Dynamically executing mathematical formulas on Windows Phone using Jace.NET

This article explains how to use Jace.NET on Windows Phone. Jace.NET is a high performance calculation engine for the .NET platform that can dynamically interpret and execute strings containing mathematical functions.

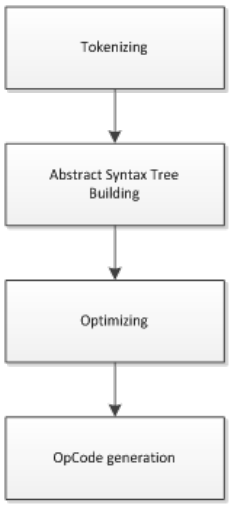
Introduction

In this article, I will explain **Jace.NET** (https://github.com/pieterderycke/Jace), an OSS framework I have developed in my free time. Jace.NET is a high performance calculation engine for the .NET platform that can dynamically interprete and execute strings containing mathematical functions. These functions can rely on variables. If variables are used, values can be provided for these variables at execution time of the mathematical function. Jace.NET is available for the various .NET flavors: .NET, WinRT, WP7 and WP8.

I will explain the architecture of Jace and how to build a calculator for Windows Phone using it, but the possibilities reach much further (payroll applications, simulation applications, banking and insurance applications).

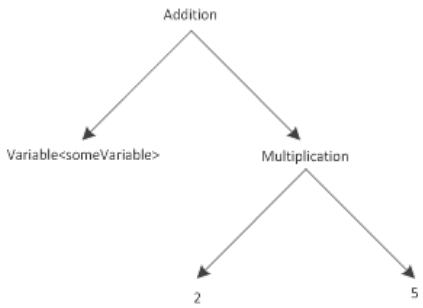
How does Jace work?

Jace.NET has an architecture similar to the one of modern compilers: interpretation and execution are performed in a number of steps. Each step focuses on one aspect of the parsing and interpretation of the formula. This keeps the overall complexity manageable.



The process starts with the tokenizing phase. During this phase the input string is converted into the various allowed tokens: integers, doubles, operations and variables. If a part of the input string contains text that does not match with any type of token, an exception is thrown and Jace will halt.

When tokenizing is successfully finished, an abstract syntax tree (AST) is constructed. This abstract syntax tree is a tree like data model that unambiguously represents the mathematical formula in memory. All mathematical precedence rules are taking into account when constructing the abstract syntax tree. Jace uses an algorithm inspired by the shunting-yard algorithm of Dijkstra to create this AST.



After AST creation, the optimizer will try to simplify the abstract syntax tree: if a part of the formula does not depend on variables but solely on constants. This part of the tree is already calculated and replaced by a constant in the tree.

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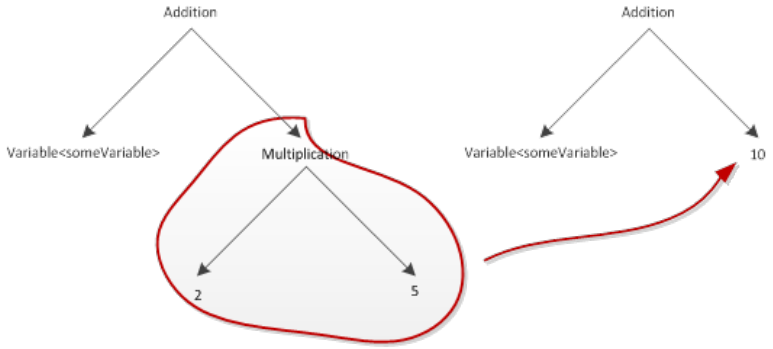
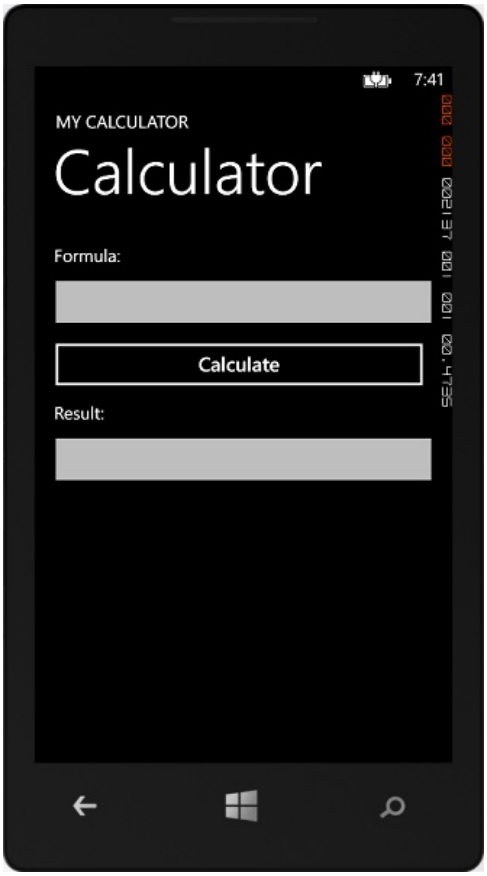


