Advanced Calculation Engine

MICROPROJECT REPORT

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In
Second Year Diploma Programme in Engineering & Technology of Maharashtra State Board of Technical Education, Mumbai
(Autonomous)
ISO 9001 :2008 (ISO/lEC-27001 13)

At
1734 - TRINITY POLYTECHNIC PUNE

MAHARASHTRA STATE BOARD
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EDUCATION, MUMBAI

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2024 – 2025 as per the MSBTE prescribed curriculum of K-Scheme.

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INTRODUCTION:

The **Advanced Calculation Engine** is a comprehensive and powerful calculator designed to handle both basic arithmetic operations and advanced number system conversions. This project is part of the curriculum for the Object-Oriented Programming (OOP) course, aimed at developing a deeper understanding of C++ programming concepts and their practical applications. In today's world, calculators are essential tools for various fields, ranging from basic academic tasks to complex engineering calculations.

The **Advanced Calculation Engine** not only performs fundamental operations like addition, subtraction, multiplication, and division but also excels in converting between binary, decimal, and hexadecimal systems, which are commonly used in computing and digital electronics.

This project showcases how object-oriented programming principles such as encapsulation, abstraction, and reusability can be applied in real-world applications. The core functionality of the calculator is built around a class-based architecture, where different mathematical operations and conversions are encapsulated within methods of the AdvancedCalculator class. This modular approach not only makes the code easier to understand and maintain but also allows for the easy expansion of features in the future.

In addition to its functional capabilities, the **Advanced Calculation Engine** emphasizes the importance of error handling and validation. For example, dividing by zero is handled gracefully using exceptions, preventing runtime errors and ensuring the reliability of the application. Moreover, conversions between number systems are performed with precision, ensuring that users receive accurate results, regardless of the input format.

The development of this calculator demonstrates the practical application of C++ in solving everyday computational problems. By integrating key features such as binary-to-decimal conversion, decimal-to-binary conversion, hexadecimal conversion, and error-free arithmetic operations, this project aims to provide a versatile tool that can assist users in a wide range of mathematical tasks.

OBJECTIVES:

The **Advanced Calculation Engine** was developed with the following key objectives in mind:

1. **Implement Basic Arithmetic Operations**
   To perform essential mathematical functions like addition, subtraction, multiplication, and division, ensuring accurate results and providing a user-friendly interface for basic calculations.

2. **Enable Number System Conversions**
   To allow users to seamlessly convert numbers between different systems, including:
   - Binary to Decimal
   - Decimal to Binary
   - Hexadecimal to Decimal
   - Decimal to Hexadecimal

3. **Showcase Object-Oriented Programming (OOP) Concepts**
   To demonstrate the practical application of OOP principles such as:
   - Encapsulation: Organizing functionality into classes and methods.
   - Abstraction: Hiding implementation details and providing clear user interaction.
   - Reusability: Designing a flexible system that can be extended or modified with ease.

4. **Ensure Robust Error Handling**
   To implement effective error detection and handling, particularly in operations that may cause runtime errors, such as division by zero or invalid number formats during conversions.

5. **Create an Extensible Framework**
   To build the calculator in such a way that additional features or number systems can be added in the future without major changes to the existing structure.

6. **Improve User Interaction and Input Handling**
   To design the program in a way that facilitates easy user input and clear output, ensuring the program can handle a variety of input formats (binary, decimal, hexadecimal) without confusion.

7. **Enhance Mathematical Understanding**
   To help users understand complex number systems and their interconversion, providing an educational tool that simplifies otherwise intricate concepts like binary and hexadecimal calculations.

By achieving these objectives, the **Advanced Calculation Engine** aims to offer a comprehensive solution for both basic arithmetic and advanced number system conversions, all while demonstrating the effectiveness of C++ in solving such computational problems.

LITERATURE REVIEW / BACKGROUND:

The **Advanced Calculation Engine** was developed by building upon a wide range of established theoretical concepts and existing technologies. The project primarily focuses on number system conversions and arithmetic operations, which are critical components of modern computing. In this section, we will explore the foundations of different number systems, existing calculators, their limitations, and previous projects related to this area, while also discussing the theoretical underpinnings of number system conversions and arithmetic operations in programming.

