Programming In C (4331105) - Summer 2024 Solution

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Question 1 [a marks]

3 Define keyword. List any four keywords for C language.

Solution

A keyword is a predefined, reserved word in C that has special meaning to the compiler and cannot be used as an identifier.

Table: Common C Keywords

Keyword	Purpose
`int`	Integer data type
`float`	Floating-point data type
`char`	Character data type
`if`	Conditional statement
`for`	Loop statement
`while`	Loop statement
`void`	Return type/parameter
`return`	Return value from function

- **Reserved words**: Keywords cannot be used as variable names
- **Pre-defined**: They have fixed meaning in the language
- **Case-sensitive**: All keywords must be in lowercase

Mnemonic

”If VoId FoR WhIle” (first letters of important keywords)

Question 1 [b marks]

4 Explain rules for naming a variable.

Solution

Variables in C must follow specific naming rules to be valid identifiers.

Table: Variable Naming Rules in C

Rule	Description	Valid Example	Invalid Example
First character	Must be a letter or underscore	`age`, `_count`	`1value`
Subsequent characters	Letters, digits, or underscores	`user_1`, `total99`	`user@1`
Case sensitivity	Uppercase and lowercase are different	`Value` ≠ `value`	-
Keywords	Cannot use reserved keywords	`counter`	`int`
Length	Should be meaningful but not too long	`studentMarks`	`sm`
Special characters	Not allowed	`firstName`	`first-name`

- **Descriptive names**: Use meaningful names that indicate purpose
- **Consistent style**: Follow a consistent naming convention
- **No spaces**: Use underscores or camelCase instead

Mnemonic

"FLASKS" (First Letter, Letters/digits, Avoid keywords, Sensitive case, Keep meaningful, Skip special chars)

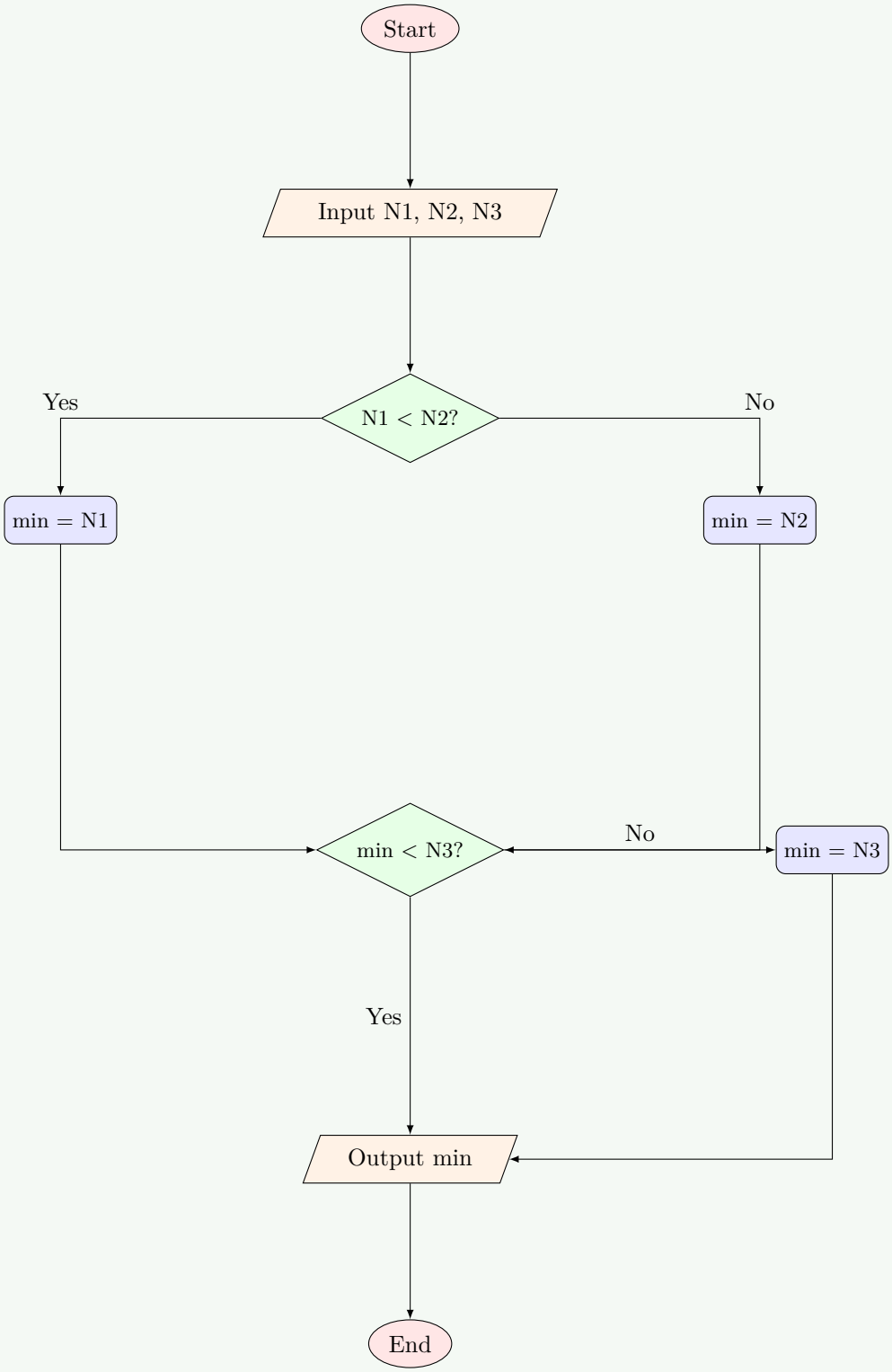
Question 1 [c marks]

7 Define flowchart. Draw flowchart to find minimum of three integer numbers N1, N2 and N3.

Solution

A flowchart is a graphical representation of an algorithm showing the steps as boxes and their order by connecting them with arrows.

Flowchart: Minimum of Three Numbers



- **Symbols used**: Oval (start/end), Parallelogram (input/output), Diamond (decision), Rectangle (process)
- **Decision points**: Compare values systematically
- **Logical flow**: Arrows show the sequence of operations

Mnemonic

"Start-Input-Compare-Output-End" (SICOE)

OR

Question 1 [c marks]

7 Define algorithm. Write an algorithm to find minimum of three integer numbers N1, N2 and N3.

Solution

An algorithm is a step-by-step procedure or finite set of well-defined instructions to solve a particular problem.

Algorithm: Find Minimum of Three Numbers

- **Step 1**: Start
- **Step 2**: Input three numbers N1, N2, and N3
- **Step 3**: Set min = N1 (assume first number is minimum)
- **Step 4**: If N2 < min, then set min = N2
- **Step 5**: If N3 < min, then set min = N3
- **Step 6**: Output min as the minimum number
- **Step 7**: End

Table: Algorithm Characteristics

Characteristic	Description
Finiteness	Algorithm must terminate after finite steps
Definiteness	Each step must be precisely defined
Input	Algorithm takes zero or more inputs
Output	Algorithm produces one or more outputs
Effectiveness	Steps must be simple and executable

- **Sequential steps**: Follows a logical order
- **Comparative approach**: Systematically finds minimum
- **Simplicity**: Easy to understand and implement

Mnemonic

"FIDEO" (Finiteness, Input, Definiteness, Effectiveness, Output)

Question 2 [a marks]

3 Differentiate gets() and puts().

Solution

`gets()` and `puts()` are standard library functions in C for input and output operations with strings.

