Exercise 6-1: Debugging

Goal

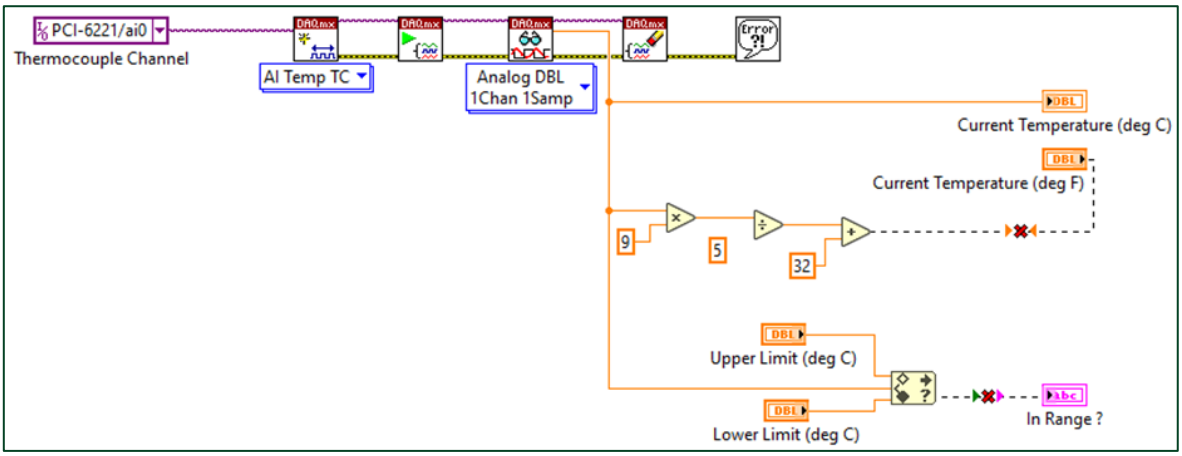
- Use debugging tools and troubleshooting techniques to fix a broken VI that returns unexpected data.

Instructions

Edit-Time Errors

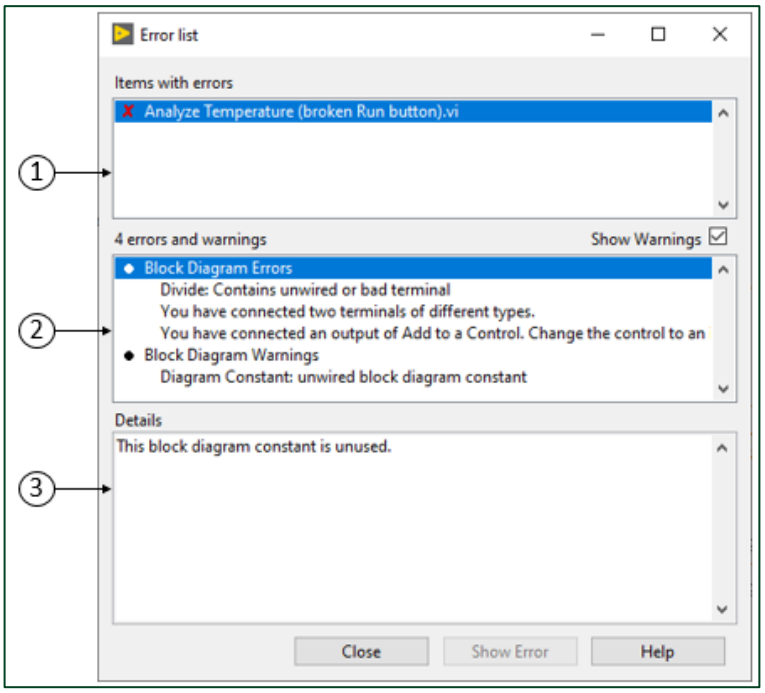
1. Open and examine the Analyze Temperature VI.
   - Open the `Debug.lvproj` in the `C:\Exercises\LabVIEW Core 1\Debug` directory.
   - Open the Analyze Temperature (broken **Run** button) VI from the **Project Explorer** window.
   - Notice the **Run** button on the toolbar appears broken, indicating that the VI is broken and cannot run.

