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### DOMAIN WINTER WINNING CAMP-Day(3)

#### 1) Fibonacci Series

**Code:**

```
#include <iostream>
using namespace std;

int fibonacci(int n) {
    if (n <= 1)
        return n;
    return fibonacci(n - 1) + fibonacci(n - 2);
}

int main() {
    int n;
    cout << "Enter a number for Fibonacci calculation: ";
    cin >> n;
    cout << "Fibonacci(" << n << "): " << fibonacci(n) << endl;
    return 0;
}
```

**Output:**

main.cpp	Output
<pre>1 #include &lt;iostream&gt; 2 using namespace std; 3 4 int fibonacci(int n) { 5     if (n &lt;= 1) 6         return n; 7     return fibonacci(n - 1) + fibonacci(n - 2); 8 } 9 10 int main() { 11     int n; 12     cout &lt;&lt; "Enter a number for Fibonacci calculation: "; 13     cin &gt;&gt; n; 14     cout &lt;&lt; "Fibonacci(" &lt;&lt; n &lt;&lt; "): " &lt;&lt; fibonacci(n) &lt;&lt; endl; 15     return 0; 16 }</pre>	<pre>Enter a number for Fibonacci calculation: 4 Fibonacci(4): 3  === Code Execution Successful ===</pre>


## 2) Factorial Using Recursion

```
#include <iostream>
using namespace std;

int factorial(int n) {
    if (n == 0 || n == 1)
        return 1;
    return n * factorial(n - 1);
}

int main() {
    int n;
    cout << "Enter a number to calculate factorial: ";
    cin >> n;
    cout << "Factorial of " << n << ": " << factorial(n) << endl;
    return 0;
}
```

### Output:

main.cpp	Run	Output
<pre>1 #include &lt;iostream&gt; 2 using namespace std; 3 4 int factorial(int n) { 5     if (n == 0    n == 1) 6         return 1; 7     return n * factorial(n - 1); 8 } 9 10 int main() { 11     int n; 12     cout &lt;&lt; "Enter a number to calculate factorial: "; 13     cin &gt;&gt; n; 14     cout &lt;&lt; "Factorial of " &lt;&lt; n &lt;&lt; ": " &lt;&lt; factorial(n) &lt;&lt; endl; 15     return 0; 16 }</pre>		<pre>Enter a number to calculate factorial: 5 Factorial of 5: 120  === Code Execution Successful ===</pre>

### 3) Perfect Number

```
#include <iostream>
using namespace std;

bool isPerfectNumber(int n) {
    if (n <= 1)
        return false;

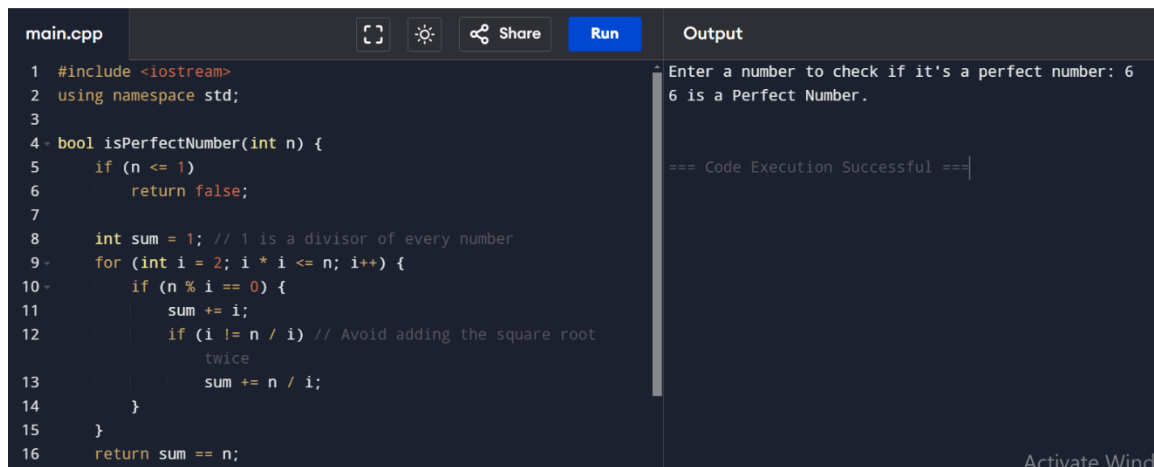
    int sum = 1; // 1 is a divisor of every number
    for (int i = 2; i * i <= n; i++) {
        if (n % i == 0) {
            sum += i;
            if (i != n / i) // Avoid adding the square root twice
                sum += n / i;
        }
    }
    return sum == n;
}

int main() {
    int n;
    cout << "Enter a number to check if it's a perfect number: ";
    cin >> n;

    if (isPerfectNumber(n)) {
        cout << n << " is a Perfect Number." << endl;
    } else {
        cout << n << " is not a Perfect Number." << endl;
    }

    return 0;
}
```