Table: Comparison of gets() and puts()

Feature	gets()	puts()
Purpose	Reads string from stdin	Writes string to stdout
Prototype	`char *gets(char *str)`	`int puts(const char *str)`
Behavior	Reads until newline	Adds newline automatically
Return value	Returns str on success, NULL on failure	Returns non-negative on success, EOF on error
Safety	Unsafe (buffer overflow risk)	Safe
Recommended	No (deprecated)	Yes

- **Input/Output**: `gets()` for input, `puts()` for output
- **Termination**: `gets()` stops at newline, `puts()` adds newline
- **Security**: `gets()` has no buffer limit check

Mnemonic

"Gets In, Puts Out" (gets reads in, puts writes out)

Question 2 [b marks]

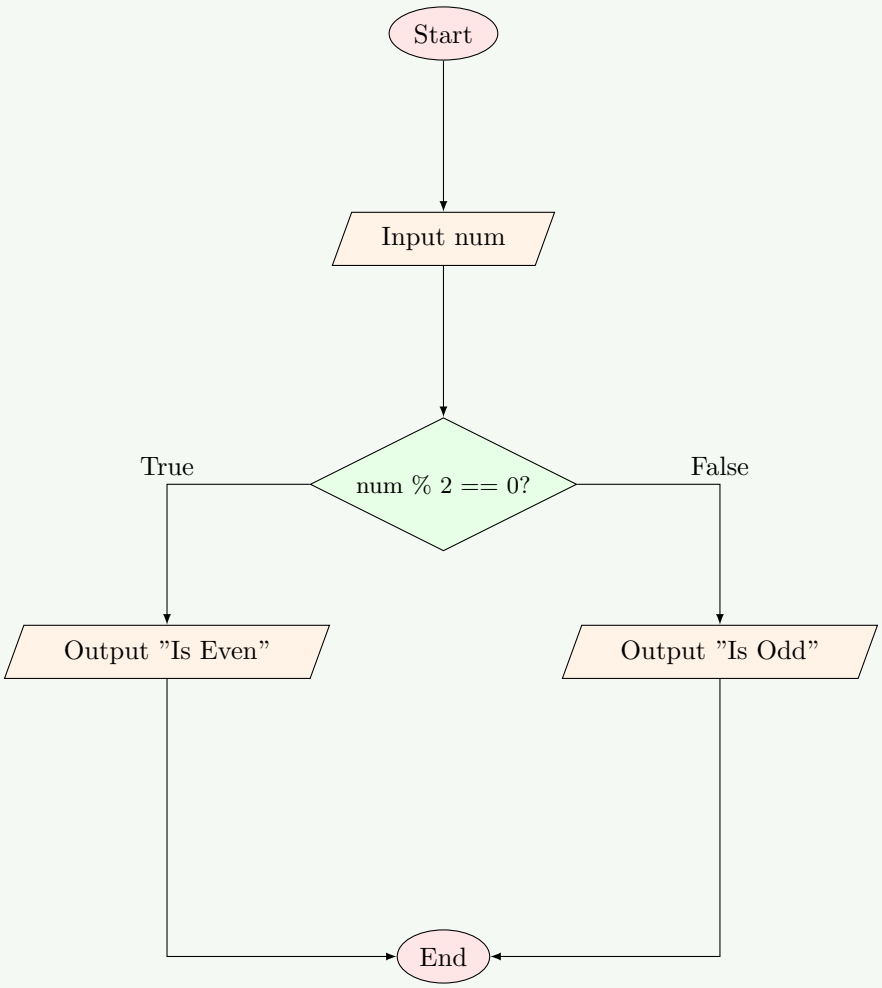
4 Develop a C program to find whether the entered number is even or odd using conditional operator.

Solution

This program uses the conditional operator to check if a number is even or odd.

```c
#include <stdio.h>

int main() {
    int num;

    printf("Enter a number: ");
    scanf("%d", &num);

    // Using conditional operator to check even or odd
    (num % 2 == 0) ? printf("%d is even\n", num) : printf("%d is odd\n", num);

    return 0;
}
```

Flowchart: Even or Odd



- **Conditional operator**: `? :` is a ternary operator
- **Modulus operation**: `%` gives remainder after division
- **Test condition**: `num % 2 == 0` checks for even number

Mnemonic

"REMinder 0 = Even" (Remainder 0 means Even)

Question 2 [c marks]

7 Explain logical & relational operators with examples.

Solution

Logical and relational operators are used to create conditions and make decisions in C programs.

Table: Relational Operators

Operator	Meaning	Example	Result
==	Equal to	5 == 5	true (1)
!=	Not equal to	5 != 3	true (1)
>	Greater than	7 > 3	true (1)
<	Less than	2 < 8	true (1)
>=	Greater than or equal to	4 >= 4	true (1)
<=	Less than or equal to	6 <= 9	true (1)

Table: Logical Operators

Operator	Meaning	Example	Result
&&	Logical AND	(5>3) && (8>5)	true (1)
||	Logical OR	(5>7) || (3<6)	true (1)
!	Logical NOT	!(5>7)	true (1)

```c
int age = 20;
int score = 75;

// Using both relational and logical operators
if ((age >= 18) && (score > 70)) {
    printf("Eligible");
}
```

- **Comparison**: Relational operators compare values
- **Combining conditions**: Logical operators connect multiple conditions
- **Truth value**: All operators return 1 (true) or 0 (false)

Mnemonic

"CORNL" (Compare with relational, OR/AND/NOT with logical)

OR

Question 2 [a marks]

3 Considering precedence of operators, write down each step of evaluation and final answer if expression 16 + (216 / ((3 + 6) * 12)) -10 is evaluated.

Solution

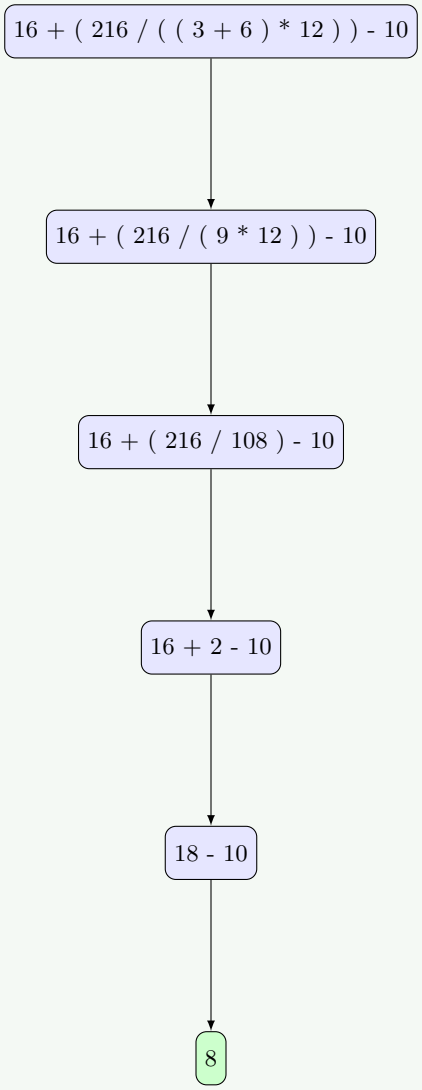
Let's evaluate the expression `16 + ( 216 / ( ( 3 + 6 ) * 12 ) ) - 10` step by step following operator precedence.

