Question 1(a) [3 marks]

List basic data types of C language with their range

Answer:

Data Type	Size (bytes)	Range
char	1	-128 to 127
int	2 or 4	-32,768 to 32,767 (2 bytes) or -2,147,483,648 to 2,147,483,647 (4 bytes)
float	4	3.4E-38 to 3.4E+38
double	8	1.7E-308 to 1.7E+308

Mnemonic: "CIFD - Computer Is Fundamentally Digital"

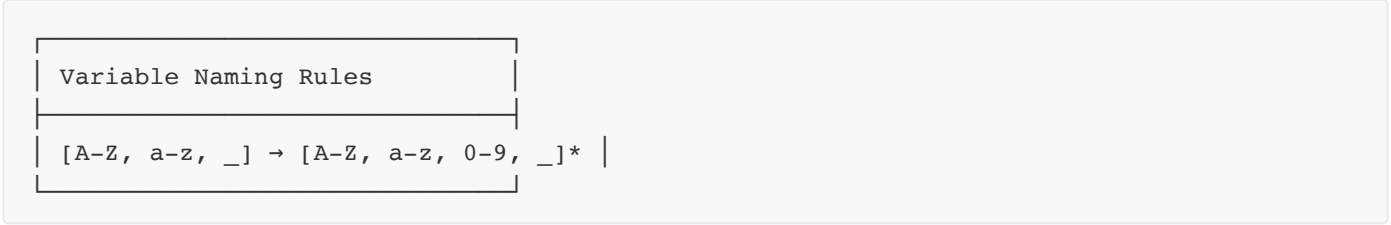
Question 1(b) [4 marks]

Explain rules for naming a variable.

Answer:

Rule	Example
Must start with letter or underscore	valid: _count, name / invalid: 1score
Can contain letters, digits, underscores	valid: user_1 / invalid: user-1
Cannot use keywords	valid: integer / invalid: int
Case sensitive	total and TOTAL are different

Diagram:



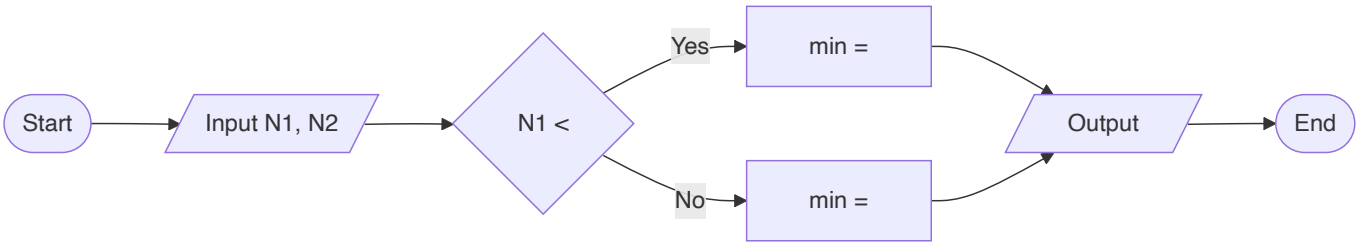
Mnemonic: "LUCK - Letters Underscore Case Keywords"

Question 1(c) [7 marks]

Define flowchart. Draw flowchart to find minimum of two integer numbers N1 and N2.

Answer:

A flowchart is a graphical representation of an algorithm showing the sequence of steps using standard symbols connected by arrows.



- **Flowchart symbols**: Visual representation of logical steps
- **Decision diamond**: Tests condition to determine flow path
- **Process boxes**: Contain calculations or operations

Mnemonic: "FAST - Flow Analysis Shown Through-charts"

Question 1(c OR) [7 marks]

Define algorithm. Write an algorithm to calculate area and circumference of circle.

Answer:

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

Algorithm for circle calculations:

```
1. START
2. Input radius r
3. Calculate area = π * r * r
4. Calculate circumference = 2 * π * r
5. Output area, circumference
6. STOP
```

Step	Operation	Formula
1	Get radius	Input r
2	Calculate area	$A = \pi \times r^2$
3	Calculate circumference	$C = 2 \times \pi \times r$
4	Display results	Output A, C

Mnemonic: "SICS - Steps In Clear Sequence"

Question 2(a) [3 marks]

Differentiate printf() and scanf().

Answer:

Feature	printf()	scanf()
Purpose	Outputs data to screen	Inputs data from keyboard
Format	printf("format", variables)	scanf("format", &variables)
Returns	Number of chars printed	Number of items successfully read
Addressing	Uses variable names	Uses address of variables (&var)

Mnemonic: "IO-AR - Input Output-Address Returns"

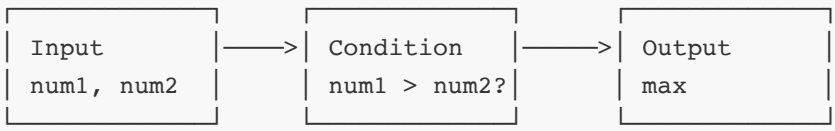
Question 2(b) [4 marks]

Develop a C program to find maximum among two numbers using conditional operator.

