Module 3
STACKS and QUEUES

Introduction to Stacks

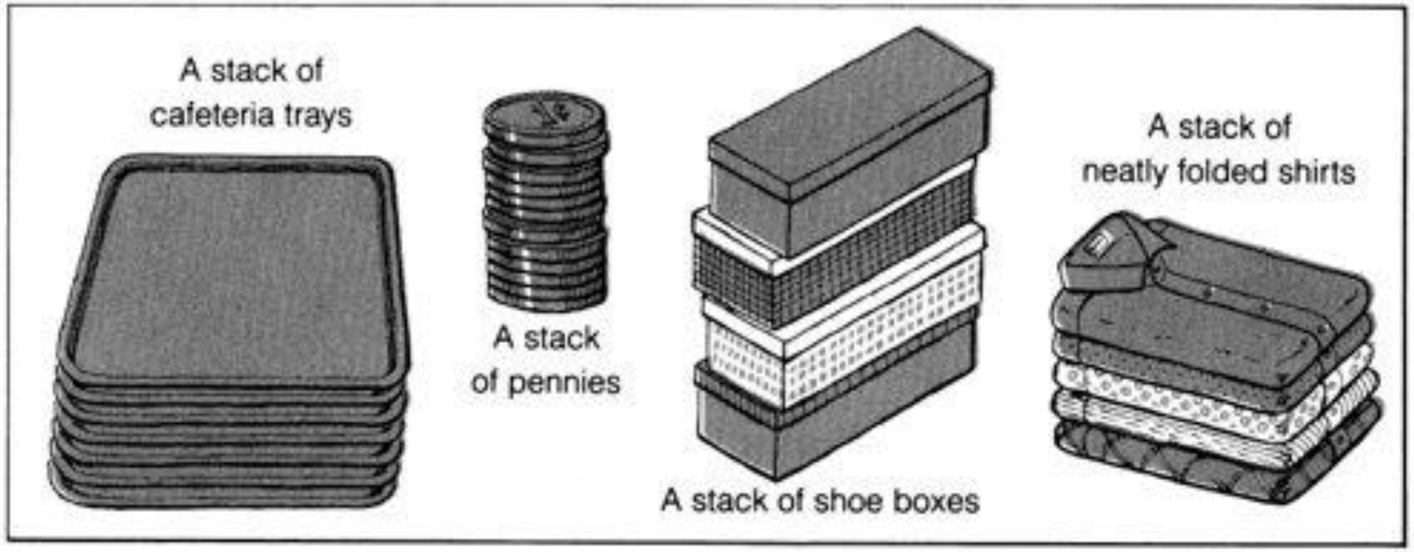
What is a Stack?

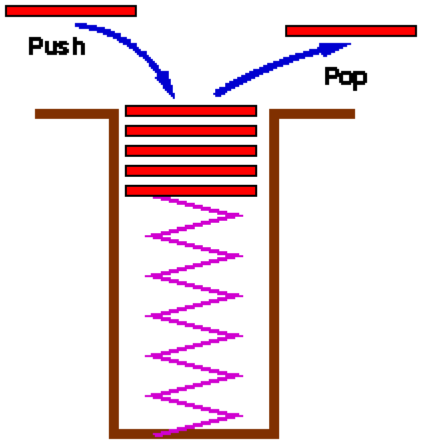
- A linear data structure that follows the Last In, First Out (LIFO) principle.
- The last element added is the first one to be removed.

Key Operations

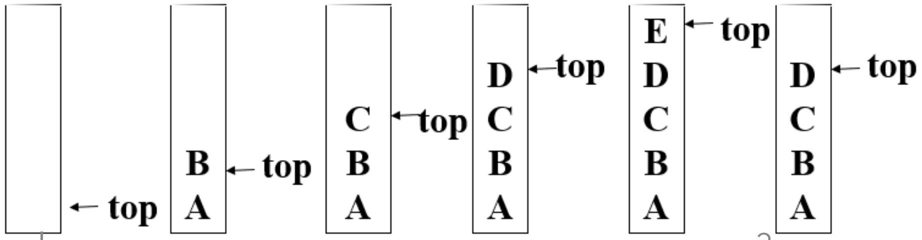
- Push: Add an element to the top of the stack.
- Pop: Remove the top element from the stack.
- Peek/Top: View the top element without removing it.
- isEmpty: Check if the stack is empty.