## Output:



The screenshot shows a C++ IDE with a file named 'main.cpp'. The code defines a function 'isPerfectNumber' that checks if a number is perfect by summing its divisors. The output window shows the program's execution for the input '6', which is a perfect number.

```
main.cpp
1 #include <iostream>
2 using namespace std;
3
4 bool isPerfectNumber(int n) {
5     if (n <= 1)
6         return false;
7
8     int sum = 1; // 1 is a divisor of every number
9     for (int i = 2; i * i <= n; i++) {
10         if (n % i == 0) {
11             sum += i;
12             if (i != n / i) // Avoid adding the square root
13                 sum += n / i;
14         }
15     }
16     return sum == n;
}
```

Output

```
Enter a number to check if it's a perfect number: 6
6 is a Perfect Number.

=== Code Execution Successful ===
```

## 4) Sum of Natural Numbers Using Recursion

```
#include <iostream>
```

```
using namespace std;
```

```
int sumNatural(int n) {
```

```
    if (n == 0)
```

```
        return 0;
```

```
    return n + sumNatural(n - 1);
```

```
}
```

```
int main() {
```

```
    int n;
```

```
    cout << "Enter a number to calculate the sum of natural numbers: ";
```

```
    cin >> n;
```

```
    cout << "Sum of first " << n << " natural numbers: " << sumNatural(n) << endl;
```

```

    return 0;
}

```

### Output:

The screenshot shows a C++ IDE with a file named `main.cpp`. The code defines a recursive function `sumNatural` and a `main` function. The `main` function prompts the user to enter a number, reads the input, and prints the sum of the first `n` natural numbers. The output window shows the user entered 10, and the program calculated the sum as 55. A message at the bottom right indicates "Activate Windows" and "Go to Settings to activate".

```

main.cpp
1  #include <iostream>
2  using namespace std;
3
4  int sumNatural(int n) {
5      if (n == 0)
6          return 0;
7      return n + sumNatural(n - 1);
8  }
9
10 int main() {
11     int n;
12     cout << "Enter a number to calculate the sum of natural
13         numbers: ";
14     cin >> n;
15     cout << "Sum of first " << n << " natural numbers: " <<
16         sumNatural(n) << endl;
17     return 0;
18 }

```

Output

```

Enter a number to calculate the sum of natural numbers: 10
Sum of first 10 natural numbers: 55

=== Code Execution Successful ===

```

Activate Windows  
Go to Settings to activate

## 5) Reverse Linked List

```

#include <iostream>

using namespace std;

// Definition for singly-linked list

struct ListNode {
    int val;
    ListNode* next;
    ListNode(int x) : val(x), next(nullptr) {}
};

// Function to reverse a linked list

ListNode* reverseList(ListNode* head) {
    ListNode* prev = nullptr;

```

```

while (head) {
    ListNode* nextNode = head->next;
    head->next = prev;
    prev = head;
    head = nextNode;
}
return prev;
}

```

// Function to create a linked list from user input

```

ListNode* createList(int n) {
    ListNode* head = nullptr;
    ListNode* tail = nullptr;
    cout << "Enter " << n << " elements: ";
    for (int i = 0; i < n; i++) {
        int val;
        cin >> val;
        ListNode* newNode = new ListNode(val);
        if (!head) {
            head = tail = newNode;
        } else {
            tail->next = newNode;
            tail = newNode;
        }
    }
    return head;
}

```

// Function to print a linked list

```
void printList(ListNode* head) {  
    while (head) {  
        cout << head->val << " ";  
        head = head->next;  
    }  
    cout << endl;  
}
```

```
int main() {  
    int n;  
    cout << "Enter size of the list: ";  
    cin >> n;  
    ListNode* head = createList(n);  
  
    cout << "Original List: ";  
    printList(head);  
  
    head = reverseList(head);  
  
    cout << "Reversed List: ";  
    printList(head);  
  
    return 0;  
}
```

