# Bifrost Calculator - Project Structure

## Introduction

The **Bifrost Calculator** is a Windows desktop app that talks to a microcontroller through **serial communication** to solve mathematical expressions. This document gives an overview of how the software is structured, along with instructions to build, run, and test it.

## Software Architecture Overview

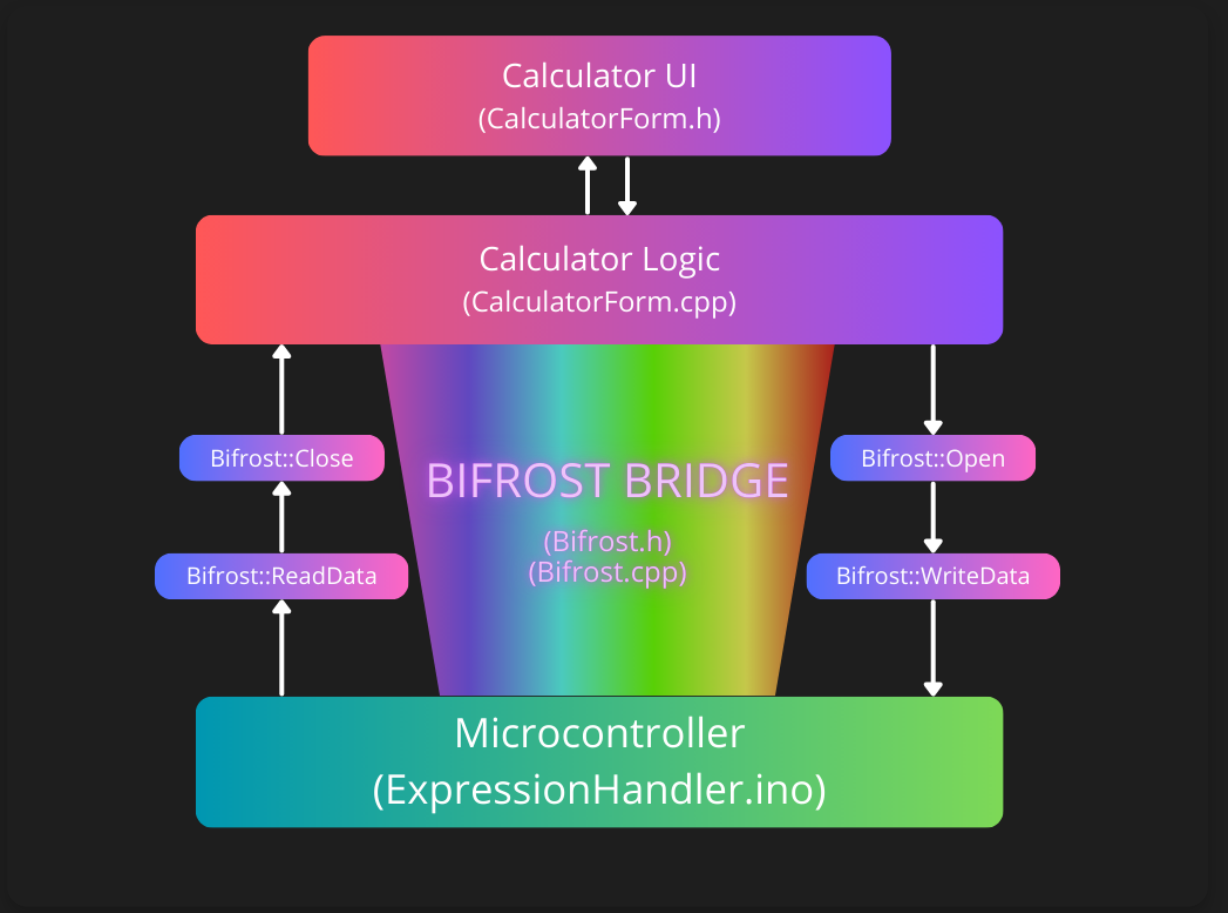
The project is made up of **two main parts**:

1. **Windows Desktop Application** (C++/CLI with Windows Forms)
2. **Microcontroller Firmware** (C++ for Arduino)

The **Windows app** sends math expressions over the serial port to the **microcontroller**, which processes them and sends back the result.

---

## Project Structure



# Key Components

## Windows Desktop Application

### CalculatorForm.h / CalculatorForm.cpp

- **Handles the user interface** using Windows Forms.
- Manages user input and **sends expressions to the microcontroller**.
- Displays the results once received from the microcontroller.
- **History feature:** Lets users click past results to reuse them.
- Uses the **Bifrost class** for serial communication.

### Bifrost.h / Bifrost.cpp

- Manages **serial communication** between the PC and microcontroller.
- Includes functions to:
  - **Open and close the serial port**
  - **Send expressions to the microcontroller**
  - **Receive the computed result**

## Microcontroller Firmware

### BifrostCalculator.ino

- Runs on the microcontroller (Arduino/ESP32).
- Uses **TinyExpr** to evaluate math expressions.
- Sends the computed result back to the PC over **UART (serial communication)**.

### TinyExpr Library

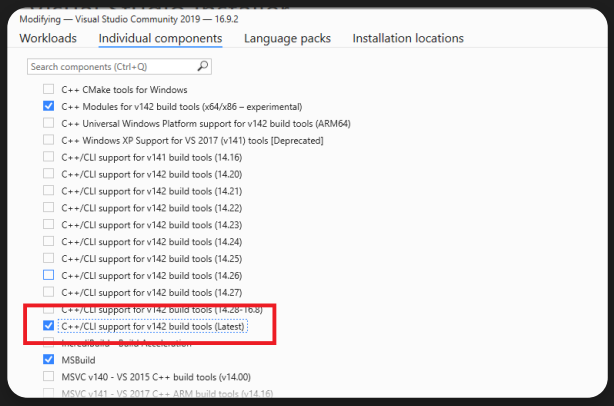
- A lightweight math parser.
- Handles expressions like `sin(1.57) + sqrt(9)` without complex manual coding.

# Compiling and Running the Software

## Compiling and Running the Windows Application

**Requirements:**

- **Visual Studio**
- **Windows Forms project support**
- **C++/CLI tools installed:**




**Steps:**

1. Open `BifrostCalculator.sln` in **Visual Studio**.
2. Click **Build** → **Build Solution**.
3. Click **Start** to run the application.

## Uploading the Sketch to the Microcontroller

**Requirements:**

- **Arduino IDE**
- **Microcontroller (Arduino/ESP32)**

**Steps:**

1. Install the **TinyExpr library** (Installation steps in `ArduinoGuide.pdf`).
2. Open `BifrostCalculator.ino` in **Arduino IDE**.
3. Select the correct **board and port**.
4. Click **Upload**.

### Testing the Connection

**Steps:**

1. Open the **Bifrost Calculator** application.
2. Enter the correct **COM port and baud rate**.
3. Type a **math expression** (e.g., `5+3*2`) and press **Enter**.
4. The microcontroller processes the expression and sends the result back.

> ⚠️ **Make sure the Serial Monitor in Arduino IDE is closed** before using the Windows app, otherwise the port will be **busy**.