The final phase is the OpCode generation. During this phase, a .NET dynamic method is created and the necessary MSIL is generated to execute the formula. This dynamic method is cached in memory. If the same formula is executed again in the future with other values for the variables. The interpretation steps are skipped and the dynamic method is directly executed. If the formulas of the calculations are frequently reoccurring, Jace.NET has near compiled code performance.

Building the calculator

The demo WP8 application we are going to build is a calculator that allows users to freely enter mathematical formulas. It consists of two textboxes (`formulaTextbox` and `resultTextBox`) and a button (`calculateButton`). The screenshot below shots the UI layout:



The easiest way to add Jace.NET to the solution is by using NuGet. Right-click on the project and choose “Manage NuGet Packages…”.

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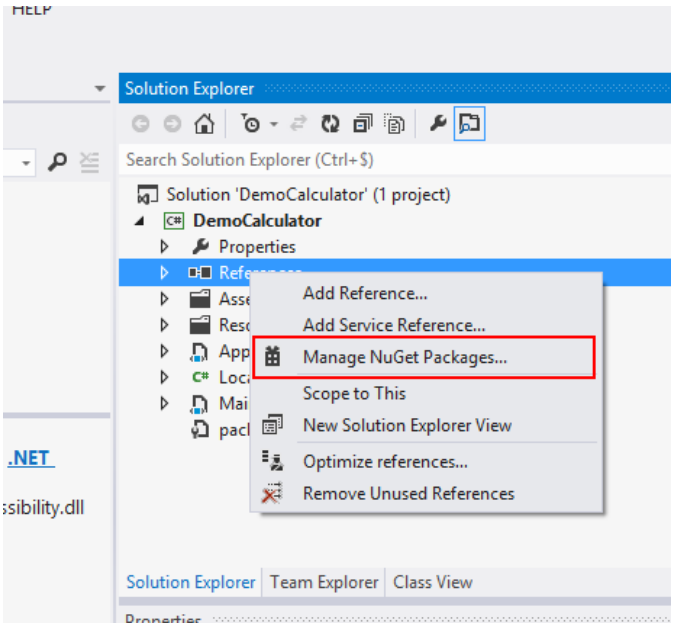
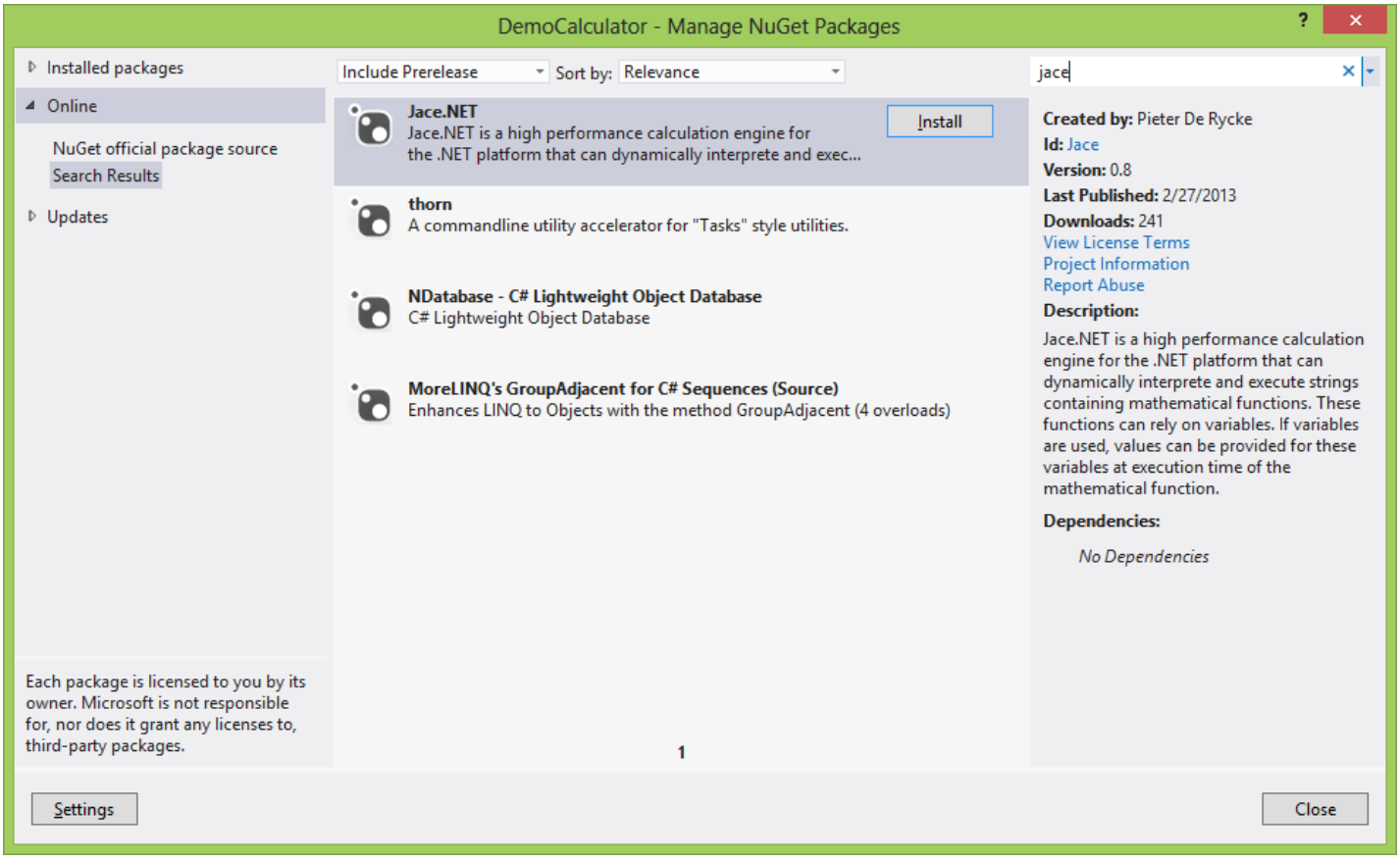