EXAMPLE AND ILLUSTRATION





Stack: A Last-In-First-Out (LIFO) list



Stack ADT Operations

- **`CreateS(max-stack-size)`** – Create empty stack.
- **`IsFull(stack, max-stack-size)`** – TRUE if full.
- **`Add(stack, item)`** – Push to top.
- **`IsEmpty(stack)`** – TRUE if empty.
- **`Delete(stack)`** – Pop from top.
- **Error Handling**: `stack-full()` and `stack-empty()` functions.

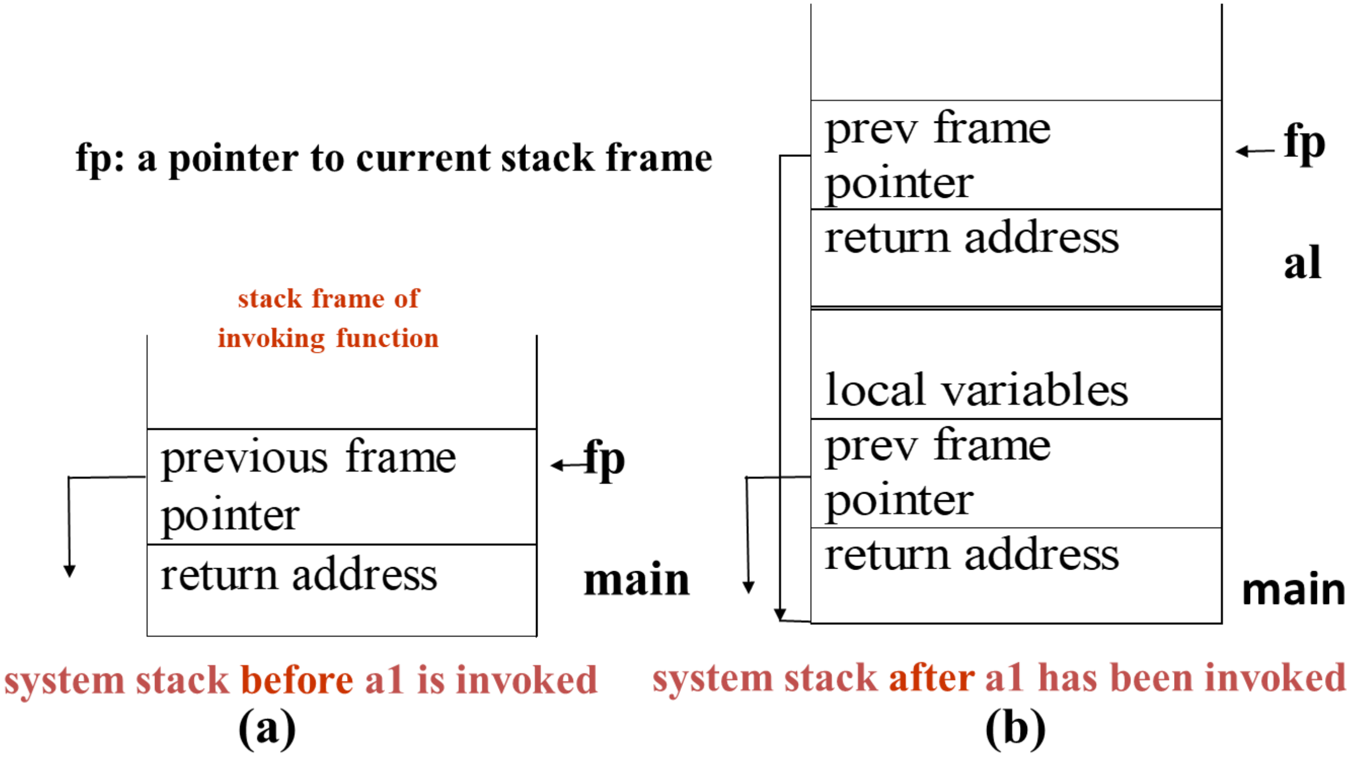
Stacks in Program Execution: Function Calls and Stack Frames

- **Stacks** are integral to program execution.
- **Essential** for managing **function/procedure calls and returns**.
- **Stack frame** enables **recursive calls** without special handling.
- **Function Call** → *Push* a new stack frame.
- **Function Return** → *Pop* the top stack frame.
- **Stack Frame Contents**:
  - Function arguments.
  - Return address (location to resume after call).
  - Local variables (non-static).

