

INDIAN INSTITUTE OF TECHNOLOGY TIRUPATI  
DEPARTMENT OF MATHEMATICS AND STATISTICS

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Class Test - 2 (Practical)    **MA517M-Basic Programming Laboratory**    25 August 2026  
**Name**    **Roll No.: MA26M**

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1. Write a C++ program to determine the day of the week for any given date. [3]
    - (a) The program should take a date in the format *dd mm yyyy* as input.
    - (b) You should calculate the day of the week starting from the reference date 01/01/1900, which was a Monday.
    - (c) Use if statements to handle leap year conditions and days in each month.
    - (d) Use a switch statement to print the name of the day (Sunday, Monday, ..., Saturday).
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**Student Scholarship System [3]**

Write a C++ program to design a **Student Scholarship System**.

The program should read the following details of a student:

1. Marks (integer, 0–100)
2. Family income (in lakhs, integer)
3. Sports participation (character: ‘Y’ for Yes, ‘N’ for No)

**Part 1 (using if or nested-if or if-else):** Determine a **scholarship code** according to these rules:

- If marks  $\geq 90$  and family income  $< 5 \rightarrow$  assign code = 1 (Merit Scholarship).
- Else if marks  $\geq 75$  and sports = ‘Y’  $\rightarrow$  assign code = 2 (Sports Scholarship).
- Else if family income  $< 3 \rightarrow$  assign code = 3 (Need-based Scholarship).
- Otherwise  $\rightarrow$  assign code = 0 (No Scholarship).

**Part 2 (using switch):** Based on the scholarship code, print the type of scholarship as follows:

- 1  $\rightarrow$  Merit Scholarship: Rs. 20,000
  - 2  $\rightarrow$  Sports Scholarship: Rs. 15,000
  - 3  $\rightarrow$  Need-based Scholarship: Rs. 10,000
  - 0  $\rightarrow$  No Scholarship
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### Train Ticket Fare Calculator [3]

Write a C++ program to design a **Train Ticket Fare Calculator**.

The program should read the following details of a passenger:

1. Age (integer)
2. Class of travel (integer: 1 = Sleeper, 2 = AC, 3 = First Class)

**Part 1 (using if or nested-if or if-else):** Determine a **discount code** according to these rules:

- If  $\text{age} < 5 \rightarrow \text{code} = 0$  (Free Ticket).
- If  $5 \leq \text{age} \leq 12 \rightarrow \text{code} = 1$  (Half Fare).
- If  $\text{age} \geq 60 \rightarrow \text{code} = 2$  (Senior Citizen Discount).
- Otherwise  $\rightarrow \text{code} = 3$  (Full Fare).

**Part 2 (using switch):** Based on the travel class and discount code, compute and print the final fare. The base fares are:

- Sleeper = Rs. 500
- AC = Rs. 1000
- First Class = Rs. 1500

The discounts are applied as:

- Code 0  $\rightarrow$  Free Ticket
  - Code 1  $\rightarrow$  Half Fare
  - Code 2  $\rightarrow$  30% Discount
  - Code 3  $\rightarrow$  No Discount
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### Flight Check-in System [3]

Write a C++ program to design a **Flight Check-in System**.

The program should read the following details of a passenger:

1. Ticket type (character: 'E' = Economy, 'B' = Business)
2. Baggage weight (in kg, integer)
3. Meal preference (character: 'Y' = Yes, 'N' = No)

**Part 1 (using if or nested-if or if-else):** Determine a **service code** according to these rules:

- If baggage weight  $> 30 \rightarrow$  code = 3 (Excess Baggage).
- Else if ticket = 'B' and meal = 'Y'  $\rightarrow$  code = 2 (Premium Service).
- Else if ticket = 'E' and meal = 'Y'  $\rightarrow$  code = 1 (Standard Service).
- Otherwise  $\rightarrow$  code = 0 (Basic Service).

**Part 2 (using switch):** Based on the service code, print the check-in message as follows:

- 3  $\rightarrow$  Excess baggage charges apply
  - 2  $\rightarrow$  Premium check-in with meal service
  - 1  $\rightarrow$  Standard check-in with meal service
  - 0  $\rightarrow$  Basic check-in without meal
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### Insurance Premium Calculator [3]

Write a C++ program to design an **Insurance Premium Calculator**.

The program should read the following details of a customer:

1. Age (integer)
2. Type of vehicle (character: 'C' = Car, 'B' = Bike, 'T' = Truck)
3. Accident history (character: 'Y' = Yes, 'N' = No)

**Part 1 (using if or nested-if or if-else):** Determine a **risk code** according to these rules:

- If accident history = 'Y'  $\rightarrow$  code = 3 (High Risk).
- Else if age  $< 25 \rightarrow$  code = 2 (Young Driver Risk).
- Else if age  $\geq 60 \rightarrow$  code = 1 (Senior Citizen Risk).
- Otherwise  $\rightarrow$  code = 0 (Normal Risk).