Answer:

```c
#include <stdio.h>

int main() {
    int num1, num2, max;

    printf("Enter two numbers: ");
    scanf("%d %d", &num1, &num2);

    max = (num1 > num2) ? num1 : num2;

    printf("Maximum number is: %d", max);

    return 0;
}
```

Diagram:



Mnemonic: "CTO - Condition Then Output"

Question 2(c) [7 marks]

Explain arithmetic & relational operators with examples.

Answer:

Type	Operators	Example	Result
Arithmetic Operators			
Addition	+	5 + 3	8
Subtraction	-	5 - 3	2
Multiplication	*	5 * 3	15
Division	/	5 / 3	1 (integer division)
Modulus	%	5 % 3	2 (remainder)
Relational Operators			
Equal to	==	5 == 3	0 (false)
Not equal to	!=	5 != 3	1 (true)
Greater than	>	5 > 3	1 (true)
Less than	<	5 < 3	0 (false)
Greater than or equal	>=	5 >= 5	1 (true)
Less than or equal	<=	5 <= 3	0 (false)

Mnemonic: "ASMDCRO - Add Subtract Multiply Divide Compare Return Output"

Question 2(a OR) [3 marks]

Considering precedence of operators, write down each step of evaluation and final answer if expression (25/3) * 4 – 10 % 3 + 9/2 is evaluated.

Answer:

Step	Operation	Calculation	Result
1	Parentheses (25/3)	25/3 = 8 (integer division)	8
2	Modulus 10 % 3	10 % 3 = 1	1
3	Division 9/2	9/2 = 4 (integer division)	4
4	Multiplication 8 * 4	8 * 4 = 32	32
5	Subtraction 32 - 1	32 - 1 = 31	31
6	Addition 31 + 4	31 + 4 = 35	35

Final answer = 35

Mnemonic: "PEMDAS - Parentheses, Exponents, Multiplication/Division, Addition/Subtraction"

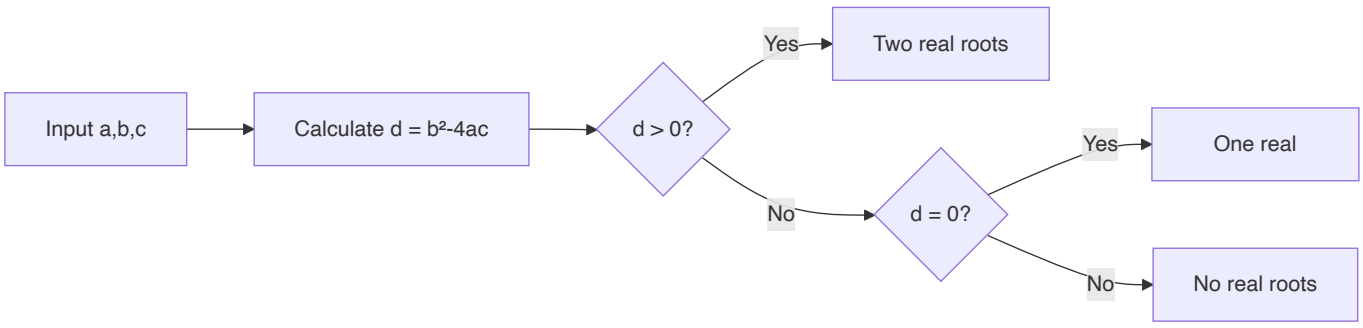
Question 2(b OR) [4 marks]

Develop a C program to find roots of an algebraic equation

Answer:

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

int main() {
    float a, b, c;
    float discriminant, root1, root2;

    printf("Enter coefficients a, b, c: ");
    scanf("%f %f %f", &a, &b, &c);

    discriminant = b*b - 4*a*c;

    if (discriminant > 0) {
        root1 = (-b + sqrt(discriminant)) / (2*a);
        root2 = (-b - sqrt(discriminant)) / (2*a);
        printf("Roots: %.2f and %.2f", root1, root2);
    } else if (discriminant == 0) {
        root1 = -b / (2*a);
        printf("Root: %.2f", root1);
    } else {
        printf("No real roots");
    }

    return 0;
}
```

Diagram:



Mnemonic: "QDR - Quadratic Discriminant Roots"

Question 2(c OR) [7 marks]

Explain logical & bit-wise operators with examples.

Answer:

Type	Operators	Example	Result
Logical Operators			
Logical AND	&&	(5>3) && (4<7)	1 (true)
Logical OR	||	(5<3) || (4<7)	1 (true)
Logical NOT	!	!(5>3)	0 (false)
Bitwise Operators			
Bitwise AND	&	5 & 3 (101 & 011)	1 (001)
Bitwise OR	|	5 | 3 (101 | 011)	7 (111)
Bitwise XOR	^	5 ^ 3 (101 ^ 011)	6 (110)
Bitwise NOT	~	~5 (~ 00000101)	-6 (11111010)
Left Shift	<<	5 << 1 (101 << 1)	10 (1010)
Right Shift	>>	5 >> 1 (101 >> 1)	2 (10)

Mnemonic: "LAND BORNS - Logical AND OR NOT, Bitwise OR AND NOT Shift"

Question 3(a) [3 marks]

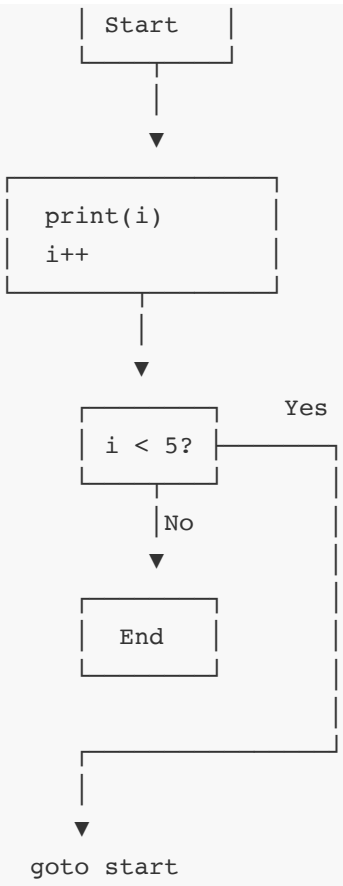
Explain the use of 'go to' statement with example

Answer:

The `goto` statement allows unconditional jump to a labeled statement in the program.