Activation Records (Stack Frames) in Function Calls

- When a function is invoked, the program creates an **activation record** (also called a **stack frame**) and places it **on top of the system stack**.
- **Initially**, the activation record contains:
- A **pointer to the previous stack frame** (points to the invoking function’s frame).
- The **return address** (location to continue execution after the function returns).
- The **previous frame pointer** links back to the stack frame of the invoking function, maintaining the call chain.

Stack Frame of Function call



System stack after function call a1

Stack Implementation Methods

Array Implementation

- Uses a fixed-size array to store stack elements.
- Simple to implement but has limited capacity.
- `top` variable tracks the current top position.

Linked List Implementation

- Uses dynamically allocated nodes linked together.
- Stack can grow or shrink at runtime (no fixed size limit).
- `top` pointer references the top node in the list.

Implementation of Stack (Array-based)

- Use **1D array** → `stack[MAX-STACK-SIZE]`.
- `top` variable tracks top index.
- Initially `top = -1` (empty).
- **Push Operation**: Increment `top` → store item.
- **Pop Operation**: Retrieve item at `top` → decrement `top`.
- **Checks**:
- `IsEmpty` → `top == -1`.
- `IsFull` → `top == MAX-STACK-SIZE - 1`

Implementation of Stack (Array-based)

- #define MAX 5
- int stack[MAX], top = -1;
- **// Push operation**
- void push(int item) {
-     if (top == MAX - 1)
-         printf("Stack Overflow!\n");
-     else
-         stack[++top] = item;
-         printf("%d pushed to stack.\n", value); }

- **// Pop operation**
- void pop() {
-     if (top == -1)
-         printf("Stack Underflow!\n");
-     else
-         printf("Popped: %d\n", stack[top--]);
- }

Implementation of Stack (Array-based)

- **// Peek function**
- void peek() {
-     if (top == -1) {
-         printf("Stack is empty!\n");
-     } else {
-         printf("Top element is: %d\n", stack[top]);
-     }
- }

- **// isEmpty function**
- void isEmpty() {
-     if (top == -1) {
-         printf("Stack is empty.\n");
-     } else {
-         printf("Stack is not empty.\n");
-     }
- }

Implementation of Stack (Array-based)

- **// Display stack**
- void display() {
-     if (top == -1)
-         printf("Stack is Empty\n");
-     else {
-         printf("Stack: ");
-         for (int i = top; i >= 0; i--)
-             printf("%d ", stack[i]);
-         printf("\n");   } }

- **int main()** {
-     int choice, item;
-     do {
-         printf("\n1.Push 2.Pop 3.Display 4.Exit\n");
-         printf("Enter choice: ");
-         scanf("%d", &choice);
-         switch (choice) {
-             case 1: printf("Enter item: ");
-                 scanf("%d", &item);
-                 push(item);
-                 break; ……………….

Implementation of Stack (Linked List-based)

- **// Node structure**
- struct Node {
-     int data;
-     struct Node* next;};
- struct Node* top = NULL;

- **// Push operation**
- void push(int value) {
-     struct Node* newNode = (structNode*)malloc(sizeof(struct Node));
-     if (!newNode) {
-         printf("Stack Overflow!\n");
-         return;   }
-     newNode->data = value;
-     newNode->next = top;
-     top = newNode;
-     printf("%d pushed to stack\n", value);}

Implementation of Stack (Linked List-based)

- **// Pop operation**
- void pop() {
-     if (top == NULL) {
-         printf("Stack Underflow!\n");
-         return;   }
-     struct Node* temp = top;
-     printf("%d popped from stack\n", top->data);
-     top = top->next;
-     free(temp); }

- **// Peek operation**
- void peek() {
-     if (top == NULL) {
-         printf("Stack is empty\n");
-         return;   }
-     printf("Top element: %d\n", top->data);}
- // isEmpty operation
- int isEmpty() {
-     return (top == NULL); }

Implementation of Stack (Linked List-based)

- **// Display stack**
- void display() {
-     struct Node* temp = top;
-     if (temp == NULL) {
-         printf("Stack is empty\n");
-         return;   }
-     printf("Stack elements: ");
-     while (temp != NULL) {
-         printf("%d ", temp->data);
-         temp = temp->next;   }
-     printf("\n"); }

- **// Main function**
- int main() {
-     int choice, value;
-     while (1) {
-         printf("\n1. Push\n2. Pop\n3. Peek\n4. isEmpty\n5. Display\n6. Exit\n");
-         printf("Enter your choice: ");
-         scanf("%d", &choice);
-         switch (choice) {
-             case 1:…........................