## Output:

main.cpp	Output
<pre>1 #include &lt;iostream&gt; 2 using namespace std; 3 4 // Definition for singly-linked list 5 struct ListNode { 6     int val; 7     ListNode* next; 8     ListNode(int x) : val(x), next(nullptr) {} 9 }; 10 11 // Function to reverse a linked list 12 ListNode* reverseList(ListNode* head) { 13     ListNode* prev = nullptr; 14     while (head) { 15         ListNode* nextNode = head-&gt;next;</pre>	<pre>Enter size of the list: 5 Enter 5 elements: 1 5 2 9 0 Original List: 1 5 2 9 0 Reversed List: 0 9 2 5 1  === Code Execution Successful ===</pre>

## 6) Reverse String

```
#include <iostream>
using namespace std;

void reverseString(string &str, int start, int end) {
    if (start >= end)
        return;
    swap(str[start], str[end]);
    reverseString(str, start + 1, end - 1);
}

int main() {
    string str;
    cout << "Enter a string to reverse: ";
    cin >> str;
    reverseString(str, 0, str.size() - 1);
    cout << "Reversed String: " << str << endl;
    return 0;
}
```



## Output :

main.cpp	Output
<pre>1 #include &lt;iostream&gt; 2 using namespace std; 3 4 void reverseString(string &amp;str, int start, int end) { 5     if (start &gt;= end) 6         return; 7     swap(str[start], str[end]); 8     reverseString(str, start + 1, end - 1); 9 } 10 11 int main() { 12     string str; 13     cout &lt;&lt; "Enter a string to reverse: "; 14     cin &gt;&gt; str; 15     reverseString(str, 0, str.size() - 1); 16     cout &lt;&lt; "Reversed String: " &lt;&lt; str &lt;&lt; endl; 17     return 0; 18 }</pre>	<pre>Enter a string to reverse: Attri Reversed String: irttA  === Code Execution Successful ===</pre>

## 7) Merge Two Sorted Linked Lists

```
#include <iostream>
using namespace std;
```

```
struct ListNode {
    int val;
    ListNode* next;
    ListNode(int x) : val(x), next(nullptr) {}
};
```

```
// Function to merge two sorted linked lists
```

```
ListNode* mergeTwoLists(ListNode* l1, ListNode* l2) {
    if (!l1) return l2;
    if (!l2) return l1;
```

```
    ListNode* head = nullptr; // Head of the merged list
    ListNode* current = nullptr; // Pointer to build the list
```

```
    // Initialize the head of the merged list
```

```
    if (l1->val < l2->val) {
        head = l1;
        l1 = l1->next;
    } else {
        head = l2;
        l2 = l2->next;
```

```

    }
    current = head;

    // Merge the remaining nodes
    while (l1 && l2) {
        if (l1->val < l2->val) {
            current->next = l1;
            l1 = l1->next;
        } else {
            current->next = l2;
            l2 = l2->next;
        }
        current = current->next;
    }

    // Append any remaining nodes
    current->next = l1 ? l1 : l2;

    return head;
}

// Function to create a linked list from user input
ListNode* createList() {
    int n, val;
    cout << "Enter the number of elements in the list: ";
    cin >> n;
    if (n == 0) return nullptr;

    cout << "Enter the elements in sorted order: ";
    cin >> val;
    ListNode* head = new ListNode(val);
    ListNode* current = head;

    for (int i = 1; i < n; ++i) {
        cin >> val;
        current->next = new ListNode(val);
        current = current->next;
    }
    return head;
}

// Function to print a linked list
void printList(ListNode* head) {
    while (head) {

```

```

        cout << head->val << " ";
        head = head->next;
    }
    cout << endl;
}

// Main function to demonstrate merging of two lists
int main() {
    cout << "Create the first sorted linked list:\n";
    ListNode* l1 = createList();

    cout << "Create the second sorted linked list:\n";
    ListNode* l2 = createList();

    ListNode* mergedList = mergeTwoLists(l1, l2);

    cout << "Merged Sorted List: ";
    printList(mergedList);

    return 0;
}