**Part 2 (using switch):** Based on the risk code and vehicle type, compute and print the premium.

The base premiums are:

- Car = Rs. 5000
- Bike = Rs. 2000
- Truck = Rs. 8000

The risk adjustments are:

- Code 3  $\rightarrow$  50% extra charge
  - Code 2  $\rightarrow$  20% extra charge
  - Code 1  $\rightarrow$  15% discount
  - Code 0  $\rightarrow$  No adjustment
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### Health Insurance Plan Selector [3]

Write a C++ program to design a **Health Insurance Plan Selector**.

The program should read the following details:

1. Age (integer)
2. Pre-existing disease (character: 'Y' = Yes, 'N' = No)
3. Plan type (character: 'B' = Basic, 'S' = Standard, 'P' = Premium)

**Part 1 (using if or nested-if):** Determine a **risk category**:

- If pre-existing disease = 'Y'  $\rightarrow$  category = 2 (High Risk).
- Else if age  $< 30 \rightarrow$  category = 0 (Low Risk).
- Else if age  $< 60 \rightarrow$  category = 1 (Medium Risk).
- Otherwise  $\rightarrow$  category = 2 (High Risk).

**Part 2 (using switch):** Based on the category and plan type, compute premium. Base premiums:

- Basic = Rs. 3000
- Standard = Rs. 5000
- Premium = Rs. 8000

Adjustments:

- Category 2  $\rightarrow$  40% extra
  - Category 1  $\rightarrow$  15% extra
  - Category 0  $\rightarrow$  No extra
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### Travel Insurance Cost Calculator [3]

Write a C++ program to compute the cost of **Travel Insurance**.

The program should read:

1. Duration of travel in days (integer)
2. Destination type (character: 'D' = Domestic, 'I' = International)
3. Purpose (character: 'L' = Leisure, 'B' = Business)

**Part 1 (using if or nested-if):** Determine **travel risk level**:

- If duration > 30 days → risk = 2 (Long Trip).
- Else if destination = 'I' → risk = 1 (International Risk).
- Otherwise → risk = 0 (Normal).

**Part 2 (using switch):** Base premiums:

- Domestic Leisure = Rs. 2000
- Domestic Business = Rs. 3000
- International Leisure = Rs. 5000
- International Business = Rs. 7000

Adjustments:

- Risk 2 → 25% extra
  - Risk 1 → 15% extra
  - Risk 0 → No extra
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### Life Insurance Premium Calculator [3]

Write a C++ program for a **Life Insurance Premium Calculator**.

The program should read:

1. Age (integer)
2. Smoker status (character: 'Y' = Yes, 'N' = No)
3. Plan type (character: 'T' = Term, 'W' = Whole Life, 'E' = Endowment)

**Part 1 (using if or nested-if):** Decide **eligibility code**:

- If age < 18 → code = -1 (Not Eligible).
- Else if smoker = 'Y' → code = 2 (High Risk).
- Else if age > 60 → code = 1 (Senior Risk).
- Otherwise → code = 0 (Normal).

**Part 2 (using switch):** Base premiums:

- Term = Rs. 4000
- Whole Life = Rs. 6000
- Endowment = Rs. 8000

Adjustments:

- Code -1 → Not eligible (print message).
  - Code 2 → 50% extra
  - Code 1 → 20% extra
  - Code 0 → No adjustment
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## PDE Classifier [2]

A second-order linear PDE is of the form

$$au_{xx} + bu_{xy} + cu_{yy} = f(x, y),$$

where  $a, b, c$  are real constants.

The nature of the PDE is determined by the discriminant  $\Delta = b^2 - 4ac$  as follows:

- $\Delta > 0 \rightarrow$  Hyperbolic
- $\Delta = 0 \rightarrow$  Parabolic
- $\Delta < 0 \rightarrow$  Elliptic

**switch only:** Write a C++ program to read  $a, b, c$  and compute the discriminant  $\Delta$ . Use only switch statements to classify the PDE type as hyperbolic, elliptic or parabolic.

## Conic Section Classifier [1]

A general second-degree equation in two variables is given by

$$ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0,$$

where  $a, b, c, g, f, h$  are real constants.

The nature of the conic is determined by the discriminant

$$\Delta = h^2 - ab$$

as follows:

- $\Delta < 0 \rightarrow$  Ellipse (if  $a = b$  and  $h = 0$ , it is a Circle)
- $\Delta = 0 \rightarrow$  Parabola
- $\Delta > 0 \rightarrow$  Hyperbola

**using if or nested-if or if-else:** Write a C++ program to read the values of  $a, b, h, g, f, c$ . Compute  $\Delta = h^2 - ab$  and classify the type of conic.

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### Quadrilateral Classification [1.5]

Write a C++ program to classify a quadrilateral based on its sides and angles. The program should read four sides  $(a, b, c, d)$  and one angle  $\theta$  (in degrees).