2. Examine the block diagram of the Analyze Temperature VI, as shown in the following figure.



This VI acquires a single temperature measurement, displays the temperature in degrees Celsius, converts the temperature to degrees Fahrenheit, and determines if the acquired temperature is within the specified range.

3. Find and fix each error.
   - Click the broken **Run** button to display the **Error list** dialog box. Examine the errors and warnings listed.
   - Click the **Show warnings** check box.



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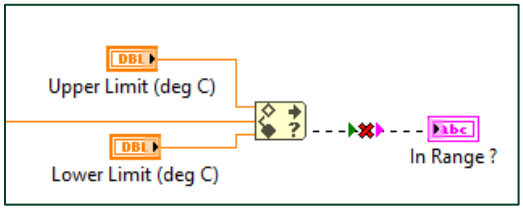
1. **Items with errors** – Lists all LabVIEW items affected by errors and warnings in the current VI. If two or more items have the same name, this list shows the specific application instance for each ambiguous item.
2. **Errors and warnings** – Lists all errors and warnings associated with the VI, if a VI is selected.
3. **Details** – Indicates specific details of the selected error or warning.

   - Double-click each **error/warning** to highlight the area on the block diagram that contains the error.



   - Use the information in the **Error list** dialog box to fix each error.
   - Notice that after you fix all the errors, the **Run** button no longer appears broken. You can now run the VI.
4. Save the VI.

Run-Time Errors

Identify and correct errors that cause the VI to behave unexpectedly and return incorrect responses.

When the results of your application are not what you expect, you can use a set of tools to determine where errors occur within your code.

Although errors are often detected automatically, sometimes your code can run successfully but not as intended. When this happens, you need to identify the source of the unintended behaviors.

The following debugging tools can help you in this process:

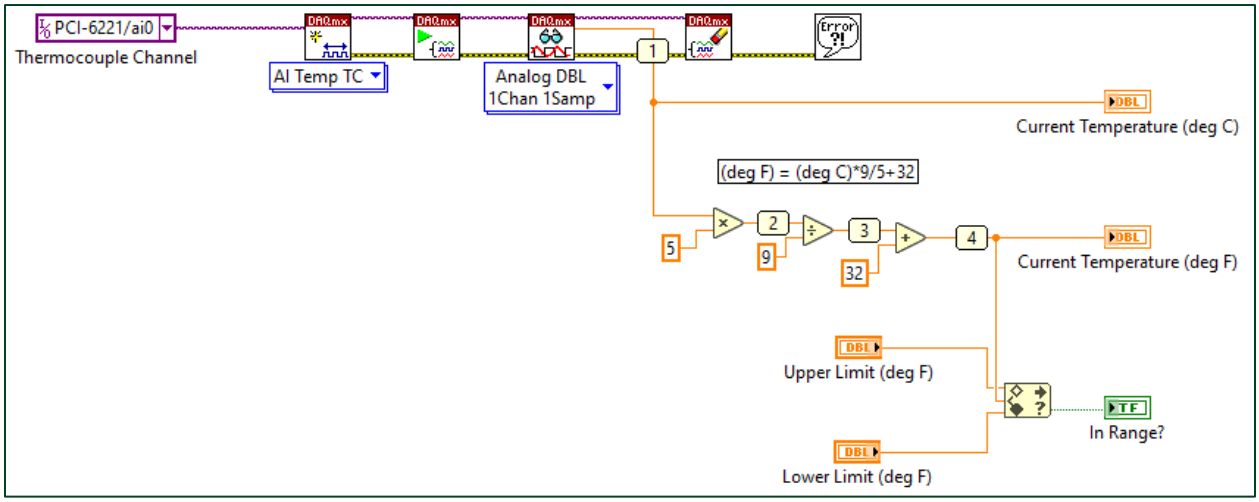
- Execution highlighting
- Probes
- Breakpoints
- Single-stepping

