists of A¡ stones. Chef and Chefina are playing a game taking alternate turns with Chef starting first. In his/her turn, a player can choose any non-empty pile and remove exactly 1 stone from it. The game ends when exactly 1 pile becomes empty. The player who made the last move wins. Determine the winner if both players play optimally.

11. Write the c program for following pattern

```
1 2 3 4 5
1 2 3 4
1 2 3
1 2
1
```

12. Write a program to obtain a number N and increment its value by 1 if the number is divisible by 4 otherwise decrement its value by 1.

*Week 7: Arrays*

1. Given a large integer represented as an integer array digits, where each digits[i] is the i-th digit of the integer, ordered from most significant to least significant in left-to-right order (without any leading zeros), implement a program to increment the large integer by one and return the resulting array of digits.

2. Chef has set a target to solve at least 10 problems every week for a duration of 4 weeks. The input consists of four integers representing the number of problems Chef solved in each week (P1, P2, P3, and P4). The task is to determine the number of weeks in which Chef met his target. The output should be a single integer indicating the count of weeks where Chef solved at least 10 problems.

3. Code Chef recently revamped its practice page to make it easier for users to identify the next problems they should solve by introducing some new features: Recent Contest Problems - contains only problems from the last 2 contests Separate Un-Attempted, Attempted, and All tabs.

Problem Difficulty Rating - the recommended dropdown menu has various difficulty ranges so that you can attempt the problems most suited to your experience Popular Topics and Tags. Like most users, Chef didn't know that he could add problems to a personal to-do list by clicking on the magic '+' symbol on the top-right of each problem page. But once he found out about it, he went crazy and added loads of problems to his to-do list without looking at their difficulty rating.

Chef is a beginner and should ideally try and solve only problems with difficulty rating strictly less than 1000. Given a list of difficulty ratings for problems in the Chef's to-do list, please help him identify how many of those problems Chef should remove from his to-do list, so that he is only left with problems of difficulty rating less than 1000.

4. You are given an array price where prices[i] is the price of a given stock on the ith day. You want to maximize your profit by choosing a single day to buy one stock and choosing a different day in the future to sell that stock. Return the maximum profit you can achieve from this transaction. If you cannot achieve any profit, return 0.

5. Given a non-empty array of integer's nums, every element appears twice except for one. Find that single one. You must implement a solution with a linear runtime complexity and use only constant extra space.

6. Given an array nums of size n, return the majority element. The majority element is the element that appears more than $\lfloor n/2 \rfloor$ times. You may assume that the majority element always exists in the array.

7. Write a C program to calculate the factorial of small positive integers. The input consists of an integer 't' representing the number of test cases, followed by 't' lines containing a single integer 'n' ($1 <= n <= 100$) for each test case. The output should display the factorial of 'n' on a separate line for each input value of 'n'.

8. (Puzzle)On the Way to Market One morning.
I was on my way to the market and met a man who had 4 wives. Each of the wives had 4 bags, containing 4 dogs and each dog had 4 puppies. Taking all things into consideration how many were going to the market?

9. Vasya likes the number 239. Therefore, he considers a number pretty if its last digit 2,3 or 9. Vasya wants to watch the numbers between L and R (both inclusive), so he asked you to determine how many pretty numbers are in this range. Can you help him?

10. You are participating in a contest which has 11 problems (numbered 1 through 11). The first eight problems (i.e. problems 1,2,…,8) are scorable, while the last three problems (9,10 and 11) are non-scorable — this means that any submissions you make on any of these problems do not affect your total score.

Your total score is the sum of your best scores for all scorable problems. That is, for each scorable problem, you look at the scores of all submissions you made on that problem and take the maximum of these scores (or 0 if you didn't make any submissions on that problem); the total score is the sum of the maximum scores you took. You know the results of all

submissions you made. Calculate your total score.

**11.** Write a C program to help Joe and Lilly multiply two matrices, A and B. The program should take input for multiple test cases. For each test case, the program should read the dimensions and values of matrices A and B. If the multiplication is possible, the program should print the output matrix values. If the multiplication is not possible, the program should print "IMPOSSIBLE".

