

LAB ASSIGNMENT 1



NORTHERN UNIVERSITY

B A N G L A D E S H

Knowledge for Innovation and Change

SUBMITTED BY

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DEPARTMENT: *CSE*

SECTION: *4B*

SUBJECT: *Algorithm design and analysis lab work*

SEMESTER: *Fall 2023*

SUBMITTED TO

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(Lecturer of CSE in NUB)

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Problem 1:

C++ code:

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

bool isPalindrome(const string& str) {
    int left = 0;
    int right = str.length() - 1;
    while (left < right) {
        if (str[left] != str[right]) {
            return false;
        }
        left++;
        right--;
    }
    return true;
}

int main() {
    ifstream inputFile("input.txt");
    ofstream outputFile("output.txt");
    ofstream recordsFile("records.txt");

    if (!inputFile || !outputFile || !recordsFile) {
        cout << "Error opening files!" << endl;
        return 1;
    }

    vector<string> lines;
    string line;
    while (getline(inputFile, line)) {
```

```

    lines.push_back(line);
}

int totalNumbers = 0;
int oddParityCount = 0;
int evenParityCount = 0;
int noParityCount = 0;
int palindromeCount = 0;
int nonPalindromeCount = 0;

for (const string& inputLine : lines) {
    istringstream iss(inputLine);

    double num;
    string word;
    if ( iss >> num >> word) {
        totalNumbers++;

        if (num == static_cast<int>(num)) {
            if (static_cast<int>(num) % 2 == 0) {
                outputFile << num << " has even parity";
                evenParityCount++;
            } else {
                outputFile << num << " has odd parity";
                oddParityCount++;
            }
        } else {
            outputFile << num << " cannot have parity";
            noParityCount++;
        }

        if (isPalindrome(word)) {
            outputFile << " and " << word << " is a palindrome" << endl;
            palindromeCount++;
        } else {
            outputFile << " and " << word << " is not a palindrome" << endl;
            nonPalindromeCount++;
        }
    }
}

```

```

    }

}

double oddParityPercentage = (static_cast<double>(oddParityCount) / totalNumbers) * 100;

double evenParityPercentage = (static_cast<double>(evenParityCount) / totalNumbers) * 100;

double noParityPercentage = (static_cast<double>(noParityCount) / totalNumbers) * 100;

double palindromePercentage = (static_cast<double>(palindromeCount) / totalNumbers) * 100;

double nonPalindromePercentage = (static_cast<double>(nonPalindromeCount) / totalNumbers) * 100;

recordsFile << "Percentage of odd parity: " << fixed << setprecision(2) << oddParityPercentage << "% "
<< endl;

recordsFile << "Percentage of even parity: " << evenParityPercentage << "% " << endl;

recordsFile << "Percentage of no parity: " << noParityPercentage << "% " << endl;

recordsFile << "Percentage of palindrome: " << palindromePercentage << "% " << endl;

recordsFile << "Percentage of non-palindrome: " << nonPalindromePercentage << "% " << endl;

inputFile.close();

outputFile.close();

recordsFile.close();

return 0;