Table: Step-by-Step Evaluation

Step	Operation	Expression after this step
1	Calculate `(3 + 6)`	`16 + ( 216 / ( 9 * 12 ) ) - 10`
2	Calculate `(9 * 12)`	`16 + ( 216 / 108 ) - 10`
3	Calculate `(216 / 108)`	`16 + 2 - 10`
4	Calculate `16 + 2`	`18 - 10`
5	Calculate `18 - 10`	`8`

Final Answer: 8

Evaluation Tree:



- **Parentheses first**: Innermost parentheses evaluated first
- **Multiplication before division**: Calculate from left to right
- **Addition and subtraction last**: From left to right

Mnemonic

"PEMDAS" (Parentheses, Exponents, Multiplication/Division, Addition/Subtraction)

Question 2 [b marks]

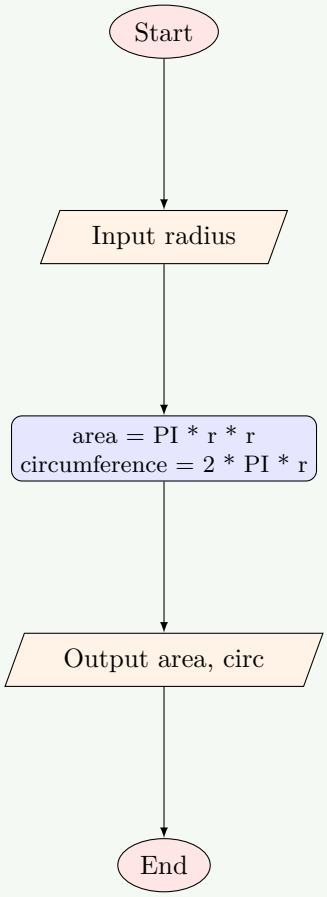
4 Write a C program to find circumference and area of a circle.

Solution

This program calculates the area and circumference of a circle based on its radius.

```c
#include <stdio.h>
#define PI 3.14159

int main() {
    float radius, area, circumference;

    printf("Enter the radius of circle: ");
    scanf("%f", &radius);

    // Calculate area and circumference
    area = PI * radius * radius;
    circumference = 2 * PI * radius;

    printf("Area of circle = %.2f square units\n", area);
    printf("Circumference of circle = %.2f units\n", circumference);

    return 0;
}
```

Flowchart: Area and Circumference



- **Formula**: Area $= \pi \times r^2$ and Circumference $= 2\pi \times r$
- **Constant definition**: Using `#define` for PI

- **Float variables**: For decimal precision

Mnemonic

"PIR^2" for area, "2PIR" for circumference

Question 2 [c marks]

7 Explain arithmetic & bit-wise operators with examples.

Solution

Arithmetic operators perform mathematical operations while bit-wise operators manipulate individual bits of integers.

Table: Arithmetic Operators

Op	Description	Example	Result
`+`	Addition	`5 + 3`	8
`-`	Subtraction	`7 - 2`	5
`*`	Multiplication	`4 * 3`	12
`/`	Division	`10 / 3`	3
`%`	Modulus	`10 % 3`	1
`++`	Increment	`a++`	Adds 1
`--`	Decrement	`--b`	Sub. 1

Table: Bitwise Operators

Op	Description	Exp (bin)	Res
`&`	Bitwise AND	`5(101) & 3(011)`	1(001)
`|`	Bitwise OR	`5(101) | 3(011)`	7(111)
`^`	Bitwise XOR	`5(101) 3(011)`	6(110)
`~`	Bitwise NOT	`5(101)`	-6
`<<`	Left Shift	`5 << 1`	10(1010)
`>>`	Right Shift	`5 >> 1`	2(10)

```c
int a = 5, b = 3;
printf("a + b = %d\n", a + b);      // 8
printf("a & b = %d\n", a & b);      // 1
printf("a << 1 = %d\n", a << 1);    // 10
```

- **Mathematical operations**: Arithmetic operators for calculations
- **Bit manipulation**: Bitwise operators work at binary level
- **Efficiency**: Bitwise operations are faster for certain tasks

Mnemonic

"SAME BARON" (Subtraction Addition Multiplication, Bitwise AND/OR/NOT)

Question 3 [a marks]

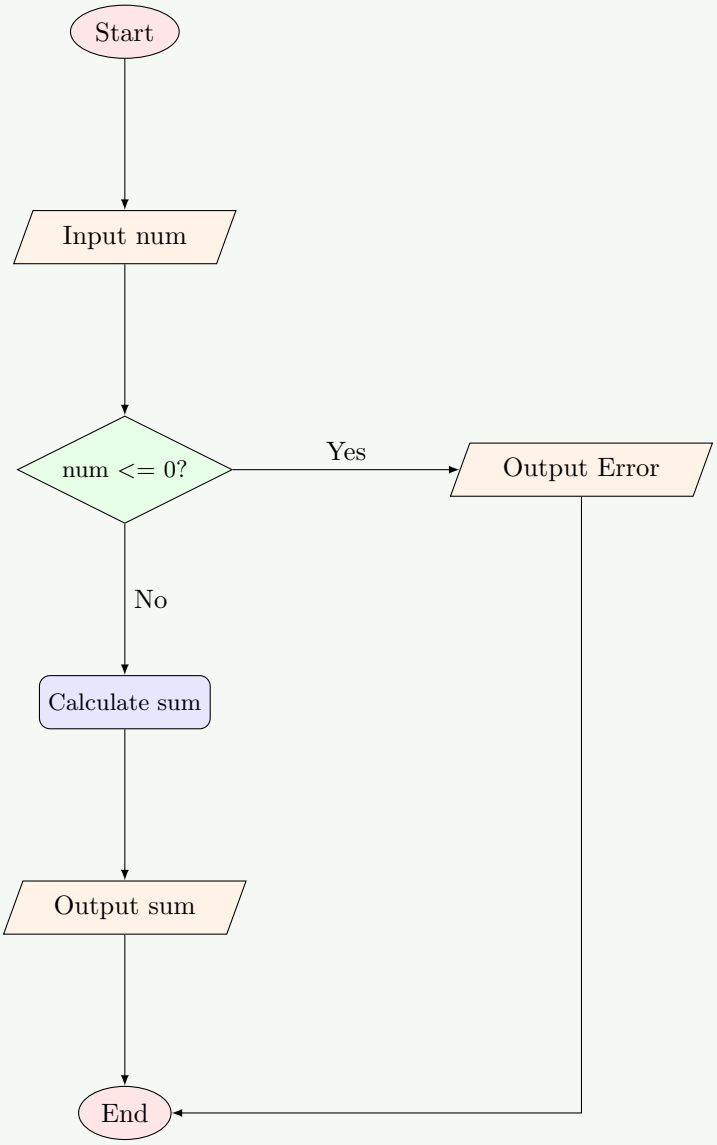
3 Explain the use of 'go to' statement with example.

Solution

The `goto` statement is used to transfer program control unconditionally to a labeled statement.

```c
#include <stdio.h>

int main() {
    int num, sum = 0;

    printf("Enter a positive number: ");
    scanf("%d", &num);

    if (num <= 0) {
        goto error;
    }

    sum = num * (num + 1) / 2;
    printf("Sum of first %d numbers = %d\n", num, sum);
    goto end;

    error:
        printf("Error: Please enter a positive number!\n");

    end:
        return 0;
}
```

Flowchart: goto Example



- **Label declaration**: Labels end with colon (:)
- **Jump statement**: `goto` transfers control to label
- **Caution**: Excessive use creates ”spaghetti code”

Mnemonic

”JUMPing LABEL” (Jump to a labeled statement)

Question 3 [b marks]

4 The marks obtained by the student in 5 different subjects are input through keyboard. The student gets grade as per following rules: Percentage above or equal to 90- Grade A. Percentage between 80 and 89- Grade B. Percentage between 70 and 79-Grade C. Percentage between 60 and 69-Grade D. Percentage between 50 and 59-Grade E. Percentage less than 50- Grade F. Write a C program to display the grade obtained by the student.