Evaluation of Expressions – infix, postfix, prefix and conversions

Applications of Stack

- Balancing Symbols (e.g., parentheses matching)
- Duplicate Parentheses
- Expression Conversion & Evaluation
    - Converting infix to prefix/postfix
    - Evaluating postfix expressions
    - Evaluating prefix expressions

Balancing the parentheses

Ensure that every opening symbol ((, {, [) has a matching closing symbol (), },]), and they are properly nested.

BALANCED EXPRESSION	UNBALANCED EXPRESSION
(a + b)	(a + b
[(c – d) * e]	[(c – d * e]
{ ( ) } [ ]	{ [( ]) }

Checking Balanced Parentheses using Stack

- **Step 1:** Create an empty stack.
- **Step 2:** Scan expression from left to right.
- **Step 3:**
- If symbol is **opening** ((, {, [), push it onto the stack.
- If symbol is **closing** (), },]):
  - If stack is empty → Not balanced.
  - Else pop from stack and check if it matches the opening symbol.
- **Step 4:** After scan, if stack is empty → Balanced, else → Not balanced.

Implementation

- #define MAX 100
- struct stack {
- char stck[MAX];
- int top;} s;

- **// Push function**
- void push(char item) {
- if (s.top == MAX - 1) return 0;{
- printf("Stack is Full\n");
- } else {
- s.top++;
- s.stck[s.top] = item; return 1;
- } }

Implementation

- **// Pop function**
- void pop() {
-     if (s.top == -1) {
-         printf("Stack is Empty\n");
-     } else {
-         s.top--;
-     } }

- **// Function to check matching pairs**
- int checkPair(char val1, char val2) {
-     return ((val1 == '(' && val2 == ')') ||
-             (val1 == '[' && val2 == ']') ||
-             (val1 == '{' && val2 == '}'));
- }

Implementation

- **// Function to check if expression is balanced**
- int checkBalanced(char expr[], int len) {
-     for (int i = 0; i < len; i++) {
-         if (expr[i] == '(' || expr[i] == '[' || expr[i] == '{') {
-             push(expr[i]);
-         } else if (expr[i] == ')' || expr[i] == ']' || expr[i] == '}') {
-             if (s.top == -1)
-                 return 0;
- else if (checkPair(s.stck[s.top], expr[i])) {
-                 pop();
-             } else {
-                 return 0;
-             }   }   }
-   return (s.top == -1); }

Implementation

- **// Main function**
- int main() {
-     char exp[MAX];
-     printf("Enter an expression: ");
-     fgets(exp, MAX, stdin);
-     exp[strcspn(exp, "\n")] = '\0';
-     int len = strlen(exp);
-     s.top = -1;
-     if (checkBalanced(exp, len))
-         printf("Balanced");
-     else
-         printf("Not Balanced");
-     return 0;
- }

Duplicate Parentheses

- An expression has *duplicate parentheses* if an extra pair of brackets surrounds a valid subexpression unnecessarily.
- In other words, if an expression is enclosed by multiple balanced parentheses without need.
- **Examples**
- `((a+b))` → **Duplicate exists** → **Return True**
- `(a+(b+c))` → **No duplicate** → **Return False**
- Duplicate parentheses reduce readability and do not change meaning of the expression.

Detect Duplicate Parentheses

1. Initialize an empty stack.

2. For each character ch in the expression:

- a) If ch is an operand or operator → Continue.
- b) If ch is an opening parenthesis '(' → Push it onto the stack.
- c) If ch is a closing parenthesis ')':
- i. If the top of the stack is '(' →
- → Duplicate found → Return True.
- ii. Else → Pop elements until '(' is found.
- (This ensures valid matching of parentheses.)

Detect Duplicate Parentheses

3. After scanning all characters:

- a) If the stack is not empty → Unmatched parentheses → Return True.
- b) Else → Return False (No duplicate parentheses).