```

## Output :

main.cpp	Output
<pre> 1  #include &lt;iostream&gt; 2  using namespace std; 3 4  struct ListNode { 5      int val; 6      ListNode* next; 7      ListNode(int x) : val(x), next(nullptr) {} 8  }; 9 10 // Function to merge two sorted linked lists 11 ListNode* mergeTwoLists(ListNode* l1, ListNode* l2) { 12     if (!l1) return l2; 13     if (!l2) return l1; 14 15     ListNode* head = nullptr; // Head of the merged list 16     ListNode* current = nullptr; // Pointer to build the list 17 </pre>	<pre> Create the first sorted linked list: Enter the number of elements in the list: 3 Enter the elements in sorted order: 1 2 5 Create the second sorted linked list: Enter the number of elements in the list: 2 Enter the elements in sorted order: 0 9 Merged Sorted List: 0 1 2 5 9  === Code Execution Successful === </pre>

## 8) Basic Calculator

```
#include <iostream>
#include <stack>
#include <string>
using namespace std;

// Helper function to perform arithmetic operations
int operate(int a, int b, char op) {
    switch (op) {
        case '+': return a + b;
        case '-': return a - b;
        case '*': return a * b;
        case '/': return a / b;
        default: return 0;
    }
}

// Function to evaluate the expression
int calculate(string s) {
    stack<int> nums; // Stack to store numbers
    stack<char> ops; // Stack to store operators
    int num = 0;
    int result = 0;
    int sign = 1;

    for (int i = 0; i < s.length(); ++i) {
        char c = s[i];

        if (isdigit(c)) {
            num = num * 10 + (c - '0');
        } else if (c == '+' || c == '-') {
            result += sign * num;
            num = 0;
            sign = (c == '+') ? 1 : -1;
        } else if (c == '(') {
            nums.push(result);
            ops.push(sign);
            result = 0;
            sign = 1;
        } else if (c == ')') {
            result += sign * num;
            num = 0;
            result = nums.top() + ops.top() * result;
            nums.pop();
            ops.pop();
        } else if (c == '*' || c == '/') {
            // Handle multiplication or division immediately
            while (i + 1 < s.length() && isspace(s[i + 1])) i++; // Skip spaces
            int nextNum = 0;
```

```

        i++;
        while (i < s.length() && isdigit(s[i])) {
            nextNum = nextNum * 10 + (s[i] - '0');
            i++;
        }
        i--; // Adjust for next iteration
        num = (c == '*' ? num * nextNum : num / nextNum;
    }
}

result += sign * num;
return result;
}

int main() {
    string expression;
    cout << "Enter a mathematical expression (e.g., 1 + (2 * 3) - 4): ";
    getline(cin, expression);

    cout << "Result: " << calculate(expression) << endl;

    return 0;
}

```

## Output :

The screenshot shows a C++ IDE with a dark theme. The left pane displays the source code for `main.cpp`, which includes headers for `<iostream>`, `<stack>`, and `<string>`, and uses the `std` namespace. A helper function `operate` is defined to handle arithmetic operations based on a character operator. The `main` function prompts the user for a mathematical expression and calls the `calculate` function. The right pane shows the output of the program, which matches the example input and output provided in the text.

```

main.cpp
1 #include <iostream>
2 #include <stack>
3 #include <string>
4 using namespace std;
5
6 // Helper function to perform arithmetic operations
7 int operate(int a, int b, char op) {
8     switch (op) {
9         case '+': return a + b;
10        case '-': return a - b;
11        case '*': return a * b;
12        case '/': return a / b;
13        default: return 0;
14    }
15 }

```

Output

```

Enter a mathematical expression (e.g., 1 + (2 * 3) - 4): 1-2+5*9/4
Result: 10

=== Code Execution Successful ===

```

## 9) Wildcard Matching

```
#include <iostream>
#include <vector>
#include <string>
using namespace std;

bool isMatch(string s, string p) {
    int m = s.length(), n = p.length();
    vector<vector<bool>> dp(m + 1, vector<bool>(n + 1, false));

    // Base case: empty string and empty pattern match
    dp[0][0] = true;

    // Fill the first row for patterns starting with *
    for (int j = 1; j <= n; ++j) {
        if (p[j - 1] == '*') {
            dp[0][j] = dp[0][j - 1];
        }
    }

    // Fill the DP table
    for (int i = 1; i <= m; ++i) {
        for (int j = 1; j <= n; ++j) {
            if (p[j - 1] == '*') {
                dp[i][j] = dp[i - 1][j] || dp[i][j - 1];
            } else if (p[j - 1] == '?' || s[i - 1] == p[j - 1]) {
                dp[i][j] = dp[i - 1][j - 1];
            }
        }
    }

    return dp[m][n];
}

int main() {
    string s, p;
    cout << "Enter the string: ";
    cin >> s;
    cout << "Enter the pattern (with wildcards ? and *): ";
    cin >> p;

    if (isMatch(s, p)) {
        cout << "The string matches the pattern." << endl;
    } else {
        cout << "The string does not match the pattern." << endl;
    }
}
```

```
    return 0;  
}
```