**using if or nested-if or if-else if-else:**

- If  $a = b = c = d$  and  $\theta = 90^\circ$ , Square
- If opposite sides are equal and  $\theta = 90^\circ$ , Rectangle
- If  $a = b = c = d$  and  $\theta \neq 90^\circ$ , Rhombus
- Otherwise, General Quadrilateral

### Point and Circle Position [1.5]

Write a C++ program to determine the position of a point relative to a circle. The program should read the circle's center  $(h, k)$ , radius  $r$ , and a point  $(x, y)$ . Compute  $d^2 = (x - h)^2 + (y - k)^2$  and  $\Delta = d^2 - r^2$ .

- $\Delta < 0 \rightarrow$  Inside the circle
- $\Delta = 0 \rightarrow$  On the circle
- $\Delta > 0 \rightarrow$  Outside the circle

Using only a switch statement, classify whether the given point  $(x, y)$  is inside the circle or on the circle, or outside the circle.

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### Point and Plane Position [1]

Write a C++ program to determine the position of a point with respect to a plane. The plane equation is  $Ax + By + Cz + D = 0$ . The program should read the plane coefficients  $(A, B, C, D)$  and a point  $(x_0, y_0, z_0)$ .

**Part 1 (using if or nested-if):** Compute  $val = Ax_0 + By_0 + Cz_0 + D$ .

- If  $val > 0$ , assign Code 1 (Point lies above the plane).
- If  $val < 0$ , assign Code 2 (Point lies below the plane).
- If  $val = 0$ , assign Code 3 (Point lies on the plane).

### Point and Sphere Position [2]

Write a C++ program to determine the position of a point relative to a sphere. The sphere is defined by center  $(h, k, l)$  and radius  $r$ . The program should read  $(h, k, l, r)$  and a point  $(x, y, z)$ .

Compute  $d^2 = (x - h)^2 + (y - k)^2 + (z - l)^2$  and  $\Delta = d^2 - r^2$ .

- $\Delta < 0 \rightarrow$  Inside the Sphere
- $\Delta = 0 \rightarrow$  On the Sphere
- $\Delta > 0 \rightarrow$  Outside the Sphere

Using only a switch statement, classify whether the given point  $(x, y, z)$  is inside the Sphere or on the Sphere, or outside the Sphere.

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### Two Spheres Relation [3]

Write a C++ program to determine the relation between two spheres. The spheres are defined by centers  $(x_1, y_1, z_1)$ ,  $(x_2, y_2, z_2)$  and radii  $r_1, r_2$ .

**Part 1 (using if or nested-if):** Compute  $d^2 = (x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2$ .

- If  $d^2 > (r_1 + r_2)^2$ , assign Code 1 (Spheres are separate).
- If  $d^2 = (r_1 + r_2)^2$ , assign Code 2 (Spheres touch externally).
- If  $(r_1 - r_2)^2 < d^2 < (r_1 + r_2)^2$ , assign Code 3 (Spheres intersect).
- If  $d^2 = (r_1 - r_2)^2$ , assign Code 4 (Spheres touch internally).
- If  $d^2 < (r_1 - r_2)^2$ , assign Code 5 (One sphere lies inside the other).

**Part 2 (using switch):** Based on the code, print the relation between the spheres. Additionally, perform extra tasks:

- Code 0: Print “Spheres are coincident.” Also display their common volume

$$V = \frac{4}{3}\pi r_1^3.$$

- Code 1: Print “Spheres touch externally.” Also display the distance  $d$ .
- Code 2: Print “Spheres touch internally.” Also display the smaller radius.
- Code 3: Print “Spheres intersect.” Also compute and display the sum of their surface areas

$$A = 4\pi r_1^2 + 4\pi r_2^2.$$

- Code 4: Print “Spheres are separate.” Also compute the gap  $g = d - (r_1 + r_2)$  and display it.
- Code 5: Print “One sphere lies inside the other.” Also compute the volume difference

$$\Delta V = \frac{4}{3}\pi (r_{\max}^3 - r_{\min}^3).$$

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### Position of Two Circles [1.5]

You are given six inputs: centers  $(x_1, y_1)$ ,  $(x_2, y_2)$  and radii  $r_1$ ,  $r_2$  of two circles.

**Using if/nested if/if-else:** Compute the distance  $d$  between the centers. Classify the relative position as:

- Coincident if  $d = 0$  and  $r_1 = r_2$ ,
- Touching externally if  $d = r_1 + r_2$ ,
- Touching internally if  $d = |r_1 - r_2|$ ,
- Intersecting if  $|r_1 - r_2| < d < r_1 + r_2$ ,
- Separate if  $d > r_1 + r_2$ ,
- One inside the other if  $d < |r_1 - r_2|$ .

### Line and Circle Position[1.5]

You are given inputs for a circle  $x^2 + y^2 = r^2$  and a line  $ax + by + c = 0$ .

**Using switch only:** Compute the perpendicular distance  $d = \frac{|c|}{\sqrt{a^2 + b^2}}$  of the line from the origin. Compare  $d$  with  $r$  and classify:

- Tangent if  $d - r = 0$ ,
  - Secant if  $d - r < 0$ ,
  - No intersection if  $d - r > 0$ .
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### Conic Section from Cone and Plane[1.5]

A cone  $z^2 = x^2 + y^2$  is cut by a plane  $z = mx + c$ .