```c
#include <stdio.h>

int main() {
    int i = 0;

start:
    printf("%d ", i);
    i++;
    if (i < 5)
        goto start;

    return 0;
}
// Output: 0 1 2 3 4
```

Diagram:



Mnemonic: "JUMP - Just Unconditionally Move Program-counter"

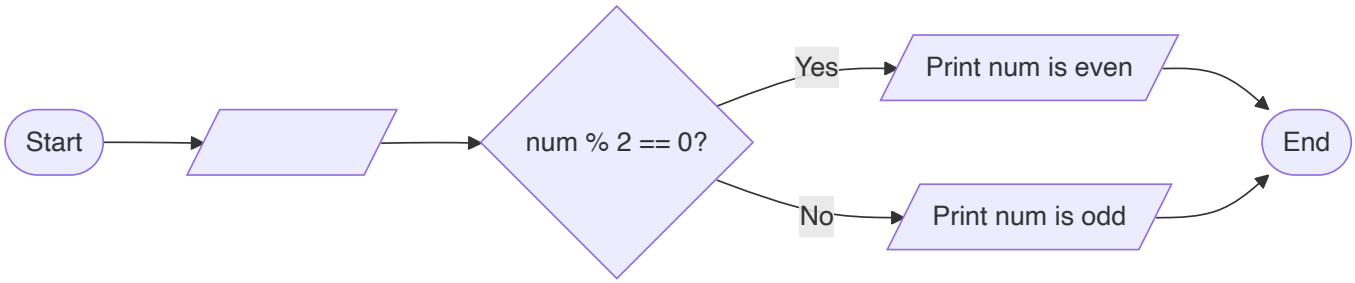
Question 3(b) [4 marks]

Develop a C program to check whether the entered number is even or odd.

Answer:

```c
#include <stdio.h>

int main() {
    int num;

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

    if (num % 2 == 0)
        printf("%d is even", num);
    else
        printf("%d is odd", num);

    return 0;
}
```

Diagram:



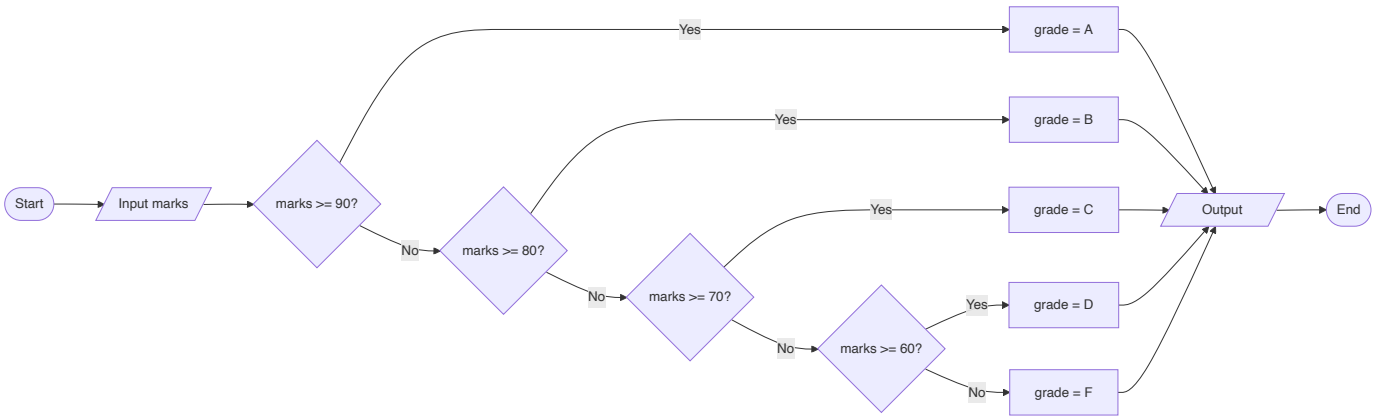
Mnemonic: "MODE - Modulo Odd-Even Determination"

Question 3(c) [7 marks]

Draw flowchart and explain else if ladder with example.

Answer:

The else-if ladder allows checking multiple conditions in sequence, executing the block associated with the first true condition.