Solution

This program calculates the grade based on the average marks in 5 subjects.

```c
#include <stdio.h>

int main() {
    int marks[5], total = 0, i;
    float percentage;
    char grade;

    // Input marks for 5 subjects
    for (i = 0; i < 5; i++) {
        printf("Enter marks for subject %d (out of 100): ", i+1);
        scanf("%d", &marks[i]);
        total += marks[i];
    }

    // Calculate percentage
    percentage = total / 5.0;

    // Determine grade
    if (percentage >= 90)
        grade = 'A';
    else if (percentage >= 80)
        grade = 'B';
    else if (percentage >= 70)
        grade = 'C';
    else if (percentage >= 60)
        grade = 'D';
    else if (percentage >= 50)
        grade = 'E';
    else
        grade = 'F';

    printf("Percentage: %.2f%%\n", percentage);
    printf("Grade: %c\n", grade);

    return 0;
}
```

Table: Grading Criteria

Percentage Range	Grade
≥ 90	A
80-89	B
70-79	C
60-69	D
50-59	E
< 50	F

- **Input array**: Stores marks of 5 subjects
- **Percentage calculation**: Sum divided by number of subjects
- **Grade determination**: Using if-else ladder

Mnemonic

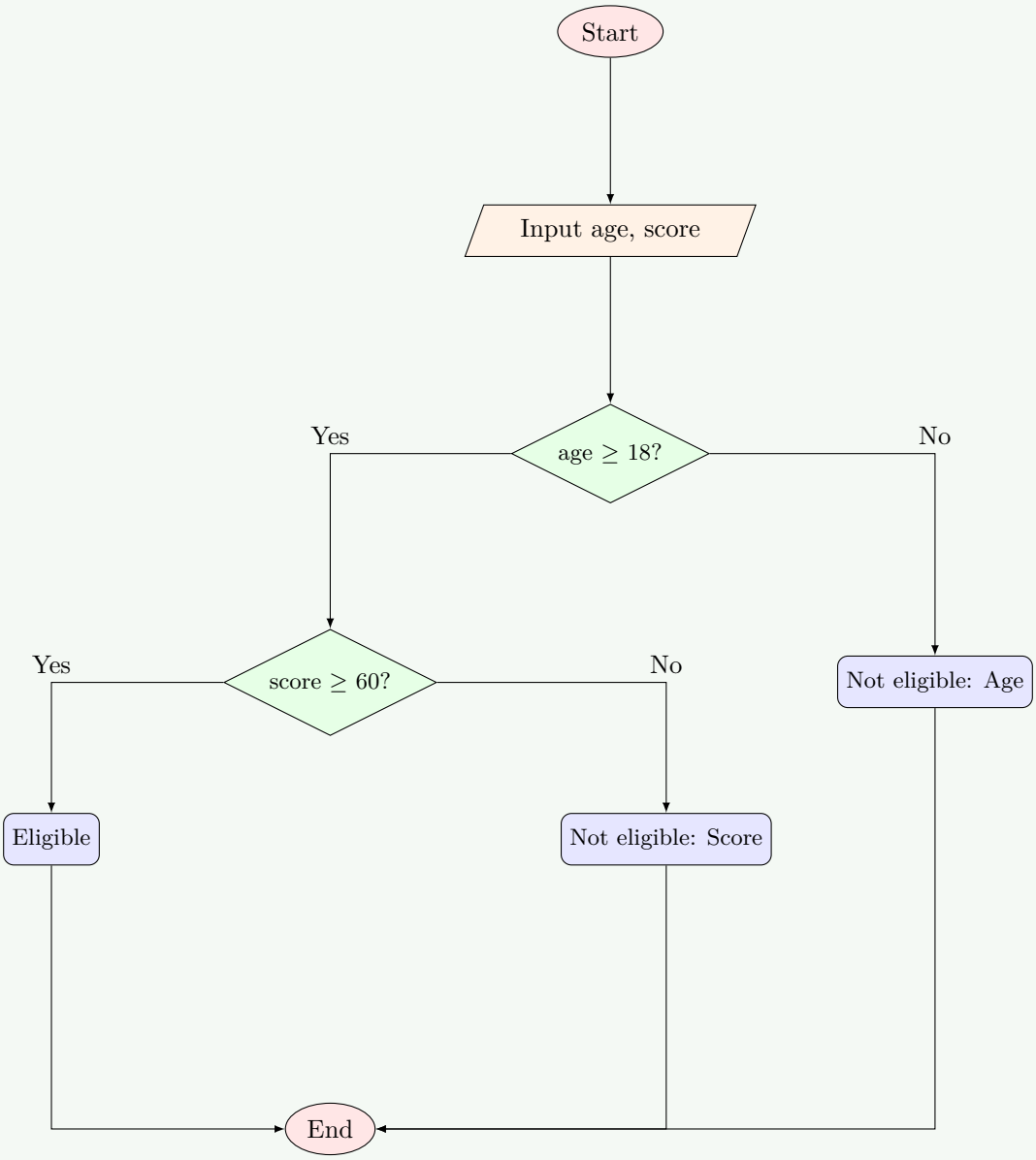
"ABCDEF-90-80-70-60-50" (Grades with their percentage thresholds)

Question 3 [c marks]

7 Draw flowchart and explain nested if-else with example.

Solution

Nested if-else is a control structure where an if or else statement contains another if-else statement within it.
Flowchart: Nested if-else




```c
#include <stdio.h>

int main() {
    int age, score;

    printf("Enter age: ");
    scanf("%d", &age);
    printf("Enter score: ");
    scanf("%d", &score);

    if (age >= 18) {
```

```c
        if (score >= 60) {
            printf("Eligible for admission");
        } else {
            printf("Not eligible: Score criteria not met");
        }
    } else {
        printf("Not eligible: Age criteria not met");
    }

    return 0;
}
```

- **Multiple conditions**: Tests several conditions in sequence
- **Hierarchical decision**: Inner condition only evaluated if outer is true
- **Indentation**: Proper indentation helps in understanding structure

Mnemonic

"CONE" (Check Outer, Nest Evaluation inside)

OR

Question 3 [a marks]

3 Explain the use of continue and break statement.

Solution

The `break` and `continue` statements control the flow of loops in different ways.

Table: Comparison of break and continue

Feature	break	continue
Purpose	Exits the loop immediately	Skips current iteration
Effect on loop	Terminates completely	Proceeds to next iteration
Applicable in	`switch`, `for`, `while`, `do-while`	`for`, `while`, `do-while`
Usage	When condition met and no more iterations needed	When current iteration should be skipped

```c
// Example with break
for (int i = 1; i <= 10; i++) {
    if (i == 5)
        break;    // Exit loop when i equals 5
    printf("%d ", i);  // Outputs: 1 2 3 4
}
```

```c
// Example with continue
for (int i = 1; i <= 10; i++) {
    if (i % 2 == 0)
        continue;  // Skip even numbers
    printf("%d ", i);  // Outputs: 1 3 5 7 9
}
```

- **Loop control**: Both used to manage loop execution
- **Break exits**: Completely stops the loop
- **Continue skips**: Only skips current iteration

Mnemonic

"BEC" (Break Exits Completely, Continue only current)

Question 3 [b marks]