Overview of Number Systems

Number systems are essential in both mathematics and computing, with the most used systems being binary, decimal, and hexadecimal.

- **Binary (Base-2)**: The binary system is the foundational number system in computing, using only two digits—0 and 1. Every value in binary is represented as a power of two. Computers inherently process information in binary due to their reliance on electrical states (on/off).

- **Decimal (Base-10)**: This is the most familiar number system for humans, consisting of digits from 0 to 9. It is the system used in everyday arithmetic and most financial or scientific calculations.

- **Hexadecimal (Base-16)**: Often used in computing, particularly in low-level programming and memory addressing, hexadecimal employs 16 distinct symbols (0–9 and A–F). It serves as a more human-readable representation of binary values because it can represent large binary numbers more compactly.

These number systems play crucial roles in various applications, from basic arithmetic to complex programming, making their conversion an important task in both education and practical applications.

Existing Calculators and Their Limitations

Standard calculators typically offer basic arithmetic functions—addition, subtraction, multiplication, and division. Some advanced calculators also support scientific operations like logarithms, trigonometric functions, and square roots.

However, these tools often lack robust support for number system conversions. Even the calculators that do support conversions between binary, decimal, and hexadecimal systems often fail to provide intuitive interfaces for users, especially when it comes to complex conversions or error handling, such as validating invalid binary or hexadecimal inputs.

Moreover, many existing calculators do not implement efficient error handling, such as division by zero, which can cause program crashes or invalid results. These limitations in existing calculators provided motivation for the development of the **Advanced Calculation Engine**, which seeks to address these shortcomings by integrating both basic and advanced operations with proper error handling and an intuitive interface.

Theoretical Foundations of Number System Conversions

Number system conversion is a fundamental concept in both mathematics and computing. Each number system operates on a different base, and converting between these systems requires careful manipulation of the numbers.

- **Binary to Decimal Conversion**: This is done by multiplying each binary digit by the power of 2 corresponding to its position (from right to left), then summing these values. This approach is essential for converting machine-level binary data into readable decimal numbers.

- **Decimal to Binary Conversion**: This is typically achieved using repeated division by 2, where the remainders represent the binary digits, starting from the least significant bit.

- **Hexadecimal to Decimal Conversion**: Similar to binary, hexadecimal digits are converted by multiplying each digit by the corresponding power of 16 based on their position, and summing the result.

These conversions are fundamental operations in digital systems, especially in areas like microprocessor programming, data encoding, and networking. By understanding the mathematical basis of these conversions, the calculator can perform these tasks with accuracy and efficiency.

Arithmetic Operations in Programming

At its core, arithmetic operations in programming involve fundamental operations like addition, subtraction, multiplication, and division, which are universally applicable in various fields. However, programming languages such as C++ provide additional challenges such as handling data types (int, float, double) and ensuring that operations are performed efficiently and safely.

- **Addition, Subtraction, Multiplication**: These operations are straightforward but need to account for potential issues such as overflow, which occurs when the result of an operation exceeds the storage capacity of the data type being used.

- **Division and Error Handling**: Division is unique because of the potential issue of division by zero. Programming languages like C++ require explicit error handling, often through exception handling mechanisms, to ensure that the program does not crash when invalid operations are attempted. This makes robust error checking a key feature of any reliable calculator.

The **Advanced Calculation Engine** incorporates these theoretical concepts to ensure that it can handle a variety of inputs and operations, all while maintaining accuracy and stability during its computations.

SYSTEM DESIGN:

The design of the **Advanced Calculation Engine** focuses on fulfilling both functional and non-functional requirements using object-oriented principles to ensure efficiency, scalability, and reliability.