1. Test the VI.
   - From the **Project Explorer** window, open Analyze Temperature (incorrect behavior) VI.
   - On the block diagram, set **Thermocouple Channel** to **PCI-6221/ai1**.
   - Switch to the front panel and run the VI. The DAQmx Read VI returns the temperature in degrees Celsius to the corresponding indicator.
   - Use a calculator to determine what the correct temperature in degrees Fahrenheit should be:
   - Temperature (deg F) = Temperature (deg C) x 9/5 + 32
     = _____ x 9/5 + 32
     = _____
   - Does the **Temperature (deg F)** indicator value match your calculation? _____
   - Notice that even though the VI runs, the VI returns an incorrect result in the **Temperature (deg F)** indicator.
   - Complete the following steps to identify the source of this error using the debugging tools and correct the error.

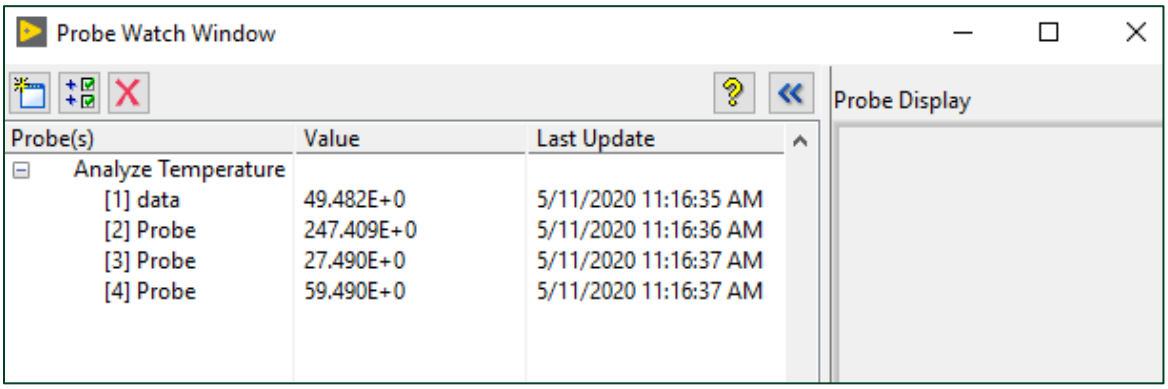
2. Animate the flow of data through the block diagram.
   - Switch to the block diagram and click the **Highlight Execution** button to enable execution highlighting and then run the VI.

   - Notice that you can see how data flows through the wires. At the output of each node, you can see the data value displays momentarily.

3. Probe the wire values.
   - Add probes to the wires, as shown in the following figure (rectangular numbered boxes on wires are probes), by right-clicking each **wire** and selecting **Probe**.



   - The **Probe Watch Window** opens after you set a probe, which shows an item for each probe you placed.
   - Run the VI.
   - Notice that the **Probe Watch Window** updates with the latest data values on the corresponding wires. The row marked [1] **data** shows the data value for the wire labeled with **Probe 1**.