4 Write a program using for loop to print this output:

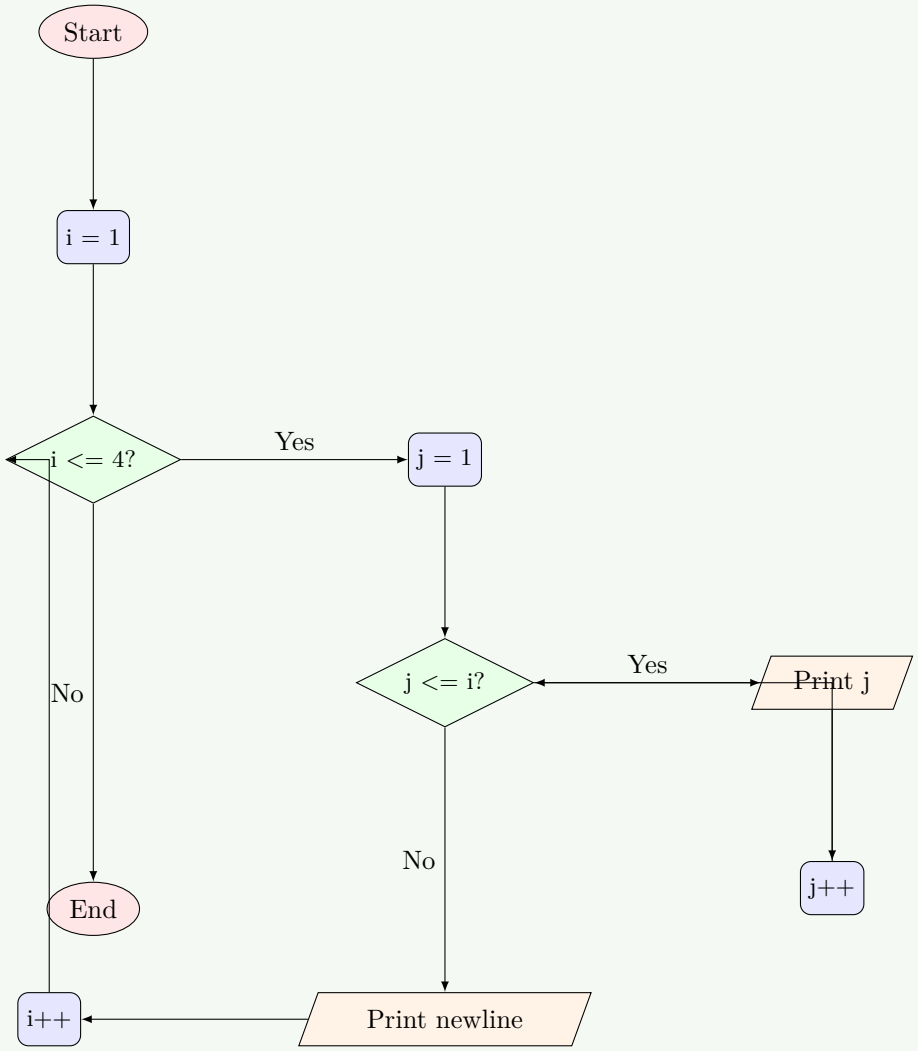
```
1
1 2
1 2 3
1 2 3 4
```

Solution

This program uses nested for loops to print the pattern of numbers.

```c
#include <stdio.h>

int main() {
    int i, j;

    // Outer loop for rows (1 to 4)
    for (i = 1; i <= 4; i++) {
        // Inner loop for columns (1 to i)
        for (j = 1; j <= i; j++) {
            printf("%d ", j);
        }
        printf("\n");  // Move to next line after each row
    }

    return 0;
}
```

Flowchart: Pattern Printing



- **Nested loops**: Outer loop for rows, inner for columns
- **Dynamic limit**: Inner loop runs j from 1 to current i
- **Incremental pattern**: Each row has one more number

Mnemonic

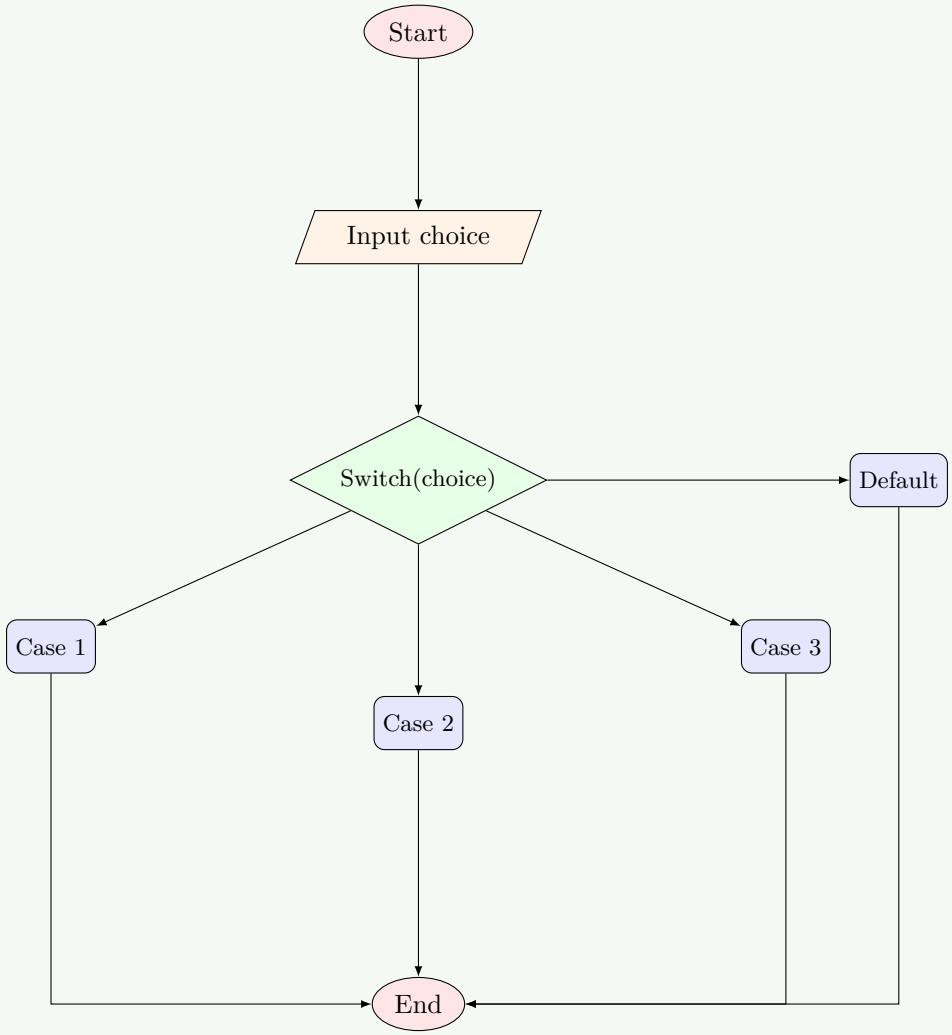
"RICI" (Row Increases, Column Increases based on row number)

Question 3 [c marks]

7 Draw flowchart and explain switch statement with example.

Solution

The `switch` statement is a multi-way decision maker that tests a variable against various case values.
Flowchart: Switch Statement




```c
#include <stdio.h>

int main() {
    int choice;

    printf("Menu:\n");
    printf("1. Add\n");
    printf("2. Subtract\n");
    printf("3. Multiply\n");
    printf("Enter your choice (1-3): ");
    scanf("%d", &choice);

    switch (choice) {
        case 1:
            printf("Addition selected\n");
            break;
        case 2:
            printf("Subtraction selected\n");
            break;
        case 3:
            printf("Multiplication selected\n");
            break;
        default:
            printf("Invalid choice\n");
    }
```

```
26
27      return 0;
28  }
```

- **Multiple cases**: Tests one variable against multiple values
- **Break statement**: Prevents fall-through to next case
- **Default case**: Handles values not matching any case
- **Case order**: Can be in any order, default usually last

Mnemonic

"CASED" (Check All Switch Expression's Destinations)

Question 4 [a marks]