## Output :

main.cpp	Output
<pre>1 #include &lt;iostream&gt; 2 #include &lt;vector&gt; 3 #include &lt;string&gt; 4 using namespace std; 5 6 bool isMatch(string s, string p) { 7     int m = s.length(), n = p.length(); 8     vector&lt;vector&lt;bool&gt;&gt; dp(m + 1, vector&lt;bool&gt;(n + 1, false)); 9 10    // Base case: empty string and empty pattern match 11    dp[0][0] = true; 12 13    // Fill the first row for patterns starting with * 14    for (int j = 1; j &lt;= n; ++j) { 15        if (p[j - 1] == '*') { 16            dp[0][j] = dp[0][j - 1]; 17        } 18    } 19 }</pre>	<pre>Enter the string: aa Enter the pattern (with wildcards ? and *): * The string matches the pattern.  === Code Execution Successful ===</pre>

## 10) Cheapest Flight with K Stops

```
#include <iostream>
#include <vector>
#include <queue>
#include <tuple>
#include <climits>

using namespace std;

int findCheapestPrice(int n, vector<vector<int>>& flights, int src, int dst, int K) {
    // Adjacency list representation
    vector<vector<pair<int, int>>> graph(n);
    for (const auto& flight : flights) {
        graph[flight[0]].emplace_back(flight[1], flight[2]);
    }

    // Min-heap to store {cost, current_city, stops_remaining}
    priority_queue<tuple<int, int, int>, vector<tuple<int, int, int>>, greater<>> pq;
    pq.emplace(0, src, K + 1); // Start with 0 cost, source city, and K+1 stops

    while (!pq.empty()) {
        auto [cost, city, stops] = pq.top();
        pq.pop();

        // If we reach the destination, return the cost
        if (city == dst) {
            return cost;
        }

        // If we have stops remaining, explore neighbors
        if (stops > 0) {
            for (const auto& [next_city, price] : graph[city]) {
                pq.emplace(cost + price, next_city, stops - 1);
            }
        }
    }

    // If no route is found
    return -1;
}

int main() {
    int n, m;
    cout << "Enter the number of cities and flights: ";
    cin >> n >> m;

    vector<vector<int>> flights(m, vector<int>(3));
    cout << "Enter the flights (from, to, price):" << endl;
    for (int i = 0; i < m; ++i) {
```



```

    cin >> flights[i][0] >> flights[i][1] >> flights[i][2];
}

int src, dst, K;
cout << "Enter the source, destination, and maximum stops: ";
cin >> src >> dst >> K;

int result = findCheapestPrice(n, flights, src, dst, K);
if (result != -1) {
    cout << "The cheapest price is: " << result << endl;
} else {
    cout << "No route available within " << K << " stops." << endl;
}

return 0;
}

```

## Output :

main.cpp	Output
<pre> 1 #include &lt;iostream&gt; 2 #include &lt;vector&gt; 3 #include &lt;queue&gt; 4 #include &lt;tuple&gt; 5 #include &lt;limits&gt; 6 7 using namespace std; 8 9 int findCheapestPrice(int n, vector&lt;vector&lt;int&gt;&gt;&amp; flights, int   src, int dst, int K) { 10     // Adjacency list representation 11     vector&lt;vector&lt;pair&lt;int, int&gt;&gt;&gt; graph(n); 12     for (const auto&amp; flight : flights) { 13         graph[flight[0]].emplace_back(flight[1], flight[2]); 14     } 15 </pre>	<pre> Enter the number of cities and flights: 4 5 Enter the flights (from, to, price): 0 1 100 1 2 100 2 0 100 1 3 600 2 3 200 Enter the source, destination, and maximum stops: 0 3 1 The cheapest price is: 700  === Code Execution Successful === </pre>

