Companion Cube Calculator
User Guide

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The repository for this project can be found at https://github.com/GenevaS/CAS741.

The Companion Cube Calculator (C^3) is a mathematical tool for determining the range of a user-specified function given the domains of the function's variables. The calculations are performed using interval arithmetic and only closed, real intervals ($[a, b]$) are supported.

The tool is restricted to the following operators:

- Addition ($+$)
- Subtraction ($-$)
- Multiplication ($*$)
- Division ($/$)
  Note: You cannot specify a divisor interval that contains zero (0).
- Exponentiation ($\hat{}$)
  Note:
  - Base numbers (B^x) must be greater than 1.
  - Exponents (x^N) must be greater than or equal to zero (0), and must be a whole number.
  - You cannot specify both the base number and the exponent as intervals.

Implicit multiplication, constant values, and round brackets ("()") are supported by the C^3 tool.

Note: If you copy values from PDFs into the C^3 tool, your data might not be processed correctly.

Full documentation for the software can be found at:

`https://github.com/GenevaS/CAS741/tree/master/Doc`

System Requirements

The C^3 tool can only be run on Windows operating systems.

Using the C^3 Tool

The C^3 tool (Figure 1) has two work flows for accepting your inputs – direct input and loading from a file.

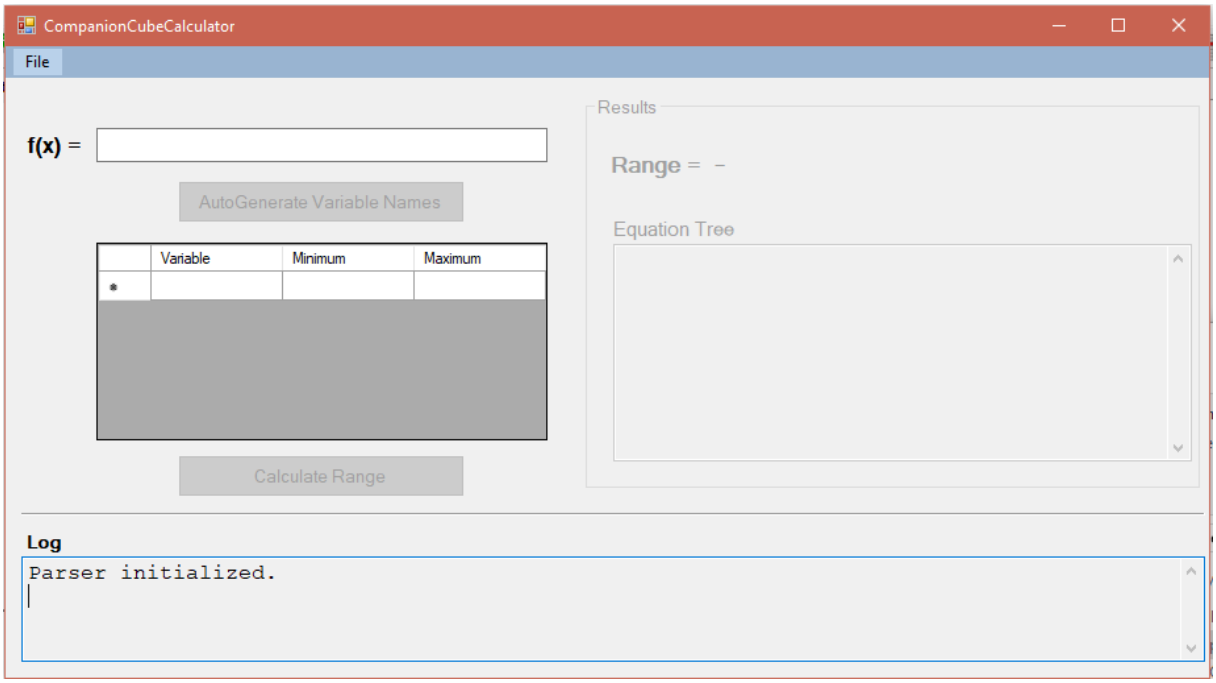

Figure 1: The C^3 tool

Direct Input

In the direct input work flow, you enter your equation and variable domains into the $f(x)$ text box and variable table respectively. The range of your equation is calculated by clicking the "Calculate Range" button. This button will not be enabled until the tool detects values in the $f(x)$ field and each named row in the variable domain table.

To make this work flow simpler, the tool contains an "AutoGenerate Variable Names" button which becomes enabled when you enter your equation into the $f(x)$ field. This button automatically populates the "Variable" column of the domain table with the variables found in your equation. You must manually enter in the values for the minimum and maximum bounds.

Loading from a File

You can load function and variable domain data into the tool from a file using the File → Load menu option. The tool will automatically calculate the results.

Only text files (*.txt) are supported at this time. You must only put one value per line in your input file. The expected format of the file is:

- The first line of the file contains your function.
- Each subsequent line contains the information for one of your variable domains, where each field is separated by a comma (,).

Example:
Given the equation $f(x) = x + y, x = [2, 4], y = [3, 5]$, the corresponding file would contain:

```
f(x) = x + y
x,2,4
y,3,5
```

You can optionally omit the equality in your user function:

```
x + y
x,2,4
y,3,5
```

You can find the sample file, `test.txt`, corresponding to this example `TestFiles` directory.

Reading the Results
You can find the calculated range of your function in the "Range" field. You cannot edit this field at any time.

The "Equation Tree" field contains the calculation tree followed during processing. If you are not getting the results that you expect, this information might help you identify how operator precedence is affecting how values are used. You can edit this field when it contains information, but no changes will be saved.