**Using if/nested if/if-elseif:** Depending on the slope  $m$ , classify the intersection:

- Parabola if  $m^2 = 1$ ,
- Ellipse if  $m^2 < 1$ ,
- Hyperbola if  $m^2 > 1$ .

### Sphere and Plane Position[1.5]

You are given inputs for a sphere  $(x - x_0)^2 + (y - y_0)^2 + (z - z_0)^2 = r^2$  and a plane  $ax + by + cz + d = 0$ .

**Using switch Only:** Compute the distance  $D = \frac{|ax_0 + by_0 + cz_0 + d|}{\sqrt{a^2 + b^2 + c^2}}$  from the center to the plane. Compare  $D$  with  $r$ :

- Tangent if  $D - r = 0$ ,
  - Secant if  $D - r < 0$ ,
  - No intersection if  $D - r > 0$ .
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### Two Circles Relation [3]

Write a C++ program to determine the relation between two circles. The circles are defined by centers  $(x_1, y_1)$ ,  $(x_2, y_2)$  and radii  $r_1, r_2$ .

**Part 1 (using if or nested-if):** Compute  $d^2 = (x_1 - x_2)^2 + (y_1 - y_2)^2$ .

- If  $d^2 > (r_1 + r_2)^2$ , assign Code 1 (Circles are separate).
- If  $d^2 = (r_1 + r_2)^2$ , assign Code 2 (Circles touch externally).
- If  $(r_1 - r_2)^2 < d^2 < (r_1 + r_2)^2$ , assign Code 3 (Circles intersect).
- If  $d^2 = (r_1 - r_2)^2$ , assign Code 4 (Circles touch internally).
- If  $d^2 < (r_1 - r_2)^2$ , assign Code 5 (One circle lies inside the other).

**Part 2 (using switch):** Based on the code, print the relation between the circles. Additionally, perform extra tasks:

- Code 0: Print “Circles are coincident.” Also display their common area

$$A = \pi r_1^2.$$

- Code 1: Print “Circles are separate.” Also compute the gap

$$g = \sqrt{d^2} - (r_1 + r_2).$$

- Code 2: Print “Circles touch externally.” Also display the distance  $d$ .
- Code 3: Print “Circles intersect.” Also compute and display the sum of their circumferences

$$C = 2\pi r_1 + 2\pi r_2.$$

- Code 4: Print “Circles touch internally.” Also display the smaller radius.
- Code 5: Print “One circle lies inside the other.” Also compute the area difference

$$\Delta A = \pi (r_{\max}^2 - r_{\min}^2).$$

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### Point and Ellipse Relation [1.5]

Write a C++ program to determine whether a point lies inside, outside, or on an ellipse. The ellipse is defined by equation

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$$

, and the point is  $(x_0, y_0)$ .

**Part 1 (using if or nested-if):** Compute

$$E = \frac{x_0^2}{a^2} + \frac{y_0^2}{b^2}$$

- If  $E = 1$ , Point lies on the ellipse.
- If  $E < 1$ , Point lies inside the ellipse.
- If  $E > 1$ , Point lies outside the ellipse.

### Point and Line Relation [1.5]

Write a C++ program to determine the relation between a point and a line. The line is defined by equation  $ax + by + c = 0$ , and the point is  $(x_0, y_0)$ .

**using switch only):** Compute  $D = ax_0 + by_0 + c$ .

- If  $D = 0$ , Point lies on the line.
  - If  $D > 0$ , Point lies on one side of the line.
  - If  $D < 0$ , Point lies on the other side of the line.
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### Point and Cube Relation [1.5]

Write a C++ program to determine the relation between a point and a cube. The cube is axis-aligned with center  $(x_c, y_c, z_c)$  and side length  $L$ . A point is  $(x_0, y_0, z_0)$ .

**Part 1 (using if or nested-if):** Compute half-length  $h = \frac{L}{2}$ .

- If  $|x_0 - x_c| \leq h$ ,  $|y_0 - y_c| \leq h$ , and  $|z_0 - z_c| \leq h$ , Point lies inside the cube.
- If one of the equalities holds exactly, Point lies on the cube surface.
- Otherwise, Point lies outside the cube.

