INDIAN INSTITUTE OF TECHNOLOGY TIRUPATI
DEPARTMENT OF MATHEMATICS AND STATISTICS

Class Test - 2 **MA517M-Basic Programming Laboratory** 29 August 2025

Name **Roll No.: MA25M**

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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 ≥ 90 and family income $< 5 \rightarrow$ assign code $= 1$ (Merit Scholarship).
- Else if marks ≥ 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 age $< 5 \rightarrow$ code = 0 (Free Ticket).
- If $5 \leq$ age $\leq 12 \rightarrow$ code = 1 (Half Fare).
- If age $\geq 60 \rightarrow$ code = 2 (Senior Citizen Discount).
- Otherwise $\rightarrow$ 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' → category = 2 (High Risk).
- Else if age < 30 → category = 0 (Low Risk).
- Else if age < 60 → category = 1 (Medium Risk).
- Otherwise → 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 → 40% extra
- Category 1 → 15% extra
- Category 0 → 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 $\rightarrow$ risk = 2 (Long Trip).
- Else if destination = 'I' $\rightarrow$ risk = 1 (International Risk).
- Otherwise $\rightarrow$ 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 $\rightarrow$ 25% extra
- Risk 1 $\rightarrow$ 15% extra
- Risk 0 $\rightarrow$ 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 $< 18 \rightarrow$ code = -1 (Not Eligible).
- Else if smoker = 'Y' $\rightarrow$ code = 2 (High Risk).
- Else if age $> 60 \rightarrow$ code = 1 (Senior Risk).
- Otherwise $\rightarrow$ code = 0 (Normal).

Part 2 (using switch): Base premiums:

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

Adjustments:

- Code -1 $\rightarrow$ Not eligible (print message).
- Code 2 $\rightarrow$ 50% extra
- Code 1 $\rightarrow$ 20% extra
- Code 0 $\rightarrow$ 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 Δ. 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 θ (in degrees).

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

- If $a = b = c = d$ and $\theta = 90°$, Square
- If opposite sides are equal and $\theta = 90°$, Rectangle
- If $a = b = c = d$ and $\theta \neq 90°$, 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 $d^2 = (x - h)^2 + (y - k) + (z - l)^2$ 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
$$\Delta V = \frac{4}{3}\pi \left(r_{\text{max}}^3 - r_{\text{min}}^3\right).$$

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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 $d = \dfrac{|c|}{\sqrt{a^2 + b^2}}$ 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 $D = \dfrac{|ax_0 + by_0 + cz_0 + d|}{\sqrt{a^2+b^2+c^2}}$ 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

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

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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: $|x| \le L/2$, $|y| \le L/2$, $|z| \le L/2$.

- 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_∞ 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 $P = \dfrac{\text{Vol(sphere)}}{\text{Vol(cube)}} = \dfrac{\frac{4}{3}\pi(L/2)^3}{L^3} = \dfrac{\pi}{6}$.
- 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 $L^3 - \dfrac{4}{3}\pi(L/2)^3$ and its probability $1 - \dfrac{\pi}{6}$.

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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

$$1 = \text{General}, \quad 2 = \text{OBC-NCL}, \quad 3 = \text{SC}, \quad 4 = \text{ST}, \quad 5 = \text{EWS}.$$

Cut-off Scores for Qualification:

$$\begin{aligned} \text{General} &: 25, \\ \text{OBC-NCL/EWS} &: 22, \\ \text{SC/ST} &: 15. \end{aligned}$$

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."

INDIAN INSTITUTE OF TECHNOLOGY TIRUPATI
DEPARTMENT OF MATHEMATICS AND STATISTICS

Class Test - 2 **MA517M-Basic Programming Laboratory** 29 August 2025

Name **Roll No.: MA25M**

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

$$1 = \text{General}, \quad 2 = \text{OBC-NCL}, \quad 3 = \text{SC}, \quad 4 = \text{ST}, \quad 5 = \text{EWS}.$$

Cut-off Scores for Qualification:

$$\begin{aligned} \text{General} &: 90, \\ \text{OBC-NCL/EWS} &: 75, \\ \text{SC/ST} &: 50. \end{aligned}$$

Part 1 (using if or nested-if): - If $S <$ 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

$$1 = \text{General}, \quad 2 = \text{OBC-NCL}, \quad 3 = \text{SC}, \quad 4 = \text{ST}, \quad 5 = \text{EWS}.$$

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

$$\begin{aligned} \text{General} &: 28, \\ \text{OBC-NCL/EWS} &: 25, \\ \text{SC/ST} &: 18. \end{aligned}$$

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

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 ≥ 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 ≥ 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.