7.1 Functional Requirements

1. **Binary to Decimal Conversion**
   Converts binary numbers to their decimal equivalents, handling a range of input sizes.
2. **Decimal to Binary Conversion**
   Converts decimal numbers to binary, supporting both positive and negative integers.
3. **Hexadecimal to Decimal Conversion**
   Converts hexadecimal numbers to decimal, supporting standard hexadecimal formats.
4. **Decimal to Hexadecimal Conversion**
   Converts decimal numbers to hexadecimal, ensuring correct format output.
5. **Basic Arithmetic Operations**
   Performs addition, subtraction, multiplication, and division, with error handling for division by zero.
6. **User Input and Validation**
   Validates user input and provides appropriate feedback for incorrect formats or operations.
7. **Error Handling**
   Manages errors (invalid input, division by zero) without crashing, providing clear error messages.

7.2 Non-functional Requirements

1. **Performance**
   Operations and conversions should execute quickly, even for large numbers.
2. **Scalability**
   The system should allow easy expansion for future functionalities, like additional number systems or operations.
3. **Usability**
   A simple, intuitive interface for clear input and output, with proper error messages.
4. **Reliability**
   Consistently accurate results and stable operation, without crashes or incorrect outputs.
5. **Maintainability**
   The code should be modular and easy to update or modify.
6. **Portability**
   The system should run across different platforms (Windows, Linux, macOS) without major changes.
7. **Security**
   Safe input handling to avoid issues like crashes from invalid data.

This design ensures that the **Advanced Calculation Engine** is efficient, user-friendly, and easy to maintain, providing a robust tool for number system conversions and basic arithmetic operations.

IMPLEMENTATION:

The **Advanced Calculation Engine** was implemented in C++, utilizing its object-oriented features to create a modular and efficient system for arithmetic operations and number system conversions.

8.1 Programming Language and Tools

- **Programming Language**: Developed in **C++** for its performance and support for object-oriented programming, making it suitable for managing various data types and operations.
- **Compiler**: Compiled using the **G++ compiler** from the GNU Compiler Collection, ensuring portability across operating systems.
- **IDE/Editor**: Development was conducted in **Visual Studio Code**, which offers extensions for efficient C++ development.

8.2 Code Structure and Modules

The project follows a **class-based architecture**, encapsulating functionalities within the AdvancedCalculator class for ease of maintenance and expansion.

1. **Class: AdvancedCalculator**
   Contains core functionalities, including arithmetic operations and number system conversions.
2. **Modules**:
   - **Arithmetic Operations**: Methods for addition, subtraction, multiplication, and division, with error handling for division by zero.
   - **Binary to Decimal Conversion**: Converts binary strings to decimal using bitwise operations.
   - **Decimal to Binary Conversion**: Converts decimal integers to binary by dividing by 2 and tracking remainders.
   - **Hexadecimal to Decimal Conversion**: Uses std::hex for converting hexadecimal strings to decimal.
   - **Decimal to Hexadecimal Conversion**: Converts decimal numbers to hexadecimal using C++ streams.
3. **Main Function**:
   Implements a menu-driven user interface to guide input selection and process user requests.
4. **Exception Handling**:
   Ensures robust error management for invalid inputs and division by zero, providing meaningful feedback without crashing the program.

This modular design promotes efficiency and makes it straightforward to add new features in the future

FEATURES:

The **Advanced Calculation Engine** offers a range of features that enhance its usability and functionality for arithmetic calculations and number system conversions:

1. Number System Conversions

- **Binary to Decimal**: Converts binary numbers to decimal format.
- **Decimal to Binary**: Converts decimal numbers into binary representation.
- **Hexadecimal to Decimal**: Transforms hexadecimal numbers into decimal.
- **Decimal to Hexadecimal**: Converts decimal values into hexadecimal format.

2. Basic Arithmetic Operations

- **Addition**: Performs addition of two numbers.
- **Subtraction**: Subtracts one number from another.
- **Multiplication**: Multiplies two numbers.
- **Division**: Includes error handling for division by zero.

3. User-Friendly Interface

- **Menu-Driven**: A clear interface guides users through operations.
- **Input Validation**: Checks inputs for correctness and provides feedback for errors.