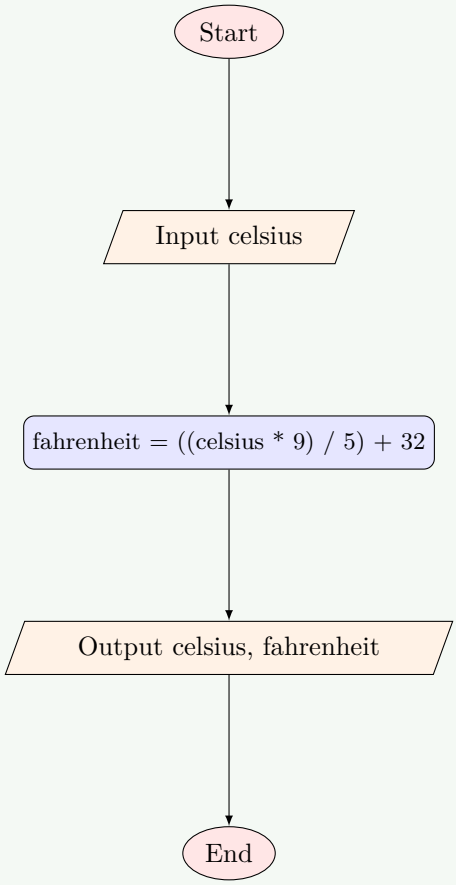
3 Develop a C program to convert temperature from Celsius to Fahrenheit using formula fahrenheit= ((celsius*9)/5)+32.

Solution

This program converts a temperature value from Celsius to Fahrenheit.

```c
#include <stdio.h>

int main() {
    float celsius, fahrenheit;

    printf("Enter temperature in Celsius: ");
    scanf("%f", &celsius);

    // Convert Celsius to Fahrenheit
    fahrenheit = ((celsius * 9) / 5) + 32;

    printf("%.2f Celsius = %.2f Fahrenheit\n", celsius, fahrenheit);

    return 0;
}
```

Flowchart: Celsius to Fahrenheit



- **Formula**: $F = ((C \times 9) \div 5) + 32$
- **Float variables**: For decimal precision
- **Formatted output**: Using `%.2f` for two decimal places

Mnemonic

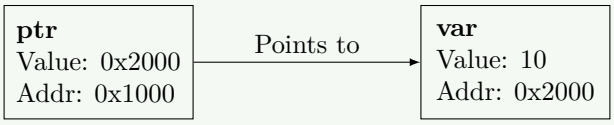
"C95+32=F" (Celsius x 9 / 5 + 32 = Fahrenheit)

Question 4 [b marks]

4 What is pointer? Explain with example.

Solution

A pointer is a variable that stores the memory address of another variable.
Memory Layout Illustration




```c
#include <stdio.h>

int main() {
    int var = 10;    // Regular variable
    int *ptr;        // Pointer variable
```

```c

    ptr = &var;      // Store address of var in ptr

    printf("Value of var: %d\n", var);       // Output: 10
    printf("Address of var: %p\n", &var);    // Output: memory address
    printf("Value of ptr: %p\n", ptr);       // Output: same memory address
    printf("Value at address stored in ptr: %d\n", *ptr); // Output: 10

    // Modify value using pointer
    *ptr = 20;
    printf("New value of var: %d\n", var);   // Output: 20

    return 0;
}
```

Table: Pointer Operations

Operation	Symbol	Description	Example
Address-of	`&`	Gets address of variable	`&var`
Dereference	`*`	Accesses value at address	`*ptr`
Declaration	`*`	Creates pointer variable	`int *ptr;`
Assignment	`=`	Assigns address to pointer	`ptr = &var;`

- **Memory address**: Pointer stores location, not value
- **Indirection**: Access value indirectly using address
- **Memory manipulation**: Allows dynamic memory access

Mnemonic

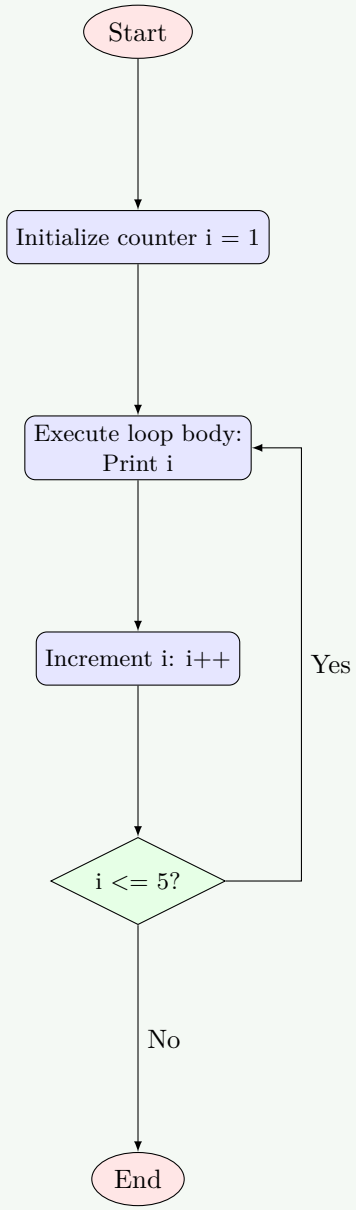
"ADA" (Address Dereferencing Access)

Question 4 [c marks]

7 Draw flowchart and explain do-while loop with example.

Solution

The `do-while` loop is a post-test loop that executes its body at least once before checking the condition.
Flowchart: do-while Loop




```c
#include <stdio.h>

int main() {
    int i = 1;

    do {
        printf("%d ", i);
        i++;
    } while (i <= 5);  // Condition checked after first execution

    // Output: 1 2 3 4 5

    return 0;
}
```

Table: Characteristics of do-while Loop

Characteristic	Description
Execution order	Body first, then condition
Minimum iterations	At least one
Condition check	At the end of loop
Termination	When condition becomes false
Syntax	`do { statements; } while (condition);`

- **Post-test loop**: Condition evaluated after loop body
- **Guaranteed execution**: Loop body always runs at least once
- **Semicolon**: Required after while condition

Mnemonic

"DECAT" (Do Execute Check After That)

OR

Question 4 [a marks]

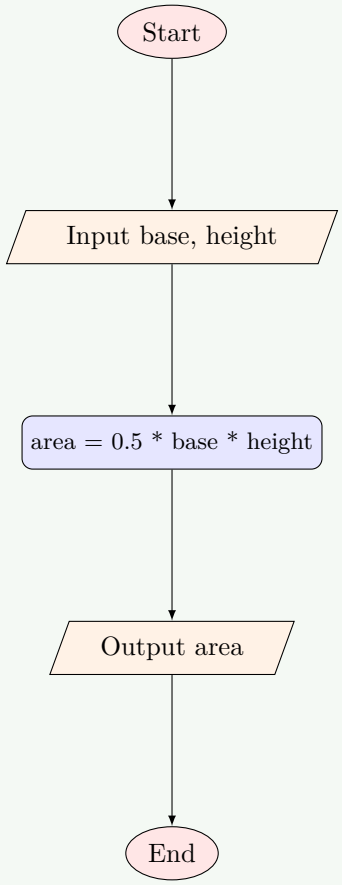
3 Develop a C program to find area of a triangle (0.5 * base * height)?

Solution

This program calculates the area of a triangle using the formula $Area = \frac{1}{2} \times base \times height$.

```c
#include <stdio.h>

int main() {
    float base, height, area;

    printf("Enter base of triangle: ");
    scanf("%f", &base);
    printf("Enter height of triangle: ");
    scanf("%f", &height);

    // Calculate area
    area = 0.5 * base * height;

    printf("Area of triangle = %.2f square units\n", area);

    return 0;
}
```

Flowchart: Area of Triangle



- **Formula**: Area = 0.5 * base * height
- **Float variables**: For decimal precision
- **User input**: Gets base and height from user

Mnemonic

"Half-BH" (Half times Base times Height)

Question 4 [b marks]

4 Explain declaration and initialization of pointer.

Solution

Pointer declaration and initialization involve creating a pointer variable and assigning it a memory address.