```c
#include <stdio.h>

int main() {
    int marks;
    char grade;

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

    if (marks >= 90)
        grade = 'A';
    else if (marks >= 80)
        grade = 'B';
    else if (marks >= 70)
        grade = 'C';
    else if (marks >= 60)
        grade = 'D';
    else
        grade = 'F';
```

```
    printf("Grade: %c", grade);

    return 0;
}
```

- **Multiple conditions**: Checks conditions sequentially
- **First match**: Only executes code for first true condition
- **Default case**: Final else handles all remaining cases

Mnemonic: "CAFE - Condition Assess First Eligible"

Question 3(a OR) [3 marks]

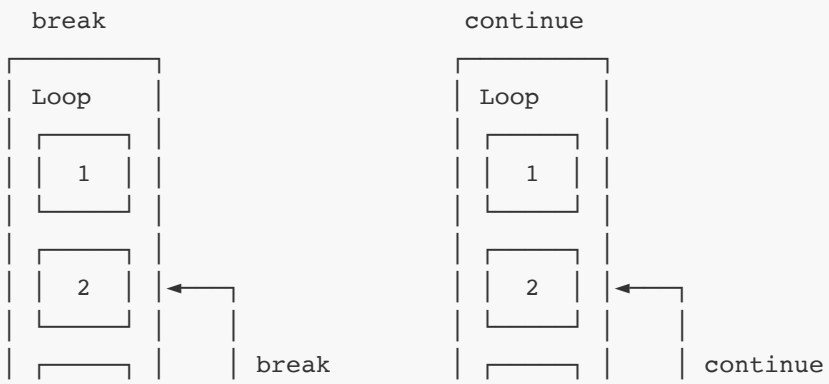
Explain the use of continue and break statement.

Answer:

Statement	Purpose	Effect
break	Exit a loop or switch	Terminates entire loop immediately
continue	Skip current iteration	Jumps to next iteration of loop

```
// break example
for(int i=1; i<=10; i++) {
    if(i == 6)
        break;      // Exits loop when i=6
    printf("%d ", i); // Output: 1 2 3 4 5
}

// continue example
for(int i=1; i<=10; i++) {
    if(i % 2 == 0)
        continue;   // Skips even numbers
    printf("%d ", i); // Output: 1 3 5 7 9
}
```

Diagram:



```
│ │  3  ├─┘      │              │ │  3  ├─┘      │
│ └─────┘        │              │ └─────┘        │
└──────────────┐ │              └─────────┬──────┘
 Exit  Loop    │ │                Next    │
               ┘ │              Iteration │
                 └────────────────────────┘
```

Mnemonic: "BEST - Break Exits, Skip with conTinue"

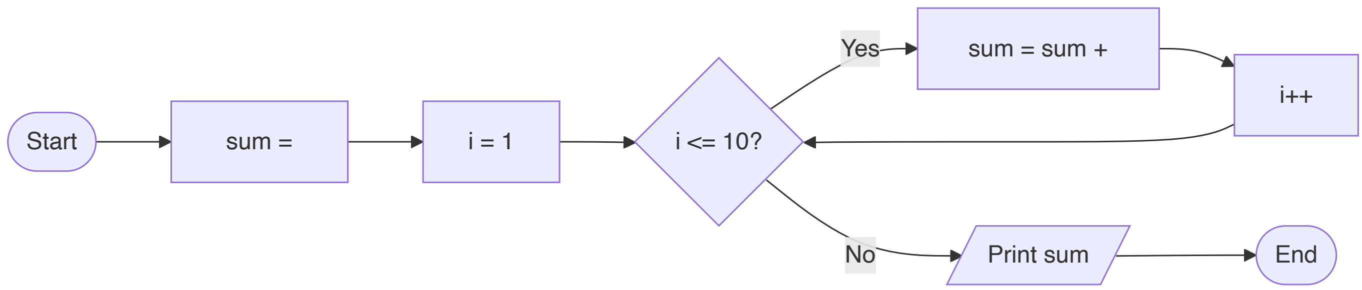
Question 3(b OR) [4 marks]

Develop a C program to print sum of 1 to 10 numbers using for loop.

Answer:

```c
#include <stdio.h>

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

    for(i = 1; i <= 10; i++) {
        sum += i;
    }

    printf("Sum of numbers from 1 to 10: %d", sum);