4. Error Handling

- **Graceful Management**: Handles exceptions like invalid inputs and division by zero without crashing, offering clear error messages.

5. Performance and Efficiency

- **Fast Computation**: Executes calculations quickly, even with large inputs.
- **Scalable Design**: Easy to add new features or mathematical functions.

6. Portability

- **Cross-Platform Compatibility**: Functions on Windows, Linux, and macOS, making it accessible to a wide audience.

These features make the **Advanced Calculation Engine** a versatile and reliable tool for users needing arithmetic and number conversion capabilities.

TESTING:

Testing is a crucial phase in the development of the **Advanced Calculation Engine** to ensure that all functionalities work as intended and to identify any defects before deployment. This section outlines the test cases and the results obtained from the testing process.

10.1 Test Cases

The following test cases were designed to evaluate the key functionalities of the system:

Test Case ID	Description	Input	Expected Output	Actual Output	Status
TC-001	Binary to Decimal Conversion	1011	11	11	Pass
TC-002	Decimal to Binary Conversion	11	1011	1011	Pass
TC-003	Hexadecimal to Decimal Conversion	A	10	10	Pass
TC-004	Decimal to Hexadecimal Conversion	10	A	A	Pass
TC-005	Addition of two numbers	5, 3	8	8	Pass
TC-006	Subtraction of two numbers	10, 4	6	6	Pass
TC-007	Multiplication of two numbers	3, 4	12	12	Pass
TC-008	Division of two numbers (valid)	8, 2	4	4	Pass
TC-009	Division by zero	8, 0	Division by zero is not allowed.	Division by zero is not allowed.	Pass
TC-010	Invalid Binary Input	102	Invalid binary number.	Invalid binary number.	Pass
TC-011	Invalid Hexadecimal Input	G	Invalid hexadecimal number.	Invalid hexadecimal number.	Pass

10.2 Test Results

The test results indicate that all functionalities of the **Advanced Calculation Engine** passed the test cases successfully. Each expected output matched the actual output, demonstrating that the calculator performs accurately for all tested operations.
Key findings from the tests include:

- **Conversion Functions**: All conversions between binary, decimal, and hexadecimal were accurate.
- **Arithmetic Operations**: The basic arithmetic functions (addition, subtraction, multiplication, and division) produced correct results, including proper handling of division by zero.
- **Input Validation**: The system effectively identified and handled invalid inputs for binary and hexadecimal conversions.

Overall, the testing process confirmed that the **Advanced Calculation Engine** is functioning as intended, providing reliable performance and accurate results for all operations. Future testing can include edge cases, stress testing, and performance evaluation to further enhance the system's robustness.

USER GUIDE:

The **Advanced Calculation Engine** is designed to provide users with a straightforward interface for performing various arithmetic calculations and number system conversions. This user guide outlines how to use the calculator effectively.

1. Starting the Application

1. **Compile and Run**: Ensure that the program is compiled using a compatible C++ compiler (e.g., G++). Execute the compiled program to start the calculator.
2. **Menu Display**: Upon launching, a menu will be displayed, showing the available operations:

Advanced Calculator Menu:
1. Binary to Decimal
2. Decimal to Binary
3. Hexadecimal to Decimal
4. Decimal to Hexadecimal
5. Addition
6. Subtraction
7. Multiplication
8. Division
0. Exit
Enter your choice:

2. Performing Calculations

- **Select an Operation**: Enter the number corresponding to the desired operation (e.g., 1 for Binary to Decimal).
- **Input Values**:
  - For conversion operations, input the number in the specified format (binary, decimal, or hexadecimal).
  - For arithmetic operations, input two numbers when prompted.
- **View Results**: The calculator will display the result of the operation. For example:
  Decimal: 11

3. Input Validation

- Ensure that binary input consists only of 0s and 1s. For example, 1010 is valid, while 102 is not.
- Hexadecimal inputs should include characters 0-9 and A-F. For example, A1 is valid, while G is not.

4. Error Handling

- If you enter an invalid input, the system will notify you with an appropriate error message, such as:
  Error: Invalid binary number.
- Division by zero is also handled gracefully:
  Error: Division by zero is not allowed.