Implementation

- #define MAX_SIZE 100
- bool isDuplicate(char s[]) {
- char Stack[MAX_SIZE];
- int top = -1;
- int n = strlen(s);
-     for (int i = 0; i < n; i++) {
-         if (s[i] == ')') {
-             // Case 1: Empty brackets ()
-             if (top != -1 && Stack[top] == '(') {
-                 return 1; // Duplicate }

- int elementsInside = 0;
-   // Pop until '(' is found
-   while (top != -1 && Stack[top] != '(') {
-                 elementsInside++;
-                 top--; }
-   // Pop the '(' also
-             if (top != -1) {
-                 top--;   }

Implementation

```
// If no valid content inside ()
        if (elementsInside < 1) {
            return true;
        } }
    else {
        // Push character onto stack
        Stack[++top] = s[i];
    }   }
```

```
// If unmatched parentheses remain
    while (top != -1) {
        if (Stack[top] == '(') {
            return true;
        }
        top--;
    }
    return false;
}
```

Implementation

```
• int main() {
•     char s[MAX_SIZE] = "(((a+(b))+(c+d)))";
•     if (isDuplicate(s)) {
•         printf("Expression contains duplicate parenthesis.\n");
•     } else {
•         printf("Expression does not contain duplicate parenthesis.\n");
•     }
•     return 0;   }
```

Expression Conversion & Evaluation

Infix, postfix and prefix expressions

- **Infix:** *operand1 operator operand2* - Ex: A+B
- **Prefix:** *operator operand1 operand2* - Ex: +AB
- **Postfix:** *operand1 operand2 operator* - Ex: AB+

PRECEDENCE AND ASSOCIATVITY

Token	Operator	Precedence[1]	Associativity
() [] -> .	function call array element struct or union member	17	left-to-right
-- ++	increment, decrement[2]	16	left-to-right
-- ++ ! ~ - + & * sizeof	decrement, increment[3] logical not one's complement unary minus or plus address or indirection size (in bytes)	15	right-to-left
(type)	type cast	14	right-to-left
* / %	multiplicative	13	left-to-right
+ -	binary add or subtract	12	left-to-right
<< >>	shift	11	left-to-right
> >= < <=	relational	10	left-to-right
== !=	equality	9	left-to-right
&	bitwise and	8	left-to-right
^	bitwise exclusive or	7	left-to-right
|	bitwise or	6	left-to-right
&&	logical and	5	left-to-right
||	logical or	4	left-to-right
?:	conditional	3	right-to-left
= += -= /= *= %= <<= >>= &= ^= |=	assignment	2	right-to-left
,	comma	1	left-to-right

Problems with Infix

- Hard to parse (ambiguous without rules).
- Requires precedence rules.
- Needs parentheses for clarity.
- Example: `(A + B) * C` vs. `A + (B * C)`.

Alternative Notations

- **Prefix (Polish Notation):** Operator before operands → +AB.
- **Postfix (Reverse Polish Notation):** Operator after operands → AB+.
- Advantage: No parentheses, no precedence/associativity issues.

Infix, postfix and prefix expressions

Infix Notation	Prefix Notation	Postfix Notation
A + B	+ AB	AB +
(A - C) + B	+ - ACB	AC – B +
A + (B * C)	+ A * BC	ABC *+
(A+B)/(C-D)	/+ AB – CD	AB + CD -/
(A + (B * C))/(C – (D * B))	/+ A * BC – C * DB	ABC * + CDB * - /

Conversion of **Infix to Postfix** Expression

- **Operands** → Send directly to output.
- **Left parenthesis (** → Push onto stack.
- **Right parenthesis)** → Pop & output until (is found.
- **Operators**
- If stack empty / top is (→ Push operator.
- If incoming operator has **higher precedence** → Push it.
- If **lower precedence** → Pop & output until condition satisfied.
- If **same precedence** →
  - **Left** → **Right associativity** → Pop & output top, then push new one.
  - **Right** → **Left associativity** → Push new one.
  - **End of expression** → Pop all operators from stack to output.