    return 0;
}
```

Diagram:



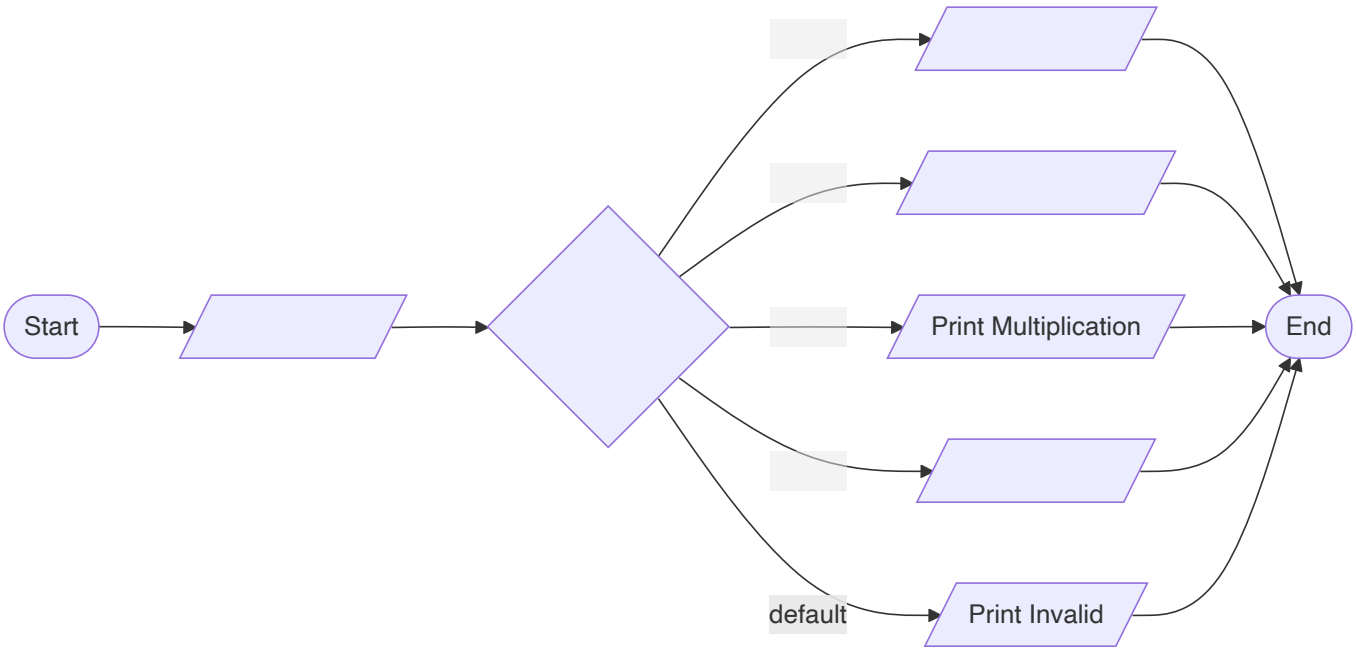
Mnemonic: "SILA - Sum Increment Loop Add"

Question 3(c OR) [7 marks]

Draw flowchart and explain switch statement with example.

Answer:

The switch statement selects one code block from multiple options based on a variable's value.




```c
#include <stdio.h>

int main() {
    int choice;

    printf("Enter operation (1-4): ");
    scanf("%d", &choice);

    switch(choice) {
        case 1:
            printf("Addition selected");
            break;
        case 2:
            printf("Subtraction selected");
            break;
        case 3:
            printf("Multiplication selected");
            break;
        case 4:
            printf("Division selected");
            break;
        default:
            printf("Invalid choice");
    }

    return 0;
}
```

- **Expression**: Takes integer or character expression
- **Case labels**: Must be constant expressions
- **Break statement**: Prevents fall-through to next case

- **Default**: Handles values not matching any case

Mnemonic: "SCBD - Switch Cases Break Default"

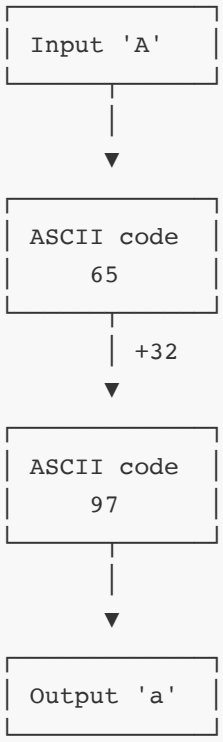
Question 4(a) [3 marks]

Develop a C program to convert uppercase alphabet to lowercase alphabet.

Answer:

```c
#include <stdio.h>

int main() {
    char upper, lower;

    printf("Enter uppercase letter: ");
    scanf("%c", &upper);

    lower = upper + 32;
    // Alternatively: lower = tolower(upper);

    printf("Lowercase letter: %c", lower);

    return 0;
}
```

Diagram:



Mnemonic: "ASCII-32 - Add 32 to Shift Characters Into Lowercase"

Question 4(b) [4 marks]

What is pointer? Explain with example.

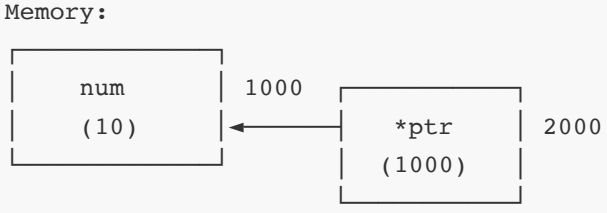
Answer:

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

Concept	Syntax	Description
Declaration	`int *p;`	Declares pointer p to int
Initialization	`p = &var;`	Store address of var in p
Dereferencing	`*p = 10;`	Access/modify pointed value
Pointer arithmetic	`p++`	Move to next memory location

```c
#include <stdio.h>

int main() {
    int num = 10;
    int *ptr;

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

    printf("Value of num: %d\n", num);
    printf("Address of num: %p\n", &num);
    printf("Value of ptr: %p\n", ptr);
    printf("Value pointed by ptr: %d\n", *ptr);