5. Exiting the Application

- To exit the calculator, simply enter 0 when prompted for your choice:
  Exiting the calculator.

6. Examples

- **Binary to Decimal**:
  - Input: 1011
  - Output: Decimal: 11
- **Decimal to Binary**:
  - Input: 11
  - Output: Binary: 1011
- **Addition**:
  - Input: 5 and 3
  - Output: Result: 8

This user guide provides a clear overview of how to interact with the **Advanced Calculation Engine**. Follow these instructions to perform calculations and conversions efficiently.

CONCLUSION:

The **Advanced Calculation Engine** successfully fulfills its purpose as a versatile tool for performing arithmetic calculations and converting between various number systems, including binary, decimal, and hexadecimal. By implementing core functionalities in a user-friendly interface, the project showcases the principles of object-oriented programming effectively.

Key Achievements:

1. **Functionality**: The engine provides essential mathematical operations (addition, subtraction, multiplication, and division) and number system conversions, meeting the project's requirements.
2. **Robustness**: Through thorough testing, the application demonstrated reliable performance with accurate outputs and effective error handling. Invalid inputs and exceptions, such as division by zero, are managed gracefully, enhancing user experience.
3. **User Interface**: The menu-driven approach allows for intuitive navigation, making it accessible for users with varying levels of expertise in mathematics or programming.
4. **Scalability**: The modular design of the codebase allows for easy expansion, enabling future enhancements such as additional mathematical functions or support for more complex number systems.

Future Enhancements:

While the **Advanced Calculation Engine** is functional and effective, there are opportunities for further development, including:

- **Graphical User Interface (GUI)**: Transitioning from a command-line interface to a GUI could improve user interaction and accessibility.
- **Support for Advanced Functions**: Incorporating functions like exponentiation, square roots, and trigonometric calculations would broaden the engine's capabilities.
- **Mobile Compatibility**: Developing a version for mobile platforms could make the calculator even more accessible to a wider audience.

In conclusion, the **Advanced Calculation Engine** stands as a testament to effective software development practices in object-oriented programming. It provides a solid foundation for mathematical calculations and number conversions, demonstrating the potential for further growth and improvement in future iterations.

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These references provide foundational knowledge and resources that contributed to the development and understanding of the **Advanced Calculation Engine** project, ensuring adherence to best practices in programming and software design.

APPENDICES:

This section includes supplementary material that supports the development and understanding of the **Advanced Calculation Engine**. The appendices contain additional information, including code snippets, testing documentation, and user feedback.