### Line and Sphere Relation [1.5]

Write a C++ program to determine the relation between a line and a sphere. The sphere is centered at  $(x_c, y_c, z_c)$  with radius  $r$ . The line is given parametrically as

$$(x, y, z) = (x_0, y_0, z_0) + t(a, b, c), \quad t \in \mathbb{R}.$$

Substitute the line into the sphere equation to obtain a quadratic in  $t$ :

$$At^2 + Bt + C = 0.$$

where

$$A = a^2 + b^2 + c^2, \quad B = 2[a(x_0 - x_c) + b(y_0 - y_c) + c(z_0 - z_c)], \quad C = (x_0 - x_c)^2 + (y_0 - y_c)^2 + (z_0 - z_c)^2 - r^2.$$

Compute  $D = B^2 - 4AC$  **switch Only:**

- If  $D > 0$ , Line intersects sphere at two points.
  - If  $D = 0$ , Line touches sphere — tangent.
  - If  $D < 0$ , Line does not intersect sphere.
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### Evaluation of a Function of Two Variables[1]

Write a C++ program to get two inputs from the user  $x$  and  $y$ . Print the value of the following function (using if or nested-if or if-else )

$$f(x, y) = \begin{cases} x^2 + y^2 - 2x^2y - \frac{4x^6y^2}{(x^2+y^2)^2} & \text{if } (x, y) \neq (0, 0) \\ 0 & \text{if } (x, y) = (0, 0) \end{cases}$$

### Point and Rectangle Relation[2]

You are given four integers that define a rectangle in the 2D coordinate plane. The rectangle is axis-aligned (its sides are parallel to the  $x$  and  $y$  axes) and is specified by two opposite corners:  $(x_1, y_1)$  and  $(x_2, y_2)$ . You are also given another point  $(x, y)$ .

**Task:** Write a C++ program to determine the position of the point  $(x, y)$  with respect to the rectangle:

- Print "Inside" if  $(x, y)$  lies strictly inside the rectangle.
  - Print "Outside" if  $(x, y)$  lies strictly outside the rectangle.
  - Print "On the Boundary" if  $(x, y)$  lies exactly on one of the sides of the rectangle.
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### Probability Distribution Classification [1.5]

Write a C++ program to classify a probability distribution based on user input.

The user enters two inputs:

$$\mu = \text{mean}, \quad \sigma^2 = \text{variance}.$$

**using if or nested-if:** Check the following conditions:

- If  $\sigma^2 = 0$ , Degenerate distribution.
- If  $\sigma^2 > 0$  and  $\mu = 0$ , Symmetric distribution about origin.
- If  $\sigma^2 > 0$  and  $\mu \neq 0$ , General distribution.
- If  $\sigma^2 < 0$ , print “Invalid input.”

### Events Independence and Mutual Exclusiveness [1.5]

Write a C++ program to classify the relation between two events  $A$  and  $B$ .

The user inputs:

$$P(A), \quad P(B), \quad P(A \cap B).$$

**switch Only:** Check the following:

- If  $\frac{P(A \cap B)}{P(A)P(B)} = 0$ , Events are mutually exclusive.
  - If  $\frac{P(A \cap B)}{P(A)P(B)} = 1$ , Events are independent.
  - Otherwise, Events have general dependence.
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### Inscribed Sphere in a Cube: Hit Probability [3]

Write a C++ program for an axis-aligned cube of side  $L$  centered at the origin. An inscribed sphere of radius  $R = L/2$  shares the same center. The user provides a point  $(x, y, z)$ .

**Part 1 (using if or nested-if):** Check cube membership:  $|x| \leq L/2, |y| \leq L/2, |z| \leq L/2$ .

- If invalid  $\Rightarrow$  Code 0 (Outside cube).
- Else let  $d^2 = x^2 + y^2 + z^2$ . If  $d^2 < R^2 \Rightarrow$  Code 1 (Inside sphere), if  $d^2 = R^2 \Rightarrow$  Code 2 (On sphere), else Code 3 (In cube only).

**Part 2 (using switch):** Additionally compute:

- Code 0: Print “Outside cube.” Also print  $L_\infty$  distance to the cube:  $\max\{0, |x| - L/2, |y| - L/2, |z| - L/2\}$ . (if allowed here)
  - Code 1: Print “Inside sphere.” Also print  $P = \frac{\text{Vol(sphere)}}{\text{Vol(cube)}} = \frac{\frac{4}{3}\pi(L/2)^3}{L^3} = \frac{\pi}{6}$ .
  - Code 2: Print “On sphere.” Also print surface area  $4\pi(L/2)^2 = \pi L^2$ .
  - Code 3: Print “In cube only.” Also print the shell volume  $L^3 - \frac{4}{3}\pi(L/2)^3$  and its probability  $1 - \frac{\pi}{6}$ .
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**JAM Admission Eligibility with Reservation [3]**

Write a C++ program to determine a student's admission eligibility in JAM based on score, All India Rank (AIR), and category.

**Inputs:** -  $S$  = Score (out of 100) -  $R$  = All India Rank (AIR) -  $C$  = Category code

1 = General,   2 = OBC-NCL,   3 = SC,   4 = ST,   5 = EWS.

**Cut-off Scores for Qualification:**

General : 25,  
OBC-NCL/EWS : 22,  
SC/ST : 15.

**Part 1 (using if or nested-if):** - If  $S < \text{cutoff}(C)$ , assign Code 0 (Not Qualified). - Else, based on  $R$ :

- Code 1: Top Ranker if  $R \leq 100$ .
- Code 2: Good Rank if  $101 \leq R \leq 1000$ .
- Code 3: Moderate Rank if  $1001 \leq R \leq 5000$ .
- Code 4: Eligible only through Reservation if  $R > 5000$  but  $C \in \{2, 3, 4, 5\}$ .
- Code 5: Not Eligible otherwise.