Then search for the Jace package and install it.



Next we call Jace to execute the formula provided in the `formulaTextBox` when calculate button gets clicked. Results are displayed in the `resultTextBox`.

```
public partial class MainPage : PhoneApplicationPage
{
    private readonly CalculationEngine engine;

    public MainPage()
    {
        InitializeComponent();

        this.engine = new CalculationEngine();
    }

    private void calculateButton_Click(object sender, RoutedEventArgs e)
```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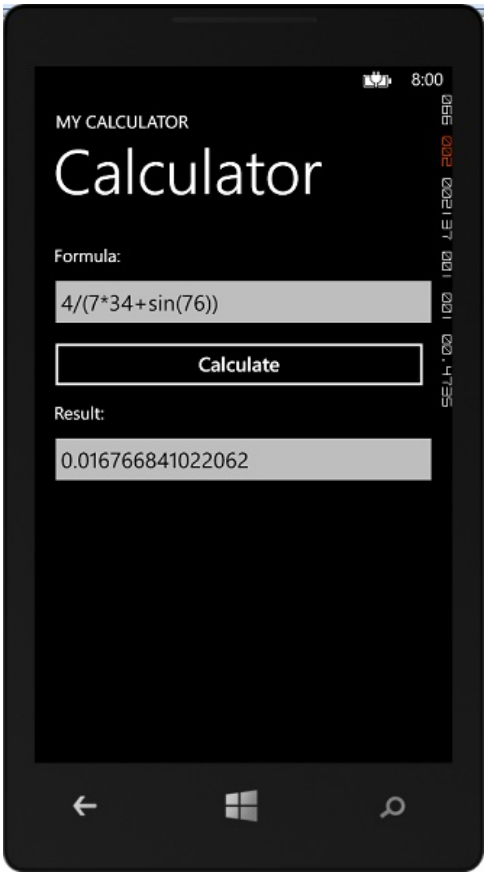
```
    {
        resultTextBox.Text = "" + engine.Calculate(formulaTextBox.Text);
    }
}
```

Now we have a calculator for Windows Phone:



You can also download the source: File:Jace calculator source.zip

Next Steps

The “Calculate” method is the simplest way to call Jace. Jace also supports the creation of Func delegates and also provides a fluent API. For more information please see: https://github.com/pieterderycke/Jace/wiki.

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