}

```

```

alglabwork.cpp - Code::Blocks 20.03
File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help
<global>
isPalindrome(const string& str): bool
Management
Projects Files FSy
C:\
PerfLogs
Program Files
Program Files (x86)
Users
Windows
1
#include <iostream>
2
#include <fstream>
3
#include <vector>
4
#include <string>
5
#include <iomanip>
6
using namespace std;
7
8
bool isPalindrome(const string& str) {
9
    int left = 0;
10
    int right = str.length() - 1;
11
12
    while (left < right) {
13
        if (str[left] != str[right]) {
14
            return false;
15
        }
16
        left++;
17
        right--;
18
    }
19
    return true;
20
}
21
22
23
int main() {
24
    ifstream inputFile("input.txt");
25
    ofstream outputFile("output.txt");
26
    ofstream recordsFile("records.txt");
27
28
    if (!inputFile || !outputFile || !recordsFile) {
29
        cout << "Error opening files!" << endl;
30
        return 1;
    }
}

```

Logs & others

Code::Blocks Search results Cccc Build log Build messages CppCheck/Vera++ CppCheck/Vera++ messages Cscope Debugger DoxyBlocks Fortran info Close

File Message

=== Build file: "no target" in "no project" (compiler: unknown) ===

=== Build finished: 0 error(s), 0 warning(s) (0 minute(s), 0 second(s)) ===

C:\Users\User\Documents\alglabwork.cpp C/C++ Windows (CR+LF) WINDOWS-1252 Line 21, Col 2, Pos 388 Insert Read/Write default 28°C Partly cloudy 9:05 PM 10/7/2023

input.txt - Code::Blocks 20.03

File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help

Management

Projects Files FSy

C:\

Mask

1 madam
2 apple
3 3.6 racecar
4 89 parrot
5 45.2 discord
6

Logs & others

Code::Blocks Search results Cccc Build log Build messages CppCheck/Vera++ CppCheck/Vera++ messages Cscope Debugger DoxyBlocks Fortran info Close

File Line Message

=== Build file: "no target" in "no project" (compiler: unknown) ===
=== Build finished: 0 error(s), 0 warning(s) (0 minute(s), 0 second(s)) ===

C:\Users\User\Documents\input.txt Plain text WINDOWS (CR+LF) WINDOWS-1252 Line 5, Col 13, Pos 54 Insert Read/Write default 9:05 PM 10/7/2023

28°C Partly cloudy

output.txt - Code::Blocks 20.03

File Edit View Search Project Build Debug Fortran wxSmith Tools Tools+ Plugins DoxyBlocks Settings Help

Management

Projects Files FSy

C:\

Mask

1 has odd parity and madam is a palindrome
2 has even parity and apple is not a palindrome
3 3.6 cannot have parity and racecar is a palindrome
4 89 has odd parity and parrot is not a palindrome
5 45.2 cannot have parity and discord is not a palindrome
6

Logs & others

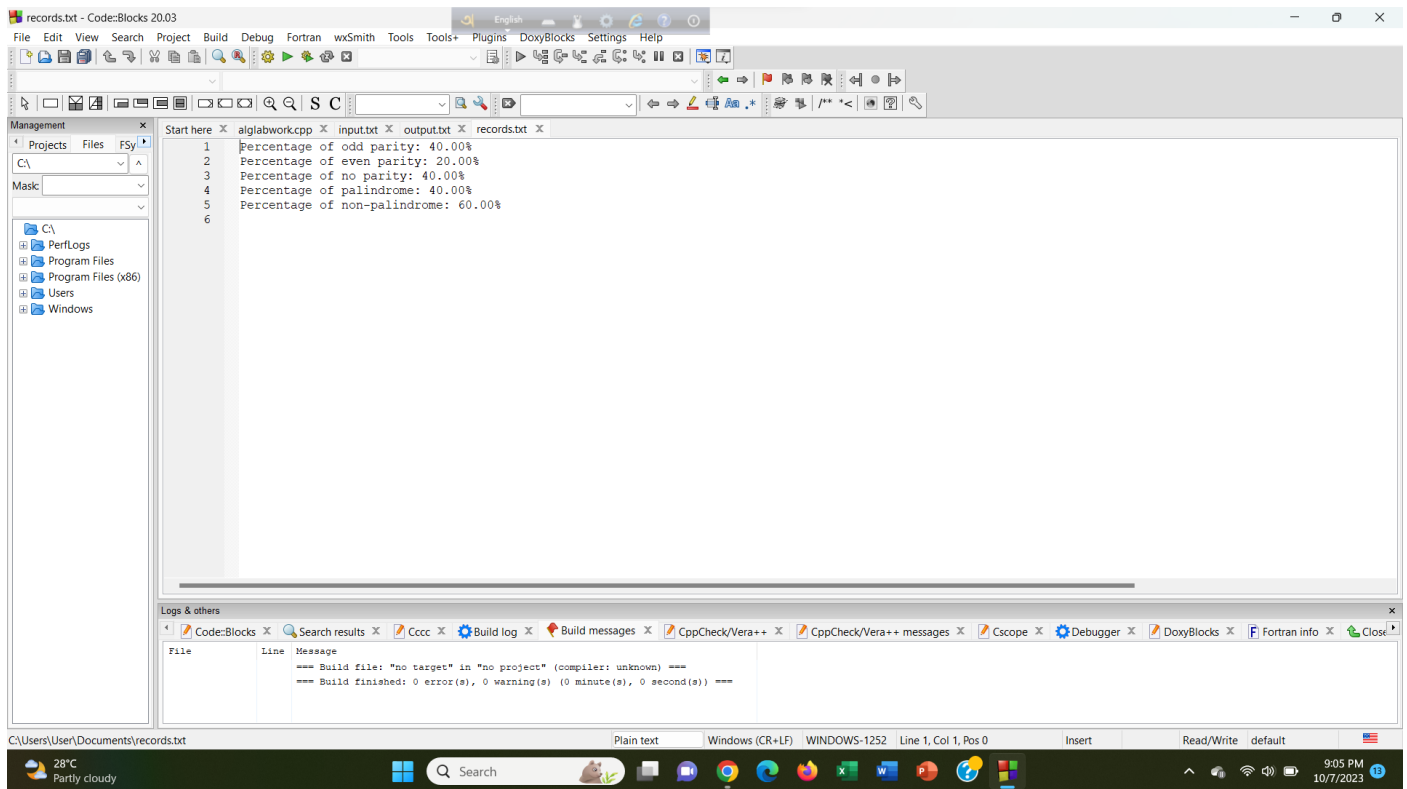
Code::Blocks Search results Cccc Build log Build messages CppCheck/Vera++ CppCheck/Vera++ messages Cscope Debugger DoxyBlocks Fortran info Close

File Line Message

=== Build file: "no target" in "no project" (compiler: unknown) ===
=== Build finished: 0 error(s), 0 warning(s) (0 minute(s), 0 second(s)) ===

C:\Users\User\Documents\output.txt Plain text WINDOWS (CR+LF) WINDOWS-1252 Line 1, Col 1, Pos 0 Insert Read/Write default 9:05 PM 10/7/2023

28°C Partly cloudy



Problem 2:

Here is the implementation of finding the N-th Fibonacci number using both methods in C++ along with the complexity analysis:

For Loop method:

```
#include <iostream>

using namespace std;

int fibonacci(int n) {
    if (n <= 0) {
        return 0;
    } else if (n == 1) {
        return 1;
    } else {
        int a = 0, b = 1;
        for (int i = 2; i <= n; i++) {
            int temp = a + b;
            a = b;
            b = temp;
        }
    }
}
```

```

    }
    return b;
}
}

int main() {
    int n;
    cout << "Enter the value of N: ";
    cin >> n;
    cout << "The " << n << "th Fibonacci number is: " << fibonacci(n) << endl;
    return 0;
}

```

The complexity of this method is $O(N)$ since we iterate N times to calculate the N -th Fibonacci number.

Recursion method:

```

#include <iostream>
using namespace std;
int fibonacci(int n) {
    if (n <= 0) {
        return 0;
    } else if (n == 1) {
        return 1;
    } else {
        return fibonacci(n-1) + fibonacci(n-2);
    }
}
}

```

```

int main() {
    int n;
    cout << "Enter the value of N: ";
    cin >> n;
}

```

```

cout << "The " << n << "th Fibonacci number is: " << fibonacci(n) << endl;

return 0;

}

```

The complexity of this method is exponential, $O(2^N)$, since we make two recursive calls for each recursive call until we reach the base case. Therefore, the recursion method is less efficient compared to the for loop method.

In conclusion, the for loop method has a linear complexity of $O(N)$ while the recursion method has an exponential complexity of $O(2^N)$.

The screenshot shows the Code::Blocks IDE with a C++ project named 'fibonacci.cpp'. The code implements a Fibonacci function using a for loop. The main function prompts the user to enter a value for N, which is 8. The output shows the 8th Fibonacci number is 21. The execution time is 3.149 seconds.