INFIX to POSTFIX- Simple expression

Token	Stack [0]	Stack [1]	Stack [2]	Top	Output
a				−1	*a*
+	+			0	*a*
b	+			0	*ab*
*	+	*		1	*ab*
c	+	*		1	*abc*
eos				−1	*abc**+

INFIX to POSTFIX- Parenthesized expression

Token	Stack [0]	Stack [1]	Stack [2]	Top	Output
a				−1	*a*
*	*			0	*a*
(	*	(		1	*a*
b	*	(		1	*ab*
+	*	(	+	2	*ab*
c	*	(	+	2	*abc*
)	*			0	*abc* +
*	*			0	*abc* +*
d	*			0	*abc* +**d*
eos	*			0	*abc* +**d**

Implementation

- #define MAX_SIZE 100
- **// Function prototypes**
- int IsOperator(char c);
- int IsOperand(char c);
- int precedence(char op);
- int hasHigherOrEqualPrecedence(char op1, char op2);
- void convert(char infix[], char postfix[]);

Implementation

- // Main function
- int main() {
-     char infix[MAX_SIZE], postfix[MAX_SIZE];
-     int ch;
-     do {
-         printf("Enter an infix expression: ");
-         fgets(infix, MAX_SIZE, stdin);
-          infix[strcspn(infix, "\n")] = '\0';
-         convert(infix, postfix);
- printf("\nInfix   : %s", infix);
- printf("\nPostfix : %s", postfix);
- printf("\n\nDo you want to enter another expression? (1/0): ");
-         scanf("%d", &ch);
-         getchar(); // clear newline from buffer
-     } while (ch == 1);
-     return 0;
- }

Implementation

- // Check if character is operator
- int IsOperator(char c) {
-     return (c == '+' || c == '-' || c == '*' || c == '/' || c == '^'); }

- // Check if character is operand (A-Z, a-z, 0-9)
- int IsOperand(char c) {
-     return ((c >= 'A' && c <= 'Z') ||
-             (c >= 'a' && c <= 'z') ||
-             (c >= '0' && c <= '9')); }

- // Return precedence value
- int precedence(char op) {
-     if (op == '+' || op == '-') return 1;
-     if (op == '*' || op == '/') return 2;
-     if (op == '^') return 3;
-     return 0;}

Implementation

- // Check precedence & associativity
- int hasHigherOrEqualPrecedence(char op1, char op2) {
-     int p1 = precedence(op1);
-     int p2 = precedence(op2);
-     if (p1 == p2) {
-         if (op1 == '^') // '^' is right-associative
-             return 0;
-         return 1;   // others are left-associative   }
-     return (p1 > p2); }

Implementation

- // Convert infix to postfix
- void convert(char infix[], char postfix[]) {
-     char stack[MAX_SIZE];
-     int top = -1, i = 0, j = 0;
-     char ch;
- // Add '(' to stack and ')' to infix (sentinel trick)
-     stack[++top] = '(';
-     strcat(infix, ")");
- while ((ch = infix[i++]) != '\0') {
-         if (ch == ' ')
-             continue;   // ignore spaces
- else if (ch == '(')
-             stack[++top] = ch;
- else if (IsOperand(ch))
-             postfix[j++] = ch;

Implementation

- else if (IsOperator(ch)) {
- while (top != -1 && hasHigherOrEqualPrecedence(stack[top], ch))
- postfix[j++] = stack[top--];
- stack[++top] = ch; }

- else if (ch == ')') {
- while (top != -1 && stack[top] != '(')
- postfix[j++] = stack[top--];
- top--; // remove '('}}
- postfix[j] = '\0';
- }

Practice Infix to Postfix in stack

- **((A*(B+D)/E)-F*(G+H/K)))**
- **(K+L- M*N+(O^P)*W/U/V *T+Q)**

Evaluation of Postfix Expression (using Stack)

1. Initialize an empty stack
2. For each symbol X in the postfix expression:
- a) If X is an operand → Push X onto stack
- b) If X is an operator:
- i. Pop the top two operands from stack
- ii. Apply the operator (second popped op <operator> first popped op)
- iii. Push the result back onto stack

3. After scanning the expression:
- The value left in the stack is the final result

EVALUATIONOF POSTFIXEXPRESSION: 23*5+

Step	Symbol	Action	Stack
1	2	Push	2
2	3	Push	2 3
3	*	Pop 3 & 2 → 2*3=6 → Push 6	6
4	5	Push	6 5
5	+	Pop 5 & 6 → 6+5=11 → Push 11	11