**Part 2 (using switch):** Based on the code, display results:

- Code 0: "Not Qualified. Score below category cutoff."
  - Code 1: "Excellent! Top Ranker. High chance of direct admission."
  - Code 2: "Good Rank. Likely to secure a seat in top institutes."
  - Code 3: "Moderate Rank. Admission possible in lower preference."
  - Code 4: "Eligible under Reservation Quota. Counseling required."
  - Code 5: "Not Eligible. Better luck next time."
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**JEE Admission Eligibility with Reservation [3]**

Write a C++ program to determine a candidate's JEE admission eligibility based on score, All India Rank (AIR), and category.

**Inputs:** -  $S$  = JEE Main score (out of 300) -  $R$  = All India Rank (AIR) -  $C$  = Category code

1 = General,   2 = OBC-NCL,   3 = SC,   4 = ST,   5 = EWS.

**Cut-off Scores for Qualification:**

General : 90,  
OBC-NCL/EWS : 75,  
SC/ST : 50.

**Part 1 (using if or nested-if):** - If  $S < \text{cutoff}(C)$ , assign Code 0 (Not Qualified for JEE Advanced). - Else, based on  $R$ :

- Code 1: Top Ranker if  $R \leq 500$ .
- Code 2: Very Good Rank if  $501 \leq R \leq 5000$ .
- Code 3: Moderate Rank if  $5001 \leq R \leq 20000$ .
- Code 4: Eligible under Reservation Quota if  $R > 20000$  but  $C \in \{2, 3, 4, 5\}$ .
- Code 5: Not Eligible otherwise.

**Part 2 (using switch):** Based on the code, display results:

- Code 0: "Not Qualified. Score below category cutoff."
  - Code 1: "Excellent! Eligible for top IITs."
  - Code 2: "Very Good! Admission possible in IITs and top NITs."
  - Code 3: "Moderate Rank. Admission possible in lower NITs/IIITs."
  - Code 4: "Eligible under Reservation Quota. Counseling required."
  - Code 5: "Not Eligible. Better luck next time."
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**GATE Admission and Eligibility with Reservation [3]**

Write a C++ program to determine a candidate's GATE admission eligibility based on marks, All India Rank (AIR), and category.

**Inputs:** -  $M$  = GATE marks (out of 100) -  $R$  = All India Rank (AIR) -  $C$  = Category code

1 = General,   2 = OBC-NCL,   3 = SC,   4 = ST,   5 = EWS.

**Cut-off Marks for Qualification (assume discipline = CS):**

General : 28,  
OBC-NCL/EWS : 25,  
SC/ST : 18.

**Part 1 (using if or nested-if):** - If  $M < \text{cutoff}(C)$ , assign Code 0 (Not Qualified for GATE). - Else, based on  $R$ :

- Code 1: Topper if  $R \leq 100$ .
- Code 2: Very Good Rank if  $101 \leq R \leq 1000$ .
- Code 3: Good Rank if  $1001 \leq R \leq 5000$ .
- Code 4: Eligible under Reservation Quota if  $R > 5000$  but  $C \in \{2, 3, 4, 5\}$ .
- Code 5: Not Eligible otherwise.

**Part 2 (using switch):** Based on the code, display results:

- Code 0: "Not Qualified. Marks below category cutoff."
  - Code 1: "Excellent! Eligible for IITs and PSUs."
  - Code 2: "Very Good! Admission possible in top NITs/IITs."
  - Code 3: "Good! Admission possible in reputed NITs/IIITs."
  - Code 4: "Eligible under Reservation Quota. Counseling required."
  - Code 5: "Not Eligible for admissions."
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### Mobile Recharge Plan Selection [3]

Write a C++ program to simulate a mobile recharge system.

**Part 1 (using if-else and nested if):** The user enters the recharge amount  $amt$ . Based on  $amt$ , decide the validity and benefits as follows:

- If  $amt < 100$ , print “Invalid recharge amount.”
- If  $100 \leq amt < 300$ , then validity = 28 days.
  - If  $amt \leq 150$ , data = 1 GB/day.
  - Else, data = 1.5 GB/day.
- If  $300 \leq amt < 600$ , then validity = 56 days.
  - If  $amt \leq 400$ , data = 2 GB/day.
  - Else, data = 2.5 GB/day + free SMS.
- If  $amt \geq 600$ , then validity = 84 days with unlimited calls and 3 GB/day.

**Part 2 (using switch):** Based on the integer division  $(amt/100)$ , classify the recharge plan:

- Case 1: Print “Basic Plan.”
- Case 2 or 3: Print “Standard Plan.”
- Case 4 or 5: Print “Advanced Plan.”
- Default: Print “Premium Plan.”