12.  You are given an m x n integer matrix with the following two properties:
Each row is sorted in non-decreasing order. The first integer of each row is greater than the last integer of the previous row. Given an integer target, return true if target is in matrix or false otherwise.

| 1 | 3 | 5 | 7 |
|---|---|---|---|
| 10 | 11 | 16 | 20 |
| 23 | 30 | 34 | 60 |

Input: matrix = [[1,3,5,7],[10,11,16,20],[23,30,34,60]], target = 3
Output: true

13. You are given an m x n integer grid accounts where accounts[i][j] is the amount of money the ith customer has in the jth bank. Return the wealth that the richest customer has A customer's wealth is the amount of money they have in all their bank accounts. The richest customer is the customer that has the maximum wealth.

14.  Given a square matrix mat, return the sum of the matrix diagonals. Only include the sum of all the elements on the primary diagonal and all the elements on the secondary

| 1 | 2 | 3 |
|---|---|---|
| 4 | 5 | 6 |
| 7 | 8 | 9 |

secondary diagonal          primary diagonal
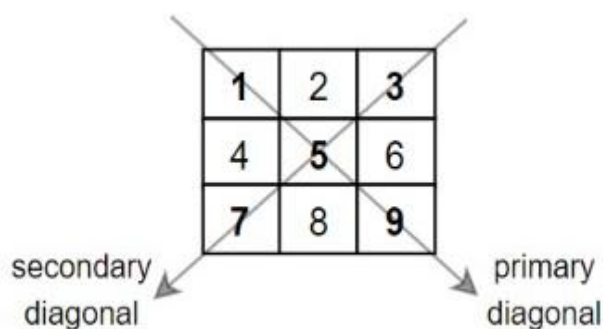
```
Input: mat = [[1,2,3],
              [4,5,6],
              [7,8,9]]
Output: 25
Explanation: Diagonals sum: 1 + 5 + 9 + 3 + 7 = 25
Notice that element mat[1][1] = 5 is counted only once.
```

diagonal that are not part of the primary diagonal.

15. Write a program to perform matrix multiplication. If Multiplication cannot be done for a given matrices then print "NOT POSSIBLE"

$$A = \begin{pmatrix} 1 & 2 \\ 3 & 4 \end{pmatrix} \quad B = \begin{pmatrix} 5 & 6 & 7 \\ 8 & 9 & 10 \end{pmatrix}$$

Multiplication of two matrixes:

$$A * B = \begin{pmatrix} 1*5 + 2*8 & 1*6 + 2*9 & 1*7 + 2*10 \\ 3*5 + 4*8 & 3*6 + 4*9 & 3*7 + 4*10 \end{pmatrix}$$

$$A * B = \begin{pmatrix} 21 & 24 & 27 \\ 47 & 54 & 61 \end{pmatrix}$$

**Input:**
1) Read the row & column size of matrix 1
2) Read the matrix 1
3) Read the row & column size of matrix 2
4) Read the matrix 2
**Output:**
Resultant Matrix.

| Sample Input | Sample Output |
|---|---|
| 2 2 | 7 10 |
| 1 2 | 15 22 |
| 3 4 | |
| 2 2 | |
| 1 2 | |
| 3 4 | |

16. Given two sorted arrays nums1 and nums2 of size m and n respectively, return the median of the two sorted arrays.
Input: nums1 = [1,3], nums2 = [2] Output: 2.00000
Explanation: merged array = [1,2,3] and median is 2.

17. Given a m x n grid filled with non-negative numbers, find a path from top left to bottom right, which minimizes the sum of all numbers along its path.
Note: You can only move either down or right at any point in time.

| 1 | 3 | 1 |
|---|---|---|
| 1 | 5 | 1 |
| 4 | 2 | 1 |

Input: grid = [[1,3,1],[1,5,1],[4,2,1]]
Output: 7
Explanation: Because the path 1 → 3 → 1 → 1 → 1 minimizes the sum.

18.     Given an array nums of size n, return the majority element. The majority element is the element that appears more than ⌊n / 2⌋ times. You may assume that the majority element always exists in the array.
**Input: nums = [3,2,3] Output: 3**

19.     Given a sorted array of distinct integers and a target value, return the index if the target is found. If not, return the index where it would be if it were inserted in order.