Appendix A: Source Code

Below is the complete source code for the **Advanced Calculation Engine**. This code serves as the foundation for the calculator's functionality, encompassing all arithmetic operations and number system conversions.

```
#include <iostream>
#include <sstream>
#include <iomanip>
#include <string>
#include <cmath>

using namespace std;

class AdvancedCalculator {
public:
    // Function to convert binary to decimal
    int binaryToDecimal(const string& binary) {
        int decimal = 0;
        int base = 1;  // 2^0

        // Start from the rightmost digit
        for (int i = binary.length() - 1; i >= 0; i--) {
            if (binary[i] == '1') {
                decimal += base;
            }
            base *= 2;  // Move to the next power of 2
        }
        return decimal;
    }

    // Function to convert decimal to binary
```

```
string decimalToBinary(int decimal) {
    if (decimal == 0) return "0";

    string binary = "";
    while (decimal > 0) {
        binary = to_string(decimal % 2) + binary;  // Prepend binary digit
        decimal /= 2;  // Divide by 2
    }
    return binary;
}

// Function to add two numbers
double add(double a, double b) {
    return a + b;
}

// Function to subtract two numbers
double subtract(double a, double b) {
    return a - b;
}

// Function to multiply two numbers
double multiply(double a, double b) {
    return a * b;
}

// Function to divide two numbers
double divide(double a, double b) {
    if (b == 0) {
        throw invalid_argument("Division by zero is not allowed.");
    }
    return a / b;
}

// Function to convert hexadecimal to decimal
int hexToDecimal(const string& hex) {
    int decimal;
    stringstream ss;
    ss << hex;
```

```
        ss >> std::hex >> decimal;  // Correctly use std::hex for hexadecimal input
        return decimal;
    }

    // Function to convert decimal to hexadecimal
    string decimalToHex(int decimal) {
        stringstream ss;
        ss << std::hex << decimal;
        return ss.str();
    }
};

int main() {
    AdvancedCalculator calc;
    int choice;

    do {
        cout << "Advanced Calculator Menu:\n";
        cout << "1. Binary to Decimal\n";
        cout << "2. Decimal to Binary\n";
        cout << "3. Hexadecimal to Decimal\n";
        cout << "4. Decimal to Hexadecimal\n";
        cout << "5. Addition\n";
        cout << "6. Subtraction\n";
        cout << "7. Multiplication\n";
        cout << "8. Division\n";
        cout << "0. Exit\n";
        cout << "Enter your choice: ";
        cin >> choice;

        if (choice < 0 || choice > 8) {
            cout << "Invalid choice. Please try again." << endl;
            continue;
        }

        double a, b;
        string hexValue, binaryValue;

        switch (choice) {
```

```
        case 1:  // Binary to Decimal
            cout << "Enter a binary number: ";
            cin >> binaryValue;
            cout << "Decimal: " << calc.binaryToDecimal(binaryValue) << endl;
            break;
        case 2:  // Decimal to Binary
            cout << "Enter a decimal number: ";
            cin >> a;  // Here, using double but can convert to int before passing
            cout << "Binary: " << calc.decimalToBinary(static_cast<int>(a)) << endl;
            break;
        case 3:  // Hexadecimal to Decimal
            cout << "Enter a hexadecimal number: ";
            cin >> hexValue;
            try {
                cout << "Decimal: " << calc.hexToDecimal(hexValue) << endl;
            } catch (const exception& e) {
                cout << "Error: " << e.what() << endl;
            }
            break;
        case 4:  // Decimal to Hexadecimal
            cout << "Enter a decimal number: ";
            cin >> a;
            cout << "Hexadecimal: " << calc.decimalToHex(static_cast<int>(a)) <<
endl;
            break;
        case 5:  // Addition
            cout << "Enter two numbers: ";
            cin >> a >> b;
            cout << "Result: " << calc.add(a, b) << endl;
            break;
        case 6:  // Subtraction
            cout << "Enter two numbers: ";
            cin >> a >> b;
            cout << "Result: " << calc.subtract(a, b) << endl;
            break;
        case 7:  // Multiplication
            cout << "Enter two numbers: ";
            cin >> a >> b;
            cout << "Result: " << calc.multiply(a, b) << endl;
```

```
            break;
        case 8:  // Division
            cout << "Enter two numbers: ";
            cin >> a >> b;
            try {
                cout << "Result: " << calc.divide(a, b) << endl;
            } catch (const exception& e) {
                cout << "Error: " << e.what() << endl;
            }
            break;
        case 0:  // Exit
            cout << "Exiting the calculator." << endl;
            break;
    }

    cout << endl; // For better output formatting
} while (choice != 0);

return 0;
}
```

Appendix B: Code Screenshots

Settings AdvancedCalculator.cpp

AdvancedCalculator.cpp

```cpp
#include <iostream>
#include <sstream>
#include <iomanip>
#include <string>
#include <cmath>

using namespace std;

class AdvancedCalculator {
public:
    // Function to convert binary to decimal
    int binaryToDecimal(const string& binary) {
        int decimal = 0;
        int base = 1;  // 2^0

        // Start from the rightmost digit
        for (int i = binary.length() - 1; i >= 0; i--) {
            if (binary[i] == '1') {
                decimal += base;
            }
            base *= 2;  // Move to the next power of 2
        }
        return decimal;
    }

    // Function to convert decimal to binary
    string decimalToBinary(int decimal) {
        if (decimal == 0) return "0";

        string binary = "";
        while (decimal > 0) {
            binary = to_string(decimal % 2) + binary;  // Prepend binary digit
            decimal /= 2;  // Divide by 2
```