Table: Pointer Declaration and Initialization

Operation	Syntax	Example	Explanation
Declaration	`type *name;`	`int *ptr;`	Creates pointer to int
Initialization	`name = &var;`	`ptr = &num;`	Assigns addr of num
Combined	`type *n = &v;`	`int *p = &n;`	Declares & initializes
Null pointer	`name = NULL;`	`ptr = NULL;`	Points to nothing

```
int main() {
    // Declaration
    int *ptr1;

```

```c
    // Declaration and initialization together
    int num = 10;
    int *ptr2 = &num;

    // Initialization with NULL
    int *ptr3 = NULL;

    printf("Value at address ptr2: %d\n", *ptr2);  // Output: 10

    return 0;
}
```

- **Asterisk syntax**: `*` used in declaration to create pointer
- **Address operator**: `&` gets address of variable
- **NULL initialization**: Safe practice to avoid wild pointers
- **Pointer type**: Must match the data type it points to

Mnemonic

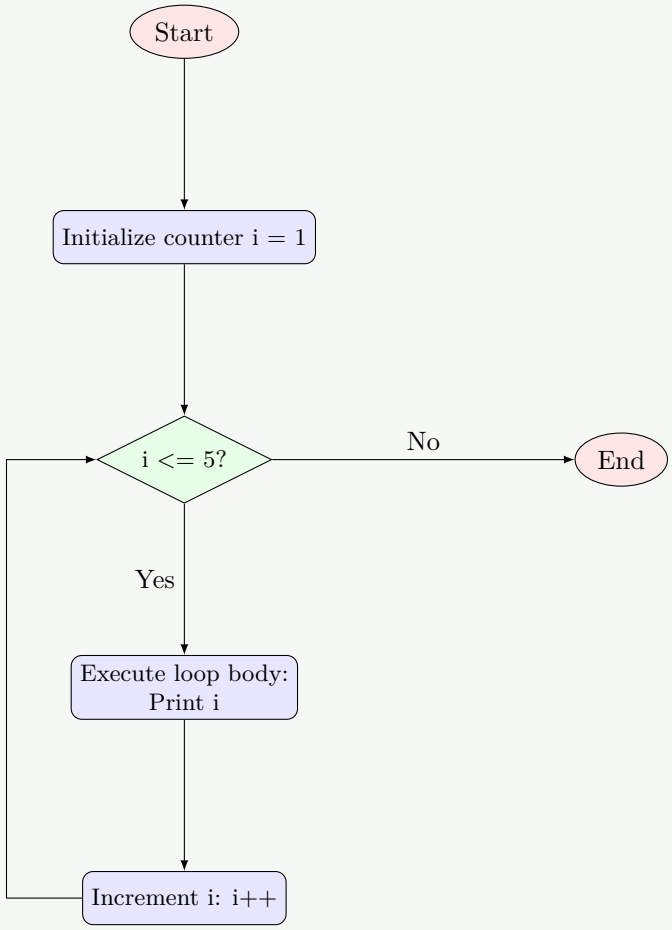
"DINA" (Declare, Initialize with NULL or Address)

Question 4 [c marks]

7 Draw flowchart and explain while loop with example.

Solution

The `while` loop is a pre-test loop that executes its body repeatedly as long as the condition remains true.
Flowchart: while Loop




```c
#include <stdio.h>

int main() {
    int i = 1;

    while (i <= 5) {  // Condition checked before each execution
        printf("%d ", i);
        i++;
    }

    // Output: 1 2 3 4 5

    return 0;
}
```

Table: Characteristics of while Loop

Characteristic	Description
Execution order	Condition first, then body
Minimum iterations	Zero (if condition initially false)
Condition check	At the beginning of loop
Termination	When condition becomes false
Syntax	`while (condition) { statements; }`

- **Pre-test loop**: Condition evaluated before loop body
- **Zero iterations possible**: Body may never execute if condition initially false
- **Loop variable**: Must be initialized before loop

Mnemonic

"CELT" (Check, Execute, Loop, Terminate)

Question 5 [a marks]

3 Build a structure to store book information: book_no, book_title, book_author, book_price

Solution

This program creates a structure to store book information with the specified fields.

```c
#include <stdio.h>
#include <string.h>

// Define structure for book information
struct Book {
    int book_no;
    char book_title[50];
    char book_author[30];
    float book_price;
};

int main() {
    // Declare a variable of Book structure
    struct Book book1;

    // Assign values to structure members
    book1.book_no = 101;
    strcpy(book1.book_title, "Programming in C");
    strcpy(book1.book_author, "Dennis Ritchie");
    book1.book_price = 450.75;

    // Display book information
    printf("Book No: %d\n", book1.book_no);
    printf("Title: %s\n", book1.book_title);
    printf("Author: %s\n", book1.book_author);
    printf("Price: Rs. %.2f\n", book1.book_price);

    return 0;
}
```

Structure Representation:

struct Book
int book_no
char book_title[50]
char book_author[30]
float book_price

- **Structure definition**: Uses `struct` keyword to define composite data type
- **Member access**: Using dot (.) operator to access members
- **String copying**: `strcpy()` for character arrays

Mnemonic

"NTAP" (Number, Title, Author, Price)

Question 5 [b marks]

4 Explain following functions with example. (1) sqrt() (2) pow() (3) strlen() (4) strcpy()

Solution

These are standard library functions in C, used for mathematical calculations and string manipulations.

Table: Library Functions

Function	Header	Purpose	Example
`sqrt()`	math.h	Square root	`sqrt(16) -> 4.0`
`pow()`	math.h	Power	`pow(2,3) -> 8.0`
`strlen()`	string.h	String length	`strlen("Hi") -> 2`
`strcpy()`	string.h	String copy	`strcpy(d, "Hi")`

```c
#include <stdio.h>
#include <math.h>
#include <string.h>

int main() {
    // sqrt() and pow() examples
    printf("sqrt(25): %.2f\n", sqrt(25));
    printf("pow(2, 4): %.2f\n", pow(2, 4));

    // strlen() example
    char str[] = "C Prog";
    printf("Length: %d\n", strlen(str));

    // strcpy() example
    char dest[10];
    strcpy(dest, "Hello");
    printf("Copied: %s\n", dest);

    return 0;
}
```

- **Math functions**: `sqrt()` and `pow()` for mathematical calculations
- **String functions**: `strlen()` and `strcpy()` for string manipulations
- **Header files**: Required to use these functions (`math.h`, `string.h`)

Mnemonic

"MPSL" (Math Power and String Length)

Question 5 [c marks]

7 Explain arrays and array initialization. Give example.

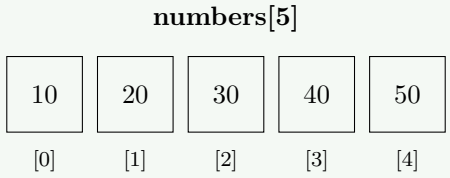
Solution

An array is a collection of elements of the same data type stored in contiguous memory locations.

Table: Array Types and Initialization

Type	Declaration	Init (Declaration)
Integer	`int a[5];`	`int a[5] = {1,2};`
Char	`char s[10];`	`char s[] = "Hi";`
Float	`float f[3];`	`float f[3] = {1.1};`
Size Inference	-	`int n[] = {1,2,3};`

Diagram: Array Memory Layout




```c
#include <stdio.h>

int main() {
    // Array declaration and initialization
    int numbers[5] = {10, 20, 30, 40, 50};

    // Access and display array elements
    printf("Array elements: ");
    for (int i = 0; i < 5; i++) {
        printf("%d ", numbers[i]);
    }

    return 0;
}
```

- **Zero-based indexing**: First element at index 0
- **Contiguous memory**: Elements stored adjacently
- **Fixed size**: Size defined at compile time

Mnemonic

"DICE" (Declaration, Initialization, Contiguous storage, Element access)

OR

Question 5 [a marks]

3 Explain declaration of structure with example.

Solution

Structure declaration in C involves defining a new data type that combines different data types under a single name.