Input: nums = [1,3,5,6], target = 5 Output: 2

20. Given a m x n matrix grid which is sorted in non-increasing order both row-wise and column-wise, return the number of negative numbers in grid.

```
Input: grid = [[4,3,2,-1],[3,2,1,-1],[1,1,-1,-2],[-1,-1,-2,-3]]
Output: 8
Explanation: There are 8 negatives number in the matrix.
```

Example 2:

```
Input: grid = [[3,2],[1,0]]
Output: 0
```

## Week 8: String Handling

1. Louise joined a social networking site to stay in touch with her friends. The signup page required her to input a *name* and a *password*. However, the password must be *strong*. The website considers a password to be *strong* if it satisfies the following criteria:
   - Its length is at least 6.
   - It contains at least one digit.
   - It contains at least one lowercase English character.
   - It contains at least one uppercase English character.
   - It contains at least one special character. The special characters are: @#$%^&*()-+!

2. A space explorer's ship crashed on Mars! They send a series of SOSmessages to Earth for help.



Letters in some of the SOS messages are altered by cosmic radiation during transmission. Given the signal received by Earth as a string, determine how many letters of the SOS message have been changed by radiation.

   s = 'SOSTOT'

**Example**

The original message was SOSSOS. Two of the message's characters were changed in transit.

**Function Description**

Complete the marsExploration function in the editor below. marsExploration has the following parameter(s):

string s: the string as received on Earth

**Returns**

int: the number of letters changed during transmission

3. Chef has a string S with him. Chef is happy if the string contains a contiguous substring of length strictly greater than 2 in which all its characters are vowels.
   Determine whether Chef is happy or not.
   Note that, in english alphabet, vowels are a, e, i, o, and u.

4. Given two strings needle and haystack, return the index of the first occurrence of needle in haystack, or -1 if needle is not part of haystack.

5. Given a string s consisting of words and spaces, return the length of the last word in the string. A word is a maximal substring consisting of non-space characters only.

6. Given a string S, reverse only all the vowels in the string and return it. The vowels are 'a', 'e', 'i', 'o', and 'u', and they can appear in both lower and upper cases, more than once.

7. You have been given a String S. You need to find and print whether this string is a palindrome or not. If yes, print "YES" (without quotes), else print "NO" (without quotes).

### *Skill Oriented Exercise*

8. Jeff, Chef's younger brother, is learning to read and knows a subset of the Latin alphabet. Chef gave Jeff a book with N words to practice. Jeff can only read words that consist of the letters he knows. The task is to determine which words Jeff can read based on the given letters and output "Yes" or "No" accordingly.

9. Timur loves code forces. That's why he has a string S having length 10 made containing only lowercase Latin letters. Timur wants to know how many indices string s differs from the string "codeforces".
For example string s= "coolforsez" differs from "codeforces" in 4 indices, shown in bold.

**Up the Ladder**
A man wants to reach window which is 40ft above from the ground. And the distance between the foot of the ladder and wall is 9 feet. How long should the ladder be?

10. Given two strings s and t, return true if t is an anagram of s, and false otherwise. An Anagram is a word or phrase formed by rearranging the letters of a different word or phrase, typically using all the original letters exactly once. Given a string s, find the first non-repeating character in it and return its index. If it does not exist, return -1.

11. A robot starts at the origin (0, 0) on a 2D plane. It is given a sequence of moves represented by the string "moves". Each move is represented by 'R' (right), 'L' (left), 'U' (up), or 'D' (down). The task is to determine if the robot returns to the origin after completing all the moves. The robot's direction is irrelevant, and all moves have the same magnitude. Return true if the robot ends up at the origin, and false otherwise.

12. Chandu is a bad student. Once his teacher asked him to print the reverse of a given string. He took three hours to solve it. The teacher got agitated at Chandu and asked you the same question. Can you solve it?

13. There is a string s of lowercase English letters that is repeated infinitely many times. Given an integer n find and print the number of letter a's in the first n letters of the infinite string.