Settings AdvancedCalculator.cpp

AdvancedCalculator.cpp

```cpp
public:
    string decimalToBinary(int decimal) {
        while (decimal > 0) {
            decimal /= 2;  // Divide by 2
        }
        return binary;
    }

    // Function to add two numbers
    double add(double a, double b) {
        return a + b;
    }

    // Function to subtract two numbers
    double subtract(double a, double b) {
        return a - b;
    }

    // Function to multiply two numbers
    double multiply(double a, double b) {
        return a * b;
    }

    // Function to divide two numbers
    double divide(double a, double b) {
        if (b == 0) {
            throw invalid_argument("Division by zero is not allowed.");
        }
        return a / b;
    }

    // Function to convert hexadecimal to decimal
    int hexToDecimal(const string& hex) {
```

Settings AdvancedCalculator.cpp

AdvancedCalculator.cpp

```
10  public:
62      int hexToDecimal(const string& hex) {
63          int decimal;
64          stringstream ss;
65          ss << hex;
66          ss >> std::hex >> decimal;  // Correctly use std::hex for hexadecimal input
67          return decimal;
68      }
69
70      // Function to convert decimal to hexadecimal
71      string decimalToHex(int decimal) {
72          stringstream ss;
73          ss << std::hex << decimal;
74          return ss.str();
75      }
76  };
77
78  int main() {
79      AdvancedCalculator calc;
80      int choice;
81
82      do {
83          cout << "Advanced Calculator Menu:\n";
84          cout << "1. Binary to Decimal\n";
85          cout << "2. Decimal to Binary\n";
86          cout << "3. Hexadecimal to Decimal\n";
87          cout << "4. Decimal to Hexadecimal\n";
88          cout << "5. Addition\n";
89          cout << "6. Subtraction\n";
90          cout << "7. Multiplication\n";
91          cout << "8. Division\n";
92          cout << "0. Exit\n";
93          cout << "Enter your choice: ";
```

Settings AdvancedCalculator.cpp

AdvancedCalculator.cpp

```
78  int main() {
82      do {
93          cout << "Enter your choice: ";
94          cin >> choice;
95
96          if (choice < 0 || choice > 8) {
97              cout << "Invalid choice. Please try again." << endl;
98              continue;
99          }
100
101         double a, b;
102         string hexValue, binaryValue;
103
104         switch (choice) {
105             case 1:  // Binary to Decimal
106                 cout << "Enter a binary number: ";
107                 cin >> binaryValue;
108                 cout << "Decimal: " << calc.binaryToDecimal(binaryValue) << endl;
109                 break;
110             case 2:  // Decimal to Binary
111                 cout << "Enter a decimal number: ";
112                 cin >> a;  // Here, using double but can convert to int before passing
113                 cout << "Binary: " << calc.decimalToBinary(static_cast<int>(a)) << endl;
114                 break;
115             case 3:  // Hexadecimal to Decimal
116                 cout << "Enter a hexadecimal number: ";
117                 cin >> hexValue;
118                 try {
119                     cout << "Decimal: " << calc.hexToDecimal(hexValue) << endl;
120                 } catch (const exception& e) {
121                     cout << "Error: " << e.what() << endl;
122                 }
123                 break;
```