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

    return 0;
}
```

Diagram:



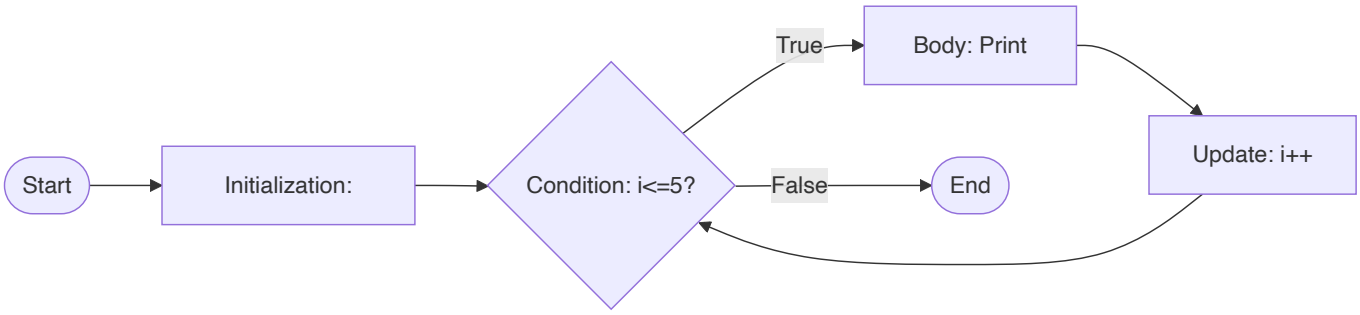
Mnemonic: "SAID - Store Address to Indirectly Dereference"

Question 4(c) [7 marks]

Draw flowchart and explain for loop with example.

Answer:

The for loop is used to repeat a block of code a specified number of times.




```c
#include <stdio.h>

int main() {
    int i;

    // Syntax: for(initialization; condition; update)
    for(i = 1; i <= 5; i++) {
        printf("%d ", i);
    }
    // Output: 1 2 3 4 5

    return 0;
}
```

- **Initialization**: Executes once before loop starts
- **Condition**: Checked before each iteration
- **Update**: Executes after each iteration
- **Body**: Code block that repeats

Mnemonic: "ICU-B - Initialize, Check, Update, Body"

Question 4(a OR) [3 marks]

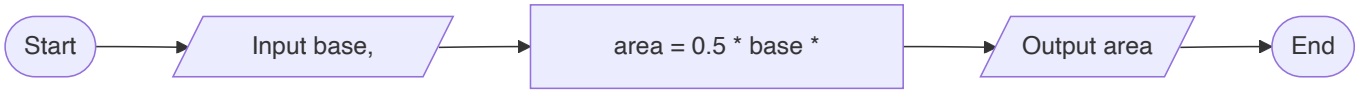
Develop a C program to find area of a triangle (½ * base * height)?

Answer:

```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);

    area = 0.5 * base * height;

    printf("Area of triangle: %.2f", area);

    return 0;
}
```

Diagram:



Mnemonic: "BHA - Base times Height divided by two equals Area"

Question 4(b OR) [4 marks]

Explain declaration and initialization of pointer.

Answer:

Operation	Syntax	Example	Description
Declaration	datatype *pointer_name;	`int *ptr;`	Creates a pointer variable
Initialization	pointer_name = &variable;	`ptr = #`	Assigns address to pointer
Combined	datatype *pointer_name = &variable;	`int *ptr = #`	Declaration with initialization
NULL pointer	pointer_name = NULL;	`ptr = NULL;`	Safe initialization when no address is available

```
#include <stdio.h>

int main() {
    int num = 10;           // Regular variable
    int *ptr1;              // Declaration only
    int *ptr2 = &num;       // Declaration with initialization

    ptr1 = &num;            // Initialization of ptr1

    printf("num value: %d\n", num);
    printf("num address: %p\n", &num);
    printf("ptr1 value: %p\n", ptr1);
    printf("ptr2 value: %p\n", ptr2);
    printf("Value via ptr1: %d\n", *ptr1);
    printf("Value via ptr2: %d\n", *ptr2);
```

```
    return 0;
}
```

Diagram:

```
Pointer Declaration:

┌─────────────┐
│ int *ptr;   │
└─────────────┘


Pointer Initialization:

┌──────────────┐      ┌─────────────┐
│ ptr = &num;  │  →   │ num (10)    │
└──────────────┘      └─────────────┘
```

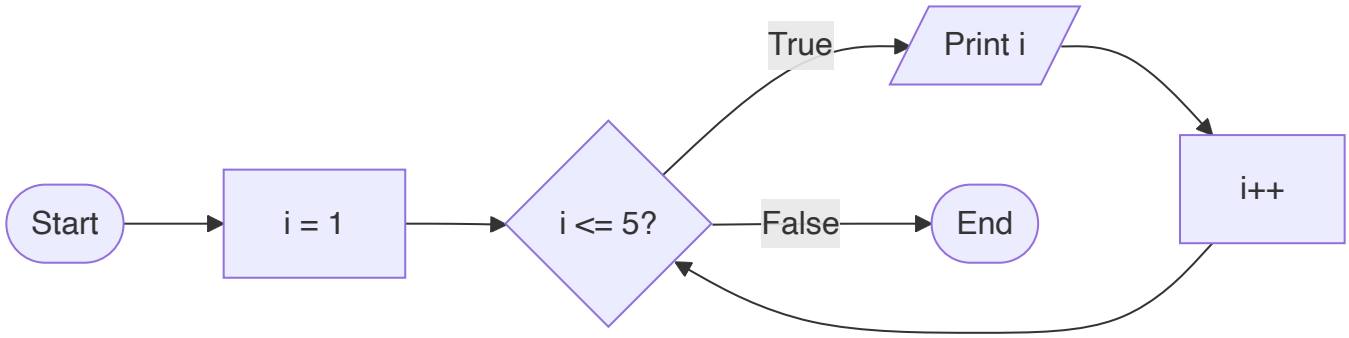
Mnemonic: "PAIN - Pointer Allocate, Initialize, Navigate"

Question 4(c OR) [7 marks]

Draw flowchart and explain while loop with example.

Answer:

The while loop repeats a block of code as long as a specified condition is true.