1.  Given an integer n, return true if it is a power of three. Otherwise, return false. An integer n is a power of three, if there exists an integer x such that n == $3^x$.
2.  You are climbing a staircase. It takes n steps to reach the top. Each time you can either climb 1 or 2 steps. In how many distinct ways can you climb to the top?

3. Given an integer n, return true if it is a power of four. Otherwise, return false. An integer n is a power of four, if there exists an integer x such that n == $4^x$.

4.  You are given an integer N. You need to print N! - the factorial of N.
**Input** The first line of the input contains a single integer *T* denoting the number of test cases. The description of *T* test cases follows. The first and only line of each test case contains a single integer *N*.
   **Output** For each test case print a single line containing a single integer *N*!

5. The Fibonacci numbers, commonly denoted F(n) form a sequence, called the Fibonacci sequence, such that each number is the sum of the two preceding ones, starting from 0 and 1

6. Kristen loves playing with and comparing numbers. She thinks that if she takes two different positive numbers, the one whose digits sum to a larger number is *better* than the other. If the sum of digits is equal for both numbers, then she thinks the smaller number is *better*. For example, Kristen thinks that 13 is better than 31 and that12 is better than 11 .Given an integer,n ,can you find the divisor of n that Kristin will consider to be the best?
7. A perfect number is a positive integer that is equal to the sum of its positive divisors, excluding the number itself. A divisor of an integer x is an integer that can divide x evenly. Given an integer n, return true if n is a perfect number, otherwise return false.
8. Given an integer num, repeatedly add all its digits until the result has only one digit, and return it.
9. **Something for Profit:** A friend of mine bought a used pressure cooker for Rs. 60. She somehow did not find it  useful and so when a friend of hers offered her Rs. 70 she sold it to her. However, she felt bad after selling it and decided to buy it back from her friend' by offering her Rs. 80. After having bought it once again she felt that she did not really need the cooker. So, she sold it at the auction for Rs. 90. How much profit did she make? Did she at all make any profit?
10.    Given a signed 32-bit integer x, return x with its digits reversed. If reversing x causes the value to go outside the signed 32-bit integer range [$-2^{31}$, $2^{31}$ - 1], then return 0.

11.          Given an integer array nums, move all 0's to the end of it while maintaining the relative order of the non-zero elements.

12.          Write a function that takes the binary representation of an unsigned integer and returns the number of '1' bits it has (also known as the Hamming weight).

13.          Martha is interviewing at Subway. One of the rounds of the interview requires her to cut a bread of size l X b into smaller identical pieces such that each piece is a square having maximum possible side length with no leftover piece of bread.

14.          Given N two-dimensional points in space, determine whether they lie on some

vertical or horizontal line.
        If yes, print YES; otherwise, print NO.

*Skill Oriented Exercise*

### PREDICT THE OUTPUT

```
#include <stdio.h> void foo(int n) {
        if (n > 0) { printf("%d ", n); foo(n - 1); printf("%d ", n);
          }
        }
int main() {
        foo(3); return 0;
}
```

**1. What is the output of the above program?**
- 3 2 1 1 2 3
- 3 2 1
- 1 2 3
- 1 2 3 3 2 1

```
#include <stdio.h> int bar(int n) {
        if (n <= 0) { return 0;
        } else {
        return n + bar(n - 2);
        }
}
int main() {
        int result = bar(7); printf("%d", result); return 0;
}
```

**2.        What is the output of the above program?**
- 20
- 16
- 14
- 12

```
#include <stdio.h> void baz(int n) {
        if (n > 0) {
        baz(n / 2); printf("%d ", n % 2);
    }
}
int main() {
        baz(10); return 0;
}
```

**3.        What is the output of the above program?**

- 1 0 1 0
- 0 1 0 1
- 0 0 1 0 1
- 1 1 0 1

```c
#include <stdio.h> int factorial(int n) {
        if (n == 0) { return 1;
        } else {
        return n * factorial(n - 1);
}
int main() {
        int result = factorial(5); printf("%d", result); return 0;
}
```

**4.       What is the output of the above program?**
- 120
- 24
- 25
- 20

```c
#include <stdio.h>
int power(int base, int exponent) { if (exponent == 0) { return 1;
        } else {
        return base * power(base, exponent - 1);
        }
}

int main() {
        int result = power(2, 4); printf("%d", result); return 0;
}
```