**Illustration:**

```
Enter recharge amount: 450
Validity: 56 days
Data: 2.5 GB/day + Free SMS
Plan Type: Advanced Plan
```

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### Microwave Oven Cooking Simulation [3]

Write a C++ program to simulate a microwave oven cooking system.

**Part 1 (using if-else and nested if):** The user enters the food type (1 = Rice, 2 = Vegetables, 3 = Pizza) and the weight of the food (in grams). Based on the inputs, calculate the cooking time:

- If food type = Rice:
  - If weight  $\leq 200$  g, cooking time = 5 minutes.
  - Else if weight  $\leq 500$  g, cooking time = 10 minutes.
  - Else, cooking time = 15 minutes.
- If food type = Vegetables:
  - If weight  $\leq 300$  g, cooking time = 7 minutes.
  - Else, cooking time = 12 minutes.
- If food type = Pizza:
  - If weight  $\leq 400$  g, cooking time = 8 minutes.
  - Else, cooking time = 15 minutes.

**Part 2 (using switch):** The user selects the power level (1 = Low, 2 = Medium, 3 = High).

- Case 1: Multiply cooking time by 1.2.
- Case 2: Cooking time remains the same.
- Case 3: Multiply cooking time by 0.8.
- Default: Print “Invalid power level.”

**Illustration:**

Enter food type (1=Rice,2=Veg,3=Pizza): 3

Enter weight in grams: 500

Enter power level (1=Low,2=Med,3=High): 2

Food: Pizza

Weight: 500 g

Cooking Time: 15 minutes

Power Level: Medium

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### Washing Machine Cycle Selection [3]

Write a C++ program to simulate a washing machine cycle selection. The user inputs the type of cloth (`cotton`, `wool`, or `synthetic`), the weight of clothes in kilograms, and the washing mode (`quick`, `normal`, or `heavy`).

**Part 1 (using if or nested-if):** Decide the water level  $W$  (in liters) and base washing time  $T$  (in minutes) as follows:

- If cloth type is cotton:  $W = 10 \times \text{weight}$ ,  $T = 30$ .
- If cloth type is wool:  $W = 7 \times \text{weight}$ ,  $T = 25$ .
- If cloth type is synthetic:  $W = 5 \times \text{weight}$ ,  $T = 20$ .

**Part 2 (using switch):** Adjust the time  $T$  based on washing mode:

- Mode = `quick`:  $T = T - 10$ .
- Mode = `normal`:  $T = T$ .
- Mode = `heavy`:  $T = T + 15$ .

Finally, display the selected cycle information:

- Cloth type, weight, and water level  $W$ .
  - Final washing time  $T$ .
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### Movie Ticket Booking System [3]

Write a C++ program to simulate a movie ticket booking system. The user enters the following details:

- Age of the person.
- Type of seat (1. Regular, 2. Premium, or 3. VIP).
- Show timing (1. Morning, 2. Afternoon, or 3. Evening).

**Part 1 (using if or nested-if):** Decide the base ticket price  $P$  (in Rs) according to seat type:

- Regular seat: Rs 150.
- Premium seat: Rs 250.
- VIP seat: Rs 400.

Apply age-based discounts:

- Children below 12 years:  $P = 0.5P$ .
- Senior citizens (age  $\geq 60$ ):  $P = 0.7P$ .
- Others:  $P = P$ .

**Part 2 (using switch):** Add an extra show-time fee:

- Morning: Rs 0.
- Afternoon: Rs 20.
- Evening: Rs 50.

**Final Output:** Display the following booking details:

- Seat type and base price.
  - Age and applied discount.
  - Show timing and extra charge.
  - Final payable amount with 18% GST.
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### Flight Ticket Booking System [3]

Write a C++ program to simulate a flight ticket booking system. The user enters the following details:

- Age of the passenger.
- Travel class (1. Economy, 2. Business, or 3. First Class).
- Distance to travel (in kilometers).
- Meal preference (Veg, Non-Veg, or No Meal).

**Part 1 (using if or nested-if):** Decide the base fare per kilometer according to travel class:

- Economy: Rs 5 per km.
- Business: Rs 10 per km.
- First Class: Rs 20 per km.

The initial fare is computed as:

$$F = (\text{base fare per km}) \times (\text{distance})$$

Apply age-based discounts using nested-if:

- Children below 12 years:  $F = 0.5F$ .
- Senior citizens (age  $\geq 60$ ):  $F = 0.8F$ .
- Others:  $F = F$ .

**Part 2 (using switch):** Add meal charges:

- Veg meal: Rs 200.
- Non-Veg meal: Rs 300.
- No Meal: Rs 0.

**Final Output:** Display the following booking details:

- Passenger age and discount applied.
  - Travel class and base fare per km.
  - Distance and initial fare.
  - Meal choice charges
  - Final payable amount with 18% GST.
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**Campus Food Court Billing System [3]**

Write a C++ program to design a **Campus Food Court Billing System**.