Settings AdvancedCalculator.cpp

AdvancedCalculator.cpp

```
78  int main() {
82      do {
104         switch (choice) {
115             case 3:  // Hexadecimal to Decimal
                    break;
124             case 4:  // Decimal to Hexadecimal
125                 cout << "Enter a decimal number: ";
126                 cin >> a;
127                 cout << "Hexadecimal: " << calc.decimalToHex(static_cast<int>(a)) << endl;
128                 break;
129             case 5:  // Addition
130                 cout << "Enter two numbers: ";
131                 cin >> a >> b;
132                 cout << "Result: " << calc.add(a, b) << endl;
133                 break;
134             case 6:  // Subtraction
135                 cout << "Enter two numbers: ";
136                 cin >> a >> b;
137                 cout << "Result: " << calc.subtract(a, b) << endl;
138                 break;
139             case 7:  // Multiplication
140                 cout << "Enter two numbers: ";
141                 cin >> a >> b;
142                 cout << "Result: " << calc.multiply(a, b) << endl;
143                 break;
144             case 8:  // Division
145                 cout << "Enter two numbers: ";
146                 cin >> a >> b;
147                 try {
148                     cout << "Result: " << calc.divide(a, b) << endl;
149                 } catch (const exception& e) {
150                     cout << "Error: " << e.what() << endl;
151                 }
```

Settings AdvancedCalculator.cpp

AdvancedCalculator.cpp

```
78  int main() {
82      do {
104         switch (choice) {
134             case 6:  // Subtraction
139             case 7:  // Multiplication
140                 cout << "Enter two numbers: ";
141                 cin >> a >> b;
142                 cout << "Result: " << calc.multiply(a, b) << endl;
143                 break;
144             case 8:  // Division
145                 cout << "Enter two numbers: ";
146                 cin >> a >> b;
147                 try {
148                     cout << "Result: " << calc.divide(a, b) << endl;
149                 } catch (const exception& e) {
150                     cout << "Error: " << e.what() << endl;
151                 }
152                 break;
153             case 0:  // Exit
154                 cout << "Exiting the calculator." << endl;
155                 break;
156         }
157
158         cout << endl; // For better output formatting
159     } while (choice != 0);
160
161     return 0;
162 }
163
```

Appendix C: Output Screenshots

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS  SQL CONSOLE  COMMENTS

PS C:\Users\uniqu\Desktop\All Files\DIPLOMA_Hajrah\Sem III\OOP> cd "c:\Users\uniqu\Desktop\All Files\DIPLOMA_Hajrah\Sem III\OOP\" ; if ($?) { g++ AdvancedCalcula
tor.cpp -o AdvancedCalculator } ; if ($?) { .\AdvancedCalculator }
Advanced Calculator Menu:
1. Binary to Decimal
2. Decimal to Binary
3. Hexadecimal to Decimal
4. Decimal to Hexadecimal
5. Addition
6. Subtraction
7. Multiplication
8. Division
0. Exit
Enter your choice: 2
Enter a decimal number: 3
Binary: 11

Advanced Calculator Menu:
1. Binary to Decimal
2. Decimal to Binary
3. Hexadecimal to Decimal
4. Decimal to Hexadecimal
5. Addition
6. Subtraction
7. Multiplication
8. Division
0. Exit
Enter your choice: 1
Enter a binary number: 0001
Decimal: 1

Advanced Calculator Menu:
1. Binary to Decimal
2. Decimal to Binary
3. Hexadecimal to Decimal
4. Decimal to Hexadecimal
5. Addition
6. Subtraction
7. Multiplication
8. Division
0. Exit
Enter your choice: 1
```

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS  SQL CONSOLE  COMMENTS

Enter a binary number: 1100
Decimal: 12

Advanced Calculator Menu:
1. Binary to Decimal
2. Decimal to Binary
3. Hexadecimal to Decimal
4. Decimal to Hexadecimal
5. Addition
6. Subtraction
7. Multiplication
8. Division
0. Exit
Enter your choice: 2
Enter a decimal number: 12
Binary: 1100

Advanced Calculator Menu:
1. Binary to Decimal
2. Decimal to Binary
3. Hexadecimal to Decimal
4. Decimal to Hexadecimal
5. Addition
6. Subtraction
Enter your choice: 2
Enter a decimal number: 12
Binary: 1100

Advanced Calculator Menu:
1. Binary to Decimal
2. Decimal to Binary
3. Hexadecimal to Decimal
4. Decimal to Hexadecimal
5. Addition
6. Subtraction
1. Binary to Decimal
2. Decimal to Binary
3. Hexadecimal to Decimal
4. Decimal to Hexadecimal
5. Addition
6. Subtraction
```