**5.       What is the output of the above program?**
- 16
- 8
- 32
- 64

1. You are building a payroll system for a company with multiple departments. Design a program using structures that stores employee details such as name, employee ID, and salary. Implement an array of structures to store employee records for each department. Calculate the total salary expenditure for each department and display it. Additionally, identify the department with the highest salary expenditure and acknowledge it as the top-performing department

**2.** VGP logistics is a premium Cargo service for Sending/receiving parcels from Vijayawada to Singapore. You are appointed as Manager in delivery department and need to maintain the arrival and delivery of the consignments sent/received. Create a structure consignment with the following Members Consignment_id, name, from, to, DOS (Date of Shipment), net weight, Address.
   For Example:
   Consignment_id: 1008 Name: Haier Steamer From: Vijayawada
   To: Singapore
   DOS (Date of Shipment): 30-may-2023 net_weight: 28.8 kg
   Address: Mint Street Chennai

3. You have been assigned the task of developing a student grading system for a prestigious college. Design a program using structures that stores student details, such as name, roll number, and marks in various subjects. Implement an array of structures to store multiple student records and calculate the overall percentage for each student. Additionally, provide a functionality to generate a grade for each student based on their percentage and display it alongside their record.

4. You are developing a soldier management system for an army unit. Each soldier's record consists of the following information: name, rank, and years of service. Implement an array of structures to store the records of multiple soldiers. Write a C program to calculate and display the average years of service for all soldiers in the unit.

5. You are working on a ship management system for a naval fleet. Each ship's record contains the following details: name, type (e.g., aircraft carrier, destroyer), and year of commissioning. Implement an array of structures to store the ship records. Write a C program to search for a specific type of ship within the fleet and display the names of all ships belonging to that type.

6. You have been assigned the task of developing a pilot roster system for an air force squadron. Each pilot's record inclu des the following information: name, rank, and flight hours. Implement an array of structures to store the pilot records. Write a C program to find and display the pilot with the highest number of flight hours in the squadron.

7. You are working on a reservation system for a luxurious hotel. Create a program using structures that stores guest details, including name, room number, and check-in date. Implement an array of structures to store multiple guest records and allow the hotel staff to search for guests by either their room number or name. Provide an additional feature that calculates the duration of each guest's stay and generates the total revenue earned by the hotel.

8. You have been tasked with developing a library management system for a renowned library. Create a program using structures that stores book information, including title, author, and publication year. Implement an array of structures to store multiple book records and allow the librarian to search for books by either title or author's name. Enhance the system by enabling the librarian to borrow and return books, updating the book status accordingly.

9. You have been assigned the task of creating a customer billing system using an array of structures. Each structure should store the customer's name, account number, and total amount due. Implement functions to add customer records, display all records, and find the customer with the highest amount due.

10. You are working on a car inventory management system using an array of structures. Each structure should hold the details of a car, including the make, model, and year of manufacture. Implement functions to add car records, display all records, and find the newest car in the inventory.

11. You are developing a product inventory management system for a retail store. Each product has a unique identifier, name, price, and quantity in stock. Implement an array of structures to store the product records. Create functions to add new products, update product details, display all products, and search for products based on their identifier or name.

*Week 11: Class and Objects:*
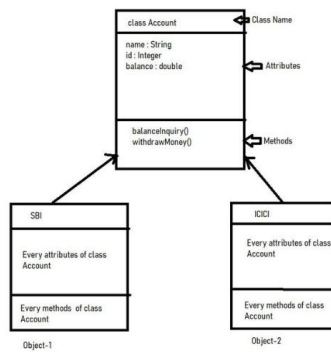


1. Create a class and the object code for the above scenario.
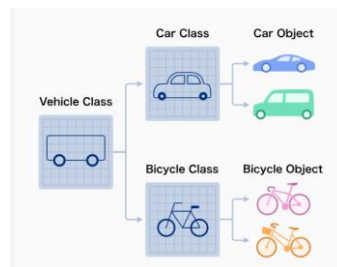


2. Develop code for Class and Object.

*Week 12: Data Abstraction*

Developing a banking application that handles various types of accounts such as savings, checking, and loans.