Table: Structure Declaration Methods

Method	Example
Basic declaration	`struct Student { int id; };`
With variables	`struct Point { int x; } p1;`
Without tag	`struct { float r; } c1;`
Typedef	`typedef struct { int w; } Rect;`

```c
struct Student {
```

```c
    int id;
    char name[30];
    float percentage;
};

int main() {
    struct Student s1;
    s1.id = 101;
    return 0;
}
```

- **Structure keyword**: `struct` used to define new data type
- **Member access**: `.` (dot) operator to access members
- **Heterogeneous data**: Can combine different data types

Mnemonic

"SMUVT" (Structure Mostly Uses Various Types)

Question 5 [b marks]

4 What is user defined function? Explain with example.

Solution

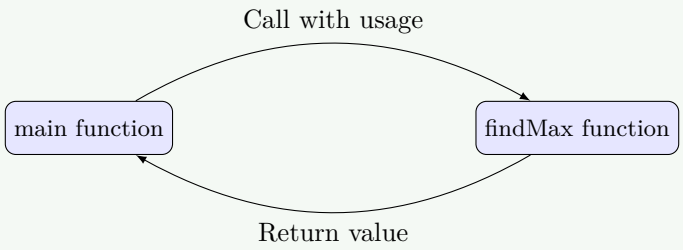
A user-defined function is a block of code written by the programmer to perform a specific task, which can be called from other parts of the program.

Table: Function Components

Component	Example
Return type	`int, float, void`
Function name	`findMax`
Parameters	`(int a, int b)`
Function body	`{ return a + b; }`
Function call	`result = findMax(5, 3);`

```c
#include <stdio.h>

// User-defined function declaration
int findMax(int a, int b);

int main() {
    int max = findMax(10, 20);
    printf("Max: %d\n", max);
    return 0;
}

// Function definition
int findMax(int a, int b) {
    if (a > b) return a;
    else return b;
}
```

Flowchart: Function Call



- **Modular code**: Break large program into smaller parts
- **Reusability**: Call function multiple times
- **Declaration vs Definition**: Prototype vs Implementation

Mnemonic

"CDRP" (Create, Define, Return, Pass)

Question 5 [c marks]

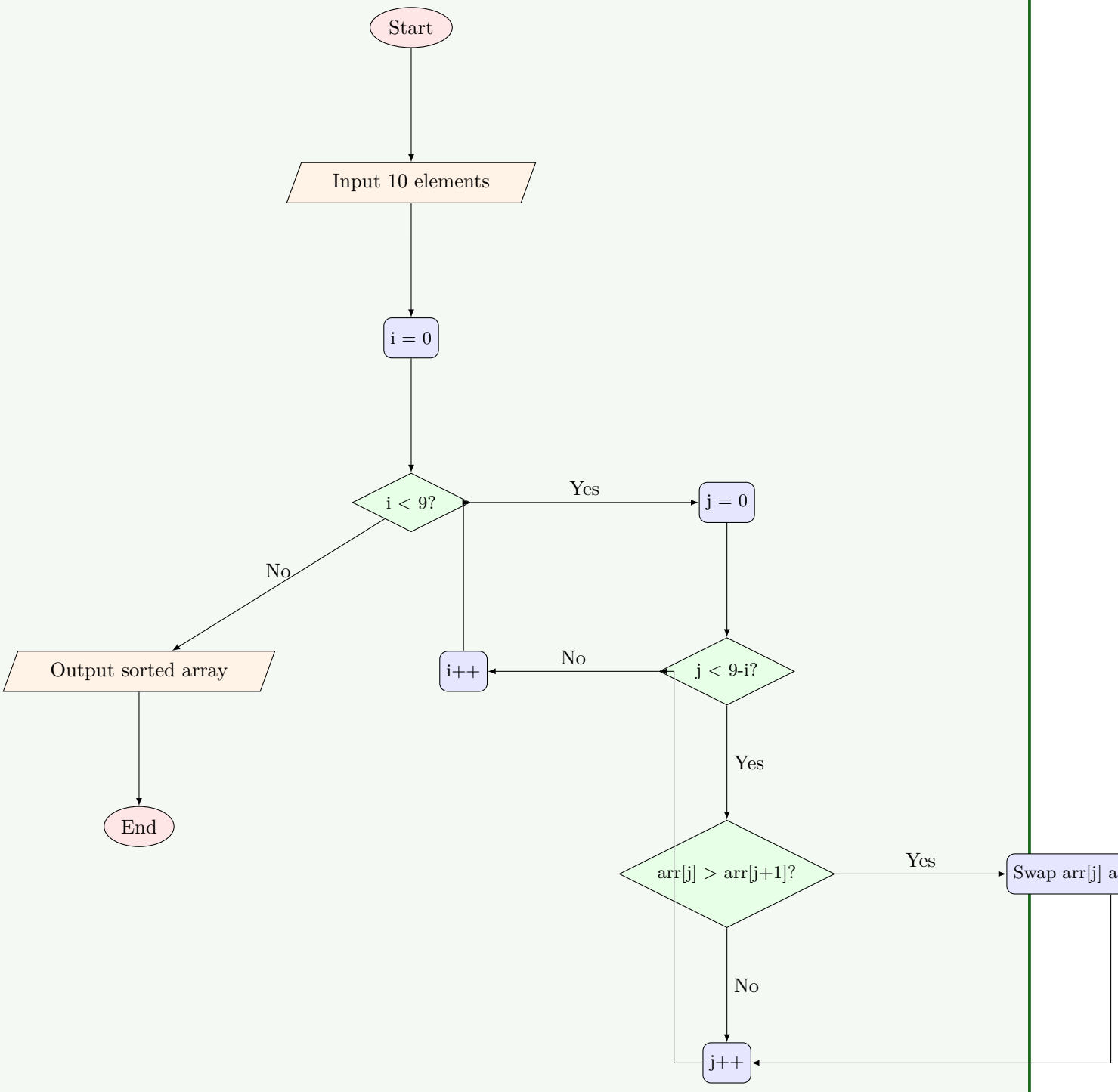
7 Develop a C program to arrange elements of an array of 10 numbers in ascending order.

Solution

This program sorts an array of 10 integers in ascending order using bubble sort algorithm.

```c
#include <stdio.h>

int main() {
    int arr[10], i, j, temp;

    // Input array elements
    printf("Enter 10 integers: \n");
    for (i = 0; i < 10; i++) {
        scanf("%d", &arr[i]);
    }

    // Bubble sort algorithm for ascending order
    for (i = 0; i < 9; i++) {
        for (j = 0; j < 9 - i; j++) {
            if (arr[j] > arr[j + 1]) {
                // Swap if current element is greater than next
                temp = arr[j];
                arr[j] = arr[j + 1];
                arr[j + 1] = temp;
            }
        }
    }

    // Display sorted array
    printf("Array in ascending order: \n");
    for (i = 0; i < 10; i++) {
        printf("%d ", arr[i]);
    }

    return 0;
}
```

Flowchart: Bubble Sort



- **Bubble sort**: Compare adjacent elements and swap if needed
- **Nested loops**: Outer loop for passes, inner loop for comparisons
- **Optimization**: Each pass fixes at least one element, so inner loop runs fewer times

Mnemonic

"BSCOT" (Bubble Sort Compares and Orders Things)