The program should read the following details:

1. Food category (integer: 1 = Snacks, 2 = Meals, 3 = Beverage)
2. Quantity ordered (integer)
3. Student status (character: 'Y' = IIT Student, 'N' = Non-student)

**Part 1 (using if or nested-if or if-else):**

Determine a **billing code** according to these rules:

- If quantity  $\geq 5$  and student = 'Y'  $\rightarrow$  code = 1 (Student Bulk Order).
- Else if quantity  $\geq 3$  and student = 'Y'  $\rightarrow$  code = 2 (Student Discount).
- Else if quantity  $\geq 5 \rightarrow$  code = 3 (Bulk Order).
- Otherwise  $\rightarrow$  code = 4 (Regular Order).

**Part 2 (using switch):**

Based on the food category, determine the base price:

- Case 1  $\rightarrow$  Snacks = Rs. 60 per item.
- Case 2  $\rightarrow$  Meals = Rs. 120 per item.
- Case 3  $\rightarrow$  Beverage = Rs. 40 per item.

Apply the billing-code adjustment:

- Code 1  $\rightarrow$  20% discount.
- Code 2  $\rightarrow$  10% discount.
- Code 3  $\rightarrow$  5% discount.
- Code 4  $\rightarrow$  No discount.

Print the final bill amount.

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### Hostel Electricity Usage Classifier [3]

Write a C++ program to design a **Hostel Electricity Usage Calculator**.

The program should read:

1. Monthly electricity consumption in units (integer)
2. Hostel type (integer: 1 = Student Hostel, 2 = Research Scholar Hostel)
3. Renewable-energy participation (character: 'Y' = Yes, 'N' = No)

**Part 1 (using if or nested-if or if-else):**

Determine a **usage code**:

- If units > 300 → code = 3 (High Consumption).
- Else if units > 150 and renewable = 'N' → code = 2 (Moderate Consumption).
- Else if renewable = 'Y' → code = 1 (Green Usage).
- Otherwise → code = 0 (Normal Usage).

**Part 2 (using switch):**

Based on hostel type, determine the base electricity charge:

- Case 1 → Student Hostel: Rs. 6 per unit.
- Case 2 → Research Scholar Hostel: Rs. 8 per unit.

Apply the usage-code adjustment:

- Code 3 → 20% extra charge.
- Code 2 → 10% extra charge.
- Code 1 → 10% discount.
- Code 0 → No adjustment.

Print the final electricity bill.

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### Library Membership and Fine Calculator [3]

Write a C++ program to design a **Library Membership and Fine Calculator**.

The program should read the following details of a student:

1. Number of overdue days (integer)
2. Membership type (integer: 1 = Regular, 2 = Premium, 3 = Research Scholar)
3. Book condition (character: 'G' = Good, 'D' = Damaged)

**Part 1 (using if or nested-if or if-else):**

Determine a **fine code** according to these rules:

- If book condition = 'D' → code = 3 (Damaged Book).
- Else if overdue days > 30 → code = 2 (Heavy Fine).
- Else if overdue days > 7 → code = 1 (Moderate Fine).
- Otherwise → code = 0 (No/Small Fine).

**Part 2 (using switch):**

Based on the membership type, determine the fine rate per overdue day:

- Case 1 → Regular Member: Rs. 5 per day.
- Case 2 → Premium Member: Rs. 3 per day.
- Case 3 → Research Scholar: Rs. 2 per day.

Apply the fine-code adjustment:

- Code 3 → Add Rs. 500 damage charge.
- Code 2 → 50% extra fine.
- Code 1 → 20% extra fine.
- Code 0 → No adjustment.

Print the final fine amount.

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### Electric Vehicle Charging System [3]

Write a C++ program to design an **Electric Vehicle Charging System**.

The program should read the following details:

1. Battery percentage before charging (integer)
2. Charging station type (integer: 1 = Normal, 2 = Fast, 3 = Super Fast)
3. Membership status (character: 'Y' = Member, 'N' = Non-member)

**Part 1 (using if or nested-if or if-else):**

Determine a **charging code** according to these rules:

- If battery percentage  $< 20$  and membership = 'Y'  $\rightarrow$  code = 1 (Priority Charging).
- Else if battery percentage  $< 20 \rightarrow$  code = 2 (Low Battery).
- Else if battery percentage  $\geq 80 \rightarrow$  code = 3 (High Battery).
- Otherwise  $\rightarrow$  code = 0 (Normal Charging).

**Part 2 (using switch):**

Based on the charging station type, determine the charging cost:

- Case 1  $\rightarrow$  Normal: Rs. 8 per unit.
- Case 2  $\rightarrow$  Fast: Rs. 12 per unit.
- Case 3  $\rightarrow$  Super Fast: Rs. 16 per unit.

Apply the charging-code adjustment:

- Code 1  $\rightarrow$  15% discount.
- Code 2  $\rightarrow$  10% extra charge.
- Code 3  $\rightarrow$  5% discount.
- Code 0  $\rightarrow$  No adjustment.

Assume the number of units consumed during charging is given by

$$U = 100 - \text{battery percentage.}$$

Compute and print the final charging cost.

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