```c
#include <stdio.h>

int main() {
    int i = 1;

    // Syntax: while(condition) { body }
    while(i <= 5) {
        printf("%d ", i);
        i++;
    }
    // Output: 1 2 3 4 5

    return 0;
}
```

- **Initialization**: Must be done before loop
- **Condition**: Evaluated at beginning of each iteration
- **Body**: Executes only if condition is true
- **Update**: Must be inside loop body

Mnemonic: "CUBE - Condition check, Update inside Body, Exit when false"

Question 5(a) [3 marks]

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

Answer:

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

struct Book {
    int book_no;
    char book_title[50];
    char book_author[50];
    float book_price;
};

int main() {
    struct Book book1;

    book1.book_no = 101;
    strcpy(book1.book_title, "Programming in C");
    strcpy(book1.book_author, "Dennis Ritchie");
    book1.book_price = 450.50;

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

    return 0;
}
```

Diagram:

```
struct Book
┌──────────────────────────────────┐
│ book_no      (int)               │
├──────────────────────────────────┤
│ book_title   (char[50])          │
├──────────────────────────────────┤
│ book_author  (char[50])          │
├──────────────────────────────────┤
│ book_price   (float)             │
└──────────────────────────────────┘
```

Mnemonic: "SNAP - Structure Needs All Properties"

Question 5(b) [4 marks]

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

Answer:

Function	Library	Purpose	Example
sqrt()	math.h	Calculates square root	`sqrt(16)` returns `4.0`
pow()	math.h	Raises to power	`pow(2, 3)` returns `8.0`
strlen()	string.h	Finds string length	`strlen("hello")` returns `5`
strcpy()	string.h	Copies string	`strcpy(dest, "hello")` copies "hello" to dest

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

int main() {
    double sqrtResult = sqrt(25);
    double powResult = pow(2, 4);
    char str[] = "Programming";
    char dest[20];
    int length = strlen(str);

    strcpy(dest, str);

    printf("sqrt(25) = %.2f\n", sqrtResult);
    printf("pow(2, 4) = %.2f\n", powResult);
    printf("Length of '%s' = %d\n", str, length);
    printf("Copied string: %s\n", dest);

    return 0;
}
```

Mnemonic: "SPSS - Square-root Power String-length String-copy"

Question 5(c) [7 marks]

Explain arrays and array initialization. Give example.

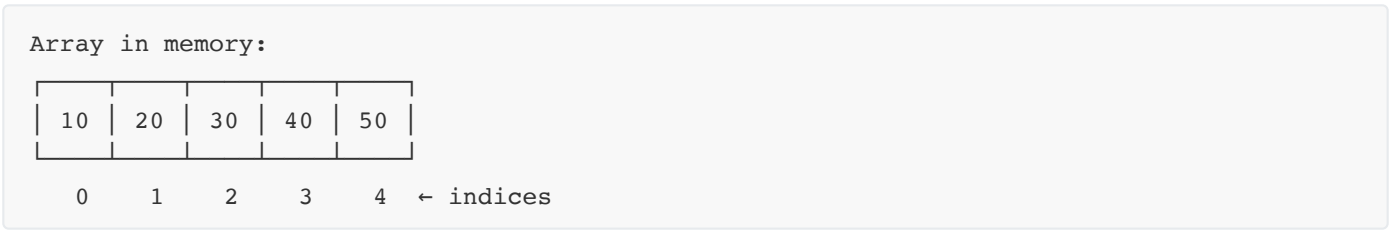
Answer:

An array is a collection of similar data elements stored at contiguous memory locations.

Method	Syntax	Example
Declaration	`data_type array_name[size];`	`int marks[5];`
Initialization at declaration	`data_type array_name[size] = {values};`	`int marks[5] = {95, 80, 85, 75, 90};`
Individual element	`array_name[index] = value;`	`marks[0] = 95;`
Partial initialization	`int arr[5] = {1, 2};`	Remaining elements are 0
Without size	`int arr[] = {1, 2, 3};`	Size determined by elements

```c
#include <stdio.h>

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

    // Accessing array elements
    printf("First element: %d\n", numbers[0]);
    printf("Third element: %d\n", numbers[2]);

    // Changing array element
    numbers[1] = 25;