EVALUATION OF POSTFIX EXPRESSION

Evaluate the postfix expression **3 8 + 9 8 / -**

3 8	8 3
+	3 + 8 = 11 11
9 8	8 9 11
/	9/8 = 1.125 1.125 11
-	11 – 1.125 = 9.875 9.875

Conversion of **Infix to Prefix** Expression

- 1. Reverse the given infix expression - While reversing, replace '(' with ')' and ')' with '('.
- 2. Initialize an empty stack for operators.
- Initialize an empty string for the output (prefix).
- 3. Scan the reversed infix expression from left to right:
- a) If the symbol is an operand → Append it to output.
- b) If the symbol is '(' → Push it onto stack.
- c) If the symbol is ')' →
- Pop from stack and append to output until '(' is found.
- Discard the '('.

Conversion of **Infix to Prefix** Expression

- d) If the symbol is an operator:
- i. If stack is empty → Push operator.
- ii. If operator has higher precedence than top of stack → Push operator.
- iii. If operator has same precedence →
- - Push operator (for left-associative ops).
- - Special case: If operator is '^' (right-associative), pop stack top and then push '^'.
- iv. If operator has lower precedence than top of stack →
- Pop from stack to output until condition is satisfied,
- then push the operator.

Conversion of **Infix to Prefix** Expression

- 4. After scanning the expression:
- Pop and append all remaining operators from stack to output.
- 5. Reverse the output string.
- This final string is the Prefix expression.

Verification

- **Reverse infix first** (with brackets swapped)
- **Operands** → **output directly**
- **Operator handling** (higher → push, equal → depends on associativity, lower → pop until safe)
- **Parentheses handling** ( ) pushed, (pops until) is found)
- **End** → **pop remaining operators**
- **Final reverse output**

Implementation

- #define MAX_SIZE 100
- int IsOperator(char c);
- int IsOperand(char c);
- int Precedence(char c);
- int isRightAssociative(char c);
- void ReverseString(char str[]);
- void ReverseAndSwap(char str[]);
- void Convert(char infix[], char prefix[]);

- int main() {
- char infix[MAX_SIZE], prefix[MAX_SIZE];
- int ch;
- do { printf("Enter an infix expression: ");
- scanf("%s", infix);
- Convert(infix, prefix);
- printf("\nInfix Expression: %s", infix);
- printf("\nPrefix Expression: %s\n", prefix);

Implementation

- printf("\nDo you want to enter another (1/0)? ");
- scanf("%d", &ch);
- } while (ch == 1);
- return 0; }
- int IsOperator(char c) {
- return (c == '+' || c == '-' || c == '*' || c == '/' || c == '^');
- }
- int IsOperand(char c) {
- return ((c >= 'A' && c <= 'Z') ||
- (c >= 'a' && c <= 'z') ||
- (c >= '0' && c <= '9')); }
- int Precedence(char c) {
- if (c == '+' || c == '-') return 1;
- if (c == '*' || c == '/') return 2;
- if (c == '^') return 3;
- return 0; }

Implementation

- // Right associativity check (only ^ is right-associative)
- int isRightAssociative(char c)
- {
-     if (c == '^') return 1;
-     return 0;
- }

- void ReverseString(char str[]) {
-     int i, j;
-     char temp;
-     for (i = 0, j = strlen(str) - 1; i < j; i++, j--) {
-         temp = str[i];
-         str[i] = str[j];
-         str[j] = temp;
-     }   }

Implementation

- // Reverse + swap brackets
- void ReverseAndSwap(char str[]) {
-     ReverseString(str);
-     for (int i = 0; str[i] != '\0'; i++) {
-         if (str[i] == '(') str[i] = ')';
-         else if (str[i] == ')') str[i] = '(';
-     }
- }

- // ---------- Conversion Function ----------
- void Convert(char infix[], char prefix[]) {
-     char stack[MAX_SIZE];
-     int top = -1;
-     int i = 0, j = 0;
-     char ch;
- // Step 1: Reverse infix and swap brackets
-     ReverseAndSwap(infix);