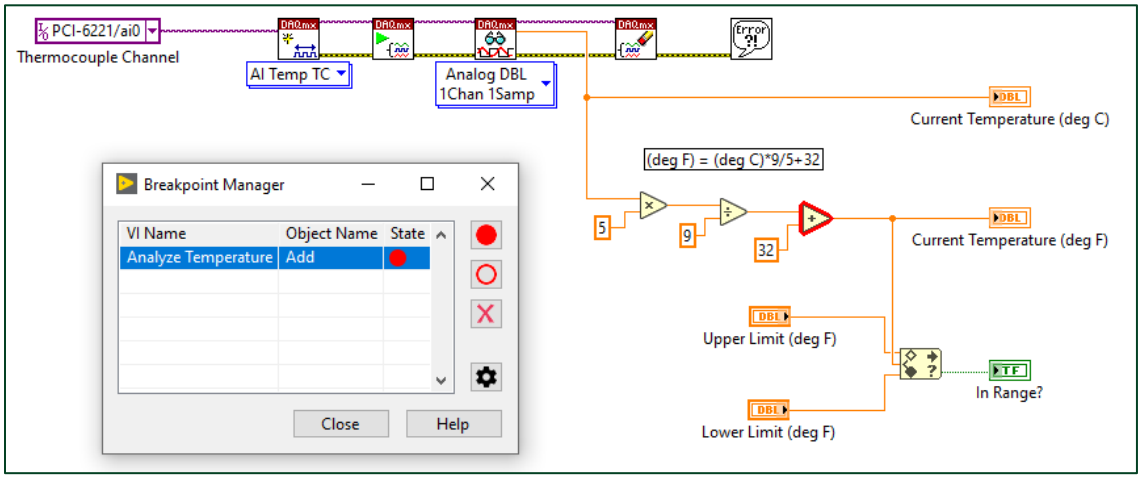
   - Double-click any **probe** item in the **Probe Watch Window** to highlight the corresponding probe on the block diagram.
   - You can view the latest data values of a probe by looking at the values in the **Probe Watch Window**.
   - By examining these probes, you determine that Probe 1 shows the correct temperature in degrees Celsius and Probe 4 shows an incorrect value for temperature in degrees Fahrenheit.
     Question 1 – What is the mistake?

- Remove all the probes by right-clicking each **probe** in the **Probe Watch Window** and selecting **Remove**.

4. Debug the VI using the single-stepping tool.
   With execution highlighting, execution slows down, and the code executes until completion. With single-stepping, you can execute a single node at a time, causing the program to pause after the node completes.
   - Turn on Highlight Execution, and on the front panel toolbar, click the **Step Over** button to start single-stepping through the VI. Execution highlighting shows the flow of data on the block diagram from one node to another. When you single-step through code, nodes are highlighted to indicate they are ready to execute.

   - Click the **Step Over** button after each node to step through the entire block diagram. Each time you click the **Step Over** button, the current node executes and pauses at the next node.
   - When you step over the last node in the block diagram, it flashes to indicate that all the nodes in the block diagram have finished executing. Click the **Finish VI** "**Analyze Temperature (incorrect behavior).vi**" button to finish running the VI.

5. Set a breakpoint to pause the VI when execution reaches a specified point in the program.
   When looking for a problem in your code, you may have an idea of the general area where the problem exists. To help focus on this area, you can use a breakpoint to pause the VI at a specified point in the program.
   - Imagine that you have determined that the problem in this VI occurs right after the Add function executes.
   - Right-click the **Add** function and select **Breakpoint»Set Breakpoint**.
   - Notice that the Add function is highlighted red now and that the highlighted function corresponds to a breakpoint item in the **Breakpoint Manager** (Right-click on the **highlighted function**, then select **Breakpoint»Breakpoint Manager**).



- Turn off the **Highlight Execution** and run the VI.
  Notice that the VI pauses when it reaches the breakpoint.
- Now that the VI has reached the area you want to examine, you can start using your debugging tools. For example, you can turn on **Highlight Execution** and click the **Step Over** button to start single-stepping through the VI.
- When finished, remove the breakpoint by right-clicking the **breakpoint** on the block diagram and selecting **Breakpoint»Clear Breakpoint**.

Note: If you select **Disable Breakpoint** instead, the breakpoint will remain on the block diagram, but it will no longer pause execution. Then, you can right-click and enable the **breakpoint** again later when you want the breakpoint to start pausing execution again.

6. Save the VI.

Answer 1:

The values obtained from those probes show that the algorithm used to convert from ºC to ºF is incorrect.

End of Exercise 6-1