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

    return 0;
}
```

Diagram:



Mnemonic: "CASED - Contiguous Arrangement of Similar Elements with Direct-access"

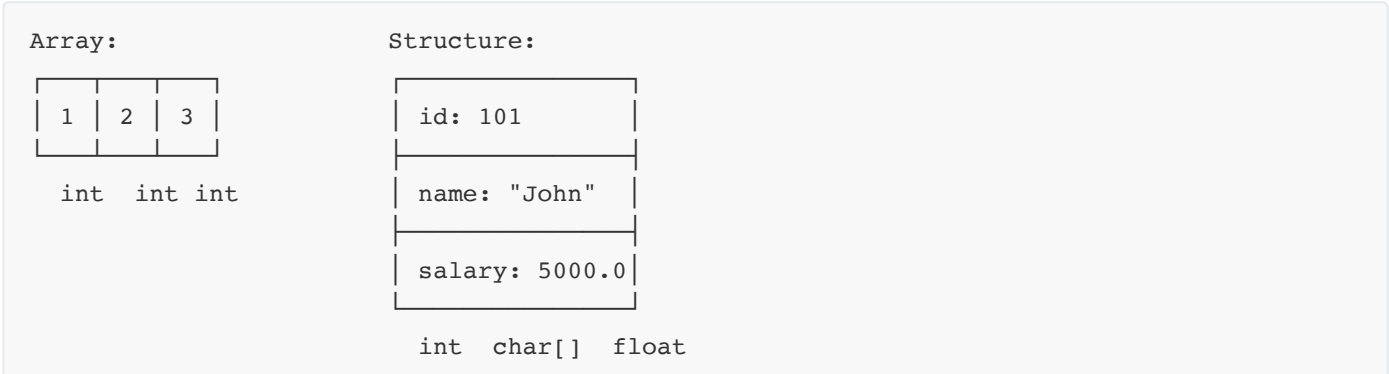
Question 5(a OR) [3 marks]

Write the difference between array and structure.

Answer:

Feature	Array	Structure
Data types	Same data type only	Different data types allowed
Access	Using index: `arr[0]`	Using dot operator: `emp.id`
Memory	Contiguous allocation	May not be contiguous
Size	Fixed at declaration	Sum of member sizes
Initialization	`int arr[3] = {1,2,3};`	`struct emp e = {101,"John",5000};`
Purpose	Collection of similar items	Collection of related items

Diagram:



Mnemonic: "HASDIP - Homogeneous vs. Assorted, Same vs. Different, Index vs. Point"

Question 5(b OR) [4 marks]

What is user defined function? Explain with example.

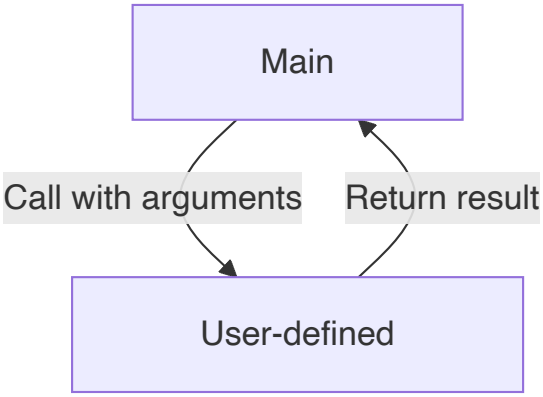
Answer:

A user-defined function is a code block that performs a specific task, created by the programmer to reuse and organize code.

Component	Description	Example
Return type	Data type returned by function	`int`, `void`, etc.
Function name	Identifier for the function	`sum`, `findMax`
Parameters	Input values in parentheses	`(int a, int b)`
Function body	Code inside curly braces	`{ return a+b; }`

```c
#include <stdio.h>

// Function declaration
int sum(int a, int b);

int main() {
    int num1 = 5, num2 = 10;
    int result;

    // Function call
    result = sum(num1, num2);

    printf("Sum = %d", result);

    return 0;
}

// Function definition
int sum(int a, int b) {
    return a + b;
}
```

Diagram:



Mnemonic: "CRPB - Create, Return, Pass, Body"

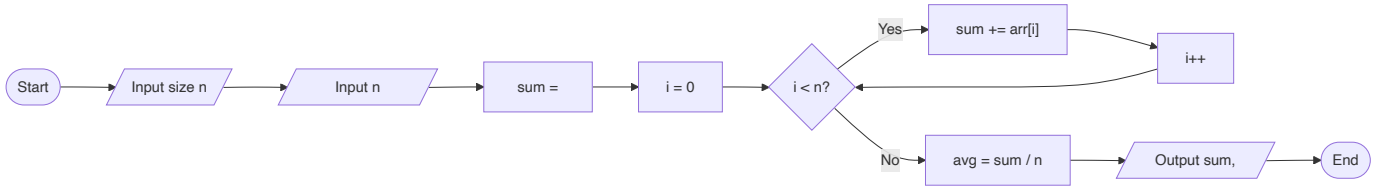
Question 5(c OR) [7 marks]

Develop a C program to find sum of array elements and average of it.

Answer:

```c
#include <stdio.h>

int main() {
    int arr[100], n, i;
    int sum = 0;
    float avg;

    printf("Enter number of elements: ");
    scanf("%d", &n);

    printf("Enter %d elements:\n", n);
    for(i = 0; i < n; i++) {
        scanf("%d", &arr[i]);
        sum += arr[i];  // Add each element to sum
    }

    avg = (float)sum / n;  // Calculate average

    printf("Sum of array elements: %d\n", sum);
    printf("Average of array elements: %.2f", avg);

    return 0;
}
```

Diagram:



Step	Operation	Example (for array [5,10,15,20])
1	Input array	[5,10,15,20]
2	Initialize sum = 0	sum = 0
3	Add each element	sum = 0+5+10+15+20 = 50
4	Divide by count	avg = 50/4 = 12.5

Mnemonic: "LISA - Loop, Increment, Sum, Average"