Implementation

- // Step 2: Scan the reversed infix
- while ((ch = infix[i++]) != '\0') {
- if (ch == ' ') continue;
- if (IsOperand(ch)) {
- prefix[j++] = ch;
- } else if (ch == '(') {
- stack[++top] = ch; }
- else if (ch == ')') {
- while (top != -1 && stack[top] != '(') {
- prefix[j++] = stack[top--]; }
- top--; // discard '(' }
- else if (IsOperator(ch)) {
- while (top != -1 &&IsOperator(stack[top])
- && (Precedence(stack[top]) > Precedence(ch) || (Precedence(stack[top]) == Precedence(ch) && isRightAssociative(ch))))
- {
- prefix[j++] = stack[top--];
- }
- stack[++top] = ch; } }

Implementation

- // Step 3: Pop remaining operators
-     while (top != -1) {
-         prefix[j++] = stack[top--];
-     }
-     prefix[j] = '\0';
-     // Step 4: Reverse result
-     ReverseString(prefix);
- }

- **Practice step by step**
- **A+B-C*D+(E^F)*G/H/I*J+K**

Evaluation of Prefix Expression

- 1. Initialize an empty stack.
- 2. Scan the prefix expression from **right to left**:
- a) If the symbol is an operand → Push it onto stack.
- b) If the symbol is an operator:
- i. Pop the top two operands from the stack.
- ii. Apply the operator as:
- result = (first popped operand) <operator> (second popped operand)
- iii. Push the result back onto the stack.
- 3. After scanning all symbols:
- The value left in the stack is the final result.

EVALUATION OF PREFIX EXPRESSION

INPUT : **/+33-+47*+123**

Prefix Evaluation:

Symbol	Stack	Action
3	3	Push 3 into stack.
2	3,2	Push 2 into stack.
1	3,2,1	Push 1 into stack.
+	3,3	Pop 1 and 2 from stack and push 1+2=3 into stack.
*	9	Pop 3 and 3 from stack and push 3*3=9 into stack.
7	9,7	Push 7 into stack.
4	9,7,4	Push 4 into stack.
+	9,11	Pop 7 and 4 from stack and push 7*4=11 into stack.
-	2	Pop 9 and 11 from stack and push 11-9=2 into stack.
3	2,3	Push 3 into stack.
3	2,3,3	Push 3 into stack.
+	2,6	Pop 3 and 3 from stack and push 3+3=6 into stack.
/	3	Pop 2 and 6 from stack and push 2/6=3 into stack.

Find the mistake

Implementation

- #define MAX 100
- ---------- Stack Definition --------
- typedef struct {
-     int data[MAX];
-     int top;
- } Stack
- ---------- Stack Functions ----------
- void Push(Stack *s, int value) {
-     if (s->top == MAX - 1) {
-         printf("Stack Overflow\n");
-         exit(1);   }
-     s->data[++(s->top)] = value; }

- int Pop(Stack *s) {
-     if (s->top == -1) {
-         printf("Stack Underflow\n");
-         exit(1);   }
-     return s->data[(s->top)--]; }

Implementation

- // ---------- Prefix Evaluation ----------
- int EvaluatePrefix(char expression[]) {
-     Stack stack;
-     stack.top = -1;
-     int i, op1, op2, result;
- // Scan expression from right to left
-     for (i = strlen(expression) - 1; i >= 0; i--) {
-         char ch = expression[i];
- if (ch == ' ')
-             continue;
-         if (isdigit(ch)) {
-             Push(&stack, ch - '0'); // convert char digit to int
-         }
-     else {
-             op1 = Pop(&stack);
-             op2 = Pop(&stack);

Implementation

- switch (ch) {
- case '+': result = op1 + op2; break;
- case '-': result = op1 - op2; break;
- case '*': result = op1 * op2; break;
- case '/': result = op1 / op2; break;
- case '%': result = op1 % op2; break;
-
- default:
- printf("Invalid operator: %c\n", ch);
- return -1; }
- Push(&stack, result);
- } }
- return Pop(&stack); // Final result
- }

Implementation

- // ---------- Main Function ----------
- int main() {
-     char expr[MAX];
-     printf("Enter a prefix expression: ");
-     scanf("%[^\n]s", expr);
- int result = EvaluatePrefix(expr);
-     printf("Result = %d\n", result);
-     return 0; }

- **Practice**
- CONVERT INFIX TO POSTFIX USING STACK
- a * b + c / d - (e + f) * g / (h - i) + j * k

- APPLY VALUES AND EVALUATE THE PREFIX FOR THE SAME EXPRESSION