```

1 #include <iostream>
2 using namespace std;
3 int fibonacci(int n) {
4     if (n <= 0) {
5         return 0;
6     } else if (n == 1) {
7         return 1;
8     } else {
9         int a = 0, b = 1;
10        for (int i = 2; i <= n; i++) {
11            int temp = a + b;
12            a = b;
13            b = temp;
14        }
15        return b;
16    }
17 }
18
19 int main() {
20     int n;
21     cout << "Enter the value of N: ";
22     cin >> n;
23     cout << "The " << n << "th Fibonacci number is: " << fibonacci(n) << endl;
24     return 0;
25 }
26
27
28

```

Execution output:

```

Enter the value of N: 8
The 8th Fibonacci number is: 21
Process returned 0 (0x0)   execution time : 3.149 s
Press any key to continue.

```

The screenshot shows the Code::Blocks IDE with a C++ project named 'fibonacci.cpp'. The code implements a Fibonacci function using recursion. The main function prompts the user to enter a value for N, which is 8. The output shows the 8th Fibonacci number is 21. The execution time is 4.318 seconds.

```

1 #include <iostream>
2 using namespace std;
3 int fibonacci(int n) {
4     if (n <= 0) {
5         return 0;
6     } else if (n == 1) {
7         return 1;
8     } else {
9         return fibonacci(n-1) + fibonacci(n-2);
10    }
11 }
12
13
14 int main() {
15     int n;
16     cout << "Enter the value of N: ";
17     cin >> n;
18     cout << "The " << n << "th Fibonacci number is: " << fibonacci(n) << endl;
19     return 0;
20 }
21
22
23

```

Execution output:

```

Enter the value of N: 8
The 8th Fibonacci number is: 21
Process returned 0 (0x0)   execution time : 4.318 s
Press any key to continue.

```


Problem 3:

The screenshot shows the CodeBlocks IDE with a C++ file named `binary_search.cpp`. The code implements a binary search algorithm. The terminal window shows the program's execution: it prints the array `1 3 5 7 9 11 13 15 17 19`, prompts for a target value, receives `13`, and outputs `Target value 13 found at index 6`. The process returned `0 (0x0)` with an execution time of `2.044 s`.

```
18     return -1;
19 }
20
21 int main() {
22     const int size = 10;
23     int arr[size] = {1, 3, 5, 7, 9, 11, 13, 15, 17, 19};
24
25     cout << "Array: ";
26     for (int i = 0; i < size; i++) {
27         cout << arr[i] << " ";
28     }
29     cout << endl;
30
31     int target;
32     cout << "Enter the target value: ";
33     cin >> target;
34
35     int iterations = 0;
36     int index = binarySearch(arr, 0, size - 1, target, iterations);
37
38     if (index != -1) {
39         cout << "Target value " << target << " found at index " << index << endl;
40     } else {
41         cout << "Target value " << target << " not found in the array." << endl;
42     }
43
44     return 0;
45 }
```

Terminal Output:

```
Array: 1 3 5 7 9 11 13 15 17 19
Enter the target value: 13
Target value 13 found at index 6

Process returned 0 (0x0)   execution time : 2.044 s
Press any key to continue.
```

```
#include <iostream>
```

```
using namespace std;
```

```
int binarySearch(int arr[], int low, int high, int target, int& iterations) {
```

```
    while (low <= high) {
```

```
        int mid = low + (high - low) / 2;
```

```
        if (arr[mid] == target) {
```

```
            return mid;
```

```
        } else if (arr[mid] < target) {
```

```
            low = mid + 1;
```

```
        } else {
```

```
            high = mid - 1;
```

```
        }
```

```
        iterations++;
```

```
    }
```

```
    return -1;
}

int main() {
    const int size = 10;
    int arr[size] = {1, 3, 5, 7, 9, 11, 13, 15, 17, 19};

    cout << "Array: ";
    for (int i = 0; i < size; i++) {
        cout << arr[i] << " ";
    }
    cout << endl;

    int target;
    cout << "Enter the target value: ";
    cin >> target;

    int iterations = 0;
    int index = binarySearch(arr, 0, size - 1, target, iterations);

    if (index != -1) {
        cout << "Target value " << target << " found at index " << index << endl;
    } else {
        cout << "Target value " << target << " not found in the array." << endl;
    }

    return 0;
}
```