- **Abstraction Use:** Create abstract classes or interfaces like Account with common methods (e.g., deposit(), withdraw(), getBalance()). Concrete classes (e.g., SavingsAccount, CheckingAccount) implement these methods. The user interacts with Account objects without needing to know the specific type of account or its internal workings.

**Inheritance**

Developing a graphical user interface (GUI) library with various types of buttons.

- **Inheritance Use:** Create a base class Button with common properties like label, size, and methods like click(). Derive subclasses like ImageButton, ToggleButton, and RadioButton that inherit from Button and add specific properties or methods unique to each type of button.

Building an e-commerce platform with different types of products.

- **Inheritance Use:** Define a base class Product with common attributes like name, price, and methods like applyDiscount(). Create subclasses like Electronics, Clothing, and Books, each adding specific attributes (e.g., Electronics might have warrantyPeriod, Clothing might have size and color).

### *Skill Oriented Exercise*

Building educational software that manages different types of learning resources.
- **Inheritance Use:** Establish a base class LearningResource with common properties like title, subject, and methods like display(). Derive subclasses such as Book, VideoLecture, and Quiz, each adding specific attributes and methods (e.g., Quiz might have questions and a method evaluate()).

Designing a system to classify and manage information about different animals.
- **Inheritance Use:** Define a base class Animal with common attributes like name, habitat, and methods like eat(), sleep(). Create subclasses such as Mammal, Bird, and Reptile, each with specific characteristics and methods (e.g., Bird might have methods fly()).

## Week 13: Polymorphism

An application that can draw various shapes such as circles, rectangles, and triangles.
- **Polymorphism Use:** Define an abstract class Shape with a method draw(). Implement subclasses Circle, Rectangle, and Triangle, each providing its specific draw() implementation. The application can then handle any shape object through the Shape interface

A program that simulates sounds of different animals.
- **Polymorphism Use:** Create a base class Animal with an abstract method makeSound(). Implement subclasses Dog, Cat, and Cow that override makeSound(). The simulator can then invoke makeSound() on any animal object

Managing different types of transportation such as cars, buses, and bicycles.

### *Skill Oriented Exercise*

- **Polymorphism Use:** Define a base class Vehicle with an abstract method move(). Implement subclasses Car, Bus, and Bicycle, each with its own implementation of move(). The system can then manage different vehicles uniformly

A system sending notifications via email, SMS, and push notifications.
- **Polymorphism Use:** Define an abstract class Notification with a method send(). Implement subclasses EmailNotification, SMSNotification, and PushNotification, each with its own send() method. The system can send notifications through any medium using the same interface

## Week 14: Virtual functions

A document editor that supports different types of documents such as text documents, spreadsheets, and presentations.

- **Virtual Function Use:** Define a base class Document with a virtual function save(). Subclasses TextDocument, Spreadsheet, and Presentation override save() to handle specific saving mechanisms.

An audio processing library that handles various audio effects such as reverb, echo, and distortion.

*Skill Oriented Exercise*

- **Virtual Function Use:** Define a base class AudioEffect with a virtual function apply(). Subclasses ReverbEffect, EchoEffect, and DistortionEffect override apply() to implement specific effects.

An AI strategy game that involves different types of game characters such as warriors, mages, and archers.

- **Virtual Function Use:** Define a base class Character with a virtual function attack(). Subclasses Warrior, Mage, and Archer override attack() to provide specific attack behaviors.

## Week 15: Exception handling

1) File Operations Scenario: An application needs to read data from a file.
Exception Handling Use: Implement code to handle scenarios where the file might not exist, the application lacks permissions, or the file is corrupted. Use try-catch blocks to manage these exceptions:

2) E-Commerce Checkout Process
Scenario: An e-commerce application processes user orders during checkout.

- Exception Handling Use: Handle errors such as invalid payment details, out-of-stock items, or delivery address issues.

*Skill Oriented Exercise*

3) An application processes images for various operations like resizing, filtering, and saving.

- Exception Handling Use: Handle errors such as unsupported file formats, corrupted files, or out-of-memory issues.